Krakow
University
of Economics

Krakow Review of Economics and Management

Zeszyty Naukowe

No 1 (1011) / 2026

ISSN 1898-6447
e-ISSN 2545-3238

Krakow
University
of Economics

Krakow Review of Economics and Management

Zeszyty Naukowe

No 1 (1011) / 2026

ISSN 1898-6447
e-ISSN 2545-3238

Scientific Board
Josef Arlt (Czech Republic), *Slavko Arsovski* (Serbia), *Daniel Baier* (Germany), *Ryszard Borowiecki* (Poland), *Giovanni Lagioia* (Italy), *Józef Pociecha* (Poland), *Aleksy Pocztowski* (Poland), *Vesna Žabkar* (Slovenia)

Editorial Board
Sławomir Wawak (Editor-in-Chief), *Sergiu Baltatescu* (Romania), *Klaudia Blachnicka* (Editorial Secretary), *Mehmet Hüseyin Bilgin* (Turkey), *Joanna Dzwończyk*, *Jan Fidrmuc* (France), *Juan José García Machado* (Spain), *Wojciech Giza*, *Michał Halagarda*, *Salvatore Ingrassia* (Italy), *Ryszard Kowalski*, *Katarzyna Maj-Serwatka* (Editorial Secretary), *Alexander Mihailov* (Great Britain), *Hana Pačaiová* (Slovakia), *Paulo Sampaio* (Portugal), *Katarzyna Sanak-Kosmowska*, *Marta Sordyl* (Editorial Secretary), *Miladin Stefanović* (Serbia), *Monika Szaraniec*, *Suat Teker* (Turkey), *Mladen Vukomanović* (Croatia), *Stanisław Wanat*, *Angelika Wodecka-Hyjek*

Statistical Editor
Paweł Ulman

Design and layout
Marcin Sokołowski

The journal is indexed by:
BazEkon (bazekon.uek.krakow.pl), CEEOL (www.ceeol.com), CEJSH (cejsh.icm.edu.pl), DOAJ (doaj.org), EBSCO (www.ebsco.com), ERIH PLUS (kanalregister.hkdir.no/publiseringskanaler/erihplus/) and ICI World of Journals (journals.indexcopernicus.com)

© Copyright by Krakow University of Economics, Kraków 2026
Content in this issue is licensed under a Creative Commons Attribution 4.0 License (CC BY 4.0)

ISSN 1898-6447
e-ISSN 2545-3238

Until 2023: Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie / Cracow Review of Economics and Management

The online journal is both the primary and reference version
The articles are available on the journal's website: krem.uek.krakow.pl

Krakow University of Economics Press, Rakowicka 27, 31-510 Kraków, Poland,
phone +48 12 293 57 42, e-mail: wydaw@uek.krakow.pl, krem@uek.krakow.pl
Printing Center, Krakow University of Economics, Rakowicka 27, 31-510 Kraków, Poland

KREM, 2026, 1(1011)
ISSN 1898-6447
e-ISSN 2545-3238

Table of Contents

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 5–24
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18729

The Rise of the Insumer: A Key Stakeholder of Crowdfunding

Oskar Kosch

Krakow University of Economics, Institute of Management, Department of Strategic Analysis, Rakowicka 27, 31-510 Kraków, Poland, e-mail: koscho@uek.krakow.pl, ORCID: https://orcid.org/0000-0003-2697-1393

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Kosch, O. (2026). The Rise of the Insumer: A Key Stakeholder of Crowdfunding. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 5–24. https://doi.org/10.15678/krem.18729

ABSTRACT

Objective: Crowdfunding is a rapidly growing part of economy, with USD 8,003,935,277 being collected through the Kickstarter.com platform alone as of 11 May 2024. Crowdfunding platforms play an essential role in the contemporary crowdfunding process by bringing together two parties: project creators and project supporters, to fund projects. Relying on praxeological theory, this paper research objective is to explore a novel stakeholder type termed "insumer" (investing consumer), which comprises project supporters of crowdfunding.
Research Design & Methods: Through a literature review, survey, archival search, and principles of taxonomy categorisation, the distinct nature of insumers as stakeholders is delineated.
Findings: The analysis indicates that insumers constitute a distinct stakeholder type, characterised by their dual role as both investors and consumers. They engage in crowdfunding with expectations anchored in both material and non-material value exchanges, while also confronting inherent risks.
Implications/Recommendations: Differentiating insumer as distinct stakeholder type should influence business model creation in crowdfunding, to comprise value flows and risk.
Contribution: Recognising the significance of insumers as stakeholders in crowdfunding ventures, this study underscores their contribution to achieving success in crowdfunding campaign.
Article type: original article.

Keywords: crowdfunding, stakeholders, praxeology, insumer.
JEL Classification: O31, M10, M14, M30.

1. Introduction

Crowdfunding, considered a part of sharing economy (although validity of this direction has been disputed, see: Light & Miskelly, 2015), is not a new phenomenon (Funk, 2019). However, it is a rapidly growing – in its information technology mediated way in 2014 has reached volume of USD 16.2bn (Massolution.com, 2015, pp. 13, 22). One of the largest reward-based crowdfunding platforms – Kickstarter – has moved from USD 2bn total donations in October 2015 (Kickstarter.com, 2015), through USD 4.2bn in April 2019 (Kickstarter.com, 2019) to USD 8,003,935,277 being collected through the Kickstarter.com platform alone as of 11 May 2024 (Kickstarter.com, 2024), which gives an indication of the dynamics since then.

The term "crowdfunding" was first coined by Michael Sullivan and introduced in 2006 on his website fundavlog.com (WordSpy, 2008). He emphasised the function of direct money flow as "money incubates, inspires and gives rise to good content. Money provides new and/or rejuvenated opportunities" and is tied to building a community and from that point of view "it can be very interesting to see how the flux of community exchanges will effect the community and whether it helps to evolve or to collapse the project" (Sullivan, 2006).

There were two channels, that developed the concept in parallel: finance one, and crowdsourcing. The core of the crowdfunding in relation to finances was understood to be "a form of capital formation whereby groups of people pool money, typically comprised of very small individual contributions, to support an effort by others to accomplish a specific goal" (Schapiro, 2011, p. 22). It was later used in *Testimony on Crowdfunding and Capital Formation* done by Meredith B. Cross (Cross, 2011) and subsequently it disseminated to be used in multiple cases, both directly cited (Griffin, 2012, p. 377) or mentioned without giving this genesis (Ahlers *et al*., 2015; Micic, 2015, p. 13).

Second tradition is related with crowdsourcing, a concept that was publicly introduced in 2006 (Howe, 2006), but has also many roots (Kleemann, Voß & Rieder, 2008, pp. 6–7, 9–10). It was more related to the aspect of source of the support and the fact, that the offer of crowdfunding is inclusive and targeted to the crowd (Howe, 2006), as well as it was mentioned that there is an assumption of being given back with some value (Belleflamme, Lambert & Schwienbacher, 2014, p. 588). Therefore, value flow is also perceived as essential to crowdfunding, and may be the basis for categorisation.

Types of crowdfunding, that are mostly spotted in reports and literature (equity, reward, donation, and lending) are categorised around character of value flow to the creators. It is, however, unclear how to properly call, and according to what exact value flow, a key stakeholder of crowdfunding, often referred to as "backer." In terms of value flow, backer in reward-based crowdfunding is sometimes referred to as consumer (Maciel & Weinberger, 2024), customer (Quero & Ventura, 2019), or investor (Bao, Wang & Zhao, 2022). Some researchers explicitly put reward-based crowdfunding as non-investment-based, as opposed to investment-based types.

Theoretical approaches in determining crowdfunding stakeholders' type miss the fact, that risk associated with projects, and thus – the anticipated premium to be gained by those, who support such projects, are all encapsulated within a single action of supporting a project, and constitute unique value flow of investing consumers. This risk prevents recognising project backers, as simple consumers of the project outcomes of any type; the non-financial nature of rewards (and their consumption) prevents treating such stakeholders as plain investors either.

Thus, the main research problem addressed in this paper is the lack of deepened understanding of risk and value flows between reward-based crowdfunding creators and supporters, that would result in defining what exactly stakeholder type the backer is. As a consequence, the research question is as follows: What are the risk and value flows between project creators, and project supporters? To date there are no comprehensive studies regarding the new term of this phenomenon named as insumer (investing consumer).[1] Until the beginning of 2024, only the paper of Maciel and Weinberger (2024) addressed the mentioned problem, but from the theoretical standpoint of gift-giving theory, not praxeological value flows. The main research objective of this paper is to explore a novel type of stakeholder – insumer.

The remainder of the paper is organised as follows: 1) theoretical background, 2) research methods, 3) results and discussion, 4) conclusions, and 5) limitations and future research recommendations.

2. Theoretical Background

Stakeholder differentiation necessitates the introduction of the stakeholder theory itself. Initially, the term "stakeholder" was used at Stanford Research Institute in 1963 to denote "those groups, without whose support the organisation would cease to exist" (Freeman, 1984, p. 31). Over time, the category of stakeholders expanded to include consumer advocates, media, environmentalists, and other key actors; Freeman (1984, p. 25) graphically presented in total 11 non-exhaustive examples of

[1] Datika (2023) has also used the term "insumer," as investing consumer, but instead of recognising the single action of both investing and consuming at once, they refer only to the motivations as with conventional investors.

different groups, leading to his definition of stakeholder as "any group or individual who can affect or is affected by the achievement of the firm's objectives." As the confusion about stakeholders raised, there were attempts to unify, or refine the definition, e.g., proposed by McGrath and Whitty (2017, p. 730) "an entity with a stake (interest) in the subject activity," complimented with the locus of interest.

Of interest remains, what are the exact groups with a stake in the crowdfunding activity of certain entities, outlined in the research on crowdfunding. Systematic literature review was performed, with search strategy including both Scopus and Web of Science:

1. Scopus: TITLE-ABS-KEY (crowdfunding AND stakeholders) run on 23 April 2019 has given 58 results.

2. WoS: TS = (stakeholders AND crowdfunding) run on 23 April 2019 has given 40 results.

In total, there were 67 distinct publications (proceedings, articles, book chapters, etc.) found. Of all of them, after abstract screening, 28 were assessed as relevant to the topic of crowdfunding stakeholders description. Most of the publications relied on three stakeholders model: founders/business, backers/crowd, platforms/website providers/technology suppliers, there was almost no deepened investigation into the basis of existence of backers (their motives placed along with value flows). Some exceptions were found: proposition to use single name for suppliers and customers in scientific literature: backers, as there are more than one flow channel between backers and business (Valančienė & Jegelevičiūtė, 2014, pp. 599, 602), notion of backers' personal networks and rewards of extrinsic (material) and intrinsic (non-material and socially/psychologically driven) nature (Beaulieu, Sarker & Sarker, 2015, p. 5), discussing values that attract backers to the project, and how they may change over time (Gleasure & Feller, 2016). The idea that stakeholders (backers) own agenda can hijack crowdsourced (and crowdfunded also) project were argued (Wilson, Robson & Botha, 2017, p. 252), which is not surprising given the fact that in the video games sample 52% of contributors apart from material return stated motivation as ability to contribute and be informed on project, and support particular founder (Steigenberger, 2017, p. 343). Also "interpersonal connectivity and attitudes toward helping others" are part of belonging to crowdfunding community, which with the ability to back innovative projects is relevant for people's intention to participate in crowdfunding (Rodriguez-Ricardo, Sicilia & López, 2018, p. 173). It was postulated that platforms should transmit their ethical values and try to have impact on the society, be committed to it, so there is a feel of cultural enrichment (Poponi *et al.*, 2019, p. 182). This may sound as a wish, but there are indications that legitimacy may be lost – as funding is – when violation of code of conduct and norms take place, and this can vastly influence enterprise's chances of gaining and sustaining success, so the transparency, fidelity

and communality in the project have to be sustained and can influence decisions (Gegenhuber & Naderer, 2019, p. 181). Also, backers are sensitive to completing the project and delivering the promised effect, and this influences future same creators crowdfunding campaigns (Wash, 2013).

As we re-approached the research on insumer, systematic literature review had to be updated. On 11 May 2024, another search was executed, this time solely on Scopus, with the exact same query, but restricted to 2019 and onwards. It delivered 142 search results. After abstract screening, 45 papers remained. Of 45 papers, 39 were accessed and downloaded. Selected concepts are briefly presented in Table 1.

Table 1. Stakeholders of Crowdfunding in the Literature

Source	Stakeholders
Funk (2019)	project initiators; the crowdfunders; crowdfunding platforms; government
Foà (2019)	creative core; platforms; financing customers; non-financing customers; investors; experts; crowdfunding associations; public institutions; social media platforms corporations; media system
Gegenhuber & Naderer (2019)	internal; external
Quero and Ventura (2019)	creative core; crowdfunding platforms; financing customers; non-financing customers; investors; experts; crowdfunding associations; regulatory public institutions
Chu *et al*. (2019)	project initiators; project supporters; moderating platforms
Shneor & Torjesen (2020)	fundraisers; platforms; funders; regulators
Aghdam *et al*. (2020)	website providers; founders; backers; angel/VC funds/banks; legal/ethical
Cummings *et al*. (2020)	issuers (entrepreneurs/founders); investors; intermediaries (crowdfunding platforms, lawyers, accountants, consultants)
Cavalcanti Junqueira (2021)	internal; external
Fanea-Ivanovici & Baber (2021)	filmmakers; backers; distributors; platform owners; future audience
Block *et al*. (2021)	proponents; backers; platforms
Ryoba, Qu & Zhou (2021)	creator; funders-backers; crowdfunding platform
Al-Mulla, Ari & Koç (2022)	entrepreneurs; investors; mentors
Bao, Wang & Zhao (2022)	crowdfunding platforms; entrepreneurs; investors
Djimesah *et al*. (2022)	investors; borrowers; platforms
Maciel and Weinberger (2024)	consumers; producers; platforms

Source: the author.

As it may be observed in Table 1, little changed in terms of stakeholders identified in the literature, that take part in crowdfunding. Three main types of stakeholders might be derived, namely: 1) project creators, 2) project supporters, 3) project moderators. Table 2 contains synonyms and examples associated with these types.

Table 2. Three Main Types of Stakeholders and Their Associated Terms (Synonyms and Examples)

Project Creators	Project Supporters	Project Moderators
initiators creative core fundraisers issuers entrepreneurs founders proponents creators borrowers producers	crowdfunders financing customers non-financing customers investors funders backers consumers	crowdfunding platforms governments experts crowdfunding associations public institutions social media platforms corporations media system regulators website providers lawyers accountants consultants mentors

Source: the author.

Thus, as can be seen, the trinary categorisation found in previous review period is still valid and functional. Complementary to the stakeholders differentiation is depicting the motivation factors, that influence project supporters' decision to transfer their funds. The factors examined in the research, regardless of their identified significance, are listed in Table 3 along with their source publications.

Table 3. Reward-based Crowdfunding Motivation Factors of Insumers

Source	Motivation Factors
Gerber & Hui (2013)	collect rewards; help others; support causes; be part of a community
Bretschneider & Leimeister (2017)	to receive recognition from others in return for their investment; to influence certain projects to fruition; to create an online image; because they simply like a venture; in anticipation of a return or reward; herding behaviour
Cox, Nguyen & Kang (2018)	intrinsic, extrinsic, image concerns
Tung & Liu (2018)	involvement; interest; playfulness; philanthropy; reward
Li & Wang (2019)	motivation when project reaches threshold (objective)

Table 3 cnt'd

Source	Motivation Factors
Zhang & Chen (2019)	self-orientation; other-orientation
Herrero, Hernández-Ortega & San Martín (2020)	project attachment; business viability
Ryu *et al*. (2020)	altruistic; reward
Bürger & Kleinert (2021)	altruistic; pecuniary rewards; community rewards
Kościółek (2021)	emotional engagement; altruism; desire to belong to a community; collect rewards; causative agency
Mitra *et al*. (2022)	natural rewards; material rewards
Ahn (2023)	altruism; enjoyment; novelty; information; economic incentive; reward; recognition; social relationship
Baber & Fanea-Ivanovici (2023)	intrinsic motivation; inner innovativeness; shared values; campaign involvement
Gang, Cha & Hong (2024)	completeness of information
Nayer, Rosenboim & Malul (2024)	Big Five attributes set of creators: openness, conscientiousness, extraversion, agreeableness, neuroticism
Maciel and Weinberger (2024)	economic value; individualistic democratisation; insider knowledge; reciprocity thrill; vicarious success

Source: the author.

Project supporters motivation factors conceptualisations differ largely, depending on authors. In general, there is a guiding principle of recognising material, and non-material motivation factors, that stimulate supporters' decision-making. Non-material rewards constitute important, and diversified category, related to the preferences of individual supporters.

3. Research Methods

This research is based on praxeology, as the theory guiding methodological choices. Praxeology posits that three essential conditions must be present for human action to occur: a sense of dissatisfaction, a vision of a better state, and the belief that purposeful behaviour can alleviate the dissatisfaction (von Mises, 1998, pp. 13–14). Additionally, humans are subjected to the economisation of time, as their lifespan is limited (von Mises, 1998, p. 101). Therefore, when two actors willingly and purposefully engage in a mutual activity, they expect to benefit from it, even if these benefits may not be recognised by the other actor.

To establish a new type of stakeholder, differentiation and typologies within stakeholders approach must be used. There are three main rules of taxonomy categorisation, in spirit of Aristotelian logic (Parry & Hacker, 1991, pp. 131–133): 1) mutual exclusiveness of subclasses (disjoint criterion), 2) subclasses must be

jointly coextensive with divided class (completeness/comprehensiveness criterion), 3) every level of division must rely on single and common principle of division. On the grounds of justification for entering a new type of stakeholder is the argument that current categorisations lack one type, and for that reason even in theoretical setting, the categories are not disjoint, thus making the whole framework inconsistent and in need for introducing a new type, whose genesis is described in the next section.

The methods employed in this study are directly aligned with the main objective of defining the novel stakeholder type, "insumer" (investing consumer), within the context of crowdfunding. The literature review provided a foundational context for insumers within existing stakeholder theories and crowdfunding literature. By synthesising previous research, we identified gaps in understanding backers' motivations and behaviours as a stakeholder differentiation basis, thereby justifying the introduction of a new category – insumers. The survey was conducted to collect primary data on the motivations, risk perceptions, and value expectations of crowdfunding supporters, which were assessed through descriptive statistics. The questions were designed to reveal insights into the dual role of insumers as both investors (risk aspect) and consumers (value aspect), directly addressing the research objective of defining this stakeholder type. Archival research complemented the survey by providing empirical data on project outcomes, further exploring the risks associated with project backing. This triangulation of data sources facilitated an understanding of the insumer's role in crowdfunding, reinforcing the rationale that distinguishes insumers from other stakeholder types.

The sample was gathered from the online communities focused on crowdfunding, such as groups on Facebook or LinkedIn. The decision to gather the sample from online communities enabled a global selection of respondents, reducing geographical and cultural biases compared to approaches such as recruiting participants at industry events. The research was conducted between 22 May and 3 June 2017, and delivered 102 filled questionnaires, of which 100 satisfied quality requirements. A sample size of 100 respondents provides a margin of error of approximately ±10% at a 95% confidence level, offering sufficient precision for our research objectives. However, as is common in survey-based studies, participation was voluntary, which introduces the possibility of self-selection bias. This may negatively impact the representativeness of the data. Furthermore, taxonomical categorisation based on logical division requires the identification of differentiation traits. Our sample size was adequate to capture these distinctions.

The questionnaire included 11 questions: seven addressing substantial topics related to crowdfunding – such as participants' relationships with crowdfunding, platforms used, and the risks and motivations of project backers and creators – and four demographic questions covering age, gender, and the respondents' location and

country. The responses were collected online using Google Forms. The details of the sample are outlined in Table 4.

Table 4. Sample Characteristics

Variable	Levels	Number of Respondents
Age	18–24	27
	25–34	25
	35–44	18
	45–54	19
	55–64	8
	65–74	2
	≥ 75	1
Gender	male	62
	female	37
	other	1
Inhabitants in place of living	< 25,000	17
	25,001–100,000	18
	100,001–250,000	13
	250,001–500,000	8
	500,001–1,000,000	13
	≥ 1,000,001	31
Relation to crowdfunding	neither supporter nor creator	13
	creator	17
	supporter	22
	both supporter and creator	48
Region (based on countries)	Africa	2
	Asia	6
	Australia and Oceania	4
	Europe	44
	North America	40
	South America	4

Source: the author.

The geographical distribution of respondents generally aligns with the regional distribution of total spending on reward-based crowdfunding, as reported by Statista (2023), with North America and Europe contributing the most.

Apart from the survey, there was an archival research conducted. Projects from one of Kickstarter's categories – technology – were sampled to reflect on the value

flow between the creators and supporters. This category is not representative of the population of categories, so it cannot be used as a basis for assessing the exact risks present in all projects; rather, the intention was to study the survival of projects at different stages of their life in order to be able to make binary conclusions about the existence or absence of different phenomena. Data collection was carried out with the following assumptions:

– the date of delivery of the project's effects was considered to be the month of creation of a comment from a supporter confirming it, or, if there were no such comments, the month of shipment announced by the creator,

– the promised date of delivery was considered the declared moment of receipt of pledges that generated the highest revenue (number of backers × minimum contribution of a pledge),

– if there were no negative comments or positive comments predominated, it was assumed that the backers were satisfied; some projects had no comments, which should indicate the absence of negative experiences.

The target group surveyed consisted of 9,088 projects from the "technology" category (one of the 15 categories of projects present on the Kickstarter platform) whose campaigns were completed before 1 January 2015, with this time frame allowing for the assessment of the project fulfilment. Of these projects, 2,252 completed their funding campaign successfully. The sampling frame was 93 projects, but due to lack of data availability (some projects have updates restricted to backers only) full information was extracted for 80 projects. It was investigated:

– whether the project was cancelled despite raising funds (and returned them to supporters),

– whether the project collapsed without returning the money to supporters,

– whether (and when) the project delivered the promised results.

As a result of this research, the true structure of investment considerations of insumers – including value flows – is presented. The primary study was conducted in 2017; however, the existence of distinct stakeholder in crowdfunding has remained underexplored in the years since. This paper seeks to address this enduring research gap, as the issue continues to be relevant and unaddressed, as evidenced by the recent literature reviewed in the preceding section. The data remains sufficient for addressing the research problem, which was pertinent at the time of the study and remains so today.

4. Results and Discussion

Crowdfunding is perceived to deliver special benefits that both parties to the exchange can obtain. Those that backers can expect are based on three main aspects according to respondents (see Fig. 1):

– the opportunity to get innovative things (67%),
– participating in changing the world for the better (64%),
– helping specific individuals (57%).

There is less interest in the motive to crowdfund as an alternative to obtaining products from the market (however, still more than 30% of respondents see this as a potential benefit).

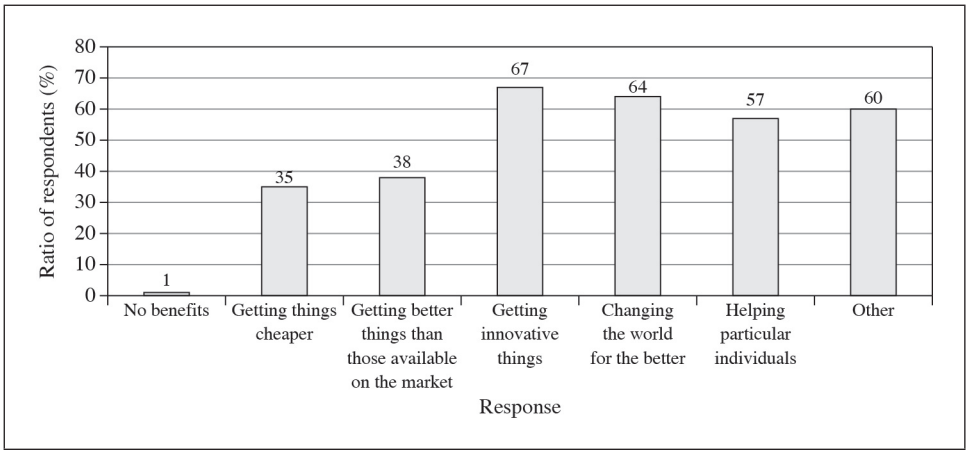

Fig. 1. Motivations of Supporting Crowdfunding Projects
Source: the author.

Among other motivation factors pointed out by respondents, there were: 1) supporting creators and belonging to the community, 2) ability to get niche products, that would not get produced if not crowdfunded, 3) spiritual satisfaction. These results are partly in line with those of Bretschneider and Leimeister (2017), Tung and Liu (2018), Kościółek (2021), and Maciel and Weinberger (2024).

The largest concerns for both parties – creators and supporters – are related to the implementation phase of the project, and comprise the risk that the project will not be completed because of insufficient resources, and supporters will irretrievably lose the funds transferred (see Fig. 2).

Among other risks indicated by respondents there were: 1) legal costs to resolve disputes, 2) the project results will appear after the time they would be of use to the backer, 3) a project might just cover diverging intentions of creators. All of the additional risks may result in lack of trust, pointed as demotivation factor by Gerber and Hui (2013).

In the technology category studied, the risk of getting involved in a project that does not get funded is high – the minimum monetary goal reaches about 25%

(see Fig. 3). This is data available even on Kickstarter itself, but unknown until now was how the situation develops later: 2.5% of projects offered refunding, while 13.75% of projects "died," without returning funds to backers.

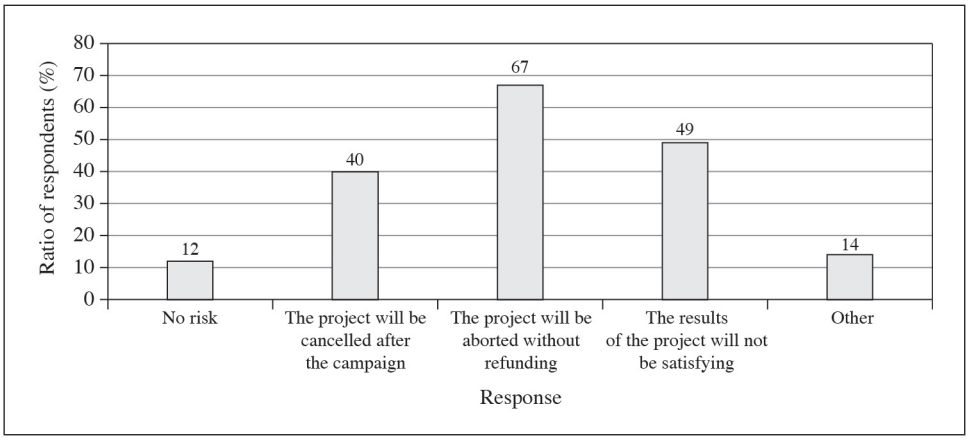

Fig. 2. Perceived Risks of Supporting Crowdfunding Projects
Source: the author.

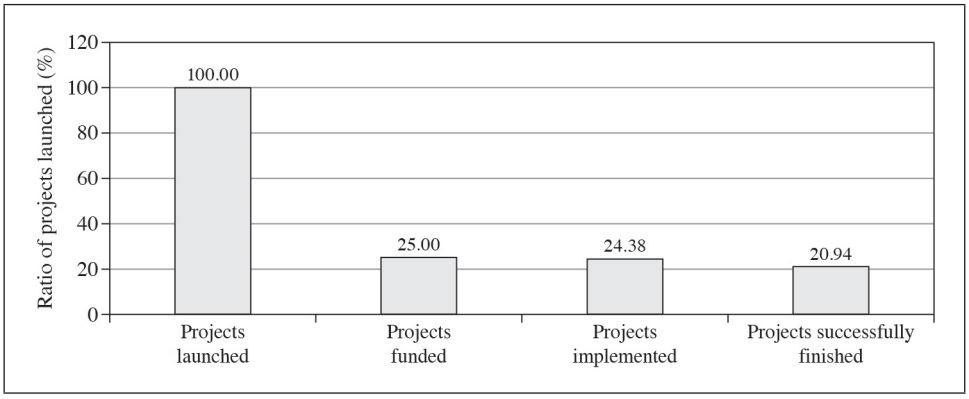

Fig. 3. The Projects Financing in the Sample of Technology Crowdfunding Projects
Source: the author.

Equally important is the presentation of what the financial share of each case is. A large share of funds eligible for refunding may be seen in Figure 4 – but it is impossible to determine exactly, how many funds were actually refunded. If a creator announces a refund, it does not mean that everyone will apply, nor that everyone will receive this refund. What is certain, however, is the more than 5% lost to projects that had no effect.

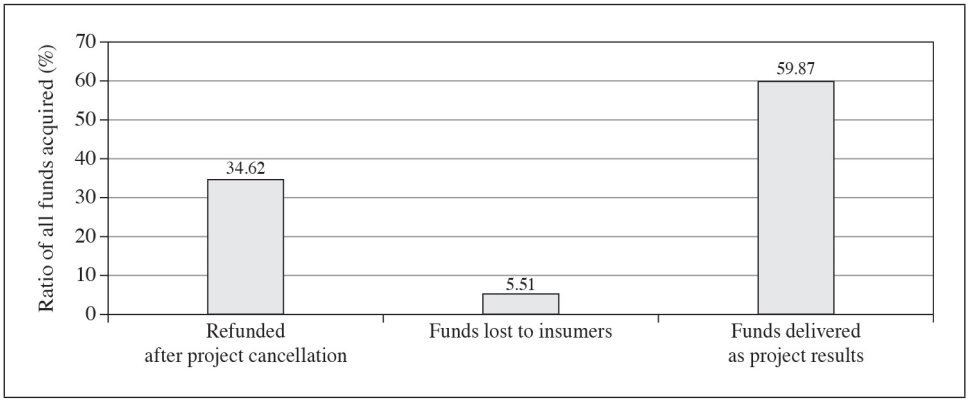

Fig. 4. Funds Usage after the Project Was Successfully Funded
Source: the author.

In addition, it was assessed that in 80.6% of cases the effects of the project were satisfactory (i.e., there were not a significant number of negative comments), with much of the dissatisfaction caused by a significant overrun of the set deadline for shipping rewards. This demonstrates the high risk of erroneous anticipation of utility, especially in temporal aspect. Only 31.34% of the projects in the sample (among those that delivered any result) were delivered on time (of which 7.46% were delivered ahead of schedule), as seen in Figure 5. The average delay of the rest was 224 days, the standard deviation was 225 days, which means that a few extreme cases of extended projects overstate the generally smaller delays. In fact, the median was 123 days. In summary, the chance that a project in the sample will be completed on time with satisfactory results is very low; using simple calculations that do not take into account correlations between characteristics, it is about 21.5% against successfully funded projects.

When considering delivery time based on the amount of funds collected, larger projects are more likely to experience delays. However, these delays are typically less extreme compared to those observed in smaller projects.

The topic of projects was touched upon: The stages they go through and the likelihood of success, related with a risk to project supporters. What has not been demonstrated, however, is the community that exists on the platform studied, or what influence it has on the course of a funding campaign. If projects are considered part of this community, the inequalities that exist in the Kickstarter community would have to be judged to be vastly out of scale, arguing against the myth of democratisation that shared/platform economy delivers. This finding corroborates the description of different narratives present in crowdfunding, as to certain extent myths (Maciel & Weinberger, 2024).

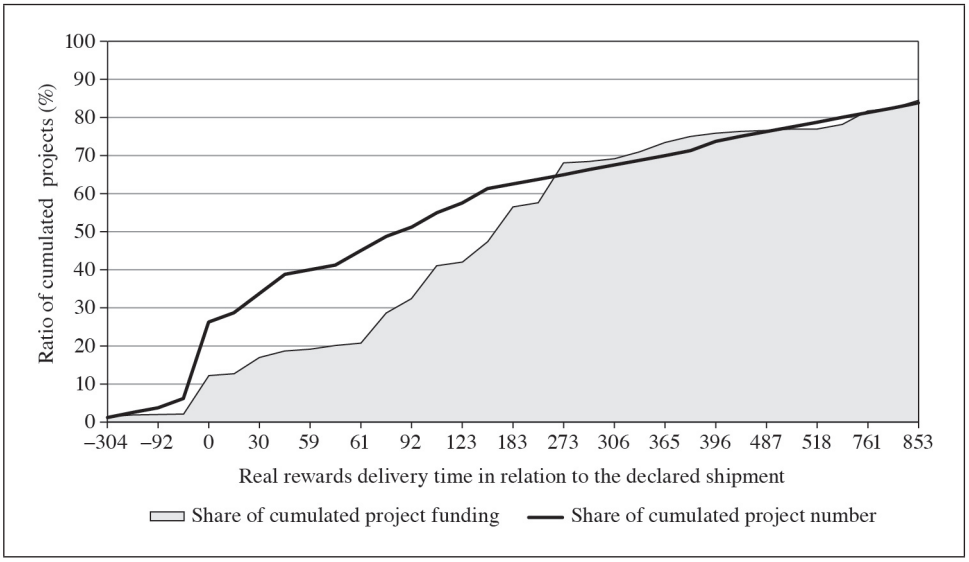

Fig. 5. Delivery Time of Projects' Effects
Source: the author.

The Gini coefficient for the distribution of the total number of backers' pledged contributions for projects is 0.885, as can be observed in the Lorenz curve (see Fig. 6).

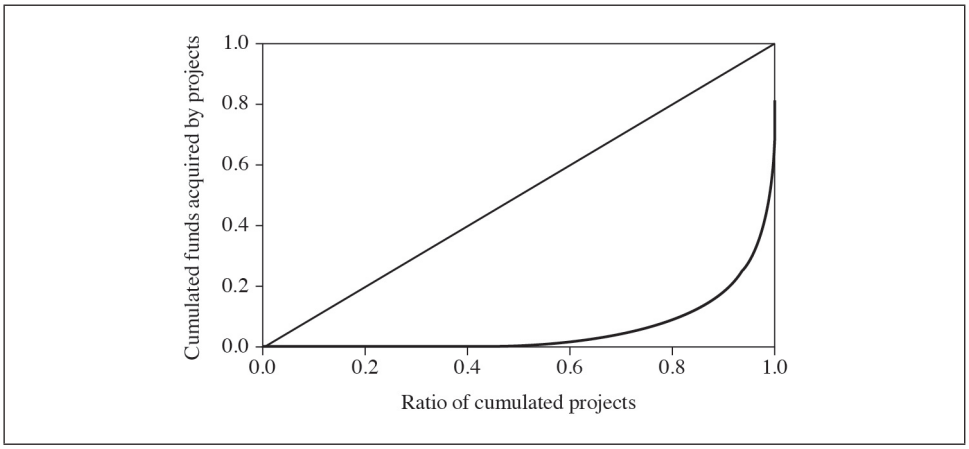

Fig. 6. Lorenz Curve and Projects' Funds Distribution
Source: the author.

The reasons for such a strong stratification are the result of the different levels of support offered by the supporters and are therefore due to the supporters' preferences and behaviours. It indicates that value flows may not be so much community--centric, as they are driven by their self-interest, which goes in line with findings of Zhang and Chen (2019).

5. Conclusions

Based upon findings regarding risk of losing funds, and value flows between project creators, and project supporters in reward-based crowdfunding, insumer is defined as investing consumer (and the consumption and investment criteria are used sequentially in differentiation), insumption therefore is an act of investing into future consumption. It is investment, for there is a risk of losing funds (regardless of the crowdfunding platform type). It is consumption, not only in reward-based crowdfunding, for even equity crowdfunding often offers perks like use of the company's product (Fundedbyme.com, 2019) and donation crowdfunding (despite also giving different physical rewards) is also enabling usage (that is, consumption) of situation that makes people feel better – which in fact resembles any cultural goods consumption, e.g., theatre spectacles. The investing consumer may be portrayed as an actor, driven by the expectancy of a single stream of both material, and non--material values, that is established by single act of backing up a project. The stream of values should be higher than perceived risk in order to convince insumer to support a project.

By explaining the utility transferred to the insumer by the project creator and risks associated with supporting a project, the research question is answered. The distinct value flows between these parties, mixed with risk, render the insumer a distinct, key stakeholder in crowdfunding. Differentiating insumer as a distinct stakeholder type should influence business model creation in crowdfunding, to comprise value flows and risk, as insumers – by transferring their funds – directly contribute to achieving success in crowdfunding campaign.

6. Limitations and Future Research Recommendations

The study holds limitation that stems from limited sample selection – however, differentiation of stakeholder types does not need a larger sample. Modelling of utility that may be transferred between parties could benefit from enlarging the data pool and integrating with more qualitative data sources and methods, e.g., interviews. It is also worth noting that the voluntary nature of participation in the survey may have led to a degree of selection bias, potentially reducing the extent to which the sample accurately reflects the broader population. The area that appears to be important for any further inference, and therefore should be a subject for

deepened research, is study of the levels of risk involved in the insumption process, the average utility levels and type of value that is being transferred (categorised in couple ways, e.g., by platform type, rewards type). This should especially comprise diverse non-material sources of utility for insumers. Such study should not only be of great value to all creators of the projects, but also could be insightful in terms of exploring which categories and platforms may be more suitable for sustainable leadership and development, explain why this is so, and predict outcomes (also in terms of non-market goods) of present and future projects.

Conflict of Interest

The author declares no conflict of interest.

References

Aghdam, M. S., Alamtabriz, A., Qazvini, A. S., & Zandhessami, H. (2020). A System Dynamics Approach to Designing a Crowdfunding Model in Technological Entrepreneurship Ecosystem with a Focus on Technology Incubator Centers. *Journal of Optimization in Industrial Engineering*, *13*(1), 113–122.

Ahlers, G. K. C., Cumming, D., Günther, C., & Schweizer, D. (2015). Signaling in Equity Crowdfunding. *Entrepreneurship Theory and Practice*, *39*(4), 955–980. https://doi.org/10.1111/etap.12157

Ahn, S. K. (2023). To Buy or to Back? Backers' Motivations for Fashion Crowdfunding Projects. *Journal of Fashion Marketing and Management*, *27*(2), 335–351. https://doi.org/10.1108/JFMM-01-2022-0013

Al-Mulla, A., Ari, I., & Koç, M. (2022). Sustainable Financing for Entrepreneurs: Case Study in Designing a Crowdfunding Platform Tailored for Qatar. *Digital Business*, *2*(2), 100032. https://doi.org/10.1016/j.digbus.2022.100032

Baber, H., & Fanea-Ivanovici, M. (2023). Motivations behind Backers' Contributions in Reward-based Crowdfunding for Movies and Web Series. *International Journal of Emerging Markets*, *18*(3), 666–684. https://doi.org/10.1108/IJOEM-01-2021-0073

Bao, L., Wang, Z., & Zhao, H. (2022). Who Said What: Mining Semantic Features for Success Prediction in Reward-based Crowdfunding. *Electronic Commerce Research and Applications*, *53*, 101156. https://doi.org/10.1016/j.elerap.2022.101156

Beaulieu, T. Y., Sarker, S., & Sarker, S. (2015). A Conceptual Framework for Understanding Crowdfunding. *Communications of the Association for Information Systems*, *37*, 1–31. https://doi.org/10.17705/1CAIS.03701

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the Right Crowd. *Journal of Business Venturing*, *29*(5), 585–609. https://doi.org/10.1016/j.jbusvent.2013.07.003

Block, J. H., Groh, A., Hornuf, L., Vanacker, T., & Vismara, S. (2021). The Entrepreneurial Finance Markets of the Future: A Comparison of Crowdfunding and Initial Coin Offerings. *Small Business Economics*, *57*(2), 865–882. https://doi.org/10.1007/s11187-020-00330-2

Bretschneider, U., & Leimeister, J. M. (2017). Not Just an Ego-trip: Exploring Backers' Motivation for Funding in Incentive-based Crowdfunding. *Journal of Strategic Information Systems*, *26*(4), 246–260.

Bürger, T., & Kleinert, S. (2021). Crowdfunding Cultural and Commercial Entrepreneurs: An Empirical Study on Motivation in Distinct Backer Communities. *Small Business Economics*, *57*(2), 667–683. https://doi.org/10.1007/s11187-020-00419-8

Cavalcanti Junqueira, M. I. (2021). Preparation to Execution: Orchestrating Campaign Processes in Organization-led Crowdfunding. In: R. Lenart-Gansiniec, J. Chen (Eds), *Crowdfunding in the Public Sector* (pp. 43–64). Springer. https://doi.org/10.1007/978-3-030-77841-5_3

Chu, C.-C., Cheng, Y.-F., Tsai, F.-S., Tsai, S.-B., & Lu, K.-H. (2019). Open Innovation in Crowdfunding Context: Diversity, Knowledge, and Networks. *Sustainability*, *11*(1), 180. https://doi.org/10.3390/su11010180

Cox, J., Nguyen, T., & Kang, S. M. (2018). The Kindness of Strangers? An Investigation into the Interaction of Funder Motivations in Online Crowdfunding Campaigns. *Kyklos*, *71*(2), 187–212. https://doi.org/10.1111/kykl.12167

Cross, M. B. (2011). *Testimony on Crowdfunding and Capital Formation*. Retrieved from: https://www.sec.gov/news/testimony/2011/ts091511mbc.htm (accessed: 6.05.2017).

Cummings, M. E., Rawhouser, H., Vismara, S., & Hamilton, E. L. (2020). An Equity Crowdfunding Research Agenda: Evidence from Stakeholder Participation in the Rule-making Process. *Small Business Economics*, *54*(4), 907–932. https://doi.org/10.1007/s11187-018-00134-5

Datika, S. (2023). *The Rise of the Insumer: Where They Fit in the Future of Finance*. Forbes.com. Retrieved from: https://www.forbes.com/sites/forbesfinancecouncil/2023/04/03/the-rise-of-the-insumer-where-they-fit-in-the-future-of-finance/ (accessed: 10.10.2024).

Djimesah, I. E., Zhao, H., Okine, A. N. D., Li, Y., Duah, E., & Kissi Mireku, K. (2022). Analyzing the Technology of Acceptance Model of Ghanaian Crowdfunding Stakeholders. *Technological Forecasting and Social Change*, *175*, 121323. https://doi.org/10.1016/j.techfore.2021.121323

Fanea-Ivanovici, M., & Baber, H. (2021). Crowdfunding Model for Financing Movies and Web Series. *International Journal of Innovation Studies*, *5*(2), 99–105. https://doi.org/10.1016/j.ijis.2021.06.001

Foà, C. (2019). Crowdfunding Cultural Projects and Networking the Value Creation: Experience Economy between Global Platforms and Local Communities. *Arts and the Market*, *9*(2), 235–254. https://doi.org/10.1108/AAM-05-2019-0017

Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach*. Pitman.

Fundedbyme.com. (2019). *blinkee.city raises EUR 209,300 through FundedByMe*. Retrieved from: https://www.fundedbyme.com/en/campaign/8339/blinkee-city/ (accessed: 5.05.2017).

Funk, A. S. (2019). *Crowdfunding in China: A New Institutional Economics Approach*. Springer. https://doi.org/10.1007/978-3-319-97253-4

Gang, K., Cha, H. S., & Hong, I. B. (2024). Incomplete Decisions on Reward-based Crowdfunding Platforms: Exploring Motivations from Temporal and Social Perspectives. *Asia Marketing Journal*, *26*(1), 1–10. https://doi.org/10.53728/2765-6500.1623

Gegenhuber, T., & Naderer, S. (2019). When the Petting Zoo Spawns into Monsters: Open Dialogue and a Venture's Legitimacy Quest in Crowdfunding. *Innovation: Organization and Management*, *21*(1), 151–186. https://doi.org/10.1080/14479338.2018.1481753

Gerber, E. M., & Hui, J. (2013). Crowdfunding: Motivations and Deterrents for Participation. *ACM Transactions on Computer-Human Interaction*, *20*(6), 34. https://doi.org/10.1145/2530540

Gleasure, R., & Feller, J. (2016). A Rift in the Ground: Theorizing the Evolution of Anchor Values in Crowdfunding Communities through the Oculus Rift Case Study. *Journal of the Association for Information Systems*, *17*(10), 708–736. https://doi.org/10.17705/1jais.00439

Griffin, Z. J. (2012). Crowdfunding: Fleecing the American Masses. *Journal of Law, Technology & the Internet*, *4*(2), 375–410.

Herrero, Á., Hernández-Ortega, B., & San Martín, H. (2020). Potential Funders' Motivations in Reward-based Crowdfunding. The Influence of Project Attachment and Business Viability. *Computers in Human Behavior*, *106*, 106240. https://doi.org/10.1016/j.chb.2019.106240

Howe, J. (2006). *Crowdsourcing: A Definition*. Retrieved from: http://crowdsourcing.typepad.com/cs/2006/06/crowdsourcing_a.html (accessed: 2.05.2017).

Kickstarter.com. (2015). *Two Billion Dollars*. Retrieved from: https://www.kickstarter.com/2billion (accessed: 1.06.2016).

Kickstarter.com. (2019). *Kickstarter Stats – Kickstarter*. Retrieved from: https://www.kickstarter.com/help/stats (accessed: 29.04.2019).

Kickstarter.com. (2024). *Kickstarter Stats – Kickstarter*. Retrieved from: https://www.kickstarter.com/help/stats (accessed: 11.05.2024).

Kleemann, F., Voß, G. G., & Rieder, K. (2008). Un(der)paid Innovators: The Commercial Utilization of Consumer Work through Crowdsourcing. *Science, Technology & Innovation Studies*, *4*(1), 5–26. https://doi.org/10.17877/DE290R-12790

Kościółek, S. (2021). Backers' Motivations in Sports Clubs Reward-based Crowdfunding Campaigns. *Journal of Physical Education and Sport*, *21*, 1165–1171. http://doi.org/10.7752/jpes.2021.s2147

Li, G., & Wang, J. (2019). Threshold Effects on Backer Motivations in Reward-based Crowdfunding. *Journal of Management Information Systems*, *36*(2), 546–573. https://doi.org/10.1080/07421222.2019.1599499

Light, A., & Miskelly, C. (2015). Sharing Economy vs Sharing Cultures? Designing for Social, Economic and Environmental Good. *Interaction Design and Architecture(s)*, *24*, 49–62.

Maciel, A. F., & Weinberger, M. F. (2024). Crowdfunding as a Market-fostering Gift System. *Journal of Consumer Research*, *50*(6), 1221–1242. https://doi.org/10.1093/jcr/ucad052

Massolution.com. (2015). *2015CF the Crowdfunding Industry Report*. Retrieved from: www.crowdsourcing.org/research (accessed: 29.05.2016).

McGrath, S. K., & Whitty, S. J. (2017). Stakeholder Defined. *International Journal of Managing Projects in Business*, *10*(4), 721–748. https://doi.org/10.1108/IJMPB-12-2016-0097

Micic, I. (2015). *Crowdfunding: Overview of the Industry, Regulation and Role of Crowdfunding in the Venture Startup*. Anchor Academic Publishing.

Mitra, P., Janssen, F., Hermans, J., & Kickul, J. (2022). Social Entrepreneurial Crowdfunding: Influence of the Type of Rewards and of Prosocial Motivation on the Crowds' Willingness to Contribute. *Entrepreneurship and Regional Development*, *34*(9–10), 1001–1024. https://doi.org/10.1080/08985626.2022.2108904

Nayer, D., Rosenboim, M., & Malul, M. (2024). The Two Sides of Crowdfunding Success: Attributes and Motivations of Backers and Entrepreneurs – Evidence from Israel. *The Journal of Entrepreneurship*, *33*(1), 155–182. https://doi.org/10.1177/09713557241233919

Parry, W. T., & Hacker, E. A. (1991). *Aristotelian Logic*. State University of New York Press.

Poponi, S., Mosconi, E. M., Ruggieri, A., & di Trifiletti, M. A. (2019). Ethic values for sharing communities. In: F. Cabitza, C. Batini, M. Magni (Eds), *Lecture Notes in Information Systems and Organisation* (Vol. 28, pp. 175–187). Springer.

Quero, M. J., & Ventura, R. (2019). Value Proposition as a Framework for Value Cocreation in Crowdfunding Ecosystems. *Marketing Theory*, *19*(1), 47–63. https://doi.org/10.1177/1470593118772213

Rodriguez-Ricardo, Y., Sicilia, M., & López, M. (2018). What Drives Crowdfunding Participation? The Influence of Personal and Social Traits. *Spanish Journal of Marketing – ESIC*, *22*(2), 163–182. https://doi.org/10.1108/SJME-03-2018-004

Ryoba, M. J., Qu, S., & Zhou, Y. (2021). Feature Subset Selection for Predicting the Success of Crowdfunding Project Campaigns. *Electronic Markets*, *31*(3), 671–684. https://doi.org/10.1007/s12525-020-00398-4

Ryu, S., Park, J., Kim, K., & Kim, Y.-G. (2020). Reward versus Altruistic Motivations in Reward-based Crowdfunding. *International Journal of Electronic Commerce*, *24*(2), 159–183. https://doi.org/10.1080/10864415.2020.1715531

Schapiro, M. L. (2011). *Schapiro–Issa letter 04062011*. Retrieved from: https://www.sec.gov/news/press/schapiro-issa-letter-040611.pdf (accessed: 4.03.2017).

Shneor, R., & Torjesen, S. (2020). Ethical Considerations in Crowdfunding. In: R. Shneor, L. Zhao, B.-T. Flåten (Eds), *Advances in Crowdfunding: Research and Practice* (pp. 161–182). Palgrave Macmillan. https://doi.org/10.1007/978-3-030-46309-0_8

Statista. (2023). *Total Spend on Reward Crowdfunding in Various Regions Worldwide in 2020 with Forecasts from 2021 to 2023*. Retrieved from: https://www.statista.com/statistics/1228796/spend-on-reward-crowdfunding-worldwide/ (accessed: 10.12.2024).

Steigenberger, N. (2017). Why Supporters Contribute to Reward-based Crowdfunding. *International Journal of Entrepreneurial Behavior & Research*, *23*(2), 336–353. https://doi.org/10.1108/IJEBR-04-2016-0117

Sullivan, M. (2006). *Crowdfunding*. Retrieved from: https://web.archive.org/web/20070224191008/http://fundavlog.com/community/index.php?op=ViewArticle&articleId=9&blogId=1 (accessed: 1.05.2017).

Tung, F.-W., & Liu, X.-Y. (2018). Understanding Backers' Motivations and Perceptions of Information on Product-based Crowdfunding Platforms. In: *Proceedings – 6th International Symposium on Computational and Business Intelligence*, *ISCBI 2018* (pp. 84–88). IEEE. https://doi.org/10.1109/ISCBI.2018.00026

Valančienė, L., & Jegelevičiūtė, S. (2014). Crowdfunding for Creating Value: Stakeholder Approach. *Procedia – Social and Behavioral Sciences*, *156*, 599–604. https://doi.org/10.1016/j.sbspro.2014.11.248

von Mises, L. (1998). *Human Action*. Ludwig von Mises Institute.

Wash, R. (2013). The Value of Completing Crowdfunding Projects. *Proceedings of the International AAAI Conference on Weblogs and Social Media*, *7*(1), 631–639. https://doi.org/10.1609/icwsm.v7i1.14388

Wilson, M., Robson, K., & Botha, E. (2017). Crowdsourcing in a Time of Empowered Stakeholders: Lessons from Crowdsourcing Campaigns. *Business Horizons*, *60*(2), 247–253. https://doi.org/10.1016/j.bushor.2016.11.009

WordSpy. (2008). *Crowdfunding*. Retrieved from: http://wordspy.com/index.php?word=crowdfunding (accessed: 10.12.2024).

Zhang, H., & Chen, W. (2019). Backer Motivation in Crowdfunding New Product Ideas: Is It about You or Is It about Me? *Journal of Product Innovation Management*, *36*(2), 241–262. https://doi.org/10.1111/jpim.12477

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 25–44
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18725

The Review of Applications of Decision-making Techniques in Supply Chain Management

Anna Tatarczak

Maria Curie-Skłodowska University in Lublin, Faculty of Economics, Department of Management Research Methods, M. Curie-Skłodowskiej Square 5, 20-031 Lublin, Poland, e-mail: anna.tatarczak@umcs.pl, ORCID: https://orcid.org/0000-0001-8573-5791

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Tatarczak, A. (2026). The Review of Applications of Decision-making Techniques in Supply Chain Management. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 25–44. https://doi.org/10.15678/krem.18725

ABSTRACT

Objective: The objective of the article is to provide a systematic literature review of Multi-criteria Decision-making (MCDM) techniques in supply chain and logistics management. It aims to fill a research gap by offering an objective overview of the latest advancements in decision-making techniques and their impact on supply chain performance.

Research Design & Methods: The paper employs a systematic literature review to examine the application MCDM techniques in supply chain management. The review follows a five-step process: 1) formulation of research questions, 2) identification of relevant studies through the Scopus database, focusing on English-language journal articles published between 2006 and 2023, 3) selection and evaluation of studies using structured keyword searches and content screening, resulting in a final sample of 348 peer-reviewed articles, 4) analysis and synthesis of the selected literature in relation to the research questions, and 5) reporting the findings to identify research gaps and suggest future research directions.

Findings: The review reveals the diverse applications of MCDM tools and models in addressing complex supply chain challenges, including demand forecasting, inventory management, distribution optimisation, and risk assessment. Furthermore, the study underscores the substantial value added by these techniques, as they lead to improved decision-making processes, enhanced

operational efficiency, cost reduction, and overall performance optimisation of supply chains. The findings also provide valuable recommendations for future research, promoting knowledge accumulation and creation in the field of MCDM techniques for supply chain management.
Implications/Recommendations: The study's findings have important implications for supply chain management, demonstrating how MCDM methodologies may improve decision-making, efficiency, and performance. The recommendations emphasise the continuous application and research of these strategies in diverse supply chain contexts. Future research is recommended to better understand and broaden the use of MCDM approaches in supply chain settings.
Contribution: This article is unique in that it provides a full examination of MCDM strategies related to supply chain and logistics management. It synthesises a wide variety of previous research to offer a comprehensive overview of the present status and promise of MCDM approaches for improving supply chain operations and results.

Article type: original article.

Keywords: multi-criteria decision-making, supply chain management, systematic literature review, decision-making techniques.

JEL Classification: C44, D81, M11.

1. Introduction

The supply chain (SC) is a fusion of operational procedures transforming raw materials into end products or services, meeting the needs of customers. The typical representation of the SC involves the progression of information, financial transactions, and materials across its stages. On the other hand, supply chain management (SCM) entails the coordination, execution, and oversight of this network (Grida, Mohamed & Zaid, 2020). In a period characterised by heightened ambiguity in demand, elevated risk in the supply domain (Cheng *et al*., 2021), and intensifying competition, achieving excellence in SC frequently depends on the organisation's capacity to seamlessly integrate and coordinate the comprehensive range of end-to-end processes. These processes encompass the acquisition of materials or components, their transformation into finished goods, and the subsequent delivery to customers (Min, 2010). Acknowledging the growing importance of information in achieving success in the SC, professionals in this field have investigated diverse approaches to enhance information management and utilise it more effectively for informed business decision-making (Min, 2010). In this research paper, we consider the following SC function: supplier selection, manufacturing, warehousing and logistics (see Fig. 1).

The implementation of MCDM methodologies in the SCM has attracted substantial interest, reflecting the rising complexity of criteria crucial for organisations in making optimum SCM decisions (Khan, Chaabane & Dweiri, 2018).

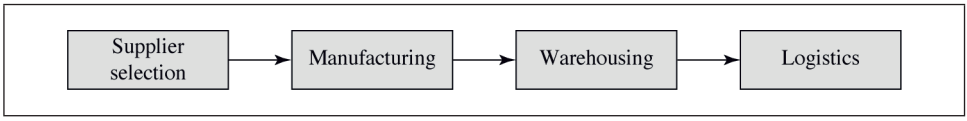

Fig. 1. Supply Chain Functions
Source: the author, based on Salomon (2018).

In recent years, several academics have focused on the investigation of MCDM methodologies in order to address the complexities of decision-making in various industry sectors. The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and its version, Fuzzy TOPSIS, which add components of fuzziness to accommodate uncertainty, are key MCDM approaches that have been extensively recognised and adopted. Furthermore, the Analytical Hierarchy Process (AHP) and its derivative, Fuzzy AHP, provide formal frameworks for making difficult decisions. Furthermore, Data Envelopment Analysis (DEA) takes a non-parametric approach to efficiency analysis, whereas Vlse Kriterijumska Optimizacija Kompromisno Resenje (VIKOR) concentrates on multi-criteria optimisation problems. The incorporation and implementation of these various MCDM approaches in SCM highlights their importance in improving decision-making processes, allowing for more nuanced and informed decisions that reflect the multidimensional character of current corporate contexts. MCDM goes well beyond just reducing procedures for decisive results in the context of supply chain management. It is a comprehensive instrument that allows researchers and managers to balance and harmonise a wide range of criteria, many of which have competing aims or purposes. The work of Sarkis and Talluri (2002) and Chai, Liu and Ngai (2013), who depict the complicated interaction of many components in the decision-making process, highlights this delicate balancing act. As observed by Banasik *et al*. (2018), the application of MCDM becomes especially important in scenarios where trade-offs are required, not only in environmental settings, but also in managing operational, financial, and strategic elements of supply chains. The research of Bai and Sarkis (2010) indicates how MCDM may combine varied objectives, providing a solid technique for harmonising distinct company aims. This integration is vital for fulfilling the complex demands of modern supply chain management, emphasising the importance of MCDM in strategic planning and operational efficiency. Organisations may negotiate the multiple issues inherent in supply chain operations by embracing MCDM, assuring a more coherent and successful management strategy.

Therefore, there is a lack of detailed discussions on MCDM in SCM research (Sahoo & Goswami, 2023). This gap presents an opportunity for a systematic review to check what has been said across a broad range of MCDM studies and use that info to build theories for SCM. Thus, the specific objective of this paper is

to provide a systematic literature review on the application of MCDM methods in SCM. This study is an attempt to answer the following research questions:

RQ1: What are the present focuses of decision-making in SCM in the reviewed literature?

RQ2: What is the distribution of MCDM methods applications in term of area of application?

RQ3: What is the distribution of MCDM methods applied at each SC decision levels: strategic, tactical and operational?

The rest of the paper is arranged as follows: The methodology adopted for the study is explained in section 2. Section 3 carries out the categorical classification of the reviewed papers and presents the results. Discussion on classified analysis results is carried out in section 4. Finally, the paper ends up with a conclusion in section 5.

2. Research Methodology

Literature reviews serve as valuable and thorough examinations utilised to explore research in evolving fields and to provide direction for future research endeavours (Junior & Godinho Filho, 2010; Govindan, 2013). Following the five--step process recommended by Denyer and Tranfield (2009) the method involves: 1) question formulation, 2) finding relevant research, 3) study selection and evaluation, 4) analysis and synthesis, and 5) sharing results (Abdirad & Dossick, 2016).

Step 1: *Question formulation*

First, the authors analysed the general research trends in the literature based on how many studies have been done on MCDM within the supply chain, looking into the study settings and the various approaches used. Subsequently, the authors evaluated the body of existing research, assessing its current state, along with the strengths and weaknesses of prior works. Then, three questions (RQ1, RQ2, RQ3) were formulated to navigate the subsequent processes of data procurement and analytical scrutiny.

Step 2: *Locating studies*

Scopus database was considered for the study because of its wide coverage of peer-reviewed academic literature. The review focused on articles issued from January 2006 through 2023, to collate peer-reviewed academic insights. Only English-language articles with a concentration on management topics were selected for examination. To ensure the high standard of the content, the review excluded conference papers, working documents, technical reports, and book sections.

Step 3: *Study selection and evaluation*

Structured keyword “supply chain management” and “MCDM” was used to search for related articles in the field. This initial query yielded over 600 articles in

the database. To narrow down the selection, the term "supply chain management" was specifically sought in the titles, abstracts, and keywords of articles listed in the Scopus online database. A total of 489 articles were generated in the first step. To evaluate relevant studies on this topic, the author reviewed the content of each paper. Preliminary refinement of the total articles left us with 389 usable articles. After a final round of refinement, 348 peer-reviewed articles remained for in-depth analysis. The information required for the study was systematically compiled using an Excel spreadsheet to facilitate the full paper analysis.

Step 4: *Analysis and synthesis*

At this stage, each study was examined in light of the three queries previously outlined in the introduction.

Step 5: *Reporting and using results*

Following the outlined methodology, this phase involves displaying the research findings by evaluating the chosen papers according to the categories that will be detailed in the forthcoming section on results. This article identifies existing research gaps and suggests directions for future studies. The paper concludes with a summary and a set of conclusions drawn from the research.

3. Results

3.1. Analysis of Articles According to Publication Years

Frequency analysis of the final sample (348 articles) based on the articles published year wise is shown in Figure 2. The examination of publication data on decision-making strategies in supply chain management from 2006 to 2023 demonstrates a considerable and consistent growth in academic interest. Beginning with a single paper in 2006, the field suffered an insignificant early phase but witnessed a significant increase in publications from 2008 forward, suggesting a rising acknowledgement of the relevance of decision-making in this industry. In response to RQ1, the analysis reveals that the focus of decision-making in SCM has progressively shifted towards the application of data-driven methodologies, particularly MCDM techniques, to enhance supply chain performance.

The significant growth in yearly publications, particularly from 2016 to 2023, highlights the expanding role of MCDM approaches in addressing the growing complexities of global supply chains. The increasing integration of artificial intelligence, machine learning, and big data analytics in SCM decision-making has been a key factor influencing this upward trend. Moreover, the surge in publications reflects an increasing emphasis on supply chain resilience, sustainability, and risk management, underscoring the role of decision-support tools in optimising supply chain operations. The peak of 60 publications in 2023 reinforces the need for advanced decision-making frameworks, emphasising how MCDM techniques

contribute to improved strategic planning, operational efficiency, and risk mitigation in modern supply chains (Althaqafi, 2023; Khan *et al*., 2023a; Liu, Gu & Chen, 2023; Tsai, Shen & Lin, 2023).

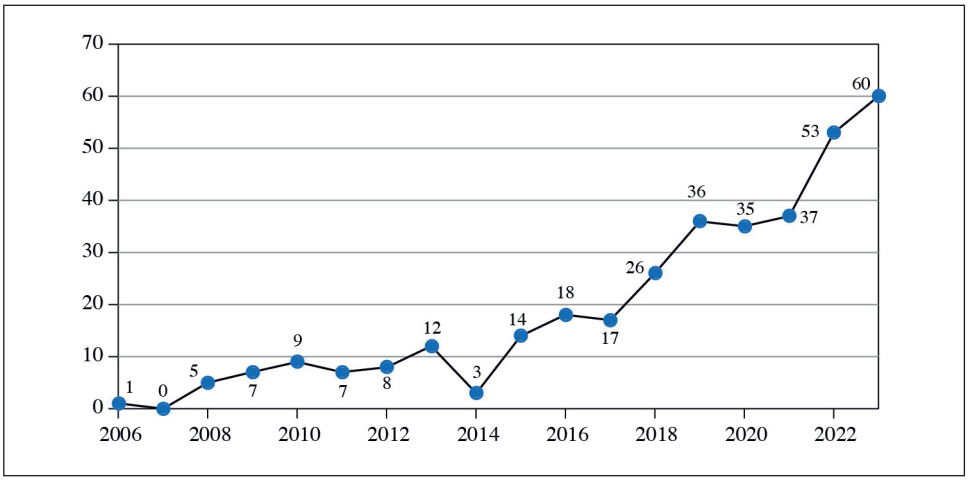

Fig. 2. Number of Review Papers Published by Year (2006–2023)
Source: the author.

3.2. Authors Actively Involved in Publishing

Within the prolific landscape of scholarly work focused on DM in SCM, a corpus of 348 articles has been analysed, drawing contributions from a diverse array of 510 authors. An overview of the leading contributors, detailed in Table 1, reveals that a select group of 17 authors has significantly impacted the field, collectively authoring 79 papers, which accounts for a notable 22.7% of the total output. Among these, D. Pamucar stands out as the foremost contributor, with a portfolio of 8 articles, comprising 2.3% of the entire collection of works analysed.

Table 1. Contribution of Main Authors by Number and Percentage of Articles

Authors	Number of Articles	Percentage
Pamucar, D	8	2.3
Ghosh, S.	5	1.4
Govindan, K.	5	1.4
Mandal, M. C.	5	1.4
Ray, A.	5	1.4
Sarkis, J.	5	1.4
Stević, Ž.	5	1.4

Table 1 cnt'd

Authors	Number of Articles	Percentage
Zavadskas, E. K.	5	1.4
Ali, Y.	4	1.1
Antucheviciene, J.	4	1.1
Hashemkhani Zolfani, S.	4	1.1
Kabak, M.	4	1.1
Kusi-Sarpong, S.	4	1.1
Liu, H. C.	4	1.1
Luthra, S.	4	1.1
Riaz, M.	4	1.1
Tomaskova, H.	4	1.1
Others	269	–

Source: the author.

3.3. Analysis of Papers by Authors' Geographical Distribution

The geographical distribution of the sources of the evaluated publications adds an intriguing feature to the entire research in the context of the comprehensive literature review done for this research (see Fig. 3). Notably, India emerges as the largest contributor with 105 articles, demonstrating the country's active participation in supply chain decision-making processes. China comes in second with 52 publications, demonstrating the country's enormous investment in establishing complex supply chain systems. Turkey, Iran, and Taiwan all provide significant contributions, with 45, 44, and 33 publications, respectively, indicating a growing interest and body of knowledge in these regions. Western nations such as the United States and the United Kingdom, which have historically been seen as pioneers in this subject, have made less contributions in this assessment.

The keyword frequency data provided for the paper is presented on Figure 3. The most frequent terms are "supply" (147 mentions) and "chain" (132 mentions) showing the papers' core focus on supply chain management. Terms like "decision" (34 instances), "decision-making" (26 mentions), and "making" (29 mentions) suggest a high emphasis on decision-making procedures in the context of supply chain management. The use of particular tools such as "fuzzy" (28 occurrences), which refers to fuzzy logic or fuzzy set theory, and "vikor" (7 mentions), which refers to another MCDM method, suggests that the study addresses multiple models and techniques for improving decision-making processes. The terms "supplier" (74 occurrences) and "selection" (53 occurrences) indicate an emphasis on the process of selecting suppliers as a significant decision-making area in SCM.

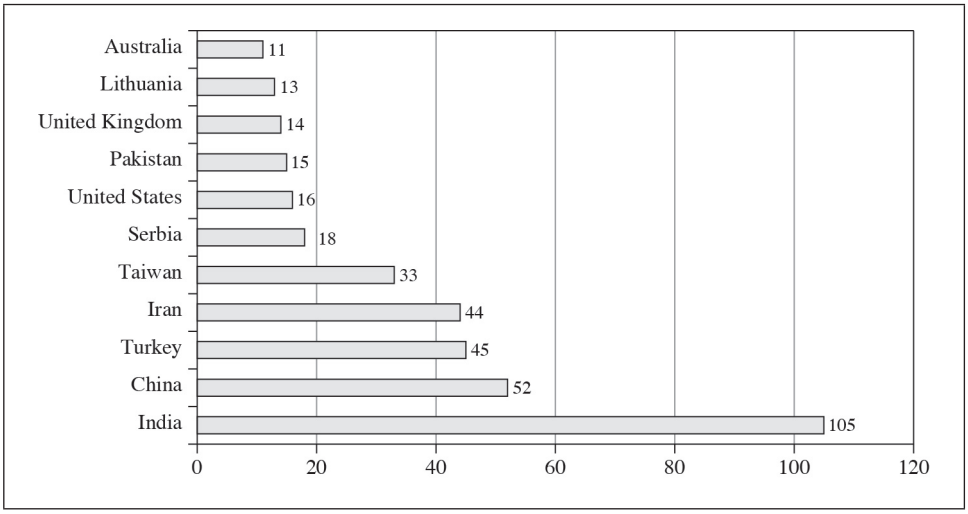

Fig. 3. Distribution of Reviewed Papers over Country
Source: the author.

Researchers employ several MCDM methodologies to model, evaluate, and assist supply chain decision-making. Table 2 displays the various MCDM approaches reported in the 348 publications under consideration. There are 133 articles that employ MCDM approaches for decision-making. TOPSIS is the most widely used approach, with 33 applications, and is praised for its capacity to handle complicated decision-making circumstances by ranking alternatives through an optimum solution. DEMATEL comes in second with 28 occurrences, demonstrating its efficacy in visualising and evaluating complicated causal links inside decision-making situations. VIKOR and AHP are also frequently used, with 24 and 21 applications, respectively, proving their robustness in dealing with multi-criteria decision-making challenges by prioritising options and selecting the optimum course of action. Fuzzy set theory is mentioned in 13 works, demonstrating its usefulness in dealing with uncertainty and imprecision in decision-making. Other approaches, such as ELECTRE, ANP, and DEA, have fewer articles (6, 4, and 4 respectively), indicating a more specialised use or a possibility for development in their acceptance in SCM research. The diverse use of these MCDM approaches emphasises their significance in tackling the various difficulties of supply chain optimisation, ranging from logistics to risk assessment and resource allocation.

TOPSIS technique has emerged as a critical instrument for improving SCM decision-making procedures (Zulqarnain *et al*., 2021; Ali *et al*., 2024). This strategy, which is based on the principle of selecting the alternative that is closest to the ideal solution and farthest from the negative-ideal solution, has been used in a variety of

SCM applications. For example, Behzadian *et al*. (2012) used TOPSIS to evaluate suppliers based on several factors to ensure optimal selection, which is a vital task in SCM. Similarly, Chai, Liu and Ngai (2013) demonstrated the use of TOPSIS in analysing supply chain sustainability, offering a complete framework for examining environmental, social, and economic issues. Furthermore, Govindan, Khodaverdi and Vafadarnikjoo (2015) broadened the scope of TOPSIS by combining it with additional approaches such as AHP to examine the complexity and dynamism of green supply chain operations. These examples demonstrate TOPSIS's adaptability and efficiency in tackling numerous aspects of SCM, ranging from supplier selection (Liao & Kao, 2011; Freeman & Chen, 2015) and performance evaluation (Tyagi, Kumar & Kumar, 2014; Moharamkhani, Bozorgi-Amiri & Mina, 2017) to the incorporation of sustainability and green practices (Büyüközkan & Çifçi, 2012; Chaharsooghi & Ashrafi, 2014; Ansari & Kant, 2017; Dhull & Narwal, 2018). As a result, TOPSIS is a strong analytical tool that aids in the complicated decision-making processes that define modern supply chain management.

Table 2. Frequency of MCDM Methods Used in Articles

MCDM Technique	Number of Papers
TOPSIS	33
DEMATEL	28
VIKOR	24
AHP	21
Fuzzy set theory	13
ELECTRE	6
ANP	4
DEA	4
BWM	3

Source: the author.

DEMATEL approach, a well-known tool in systems engineering, has been successfully adapted for a variety of SCM applications (Giri, Molla & Biswas, 2022; Saroha, Garg & Luthra, 2022). This technique excels at assessing complicated cause-and-effect interactions within system components, making it important for SCM decision-making. Kaur *et al*. (2018) present a DEMATEL-based analysis of barriers to Green Supply Chain Management (GSCM) in the Canadian electronic goods sector, identifying key obstacles in knowledge, commitment, and product design that hinder the implementation of environmentally sustainable practices. Chang, Chang and Wu (2011) use the fuzzy DEMATEL method to identify key factors in supplier selection for SCM, evaluating supplier performance to improve

decision-making in SCM supplier selection, with findings indicating stable delivery as the most influential criterion. The adaptability of the DEMATEL method in SCM is demonstrated by its use in diverse areas such as evaluating key factors in supplier selection, analysing green supply chain practices (Hsu *et al*., 2013; Abdel-Basset *et al*., 2018), and assessing the impact of external pressures on SCM performance (Najmi & Makui, 2010; Senvar, Tuzkaya & Kahraman, 2014), thereby significantly improving decision-making processes by revealing intricate interdependencies and impact patterns.

AHP is used to prioritise and choose suppliers by evaluating them against a set of weighted criteria (Yücenur, Vayvay & Demirel, 2011; Ayhan, 2013; Zekhnini *et al*., 2021). Fuzzy set theory is used to handle uncertainty and imprecision in areas such as demand forecasting and risk assessment (Moeinzadeh & Hajfathaliha, 2009), making it an important tool in supply chain management. The ELECTRE approach is used in complicated decision-making settings such as selecting the best logistics service provider based on several competing factors (Celik, Gumus & Erdogan, 2016; Govindan *et al*., 2019). The ANP is utilised in the network structure of supply chain choices to capture the interdependencies among various elements such as costs, quality, and delivery time (Raisinghani & Meade, 2005). The DEA is used to monitor and benchmark the efficiency of supply chain organisations such as warehouses and distribution facilities (Ross & Droge, 2002; Hahn, Brandenburg & Becker, 2021; Rajak, Parthiban & Dhanalakshmi, 2021). Finally, the BWM is used to optimise procurement strategies by identifying the best and worst criteria, resulting in better supplier selection and assessment throughout the supply chain (Oly Ndubisi *et al*., 2005; Shemshadi *et al*., 2011; Rezaei *et al*., 2016; Khan *et al*., 2023b).

Fig. 4. Keywords Frequency

Source: the author, using WordClouds (https://www.wordclouds.com/).

In response to RQ2, the findings indicate that MCDM methods are widely applied in SCM, particularly in supplier selection, performance evaluation, and risk assessment. The keyword analysis (Fig. 4) highlights a strong focus on supplier evaluation (supplier – 74 occurrences, selection – 53 occurrences). Table 2 identifies TOPSIS (33 applications) and DEMATEL (28 applications) as the most frequently used techniques, valued for ranking alternatives and analysing causal relationships. Additionally, VIKOR, AHP, and fuzzy set theory are commonly applied across various SCM contexts, demonstrating their adaptability in addressing complex decision-making challenges.

3.4. Analysis of Papers by Subject Area

The review emphasises an interdisciplinary approach to supply chain management decision-making processes (see Table 3). Engineering (146 publications) is at the forefront of the research, demonstrating technical solutions to supply chain difficulties. Following that are Computer Science (118) and Business, Management, and Accounting (110), emphasising the importance of computational tactics and financial considerations in supply chain choices. The works in Decision Sciences (83), Environmental Science (79), and Social Science (64) reflect various analytical, sustainable, and sociological issues that are essential to supply chain management. Mathematics (55), Energy (48), and Materials Science (16) studies integrate optimisation and energy management with supply chain operations, while Economics, Econometrics, and Finance (24), and Materials Science (16) contribute economic and material-specific insights. A smaller group of Multidisciplinary (7) publications and articles classified as "Others" (40) demonstrate the broad scope of decision-making applications. This mosaic of research underscores the value of integrating various academic disciplines to enhance supply chain decision-making frameworks.

Table 3. Distribution of Papers According to Subject Area: Numbers and Percentage

Subject Area	Number of Papers	Percentage
Engineering	146	18
Computer Science	118	15
Business, Management and Accounting	110	14
Decision Sciences	83	11
Environmental Science	79	10
Social Science	64	8
Mathematics	55	7
Energy	48	6

Table 3 cnt'd

Subject Area	Number of Papers	Percentage
Economics, Econometrics and Finance	24	3
Materials Science	16	2
Multidisciplinary	7	1
Others	40	5

Source: the author.

The distribution of MCDM methods across different decision-making levels in SCM is evident from the reviewed literature. In response to RQ3, the findings indicate that at the strategic level, methods such as AHP and ANP are predominantly employed for long-term decision-making, particularly in supplier selection and supply chain network design. At the tactical level, DEMATEL and ELECTRE are widely applied for supplier performance evaluation, logistics optimisation, and managerial decision-making. At the operational level, DEA and BWM are frequently utilised to enhance resource allocation, inventory management, and real-time decision support. This categorisation aligns with Table 3, further reinforcing the interdisciplinary nature of SCM decision-making research. The findings confirm the versatility of MCDM approaches in addressing decision-making challenges across strategic, tactical, and operational levels, demonstrating their essential role in optimising supply chain performance across various domains.

4. Discussion

The research provides a thorough evaluation of 348 peer-reviewed publications published between 2006 and 2023 on the application of MCDM in SCM. The research paper organises all available literature according to the following criteria: increasing number of publications over time and pioneering journals, research methodology and research design used, type of industry focused in research, scholars' contribution to research topic, and countries actively involved. The findings of these categories allow us to identify research gaps and establish new research possibilities. But, before we get into that, let's go over some of the study's key results that will help us grasp the current status of the subject.

The growing interest in decision-making techniques within supply chain management, as demonstrated by the literature, suggests an increasing recognition of the complexity and critical nature of supply chain decisions. The field has evolved considerably over the years, with 2023 marking a zenith in research productivity.

Geographically, the distribution of research highlights the active engagement of countries like India and China in enhancing their supply chain decision-making processes. The commitment of these countries to advancing SCM research is

particularly noteworthy, given their roles as major global economic players and manufacturing hubs. It underscores the strategic importance they place on optimising supply chain operations, which is essential for maintaining competitive advantages in the global market.

The interdisciplinary nature of the research showcases the convergence of different academic disciplines in addressing the multifaceted challenges of SCM. Engineering, Computer Science, and Business, Management, and Accounting have emerged as the leading areas, indicating a strong link between technical, computational, and economic aspects of SCM. The involvement of Decision Sciences, Environmental Science, and Social Science reflects the broader impact of SCM decisions on society and the environment, highlighting the need for sustainable and ethically grounded decision-making frameworks.

The following material gathered from the evaluated literature gives insights into the research issues stated in the study. For RQ1, which focuses on current decision--making in SCM, the literature stresses the use of MCDM approaches. TOPSIS, Fuzzy TOPSIS, AHP, and Fuzzy AHP are well-known approaches for dealing with difficulties in several industry sectors. These techniques are critical for dealing with the increasing difficulties of making optimum SCM decisions. In response to RQ2, which concerns the distribution of MCDM approaches in terms of application areas, the literature illustrates the flexibility of these methods across a range of SCM applications. The DEMATEL technique, for example, is used to evaluate critical supplier selection variables, analyse green supply chain practices, and examine the influence of external pressures on SCM performance, demonstrating its adaptability. In answer to RQ3, which asks about the distribution of MCDM approaches in SCM across strategic, tactical, and operational decision levels, numerous methods are mentioned for their unique uses. The ELECTRE approach is used in complex decision settings such as logistics service provider selection, ANP for capturing interdependencies in supply chain decisions, DEA for efficiency monitoring and benchmarking in supply chain organisations, and BWM for optimising procurement strategies, all of which contribute to better decision-making across the supply chain. These findings demonstrate the extensive and multidimensional impact of MCDM approaches in improving decision-making processes in the field of SCM, addressing a variety of difficulties and decision-making levels ranging from strategic to tactical.

5. Future Work

In light of the evolving landscape of SCM, the relevance of MCDM has never been more pronounced. While AI garners widespread attention, it is the nuanced capabilities of MCDM that hold profound potential for SCM. Given the breadth of current literature and emerging trends, we propose a focused trajectory for MCDM research and application within SCM. First, there is a compelling need to explore

how MCDM methods can be amalgamated with big data analytics. This research could develop MCDM frameworks designed to capitalise on the vast amounts of data available, enhancing decision-making accuracy and scope, particularly in the realms of demand forecasting and market analytics. Second, as environmental and social governance become more fundamental to business objectives, MCDM can help companies make decisions that are both sustainable and ethical. Future research might focus on developing decision-making models that balance profit and purpose, weighing trade-offs between economic efficiency, environmental stewardship, and social responsibility. Third, because global supply networks are dynamic, comprehensive risk management frameworks are required. MCDM research may be focused toward the creation of risk-evaluation and risk-mitigation models, with an emphasis on supply chain resilience, vulnerability assessments, and disruption response techniques. Following that, a significant study subject is tailoring MCDM techniques to improve vendor selection criteria such as capabilities, compatibility, and stability. In addition, utilising MCDM models to optimise supply chain network architecture for cost, speed, and flexibility may help organisations adjust to changing market needs and technology changes. Finally, there is a clear demand for powerful and user-friendly MCDM tools and software solutions. Future research should focus on developing scalable and adaptable tools to assist practitioners in many sectors in modelling diverse scenarios and making effective strategic decisions. Addressing these objectives has the potential to considerably improve the strategic application of MCDM in SCM, ensuring that decision-making is not only economically sound but also adaptive, forward-thinking, and socially responsible.

6. Concluding Remarks

The study emphasises the importance of MCDM techniques in tackling the complexity of decision-making in SCM across many industrial sectors. The applicability of methodologies such as DEMATEL, ELECTRE, ANP, DEA, and BWM across many SCM applications and decision levels, from strategic to tactical to operational, emphasises their contribution to more successful SCM decision-making. These findings show the broad and diverse influence of MCDM techniques in navigating different problems and decision-making levels in SCM, consequently improving overall efficiency and strategic planning in the area.

In response to RQ1, the findings confirm that the growing complexity of SCM decision-making has increased reliance on structured, data-driven approaches, with MCDM methods playing a key role in supplier selection, risk management, logistics, and supply chain design. Regarding RQ2, MCDM techniques demonstrate broad applicability, particularly in supplier evaluation and network design, enabling a comprehensive assessment of tangible and intangible criteria (Rajasekaran *et al*., 2016; Manucharyan, 2021). Additionally, decision-support models effectively

address risk-benefit trade-offs in global supply chains (Reich, Wakolbinger & Kinra, 2020), though further innovation in non-conventional selection models remains an area for development (Manucharyan, 2021). For RQ3, MCDM methods are systematically applied across SCM decision levels: AHP and ANP at the strategic level for long-term supplier selection and network optimisation, DEMATEL and ELECTRE at the tactical level for supplier performance and logistics, and DEA and BWM at the operational level for resource allocation and inventory management. This structured application enhances efficiency, adaptability, and resilience in supply chain operations.

The versatility of these MCDM techniques enables their use in a variety of scenarios, allowing companies to efficiently solve complex and varied issues. Whether optimising logistics, improving resource allocation, or controlling risks, MCDM approaches provide detailed analysis that leads to educated, robust, and strategic decisions. This broad application demonstrates the importance of MCDM techniques in improving operational efficiency and strategic planning within SCM. Furthermore, the insights gained from these methodologies allow firms to not only respond to urgent operational needs but also foresee future issues and opportunities, promoting proactive management practices. This dynamic approach to decision-making is critical in today's fast-changing market settings, where agility and strategic foresight are essential. Furthermore, combining MCDM methodologies with future technologies like AI and big data analytics has the potential to significantly transform SCM procedures (Yasmin *et al*., 2020). This collaboration can result in the creation of more complex decision-support systems that increase accuracy, lower costs, and overall supply chain resilience.

Acknowledgement and Financial Disclosure

The author would like to express their gratitude for the opportunity to undertake a scientific internship at Georgian Technical University, Georgia. This article is a direct outcome of that internship. Special thanks are extended to Prof. Rezo Tedoradze for his valuable comments on the draft version of this paper and for inspiring further research study. The paper was supported under the Zawacka NAWA Programme (BPS/ZAW/2023/1/00098).

Conflict of Interest

The author declares no conflict of interest.

References

Abdel-Basset, M., Manogaran, G., Gamal, A., & Smarandache, F. (2018). A Hybrid Approach of Neutrosophic Sets and DEMATEL Method for Developing Supplier Selection Criteria. *Design Automation for Embedded Systems*, *22*, 257–278. https://doi.org/10.1007/s10617-018-9203-6

Abdirad, H., & Dossick, C. S. (2016). BIM Curriculum Design in Architecture, Engineering, and Construction Education: A Systematic Review. *Journal of Information Technology in Construction*, *21*(17), 250–271.

Ali, I., Charles, V., Modibbo, U. M., Gherman, T., & Gupta, S. (2024). Navigating COVID-19: Unraveling Supply Chain Disruptions through Best-worst Method and Fuzzy TOPSIS. *Benchmarking: An International Journal*, *31*(5), 1548–1589. https://doi.org/10.1108/BIJ-11-2022-0708

Althaqafi, T. (2023). Cultivating Sustainable Supply Chain Practises in Electric Vehicle Manufacturing: A MCDM Approach to Assessing GSCM Performance. *World Electric Vehicle Journal*, *14*(10), 290. https://doi.org/10.3390/wevj14100290

Ansari, Z. N., & Kant, R. (2017). A State-of-art Literature Review Reflecting 15 Years of Focus on Sustainable Supply Chain Management. *Journal of Cleaner Production*, *142*, 2524–2543. https://doi.org/10.1016/j.jclepro.2016.11.023

Ayhan, M. B. (2013). A Fuzzy AHP Approach for Supplier Selection Problem: A Case Study in a Gear Motor Company. *International Journal of Managing Value and Supply Chains*, *4*(3), 11–23. https://doi.org/10.48550/arXiv.1311.2886

Bai, C., & Sarkis, J. (2010). Integrating Sustainability into Supplier Selection with Grey System and Rough Set Methodologies. *International Journal of Production Economics*, *124*(1), 252–264. https://doi.org/10.1016/j.ijpe.2009.11.023

Banasik, A., Bloemhof-Ruwaard, J. M., Kanellopoulos, A., Claassen, G. D. H., & van der Vorst, J. G. (2018). Multi-criteria Decision Making Approaches for Green Supply Chains: A Review. *Flexible Services and Manufacturing Journal*, *30*, 366–396. https://doi.org/10.1007/s10696-016-9263-5

Behzadian, M., Otaghsara, S. K., Yazdani, M., & Ignatius, J. (2012). A State-of-the-art Survey of TOPSIS Applications. *Expert Systems with Applications*, *39*(17), 13051–13069. https://doi.org/10.1016/j.eswa.2012.05.056

Büyüközkan, G., & Çifçi, G. (2012). A Novel Hybrid MCDM Approach Based on Fuzzy DEMATEL, Fuzzy ANP and Fuzzy TOPSIS to Evaluate Green Suppliers. *Expert Systems with Applications*, *39*(3), 3000–3011. https://doi.org/10.1016/j.eswa.2011.08.162

Celik, E., Gumus, A. T., & Erdogan, M. (2016). A New Extension of the ELECTRE Method Based upon Interval Type-2 Fuzzy Sets for Green Logistic Service Providers Evaluation. *Evaluation*, *44*(5), 1813–1827. https://doi.org/10.1520/JTE20140046

Chaharsooghi, S. K., & Ashrafi, M. (2014). Sustainable Supplier Performance Evaluation and Selection with Neofuzzy TOPSIS Method. *International Scholarly Research Notices*, *2014*, 34168. https://doi.org/10.1155/2014/434168

Chai, J., Liu, J. N., & Ngai, E. W. (2013). Application of Decision-making Techniques in Supplier Selection: A Systematic Review of Literature. *Expert Systems with Applications*, *40*(10), 3872–3885. https://doi.org/10.1016/j.eswa.2012.12.040

Chang, B., Chang, C.-W., & Wu, C.-H. (2011). Fuzzy DEMATEL Method for Developing Supplier Selection Criteria. *Expert Systems with Applications*, *38*(3), 1850–1858. https://doi.org/10.1016/j.eswa.2010.07.114

Cheng, S., Jianfu, S., Alrasheedi, M., Saeidi, P., Mishra, A. R., & Rani, P. (2021). A New Extended VIKOR Approach Using q-Rung Orthopair Fuzzy Sets for Sustainable Enterprise Risk Management Assessment in Manufacturing Small and Medium-sized Enterprises. *International Journal of Fuzzy Systems*, *23*, 1347–1369. https://doi.org/10.1007/s40815-020-01024-3

Denyer, D., & Tranfield, D. (2009). Producing a Systematic Review. In: D. A. Buchanan, A. Bryman (Eds), *The Sage Handbook of Organizational Research Methods* (pp. 671–689). Sage Publications Ltd.

Dhull, S., & Narwal, M. S. (2018). Prioritizing the Drivers of Green Supply Chain Management in Indian Manufacturing Industries Using Fuzzy TOPSIS Method: Government, Industry, Environment, and Public Perspectives. *Process Integration and Optimization for Sustainability*, *2*(1), 47–60. https://doi.org/10.1007/s41660-017-0030-1

Freeman, J., & Chen, T. (2015). Green Supplier Selection Using an AHP-Entropy-TOPSIS Framework. *Supply Chain Management: An International Journal*, *20*(3), 327–340. https://doi.org/10.1108/SCM-04-2014-0142

Giri, B. C., Molla, M. U., & Biswas, P. (2022). Pythagorean Fuzzy DEMATEL Method for Supplier Selection in Sustainable Supply Chain Management. *Expert Systems with Applications*, *193*, 116396. https://doi.org/10.1016/j.eswa.2021.116396

Govindan, K. (2013). Vendor-managed Inventory: A Review Based on Dimensions. *International Journal of Production Research*, *51*(13), 3808–3835. https://doi.org/10.1080/00207543.2012.751511

Govindan, K., Kadziński, M., Ehling, R., & Miebs, G. (2019). Selection of a Sustainable Third-party Reverse Logistics Provider Based on the Robustness Analysis of an Outranking Graph Kernel Conducted with ELECTRE I and SMAA. *Omega*, *85*, 1–15. https://doi.org/10.1016/j.omega.2018.05.007

Govindan, K., Khodaverdi, R., & Vafadarnikjoo, A. (2015). Intuitionistic Fuzzy Based DEMATEL Method for Developing Green Practices and Performances in a Green Supply Chain. *Expert Systems with Applications*, *42*(20), 7207–7220. https://doi.org/10.1016/j.eswa.2015.04.030

Grida, M., Mohamed, R., & Zaid, A. H. (2020). A Novel Plithogenic MCDM Framework for Evaluating the Performance of IoT Based Supply Chain. *Neutrosophic Sets and Systems*, *33*(1), 323–341.

Hahn, G. J., Brandenburg, M., & Becker, J. (2021). Valuing Supply Chain Performance within and across Manufacturing Industries: A DEA-based Approach. *International Journal of Production Economics*, *240*, 108203. https://doi.org/10.1016/j.ijpe.2021.108203

Hsu, C.-W., Kuo, T.-C., Chen, S.-H., & Hu, A. H. (2013). Using DEMATEL to Develop a Carbon Management Model of Supplier Selection in Green Supply Chain Management. *Journal of Cleaner Production*, *56*, 164–172. https://doi.org/10.1016/j.jclepro.2011.09.012

Junior, M. L., & Godinho Filho, M. (2010). Variations of the Kanban System: Literature Review and Classification. *International Journal of Production Economics*, *125*(1), 13–21. https://doi.org/10.1016/j.ijpe.2010.01.009

Kaur, J., Sidhu, R., Awasthi, A., Chauhan, S., & Goyal, S. (2018). A DEMATEL Based Approach for Investigating Barriers in Green Supply Chain Management in Canadian Manufacturing Firms. *International Journal of Production Research*, *56*(1–2), 312–332. https://doi.org/10.1080/00207543.2017.1395522

Khan, S. A., Chaabane, A., & Dweiri, F. T. (2018). Multi-criteria Decision-making Methods Application in Supply Chain Management: A Systematic Literature. In: V. A. P. Salomon (Ed.), *Multi-criteria Methods and Techniques Applied to Supply Chain Management*. InTech. https://doi.org/10.5772/intechopen.74067

Khan, S., Kaushik, M. K., Kumar, R., & Khan, W. (2023a). Investigating the Barriers of Blockchain Technology Integrated Food Supply Chain: A BWM Approach. *Benchmarking: An International Journal*, *30*(3), 713–735. https://doi.org/10.1108/BIJ-08-2021-0489

Khan, W., Khan, S., Dhamija, A., Haseeb, M., & Ansari, S. A. (2023b). Risk Assessment in Livestock Supply Chain Using the MCDM Method: A Case of Emerging Economy. *Environmental Science and Pollution Research*, *30*(8), 20688–20703. https://doi.org/10.1007/s11356-022-23640-2

Liao, C.-N., & Kao, H.-P. (2011). An Integrated Fuzzy TOPSIS and MCGP Approach to Supplier Selection in Supply Chain Management. *Expert Systems with Applications*, *38*(9), 10803–10811. https://doi.org/10.1016/j.eswa.2011.02.031

Liu, J., Gu, B., & Chen, J. (2023). Enablers for Maritime Supply Chain Resilience during Pandemic: An Integrated MCDM Approach. *Transportation Research Part A: Policy and Practice*, *175*, 103777. https://doi.org/10.1016/j.tra.2023.103777

Manucharyan, H. (2021). Multi-criteria Decision Making for Supplier Selection: A Literature Critique. *Independent Journal of Management & Production*, *12*(1), 329–352. https://doi.org/10.14807/ijmp.v12i1.1265

Min, H. (2010). Artificial Intelligence in Supply Chain Management: Theory and Applications. *International Journal of Logistics: Research and Applications*, *13*(1), 13–39. https://doi.org/10.1080/13675560902736537

Moeinzadeh, P., & Hajfathaliha, A. (2009). A Combined Fuzzy Decision Making Approach to Supply Chain Risk Assessment. *International Journal of Industrial and Manufacturing Engineering*, *3*(12), 1631–1647.

Moharamkhani, A., Bozorgi-Amiri, A., & Mina, H. (2017). Supply Chain Performance Measurement Using SCOR Model Based on Interval-valued Fuzzy TOPSIS. *International Journal of Logistics Systems and Management*, *27*(1), 115–132.

Najmi, A., & Makui, A. (2010). Providing Hierarchical Approach for Measuring Supply Chain Performance Using AHP and DEMATEL Methodologies. *International Journal of Industrial Engineering Computations*, *1*(2), 199–212. https://doi.org/10.5267/j.ijiec.2010.02.008

Oly Ndubisi, N., Jantan, M., Cha Hing, L., & Salleh Ayub, M. (2005). Supplier Selection and Management Strategies and Manufacturing Flexibility. *Journal of Enterprise Information Management*, *18*(3), 330–349. https://doi.org/10.1108/17410390510592003

Raisinghani, M. S., & Meade, L. L. (2005). Strategic Decisions in Supply-chain Intelligence Using Knowledge Management: An Analytic-network-process Framework. *Supply Chain Management: An International Journal*, *10*(2), 114–121. https://doi.org/10.1108/13598540510589188

Rajak, S., Parthiban, P., & Dhanalakshmi, R. (2021). A DEA Model for Evaluation of Efficiency and Effectiveness of Sustainable Transportation Systems: A Supply Chain Perspective. *International Journal of Logistics Systems and Management*, *40*(2), 220–241. https://doi.org/10.1504/IJLSM.2021.118737

Rajasekaran, K. G., Bhaskar, G. B., Chandrasekaran, M., & Murali, S. (2016). A Review on Employing Multi Criteria Decision Making Methods for Supplier Selection. *Asian Journal of Research in Social Sciences and Humanities*, *6*(6), 802–810. https://doi.org/10.5958/2249-7315.2016.00245.8

Reich, J., Wakolbinger, T., & Kinra, A. (2020). Development of a Decision Support Model for Managing Supply Chain Design Problems in Global Service Supply Chains. In: M. Freitag, H.-D. Haasis, H. Kotzab, J. Pannek (Eds), *Dynamics in Logistics: Proceedings of the 7th International Conference LDIC 2020*, *Bremen*, *Germany* (pp. 299–308). Springer International Publishing. https://doi.org/10.1007/978-3-030-44783-0_29

Rezaei, J., Nispeling, T., Sarkis, J., & Tavasszy, L. (2016). A Supplier Selection Life Cycle Approach Integrating Traditional and Environmental Criteria Using the Best Worst Method. *Journal of Cleaner Production*, *135*, 577–588. https://doi.org/10.1016/j.jclepro.2016.06.125

Ross, A., & Droge, C. (2002). An Integrated Benchmarking Approach to Distribution Center Performance Using DEA Modeling. *Journal of Operations Management*, *20*(1), 19–32. https://doi.org/10.1016/S0272-6963(01)00087-0

Sahoo, S. K., & Goswami, S. S. (2023). A Comprehensive Review of Multiple Criteria Decision-making (MCDM) Methods: Advancements, Applications, and Future Directions. *Decision Making Advances*, *1*(1), 25–48. https://doi.org/10.31181/dma1120237

Salomon, V. (Ed.). (2018). *Multi-criteria Methods and Techniques Applied to Supply Chain Management*. InTech. https://doi.org/10.5772/intechopen.71296

Sarkis, J., & Talluri, S. (2002). A Model for Strategic Supplier Selection. *Journal of Supply Chain Management*, *38*(4), 18–28. https://doi.org/10.1111/j.1745-493X.2002.tb00117.x

Saroha, M., Garg, D., & Luthra, S. (2022). Identification and Analysis of Circular Supply Chain Management Practices for Sustainability: A Fuzzy-DEMATEL Approach. *International Journal of Productivity and Performance Management*, *71*(3), 722–747. https://doi.org/10.1108/IJPPM-11-2020-0613

Senvar, O., Tuzkaya, U. R., & Kahraman, C. (2014). Supply Chain Performance Measurement: An Integrated DEMATEL and Fuzzy-ANP Approach. In: C. Kahraman, B. Öztayşi (Eds), *Supply Chain Management under Fuzziness: Recent Developments and Techniques* (pp. 143–165). Springer.

Shemshadi, A., Shirazi, H., Toreihi, M., & Tarokh, M. J. (2011). A Fuzzy VIKOR Method for Supplier Selection Based on Entropy Measure for Objective Weighting. *Expert Systems with Applications*, *38*(10), 12160–12167. https://doi.org/10.1016/j.eswa.2011.03.027

Tsai, J. F., Shen, S. P., & Lin, M. H. (2023). Applying a Hybrid MCDM Model to Evaluate Green Supply Chain Management Practices. *Sustainability*, *15*(3), 2148. https://doi.org/10.3390/su15032148

Tyagi, M., Kumar, P., & Kumar, D. (2014). A Hybrid Approach Using AHP-TOPSIS for Analyzing e-SCM Performance. *Procedia Engineering*, *97*, 2195–2203. https://doi.org/10.1016/j.proeng.2014.12.463

Yasmin, M., Tatoglu, E., Kilic, H. S., Zaim, S., & Delen, D. (2020). Big Data Analytics Capabilities and Firm Performance: An Integrated MCDM Approach. *Journal of Business Research*, *114*, 1–15. https://doi.org/10.1016/j.jbusres.2020.03.028

Yücenur, G. N., Vayvay, Ö., & Demirel, N. Ç. (2011). Supplier Selection Problem in Global Supply Chains by AHP and ANP Approaches under Fuzzy Environment. *The International Journal of Advanced Manufacturing Technology*, *56*, 823–833. https://doi.org/10.1007/s00170-011-3220-y

Zekhnini, K., Cherrafi, A., Bouhaddou, I., & Benghabrit, Y. (2021). Analytic Hierarchy Process (AHP) for Supply Chain 4.0 Risks Management. In: T. Masrour, A. Cherrafi, I. El Hassani (Eds), *Artificial Intelligence and Industrial Applications: Smart Operation Management* (pp. 89–102). Springer International Publishing. https://doi.org/10.1007/978-3-030-51186-9_7

Zulqarnain, R. M., Xin, X. L., Siddique, I., Asghar Khan, W., & Yousif, M. A. (2021). TOPSIS Method Based on Correlation Coefficient under Pythagorean Fuzzy Soft Environment and Its Application towards Green Supply Chain Management. *Sustainability*, *13*(4), 1642. https://doi.org/10.3390/su13041642

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 45–68
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18713

Centrality Index Revealing the Central and Hidden Places in Mazowieckie Voivodeship

Ewelina Szczech-Pietkiewicz[1], **Mariusz-Jan Radło**[2], **Artur F. Tomeczek**[3]

[1] SGH Warsaw School of Economics, European Union Unit, Niepodległości 162, 02-554 Warszawa, Poland, e-mail: eszcze@sgh.waw.pl, ORCID: https://orcid.org/0000-0001-7004-1631

[2] SGH Warsaw School of Economics, Global Economic Interdependence Department, Niepodległości 162, 02-554 Warszawa, Poland, e-mail: mjradlo@sgh.waw.pl, ORCID: https://orcid.org/0000-0001-7756-1613

[3] SGH Warsaw School of Economics, Global Economic Interdependence Department, Niepodległości 162, 02-554 Warszawa, Poland, e-mail: artur.tomeczek@sgh.waw.pl, ORCID: https://orcid.org/0000-0003-4888-2535

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Szczech-Pietkiewicz, E., Radło, M.-J., & Tomeczek, A. F. (2026). Centrality Index Revealing the Central and Hidden Places in Mazowieckie Voivodeship. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 45–68. https://doi.org/10.15678/krem.18713

ABSTRACT

Objective: This article aims to calculate a centrality index for Mazowieckie voivodeship using an empirical application of Christaller's central place theory.

Research Design & Methods: We calculate the value of a centrality index for 89 cities in Mazowieckie voivodeship using data for 32 central activities (independent variables). The proposed centrality index (synthetic indicator based on a non-model method) can be used to identify cities that are important for regional development. The population-adjusted centrality index shows which cities overperform, or underperform, compared to their size; the scores are useful for the identification of the hidden centres of urban activity.

Findings: The analysis identifies three types of cities that are of interest in light of the central place theory: 16 central places (centrality index ≥ 3), 27 hidden places (population-adjusted centrality index ≥ 2), and three hidden central places (classified as both central places and hidden

places). The regional supremacy of Warsaw is visible in its perfect centrality index score; other central places include Radom and Płock. On the other hand, hidden places are exemplified by Lipsko, Przysucha, and Podkowa Leśna. Wołomin, Grodzisk Mazowiecki, and Wyszków are classified as the three hidden central places of the Mazowieckie voivodeship.

Implications/Recommendations: Hidden central places can be crucial for the future growth of the region. The dominant role of Warsaw is not going to be challenged, but, with sufficient support, the hidden central places could disperse geographically some of the essential functions in a more sustainable, inclusive, and accessible way.

Contribution: The research contributes to the understanding of the regional development of Mazovia and the practical applications of the central place theory. The devised method can be used in the analysis of different regions.

Article type: original article.

Keywords: centrality index, central place theory, cities, Mazovia, Poland.

JEL Classification: R10, R12, R58, O18.

1. Introduction

Walter Christaller introduced the central place theory in the 1930s (Christaller, 1933, 1966). Its core concept lies in the idea that a large city will form functional ties with other smaller cities in its vicinity, thus limiting the need to replicate said functions in those smaller cities. Originally based on the data and urban areas of Southern Germany, the theory underscores the importance of cities as hubs of regional development. The framework of such analysis delves into the role played by influential central places, the functional hierarchies of large and small cities, and ties between centres and their surrounding areas.

Centrality refers to the significance of a city or location within a regional or national system, typically characterised by its ability to provide goods and services to surrounding areas. The concept originates from Christaller's theory, which posits that settlements function as "central places" offering specialised services to a dispersed population. Centrality is measured by the city's capacity to attract flows of people, goods, and services, establishing its role as a hub within a hierarchical urban network. Accordingly, higher-order central places provide a wider range of goods and services than lower-order ones, which tend to serve smaller, more localised populations.

This article aims to calculate a centrality index for 89 cities in the Mazowieckie voivodeship using an empirical application of central place theory. The study seeks to classify the cities into central places, hidden places, and hidden central places, contributing to a better understanding of regional development dynamics and providing insights for informed policymaking. To achieve this objective, we propose

three research questions: [RQ1] Which cities in Mazowieckie voivodeship can be classified as central places, hidden places, or hidden central places? [RQ2] How can a centrality index be applied in regional policymaking? [RQ3] Is Christaller's central place theory still relevant for the regional development of modern Poland?

Mazowieckie voivodeship, which includes the Capital City of Warsaw, is a region of Poland characterised by rapid economic growth, uneven level of economic development, and a strong monocentric structure (Napiórkowski & Radło, 2022; Radło & Szczech-Pietkiewicz, 2022; Szczech-Pietkiewicz, Radło & Tomeczek, 2022). For this study, we define a city as a settlement with Poland's official administrative designation of a city, regardless of its population. As such, to complement the existing central place theory we omit the classical division of cities/towns/hamlets, and instead, we introduce the concepts of hidden places and hidden central places. The initial results of the model were published as a part of a monograph (Szczech-Pietkiewicz, Radło & Tomeczek, 2022). This article extends that analysis by providing an expanded literature review, detailed methodology (e.g., procedure steps), results (e.g., categories scores), and interpretations.

Central places are defined as cities of high importance for their surrounding regions; most of them have a large population. They have a relatively high centrality index value of at least 3. The best example is Warsaw, followed by Radom and Płock.

Hidden places are cities whose centrality is not high enough to be classified as central places, but relative to their population, they serve as important functional centres for their regions. According to the central place theory (Christaller, 1933, 1966), centrality refers to the ability of a city to provide goods and services to surrounding areas, making it a hub within the urban network. In the case of hidden places, although their centrality index does not meet the criteria for central places, their population-adjusted centrality index is high (at least 2), reflecting their hidden yet significant role in the region. Examples of hidden places include Lipsko, Przysucha, and Podkowa Leśna.

To be classified as a hidden central place, a city must combine the characteristics of both central and hidden places. These cities have enough centrality to influence surrounding areas (centrality index ≥ 3) and maintain a relatively small population (population-adjusted centrality index ≥ 2), making them hidden within the urban system. Wołomin, Grodzisk Mazowiecki, and Wyszków are examples of such cities, showcasing the complexity of centrality where functional importance outweighs population size in determining regional significance.

The article comprises five sections, including this introduction. Section 2 reviews the literature on central places and the measurement of centrality. Section 3 details the methodology (synthetic indicator based on a non-model method) and data sources (e.g., Local Data Bank of Statistics Poland). Section 4 explores the results

of the analysis, namely centrality index scores and population-adjusted centrality index scores. Section 5 concludes the study and provides implications of the results.

2. Literature Review

The central place theory originated from the seminal works of Christaller (1966) in the 1930s. There have been numerous explorations and expansions of this theory through the decades. Christaller's contributions have been acknowledged by many influential economic studies such as those by Arthur (1994), Hall (2014), Krugman (1991), and Smith (2008).

Boussauw, van Meeteren and Witlox (2014) look at the central place theory through the lens of the home-school distance data for Belgium. Peredo and Chrisman (2006) show how local community-based enterprises can strengthen growth in poor neighborhoods. Davies (1968) puts forward a concept of central place morphology, where cities and their buildings evolve with the additions of new commercial activities. According to Siddall (1961), the crucial measure of centrality is the employment in wholesale trade, as a city with a high wholesale/retail ratio is engaging in trade with numerous clients from surrounding areas. Nowosielska (1992) provides an extended theoretical overview of Christaller's theory. Castells and Hall (1994) explore the concept of technopoles, local technology centres that serve as engines of growth for high-tech industries and overall economic development. Fleming and Hayuth (1994) look at the combination of traffic in transport networks: passengers for airports and containers for seaports. Naess (2012) reviews the high impact of urban areas on travel. The central place theory incorporates accessibility by organising settlements in a hierarchical and hexagonal pattern, ensuring efficient access to goods and services. The proximity and ease of reaching central places depend on transportation networks, with lower-order centres offering more frequent access to basic services and higher-order centres providing specialised services at greater distances.

A valid criticism of the central place theory is that it only describes reality and does not explore the in-depth causal relationship (Fujita, Krugman & Venables, 1999). Bird (1973) underscores that seaport cities' centrality tends to be underrated in the classical approach. Derudder and Witlox (2004) state that the classic central place theory is unable to adequately model globalisation, which caused a shift from manufacturing and local trade to knowledge creation, services, and international inter-city flows.

A rising trend in urban studies is the use of network analysis to calculate various centralities and identify central places. An early example of this notion is the article by Irwin and Hughes (1992). A study by Neal (2011) shows that the functional networks now dominate the urban landscape of the United States in lieu of the size-

-based hierarchies. Tsiotas and Polyzos (2015) use network analysis to examine the commuting and road transportation networks in Greece, while Gonçalves, Portugal and Nassi (2009) analyse railway networks in Brazil.

There is a growing notion of mid-size and small cities' importance for economic development (Bell & Jayne, 2009; Dijkstra, Garcilazo & McCann, 2013). The previous studies on the topic include those by Jamal (2018) for mid-sized cities in Canada, Audretsch, Belitski and Desai (2015) for various European cities of all sizes, Fahmi *et al*. (2014) for small and mid-sized cities in Indonesia, Véron (2010) for small cities in India, Erickcek and McKinney (2006) for small and mid-sized cities in the United States, Henríquez, Azócar and Romero (2006) for mid-sized cities in Chile, and van Dijk and Mingshun (2005) for mid-sized cities in China. Our article seeks to accentuate the role played by small and mid-sized urban areas by looking at the centrality of cities with various population sizes.

Both centrality and synthetic indicators have an important place in economic literature. Davies (1967) calculates a synthetic centrality index for the area of South Wales around Pontypridd. Berry and Garrison (1958) calculate one for Snohomish County, Washington. Brush's (1953) research encompasses southwestern Wisconsin. Bracey (1953) calculates a service-based centrality index for Somerset. He later expanded his index to other counties of the United Kingdom (Bracey, 1956). Preston (1971) computes a monetary centrality index for the Pacific Northwest region, using the value of sales and services, median income, and consumption. Zhong *et al*. (2017) construct a centrality index based on density (concentration of activities) and diversity (how mixed the activities are) using travel survey data for Singapore. In their overview of creative cities, Lewis and Donald (2010) find that synthetic indicators usually tend to favour big cities over small cities. Mokhtarian (1998) uses a synthetic indicator in the study of how remote work changes travel patterns. Taylor, Hoyler and Verbruggen (2010) extend central place theory to incorporate flows (central flow theory), in which the focus is not on the cities but rather on the business networks connecting them. Capello (2000) shows the positive impact of externalities in cooperative networks of cities. For regions of Poland, Gwosdz (2004), Mularczyk (2014), and Sokołowski (1999) calculate centrality indices for Upper Silesia, Świętokrzyskie voivodeship, and small settlements, respectively. Sokołowski (2006) also made a significant contribution to the study of urban systems in Poland by analysing the functional hierarchy of cities and the structure of their central activities. Additionally, Biderman and Kamiński (1993) examined the role of Poznań in the regional redistribution of population, also contributing to the body of research on the central functions of cities. Further applications of synthetic indicators based on Polish data include capital markets (Dmitruk & Gawinecki, 2017) and demographics (Mastalerz-Kodzis & Pośpiech, 2015).

3. Methodology and Data

Synthetic indicators based on a non-model method are a useful tool for comparing relatively similar objects when their description requires consideration of multiple diagnostic variables. Most commonly, it is achieved through classification. Such indicators are an example of the application of multidimensional comparative analysis. In contrast to the model method, the non-model method construction does not require a comparison with the model. Its simple design makes it possible to compare objects with both stimulant, destimulant, and nominant descriptor variables. This necessitates a process of transformation of variables and unification of their nature in the first place (Panek, 2009, p. 33). A simple formula based on a weighted arithmetic mean can be used in the construction of a synthetic indicator based on a non-model method (Panek, 2009, p. 137). The identified diagnostic variables can have the same or different weights depending on their importance for the description of the object (Panek, 2009, p. 32). Such indicators can be normalised and take values within a certain range, usually from 0 to 1, from 0 to 10, or from 0 to 100.

We calculate the value of a centrality index (C) for 89 cities in Mazowieckie voivodeship [*województwo mazowieckie*] using data for 32 central activities (independent variables). For simplicity, we use the Polish spelling for the names of all the cities other than Warsaw [*Warszawa*]. Our centrality index is a synthetic indicator based on a non-model method. Since every one of the central activities we chose has a positive impact on the centrality score, the following simple Min-Max normalisation has been utilised in the preparation of the data (Kukuła, 1999, pp. 7, 16; Panek, 2009, p. 39; Patro & Sahu, 2015, p. 20):

$$v_{ij} = \frac{x_{ij} - \min\limits_{i} x_{ij}}{\max\limits_{i} x_{ij} - \min\limits_{i} x_{ij}}, \quad \max_{i} x_{ij} \neq \min_{i} x_{ij},$$

where v_{ij} is the normalised variable of central activity j for city i, and x is the original data. Normalisation provides us with variables with a range of values [0, 1]. Every variable is then multiplied by 100, which gives us 32 variables with a range of values between 0 (for the city/cities with the lowest score) and 100 (for the city/cities with the highest score).

Next, we calculate weights for every variable (central activity), which tells us how important they are for the centrality of the cities. The weight for every variable is taken from the following equation (Gwosdz, 2004, p. 18; Mularczyk, 2014, p. 384; Sokołowski, 1999, p. 298):

$$w_j = 100 - \frac{m_j}{m} \cdot 100,$$

where w_j is the weight for variable j, m_j is the number of cities where variable j is higher than 0, m is the total number of analysed cities. The weight of a variable

is directly proportional to its rarity as a central activity (the number of cities where the variable equals 0). Since variables have been Min-Max normalised, the lowest possible weight is 1.12 (when an activity is present in every city but one) and the highest possible weight is 98.88 (when an activity is absent in every city but one).

Finally, the centrality index is calculated using the following equation (Davies, 1967, p. 63; Sokołowski, 1999, p. 298; Gwosdz, 2004, p. 18; Mularczyk, 2014, p. 385):

$$C_i = \frac{\sum_{j=1}^{k}(w_j)}{\sum_{j=1}^{v}(w_j)} \cdot 100,$$

where C_i is the value of the centrality index for city i, w_j is the weight for variable j, k is the number of analysed central activities (variables higher than 0) in a given city, v is the number of all analysed central activities (total variables). After calculating all the weights (Table 2) we can estimate the weighted average for every city. We multiply the 32 normalised variables for a city by the 32 calculated weights, sum up the results, and then divide the sum by the sum of all weights. The result is the centrality index (full results for every city are available in Table A.1 attached in the Appendix). Additionally, we calculate a simple index of the population (Warsaw = 100) to compare the centrality of a city (as measured by our centrality index) to its size. Population-adjusted centrality index is centrality index divided by population index: Values higher than 1 suggest that a city's centrality is higher than its size might suggest, and values lower than 1 suggest the inverse.

The data comes from the most recent available year (mostly from 2018), but for the cases where such data is not available (e.g., it is not updated annually or it is no longer updated for cities), we take older data as long as it is available for every city in that period. Most of the data used in this article, including cities' population, come from Local Data Bank, Statistics Poland (bdl.stat.gov.pl) [*Bank Danych Lokalnych*]; other data sources are as indicated in Table 1.

Table 1. Central Activities (Variables) and Data Sources

Category	Central Activity (Variable)	Source	Description
Public administration	1.1 – police	bip.gov.pl	The number of police headquarters of various levels (e.g., district, national), 2020
	1.2 – courts	bip.gov.pl	The number of courts, excluding courts of appeals and the Supreme Court, 2020
	1.3 – tax and civic registry offices	dane.gov.pl, podatnik.info	The number of tax and civic registry offices, 2020

Table 1 cnt'd

Category	Central Activity (Variable)	Source	Description
Culture and arts	2.1 – museums, theatres, philharmonics, and operas	bdl.stat.gov.pl, baza-firm.com.pl	The number of museums, theatres, philharmonics, and operas, 2018–2020
	2.2 – public libraries and community centres	bdl.stat.gov.pl	The number of public libraries and community centres, 2018
	2.3 – concerts and festivals	bdl.stat.gov.pl	The number of concerts and festivals (mass gatherings), 2019
	2.4 – cinemas	bdl.stat.gov.pl	The number of cinemas, 2018
Healthcare	3.1 – general hospitals	bdl.stat.gov.pl	The number of general hospitals, 2003 (data discontinued for cities)
	3.2 – clinics	bdl.stat.gov.pl	The number of clinics [*przychodnie*], 2018
	3.3 – pharmacies	bdl.stat.gov.pl	The number of pharmacies, 2018
Public interest and education	4.1 – hotels	bdl.stat.gov.pl	The number of hotels (any standard), 2019
	4.2 – sports stadiums	bdl.stat.gov.pl	The number of sports stadiums, 2018
	4.3 – higher education institutions	bdl.stat.gov.pl, rgsw.edu.pl	The number of higher education institutions [*uczelnie*], 2018–2020
	4.4 – general secondary education institutions	bdl.stat.gov.pl	The number of general secondary education institutions [*szkoły ogólnokształcące*], 2018
Organisations	5.1 – associations, etc.	ekrs.ms.gov.pl	The number of associations and foundations of various kind [*stowarzyszenia*, *inne organizacje społeczne i zawodowe*, *fundacje*, *ZOZ*], 2020
	5.2 – foundations under Ministries: of Environment, of Climate, of National Defence	dane.gov.pl	The number of foundations under the Ministry of Environment, Ministry of Climate, Ministry of National Defence, 2020
	5.3 – sports clubs	bdl.stat.gov.pl	The number of sports clubs of various levels, 2018

Table 1 cnt'd

Category	Central Activity (Variable)	Source	Description
Retail trade	6.1 – supermarkets	bdl.stat.gov.pl	The number of supermarkets, 2018
	6.2 – hypermarkets	bdl.stat.gov.pl	The number of hypermarkets, 2018
	6.3 – permanent and seasonal markets	bdl.stat.gov.pl	The number of permanent and seasonal markets (including stands), 2018
	6.4 – gas stations	bdl.stat.gov.pl	The number of gas stations, 2003 (data discontinued for cities)
Professional services	7.1 – construction companies	baza-firm.com.pl	The number of construction companies, 2020
	7.2 – energy companies	stat.gov.pl	The number of energy companies (Sekcja D, PKD), 2019
	7.3 – finance and insurance companies	stat.gov.pl	The number of finance and insurance companies (Sekcja K, PKD), 2019
	7.4 – consulting, scientific, and technical companies	stat.gov.pl	The number of consulting, scientific, and technical companies (Sekcja M, PKD), 2019
Labour market	8.1 – commuting to work: arrivals	bdl.stat.gov.pl	The number of persons commuting to a city, 2011 (data from National Census of 2011)
	8.2 – commuting to work: balance	bdl.stat.gov.pl	The balance of the number of persons commuting to and from a city, 2011 (data from National Census of 2011)
	8.3 – employment	bdl.stat.gov.pl	Total employment, 2018
Transport	9.1 – taxis	bdl.stat.gov.pl	The number of officially licensed taxis registered in the city, 2018
	9.2 – postal offices	bdl.stat.gov.pl	The number of post offices, 2000 (data discontinued for cities)
	9.3 – Park & Ride	bdl.stat.gov.pl	The number of Park & Ride car-parks [*system Parkuj i Jedź*], 2018
	9.4 – railway stations	koleo.pl	The number of railway stations (Polish State Railways [*Polskie Koleje Państwowe*]), 2020

Source: the authors.

4. Results

Table 2 shows the results of the weight calculation for each variable. Immediately, an intuitive solution would be to remove the variables with the lowest weight. However, this makes the centrality index very unreliable for the smallest cities, where the central activities with high weights might not occur at all. Centrality scores of the cities in the lowest deciles of the rank depend in large part on these seemingly unimportant variables. Since the official administrative designation of Poland recognises only cities and villages, our data represent a wide spectrum of settlements that in other studies on central places would be considered cities, towns, or hamlets. Thus, we believe that the study warrants the inclusion of all variables. However, for future studies of similarly-sized settlements, a version of the index where only several central activities with the highest weights are chosen would be accurate and much easier to calculate.

Table 2. Weights

Variable	Weight	Variable	Weight	Variable	Weight	Variable	Weight
1.1	59.55	3.2	1.12	5.3	6.74	7.4	1.12
1.2	62.92	3.3	1.12	6.1	4.49	8.1	1.12
1.3	58.43	4.1	50.56	6.2	82.02	8.2	1.12
2.1	59.55	4.2	21.35	6.3	2.25	8.3	1.12
2.2	5.62	4.3	84.27	6.4	5.62	9.1	24.72
2.3	43.82	4.4	16.85	7.1	40.45	9.2	2.25
2.4	51.69	5.1	1.12	7.2	34.83	9.3	80.90
3.1	51.69	5.2	76.40	7.3	1.12	9.4	42.70

Source: the authors' own calculations based on data from Table 1.

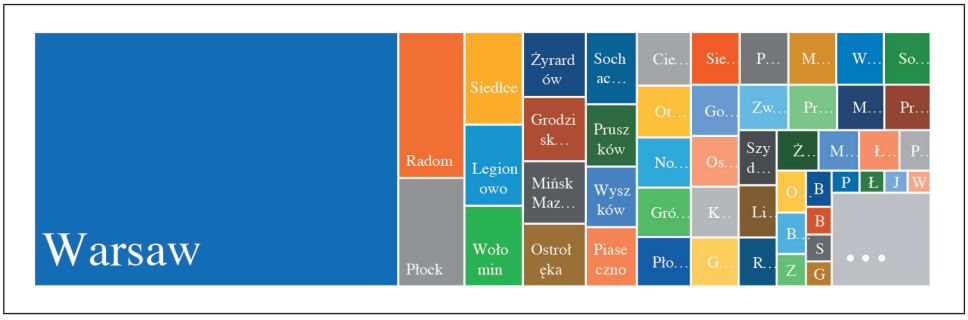

Fig. 1. Centrality Index

Source: the authors' own calculations based on data from Table 1.

Figure 1 visualises the centrality index for all the cities, Figure 2 presents ranks 2–45, and Figure 3 shows ranks 46–89. The key takeaway from the results of our centrality index is that Mazowieckie voivodeship is extremely centralised around Warsaw, to the point where the entire region could be considered its hinterlands in the traditional nomenclature.

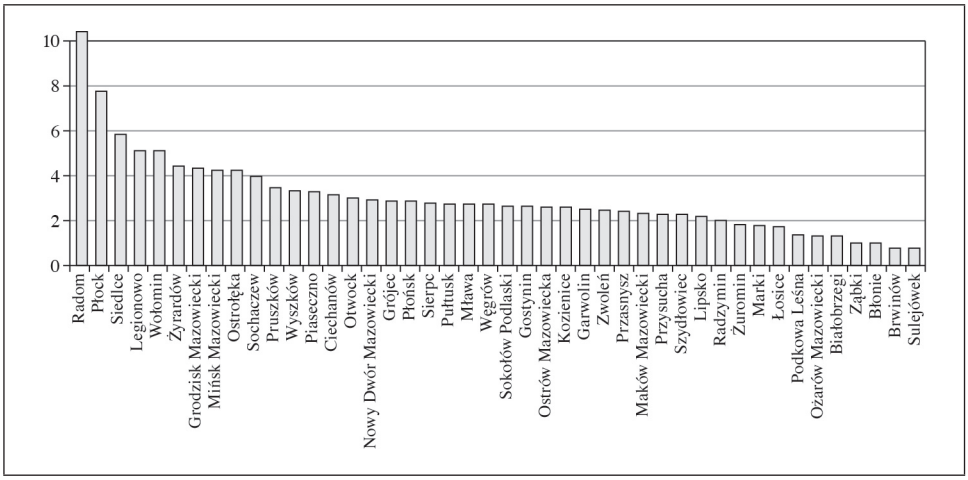

Fig. 2. Centrality Index, Ranks 2–45

Source: the authors' own calculations based on data from Table 1; also available in Szczech-Pietkiewicz, Radło & Tomeczek (2022, p. 64).

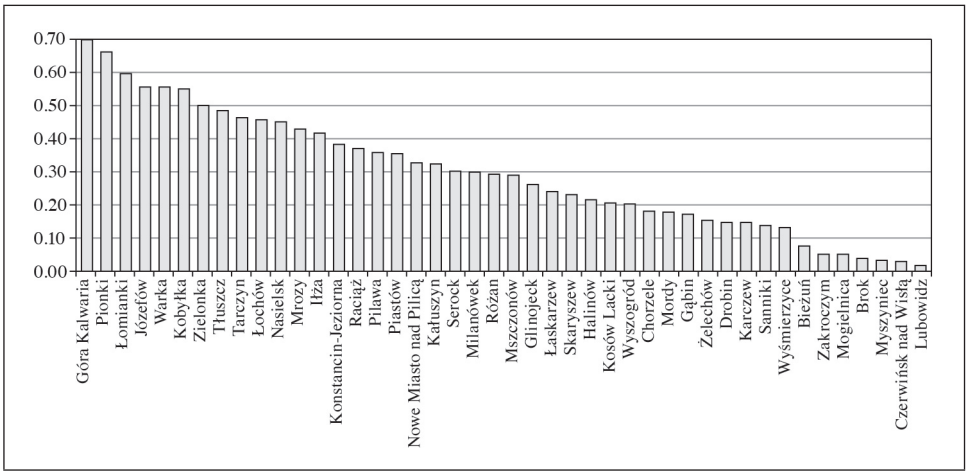

Fig. 3. Centrality Index, Ranks 46–89

Source: the authors' own calculations based on data from Table 1; also available in Szczech-Pietkiewicz, Radło & Tomeczek (2022, p. 65).

Figure 4 and Figure 5 give unweighted averages for central activities included in the nine categories – the former is concerned with cities with the highest centrality index (excluding Warsaw, which makes the data easier to visualise) and the latter with cities with the highest population-adjusted centrality index.

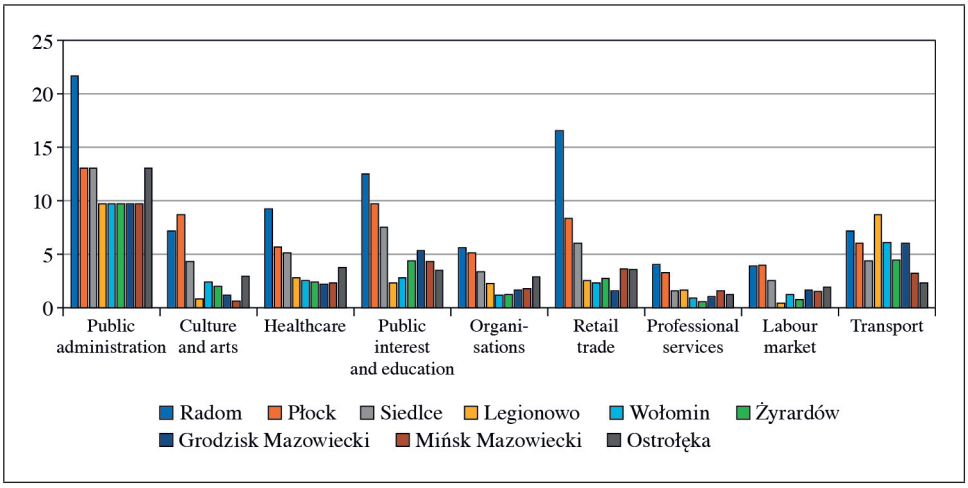

Fig. 4. Unweighted Averages for Categories, Cities with Highest Centrality Index (Excluding Warsaw)

Source: the authors' own calculations based on data from Table 1.

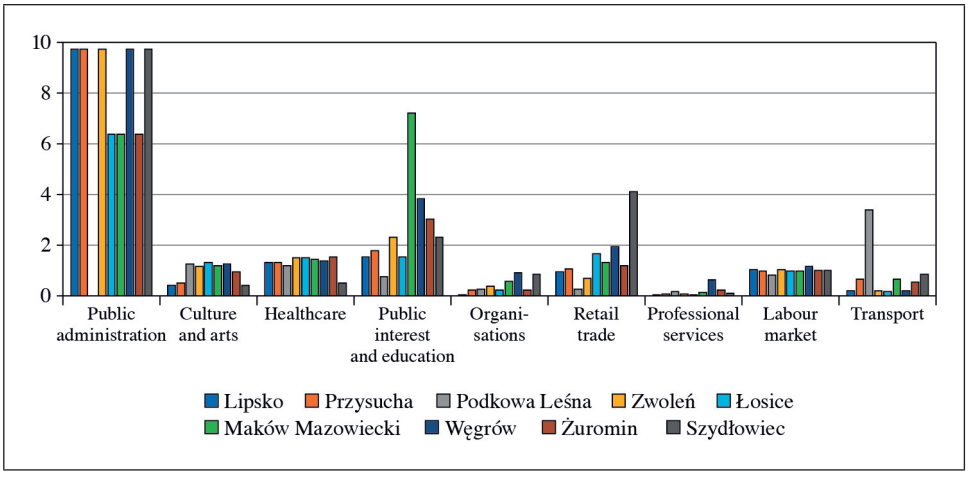

Fig. 5. Unweighted Averages for Categories, Cities with the Highest Population-adjusted Centrality Index

Source: the authors' own calculations based on data from Table 1.

Table 3. Central Places, Hidden Places, and Hidden Central Places of Mazowieckie Voivodeship

Central Places (Centrality Index ≥ 3)	Hidden Places (Population-adjusted Centrality Index ≥ 2)	Hidden Central Places (Central Places ∩ Hidden Places)
Warsaw 100.00	Lipsko 7.05	Wołomin
Radom 10.43	Przysucha 6.98	Grodzisk Mazowiecki
Płock 7.77	Podkowa Leśna 6.30	Wyszków
Siedlce 5.86	Zwoleń 5.67	
Legionowo 5.12	Łosice 4.39	
Wołomin 5.11	Maków Mazowiecki 4.22	
Żyrardów 4.41	Węgrów 3.84	
Grodzisk Mazowiecki 4.33	Żuromin 3.65	
Mińsk Mazowiecki 4.25	Szydłowiec 3.46	
Ostrołęka 4.22	Białobrzegi 3.40	
Sochaczew 3.99	Grójec 3.08	
Pruszków 3.45	Radzymin 2.79	
Wyszków 3.34	Sierpc 2.75	
Piaseczno 3.28	Kozienice 2.70	
Ciechanów 3.14	Wyśmierzyce 2.63	
Otwock 3.00	Gostynin 2.53	
	Garwolin 2.53	
	Pułtusk 2.51	
	Sokołów Podlaski 2.48	
	Przasnysz 2.48	
	Grodzisk Mazowiecki 2.45	
	Wołomin 2.44	
	Płońsk 2.30	
	Wyszków 2.21	
	Mrozy 2.13	
	Ostrów Mazowiecka 2.06	
	Ożarów Mazowiecki 2.04	

Source: the authors' own calculations based on data from Table 1; also available in Szczech-Pietkiewicz, Radło & Tomeczek (2022, p. 67).

Table 3 represents the central places, hidden places, and hidden central places that we have identified during our research. The cities of interest, in light of the central place theory, can be grouped into three types: 16 central places (cities with centrality index ≥ 3), 27 hidden places (cities with population-adjusted centrality index ≥ 2), and three hidden central places (cities classified as both central places and hidden places). By far, the most important central place is Warsaw (100.00), distantly followed by Radom (10.43), Płock (7.77), Siedlce (5.86), Legionowo (5.12), and Wołomin (5.11).

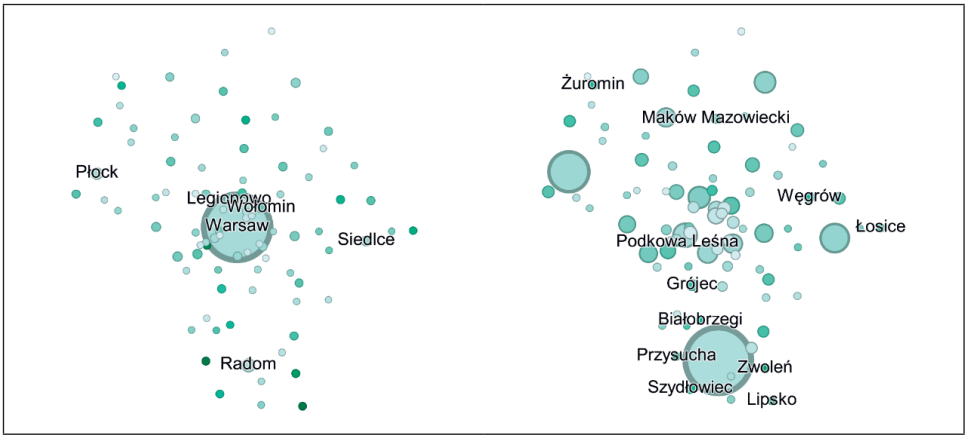

Fig. 6. Centrality Map (Size: Centrality Index, Colour: Population-adjusted Centrality Index, Left Labels: Centrality Index ≥ 5, Right Labels: Population-adjusted Centrality Index ≥ 3)
Source: the authors' own calculations based on data from Table 1.

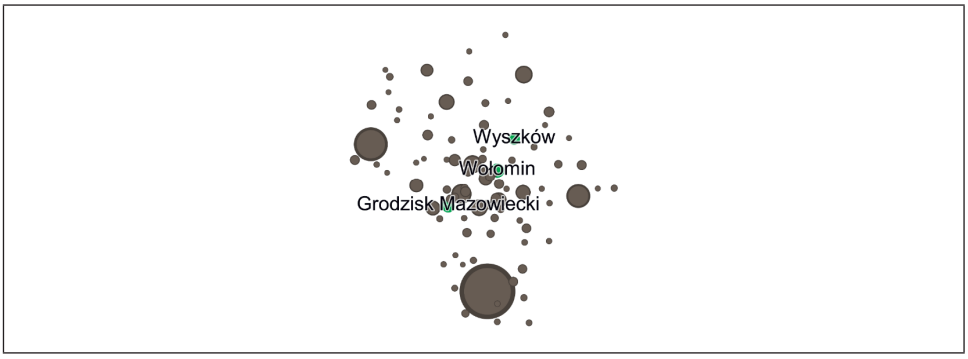

Fig. 7. Centrality Maps, Excluding Warsaw (Size: Centrality Index, Colour: Hidden Central Places, Labels: Hidden Central Places)
Source: the authors' own calculations based on data from Table 1.

The centrality index reflects a city's ability to provide goods and services to surrounding areas; thus, a higher score indicates a stronger influence over its region. For example, Warsaw's centrality index score means it is the dominant city, serving as the main hub for the entire region, whereas Radom's much lower score shows that, while still important, its influence is significantly smaller compared to Warsaw. The list of hidden places includes cities like Lipsko (7.05), Przysucha (6.98), Podkowa Leśna (6.30), Zwoleń (5.67), Łosice (4.39), and Maków Mazowiecki (4.22). Similarly, within the hidden places category, higher population-adjusted centrality index scores

indicate a stronger functional significance relative to the city's population size. Finally, there are three hidden central places, which combine the characteristics of central places and hidden places: Wołomin, Grodzisk Mazowiecki, and Wyszków. The context for drawing implications of our study is also given by Sokołowski (2005), who distinguishes centrality as the exogenous component of employment and nodality as a broader concept that includes both centrality and local consumption (endogenous employment). While centrality measures a city's external influence, nodality provides a more comprehensive view of a city's overall economic function. In our study, we focus on centrality as a regional influence measure, but future research should incorporate nodality to better capture the economic roles of smaller cities, especially those with strong local consumption.

Figure 6 and shows a centrality map where nodes representing cities are sized according to their centrality index and coloured according to their population-adjusted centrality index; the graph on the right is based on the same data, but Warsaw is excluded to better accentuate the differences between other cities. Labels are visible for nodes above a certain threshold. Lastly, Figure 7 explores the location of the three hidden central places identified in this research. Nodes representing cities are sized according to their centrality index, and the green color and labels indicate hidden central places. The full results for 89 cities in Mazowieckie voivodeship are presented in Table A.1 attached in the Appendix.

5. Discussion of Results

This section is organised around three research questions to examine the findings of the centrality index. The discussion integrates these findings with the existing literature to highlight theoretical and practical implications. The results identify three categories of cities based on the centrality index: 16 central places, 27 hidden places, and three hidden central places [RQ1]. The dominance of Warsaw is evident, with its perfect centrality index score of 100, far surpassing other cities such as Radom, Płock, and Siedlce. These cities, alongside smaller centres like Wołomin and Legionowo, serve as key central places in the region.

The hidden places, including cities such as Lipsko, Przysucha, and Podkowa Leśna, demonstrate high population-adjusted centrality scores. These cities, despite their smaller size, provide important regional services and function as crucial "hidden" hubs within their local economies. This supports the literature that highlights the growing importance of mid-sized and smaller cities in regional development (Bell & Jayne, 2009; Dijkstra, Garcilazo & McCann, 2013).

Hidden central places – cities like Wołomin, Grodzisk Mazowiecki, and Wyszków – are unique because they combine high centrality and population-adjusted scores. These cities play a dual role, serving both as central hubs and as hidden places relative to their size, reinforcing the concept that functional

significance can surpass population size in determining a city's influence (Lewis & Donald, 2010).

The centrality index offers a powerful tool for identifying key urban centres that should be prioritised for regional policy interventions [RQ2]. In the case of Mazowieckie voivodeship, the overwhelming centrality of Warsaw reflects a monocentric structure, which can lead to regional inequalities. Policies aimed at decentralising some of the region's functions could benefit hidden central places like Grodzisk Mazowiecki and Wołomin, which are well-positioned to take on additional economic activities.

The literature on regional development (Capello, 2000; Neal, 2011) suggests that mid-sized and smaller cities can relieve pressure from dominant urban centres by acting as secondary growth hubs. The identification of hidden places and hidden central places supports this notion, as cities like Lipsko and Przysucha, despite their small size, could play a larger role in regional economic strategies through targeted investments.

The findings support the continued relevance of the central place theory in understanding regional development, particularly in its application to the Mazowieckie voivodeship [RQ3]. The hierarchical structure of cities identified in this study – central places, hidden places, and hidden central places – aligns with the traditional framework of central place theory, where larger cities provide a broader range of services to surrounding areas.

However, the concept of hidden places introduces a modern adaptation to Christaller's theory, as it reflects the functional importance of cities that might not traditionally be recognised as central places. This is in line with contemporary urban studies, which highlight the increasing significance of smaller cities and their functional roles (Derudder & Witlox, 2004). Additionally, Sokołowski (2005) introduces the idea of nodality, a broader concept that includes both centrality and local consumption, offering a more comprehensive view of a city's economic role.

The centrality index reveals the hierarchical structure of cities in Mazowieckie voivodeship, with Warsaw's dominance and the presence of important hidden places and hidden central places. The findings suggest that decentralisation policies focusing on these hidden centres could contribute to more balanced regional development. Christaller's central place theory remains a useful framework, but future research should integrate concepts such as nodality to better capture the complexities of modern urban systems.

6. Summary and Policy Implications

The article explores the regional development of Mazovia in the context of Christaller's central place theory. We calculate the value of the centrality index

revealing the central and hidden places in Mazowieckie voivodeship. The proposed centrality index is a synthetic indicator based on a non-model method. The population-adjusted version of the centrality index indicates which cities overperform compared to their size (values higher than 1) and which cities underperform (values lower than 1). The centrality index can be used to identify cities that are important for regional development. Especially the population-adjusted centrality index is useful for the identification of the hidden centres of urban activity. As expected, and in line with the central place theory, the index scores show the overwhelming role of Warsaw in the regional economy of the Mazowieckie voivodeship. The devised method can be used in the analysis of different regions.

The analysis identifies three types of cities that are of interest in light of the central place theory: 16 central places (centrality index ≥ 3), 27 hidden places (population-adjusted centrality index ≥ 2), and three hidden central places (classified as both central places and hidden places). The regional supremacy of Warsaw is visible in its perfect centrality index score; other central places include Radom (10.43), Płock (7.77), Siedlce (5.86), Legionowo (5.12), and Wołomin (5.11). Hidden places are exemplified by Lipsko (7.05), Przysucha (6.98), Podkowa Leśna (6.30), Zwoleń (5.67), Łosice (4.39), and Maków Mazowiecki (4.22). Wołomin, Grodzisk Mazowiecki, and Wyszków are classified as the three hidden central places of the Mazowieckie voivodeship.

The research contributes to the understanding of the regional development of Mazovia and the practical applications of the central place theory. Hidden central places can be crucial for the future growth of the region. These cities could potentially take on the role of local growth centres in Mazovia. The dominant role of Warsaw is not going to be challenged, but if the hidden centres were to be sufficiently supported by the government, they might disperse geographically some of the crucial functions in a more sustainable, inclusive, and accessible way.

In terms of policy implications, the centrality index provides a valuable tool for identifying cities that could be targeted for investment to alleviate the over-reliance on Warsaw. By supporting hidden central places and smaller urban hubs, regional development can become more balanced, inclusive, and sustainable. This study affirms the continued relevance of Christaller's central places but also suggests the need for integrating modern concepts such as nodality to capture the full scope of a city's economic role. Future research should explore the interplay between centrality, nodality, and local economic functions, particularly in the context of smaller and mid-sized cities, to inform more comprehensive regional development policies.

Acknowledgement and Financial Disclosure

This research was funded by the National Centre for Research and Development (NCBR), grant number: Gospostrateg1/388207/9/NCBR/2018.

Authors' Contribution

The authors' individual contribution is as follows: Each contributed a third.

Conflict of Interest

The authors declare no conflict of interest.

References

Arthur, W. B. (1994). *Increasing Returns and Path Dependence in the Economy*. University of Michigan Press.

Audretsch, D. B., Belitski, M., & Desai, S. (2015). Entrepreneurship and Economic Development in Cities. *The Annals of Regional Science*, *55*(1), 33–60. https://doi.org/10.1007/s00168-015-0685-x

Bell, D., & Jayne, M. (2009). Small Cities? Towards a Research Agenda. *International Journal of Urban and Regional Research*, *33*(3), 683–699. https://doi.org/10.1111/j.1468-2427.2009.00886.x

Berry, B. J. L., & Garrison, W. L. (1958). The Functional Bases of the Central Place Hierarchy. *Economic Geography*, *34*(2), 145–154. https://doi.org/10.2307/142299

Biderman, E., & Kamiński, Z. (1993). Rola Poznania w procesie regionalnej redystrybucji ludności. *Kronika Miasta Poznania*, 3–4, 404–421.

Bird, J. H. (1973). Of Central Places, Cities and Seaports. *Geography*, *58*(2), 105–118.

Boussauw, K., van Meeteren, M., & Witlox, F. (2014). Short Trips and Central Places: The Home-school Distances in the Flemish Primary Education System (Belgium). *Applied Geography*, *53*, 311–322. https://doi.org/10.1016/j.apgeog.2014.06.025

Bracey, H. E. (1953). Towns as Rural Service Centres: An Index of Centrality with Special Reference to Somerset. *Transactions and Papers* (*Institute of British Geographers*), 19, 95–105. https://doi.org/10.2307/621230

Bracey, H. E. (1956). A Rural Component of Centrality Applied to Six Southern Counties in the United Kingdom. *Economic Geography*, *32*(1), 38–50. https://doi.org/10.2307/141929

Brush, J. E. (1953). The Hierarchy of Central Places in Southwestern Wisconsin. *Geographical Review*, *43*(3), 380–402. https://doi.org/10.2307/211754

Capello, R. (2000). The City Network Paradigm: Measuring Urban Network Externalities. *Urban Studies*, *37*(11), 1925–1945. https://doi.org/10.1080/713707232

Castells, M., & Hall, P. (1994). *Technopoles of the World: The Making of Twenty-first-century Industrial Complexes*. Routledge.

Christaller, W. (1933). *Die zentralen Orte in Süddeutschland*. Gustav Fisher Verlag.

Christaller, W. (1966). *Central Places in Southern Germany*. Prentice-Hall.

Davies, W. K. D. (1967). Centrality and the Central Place Hierarchy. *Urban Studies*, *4*(1), 61–79. https://doi.org/10.1080/00420986720080041

Davies, W. K. D. (1968). The Morphology of Central Places: A Case Study. *Annals of the Association of American Geographers*, *58*(1), 91–110. https://doi.org/10.1111/j.1467-8306.1968.tb01638.x

Derudder, B., & Witlox, F. (2004). Assessing Central Places in a Global Age: On the Networked Localization Strategies of Advanced Producer Services. *Journal of Retailing and Consumer Services*, *11*(3), 171–180. https://doi.org/10.1016/S0969-6989(03)00023-7

Dijkstra, L., Garcilazo, E., & McCann, P. (2013). The Economic Performance of European Cities and City Regions: Myths and Realities. *European Planning Studies*, *21*(3), 334–354. https://doi.org/10.1080/09654313.2012.716245

Dmitruk, J., & Gawinecki, J. (2017). Methods of Multidimensional Comparative Analysis – Construction and Application. *Bulletin of the Military University of Technology*, *66*(4), 103–119. https://doi.org/10.5604/01.3001.0010.8224

Erickcek, G. A., & McKinney, H. (2006). "Small Cities Blues": Looking for Growth Factors in Small and Medium-sized Cities. *Economic Development Quarterly*, *20*(3), 232–258. https://doi.org/10.1177/0891242406290377

Fahmi, F. Z., Hudalah, D., Rahayu, P., & Woltjer, J. (2014). Extended Urbanization in Small and Medium-sized Cities: The Case of Cirebon, Indonesia. *Habitat International*, *42*, 1–10. https://doi.org/10.1016/j.habitatint.2013.10.003

Fleming, D. K., & Hayuth, Y. (1994). Spatial Characteristics of Transportation Hubs: Centrality and Intermediacy. *Journal of Transport Geography*, *2*(1), 3–18. https://doi.org/10.1016/0966-6923(94)90030-2

Fujita, M., Krugman, P. R., & Venables, A. (1999). *The Spatial Economy: Cities, Regions and International Trade*. MIT Press. https://doi.org/10.7551/mitpress/6389.001.0001

Gonçalves, J. A. M., Portugal, L. da S., & Nassi, C. D. (2009). Centrality Indicators as an Instrument to Evaluate the Integration of Urban Equipment in the Area of Influence of a Rail Corridor. *Transportation Research Part A: Policy and Practice*, *43*(1), 13–25. https://doi.org/10.1016/j.tra.2008.06.010

Gwosdz, K. (2004). *Ewolucja rangi miejscowości w konurbacji przemysłowej: Przypadek Górnego Śląska*. Instytut Geografii i Gospodarki Przestrzennej Uniwersytetu Jagiellońskiego.

Hall, P. (2014). *Cities of Tomorrow: An Intellectual History of Urban Planning and Design since 1880* (4th ed.). Wiley-Blackwell.

Henríquez, C., Azócar, G., & Romero, H. (2006). Monitoring and Modeling the Urban Growth of Two Mid-sized Chilean Cities. *Habitat International*, *30*(4), 945–964. https://doi.org/10.1016/j.habitatint.2005.05.002

Irwin, M. D., & Hughes, H. L. (1992). Centrality and the Structure of Urban Interaction: Measures, Concepts, and Applications. *Social Forces*, *71*(1), 17–51. https://doi.org/10.2307/2579964

Jamal, A. C. (2018). Coworking Spaces in Mid-sized Cities: A Partner in Downtown Economic Development. *Environment and Planning A: Economy and Space*, *50*(4), 773–788. https://doi.org/10.1177/0308518X18760857

Krugman, P. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy*, *99*(3), 3. https://doi.org/10.1086/261763

Kukuła, K. (1999). Metoda unitaryzacji zerowanej na tle wybranych metod normowania cech diagnostycznych. *Acta Scientifica Academiae Ostroviensis*, *4*, 5–31.

Lewis, N. M., & Donald, B. (2010). A New Rubric for 'Creative City' Potential in Canada's Smaller Cities. *Urban Studies*, *47*(1), 29–54. https://doi.org/10.1177/0042098009346867

Mastalerz-Kodzis, A., & Pośpiech, E. (2015). Wielowymiarowa analiza porównawcza w ujęciu dynamicznym na przykładzie wybranych charakterystyk ekonomicznych. *Metody Ilościowe w Badaniach Ekonomicznych*, *16*(4), 24–33.

Mokhtarian, P. L. (1998). A Synthetic Approach to Estimating the Impacts of Telecommuting on Travel. *Urban Studies*, *35*(2), 215–241. https://doi.org/10.1080/0042098984952

Mularczyk, M. (2014). Hierarchia funkcjonalna miast a dominujące funkcje ich wiejskiego otoczenia (przykład woj. świętokrzyskiego). In: W. Kamińska, K. Heffner (Eds), *Obszary wiejskie, wielofunkcyjność, migracje, nowe wizje rozwoju* (pp. 379–404). KPZK PAN.

Naess, P. (2012). Urban Form and Travel Behavior: Experience from a Nordic Context. *Journal of Transport and Land Use*, *5*(2), 21–45. https://doi.org/10.5198/jtlu.v5i2.314

Napiórkowski, T. M., & Radło, M.-J. (2022). *Czynniki wzrostu gospodarczego regionów i podregionów województwa mazowieckiego*. Oficyna Wydawnicza SGH – Szkoła Główna Handlowa w Warszawie. https://doi.org/10.33119/978-83-8030-530-4.2022

Neal, Z. P. (2011). From Central Places to Network Bases: A Transition in the U.S. Urban Hierarchy, 1900–2000. *City & Community*, *10*(1), 49–75. https://doi.org/10.1111/j.1540-6040.2010.01340.x

Nowosielska, E. (1992). *Teoria Christallera – prawda i mity. W sprawie nieporozumień pojęciowych*. Zakład Narodowy im. Ossolińskich – Wydawnictwo PAN.

Panek, T. (2009). *Statystyczne metody wielowymiarowej analizy porównawczej*. Oficyna Wydawnicza SGH.

Patro, S. G. K., & Sahu, K. K. (2015). Normalization: A Preprocessing Stage. *International Advanced Research Journal in Science*, *Engineering and Technology*, *2*(3), 20–22. https://doi.org/10.17148/IARJSET.2015.2305

Peredo, A. M., & Chrisman, J. J. (2006). Toward a Theory of Community-based Enterprise. *Academy of Management Review*, *31*(2), 2. https://doi.org/10.5465/amr.2006.20208683

Preston, R. E. (1971). The Structure of Central Place Systems. *Economic Geography*, *47*(2), 136–155. https://doi.org/10.2307/143042

Radło, M.-J., & Szczech-Pietkiewicz, E. (2022). *Przedsiębiorstwa w regionach i podregionach województwa mazowieckiego i ich powiązania w łańcuchach wartości*. Oficyna Wydawnicza SGH – Szkoła Główna Handlowa w Warszawie. https://doi.org/10.33119/978-83-8030-529-8.2022

Siddall, W. R. (1961). Wholesale-retail Trade Ratios as Indices of Urban Centrality. *Economic Geography*, *37*(2), 124–132. https://doi.org/10.2307/141843

Smith, N. (2008). *Uneven Development: Nature, Capital, and the Production of Space* (3rd ed.). University of Georgia Press.

Sokołowski, D. (1999). Funkcje centralne w zbiorze małych miast i większych osiedli wiejskich w Polsce. *Przegląd Geograficzny*, *71*(3), 295–316. https://doi.org/10.5281/zenodo.1146068

Sokołowski, D. (2005). Centralność a węzłowość większych miast w Polsce. *Przegląd Geograficzny*, *77*(4), 507–526. https://doi.org/10.5281/zenodo.1120377

Sokołowski, D. (2006). *Funkcje centralne i hierarchia funkcjonalna miast w Polsce*. Wydawnictwo Uniwersytetu Mikołaja Kopernika w Toruniu.

Szczech-Pietkiewicz, E., Radło, M.-J., & Tomeczek, A. F. (2022). *Powiązania miast w województwie mazowieckim. Determinanty i konstrukcja modelu funkcjonalnego województwa*. Oficyna Wydawnicza SGH – Szkoła Główna Handlowa w Warszawie. https://doi.org/10.33119/978-83-8030-527-4.2022

Taylor, P. J., Hoyler, M., & Verbruggen, R. (2010). External Urban Relational Process: Introducing Central Flow Theory to Complement Central Place Theory. *Urban Studies*, *47*(13), 2803–2818. https://doi.org/10.1177/0042098010377367

Tsiotas, D., & Polyzos, S. (2015). Introducing a New Centrality Measure from the Transportation Network Analysis in Greece. *Annals of Operations Research*, *227*, 93–117. https://doi.org/10.1007/s10479-013-1434-0

van Dijk, M. P., & Mingshun, Z. (2005). Sustainability Indices as a Tool for Urban Managers, Evidence from Four Medium-sized Chinese Cities. *Environmental Impact Assessment Review*, *25*(6), 667–688. https://doi.org/10.1016/j.eiar.2004.10.001

Véron, R. (2010). Small Cities, Neoliberal Governance and Sustainable Development in the Global South: A Conceptual Framework and Research Agenda. *Sustainability*, *2*(9), 2833–2848. https://doi.org/10.3390/su2092833

Zhong, C., Schläpfer, M., Müller Arisona, S., Batty, M., Ratti, C., & Schmitt, G. (2017). Revealing Centrality in the Spatial Structure of Cities from Human Activity Patterns. *Urban Studies*, *54*(2), 437–455. https://doi.org/10.1177/0042098015601599

Appendix

Table A.1. Centrality Index

Rank	City	Centrality Index (0–100)	Population--adjusted Centrality Index	Population Index (Warsaw = 100)
1	Warsaw	100.00	1.00	100.00
2	Radom	10.43	0.88	11.89
3	Płock	7.77	1.16	6.72
4	Siedlce	5.86	1.33	4.40
5	Legionowo	5.12	1.68	3.04
6	Wołomin	5.11	2.44	2.09
7	Żyrardów	4.41	1.96	2.25
8	Grodzisk Mazowiecki	4.33	2.45	1.77
9	Mińsk Mazowiecki	4.25	1.85	2.29
10	Ostrołęka	4.22	1.44	2.93
11	Sochaczew	3.99	1.95	2.05
12	Pruszków	3.45	0.99	3.47
13	Wyszków	3.34	2.21	1.51
14	Piaseczno	3.28	1.21	2.71
15	Ciechanów	3.14	1.26	2.48
16	Otwock	3.00	1.19	2.52
17	Nowy Dwór Mazowiecki	2.91	1.81	1.61
18	Grójec	2.89	3.08	0.94
19	Płońsk	2.86	2.30	1.24
20	Sierpc	2.77	2.75	1.01
21	Pułtusk	2.75	2.51	1.09
22	Mława	2.73	1.55	1.76
23	Węgrów	2.72	3.84	0.71
24	Sokołów Podlaski	2.64	2.48	1.07
25	Gostynin	2.64	2.53	1.04
26	Ostrów Mazowiecka	2.59	2.06	1.26
27	Kozienice	2.59	2.70	0.96
28	Garwolin	2.50	2.53	0.99
29	Zwoleń	2.46	5.67	0.43
30	Przasnysz	2.39	2.48	0.97
31	Maków Mazowiecki	2.31	4.22	0.55
32	Przysucha	2.28	6.98	0.33

Table A.1 cnt'd

Rank	City	Centrality Index (0–100)	Population--adjusted Centrality Index	Population Index (Warsaw = 100)
33	Szydłowiec	2.27	3.46	0.66
34	Lipsko	2.16	7.05	0.31
35	Radzymin	2.02	2.79	0.72
36	Żuromin	1.81	3.65	0.50
37	Marki	1.78	0.93	1.91
38	Łosice	1.74	4.39	0.40
39	Podkowa Leśna	1.37	6.30	0.22
40	Ożarów Mazowiecki	1.33	2.04	0.65
41	Białobrzegi	1.32	3.40	0.39
42	Ząbki	1.02	0.49	2.06
43	Błonie	1.01	1.46	0.69
44	Brwinów	0.77	1.01	0.76
45	Sulejówek	0.75	0.68	1.11
46	Góra Kalwaria	0.70	1.03	0.68
47	Pionki	0.66	0.65	1.02
48	Łomianki	0.60	0.63	0.95
49	Józefów	0.56	0.48	1.16
50	Warka	0.56	0.83	0.67
51	Kobyłka	0.55	0.41	1.33
52	Zielonka	0.50	0.50	0.99
53	Tłuszcz	0.49	1.06	0.46
54	Tarczyn	0.46	1.99	0.23
55	Łochów	0.46	1.19	0.38
56	Nasielsk	0.45	1.04	0.43
57	Mrozy	0.43	2.13	0.20
58	Iłża	0.42	1.57	0.27
59	Konstancin-Jeziorna	0.38	0.40	0.96
60	Raciąż	0.37	1.50	0.25
61	Pilawa	0.36	1.38	0.26
62	Piastów	0.36	0.28	1.27
63	Nowe Miasto nad Pilicą	0.33	1.56	0.21
64	Kałuszyn	0.32	1.99	0.16
65	Serock	0.30	1.22	0.25
66	Milanówek	0.30	0.33	0.92

Table A.1 cnt'd

Rank	City	Centrality Index (0–100)	Population--adjusted Centrality Index	Population Index (Warsaw = 100)
67	Różan	0.29	1.91	0.15
68	Mszczonów	0.29	0.81	0.36
69	Glinojeck	0.26	1.54	0.17
70	Łaskarzew	0.24	0.88	0.27
71	Skaryszew	0.23	0.95	0.24
72	Halinów	0.22	1.02	0.21
73	Kosów Lacki	0.21	1.75	0.12
74	Wyszogród	0.20	1.40	0.15
75	Chorzele	0.18	1.04	0.18
76	Mordy	0.18	1.82	0.10
77	Gąbin	0.17	0.75	0.23
78	Żelechów	0.15	0.70	0.22
79	Drobin	0.15	0.92	0.16
80	Karczew	0.15	0.27	0.56
81	Sanniki	0.14	1.25	0.11
82	Wyśmierzyce	0.13	2.63	0.05
83	Bieżuń	0.08	0.72	0.10
84	Zakroczym	0.05	0.29	0.18
85	Mogielnica	0.05	0.40	0.13
86	Brok	0.04	0.35	0.11
87	Myszyniec	0.03	0.17	0.19
88	Czerwińsk nad Wisłą	0.03	0.49	0.06
89	Lubowidz	0.02	0.18	0.09

Source: the authors' own calculations based on data from Table 1; also available in Szczech-Pietkiewicz, Radło & Tomeczek (2022, pp. 62–63).

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 69–85
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18721

Artificial Intelligence-induced Transformation of the Value Creation Paradigm in the Economy

Jan Rymarczyk

WSB Merito University Poznan, Powstańców Wielkopolskich 5, 61-895, Poznań, Poland,
e-mail:jan.rymarczyk@wsb.merito.pl, ORCID: https://orcid.org/0000-0003-4701-439X

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Rymarczyk, J. (2026). Artificial Intelligence-induced Transformation of the Value Creation Paradigm in the Economy. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 69–85. https://doi.org/10.15678/krem.18721

ABSTRACT

Objective: The objective of the article is to determine how artificial intelligence (AI) influences and can influence changes in the value-creation model in the economy.
Research Design & Methods: The article is theoretical and conceptual, based on a literature review and the author's knowledge and reflections.
Findings: The author formulates and verifies the hypothesis that AI gradually, consistently, and significantly increases enterprises' potential for value creation.
Implications/Recommendations: Replacing people with robots will increase work efficiency, accelerate economic growth, and improve people's quality of life. However, there is also the flip side. AI may cause mass unemployment and the polarisation of income within and between countries. AI-based cyberattacks may paralyse societies. Although the reality of AI becoming a general-purpose technology is quite distant, it is necessary not only to monitor and support its development but also to take actions to limit its potential adverse effects.
Contribution: The article comprehensively presents the implementation processes of various AI devices at individual stages of the value creation chain, i.e., supply, production, distribution and communication with customers, highlighting their positive effects as well as the threats. On this basis, it recommends actions to mitigate the potential adverse effects of AI implementation.

It presents the significant cognitive value of the phenomenon, which will radically change not only the paradigm of value creation but also the functioning of societies as a whole.

Article type: original article.

Keywords: paradigm, value creation, artificial intelligence, Industrial Revolution 4.0.

JEL Classification: L2.

1. Introduction

Artificial intelligence is widely regarded as a breakthrough technology that will, in the next few decades, radically change the functioning of societies. Its importance is comparable to the use of steam in the first, electricity in the second, and microprocessors in the third of the industrial revolutions.

The term "artificial intelligence" (AI) is attributed to John McCarthy, who, at the turn of the 1950s, described it as "the science and engineering of making intelligent machines" (Peart, 2020). Currently, it is defined as computer systems capable of performing tasks that usually require human intelligence, such as observing the environment, learning, understanding, thinking, reasoning, planning and making decisions (Abrardi, Cambini & Rondi, 2019; Roy, Vertesy & Damioli, 2020). Its construction draws on achievements from many fields of knowledge, primarily mathematics, logic, engineering, computer science, biology, neuroscience, linguistics, psychology, and philosophy.

There is a distinction between narrow (weak) AI, general (strong) AI and superintelligence (Joshi, 2019; Ray & Seamans, 2019; Coombs *et al*., 2020; Collins *et al*., 2021). The first is software that uses highly complex algorithms to determine action patterns from the data provided and predict how certain phenomena will unfold in the future. This type of AI can match and exceed human intelligence, albeit only in specific cases, such as solving equations or playing chess. Systems based on narrow intelligence may also recognise speech and faces, analyse images, translate texts, compose music, prepare financial statements, or operate devices such as the Internet of Things, advanced robots, drones, driverless cars, and other devices at various stages of value creation. The concept of general artificial intelligence refers to software that can perceive, understand, learn, and perform other functions at a human level. It is a system programmed to solve problems without human intervention. It is equivalent to being classified as "machines with the ability to understand and empathise." The third type, superintelligence, is a form of intelligence that exceeds human intelligence in every respect. It is the highest level of intelligence, not yet present on Earth, and it possesses self-awareness. If it comes into being, it will have incomparably greater memory capabilities for analysing data

and processes, and for predicting and making optimal decisions across all fields of human activity. Achieving this is the subject of intense research, and many scientists, offering different time horizons, claim it will arrive in quite a distant future. However, there is no shortage of sceptics questioning its possibility. Still, there is no doubt that the development of AI in companies will radically change the paradigm of their value creation, making it far more effective than the traditional one.

2. Literature Review

2.1. Development of Artificial Intelligence

There is a consensus among scientists that the development of artificial intelligence has become possible thanks to (Manyika *et al*., 2016; Ernst, Merola & Samaan, 2018; Manyika & Bughin, 2018):

– the development and widespread application of digital communication devices, such as the Internet and "cloud computing," that have enabled the collection, analysis and use of big data sets necessary for the functioning of AI;

– a drastic decrease in the cost of digital technologies; in this way, the barrier for small technological companies (startups) to enter this sphere has been reduced;

– the ability to acquire a massive amount of data, available for processing by software neural networks;

– innovations in the field of adaptation of neural networks, sensors, machine vision, algorithmic navigation, mapping and satellite technology, e.g., LIDAR1, etc. devices.

Paradoxically, the digital development of small businesses has led to the emergence of new forms of industrial concentration in the shape of eco-platforms such as Apple, Amazon, Facebook, Google, Baidu and many others that may be compared to industrial and commercial giants such as General Motors, General Electric, Bosch, Dunlop, Philips, Coca-Cola, Ford, Hewlett Packard, Daimler-Benz, Unilever, Toyota, Wal-Mart and many others.

Contemporary research on AI and its applications concerns mainly two fundamental areas of its functioning: autonomous robots and artificial neural networks (Cockburn, Henderson & Stern, 2017; Chui, Manyika & Miremadi, 2018). The most spectacular examples of the first application include industrial robots, i.e., precision devices programmed to perform specific tasks. They have a certain degree of operational autonomy within a defined environment. Specific types of robots are used in car communication (driverless cars), in aviation (drones), in medicine (robots supporting medical procedures, the so-called telemanipulators, for research

[1] LIDAR (Light Detection and Ranging) is a device that is a fusion of laser and telescope. It has been applied in meteorology, seeking for objects on land and the environment protection, to name a few.

purposes, often in an environment unfriendly to humans (e.g., space exploration), for military purposes, in training, entertainment, in care for the elderly and disabled, etc. Highly complex devices, still in the research phase, include nanorobots that interact with nanoscale objects with nanometre precision. Their application in medicine, for example, may significantly prolong human life or even make them immortal.

In turn, artificial neural networks involve hardware and software that operate on principles similar to those of neurons in the human brain. They consist of many layers of neurons that sequentially receive input data, process it, and pass it to the last layer as output. They have an extensive range of applications, including speech-to-text processing, image and handwriting recognition, weather forecasting, predicting stock exchange rates, sales volumes, and the prices of raw materials and finished products, and analysing the creditworthiness of bank customers, etc.

Refining the performance of the above-mentioned functions, i.e., their autonomous development through experience-based learning using complex algorithms and neural networks, is called "deep learning." It constitutes an advanced form of "machine learning," i.e., the process of autonomously detecting patterns in processed data and predicting future logical or physical events.

2.2. Contemporary Implementations of Artificial Intelligence

The application of AI devices across various spheres of societal functioning is gradual. It is determined by a set of factors, including progress in research and development, economic, social, and political considerations, and competition. The basic AI-supported devices include advanced robots, autonomous vehicles, the Internet of Things, cloud computing, 3D printing, big data, digital twin, augmented reality and blockchain. They are characterised by varying degrees of technological maturity and varying ranges of practical application. High-tech industries, telecommunications, automotive and assembly industries, financial services, media, entertainment, retail trade, transport and logistics, education, healthcare and professional medical services, building materials industry, construction, and travel and tourism are areas in which AI has found the most excellent applications so far. It is estimated that about 60% of all resources globally spent on the development of AI are currently allocated to machine learning, because it enables the development of many other technologies, such as intelligent robots and speech and image recognition (Bughin *et al*., 2017; Chui *et al*., 2018; Furman & Seamans, 2018; *What Countries Are Leading the AI Race*, 2023).

The higher a country's level of development, the greater its involvement in artificial intelligence research and development. Both the outlays for these purposes and the investments into their implementation are higher. Significant financial resources and research laboratories equipped with cutting-edge equipment attract talented staff

not only domestically but also from abroad. The United States and China account for the most significant research and investment activity in AI (Bughin *et al*., 2019; WIPO, 2019; Hoffman & Nurski, 2021). Germany, Japan, Canada and the United Kingdom follow suit, also achieving significant successes in the commercialisation of AI inventions due to the economies of scale and networking associated with their enormous market potential. A high level of research and implementation of AI is also demonstrated by relatively small countries that are among the most developed in the world, namely Belgium, the Netherlands, South Korea, Singapore, and Sweden. The third group includes Italy, Brazil, India, and Malaysia, whose positions are generally significantly weaker than those of the previously mentioned countries. In some areas related to AI, however, they present a comparative advantage – for example, India in the field of information technology. Meanwhile, the largest group of emerging markets and developing countries lags behind the world leaders due to underdeveloped research infrastructure, limited R&D funding, a lack of highly qualified staff, and a limited scale of economic digitisation. For example, Poland ranked 18th out of 23 countries in a study of AI readiness (Bughin *et al*., 2019).

The conducted research shows that transnational corporations focusing on the construction of cyber-physical devices, autonomous robots and vehicles, machine learning, speech and image recognition, supporting retail sales, and virtual agents are the centres of R&D and AI investment. The leaders primarily include large digital platforms such as Amazon, Facebook, Yahoo, Apple, Baidu, Google, Netflix, Twitter, LinkedIn, Instagram, and Pinterest. The second group consists of industrial corporations, including Toyota and BMW, developing autonomous cars; ABB; Tesla; Bosch; General Electric; Siemens; Microsoft; Toshiba; and many other industrial giants investing in AI related to their core businesses. IBM, for example, allocated USD 3 billion for the construction of an intelligent robot.

To increase efficiency and shorten the time to R&D implementation, large corporations enter into hundreds of strategic alliances, make mergers and acquisitions, and post complex problems on Internet platforms for competitive solutions. Establishing branches in high-tech clusters such as Silicon Valley, Seattle, Boston, Bangalore, and many others is an important way to acquire knowledge and monitor competitors' R&D progress on an ongoing basis. They enable the spill-over of modern technological solutions and the capture of talent. A critical problem is the shortage of highly qualified specialists, including scientists and engineers. To acquire them, large corporations buy high-tech startups and are willing to pay as much as USD 5 to 10 million for a high-class specialist (Bughin *et al*., 2017; Furman & Seamans, 2018). Hedge funds, venture capital firms, private equity firms, business incubators, and business angel funds are also increasingly important for investing in the AI sphere. In general, however, such investing is in its early stages and mainly concerns large companies that have already invested in AI-related

digital technologies, such as the Internet of Things, cloud computing, and big data. They view AI as the next, higher stage in the development of these technologies. They see it as an opportunity for a breakthrough increase in the innovativeness of their products, lower costs, greater efficiency, and, consequently, an advantage over competitors.

However, the vast majority of companies do not undertake any R&D or AI adaptation activities. This applies primarily to small and medium-sized enterprises and is mainly due to limited financial resources, insufficient professional staff, limited knowledge and a lack of willingness to take risks, the need to focus on current operations, and the inability to act on a large scale. Therefore, support from governments and NGOs is of extreme importance to them. Generally, AI implementation will be long-term. It is expected that, in the next 10 years, it will be used in many spheres, and in 45 years, in virtually all spheres of the functioning of the economy and society, while, in 120 years, all human work will be automated (Peart, 2020).

3. Methodology

To achieve the goals defined at the beginning of the article, the method of studying literature, subject-related items in periodicals and compact publications, and various Internet sources located on websites such as Google, Scholar, and Web of Science were adopted. A combination of the desk research method together with the knowledge and thoughts of the author, resulting from research conducted for several years on the impact of artificial intelligence (AI) and other inventions related to the Industrial Revolution 4.0 (IR 4.0) on the way in which enterprises had created value, allowed for a holistic approach to the studied phenomena and their creative interpretation. The article, in accordance with its logical structure, moves from general issues to specific research results and primarily presents the essence, development, and forms of AI, as well as the current state of its implementation in the economy. The central part of the article presents theoretical findings, supported by results from other research, on the positive impact of AI on the basic spheres of value creation, i.e., R&D, demand forecasting, procurement, supply, production, and distribution. It also includes findings on the threats posed by AI implementation and the need to take the necessary actions to eliminate them. The author's research is qualitative, using techniques such as indirect observation, cause-and-effect analysis, predictive analysis, synthesis, induction, and description. The use of these classic research techniques and the desk research method verified the hypothesis at the beginning of the article: the change in the value-creation paradigm resulting from the implementation of artificial intelligence has led to an extraordinary increase in value creation potential.

4. Discussion and Results

4.1. Positive Artificial Intelligence Effects for Value Creation

According to the general opinion of the researchers including the author of the article, AI has a vast potential and, to a limited extent, an actual positive impact on the way the companies create value by (Bughin *et al*., 2017; Bessen *et al*., 2018; Chui *et al*., 2018; Zahrani & Marghalani, 2018; Rymarczyk, 2020; Douge, 2020; Al Zadjali & Ullah, 2021; Buntak, Kovačić & Mutavdžija, 2021; Woo, 2021; Marr, 2022; Zhang, 2022):

– optimisation of research and development (R&D),

– better prediction of demand for products and services and their design,

– improvement of supplies,

– an increase in their ability to produce goods and services at a lower cost and of higher quality, and goods that are personalised,

– contribution to the increase in sales efficiency and customer satisfaction by offering goods at the right price with the correct information (advertising) and in a way that is convenient for them.

AI can significantly improve the effectiveness of R&D. Machine learning can provide information that helps researchers assess the probability that a designed product will achieve market success. Both the design and testing of different patterns of a given product can be carried out much more quickly and with better results than with conventional methods. The development of more efficient models will help reduce waste from the outset. A significant decrease in the design period will allow for a faster product launch and shorten the product life cycle. Accelerating the product innovation process will help companies gain a competitive advantage.

Forecasting trends in demand and, on this basis, designing product types, their features, sizes, and production scope is the next step in value creation chains, the effectiveness of which can be enhanced through AI. Compared with traditional forecasting methods, AI can absorb and process much more data, thereby improving forecast accuracy while reducing development time and related costs. Subjective assessment, the factor that often leads to erroneous conclusions, may be eliminated. Forecasters may follow random intuition. It may bring desired results, but it also brings failures, and it is absent in machines. Proper demand forecasts ensure the optimisation of the company's stock levels, i.e., raw materials, components, work in progress, and finished goods. Their scale will flexibly and adequately adjust to changes in expected demand.

The automation of the ordering process, including the purchase of raw materials and components, their storage, and their transfer to production, rationalises the process, resulting in time, space, and cost savings. Purchasing planning, requests for quotation, supplier financial analysis, contracting, and payments may be performed

by intelligent, autonomous devices. The Internet of Things, big data, algorithms, and neural networks enable the collection, sorting, and analysis of vast amounts of data in a predictive manner. Critical data will be recorded by sensors, collected, analysed and converted into activities performed by various cyber-physical appliances. They provide a better understanding of suppliers and markets, the identification of threats, and the selection of optimal sources of supply. Fully automated product storage and retrieval systems and their quality control can be particularly useful in warehouses with rapidly changing loads due to fluctuating demand. They will enable optimising the warehouse space and its use while ensuring an appropriate and flexible level of stock.

Production is the area where AI can contribute most to the company's growth in value. Intelligent manufacturing is based on automation and the application of cyber-physical systems that identify the environment and communicate and collaborate safely with people. They use internal and external information to make autonomous decisions, implement them, monitor the production process, and correct errors. AI enables preventive maintenance of machinery and equipment, reducing downtime from failures and extending their lifespans. Reprogramming production due to changes in demand, which typically requires human intervention and machine stopping, can be done autonomously. This is particularly important in discrete, low-volume production. Its implementation will commonly be achieved at a relatively low cost through the use of "additive manufacturing" technology, i.e., 3D printing. It involves the production of three-dimensional objects based on a computer design. According to the programmed pattern, a special device (a printer) applies successive layers of material until the final shape of the product is obtained. The widespread use of these devices will make product customisation much easier, cheaper, and better. International supply chains may thus be shortened. Complete production may be carried out at the point of demand and intensify reshoring, i.e., a reversal of locating particular segments of the value creation chain in places of comparative advantage, mainly in the form of cheap labour. The ultimate effect of using AI in production will be a significant increase in work efficiency, expressed as machines replacing people, shortened production cycles, innovation, excellent product quality, mass customisation, lower production costs, and, thus, increased scale and scope of production.

Automation and digitisation will cover the distribution process for goods. Activities related to order acceptance, packaging, labelling, shipping, invoicing, payment tracking, transportation, reloading, returns, servicing and maintenance will be performed with minimal human involvement. Here, an important role will be played by the Internet of Things, autonomous vehicles, augmented reality, and blockchain technology, i.e., a distributed and decentralised database that serves as a register

of concluded transactions and smart contracts, as well as payment systems using cryptocurrencies based on the database.

Building the right customer relationships and driving sales are other areas where AI can increase value for both manufacturers and consumers. Interactive communication between these entities is the basis for decision-making regarding product customisation. Its digitisation, the use of "cloud" technology, big data, the Internet of Things, and artificial intelligence will enable a more in-depth analysis of consumer tastes across various segments, anticipating and even suggesting tastes based on historical observations. The high quality and effectiveness of these activities should translate into close adjustment of the offers to the changing needs of customers. In turn, their satisfaction will lead to an increase in the company's size and income.

Setting the correct prices is extremely important for effective communication with the client. While introducing an innovative product, a company can use the "creaming-off" strategy, i.e., obtaining the highest possible income from sales in a short time at a high price (Rymarczyk, 2013). Alternatively, it may aim to achieve greater benefits through a "penetration pricing" strategy, i.e., a relatively low price for this product, to secure a higher market share. If there are similar products already on the market, the company will likely set the new product's price at the market level, i.e., it will follow the market price. Choosing the optimal strategy requires a complex, dynamic, real-time analysis of a lot of data to determine the price elasticity of demand. From the company's income perspective, the effectiveness of such AI analysis will likely be much higher than that of traditional methods. AI will enable companies to predict individual customers' behaviour and price sensitivity, and consequently refine their differentiation across customer groups (Goldfarb & Tucker, 2017).

AI can also help identify the company's most profitable customer segments and the promotional measures that will keep them loyal. AI devices, generally based on the registration of behavioural and demographic characteristics of customers, can indicate the most effective prices and promotion measures (rebates, discounts, coupons, gifts, samples, etc.) and even their personalisation in relation to individual customer segments. The information can be transferred to customers' mobile communication devices (smartphones) while they are shopping. It is estimated that algorithmic price differentiation can even double sellers' profits (Abrardi, Cambini & Rondi, 2019). A relatively new invention, used by Amazon, for example, enables customers to shop in-store without stopping at the checkout and to have their accounts debited automatically. Delivering purchases using drones is also at the design stage. In general, based on 2021 data, it is estimated that by 2030, AI will increase global GDP growth by 1.2% annually, i.e., by over USD 10 trillion. To a large extent, companies using AI will grow three times faster than others (Bughin *et al*., 2018).

4.2. Threats Related to Artificial Intelligence

The concentration of capital, knowledge, innovation and income in the hands of the leaders of digitisation already taking place and progressing at high speed as well as the emergence of companies that are "super-stars" in this sphere will lead to the marginalisation and bankruptcy of companies that, for various reasons, are not able to keep up with the revolutionary changes in the manufacturing technology. In accordance with the "winner takes all" principle, the space for companies that do not rely on AI to operate will be drastically reduced. A significant further widening of the gap between income from capital and labour will occur, leading to large-scale social conflict. Industrial Revolution 4.0 may trigger social revolution 4.0. Conflicts based on the modern industrial revolution may go beyond country borders and take on an international character of a clash between "AI countries" and other countries of slower development, with such consequences as enormous migration pressure from the non-AI countries and the destabilisation of the global order in trade, investments and other spheres of international cooperation.

The potential impact of AI on labour markets is the most significant source of concern. In general, AI can cause the following employment effects (Ernst, Merola & Samaan, 2018; Baecker *et al*., 2023):

– the substitution effect – robots will replace workers in many sectors,

– the complementarity effect – there will be an increase in the demand for employees necessary for the development, installation, monitoring and cooperation with robots,

– the expansion effect – an increase in labour productivity will cause a decrease in the prices of goods and an increase in the income of the population and, as a consequence, a greater demand for goods, services and an increase in the volume of their production and employment.

It is not possible to determine at present which of these effects will prove dominant. Specialists differ in their opinions, focusing mainly on the substitution effect. The negative impact of new technologies on global employment is estimated to range from below 5% to as much as 80% (Frey & Osborne, 2013; Manyika *et al*., 2016; Oxford Martin School, 2016; Berriman & Hawksworth, 2017; Bonciu, 2017; Brückner, LaFleur & Pitterle, 2017; Kurz, 2017; Marr, 2017).

There is no shortage of optimism in opinions that the decrease in employment will be compensated for by the creation of new jobs (Absenger *et al*., 2016; Aepli *et al*., 2017; Brynjolfsson, Rock & Syverson, 2017; Saithibvongsa & Yu, 2018; Badet, 2021). Assuming that the impact of technological progress on employment will be similar to that in the period of the first, second and third industrial revolutions, optimists should be proven right. However, there is consensus that employment structures will undergo far-reaching changes (Hirsch-Kreinsen, 2015; Zenhäusern & Vaterlaus, 2017). There will be an increase in the global employment share by

people with high qualifications, in particular related to the Industrial Revolution 4.0, as well as people with lower qualifications performing activities related to unique movements, interaction, physical and mental contact with the environment (e.g., nurses and healthcare professionals, the entertainment sector, catering, sports, hairdressing and beauty services, servicing, recreation and tourism related services). This will be accompanied by redundancies among workers with medium and low qualifications who perform repetitive mental and physical activities. Changes in the structure of employment will cause significant income polarisation in societies. Groups whose employment is related to AI devices will achieve very high incomes. At the other extreme, there will be people doing menial jobs and contracted workers (online gig economy). At the third extreme, there is a large group of unemployed people who are the potential recipients of the planned universal basic income (UBI) project.

In addition to those related to employment, the most serious negative consequences of AI include (Excell & Earnshaw, 2015; Schwab, 2016; Bostrom & Yudkowsky, 2018; Boukherouaa *et al*., 2021):

– Threat of cyberattacks. Hackers are already breaking through the security systems of many companies and institutions, stealing secret information and technologies, and introducing false information that can, among other things, influence the outcome of political elections. There are, for example, justified suspicions that Russian hackers who supported Donald Trump, the opponent of Hilary Clinton in the US presidential election, disseminated fake news about her;

– Privacy threat. The accuracy of decisions made by AI devices regarding the type of manufactured products, their features, and the scale of production and marketing depends on the amount and quality of information they collect and process. It can be used in ways customers did not expect or that conflict with their interests. The lack of transparency into how companies use data may lead to privacy breaches;

– Super-intelligent systems may carry out programmed projects regardless of their adverse side effects, e.g. changing the ecosystem, and they may approach human endeavours to stop that as an obstacle that should be overcome;

– The use of super-intelligent weapons by terrorists;

– Unforeseen failures of complex cyber-physical systems may cause considerable losses in industrial production, trade and finance and other spheres of functioning of societies;

– If left without supervision, intelligent machines can trigger a third world war;

– Experiments in genes can release organisms that are dangerous to human health and life;

– In general, the possibility of constructing robots with intelligence far superior to that of humans, which would eliminate humans and take over the world, is treated

as science fiction. Some researchers warn that such a scenario of AI development is real.

For the reasons cited here, there is a need for both national and international coordinated actions aimed at preventing the adverse or even catastrophic effects of AI development (Cheatham, Javanmardian & Samandari, 2019; Thomas, 2023). First of all, long-term measures should be taken in education. Graduates of various types of schools should be prepared to work with the appliances of the Industrial Revolution 4.0. Particular emphasis should be placed on IT knowledge and operating sophisticated computers. Educational institutions should teach critical thinking, practical problem-solving, creativity, social and communication skills, and flexibility to adapt to changing conditions and take up jobs that do not yet exist. Multi-channel investment in human capital and the stimulation of such activities by business entities should be a priority for the relevant authorities.

Governments should achieve a more socially equitable distribution of income – a transfer of profits from capital to income from work – through the tax system and other fiscal and financial policy instruments.

The state should strongly support small and medium-sized enterprises and new forms of entrepreneurship, especially in AI startups and venture capital.

Antitrust legislation should be strengthened, and its enforcement effectiveness increased. In light of the increasingly common cyber-attacks involving not only the interception of confidential information and instructions of companies but also making an impact on political decisions in a given country (elections) and posing a threat to the security systems and infrastructure, strong security measures, based on relevant agreements, are required to be introduced both on the national and international scale.

Regarding the protection of private data and its use, specific measures have already been taken in many countries, especially in Europe, where, among others, the General Data Protection Regulation has been introduced. However, it has an enormous capacity to download, store, and process vast amounts of data. In contrast, its ability to control these processes remains limited; the widespread use of AI will pose new challenges.

In parallel with research on the development and application of AI, scientists should develop effective systems to protect against the possibility of its autonomous actions that are incompatible with people's intentions and interests.

Striving for success may cause some scientists to exceed acceptable ethical and research-safety limits, leading to the effects of their research spiralling out of control. These valid fears are shared by many experts dealing with the problem, including Stephen Hawking, the late astrophysicist; Bill Gates, the founder of Microsoft; and Elon Musk, the founder of SpaceX and the designer and organiser of private space flights (Metz, 2023).

In general, the activities of the authorities of individual countries and international organisations in the field of AI should consist of supporting its development, as well as of reducing, through appropriate legislation and administrative action, the risk of its use that would pose a danger to people.

5. Conclusions

AI should provide applications that will significantly reduce costs across various spheres of the economy and the functioning of society, increase labour productivity and income, and enable a more ecologically sustainable use of natural resources. Thanks to AI, the pace of economic development in countries that implement AI-based appliances in practice and the well-being of their societies should increase.

Apart from the undoubted benefits, however, AI also carries significant risks. Although some of them, such as AI surpassing human intelligence and robots eliminating humans, seem like science fiction, the most significant real threat lies in their possible impact on labour markets, i.e., causing mass unemployment. A real threat with unimaginable catastrophic consequences may also be the use of AI by terrorists. There are also areas where potential changes will bring effects that are difficult to assess unequivocally. These include transhumanisation and the expected, practically indefinite extension of human life through gene interference and the use of nanomedicines. The fact that the world is already struggling with overpopulation poses the question of what would happen if people were to become "immortal"? It is currently impossible to predict which of the scenarios for AI's development will come true. It can elevate value-creation processes to an unimaginably high level of quality and, consequently, lead to a massive increase in social well-being and quality of life. However, it may result in catastrophic consequences.

Therefore, actions that would stimulate AI development while preventing Armageddon are necessary. Some actions, such as investments in human capital and public safety, and a fairer distribution of income, can and should be implemented by the authorities and institutions of individual countries. Others will require cooperation between countries and the activities of international organisations. These include establishing the ethical and safety boundaries of the research and its supervision, as well as eliminating the widening gap between highly developed countries and others in terms of technical development and income. The extreme importance of the discussed issues requires constant observation of the changes taking place, their predictive and prescriptive analysis, and on this basis, taking measures adequate to the needs. The article's word limit prevented the inclusion of case studies that would undoubtedly have enriched its content.

Conflict of Interest

The author declares no conflict of interest.

References

Abrardi, L., Cambini, C., & Rondi, L. (2019). *The Economics of Artificial Intelligence: A Survey* (EUI Working Paper RSCAS 2019/58). European University Institute, Robert Schuman Centre for Advanced Studies, Florence School of Regulation.

Absenger, N., Ahlers, E., Herzog-Stein, A., Lott, Y., Maschke, M., & Schietinger, M. (2016). *Digitalisierung der Arbeitswelt?* Hans Böckler Stiftung Report No. 24.

Aepli, M., Angst, V., Iten, R., Kaiser, H., Lüthi, I., & Schweri, J. (2017). Die Entwicklung der Kompetenzanforderung auf dem Arbeitsmarkt im Zuge der Digitalisierung. *Arbeitsmarktpolitik*, *47*.

Al Zadjali, S., & Ullah, A. (2021). Impact of Industry 4.0 in Manufacturing Sector. *International Journal of Management Science and Business Administration*, *7*(6), 25–33. https://doi.org/10.18775/ijmsba.1849-5664-5419.2014.76.1003

Badet, J. (2021). AI, Automation and New Jobs. *Open Journal of Business and Management*, *9*(5), 2452–2463. https://doi.org/10.4236/ojbm.2021.95132

Baecker, C., Yogiputra, G. P., Nguyen, T. D., & Alabbadi, O. (2023). *Threats Provided by Artificial Intelligence That Could Disrupt the Democratic System*. Brandenburg Technische Hochschule.

Berriman, R., & Hawksworth, J. (2017). *Will Robots Steal Our Jobs? The Potential Impact of Automation on the UK and Other Major Countries*. PWC Economic Outlook.

Bessen, J., Impink, S. M., Reichensperger, L., & Seamans, R. (2018). *The Business of AI Startups* (Law & Economics Series Paper No. 18–28). Boston University School of Law.

Bonciu, F. (2017). Evaluation of the Impact of the 4th Industrial Revolution on the Labor Market. *Romanian Economic and Business Review*, *12*(2), 7–16.

Bostrom, N., & Yudkowsky, E. (2018). The Ethics of Artificial Intelligence. In: R. V. Yampolski (Ed.), *Artificial Intelligence Safety and Security*. Taylor & Francis.

Boukherouaa, E. L. B., Shabsigh, G., AlAjmi, K., Deodoro, J., Farias, A., Iskender, E. S., Mirestean, A. T., & Ravikumar, R. (2021). *Powering the Digital Economy: Opportunities and Risk of Artificial Intelligence* (Departmental Paper No. DP/2021/024). International Monetary Fund. Retrieved from: https://www.imf.org/-/media/files/publications/dp/2021/english/pdeoraifea.pdf (accessed: 10.01.2022).

Brückner, M., LaFleur, M., & Pitterle, I. (2017). *The Impact of the Technological Revolution on the Labor Markets and Income Distribution*. Frontier Issues. UN Department of Economic and Social Affairs.

Brynjolfsson, E., Rock, D., & Syverson, C. (2017). *Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics* (NBER Working Paper No. 24001). National Bureau of Economic Research. https://http://doi.org/10.3386/w24001

Bughin, J., Hazan, E., Ramaswamy, S., Chui, M., Allas, T., Dahlström, P., Henke, N., & Trench, M. (2017). *Artificial Intelligence. The Next Digital Frontier?* (Discussion Paper, June). McKinsey Global Institute.

Bughin, J., Seong, J., Manyika, J., Chui, M., & Joshi, R. (2018). *Notes from the AI Frontier: Modeling the Impact of AI on the World Economy* (Discussion Paper, September). McKinsey Global Institute.

Bughin, J., Seong, J., Manyika, J., Hämäläinen, L., Windhagen, E., & Hazan, E. (2019). *Notes from the AI Frontier: Tackling Europe's Gap in Digital and AI* (Discussion Paper, February). McKinsey Global Institute.

Buntak, K., Kovačić, M., & Mutavdžija, M. (2021). Application of Artificial Intelligence in the Business. *International Journal for Quality Research*, *15*(2), 403–416. https://doi.org/10.24874/IJQR15.02-03

Cheatham, B., Javanmardian, K., & Samandari, H. (2019). *Confronting the Risks of Artificial Intelligence*. McKinsey. Retrieved from: https://www.mckinsey.com/capabilities/quantumblack/our-insights/confronting-the-risks-of-artificial-intelligence (accessed: 4.11.2021).

Chui, M., Manyika, J., & Miremadi, M. (2018). What AI Can and Can't Do (Yet) for Your Business. *McKinsey Quarterly*, *1*, 16–108.

Chui, M., Manyika, J., Miremadi, M., Henke, N., Chung, R., Nel, P., & Malhotra, S. (2018). *Notes from the AI Frontier: Applications and Value of Deep Learning*. McKinsey Global Institute.

Cockburn, I. M., Henderson, R., & Stern, S. (2017). *The Impact of Artificial Intelligence on Innovation*. NBER Conference on Research Issues in Artificial Intelligence. Toronto, September 2017.

Collins, C., Dennehy, D., Conboy, K., & Mikalef, P. (2021). Artificial Intelligence in Information Systems Research: A Systematic Literature Review and Research Agenda. *International Journal of Information Management*, *60*, 102383. https://doi.org/10.1016/j.ijinfomgt.2021.102383

Coombs, C., Hislop, D., Taneva, S. K., & Barnard, S. (2020). The Strategic Impacts of Intelligent Automation for Knowledge and Service Work. An Interdisciplinary Review. *The Journal of Strategic Information Systems*, *29*(4), 101600. https://doi.org/10.1016/j.jsis.2020.101600

Douge, O. (2020). Robotic Process Automation (RPA) and Its Future. In: U. Hacioglu (Ed.), *Handbook of Research on Strategic Fit and Design in Business Ecosystems*. IGI Global. https://doi.org/10.4018/978-1-7998-1125-1.ch021

Ernst, E., Merola, R., & Samaan, D. (2018). *The Economics of Artificial Intelligence: Implications for the Future Work* (ILO Future of Work. Research Papers Series No. 5). International Labour Organization.

Excell, P. S., & Earnshaw, R. A. (2015). The Future of Computing – the Implications for Society of Technology Forecasting and the Kurzweil Singularity. In: *2015 IEEE International Symposium on Technology and Society* (*ISTAS*). https://doi.org/10.1109/ISTAS.2015.7439406

Frey, C. B., & Osborne, M. A. (2013) *The Future of Employment: How Susceptible Are Jobs to Computerization* (Working Paper). Oxford Martin Programme on Technology and Employment. Oxford Martin School. University of Oxford.

Furman, J., & Seamans, R. (2018). *AI and the Economy* (NBER Working Paper Series No. 24689). National Bureau of Economic Research. https://doi.org/10.3386/w24689

Goldfarb, A., & Tucker, C. E. (2017). *Digital Economics* (NBER Working Paper Series No. 23684). National Bureau of Economic Research. https://doi.org/10.3386/w23684

Hirsch-Kreinsen, H. (2015). *Digitalisierung Arbeit: Folgens, Grenzen und Perspektiven* (Soziologisches Arbeitspaper Nr 43). Technische Universität Dortmund. https://doi.org/10.17877/DE290R-17066

Hoffman, M., & Nurski, L. (2021). *What Is Holding Back Artificial Intelligence Adoption in Europe* (Policy Contribution No. 24). Bruegel.

Joshi, N. (2019). 7 Types of Artificial Intelligence. *Forbes*. Retrieved from: https://www.forbes.com/sites/cognitiveworld/2019/06/19/7-types-of-artificial-intelligence (accessed: 14.05.2022).

Kurz, H. D. (2017). Auf der Schwelle zur „Vierten Industriellen Revolution". *Wirtschaftsdienst*, *97*(11), 785–792. https://doi.org/10.1007/s10273-017-2215-1

Manyika, J., & Bughin, J. (2018). *The Promise and Challenge of the Age Artificial Intelligence*. Executive Briefing. McKinsey Global Institute.

Manyika, J., Lund, S., Bughin, J., Woetzel, L., Stamenov, K., & Dhingra, D. (2016). *Digital Globalisation: The New Era of Global Flows*. McKinsey Global Institute.

Marr, B. (2017). The 4th Industrial Revolution and the Jobless Future – a Good Thing? *Forbes*. Retrieved from: https://www.forbes.com/sites/bernardmarr/2017/03/03/the-4th-industrial-revolution-and-a-jobless-future-a-good-thing/ (accessed: 16.09.2023).

Marr, B. (2022). *Data Strategy: How to Profit from a World of Big Data, Analytics and Artificial Intelligence* (2nd ed.). Kogan Page.

Metz, C. (2023). What Exactly Are the Dangers Posed by AI. *The New York Times*. Retrieved from: https://www.nytimes.com/2023/05/01/technology/ai-problems-danger-chatgpt.html (accessed: 5.07.2023).

Oxford Martin School. (2016). *Technology at Work v. 2.0: The Future is Not What It Used to Be*. CITI GPS Report. Oxford Martin School.

Peart, A. (2020). *Homage to John McCarty, the Father of Artificial Intelligence*. Retrieved from: https://www.artificial-solutios.com (accessed: 2.12.2023).

Ray, M., & Seamans, R. (2019). Primer on Artificial Intelligence. *Journal of Organization Design*, *8*(11), 1–14. https://doi.org/10.1186/s41469-019-0050-0

Roy, V. V., Vertesy, D., & Damioli, G. (2020). AI in Robotics Innovations. In: K. F. Zimmermann (Ed.), *Handbook of Labor: Human Resources and Population*. Springer. https://doi.org/10.1007/978-3-319-57365-6_12-2

Rymarczyk, J. (2013). *Biznes międzynarodowy*. PWE.

Rymarczyk, J. (2020). Technologies, Opportunities and Challenges of the Industrial Revolution 4.0: Theoretical Considerations. *Entrepreneurial Business and Economics Review*, *8*(1), 185–198. https://doi.org/10.15678/EBER.2020.080110

Saithibvongsa, P., & Yu, J. E. (2018). Artificial Intelligence in the Computer-age Threatens Human Beings and Working Conditions at Workplaces. *Electronic Science Technology and Applications*, *5*(3), 1–12. https://doi.org/10.18686/esta.v5i3.76

Schwab, K. (2016). *The Fourth Industrial Revolution*. World Economic Forum.

Thomas, M. (2023). *8 Risks and Dangers of Artificial Intelligence*. BuiltIn.

What Countries Are Leading the AI Race. (2023). https://investglass.com (accessed: 8.05.2024).

WIPO. (2019). *WIPO Technology Trends 2019. Artificial Intelligence. Executive Summary*. Retrieved from: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf (accessed: 17.10.2023).

Woo, H. (2021). *The Positive and Negative Effects of Artificial Intelligence*. Retrieved from: https://www.linkedin.com/pulse/positive-negative-effects-artificial-intelligence-economy-hao-wu (accessed: 18.11.2023).

Zahrani, A., & Marghalani, A. (2018). *How Artificial Intelligence Transform Business?* https://doi.org/10.13140/RG.2.2.20426.67522

Zenhäusern, P., & Vaterlaus, S. (2017). *Digitalisierung und Arbeitsmarktfolgen. Metastudie zum Stand der Literatur und zu den Entwicklungen in der Schweiz*. Studie von Polynomics AG.

Zhang, F. (2022). Digital Transformation of Enterprise under Big Data and Cloud Computing. *Wireless Communications and Mobile Computing*, *2022*(1), 1–7. https://doi.org/10.1155/2022/1068467

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 87–103
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18720

Artificial Intelligence: Challenges of AI in Accounting

Judyta Witowska

University of Applied Sciences in Nowy Sącz, Faculty of Economic Sciences, Department of Economics and Finances, Staszica 1, 33-300 Nowy Sącz, Poland, e-mail: jwitowska@ans-ns.edu.pl,
ORCID: https://orcid.org/0000-0001-9997-0522

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Witowska, J. (2026). Artificial Intelligence: Challenges of AI in Accounting. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 87–103. https://doi.org/10.15678/krem.18720

ABSTRACT

Objective: The aim of the article is to present the AI solutions used by accounting departments and the challenges they bring to the accounting field.

Research Design & Methods: The article was developed based on the literature, reports of companies which are currently implementing AI solutions in their accounting departments, and author's own research findings. The empirical part of the article includes the results of qualitative research. In the research process, the method of a diagnostic survey using the questionnaire technique was used. The study was conducted from February to March 2024, and involved 108 participants. The selection of respondents was deliberate and included a group of companies from the Małopolskie province.

Findings: The conducted research confirms that AI solutions have not been widely used in finance and accounting departments yet. However, respondents recognise the benefits and potential that the introduction of AI solutions and tools brings in terms of improving processes and tasks carried out in various enterprises. The obtained responses confirm that respondents are open to the introduction of new technologies and intend to use them in their organisations in the future. They do, however, express certain concerns about software errors or potential changes in employment levels.

Implications/Recommendations: AI solutions will be increasingly used in accounting. The challenge for future accounting departments will be to create a harmonious environment in which artificial intelligence will collaborate with human intelligence. The profession of an accountant will not disappear as a result of the introduction of improvements and the transfer of routine tasks to machines. Modern accounting systems will still require human supervision. However, the role of the accountant will change, as they will become operators of intelligent accounting applications in the future.

Contribution: The article addresses the current yet relatively scientifically understudied area of the practical use of AI solutions in the accounting departments of enterprises. The article partially fills the research gap and is one of the first studies presenting the results of research on the use of artificial intelligence solutions in the financial and accounting departments of the Małopolskie province. The research was exploratory and related to a limited group of enterprises. However, the presented research results may serve as a starting point for conducting more comprehensive studies on the discussed issue.

Article type: original article.

Keywords: accounting, artificial intelligence, robotic process automation (RPA), generative artificial intelligence.

JEL Classification: M41, M42.

1. Introduction

The technological landscape is constantly changing and evolving, providing entrepreneurs with innovative tools and methods of work. According to Calvino and Criscuolo (2019) in *Business Dynamics and Digitalization* on the example of 15 countries, the progressive processes of digitisation have significantly revolutionised most areas of business activity and contributed to the emergence of new business models. New technologies are also entering the field of accounting, streamlining the daily work of accounting departments.

Changes in the digitisation of tax settlements have significantly contributed to the reorganisation of the functioning model of accounting departments in business entities (Łada & Mierzejewska, 2021; Remlein, Jastrzębowski & Obrzeżgiewicz 2022). However, despite the government's introduction of online fiscal cash registers, a national e-invoice system, and the necessity for cooperation of transmitted files with government databases (JPK files), we are only at the beginning of the road to full automation of reporting (Semrau, 2021; Remlein, Nowak & Romanchuk, 2024).

According to the *Digitalisation in Europe 2022–2023* report by the European Investment Bank (EIB, 2023), more than half of companies in the European Union decided to introduce new digital solutions in their units during the COVID-19

pandemic. However, the level of digitalisation depended on the location of companies and their size (Jaumotte *et al*., 2023). On the other hand, research on small and medium-sized enterprises in Poland showed that only 38% of enterprises use basic digitisation tools, and 60% of enterprises see the need for full digitisation of business processes (Remlein, Nowak & Romanchuk, 2024). In addition, the European Investment Bank report highlights the role of advanced digital technologies such as artificial intelligence, business process automation, machine learning, and robotics (see: Jaumotte *et al*., 2023).

Among the most widespread technologies in accounting is the automation of serial business processes through the use of computer programmes (Januszewski, Kujawski & Buchalska-Sugajska, 2021; Borowiec, 2022). An example of accounting processes automation may be the mechanical calculation of salaries based on completed time records or the generation of financial statements in accordance with the documents, which are entered in the accounts. These programmes, through the simulation of human work, can automatically perform repetitive tasks. The characteristic feature of robots performing process automation is that they always perform their tasks according to the same scheme. They always act in the same way, not learning from mistakes, not seeking new solutions, always proceeding in accordance with the specified scheme.

What robots performing process automation cannot do, can be done by artificial intelligence (AI). This is because AI is the technology of intelligent computer programmes that learn by acquiring information. Artificial intelligence can reason and improve its actions by learning from mistakes.

In the era of dynamic technological development, entrepreneurs are forced to constantly improve processes and activities in their financial and accounting units. The aim of the article is to present artificial intelligence solutions used in accounting departments and the challenges they bring in the area of accounting. For the purpose of achieving the assumed goal, the following research questions were formulated:

1. Which of the artificial intelligence and automation solutions is most often used in the finance and accounting departments of the analysed units?

2. What opportunities and threats do respondents see in connection with the use of artificial intelligence solutions in their accounting departments?

3. What impact will artificial intelligence have on work in the future for accounting departments?

For the purpose of searching for answers to such research questions, the author has divided the considerations into two parts. In the first part, she introduces the reader to issues related to the use of artificial intelligence in accounting, focusing on discussing examples of practical solutions that have so far dominated in accounting departments. The presentation of specific solutions will give the opportunity to specify the benefits of their implementation in financial and accounting units in the

following part of the article. The second, most important part of the article focuses on the presentation and discussion of the results of own research on the use of artificial intelligence and automation solutions in accounting processes.

2. Examples of AI Solutions Used in Accounting

The availability of various modern technologies referred to as artificial intelligence significantly translates into the automation of financial and accounting processes in organisations. The possibility to automate learning processes, communicate in a way that mimics human behaviour has propelled accounting into a phase of the development of intelligent automation (Łada & Martinek-Jaguszewska, 2023b). Artificial intelligence in accounting mostly operates in conjunction with other automation technologies. AI technology typically performs selected tasks, which, combined with other activities carried out by employees or technology (e.g., automation tools), are integrated into entire processes.

Among the examples of intelligent technology applications in accounting, we should mention (Bornet, Barkin & Wirtz, 2020; Łada & Martinek-Jaguszewska, 2023a, 2023b; Martinek-Jaguszewska & Rogowski, 2023):

– optical character recognition (OCR),
– robotic process automation (RPA),
– machine learning models (ML),
– natural language processing (NLP),
– and generative artificial intelligence (GenAI – LLM).

Optical character recognition technology is software or a set of tools to scan an image of text, then identify individual characters, and finally convert those characters into digital text. OCR systems can analyse each element of a given document to subsequently process it into another computer programme. In the accounting domain, optical character recognition is mainly used to support the process of recording purchase invoices. Scanned invoices and receipts have certain mandatory elements that the system can identify and then record appropriately in the accounting books using other software in the field of automated processes. The application of OCR methods by finance and accounting departments increases efficiency in terms of the quantity of recorded financial documents when compared to manual recording. Computerised character recognition also reduces the risk of misinterpreting the data in documents, which in turn results in higher quality and reliability of the accounting records. It also enables workers to reduce tedious routine tasks such as checking the correctness of data in purchase invoices as well as time required for their registration in the financial and accounting programme in the appropriate position. It is worth noting that the planned implementation of mandatory invoicing by the government, within the National e-Invoice System (KSeF)

and the possibility of downloading them directly into accounting programmes will reduce the need for OCR, but it may still be used for foreign invoices or contracts concluded with non-business entities.

Business process automation has already been widely used by accounting departments to perform repetitive tasks (Remlein, Nowak & Romanchuk, 2024). It is most commonly utilised in the areas of accounting where electronic data is structured (Borowiec, 2022). The examples of activities, which involve business process automation include (Nowak, 2023):

– automatic order registration and generation of sales documents for orders,

– document circulation in the company – automatic registration of invoices and forwarding them to the relevant department to which the purchase relates,

– payroll processing – automatic generation of payroll,

– preparation of financial statements and tax returns,

– verification of financial data such as contractor identification data, bank account from the whitelist, balance of the contractor's account.

Business process automation is applied during the transfer and transformation of data, which reflects actions performed manually in accordance with the adopted rules and which will be coordinated by algorithms developed by artificial intelligence (Łada, 2022; Remlein *et al*., 2022; Łada & Martinek-Jaguszewska, 2023a) – see Table 1.

Table 1. Differences between Business Process Automation and Artificial Intelligence Operations

Specification	Process Robotisation	Artificial Intelligence
Operation algorithm	Tasks are performed in accordance with accepted rules	Follow its own logic while performing tasks
Operation scheme	Each time tasks are performed according to the accepted scheme	Is able to improve its operations by learning from mistakes
Data used in information processing	Uses structured data compiled in specific form fields	Can use unstructured information such as images, natural speech, text

Source: the author, based on Nowak (2023).

Machine learning models are also popular artificial intelligence solutions, mainly used in internal and external audit processes. Machine learning models allow for proper sample selection during financial audits (statistical sampling method), ensuring randomness in the elements analysed while maintaining appropriate risk level proportions for the examined organisation (Karmańska, 2022). An example may be identifying non-obvious relationships between invoices and complex orders.

In machine learning models, the computer learns through trial and error to recognise patterns stored in the source data and identifies events that may cause their occurrence (Łada & Martinek-Jaguszewska, 2023b).

Another technology of intelligent automation is natural language processing. The main task of this technology is to transform a text saved in the continuous form, without a structured format, in such a way that the obtained data is understandable to machines. It is a special type of machine learning algorithm that interprets not only the written words but also learns to understand the language structure and contextual meaning to accurately represent the meaning of the analysed text. These algorithms learn to increase the correctness of interpreted documents. An example of NLP technology application is mailbox management by accounting divisions. Based on text analysis, the programme can recognise which messages are orders, which are received purchase invoices, or other financial information, and can sort and forward specific messages to the relevant departments.

An example of advanced AI solutions is generative artificial intelligence. It not only understands but also creates new content based on the analysis of multiple sources. In the accounting domain, this model can be used to create descriptive parts of financial statements. Based on the balance sheet or profit and loss statement, the model can assess the profitability of the entity, the level of indebtedness, or suggest interpretations of financial indicators. The described interpretation format can also be used in financial audits (Łada & Martinek-Jaguszewska, 2023b).

The above-presented artificial intelligence solutions are the tools that are most commonly used in financial accounting departments. Technological advancements mean that they are subject to continuous evaluation and adaptation to the specific, individual needs of the respective entities. At the same time, their scope of operation and tasks to be performed will expand in the future.

3. Benefits of Using AI Tools in Finance and Accounting Departments

Introducing AI technology and automated processes into finance and accounting departments offers a wide range of benefits.

One of the main benefits is the improved efficiency and effectiveness in uploading financial documents to accounting software (Gawrońska, 2021). Taking over the tedious task of recording each individual business operation from the employee significantly saves time. Additionally, automatically recorded invoices minimise the risk of human error. Uploading documents via software also contributes to more accurate recording of business operations in accordance with applicable provisions and accounting principles.

Transferring tedious routine tasks to be performed by machines further contributes to improved morale among employees. Relieved accountants can focus their efforts on more creative tasks that will bring greater benefits to the company (Prędkiewicz & Biegun, 2024). Implementing automation of accounting processes reduces the risk of delays due to factors such as employee illness, as machines operate 24 hours a day, 7 days a week. Accounting software allows for faster data analysis and reporting, and makes it possible to share the customer panel, where clients can check their company's results on an ongoing basis.

Accounting and finance are areas where experience and knowledge of current legal regulations will always be highly desirable. Modern accounting systems will still require human supervision to manage more complex cases efficiently and make appropriate decisions. Artificial intelligence, however, presents both a challenge and a significant opportunity for accountants (Olaru, 2021). The accounting profession will not disappear due to the development of artificial intelligence. The challenge for accounting departments will be to create a harmonious environment for the cooperation between human intelligence and experience and technological potential offered by accounting software. In the future, accountants will play an even greater role in operating advanced accounting software. Artificial intelligence will take over the execution of tedious routine work, leaving room for professionals to perform more advanced tasks (Herbert, 2023). Accountants will be able to dedicate more time to quality control, and deal with disputable and exceptional cases or tasks that require proper assessment of the given situation and decision-making (Gulin, Hladika & Valenta, 2019; Krawczyńska, 2020; Brabete & Goagara, 2022).

Accountants who can effectively handle new technologies and AI solutions enjoy a competitive advantage in the job market. They become more attractive to entrepreneurs and companies seeking modern financial and accounting services. Their value will increase year by year. At the same time, thanks to process automation, they will be able to serve a larger number of clients while focusing on a broader range of advisory services.

The tasks accountants will perform in the future will go beyond traditional bookkeeping and financial reporting, and involve business consulting and skills in managing automation processes. These changes will require accountants to enhance their soft skills as well as their IT and data analysis competencies (Li & Zheng, 2018; Jędrzejka, 2019; Zajączkowska & Żujewski, 2021).

4. Utilisation of Artificial Intelligence and Automation in Accounting Processes – Research Results

For the purposes of the present paper, research was conducted to assess whether companies in the Małopolskie province apply AI solutions in their accounting departments.

For the purpose of the present study, a diagnostic survey method was applied through the use of the CAWI method (online survey technique). The study was conducted from February to March 2024, and involved 108 participants. The results presented in the article are part of a broader study conducted with the courtesy of the Association of Accountants in Poland, branch in Nowy Sącz. As part of this research, a survey was developed containing questions formulated by various authors in their respective areas of study. The presented research results were based on the questions prepared by the author of this article. The questionnaire consisted of 10 questions, of which the first 3 were a metric characterising the group of respondents. Subsequent questions were single-choice or multiple-choice with the possibility of completing the answers. The questionnaire constructed in this way allowed for qualitative analyses.

The respondents were mostly financial directors, chief accountants, owners, and heads of departments. Over half of the respondents represented the financial and accounting services sector (52.8%). Nearly 40% of the respondents were representatives of micro-enterprises, which employ up to 5 employees. The surveyed individuals possessed extensive professional experience. Approximately 55% of respondents were specialists with more than 10 years of professional experience.

The detailed structure of respondents according to sector of economic activity, company size, and professional experience is presented in Figures 1–3.

AI solutions have not yet been widely used by enterprises. This is confirmed by the fact that when asked a question "Are AI solutions used in the accounting department of your company?", nearly 54% of the respondents indicated "No" or "I don't know" (Fig. 4).

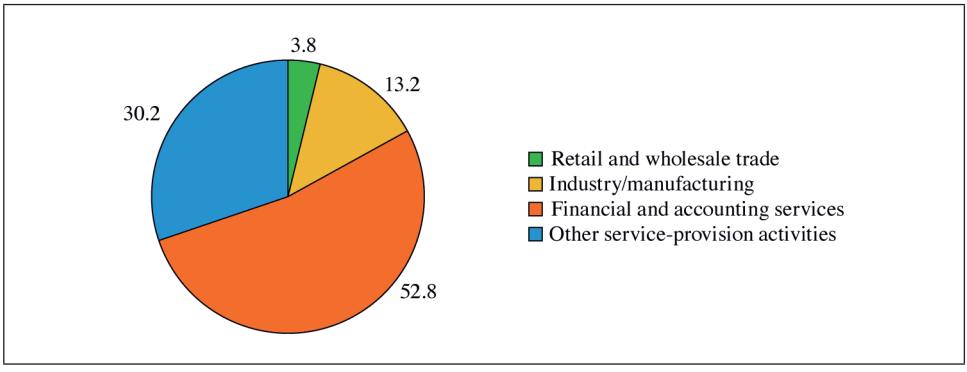

Fig. 1. Respondents' Sector of Economic Activity (in %)

Source: the author, based on empirical research.

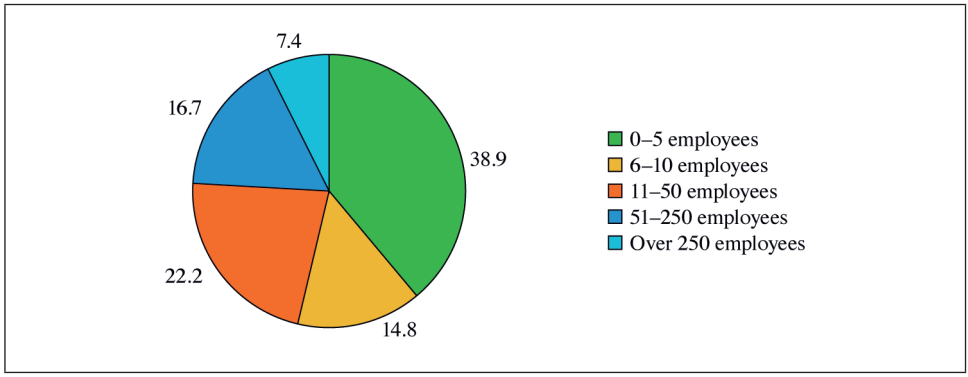

Fig. 2. Company Size – Number of Employees (in %)

Source: the author, based on empirical research.

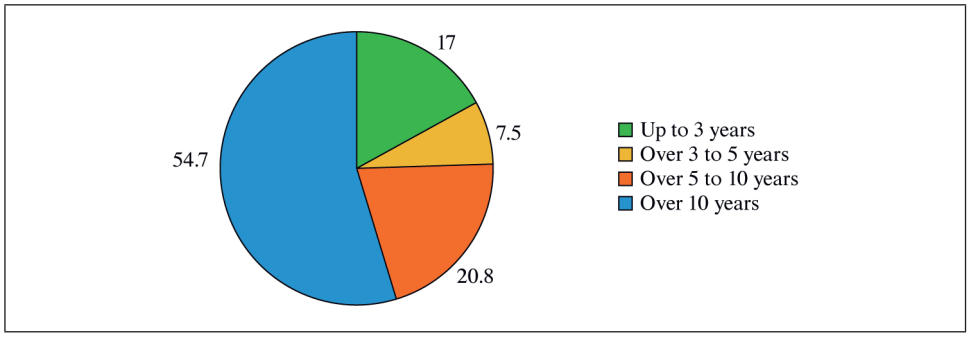

Fig. 3. Professional Experience of Respondents (in %)

Source: the author, based on empirical research.

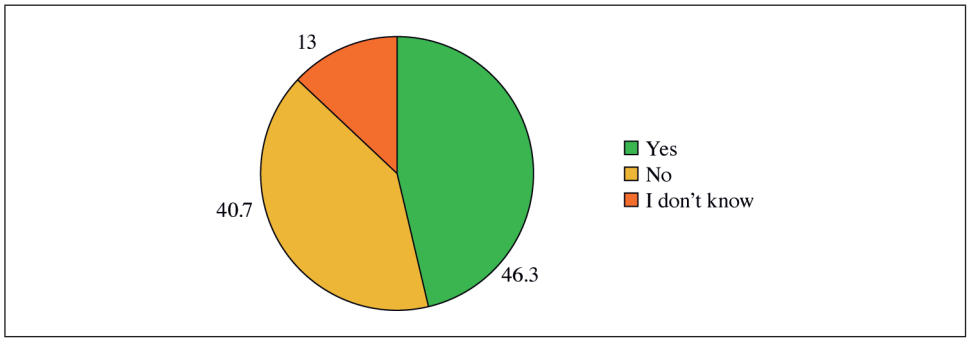

Fig. 4. Level of Utilisation of AI Tools in Accounting Departments of the Surveyed Enterprises (in %)

Source: the author, based on empirical research.

Among the AI and automation solutions used in financial and accounting activities of the surveyed companies, the most frequently utilised are machine translation software (translators – 30.8%), programmes enabling data extraction from scanned documents (23.1%), and programmes for robotic automation of specific processes such as posting of accounting documents, generation of financial statements, tax declarations, or payroll processing – 23% (see Fig. 5).

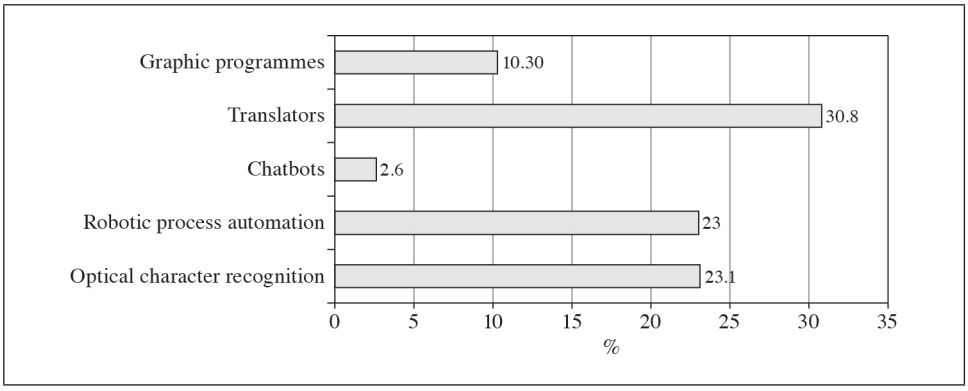

Fig. 5. AI and Automation Solutions Used by Surveyed Enterprises

Source: the author, based on empirical research.

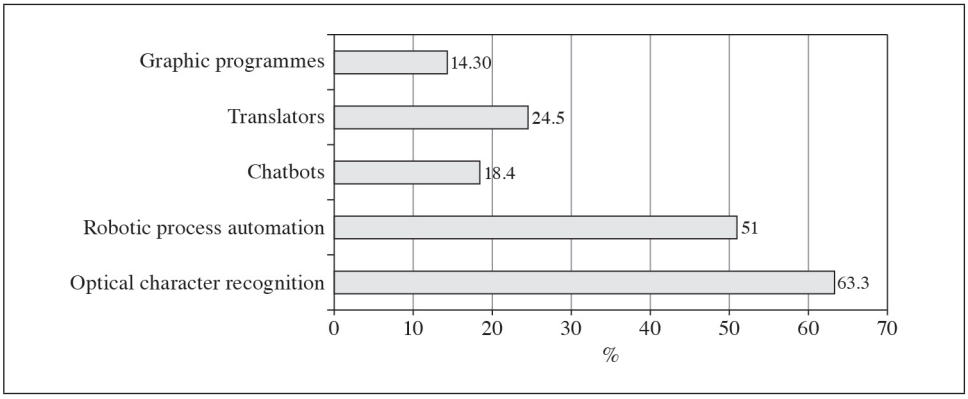

Fig. 6. AI and Automation Solutions Which Respondents Would Like to Use in Their Companies in the Future

Source: the author, based on empirical research.

Being aware that AI and automation solutions are not popular and still pose challenges for accounting departments, the author asked the question „Which AI tools would you like to use in your daily work in the future?". The responses obtained clearly indicate that accountants are interested in introducing technological improvements (see Fig. 6). When answering this question, respondents had the opportunity to select more than one option and provide their own suggestions. 64% of the respondents see potential in OCR programmes, while 51% of the surveyed individuals want to improve accounting processes using robotic process automation. Accountants also point to chatbots as a tool that they would like to use in the future. Among the suggestions added by respondents are simple interfaces of accounting programmes that provide owners with remote access to their company's results in real-time and document management system (DMS).

Respondents recognise the benefits of using AI tools by the finance and accounting departments (Fig. 7). Primarily, it is the possibility of eliminating daily tedious routine tasks (66.7%). According to over half of the respondents, technological solutions allow for the elimination of error risk while increasing work efficiency and resources. The introduction of AI solutions will also, according to respondents, increase employee satisfaction by relieving them of excess duties while providing the opportunity to perform more creative tasks that generate greater value in business.

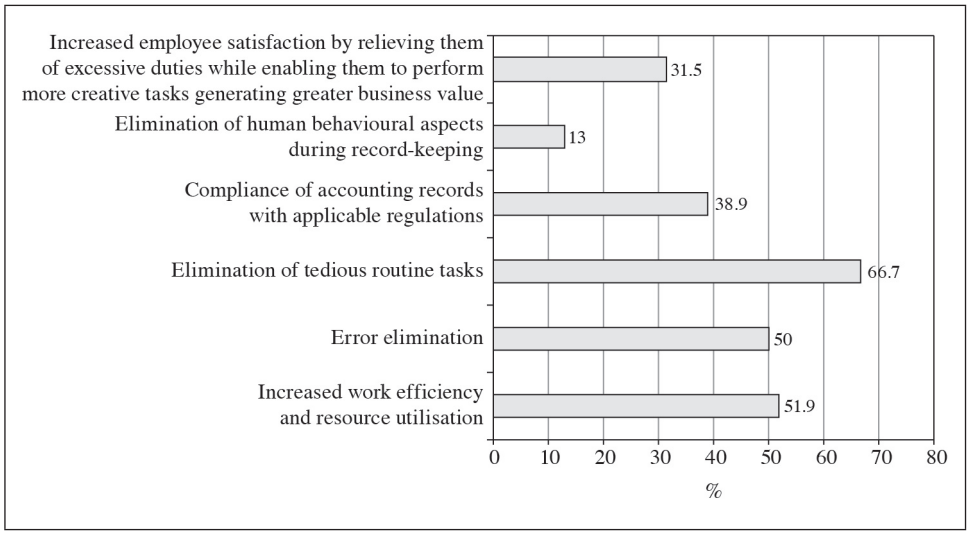

Fig. 7. Benefits of Using AI Solutions in Accounting Departments According to Respondents
Source: the author, based on empirical research.

Introducing technological innovations often entails concerns in the processes of their implementation. The finance and accounting departments of every enterprise are specific areas where the risk of software errors can bring about serious financial consequences. Employees in accounting departments are experienced individuals who understand how the outcomes of their work translate into the overall results of the company. They cannot afford software errors to result in inaccurate data subsequently presented in financial statements and reports. Therefore, their greatest concern is software errors, the occurrence of which could distort the presented results (Fig. 8). Another significant concern indicated by the respondents is the omission of specific details in accounting operations by programmes (63%) or the difficulty in interpreting complex regulations (55.6%). By recognising potential threats associated with the use of artificial intelligence in accounting departments, respondents see the need to control what has been done by artificial intelligence.

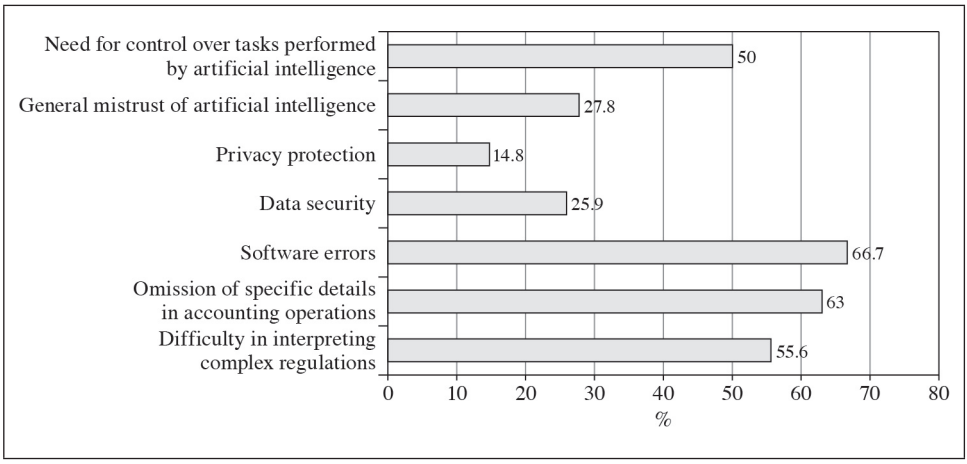

Fig. 8. Threats Associated with the Use of AI Solutions in Accounting Departments According to Respondents

Source: the author, based on empirical research.

Despite many concerns, respondents are aware that AI solutions will increasingly be used in finance and accounting departments of various enterprises. According to the respondents, tasks in which AI solutions will be most extensively used in the future include: posting and booking transactions (59.3%), document sorting and circulation (57.4%), and financial data analysis (48.1%) – Figure 9. However, respondents see limited potential for the use of artificial intelligence in creating non-financial information (only 16.7%).

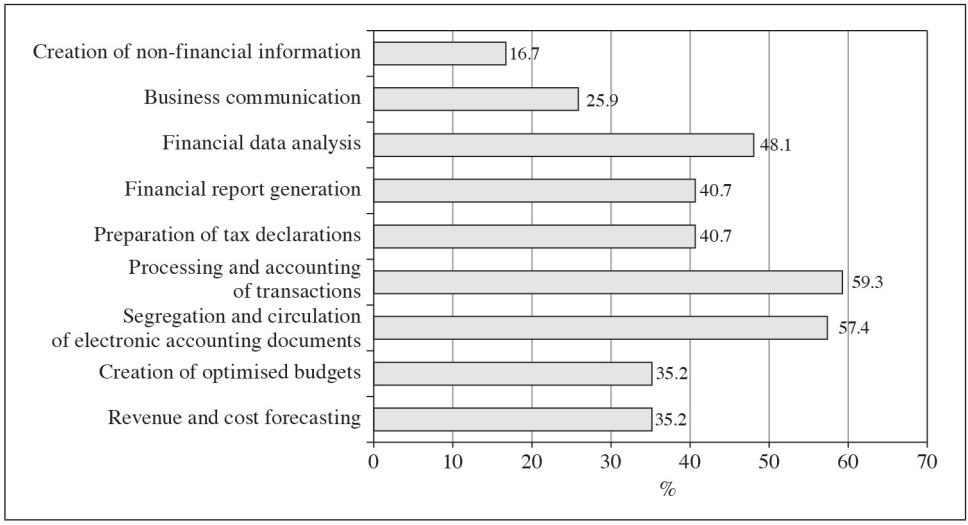

Fig. 9. Areas of Accounting Where AI Solutions Can Be Most Extensively Used According to Respondents

Source: the author, based on empirical research.

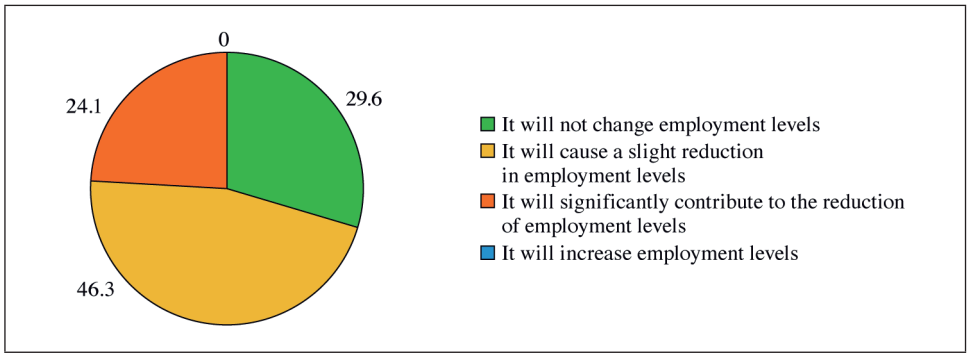

Fig. 10. Changes in the Level of Employment after the Introduction of AI Solutions (in %)

Source: the author, based on empirical research.

Introducing new technologies into accounting departments raises concerns not only about the accuracy of data entered by machines but also about how the introduction of AI solutions will affect the employment levels. According to nearly 30% of the respondents, the introduction of modern tools and methods into financing and accounting programmes will not lead to a reduction in employment, while according to 46.3%, it will lead to redundancies, but to a small extent only (Fig. 10). None of the respondents, however, indicated that the introduction of AI solutions would lead to an increase in employment levels.

5. Summary and Conclusions

Modern technologies and AI solutions are increasingly being used across all segments of business activities. Also, in the accounting and finance departments, such software is being introduced to increase efficiency and effectiveness as well as eliminate repetitive tasks.

Among the AI tools most commonly used by organisations, we can include robotic process automation and optical character recognition of scanned documents. The results of the conducted research have confirmed that entrepreneurs are open to introducing new technologies into their accounting departments. They recognise the benefits of implementing AI technology and mention some of them, namely error elimination, accounting business transactions in accordance with applicable legal provisions and improving employee satisfaction.

The latest scientific research confirms that the scope and manner of work performed in accounting departments are changing dramatically. In the future, to an even greater extent than before, accountants will serve as operators of advanced financial and accounting applications. Artificial intelligence will allow professionals to devote more time to solving exceptional cases or deal with quality control.

However, accounting will still remain a field that requires interpersonal contacts, and due to the necessity of providing businesses with customised accounting services and guidance, it will probably never be replaced by robots. The key is to create a harmonious environment for human-machine collaboration.

Introducing artificial intelligence into the accounting field is a challenge for accountants. They must be open to the opportunities offered by technological innovations and be aware that the ability to operate intelligent accounting applications is an opportunity that gives them a competitive advantage in the job market among other specialists.

The author is aware that the topic she has taken up is worth discussing in at least three areas. Firstly, the research method used, and in particular the research tool prepared. The forms of questions used (mainly single and multiple choice) can be analysed primarily qualitatively by analysing the respondents' beliefs about the issues formulated in the questions. A differently constructed research tool would probably allow for the use of a wider range of statistical methods. Secondly – the degree of return of the surveys. Every researcher wants a high return rate of survey questionnaires. In the research process, an attempt was made to collect a large number of questionnaires through the use of an electronic system for filling them in. High reflexivity was also taken care of by asking the Accountants Association in Poland, Nowy Sącz branch, to disseminate the survey among the members of the association. The attempts made it possible to collect 108 questionnaires. The third area of limitations is the selection of respondents. It was intentional and covered enterprises from the Małopolskie province. The respondents to the

survey were mainly representatives of micro-enterprises operating in the financial and accounting services sector. The author is aware that the results obtained from representatives of micro-enterprises may differ from the results of large enterprises. However, it should be remembered that micro, small, and medium-sized enterprises are the largest group of business units in Poland. The sector of business activity probably also translated into the results obtained.

The research results presented in the article are the starting point for further analyses on the process of using artificial intelligence in accounting. It also seems interesting to conduct a comparative analysis of the benefits and costs of implementing artificial intelligence solutions in finance and accounting departments. Such research would allow for the assessment of real measurable financial benefits for enterprises. It is equally interesting, or even necessary, to conduct this type of research periodically due to the dynamics of the development of artificial intelligence and its application in accounting.

Conflict of Interest

The author declares no conflict of interest.

References

Bornet, P., Barkin, I., & Wirtz, J. (2020). *Intelligent Automation. Weclome to the World of Hyperautomation*. World Scientific Publishing.

Borowiec, L. (2022). Koszty i korzyści finansowe wdrożenia robotyzacji wybranych procesów w rachunkowości. *Zeszyty Teoretyczne Rachunkowości*, *46*(2), 11–26. https://doi.org/10.5604/01.3001.0015.8807

Brabete, V., & Goagara, D. (2022). Digitalization – a Danger to Accounting Professionals? *Journal of Corporate Governance, Insurance, and Risk Management*, *9*(1), 25–48. https://doi.org/10.51410/jcgirm.9.1.3

Calvino, F., & Criscuolo, C. (2019). *Business Dynamics and Digitalization* (OECD Science, Technology and Industry Policy Papers No. 62). OECD Publishing. https://doi.org/10.1787/6e0b011a-en

EIB. (2023). *Digitalisation in Europe 2022–2023: Evidence from the EIB Investment Survey*. European Investment Bank. https://doi.org/10.2867/745542

Gawrońska, Z. (2021). Wpływ programów komputerowych na efektywność pracy pracowników biurowych w oparciu o program InsERT nexo. *Współczesne Problemy Zarządzania*, *9*(1(18)), 31–42. https://doi.org/10.52934/wpz.129

Gulin, D., Hladika, M., & Valenta, I. (2019). Digitalization and the Challenges for the Accounting Profession. In: *Proceedings of the ENTRENOVA – ENTerprise REsearch InNOVAtion Conference, Rovinj, Croatia, 12–14 September 2019* (pp. 502–511). IRENET – Society for Advancing Innovation and Research in Economy.

Herbert, T. (2023). *Automation Mindset: Beyond the Numbers*. Retrieved from: https://www.accountingweb.co.uk/tech/tech-pulse/automation-mindset-beyond-the-numbers (accessed: 10.04.2024).

Januszewski, A., Kujawski, J., & Buchalska-Sugajska, N. (2021). Benefits of and Obstacles to RPA Implementation in Accounting Firms. *Procedia Computer Science*, *192*, 4672–4680. https://doi.org/10.1016/j.procs.2021.09.245.

Jaumotte, F., Li, L., Medici, A., Oikonomou, M., Pizzinelli, C., Shibata, I., Soh, J., & Tavares, M. M. (2023). *Digitalization during the COVID-19 Crisis: Implications for Productivity and Labor Markets in Advanced Economies* (Staff Discussion Note SDN2023/003). International Monetary Fund.

Jędrzejka, D. (2019). Robotic Process Automation and Its Impact on Accounting. *Zeszyty Teoretyczne Rachunkowości*, *105*(161), 137–166. https://doi.org/10.5604/01.3001.0013.6061

Karmańska, A. (2022). Artificial Intelligence in Audit. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *66*(4), 87–99. https://doi.org/10.15611/pn.2022.4.06

Krawczyńska, M. (2020). Postrzeganie kompetencji specjalistów rachunkowości zarządczej w kontekście zmian otoczenia biznesowego przedsiębiorstw. *Zeszyty Teoretyczne Rachunkowości*, *107*(163), 39–69. https://doi.org/10.5604/01.3001.0014.2464

Li, Z., & Zheng, L. (2018). The Impact of Artificial Intelligence on Accounting. *Advances in Social Science, Education and Humanities Research* (*ASSEHR*), *181*, 813–816. https://doi.org/10.2991/icsshe-18.2018.203

Łada, M. (2022). Kryteria robotyzacji procesów biznesowych: badania eksploracyjne. *e-mentor*, *5*(97), 5–12. https://doi.org/10.15219/em97.1585

Łada, M., & Martinek-Jaguszewska, K. (2023a). Autonomizacja procesów rachunkowości. *Zeszyty Teoretyczne Rachunkowości*, *47*(3), 95–111. https://doi.org/10.5604/01.3001.0053.7697

Łada, M., & Martinek-Jaguszewska, K. (2023b). *Zastosowania sztucznej inteligencji w rachunkowości*. Stowarzyszenie Księgowych w Polsce. Retrieved from: https://rachunkowosc.com.pl/zastosowania-sztucznej-inteligencji-w-rachunkowosci (accessed: 24.03.2024).

Łada, M., & Mierzejewska, M. (2021). Robotyzacja procesów podatkowych w przedsiębiorstwie. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 3(993), 109–120. https://doi.org/10.15678/ZNUEK.2021.0993.0306

Martinek-Jaguszewska, K., & Rogowski, W. (2023). Development and Validation of the Business Process Automation Maturity Model: Results of the Delphi Study. *Information Systems Management*, *40*(2), 169–185. https://doi.org/10.1080/10580530.2022.2071506

Nowak, J. (2023). *Sztuczna inteligencja* (*AI*) *w księgowości – czy roboty zastąpią księgowych?* Enova365. Retrieved from: https://www.enova.pl/blog/nadazaj-w-biznesie/sztuczna-inteligencja-ai-w-ksiegowosci-czy-roboty-zastapia-ksiegowych/ (accessed: 30.03.2024).

Olaru (Colbea), E. A. (2021). Impactul blockchain asupra profesiei contabile. *CECCAR Business Review*, 3, 49–58. https://doi.org/10.37945/cbr.2021.03.06

Prędkiewicz, K., & Biegun, K. (2024). AI – sztuczna inteligencja w finansach przedsiębiorstw. In: M. Sierpińska, P. Szczepankowski (Eds), *Finanse przedsiębiorstw* (pp. 319–332). Polska Akademia Nauk. Retrieved from: https://publikacje.pan.pl/Content/132530/18_2024_Finanse.pdf?handler=pdf (accessed: 20.11.2024).

Remlein, M., Bejger, P., Olejnik, I., Jastrzębowski, A., & Obrzeżgiewicz, D. (2022). Zastosowanie automatyzacji procesów z wykorzystaniem robotyzacji w rachunkowości finansowej w jednostkach gospodarczych działających w Polsce. *Zeszyty Teoretyczne Rachunkowości*, *46*(1), 47–65. https://doi.org/10.5604/01.3001.0015.7988

Remlein, M., Jastrzębowski, A., & Obrzeżgiewicz, D. (2022). The Impact of Legislation on the Development of Accounting Digitisation in Poland. *Zeszyty Teoretyczne Rachunkowości*, *46*(4), 115–127. https://doi.org/10.5604/01.3001.0016.1305

Remlein, M., Nowak, D., & Romanchuk, K. (2024). Korzyści z wdrożenia automatyzacji procesów w rachunkowości. *Zeszyty Teoretyczne Rachunkowości*, *48*(3), 133–153. https://doi.org/10.5604/01.3001.0054.7260

Semrau, A. (2021). Wpływ sztucznej inteligencji na pracę biur rachunkowych. In: M. Sitek, J. B. Navarro (Eds), *Human Rights: Evolution in Digital Era* (pp. 266–282). Alcide De Gasperi University of Euroregional Economy in Józefów.

Zajączkowska, K., & Żujewski, J. (2021). Analiza szans i zagrożeń dla pracowników w sektorze rachunkowości. In: I. Franczak, A. Konior (Eds), *Rachunkowość przyszłości – szanse i zagrożenia* (pp. 39–48). Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach.

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 105–128
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18714

Social Expectations Regarding Municipal Parks in the Aspect of Work-life Balance (Using the Example of Lubelskie Voivodeship)

Agnieszka Komor[1], **Anna Goliszek**[2], **Agnieszka Kępkowicz**[3], **Halina Lipińska**[4]

[1] University of Life Sciences in Lublin, Department of Management and Marketing, Akademicka 13, 20-950 Lublin, Poland, e-mail: agnieszka.komor@up.lublin.pl, ORCID: https://orcid.org/0000-0002-7532-3141

[2] University of Life Sciences in Lublin, Department of Management and Marketing, Akademicka 13, 20-950 Lublin, Poland, e-mail: anna.goliszek@up.lublin.pl, ORCID: https://orcid.org/0000-0002-1915-3846

[3] University of Life Sciences in Lublin, Department of Grassland and Landscape Shaping, Akademicka 13, 20-950 Lublin, Poland, e-mail: agnieszka.kepkowicz@up.lublin.pl, ORCID: https://orcid.org/0000-0003-2972-2309

[4] University of Life Sciences in Lublin, Department of Grassland and Landscape Shaping, Akademicka 13, 20-950 Lublin, Poland, e-mail: halina.lipinska@up.lublin.pl, ORCID: https://orcid.org/0000-0003-0135-5121

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Komor, A., Goliszek, A., Kępkowicz, A., & Lipińska, H. (2026). Social Expectations Regarding Municipal Parks in the Aspect of Work-life Balance (Using the Example of Lubelskie Voivodeship). *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 105–128. https://doi.org/10.15678/krem.18714

ABSTRACT

Objective: Using the Lubelskie voivodeship as an example, this paper seeks to identify and analyse consumers' (users of municipal parks) expectations regarding the functions of municipal parks in the context of work-life balance. We determined expectations regarding the parks' functions based on the reasons for visiting them.

Research Design & Methods: The primary data collection method was a survey method, which used a questionnaire technique. Non-random sampling was used. Respondents were recruited online using a snowball technique. The survey was conducted remotely using Google Forms. The gathered primary data were subjected to quantitative analysis, that is, the mean score test, Mann-Whitney *U* test and exploratory factor analysis.
Findings: We confirmed that the offer of municipal parks improves the likelihood of achieving a work-life balance, mainly due to recreation and leisure and health-promoting functions. The pilot survey revealed that interviewed consumers who used municipal parks in the Lubelskie voivodeship had varying expectations regarding the parks' roles. The foremost expectations involved parks' leisure function, which is the ability to relax in a natural environment, experience tranquillity and seek shelter from the sun, admire the beauty and sounds of nature, and engage in leisure activities, including meeting family and friends. Furthermore, the Mann-Whitney *U* test showed that the variable frequency of visits to city parks was not a statistically significant differentiating variable for most respondents' expectations regarding their function. Nevertheless, through factor analysis, segments were identified for each category of respondents analysed that differed in their expectations regarding the urban park offer.
Implications/Recommendations: The study's findings can be utilised by city authorities to develop local municipal park management policies. Knowing what residents look for from municipal parks allows them to update their municipal park management strategies to align them with the demands of the public and to boost their appeal to city inhabitants. It can be applied to the management of existing parks and the development of new park spaces in cities.
Contribution: The review of the literature and the analyses enrich the literature focusing on work-life balance, specifically examining the impact of municipal parks on worker well-being and the significance of measures and innovations related to developing green areas as part of city policy. The presented findings can be a starting point for further research on this topic.

Article type: original article.

Keywords: municipal parks, work-life balance, local policy, social expectations.

JEL Classification: J22, J24, J28, Q57.

1. Introduction

The concept of work-life balance is associated with the desire to achieve goals in various aspects of one's life. This concept emphasises the significance of correctly prioritising work and private life, including family, leisure, enjoyment, and spiritual development (Khan & Fazili, 2016). Work-life balance is becoming increasingly important in light of the following:

– considerably rising expectations towards workers and businesses associated, among other things, with global competition, the need to align working hours with customer demands, and order processing time,

– dynamic development of innovative technologies and information and communications technologies, for instance, using communication platforms and mobile devices, allowing the workers to stay connected with the workplace and leading to the blurring of awareness of the necessity to separate their personal lives from work,

– increasing significance of remote working,

– workers' desire to increase their income and improve their quality of life.

The literature includes considerations of the relationship between the offer of municipal parks and work-life balance, consumer expectations regarding municipal parks and the gender and age of respondents, and the functions of municipal parks in this context. However, there is a research gap in terms of studies identifying expectations regarding the role of municipal parks according to the frequency with which respondents visit them. There is also a lack of studies identifying consumer segments according to reasons for visiting municipal parks among those who visit them rarely and often. This is a research gap that the present study attempts to address.

The research problem in this study is to identify and analyse the expectations regarding the offer of municipal parks due to the frequency of visits by respondents, together with the identification of respondent segments according to the reasons for visiting municipal parks among people who rarely and often visit them.

Using the Lubelskie voivodeship as an example, this paper seeks to identify and analyse consumers' (users of municipal parks) expectations regarding the functions of municipal parks in the context of work-life balance depending on the frequency of visiting parks. We determined expectations regarding the parks' functions based on the reasons for visiting them.

This research objective raises the following research questions:

– What is the relationship between municipal park offer and work-life balance in the light of the literature?

– What functions do consumers expect regarding municipal parks?

– What are the specific segments of respondents according to reasons for visiting municipal parks among all the respondents?

– Are there any statistically significant differences in respondents' expectations regarding the roles of municipal parks based on how frequently they visit these places?

– What are the specific segments of respondents according to reasons for visiting municipal parks among people who rarely and often visit them?

To achieve this research objective, we sought to verify the hypothesis that expectations regarding the roles of municipal parks differ depending on how frequently they are visited.

The study's findings can be utilised by city authorities to develop local municipal park management policies. Knowing what residents look for in municipal parks

allows city authorities to update municipal park management strategies to align them with the demands of the public and to boost their appeal to city inhabitants. It can be applied to the management of existing parks and the development of new park spaces in cities. The study indicates the expectations, important to respondents, regarding the offer of municipal parks, the implementation of which is the task of the municipal authorities and the urban planners working with them. Knowledge of park visitors' expectations according to the frequency of their visits can also give urban planners clues as to how parks should be laid out. The division of park space into different zones suited to particular consumer groups, the offer of specific facilities (e.g., playgrounds, sports equipment) and additional services (e.g., the possibility of organising events for family and friends) are important.

2. Theoretical Background

Nowadays, the concept of work-life balance is gaining increasing importance, although it is sometimes criticised for the lack of clarity in its definition, as well as ambiguity and the lack of consistent measures to assess work-life interactions (Omar & Zakaria, 2015). Furthermore, it is also pointed out that the focus is mainly on the quality of work-life areas, neglecting the causes of imbalance and precarious working conditions (Resch & Bamberg, 2005). Work-life balance policies can sometimes also reinforce gender inequalities and paradoxically lead to increased levels of work-life conflict (Brough *et al*., 2008).

Despite these critical elements, the literature indicates that lack of work-life balance can cause conflicts between the two domains, resulting in frustration at work, job burnout and poor performance (Chandran & Abukhalifeh, 2021). Overworking also leads to various health problems and may be a source of stress at the individual level (manifested, for example, as anxiety, helplessness, and psychosomatic disorder), interpersonal level (e.g., worker irritability or generating conflicts), and organisational level (manifested, for instance, as dissatisfaction with one's job or a loss of motivation to work) (Chirkowska-Smolak, 2008). Employers who implement an innovative and accommodating work-life balance strategy have more resolute employees who are more productive, eventually contributing to increased business performance (Yadav, Pandita & Singh, 2022). The research outcomes imply a beneficial correlation between the workers' impact on the work schedule and work-life balance approach on the one hand and their psychological well-being and job satisfaction on the other (Jang, Park & Zippay, 2011). This approach integrates, for example, flexible working hours to improve the balance between work and family life (Hill *et al*., 2001).

The desire to preserve work-life balance is linked to leisure activities such as engagement with nature in parks. Research indicates that there is a link between

lower levels of work-life balance and poorer mental and physical health (Borowiec & Drygas, 2023). Hence, there is a need to implement activities aimed at improving the health of employees, which will contribute to a better work-life balance. In light of the literature, interaction with nature has numerous benefits, including a positive impact on the population's health (physical and mental), quality of life, stress reduction, increased job productivity and efficiency, and the establishment of social ties (Szulczewska, 2020). This is particularly relevant in cities, which, compared to the countryside, provide fewer opportunities for spending time outdoors in a natural setting. Thus, city officials' efforts to expand park offerings are vital. It should be mentioned that during the COVID-19 pandemic, the importance of municipal parks and other green areas increased (as indicated by the growing number of park visitors) because of their advantageous impact on citizens' physical and psychological well-being (Geng *et al*., 2021). The COVID-19 pandemic also raised the value of work-life balance and the number of interactions with nature, as evidenced by different measures and innovations in municipal strategies regarding the expansion of green areas and investments in city transport and green spaces (Mittal & Woodside, 2022). Visits to municipal parks can considerably improve general health and meet an individual's desire to connect with others (Xie *et al*., 2020). Furthermore, they can influence how city people describe their enjoyment (Cheng *et al*., 2021).

Green areas, including city parks, have the following main functions: recreation and leisure, environmental protection, health-promoting functions, aesthetic roles, and education (Chojecka, 2014). The recreational and leisure functions associated with the possibility of spending spare time on various forms of physical activity (walking, hiking, and sports), relaxation in a green area, and meeting and interacting with people exemplify the impact of municipal parks on the ability to maintain work-life balance. The use of municipal parks plays a significant role in improving work-life balance by, among other things, reducing stress and improving mental health of individuals (including employees) by spending time in municipal parks (Wang, 2023). Parks also offer a variety of opportunities to engage in physical activity, which contributes to both improving physical health and alleviating work-related stress (Koramaz & Türkoğlu, 2018; Zhao, Aziz & Ujang, 2024). Spending time in municipal parks facilitates social interactions and social connections that provide emotional support and a sense of belonging, which are important for work-life balance (Jang, Choi & Kim, 2024).

Furthermore, the environmental protection function is linked to the parks' health-promoting functions, which are directly related to protecting city residents from pollution and other external aggressors while establishing a healthy microclimate. In the work-life balance context, it is particularly significant that green areas affect people's general health and physical activity, reduce stress and fatigue,

improve concentration, accelerate recovery from surgeries and diseases, and increase pain tolerance (Kosmala & Błaszczyk, 2012). Studies demonstrate that even short excursions to natural places (e.g., municipal parks) have a beneficial influence on stress alleviation compared to the built-up environment (Tyrväinen *et al*., 2014). The offer of municipal parks related to cultural services, relaxation and exercise spaces, and leisure activities, among others, influences the quality of urban life, which contributes to a better work-life balance (Zhao, 2020).

Municipal parks attract visitors for a variety of reasons, which can be divided into several key segments based on their motivations:

– the opportunity for rest and relaxation (Liu *et al*., 2017; Gong *et al*., 2023),

– engaging in physical activity (Liu *et al*., 2017; Gong *et al*., 2023),

– meeting place with family and friends (Hui & Jim, 2022; Gong *et al*., 2023),

– the desire to connect with nature (Taylor *et al*., 2020),

– presence of specific amenities, e.g., playgrounds, picnic areas, sports fields (Taylor *et al*., 2020; El-Murr *et al*., 2021),

– proximity of the park to one's place of residence or work (Gao *et al*., 2017; Chiang & Li, 2019).

A review of the literature indicates that studies on expectations of municipal parks look for relationships with socio-demographic characteristics, i.e., gender (Derose *et al*., 2018; Bąkowska-Waldmann & Piniarski, 2023) and age (Brkljačić, Majetić & Tarabić, 2017; Kimic & Polko, 2022). Studies in the literature have examined, for example, different characteristics of visitation and activity patterns for different socio-demographic groups (Hui & Jim, 2022), or the influence of socio-demographic, environmental and individual variables on the frequency of park visitation (Liu *et al*., 2017). It is noteworthy that there is a lack of studies in the literature indicating whether expectations regarding the function of municipal parks vary according to how often they are visited. Studies indicating consumer segments according to reasons for visiting municipal parks among those who visit them rarely and often were also not found. This is a research gap that this study attempts to address.

In summary, people who visit municipal parks expect accessible space (i.e., close to where they live or work) for rest and relaxation, physical activity, meetings with family and friends, contact with nature, and use of amenities. Municipal parks support work-life balance by providing spaces for stress relief, physical activity and social interaction (Fig. 1). It seems that the described relationship may be a self--reinforcing mechanism, i.e., the increasing quality of life of residents resulting from, among other things, the offer of municipal parks and the implementation of the work-life balance concept may contribute to increasing expectations regarding the offer of municipal parks (e.g., in the form of special amenities in parks or the offer of cultural events). This, in turn, may translate into the quality and diversity of

the parks' offer and have an even greater impact on the quality of life and work-life balance of residents.

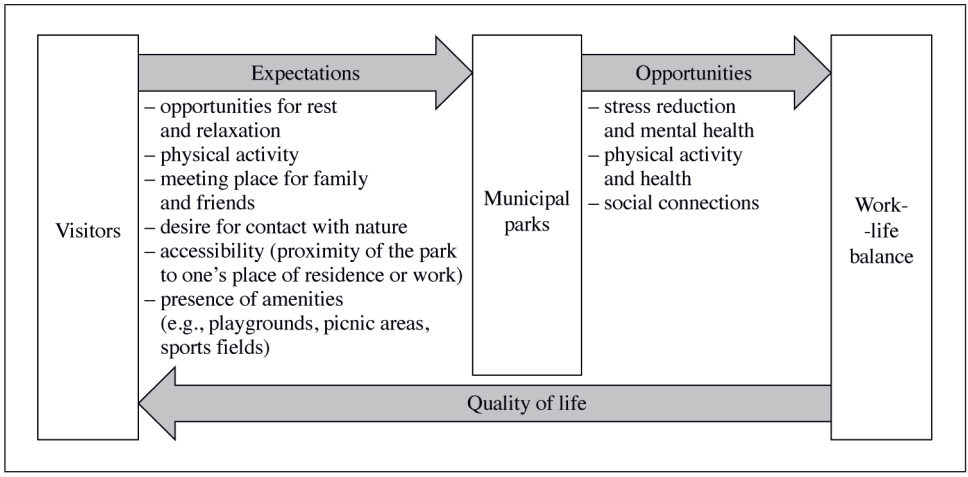

Fig. 1. Relationship between Work-life Balance and Municipal Parks and Visitor Expectations
Source: the authors.

3. Materials and Methods

We conducted an empirical pilot study to achieve the study objective and test the research hypothesis. We gathered primary data through a survey. Non-random sampling was used. The respondents were recruited online using the snowball technique. The sampling technique used does not guarantee that the sample is representative of the population from which it was drawn. In order to mitigate this risk, five urban parks from the Lubelskie voivodeship, different in terms of their functions, were selected, three located in the administrative area of the city of Lublin (Saski Garden – located in the strict centre of the city, in close proximity to the academic town; Park Ludowy – located in the centre of the city, in close proximity to the Lublin Fair and the Arena Lublin and Aqua Lublin sports facilities; and Zawilcowa Park – located in an outlying district of the city of Lublin), two located in the area of urban-rural municipalities: Opole Lubelskie and Poniatowa. In the administrative areas of the parks, using observation techniques, and face-to-face interviews, people who were in the urban parks were segmented, taking into account the variables: age (young people under 25 and adults over 25), and how they spent their time (active/passive and alone/companion). From these six categories of people, "seeds" were recruited ($n = 40$), i.e., people who not only participated in the survey, but also recommended other people from their network who also meet the research criteria.

The survey sample was limited only to people who use the offerings of city parks, a practice often used in the literature (Brkljačić, Majetić & Tarabić, 2017; Hanif, Shirazi & Majid, 2020), due to the fact that these are the groups who, through the direct benefits they derive from being in city parks, are most familiar with their offerings, are aware of the relevance of those offerings to their own needs, and are best able to indicate their expectations regarding them. The survey was conducted remotely using Google Forms. The filtering questions used in the questionnaire, as well as the distribution of the questionnaire via a link, allowed the survey to reach the segments of respondents identified during direct observation. The use of this tool was negatively reflected in the low level of returns, especially from respondents of retirement age, who often make limited use of the Internet. A low level of returns was also obtained in the male category. The next round of surveys is worth conducting face-to-face surveys (PAPI). Participation in the survey was voluntary. The survey was conducted in the second half of 2022 among residents of the Lubelskie voivodeship. A total of 154 respondents took part in the survey. The small sample size is due to the fact that the survey was discontinued on 30 September. This is because it was considered that the change of season, and the end of the vacation and vacation season, could change the respondents' expectations. Respondents were between the ages of 18 and 75 (average age: 32.27). Women (121) made up the majority (78.6%), while men (33) accounted for only 21.4%. The underestimation of the male category in the survey is an important limitation. Therefore, it is significant for the next edition of the survey to include the gender category when defining research categories. Those who were most likely to be alone in the parks accounted for 57%, and those who spent time actively – 36%. This study had a much broader scope than that presented in this paper. This article covers an independent variable – the frequency of visits to municipal parks, and a dependent variable – the reasons for park visits, serving as an indicator of consumer expectations regarding the functions of this type of green space:

– looking for some rest in a quiet place – $X1$,
– looking for some rest and shelter from the sun – $X2$,
– looking for some rest surrounded by nature – $X3$,
– looking for a place to spend my free time – $X4$,
– looking for a pet (dog, cat) walking area – $X5$,
– looking for a place to admire beautiful nature – $X6$,
– looking for a place with a friendly microclimate – $X7$,
– looking for a place where I feel safe – $X8$,
– looking for a place that is good for my health – $X9$,
– looking for a place to meet family/friends – $X10$,
– looking for pleasant sounds of nature (e.g., water, leaves, bird song) – $X11$,

– looking for a playground for my child/grandchild/charge – *X*12,
– looking for a place to meet new people – *X*13,
– looking for a location to throw a party for my family and friends (e.g., birthday party) – *X*14,
– looking for a prominent venue bringing prestige to visitors – *X*15,
– looking for a place for active leisure (running, walking, cycling/roller-skating, gymnastics) – *X*16,
– looking for a place to read a book/magazine – *X*17,
– looking for beautiful landscapes – *X*18,
– looking for a sunny place – *X*19,
– looking for a peaceful place where I could contemplate or meditate – *X*20,
– visiting because of its comfortable location (e.g., close to one's place of residence, easy access, car park) – *X*21,
– visiting because it is a convenient route to my work/school/shop/university – *X*22.

All motives were positively coloured, but were related to different types of needs: health needs, aesthetic needs, social needs, recreational needs, safety needs.

The gathered primary data were subjected to quantitative analysis, that is, the mean score test, Mann-Whitney *U* test and exploratory factor analysis. The non-parametric Mann-Whitney *U* test was used to compare two independent groups. It applies when a dependent variable is assessed, at least on an ordinal scale, but the analysed data do not meet the assumptions for parametric tests. The Mann-Whitney *U* test ranked the scores for the dependent variable (from lowest to highest) in the groups under review. The test statistic for the null hypothesis assuming no differences between groups is the comparison of the mean ranks for each of the two variables (groups) (Kowal, 1998, pp. 81–82; Milenovic, 2011, pp. 73–79) and establishing whether the difference is statistically significant at the assumed level of significance $p \leq 0.05$ (Cypryańska & Bedyńska, 2007, pp. 184–207). Statistical analysis of the gathered primary data was performed using IBM SPSS Statistics Ver. 9.0.

We applied exploratory factor analysis in reducing observable variables by converting a mutually correlated set of observable variables into a new set of variables that are not mutually correlated but comparable with the observable variables set. It is assumed that the identified factors reach a "deeper" level of the reality under review and are reasons underlying the observable changes. Therefore, an advantage of factor analysis is the possibility of discovering the optimum number of hidden variables, which explain the relationships between observable variables (Kowalska-Musiał & Ziółkowska, 2013). We used this analysis to reduce the set of variables affecting the research category "reasons for visiting municipal parks" and detect

internal correlations in the relationships between such variables. The factors were differentiated using the principal component analysis. We used the Kaiser criterion to determine the number of shared factors (so-called principal components). The Kaiser rule is to drop all components with eigenvalues under 1. Each component explains a certain level of the common variance of the analysed phenomenon, defined by the percentage of variance, which can be interpreted as a measure to explain it. The factors were rotated using Varimax. For individual factors we identified variables with the largest factor loadings in relation to the specific coefficient, that is, variables with the value of at least 0.7, which is the generally acceptable limit according to the reference literature (Bedyńska & Cypryańska, 2007, pp. 134–161).

4. Results

Based on a cognitive and critical review of the reference literature as well as the outcomes of unstructured interviews conducted during the survey questionnaire preparation process, we found 22 reasons for visiting municipal parks (Table 1).

Table 1. Reasons for Visiting Municipal Parks

Variables	Responses (%)					Mean	Standard Deviation	Coefficient of Variation	Rank
	1	2	3	4	5				
*X*1	5.8	10.4	14.9	27.9	40.9	3.88	1.222	31.49485	2
*X*2	8.4	11	20.1	29.9	30.5	3.63	1.257	34.6281	5
*X*3	5.8	3.2	13.6	29.9	47.4	4.1	1.125	27.43902	1
*X*4	3.9	7.1	25.3	26.6	37	3.86	1.117	28.93782	3
*X*5	50	9.7	10.4	6.5	23.4	2.44	1.672	68.52459	17
*X*6	7.0	10.0	29.0	21.0	34.0	3.65	1.229	33.67123	4
*X*7	9.1	14.3	23.4	26.6	26.6	3.47	1.274	36.7147	9
*X*8	16.9	17.5	22.7	24.7	18.2	3.1	1.352	43.6129	12
*X*9	14.3	9.1	24	22.1	30.5	3.45	1.382	40.05797	10
*X*10	11	12.3	17.5	28.6	30.5	3.55	1.334	37.57746	7
*X*11	7.8	11	26	26	29.2	3.58	1.236	34.52514	6
*X*12	56.5	7.1	8.4	14.3	13.6	2.21	1.555	70.36199	19
*X*13	58.4	22.7	9.7	3.9	5.2	1.75	1.118	63.88571	21
*X*14	66.9	16.9	9.1	4.5	2.6	1.59	1.007	63.33333	22
*X*15	63.6	12.3	10.4	9.1	4.5	1.79	1.215	67.87709	20
*X*16	26	16.2	21.4	18.2	18.2	2.86	1.451	50.73427	14
*X*17	39	18.8	16.2	18.2	7.8	2.37	1.362	57.46835	18

Table 1 cnt'd

Variables	Responses (%)					Mean	Standard Deviation	Coefficient of Variation	Rank
	1	2	3	4	5				
*X*18	7.1	14.3	29.2	21.4	27.9	3.49	1.238	35.47278	8
*X*19	26.6	27.3	17.5	16.9	11.7	2.6	1.35	51.92308	15
*X*20	22.1	16.9	22.1	20.8	18.2	2.96	1.414	47.77027	13
*X*21	9.7	14.9	29.2	23.4	22.7	3.34	1.254	37.54491	11
*X*22	37	14.3	17.5	16.9	14.3	2.57	1.481	57.62646	16

Source: the authors.

These reasons represent consumer expectations for parks, while also identifying their expected principal functions. Respondents were asked to indicate their level of individual motivation using a five-point Likert scale, where 1 means "strongly disagree," 2 – "disagree," 3 – "neutral," 4 – "agree," and 5 – "strongly agree."

The findings indicate that the arithmetic mean for the 22 analysed reasons why people go to municipal parks ranges from 1.59 to 4.1. The strongest drivers of park visits were looking for some rest surrounded by nature, looking for rest in a quiet place, looking for a place to spend their free time, looking for a place to admire beautiful nature, looking for some rest and shelter from the sun, looking for the sounds of nature, and looking for a place to meet family/friends. The mean values for these seven variables were above 3.5, whereas "looking for some rest surrounded by nature" scored the highest – 4.1. For the reasons listed above, more than 55% of the respondents answered "agree" or "strongly agree." The findings show that the most essential motivations for visiting a park are recreation, contemplation of nature, and the preservation of social relationships. Similar results were also found in earlier studies (e.g., Liu *et al*., 2017; Taylor *et al*., 2020; Hui & Jim, 2022; Gong *et al*., 2023).

The second group of drivers of municipal parks visits includes reasons with an arithmetic mean ranging from 3.0 to 3.5. This category covers variables such as looking for beautiful landscapes, places with a healthy microclimate, health--promoting places, comfortable locations, and safe places. These reasons were a very important or important motivation for 40–55% of the respondents. This implies that respondents expect municipal parks to be not just visually appealing but also safe for human health and conveniently located.

The third group of reasons encouraging respondents to spend their time in a park included looking for a place to meditate, looking for a place for active leisure, looking for a sunny place, a convenient location on the way to work/shop/university, looking for a place to walk a pet, looking for a place to read a book, and looking for a playground. The arithmetic mean for these drivers ranges from 2.0 to 3.0,

and 25–40% of the respondents find them important or very important. A characteristic shared by these drivers is their relationship to seeking a good place to pursue one's hobby (except for two: convenient location and spending time with one's kids/charges).

The weakest drivers of park visits are the need to socialise and the desire for prestige: looking for a prominent venue, looking for a place to meet new people, and looking for a location to throw a party. The arithmetic mean for these drivers is below 2.0. Less than one-sixth of the respondents found them important.

To compare the distribution of the results for individual variables, we calculated the coefficient of variation. For 12 variables, it falls within the range from 20% to 40%, suggesting a moderate variation in their value, while for six variables the coefficient of variation ranges from 40% to 60%, which points to a strong variation – a significant distribution of the variable. Thus, the arithmetic mean was an acceptable measure for this set of variables. For the remaining five variables, the coefficient of variation exceeded 60%, indicating a very strong variation in the value of individual variables; this group varied relative to the extent of these features.

Next, we attempted to determine whether there were variations in respondents' expectations regarding the parks' functions based on how frequently they visited them and whether such differences were statistically significant. To this end, we assigned the respondents to two categories (Table 2). The first group consisted of people who rarely went to parks, that is, once a month or less frequently (49.4%), and the second group comprised frequent visitors, that is, people who went there more than once a month.

Table 2. Frequency of Visits to Municipal Parks

Frequency Categories	Frequency	Responses (%)	
Rarely	max. once a year	12.3	49.4
	several times a year	31.8	
	approx. once a month	5.2	
Often	2–3 times a month	20.1	50.6
	once a week	14.9	
	several times a week	12.3	
	every day	3.2	

Source: the authors.

Afterwards, we ran a non-parametric Mann-Whitney *U* test, which revealed that at the level of significance $p \leq 0.05$, the variable "reasons for visiting municipal parks" shows a statistically significant variation in respondents' expect-

ations regarding six of the 22 listed functions of the park (Table 3). As a result, the research hypothesis's claim was valid for only six types of expectations. Visibly more likely to go to the park are people who walk their pets (*X*5), people who actively engage in sports (*X*16), people who seek sunny places (*X*19), people who seek places that allow them to quiet down and collect their thoughts, and people (*X*20) for whom parks are conveniently located (*X*21, *X*22). Therefore, the frequency of visits to municipal parks is not a characteristic that determines the variation in most respondents' expectations regarding the functions under consideration.

Table 3. Analysis of the Significance of Variations between the Respondents' Answers Given the Frequency of Visits to Municipal Parks

Variables	How Often Do You Visit the Park	Mean Rank	Total Ranks	Mann-Whitney *U* Test	Asymptomatic Significance (Bilateral)
*X*1	R	79.55	6,046	2,808	0.553
	O	75.5	5,889		
*X*2	R	73.45	5,582.5	2,656.5	0.25
	O	81.44	6,352.5		
*X*3	R	74.66	5,674.5	2,748.5	0.402
	O	80.26	6,260.5		
*X*4	R	74.22	5,640.5	2,714.5	0.346
	O	80.7	6,294.5		
*X*5	R	69.88	5,310.5	2,384.5	0.024
	O	84.93	6,624.5		
*X*6	R	72.59	5,517	2,591	0.162
	O	82.28	6,418		
*X*7	R	74.59	5,668.5	2,742.5	0.41
	O	80.34	6,266.5		
*X*8	R	72.06	5,476.5	2,550.5	0.127
	O	82.8	6,458.5		
*X*9	R	71.57	5,439.5	2,513.5	0.094
	O	83.28	6,495.5		
*X*10	R	74.51	5,662.5	2,736.5	0.396
	O	80.42	6,272.5		
*X*11	R	78.79	5,988	2,866	0.715
	O	76.24	5,947		

Table 3 cnt'd

Variables	How Often Do You Visit the Park	Mean Rank	Total Ranks	Mann-Whitney *U* Test	Asymptomatic Significance (Bilateral)
*X*12	R	77.07	5,857.5	2,931.5	0.896
	O	77.92	6,077.5		
*X*13	R	73.13	5,557.5	2,631.5	0.176
	O	81.76	6,377.5		
*X*14	R	75.07	5,705	2,779	0.423
	O	79.87	6,230		
*X*15	R	71.85	5,460.5	2,534.5	0.071
	O	83.01	6,474.5		
*X*16	R	68.95	5,240	2,314	0.016
	O	85.83	6,695		
*X*17	R	74.25	5,643	2,717	0.353
	O	80.67	6,292		
*X*18	R	73.47	5,584	2,658	0.254
	O	81.42	6,351		
*X*19	R	68.78	5,227.5	2,301.5	0.014
	O	85.99	6,707.5		
*X*20	R	69.8	5,305	2,379	0.031
	O	85	6,630		
*X*21	R	67.2	5,107	2,181	0.004
	O	87.54	6,828		
*X*22	R	70.28	5,341.5	2,415.5	0.04
	O	84.53	6,593.5		

Notes: R – rarely visiting; O – often visiting.

Source: the authors.

Analysis of mean values does not allow for identifying hidden relationships between variables. To determine the optimum number of hidden variables explaining the correlations between observable variables such as "reasons for visiting municipal parks" and compare the reasons for people who often and rarely visit municipal park, we conducted an exploratory factor analysis for all the respondents, and for each of the two groups identified based on the variable frequency of visits to municipal parks. Having standardised the data, we used the Cronbach's alpha to measure the reliability of the research tool. The catalogue of expectations for municipal parks contained 22 observable variables for which the Cronbach's alpha was 0.889,

that is, exceeded 0.8. It proves that the scale is highly reliable and thus features high internal consistency (Bedyńska & Cypryańska, 2007, pp. 134–161). Next, based on the Kaiser rule, we identified five factors for all the respondents, six factors for people who rarely visit municipal parks, and seven factors for frequent visitors with the eigenvalues of variables above 1. In each case, these factors explain 60% of the common variance of the phenomenon under review (Table 4).

Table 4. Hierarchy of Factors According to Their Eigenvalues Determined Using the Kaiser Rule (for All the Respondents and for People Rarely and Often Visiting Municipal Parks)

Factor	Eigenvalue			Cumulative Eigenvalue			% of All Eigenvalues (Variance)			Cumulative % of Eigenvalues		
	T	R	O	T	R	O	T	R	O	T	R	O
1	7.027	7.641	6.316	7.027	7.641	6.316	17.985	18.845	16.790	17.985	18.845	16.790
2	2.412	2.595	2.442	9.439	10.236	8.758	15.064	14.834	14.610	33.049	33.680	31.400
3	1.371	1.534	1.786	10.81	11.77	10.544	13.349	12.942	10.581	46.398	46.622	41.981
4	1.343	1.300	1.455	12.153	13.07	11.999	7.883	8.783	7.984	54.282	55.405	49.965
5	1.100	1.230	1.269	13.253	14.3	13.268	5.965	7.740	7.509	60.247	63.145	57.474
6	–	1.080	1.214	–	15.38	14.482	–	6.768	7.129	–	69.913	64.603
7	–	–	1.074	–	–	15.556	–	–	6.107	–	–	70.710

Notes: T – total (all respondents); R – rarely visiting; O – often visiting. "Total" – sampling adequacy measured using the Kaiser-Meyer-Olkin (*KMO*) test is 0.852, that is, more than 0.7. The Bartlett's test of sphericity is significant (the variables are significantly statistically correlated); chi^2 = 1,450.138; and $p < 0.001$; "Rarely visiting" – *KMO* = 0.814; the Bartlett's sphericity test is significant; chi^2 = = 879.162; and $p < 0.001$; "Often visiting" – *KMO* = 0.756; the Bartlett's sphericity test is significant; chi^2 = 749.191; and $p < 0.001$.

Source: the authors.

Analysing the internal structure of individual factors (Table 5), we observed explicit differences between people who visited municipal parks rarely and often, and between each of the two categories and all the respondents. The first principal component for all the respondents consists of five variables, for those who rarely visit parks – one variable, and for those who visit them often – four variables. In addition, for respondents who often visit parks, the variables are identical with those for all the respondents. As regards the first factor for people who rarely go to the park, its variable is a component of the second factor for people who often visit parks, but is not a component of any factor for all the respondents. Thus, the structure of the first factor for all the respondents and for those who often visit parks is very similar. The second factor for all the respondents comprises one variable, three for those who rarely visit parks, and two for people who often go to the park.

Table 5. Results of the Factor Analysis of Reasons for Visiting Parks (for All the Respondents and for Those Who Visit Parks Rarely and Often)

Variables	Factors																				
	1			2			3			4			5			6			7		
	T	R	O	T	R	O	T	R	O	T	R	O	T	R	O	T	R	O	T	R	O
*X*7	0.763	0.43	0.748	0.324	0.162	0.35	0.099	0.695	–0.08	0.085	0.075	0.062	0.05	0.176	0.13	–	0.22	0.178	–	–	0.15
*X*8	0.761	0.532	0.838	0.197	0.32	0.163	0.164	0.247	–0.009	0.145	0.198	0.12	–0.126	0.3	0.089	–	0.22	0.053	–	–	–0.163
*X*9	0.729	0.698	0.806	0.323	0.19	0.123	0.071	0.307	0.147	0.182	0.131	–0.057	0.025	0.322	–0.016	–	0.09	0.096	–	–	–0.013
*X*11	0.727	0.447	0.676	0.175	–0.077	0.119	0.054	0.482	0.316	0.099	0.295	0.138	0.06	–0.047	0.104	–	0.414	0.055	–	–	0.035
*X*6	0.705	0.378	0.701	0.351	0.242	0.361	0.162	0.712	0.206	–0.007	0.054	–0.003	0.195	0.08	0.037	–	0.137	–0.0103	–	–	0.188
*X*18	0.504	0.188	0.388	0.32	0.139	0.245	0.181	0.762	0.67	0.257	0.228	0.034	0.03	0.14	–0.059	–	0.057	0.031	–	–	–0.279
*X*12	0.463	0.021	0.255	–0.22	0.11	–0.006	0.318	0.154	–0.055	–0.251	–0.074	0.801	–0.439	–0.028	–0.054	–	0.878	–0.076	–	–	–0.186
*X*3	0.431	0.595	0.396	0.736	–0.088	0.792	0.028	0.485	0.063	–0.031	–0.052	0.052	–0.145	0.287	0.188	–	0.051	–0.047	–	–	–0.106
*X*1	0.339	0.827	0.189	0.691	–0.107	0.813	–0.017	0.164	0.167	–0.044	0.069	0.171	0.032	0.056	–0.14	–	0.013	–0.04	–	–	–0.037
*X*4	0.234	0.388	0.277	0.674	0.029	0.684	0.181	0.152	0.11	–0.057	–0.204	0.081	–0.415	0.735	0.301	–	0.181	–0.046	–	–	–0.08
*X*20	0.277	0.654	0.218	0.615	0.073	0.399	0.104	0.362	0.321	0.224	0.098	–0.19	0.14	0.062	0.343	–	–0.118	0.24	–	–	–0.154
*X*2	0.268	0.603	0.2	0.565	0.221	0.657	0.054	0.106	–0.004	0.112	0.076	–0.218	0.095	0.162	–0.099	–	0.116	0.127	–	–	0.152
*X*17	0.011	0.611	–0.129	0.515	0.401	0.405	0.43	0.11	0.314	0.006	0.053	0.03	0.26	–0.368	0.629	–	–0.097	–0.03	–	–	0.153
*X*14	0.056	–0.067	–0.08	–0.049	0.878	0.041	0.859	0.097	0.236	0.03	0.118	0.694	0.044	0.092	0.304	–	0.049	0.159	–	–	0.261
*X*15	0.157	0.179	0.077	0.012	0.877	–0.112	0.763	0.096	0.54	0.131	0.057	0.352	0.23	–0.021	0.157	–	0.058	0.254	–	–	0.317
*X*13	0.06	0.143	–0.158	0.225	0.758	0.324	0.726	0.067	0.6	0.158	0.329	0.344	0.086	0.111	0.101	–	0.172	0.048	–	–	0.1
*X*16	0.27	0.167	0.301	0.094	0.516	–0.093	0.471	0.23	0.056	0.137	0.001	0.196	–0.125	0.211	0.781	–	–0.165	0.062	–	–	–0.102
*X*10	0.065	0.072	0.039	0.36	0.245	0.439	0.435	0.104	0.297	0.266	0.257	0.421	–0.192	0.719	0.128	–	–0.109	0.272	–	–	0.115
*X*22	0.1	–0.012	0.06	–0.096	0.127	–0.05	0.142	0.152	0.263	0.813	0.853	0.06	0.223	–0.087	–0.252	–	–0.197	0.806	–	–	0.161
*X*21	0.191	0.22	0.132	0.126	0.144	0.086	0.189	0.117	–0.104	0.7	0.66	0.033	–0.214	0.176	0.306	–	0.194	0.777	–	–	–0.107
*X*19	0.281	0.563	0.302	0.328	0.318	0.067	0.327	0.048	0.762	0.426	0.548	–0.076	0.211	0.014	0.16	–	–0.113	0.002	–	–	0.047
*X*5	0.179	0.057	0.063	0.012	0.437	0.008	0.279	0.548	0.025	0.01	0.043	0.008	0.716	–0.193	–0.042	–	–0.4	0.019	–	–	0.902

Notes: T – total (all respondents); R – rarely visiting; O – often visiting. Underlined numbers indicate the highest factor loadings (≥ 0.7), which served as the basis for the interpretation of the extracted factors.

Source: the authors.

Each category of respondents shows great variations between the component variables (only one variable forms a part of the second factor for all the respondents and for people who often go to the park). The third factor for all the respondents comprises three variables, two variables for those who rarely visit parks, and one variable for people who often go to the park. The third factor in each of the analysed categories of respondents consists of a different group of component variables; however, the variables forming this factor for all the respondents are identical with the variables forming the second factor for respondents who rarely visit parks. The fourth factor for all the respondents comprises two variables, and for respondents who visit parks rarely and often – one variable. One of the variables forming the fourth factor for all the respondents is a component of the fourth factor for people who rarely visit parks and of the sixth factor for those who often go to the park. The fifth factor consists of one variable for all the respondents and for those who often go to the park and of two variables for respondents who rarely visit parks. For each of the analysed category of respondents, this factor comprises another group of variables. The sixth factor was diagnosed only for two categories of respondents according to variable "frequency of staying in the parks" – for those who rarely visit parks it comprises one variable, and two variables for those who visit them often. The component variables differ between both groups of respondents. The seventh factor was identified only for the category of respondents who often visit parks, and its component variable is identical with the component variable of the fifth factor for all the respondents. The results of analyses imply a variation in the number of principal components identified for individual groups of respondents and within their internal structure.

In discovering the reasons for visiting municipal parks, the factor analysis result is the key since it makes it possible to identify individual factors with the segments of consumers of the municipal park offer (Table 6). After analysing the respondents' reasons for visiting municipal parks, we have identified five consumer segments among all the respondents, six segments among those who rarely visit municipal parks, and seven segments among those who visit parks often.

The first factor, explaining 18% of the common variance of the phenomenon under review, covers four variables associated with the need for physical and psychological safety: a place to feel safe, with a safe microclimate, safe to health, and with friendly sounds of nature. The second factor explains 15% of the common variance of the phenomenon. It covers two variables determining the need for leisure in a natural environment: rest surrounded by nature, and rest in a quiet place. The third factor comprises three variables associated with the need for socialising: a venue for team-building events, a prominent place, and a place to meet new people. This factor explains 13% of the common variance of the phenomenon. The fourth factor, explaining 9% of the common variance of the phenomenon, comprises one variable associated with the attractive location of municipal parks.

Table 6. Segments of Respondents Identified Based on Reasons for Which They Use the Offer of Municipal Parks (for All the Respondents and for Those Who Stay in the Parks Rarely and Often)

Segment	Description of the Segment		
	All respondents	Rarely visiting	Often visiting
1	– Looking for a place with a friendly microclimate – Looking for a place where I feel safe – Looking for a place that is good for my health – Looking for pleasant sounds of nature (e.g., water, leaves, bird song) – Looking for a place to admire beautiful nature	– Looking for some rest in a quiet place	– Looking for a place with a friendly microclimate – Looking for a place where I feel safe – Looking for a place that is good for my health – Looking for a place to admire beautiful nature
2	– Looking for some rest surrounded by nature	– Looking for a location to throw a party for my family and friends (e.g., birthday party) – Looking for a prominent venue bringing prestige to visitors – Looking for a place to meet new people	– Looking for some rest in a quiet place – Looking for some rest surrounded by nature
3	– Looking for a location to throw a party for my family and friends (e.g., birthday party) – Looking for a prominent venue bringing prestige to visitors – Looking for a place to meet new people	– Looking for beautiful landscapes – Looking for a place to admire beautiful nature	– Looking for a sunny place
4	– Visiting because it is a convenient route to my work/school/shop/university – Visiting because of its comfortable location (e.g., close to one's place of residence, easy access, car park)	– Visiting because it is a convenient route to my work/school/shop/university	– Looking for a playground for my child/grandchild/charge

Table 6 cnt'd

Segment	Description of the Segment		
	All respondents	Rarely visiting	Often visiting
5	– Looking for a pet (dog, cat) walking area	– Looking for a place to spend my free time – Looking for a place to meet family/friends	– Looking for a place for active leisure (running, walking, cycling/roller-skating, gymnastics)
6	–	– Looking for a playground for my child/grandchild/charge	– Visiting because it is a convenient route to my work/school/shop/university – Visiting because of its comfortable location (e.g., close to one's place of residence, easy access, car park)
7	–	–	– Looking for a pet (dog, cat) walking area

Source: the authors.

To match factors with consumer segments, the result of the factor analysis is crucial for determining the product's features considered in making decisions. Consumers in each segment had similar motivations for staying in the park, suggesting expected municipal park functions that differed from other categories.

Among all the respondents, the first segment consists of people who in the offer of parks seek qualities such as safety for physical and mental health and contemplation of the beauty of nature. The second segment comprises respondents who see parks as places to rest surrounded by nature. The third segment represents those for whom parks are mostly prominent venues for social integration, the fourth segment – respondents who highlight the attractive location of parks, and the fifth segment – people who choose parks as places to walk their pets.

Among respondents who rarely use the offer of parks, the first segment consists of people looking for some rest in a quiet place, the second – looking for prominent venues for socialising, the third – looking for a place to contemplate the beauty of nature, the fourth – highlighting the attractive location of parks, the fifth – looking for a place to meet family and friends in their spare time, and the sixth segment comprises people going to the park with a child, grandchild or a person under their care.

The category of people who often use the offer of municipal parks includes seven segments. The first segment looks for physical and psychological safety and a place to contemplate the nature, the second segment looks for some rest in a quiet place surrounded by nature, the third segment looks for sunny spots in parks, the fourth

segment looks for playgrounds for children under their care, the fifth segment seeks places for active leisure, the sixth segment highlights the attractive location of parks, and the seventh segment visits municipal parks with their pets.

By distinguishing different segments of respondents, we can tailor the offer of city parks to them, ensuring physical and psychological safety throughout their territory, and separating zones for quiet rest, where consumers will be able to safely relax in the bosom of nature and contemplate it; zones dedicated to social integration, where visitors will be provided with infrastructure for meeting with family and friends; a play zone for children, where they can spend time actively; a zone of active recreation for adults, i.e., places where visitors will be able to engage in physical activity; and a pet-friendly zone, allowing pets to be safely taken outside. It is also important to keep in mind the development of infrastructure to improve the accessibility of city parks.

The limitations of the survey results are mainly due to the low sample size and also the underestimation of the male category, which was caused by the method and technique used to collect data, i.e., the online survey method and the snowball technique. Despite attempts to eliminate the limitations of this technique by isolating segments of respondents and recruiting seeds from them, it was not possible to fully eliminate its limitations. When planning future surveys, therefore, online surveys should be replaced by PAPI surveys.

5. Conclusions

The work-life balance concept emphasises the adverse effects of overworking on workers' health and job performance (including stress generation). Visiting a municipal park is a leisure activity that can help individuals enhance their physical and psychological well-being. Parks serve a variety of purposes, including stress relaxation, physical activity, social relationships, environmental improvement, and the formation of a favourable microclimate for visitors, which consequently contributes to an increased quality of life. Therefore, the objective of this paper, which is to identify and analyse social expectations about the functions of municipal parks in the context of work-life balance depending on the frequency of visiting parks, is essential. The research was conducted on the example of the Lubelskie voivodeship.

Our analyses demonstrated that the consumers of municipal parks' offerings in the Lubelskie voivodeship had varying expectations regarding the functions the parks should provide. The foremost expectations involved parks' leisure function, which is the ability to relax in a natural environment, experience tranquillity and seek shelter from the sun, admire the beauty and sounds of nature, and leisure activities, including meeting family and friends. This is in line with the results of other studies, which emphasise that the most important functions of parks are recreation and contemplation of nature, as well as social and cultural functions (Liu *et al.*,

2017; Taylor *et al*., 2020; Hui & Jim, 2022; Gong *et al*., 2023). It also seems that this dissimilarity of expectations with regard to the functions of parks is not a contradiction in terms, since the same infrastructural elements of urban parks can serve different purposes. Therefore, city authorities, when creating urban park offerings, should pay special attention to aligning local park management policies with the expectations of park users, creating infrastructure that will be used for a variety of purposes that meet their diverse needs. A review of the literature indicates that studies on expectations of urban parks look for correlations with socio-demographic characteristics, i.e., gender (Derose *et al*., 2018; Bąkowska-Waldmann & Piniarski, 2023) and age (Brkljačić, Majetić & Tarabić, 2017; Kimic & Polko, 2022). Based on the literature survey, it was noted that there is a lack of analysis on the relationship between expectations of the functions of urban parks and the frequency of their visitation. In order to look at this problem, a Mann-Whitney *U* test was conducted, the result of which shows that the frequency of visits to city parks is not an indicator of respondents' differentiated expectations regarding their functions. This variable differentiates the respondents' expectations about six out of 22 functions of parks in a statistically significant manner and the hypothesis is true only for them. People who walk their pets (*X*5), people who actively play sports (*X*16), people who seek sunny places (*X*19), people who look for places that allow them to calm down and collect their thoughts, and people (*X*20) for whom parks are conveniently located (*X*21, *X*22) go to the park more often. Thus, the frequency of visits to city parks is not a characteristic that determines the variation in respondents' expectations regarding most of the surveyed functions.

The factor analysis result made it possible to identify a varied number of segments for the analysed categories of respondents. Consumers in each segment showed similar motivations for staying in the park, suggesting expected functions of parks that differed from those reported by people from other categories. Analysing the internal structure of individual factors, we observed explicit differences between people who visited municipal parks rarely and often, and between each of the two categories and all the respondents. The identified principal components differ in their internal structure, which may imply that the analysed feature differentiated the reasons for visiting municipal parks. The individual factors were identified with consumer segments of the municipal park offer, within which consumers showed identical or very similar motivations for staying in parks. This allows municipal park management institutions to shape a specialised municipal park offer for selected target segments identified by frequency of stay in parks and to conduct marketing activities more effectively. Knowledge of the expectations of park visitors according to the frequency of their visits can also give urban planners clues as to how parks should be laid out. The division of park space into different zones suited to particular consumer groups, the offer of specific facilities (e.g., playgrounds,

sports equipment) and additional services (e.g., the possibility of organising events for family and friends) are important.

Future research directions could include conducting a study of respondents' perceptions of the role of parks in shaping work-life balance, including, among other things, reducing stress and improving mental health, enhancing physical activity or improving social relations. This would make it possible to determine to what extent, according to the respondents, municipal parks contribute to work-life balance and what could be further improved and supplemented in the municipal park offer in this context.

Authors' Contribution

The authors' individual contribution is as follows: Agnieszka Komor 42%, Anna Goliszek 43%, Agnieszka Kępkowicz 10%, Halina Lipińska 5%.

Conflict of Interest

The authors declare no conflict of interest.

References

Bąkowska-Waldmann, E., & Piniarski, W. (2023). Gender-specific Preferences Regarding Urban Green Areas. *Quaestiones Geographicae*, *42*(4), 23–41. https://doi.org/10.14746/quageo-2023-0037

Bedyńska, S., & Cypryańska, M. (2007). Zaawansowane sposoby tworzenia wskaźników: Zastosowanie analizy czynnikowej oraz analizy rzetelności pozycji. In: S. Bedyńska, M. Cypryańska (Eds), *Statystyczny drogowskaz. Praktyczny poradnik analizy danych w naukach społecznych na przykładach z psychologii* (pp. 134–161). Wydawnictwo Szkoły Wyższej Psychologii Społecznej Academica.

Borowiec, A. A., & Drygas, W. (2023). Work–Life Balance and Mental and Physical Health among Warsaw Specialists, Managers and Entrepreneurs. *International Journal of Environmental Research and Public Health*, *20*(1), 492. https://doi.org/10.3390/ijerph20010492

Brkljačić, T., Majetić, F., & Tarabić, B. N. (2017). Smart Environment: Cyber Parks (Connecting Nature and Technology). In: L. C. Carvalho (Ed.), *Handbook of Research on Entrepreneurial Development and Innovation within Smart Cities* (pp. 150–172). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-5225-1978-2.ch008

Brough, P., Holt, J., Bauld, R., Biggs, A., & Ryan, C. (2008). The Ability of Work–Life Balance Policies to Influence Key Social/Organisational Issues. *Asia Pacific Journal of Human Resources*, *46*(3), 261–274. https://doi.org/10.1177/1038411108095758

Chandran, K. S., & Abukhalifeh, A. N. (2021). Systematic Literature Review of Research on Work-life Balance in Hospitality Industry since Millennium. *Review of Integrative Business and Economics Research*, *10*(1), 14–33. Retrieved from: https://sibresearch.org/uploads/3/4/0/9/34097180/riber_10-1_02_h19-076_14-33.pdf (accessed: 2.04.2024).

Cheng, Y., Zhang, J., Wei, W., & Zhao, B. (2021). Effects of Urban Parks on Residents' Expressed Happiness before and during the COVID-19 Pandemic. *Landscape and Urban Planning*, *212*, 104118. https://doi.org/10.1016/j.landurbplan.2021.104118

Chiang, Y.-C., & Li, D. (2019). Metric or Topological Proximity? The Associations among Proximity to Parks, the Frequency of Residents' Visits to Parks, and Perceived Stress. *Urban Forestry & Urban Greening*, *38*, 205–214. https://doi.org/10.1016/j.ufug.2018.12.011

Chirkowska-Smolak, T. (2008). Równowaga między pracą a życiem osobistym. *Ruch Prawniczy, Ekonomiczny i Socjologiczny*, *70*(1), 235–249. https://hdl.handle.net/10593/5063

Chojecka, A. (2014). Znaczenie terenów zielonych w przestrzeni publicznej oraz ich wpływ na jakość życia miejskiego. *Rynek – Społeczeństwo – Kultura*, 1(9), 48–54. Retrieved from: https://bazhum.muzhp.pl/media/files/Rynek_Spoleczenstwo_Kultura/Rynek_Spoleczenstwo_Kultura-r2014-t-n1_(9)/Rynek_Spoleczenstwo_Kultura-r2014-t-n1_(9)-s48-54/Rynek_Spoleczenstwo_Kultura-r2014-t-n1_(9)-s48-54.pdf (accessed: 2.04.2024).

Cypryańska, M., & Bedyńska, S. (2007). Porównanie dwóch grup: Testy t-Studenta i ich nieparametryczne odpowiedniki. In: S. Bedyńska, M. Cypryańska (Eds), *Statystyczny drogowskaz. Praktyczny poradnik analizy danych w naukach społecznych na przykładach z psychologii* (pp. 184–207) Wydawnictwo Szkoły Wyższej Psychologii Społecznej Academica.

Derose, K. P., Han, B., Williamson, S., & Cohen, D. A. (2018). Gender Disparities in Park Use and Physical Activity among Residents of High-poverty Neighborhoods in Los Angeles. *Women's Health Issues*, *28*(1), 6–13. https://doi.org/10.1016/j.whi.2017.11.003

El-Murr, K., Robillard, A., Waygood, O., & Boisjoly, G. (2021). Walking Accessibility to Parks: Considering Number of Parks, Surface Area and Type of Activities. *Findings*, October. https://doi.org/10.32866/001c.27479

Gao, W., Lyu, Q., Fan, X., Yang, X., Liu, J., & Zhang, X. (2017). Building-based Analysis of the Spatial Provision of Urban Parks in Shenzhen, China. *International Journal of Environmental Research and Public Health*, *14*(12), 1521. https://doi.org/10.3390/ijerph14121521

Geng, D., Innes, J., Wu, W., & Wang, G. (2021). Impacts of COVID-19 Pandemic on Urban Park Visitation: A Global Analysis. *Journal of Forestry Research*, *32*, 553–567. https://doi.org/10.1007/s11676-020-01249-w

Gong, Y., Mamat, Z., Shi, L., & Liu, F. (2023). Restorative Effects of Park Visiting on Physiology, Psychology, and Society and the Factors Influencing Park Visiting. *Sustainability*, *15*(1), 841. https://doi.org/10.3390/su15010841

Hanif, A., Shirazi, S. A., & Majid, A. (2020). Role of Community for Improvement of Ecosystem Services in Urban Parks. *Pakistan Journal of Agricultural Sciences*, *57*(6), 1591–1596. https://doi.org/10.21162/PAKJAS/20.352

Hill, E. J., Hawkins, A. J., Ferris, M., & Weitzman, M. (2001). Finding an Extra Day a Week: The Positive Influence of Perceived Job Flexibility on Work and Family Life Balance. *Family Relations*, *50*(1), 49–58. https://doi.org/10.1111/j.1741-3729.2001.00049.x

Hui, L.-C., & Jim, C.-Y. (2022). Unraveling Visiting-activity Patterns of Heterogeneous Communities for Urban-park Planning and Design. *Forests*, *13*(6), 841. https://doi.org/10.3390/f13060841

Jang, E., Choi, H. B., & Kim, M. (2024). The Restorative Effects of Urban Parks on Stress Control Ability and Community Attachment. *Sustainability*, *16*(5), 2113. https://doi.org/10.3390/su16052113

Jang, S. J., Park, R., & Zippay, A. (2011). The Interaction Effects of Scheduling Control and Work–life Balance Programs on Job Satisfaction and Mental Health. *International Journal of Social Welfare*, *20*(2), 135–143. https://doi.org/10.1111/j.1468-2397.2010.00739.x

Khan, O. F., & Fazili, A. I. (2016). Work Life Balance: A Conceptual Review. *Journal of Strategic Human Resource Management*, *5*(2), 20–25. Retrieved from: https://www.proquest.com/openview/a3c409bf44a9fd5911eb1e057e0b89f8/1?pq-origsite=gscholar&cbl=2030931 (accessed: 2.04.2024).

Kimic, K., & Polko, P. (2022). The Use of Urban Parks by Older Adults in the Context of Perceived Security. *International Journal of Environmental Research and Public Health*, *19*(7), 4184. https://doi.org/10.3390/ijerph19074184

Koramaz, E. K., & Türkoğlu, H. (2018). Measuring and Understanding Urban Parks' Contribution to Quality of Life in Istanbul. *Social Indicators Research*, *138*, 335–351. https://doi.org/10.1007/s11205-017-1657-6

Kosmala, M., & Błaszczyk, M. (2012). Społeczny wymiar zieleni i jej wpływ na jakość życia mieszkańców miast. *Przegląd Komunalny*, 8, 51–57.

Kowal, J. (1998). *Metody statystyczne w badaniach sondażowych rynku*. Wydawnictwo Naukowe PWN.

Kowalska-Musiał, M., & Ziółkowska, A. (2013). Analiza czynnikowa w badaniach struktury relacji w marketingu relacyjnym. *Zeszyty Naukowe Wyższej Szkoły Zarządzania i Bankowości w Krakowie*, *27*, 1–15. Retrieved from: https://cejsh.icm.edu.pl/cejsh/element/bwmeta1.element.desklight-75218ec8-1d65-4aad-aecf-a89f680596a1 (accessed: 2.04.2024).

Liu, H., Li, F., Xu, L., & Han, B. (2017). The Impact of Socio-demographic, Environmental, and Individual Factors on Urban Park Visitation in Beijing, China. *Journal of Cleaner Production*, *163*, 181–188. https://doi.org/10.1016/j.jclepro.2015.09.012

Meunier, I. M. J. (2009). Percepções e expectativas de moradores do Grande Recife-pe em relação aos parques urbanos. *Revista da Sociedade Brasileira de Arborização Urbana*, *4*(2), 35–43. https://doi.org/10.5380/REVSBAU.V4I2.66401

Milenovic, Z. M. (2011). Application of Mann-Whitney U Test in Research of Professional Training of Primary School Teachers. *Metodički Obzori*, *6*(1), 73–79. https://doi.org/10.32728/mo.06.1.2011.06

Mittal, B., & Woodside, A. G. (2022). Nurturing Urban Innovation and Knowledge in the ongoing COVID-19 World. *Journal of Innovation & Knowledge*, *7*(3), 100217. https://doi.org/10.1016/j.jik.2022.100217

Omar, M. K., & Zakaria, A. (2015). Conceptualising Work-life Balance; Extension of Work-family Balance. *Advanced Science Letters*, *21*(6), 2155–2158. https://doi.org/10.1166/asl.2015.6240

Resch, M., & Bamberg, E. (2005). Work-Life-Balance – Ein neuer Blick auf die Vereinbarkeit von Berufs- und Privatleben? *Zeitschrift für Arbeits- und Organisationspsychologie A&O*, *49*(4), 171–175. https://doi.org/10.1026/0932-4089.49.4.171

Szulczewska, B. (Ed.). (2020). *O znaczeniu zieleni w miastach*. Instytut Rozwoju Miast i Regionów.

Taylor, L., Leckey, E. H., Lead, P. J., & Hochuli, D. F. (2020). What Visitors Want from Urban Parks: Diversity, Utility, Serendipity. *Frontiers in Environmental Science*, *8*, 595620. https://doi.org/10.3389/fenvs.2020.595620

Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., & Kagawa, T. (2014). The Influence of Urban Green Environments on Stress Relief Measures: A Field Experiment. *Journal of Environmental Psychology*, *38*, 1–9. https://doi.org/10.1016/j.jenvp.2013.12.005

Wang, S. (2023). Urban Park Healing Landscape Based on Spatial Correlation Quantitative Model. *Applied Mathematics and Nonlinear Sciences*, *8*(2), 1913–1922. https://doi.org/10.2478/amns.2023.1.00295

Xie, J., Luo, S., Furuya, K., & Sun, D. (2020). Urban Parks as Green Buffers during the COVID-19 Pandemic. *Sustainability*, *12*(17), 6751. https://doi.org/10.3390/su12176751

Yadav, A., Pandita, D., & Singh, S. (2022). Work-life Integration, Job Contentment, Employee Engagement and Its Impact on Organizational Effectiveness: A Systematic Literature Review. *Industrial and Commercial Training*, *54*(3), 509–527. https://doi.org/10.1108/ICT-12-2021-0083

Zhao, J., Aziz, F. A., & Ujang, N. (2024). Factors Influencing the Usage, Restrictions, Accessibility, and Preference of Urban Neighborhood Parks – a Review of the Empirical Evidence. *Urban Forestry & Urban Greening*, *100*, 128473. https://doi.org/10.1016/j.ufug.2024.128473

Zhao, L. (2020). Study of Factors Influencing Quality of Life through Matches between Demand and Satisfaction of Cultural Services in Urban Parks. *Journal of Urban Planning and Development*, *146*(3), 04020022. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000576

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 129–142
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18710

The Impact of Socio-economic Factors on the Diffusion of Mobile Technologies in Polish Voivodeships

Marcin Salamaga

Krakow University of Economics, Institute of Quantitative Methods in Social Sciences, Department of Statistics, Rakowicka 27, 31-510 Kraków, Poland, e-mail: salamaga@uek.krakow.pl, ORCID: https://orcid.org/0000-0003-0225-6651

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Salamaga, M. (2026). The Impact of Socio-economic Factors on the Diffusion of Mobile Technologies in Polish Voivodeships. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 129–142. https://doi.org/10.15678/krem.18710

ABSTRACT

Objective: The aim of the article is to identify socio-economic factors influencing the diffusion of mobile technologies in Poland.

Research Design & Methods: The phenomenon of diffusion of mobile innovations was modelled using Gompertz functions, which were estimated separately for each voivodeship. The impact of socio-economic factors on the rate of innovation diffusion was modelled using multi-equation models. The Gauss-Newton algorithm was used to estimate the Gompertz function, and multi-equation models were estimated using three stage least square (3SLS).

Findings: The research results included in this study indicate that the highest levels of market saturation occur in voivodeships with large populations. The phase of increasing innovation diffusion usually lasts longer in more urbanised voivodeships. The level of education of society and its digitalisation are potentially important determinants of the dynamics of diffusion of mobile technology innovations. More educated populations generally had inflection points pushed back in time and therefore the waiting time for the peak of the wave of mobile technology diffusion was generally longer there.

Implications/Recommendations: Knowledge of the phase cycle of the innovation diffusion pattern can help in planning the introduction of technologically advanced products to the market

in a coordinated way, so that the peak of the market penetration process occurs at the desired moment from the point of view of the company's strategy. The research approach presented here may be useful for company managers in planning strategies for introducing new products and services.

Contribution: The article presents for the first time the diffusion of mobile technologies in Poland from a spatial perspective (by voivodeships). The identification of socio-economic factors of the diffusion of mobile technologies made using multi-equation models should be considered an original approach in research on the spread of innovations.

Article type: original article.

Keywords: innovation diffusion, mobile technology, Gompertz model, multi-equation model, voivodeships.

JEL Classification: O30, C01, C22.

1. Introduction

The information revolution has led to the emergence of the information society and information economy and has become a catalyst for the development of mobile technologies. Technological progress of the last two decades and the accompanying "information revolution 4.0" have resulted in very deep and dynamic changes in the functioning of economies, industry, work organisation and of entire societies. The impact of the revolution in information and communication technology, the development of artificial intelligence, and the digitalisation of economies have resulted in the emergence of "societies 5.0." This would not be possible without the development of mobile technologies, which are currently among the fastest developing technologies, and their participation in everyday life of modern society is visible in virtually all areas. Mobile technologies can be defined as a set of technologies and solutions that enable communication, access to information, entertainment and many other functions using portable devices such as smartphones, tablets, laptops or smartwatches (Choudrie, Pheeraphuttharangkoon & Davari, 2020; Dhakal & Lim, 2020; Jha & Saha, 2020; Lartey, 2020). The terms refer to both the hardware and software that allow these devices to operate on mobile networks and stay connected to the Internet at all times. It is hard to imagine modern society without access to such technologies since they play a major role in many aspects of people's lives and in the functioning of entire economies – one can point to mobile banking and financial services, remote education, e-commerce, social media as examples of true impact (Mitra, 2019; Hew, Lee & Leong, 2023).

The features of mobile technologies centre on directness and immediacy that permit the use these technologies anywhere and at any time, the ability to quickly connect, geolocation (GPS), data portability and sharing of data and services,

the ability to archive data on various media (including the cloud), the ability to personalise and adapt devices to one's needs in terms of configuration, appearance, etc. (Grantham & Tsekouras, 2005). Smartphones and tablets are a representative example of devices, which embody mobile technologies. They are multifunctional devices and highly popular. Today's smartphones and tablets are an example of extremely advanced technologies and are miniaturised computers with a versatile purpose, for which making phone calls is just one of their many functions (Hew, Lee & Leong, 2023). For this reason, the modelling of mobile innovation diffusion was carried out in this study based on the process of proliferation of such devices. In the subject literature the issue of innovation diffusion in the area of mobile technologies in Poland, which utilises a spatial approach, is rarely discussed, and it is even more difficult to find studies in which the factors influencing the geographical diversity of this phenomenon are analysed. This article attempts to fill the existing research gap in this area. The author of the study aims to build models of diffusion of mobile technologies for individual voivodeships, as well as to indicate statistically significant socio-economic factors that affect these characteristics. The research objectives were achieved using the Gompertz curve and multi-equation models.

2. Literature Review

The issue of innovation diffusion can be analysed from different perspectives, depending on the research objective. Diffusion is thus analysed in terms of consumer behavior and marketing (Hew, Lee & Leong, 2023). A particularly frequent subject of research on mobile innovations is the study of the diffusion of telecommunication technology, mobile telephony (Gündüc, 2019; Honoré, 2019; Morya & Shankar, 2019; Spaho & Kraja, 2019; Sujatha & Sekkizhar, 2019, Toğa & Toğa, 2019; Choudrie, Pheeraphuttharangkoon & Davari, 2020; Jha & Saha, 2020; Lartey, 2020; Kalem *et al*., 2021; Chandrasekaran, Tellis & James, 2022). The technological progress that has taken place in this area is unprecedented in the history of technological thought development. The multifunctionality of constantly improved mobile devices, rapid development of telecommunication infrastructure, increasing affordability, and the appropriate marketing policy of corporations producing and selling such devices that creates specific needs among customers, all cause the emergence of a market suction effect.

However, the proliferation of technological novelties in this area takes place at different rates and in different ways, depending on many socio-economic, demographic, cultural and other factors. In innovation diffusion studies, S-shaped curves are of course used (Rogers, 1995). In order to gain a more in-depth understanding of diffusion processes, some of the characteristics of such models as inflection point and saturation level need to be investigated. In innovation diffusion models, quite popular models are the Bass and logistic models (Gündüc, 2019; Jha & Saha, 2020;

Lartey, 2020). However, many researchers indicate the advantage of the Gompertz model over other models (Liu *et al*., 2014; Spaho & Kraja, 2019; Dhakal & Lim, 2020; Jha & Saha, 2020; Lartey, 2020) and therefore this model will be the basis for the analysis in this research. The dynamics and causes of mobile technology innovation are studied from a global, cross-country perspective (Gündüc, 2019; Morya & Shankar, 2019; Roy, Dutta & Das, 2019; Sujatha & Sekkizhar, 2019; Choudrie, Pheeraphuttharangkoon & Davari, 2020). They examined the dynamics and causes of innovation in mobile technologies from a global, cross-country perspective. Perkins and Neumayer (2005) studied the rate of diffusion of telecommunications technologies using event history analysis. They found that the pace among those who later adopted such technologies was the fastest in the field of mobile digital technology. In developing countries, such technologies spread faster than in developed countries. Choudrie, Pheeraphuttharangkoon and Davari (2020) in modelling the diffusion of innovations successfully applied the structural equation modelling (PLS-SEM) technique. They investigated, among others: the impact of demographic factors and functional features of smartphones on the diffusion of innovations. Marketing analyses check what factors may influence the diffusion of mobile innovations. Researchers argue that the spread of Internet technologies in many countries is mainly influenced by GDP *per capita* and the average age of the population (Kiiski & Pohjola, 2002). Mukhopadhyay, Bagchi and Udo (2024) studied the impact of population income, human development, and urbanisation on the rate of mobile telephony diffusion. There may, of course, be more potential factors that may influence the diffusion of mobile innovations and they may be economic, demographic, social and cultural in nature (Liu *et al*., 2014; Gündüc, 2019; Morya & Shankar, 2019; Choudrie, Pheeraphuttharangkoon & Davari, 2020). This study combined the estimation of the Gompertz S-shaped curve with a cause-and-effect analysis, which checked what factors determined the dynamics of diffusion, the inflection point of the curve and its saturation level in relation to mobile technologies in Poland. Such a study was carried out by voivodeship, which allowed for an analysis of the diffusion of the discussed innovations in spatial terms. Research from this perspective should be considered pioneering on the Polish mobile technology market. It should be assumed that the results obtained will be helpful in understanding the course of the innovation diffusion process, and it will help decision-makers responsible for establishing the marketing strategy of companies providing mobile technologies to build forecasts and make appropriate decisions.

3. Research Methodology

Modelling of mobile innovation diffusion was carried out based on the process of proliferation of smartphones and tablets with Internet access. Two groups of statistical data from the Local Data Bank of the Polish Central Statistical Office (GUS)

from 2022 were used, which may potentially affect the diffusion of mobile technologies, in the cross-section of voivodeships:

– number of companies equipping employees with mobile devices enabling mobile access to the Internet (portable computers, smartphones),

– selected socio-demographic features of the society.

The Gompertz model was used to model the diffusion process of mobile technologies, the effectiveness of which in similar analyses has been confirmed in many papers (Desiraju, Nair & Chintagunta, 2004; Lei & Zhang, 2004; Liu *et al*., 2014; Spaho & Kraja, 2019; Dhakal & Lim, 2020; Jha & Saha, 2020). This model reflects the dynamics of the diffusion of innovative technologies, the course of which corresponds to the shape of the letter S.

The function used in this analysis is as follows:

$$f(t) = A\exp(-\exp(-B(t-C))), \tag{1}$$

where:

A, B, C – parameters of the Gompertz function.

The rate of change in the Gompertz function is given by the formula:

$$GRG = \frac{dy}{dt}\frac{1}{y} = B\exp(-B(t-C)). \tag{2}$$

In the Gompertz function, it is possible to indicate an area where it has a clearly increasing growth rate and a range where it is characterised by a decreasing growth rate, ultimately progressing to the level of saturation expressed by the asymptote $y = A$. The point that separates the rapid growth rate of the curve from the decreasing rate of growth is called the inflection point. It can be shown that its abscissa in the coordinate system has a value corresponding to the value of the parameter C, and the elevation takes the value of Ae^{-1}. The rate of change of the Gompertz function at the inflection point is given by:

$$\frac{dy}{dt}\frac{1}{y}(C) = B. \tag{3}$$

Thus, each of the parameters of the Gompertz function (1) has its own interpretation in the analysis of the process of innovation diffusion. Parameter A expresses the potential size of the market, parameter B expresses the diffusion rate, and parameter C expresses the inflection point. On their basis, it is possible to trace in depth the diffusion of innovations in terms of the pace of this process, the duration of the dynamic growth phase of the process, as well as its level of saturation. Therefore, it is justified to investigate what the elements depend on and what determinants shape them. Since the recipients of devices that are carriers of mobile technologies are primarily populations of state residents, it is justified to look for determinants of diffusion processes among socio-demographic characteristics. It should be expected that the size of the market for electronic devices such as smartphones and tablets

(parameter *A*) may depend on the size of the population in a given country (region), the degree of its urbanisation, the level of wealth of the society, the level of education in the society and the openness of the society to digital technologies. The impact of such variables in similar analyses was examined by authors such as Liu *et al*. (2014), Prince and Simon (2009), Katona, Zubcsek and Sarvary (2011). In addition, it can be expected that the size of the market may also be affected by the length of the period during which the diffusion processes intensify. The duration of this period can be determined based on the inflection point, and given that it takes time for the relevant market period to occur, it is advisable to include a lagging variable in the model to represent the inflection point. Some of these variables may also determine the rate of mobile technology diffusion. This applies, for example, to the urbanisation rate, the level of education of the population and the extent of the society's digital competences. It should also be assumed that the dynamics of diffusion of digital technologies is a result of the level of market saturation with such technologies (market size) and the length of the period of intensive diffusion of innovation (measured by the inflection point). It can be expected that the length of the period of intensive growth of diffusion dynamics is also due to the level of urbanisation, the education of the society, its digital competences, as well as the level of economic development of the country or region (Liu *et al*., 2014). The Gompertz curve inflection point can also be affected by the diffusion rate and market size. Potential feedbacks that may occur between variables are a premise for using a multi-equation model with interdependent variables in the study:

$$\ln A_i = \delta_0^{(1)} + \alpha_1^{(1)} \ln C_i + \beta_1^{(1)} \ln X_{1i} + \beta_2^{(1)} X_{2i} + \beta_3^{(1)} \ln X_{3i} + \beta_4^{(1)} \ln X_{4i} + \beta_5^{(1)} X_{5i} + \varepsilon_i^{(1)} \quad (4)$$

$$\ln B_i = \delta_0^{(2)} + \alpha_1^{(2)} \ln A_i + \alpha_2^{(2)} \ln C_i + \beta_2^{(2)} X_{2i} + \beta_4^{(2)} \ln X_{4i} + \beta_5^{(2)} X_{5i} + \varepsilon_i^{(2)} \quad (5)$$

$$\ln C_i = \delta_0^{(3)} + \alpha_1^{(3)} \ln A_i + \alpha_2^{(3)} \ln B_i + \beta_2^{(3)} X_{2i} + \beta_4^{(3)} \ln X_{4i} + \beta_5^{(3)} X_{5i} + \beta_6^{(3)} \ln X_{6i} + \varepsilon_i^{(3)} \quad (6)$$

where:

A_i – the level of market saturation,
B_i – dynamics of growth of the Gompertz curve at the inflection point,
C_i – inflection point of the Gompertz curve,
X_{1i} – population (in 10,000),
X_{2i} – urbanisation index,
X_{3i} – average salary in PLN,
X_{4i} – the number of university graduates per 10,000 population,
X_{5i} – percentage of the population with a PC with Internet access,
X_{6i} – voivodeship *per capita* income in PLN.

By logging the variables (except for the indicators expressed as a percentage – X_{2i} and X_{5i}) in equations (4)–(5), a better fit of the model to the data is obtained, and the parameters can be interpreted as elasticities. Three stage least square (3SLS)

was used to estimate the parameters in this multi-equation model (Greene, 2007; Liu *et al*., 2014). This method is more efficient than the two stage least square (2SLS) method and permits better associations between the error components in each model equation, reducing their potential impact (Zellner, 1962; Greene, 2007). The multi-equation model uses cross-sectional data, with the values of the variables A_i, B_i, C_i for each voivodeship coming from the Gomertz model, and the values of the remaining variables X_{1i}–X_{6i} were adopted from 2022. Model estimations were carried out using Statistica and Gretl computer programmes.

4. Empirical Results and Discussion

The results of the estimation of the parameters of the Gompertz model describing the diffusion of mobile technologies in individual Polish voivodeships are presented in Table 1. They show that the time needed to reach the highest point of market penetration differs between voivodeships. It is much longer in voivodeships with a large number of inhabitants and ones that are quite highly urbanised, such as Mazowieckie (approx. 4 years and 6 months) and Śląskie (approx. 3 years and 6 months). On the other hand, the shortest waiting time for the maximum market penetration point was recorded in the following voivodeships: Warmińsko-mazurskie (approx. 1 year and 3 months) and Świętokrzyskie (approx. 1 year and 8 months), i.e., in voivodeships with a smaller population and less urbanisation. On the other hand, the highest diffusion dynamics at the inflection point were recorded in voivodeships with a short waiting time for the maximum diffusion growth rate (Warmińsko-mazurskie and Świętokrzyskie), while the lowest diffusion growth dynamics were recorded in Śląskie and Małopolskie. A clear negative relationship can be observed between the inflection point value and the diffusion dynamics: The longer the waiting time needed to reach the highest point of market penetration, the weaker the diffusion dynamics in general, and vice versa.

The level of market saturation (parameter *A*) is strongly related to the number of voivodeship inhabitants, which seems natural – a larger number of inhabitants means potentially more consumers and users of smartphones and tablets. The largest size was recorded in the market of the Mazowieckie and Wielkopolskie voivodeships, while the smallest was recorded in the market of smartphones and tablets in the Opolskie and Świętokrzyskie voivodeships.

Table 1. Results of Estimates of the Gompertz Function for Polish Voivodeships

Voivodeship	*A*	*B*	*C*	R^2
Dolnośląskie	3,640.439**	0.376**	2.496	0.958
Kujawsko-pomorskie	2,782.084**	0.465	1.938**	0.791
Lubelskie	2,129.665	0.437**	1.684	0.748

Table 1 cnt'd

Voivodeship	*A*	*B*	*C*	R^2
Lubuskie	1,527.669**	0.314	2.319**	0.815
Łódzkie	3,098.298**	0.328	2.368	0.733
Małopolskie	5,496.270**	0.246**	3.481**	0.719
Mazowieckie	6,613.780	0.519	4.490	0.875
Opolskie	1,008.371	0.461**	1.743	0.887
Podkarpackie	2,714.680*	0.333**	2.891*	0.816
Podlaskie	1,656.184**	0.350**	2.448	0.771
Pomorskie	3,958.404	0.269**	3.180	0.799
Śląskie	5,443.453	0.270*	3.529	0.730
Świętokrzyskie	1,194.812	0.569**	1.670	0.715
Warmińsko-mazurskie	1,327.075**	0.596*	1.237**	0.956
Wielkopolskie	5,667.875**	0.340**	2.372	0.791
Zachodniopomorskie	1,838.693**	0.462**	2.403**	0.967

The significance levels of 0.01, 0.05 and 0.1 are marked respectively with ***, ** and *.
Source: the author's own calculations.

Figure 1 presents Gompertz curves fitted to individual voivodeships.

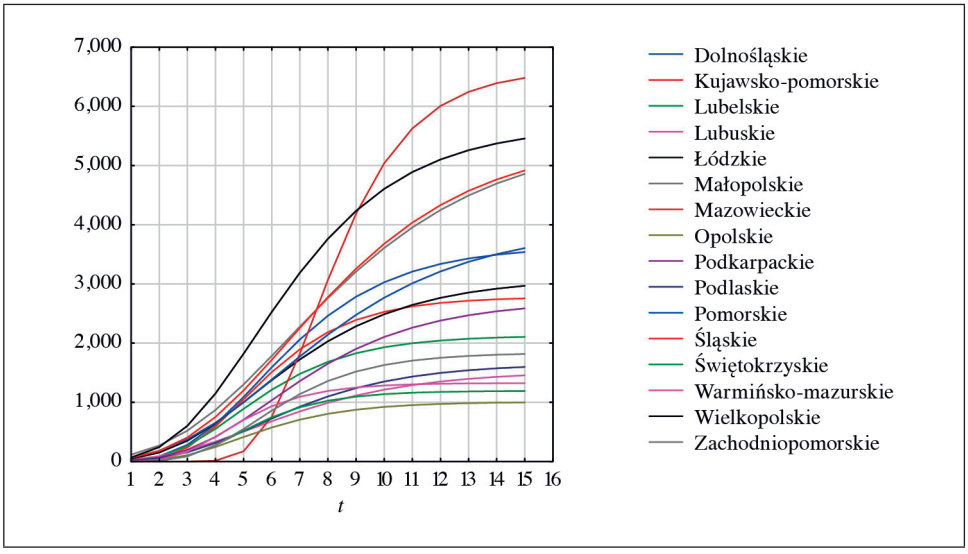

Fig. 1. Gompertz Curve for Polish Voivodeships
Source: the author, based on research results.

Descriptive statistics of socio-demographic variables X_{1i}–X_{6i} used in multi--equation are presented in Table 2.

Table 2. Descriptive Statistics of Socio-demographic Variables for Polish Voivodeships

Variable	Mean	Std. Dev.	Median	Max	Min
Population (in 10,000)	236.04	125.48	205.19	551.06	94.24
Urbanisation index	58.06	9.33	59.95	75.90	41.10
Average salary in PLN	6,286.70	576.22	6,076.93	7,913.14	5,662.53
Number of university graduates per 10,000 population	69.06	21.89	65.00	108.00	29.00
Percentage of the population with a PC with Internet access	73.49	3.57	73.85	78.60	66.60
Voivodeship *per capita* income in PLN	656.92	90.18	641.44	815.48	488.07

Source: the author's own calculations.

The results of the estimation of the model (1) presented in Table 3 were the basis for the estimation of the parameters of the equations of the multi-equation model with interdependent variables (4)–(6). The results of this estimate are presented in Table 3.

Table 3. Multi-equation Model Estimation Results (4–6) for Cross-sectional Data

Explanatory Variables	Dependent Variable		
	$\ln A_i$ (market saturation level)	$\ln B_i$ (diffusion growth rate)	$\ln C_i$ (inflection point)
const	–1.0099*	3.4927*	1.6636
$\ln A_i$	–	–0.3247*	–0.1736**
$\ln B_i$	–	–	–0.2749**
$\ln C_i$	0.2424**	–1.1297	–
$\ln X_{1i}$	0.7339***	–	–
X_{2i}	0.0060***	0.0051**	0.0038**
$\ln X_{3i}$	0.3231**	–	–
$\ln X_{4i}$	0.5170**	0.4433**	0.6803**
X_{5i}	0.0028*	–0.0045***	–0.0024***
$\ln X_{6i}$	–	–	–0.8793**

The significance levels of 0.01, 0.05 and 0.1 are marked respectively with ***, ** and *.

Source: the author's own calculations.

Table 3 shows the positive impact of population on the level of market saturation: 1% increase in population results in an increase in the level of market saturation with smartphones and tablets by about 7.4%, *ceteris paribus*.

Similarly, the urbanisation index has a positive and statistically significant impact on the size of the market (an increase in market size by approx. 0.6%, *ceteris paribus*, respectively, with an increase in the urbanisation index by 1).

The level of remuneration has also the positive impact on the size of the market. A 1% increase in wages implies an average increase in the size of the market by approx. 0.32%, *ceteris paribus*. The impact of the number of university graduates per 10,000 population on the size of the market is positive and statistically significant: an increase in market size by approx. 0.52%, *ceteris paribus*, respectively, with an increase in the number of graduates per 10,000 population by 1 percentage point). Also, the percentage of people with PCs is positively correlated with the level of market saturation, but this relationship is not statistically significant. Let's notice, that the time needed to reach the highest market penetration point (C_t) has a positive and significant impact on the size of the market.

The impact of the urbanisation index on the diffusion rate of mobile devices is positive and statistically significant. An increase in the urbanisation rate by 1, the diffusion rate increases by approx. 0.51%, *ceteris paribus*.

The education level also has a positive impact on the rate of changes in the diffusion of mobile technologies, with this relationship being significant at the level of 0.05: An increase in the number of university graduates per 10,000 population by 1 percentage point results in an increase in the diffusion rate by approx. 0.44%, *ceteris paribus*.

The variable *Percentage of people with a PC* has the negative impact on the dynamics of diffusion growth: The increasing share of people with their own computer slows down the diffusion rate. An increase in the percentage of people with a PC by 1 percentage point results in a decrease in the diffusion rate by 0.45%, *ceteris paribus*.

Market saturation (variable A_t) in the current period is the destimulant of the growth rate of diffusion of mobile technologies. An increase in market size by 1% results in a decrease in the diffusion rate of mobile technologies by approx. 0.32%, *ceteris paribus*. The *Inflection point* (C_t) variable had a negative and statistically insignificant effect on the rate of diffusion dynamics.

The degree of voivodeship urbanisation has a positive impact on the waiting time for the maximum market penetration point at the significance level of 0.05. An increase in the urbanisation rate by 1 results in an increase in the waiting time for the maximum market penetration point by approx. 0.24%, *ceteris paribus*. The level of education also has a positive effect on the inflection point of the Gompertz curve. The number of university graduates per 10,000 population increased by 1% causes

an increase in the waiting time for the maximum market penetration point by approx. 0.68%, *ceteris paribus*.

The percentage of people who have their own PC is a determinant of the waiting time for the maximum point of market penetration. Thus, the effect of strong market suction related to the desire to own a smartphone or tablet is shortened by a correspondingly high saturation of the market with computer equipment. An increase in the share of people with a PC by 1 percentage point results in a reduction of the waiting time for the highest market penetration point by an average of approx. 0.24%. The affluence of voivodeships turned out to be a destimulant of the inflection point of the Gompertz curve, i.e., it contributed to shortening the waiting time for the peak of the diffusion wave. An increase in the level of voivodeship income by 1% implies a reduction in the waiting time for the peak of diffusion by approx. 0.88%, *ceteris paribus*.

The influence of the level of market saturation (variable A_t) and the rate of increase in diffusion (variable B_t) have a negative effect on the inflection point of the Gompertz curve.

A 1% increase in the level of market saturation results in a reduction in the time required for the peak of the diffusion wave by approx. 0.17%, and the same growth of the diffusion rate results in a reduction of this time by approx. 0.27%, *ceteris paribus*, respectively.

5. Conclusions

The results presented in this article allow for the conclusion that Gompertz growth curve models are effective tools in mapping the rate and magnitude of diffusion of mobile technologies. This is also confirmed by the results obtained by various authors, in which the Gompertz model was compared with other models in the context of describing the process of innovation diffusion (Liu *et al*., 2014; Spaho & Kraja, 2019; Dhakal & Lim, 2020; Jha & Saha, 2020; Lartey, 2020; Singh & Singh, 2023).

Multi-equation models, on the other hand, made it possible to determine the directions and strength of the impact of various socio-demographic variables (taking into account their feedback loops) on the characteristics of the diffusion process of mobile innovations. Thanks to these models, it was possible to identify important determinants of the parameters of the Gompertz model, such as population size, degree of urbanisation of regions, level of education of residents, households equipped with computer equipment, and others.

The research has shown that the faster mobile technologies spread, the more dynamic the process generally becomes. The saturation of the market with modern computer hardware weakens the growth dynamics of mobile technologies in the current period, but historical levels of market saturation usually do not significantly

affect the values of the Gompertz function at the inflection point. The level of education of the society and its digitisation are potentially significant determinants of the dynamics of diffusion of mobile technology innovations. More educated populations generally had shifted inflection points, and thus the waiting time for the peak of the wave of diffusion of mobile technologies was generally longer. A similar nature of the influence of factors related to the level of education on Internet technologies can be found in the study of other authors (Prince & Simon, 2009). Also Singh and Singh (2023) and Liu *et al*. (2014) showed that the level of education stimulates the diffusion process of mobile technologies based on mobile telephony.

Knowing the phase cycle of the innovation diffusion pattern can support planning for the launch of high-tech products in a coordinated manner, so that the peak of the market penetration process occurs at the desired moment from the point of view of the company's strategy. The research approach presented in this article can be useful for company managers in planning strategies for the introduction of new products and services. Future research in this area should include modelling using other growth curves, as well as broadening the range of socio-demographic factors that may influence the diffusion of mobile technologies. The research results presented in this article have their limitations, which determine the next stages of research. In the future research, other diffusion models based on the S-shaped diffusion curve should be used (logistic model, Bass model and others), which will allow comparing these models and selecting the best one. Moreover, subsequent research may attempt to expand the list of explanatory variables, which may include important determinants of innovation diffusion. In the longer term, it also seems justified to conduct periodic surveys on a sufficiently large sample of mobile technology recipients. However, collecting the data necessary to analyse the diffusion process in this way will require repeating the survey over a period of at least several or a dozen years.

Acknowledgement and Financial Disclosure

The article presents the result of the Project no 091/EIT/2024/POT financed from the subsidy granted to the Krakow University of Economics.

Conflict of Interest

The author declares no conflict of interest.

References

Chandrasekaran, D., Tellis, G. J., & James, G. M. (2022). Leapfrogging, Cannibalization, and Survival during Disruptive Technological Change: The Critical Role of Rate of Disengagement. *Journal of Marketing*, *86*(1), 149–166. https://doi.org/10.1177/0022242920967912

Choudrie, J., Pheeraphuttharangkoon, S., & Davari, S. (2020). The Digital Divide and Older Adult Population Adoption, Use and Diffusion of Mobile Phones: A Quantitative Study. *Information Systems Frontiers*, *22*, 673–695. https://doi.org/10.1007/s10796-018-9875-2

Desiraju, R., Nair, H., & Chintagunta, P. (2004). Diffusion of New Pharmaceutical Drugs in Developing and Developed Nations. *International Journal of Research in Marketing*, *21*(4), 341–357. https://doi.org/10.1016/j.ijresmar.2004.05.001

Dhakal, T., & Lim, D. E. (2020). Understanding ICT Adoption in SAARC Member Countries. *Letters in Spatial and Resource Sciences*, *13*, 67–80. https://doi.org/10.1007/s12076-020-00245-2

Grantham, A., & Tsekouras, G. (2005). Diffusing Wireless Applications in a Mobile World. *Technology in Society*, *27*(1), 85–104. https://doi.org/10.1016/j.techsoc.2004.10.003

Greene, W. H. (2007). *Econometric Analysis* (6th ed.). Prentice Hall.

Gündüc, S. (2019). Diffusion of Innovation in Competitive Markets – a Study on the Global Smartphone Diffusion. *Acta Physica Polonica: A*, *135*(3), 485–494. https://doi.org/10.12693/APhysPolA.135.485

Hew, J.-J., Lee, V.-H., & Leong, L.-Y. (2023). Why Do Mobile Consumers Resist Mobile Commerce Applications? A Hybrid fsQCA-ANN Analysis. *Journal of Retailing and Consumer Services*, *75*, 103526. https://doi.org/10.1016/j.jretconser.2023.103526

Honoré, B. (2019). Diffusion of Mobile Telephony: Analysis of Determinants in Cameroon. *Telecommunications Policy*, *43*(3), 287–298. https://doi.org/10.1016/j.telpol.2018.08.002

Jha, A., & Saha, D. (2020). Forecasting and Analysing the Characteristics of 3G and 4G Mobile Broadband Diffusion in India: A Comparative Evaluation of Bass, Norton-Bass, Gompertz, and Logistic Growth Models. *Technological Forecasting and Social Change*, *152*(C), 119885. https://doi.org/10.1016/j.techfore.2019.119885

Kalem, G., Vayvay, O., Sennaroglu, B., & Tozan, H. (2021). Technology Forecasting in the Mobile Telecommunication Industry: A Case Study towards the 5G Era. *Engineering Management Journal*, *33*(1), 15–29. https://doi.org/10.1080/10429247.2020.1764833

Katona, Z., Zubcsek, P. P., & Sarvary, M. (2011). Network Effects and Personal Influences: The Diffusion of an Online Social Network. *Journal of Marketing Research*, *48*(3), 425–443. https://doi.org/10.1509/jmkr.48.3.425

Kiiski, S., & Pohjola, M. (2002). Cross-country Diffusion of the Internet. *Information Economics and Policy*, *14*(2), 297–310. https://doi.org/10.1016/S0167-6245(01)00071-3

Lartey, F. M. (2020). Predicting Product Uptake Using Bass, Gompertz, and Logistic Diffusion Models: Application to a Broadband Product. *Journal of Business Administration Research*, *9*(2), 5–18. https://doi.org/10.5430/jbar.v9n2p5

Lei, Y. C., & Zhang, S. Y. (2004). Features and Partial Derivatives of Bertalanffy-Richards Growth Model in Forestry. *Nonlinear Analysis: Modelling and Control*, *9*(1), 65–73. https://doi.org/10.15388/NA.2004.9.1.15171

Liu, A. X., Wang, Y., Chen, X., & Jiang, X. (2014). Understanding the Diffusion of Mobile Digital Content: A Growth Curve Modelling Approach. *Information Systems and e-Business Management*, *12*(2), 239–258. https://doi.org/10.1007/s10257-013-0224-1

Mitra, S. (2019). Forecasting the Diffusion of Innovative Products Using the Bass Model at the Takeoff Stage: A Review of Literature from Subsistence Markets. *Asian Journal of Innovation and Policy*, *8*(1), 141–161. https://doi.org/10.7545/ajip.2019.8.1.141

Morya, K. K., & Shankar, A. (2019). Diffusion of Mobile Telephony Services in India. *International Journal of Recent Technology and Engineering*, *8*(4), 10298–10308. https://doi.org/10.35940/ijrte.D4520.118419

Mukhopadhyay, A., Bagchi, K. K., & Udo, G. J. (2024). Exploring the Main Factors Affecting Mobile Phone Growth Rates in Indian States. *Journal of the Knowledge Economy*, *15*, 5746–5768. https://doi.org/10.1007/s13132-023-01206-y

Perkins, R., & Neumayer, E. (2005). International Technological Diffusion, Latecomer Advantage and Economic Globalization: A Multi-technology Analysis. *Annals of the Association of American Geographers*, *95*(4), 789–808. https://doi.org/10.1111/j.1467-8306.2005.00487.x

Prince, J. T., & Simon, D. H. (2009). *Has the Internet Accelerated the Diffusion of New Products?* (Indiana University, Bloomington: School of Public & Environmental Affairs Research Paper No. 2008-12-01). School of Public and Environmental Affairs. Indiana University. https://doi.org/10.2139/ssrn.1936107

Rogers, E. M. (1995). *Diffusion of Innovations* (4th ed.). Free Press.

Roy, A., Dutta, G., & Das, P. K. (2019). Exploring the Determinants of Mobile-based Services Diffusion: Past Determinants, Emergent Pattern and a Proposed Framework. *International Journal of Business Innovation and Research*, *18*(4), 429–452. https://doi.org/10.1504/IJBIR.2019.098759

Singh, S. K., & Singh, V. L. (2023). Internet Diffusion in India: A Study Based on Growth Curve Modelling. *Management Research and Practice*, *15*(2), 29–42.

Spaho, A. B., & Kraja, A. (2019). Modeling and Forecasting the Diffusion of Mobile Telephony in Albania and Turkey. *Journal of Engineering Technology and Applied Sciences*, *4*(3), 115–124. https://doi.org/10.30931/jetas.599517

Sujatha, R., & Sekkizhar, J. (2019). Determinants of M-commerce Adoption in India Using Technology Acceptance Model Infused with Innovation Diffusion Theory. *Journal of Management Research*, *19*(3), 193–204.

Toğa, G., & Toğa, M. (2019). Diffusion and Substitution Effect on Telecommunication Technologies in Turkey. *Academic Platform – Journal of Engineering and Science*, *7*(3), 496–506. https://doi.org/10.21541/apjes.432190

Zellner, A. (1962). An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias. *Journal of the American Statistical Association*, *57*(298), 348–368. https://doi.org/10.2307/2281644

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 143–160
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18697

Accessibility Coordinator: Manager and Leader of Change

Anna Pluszyńska[1], **Agnieszka Konior**[2]

[1] Jagiellonian University in Kraków, Faculty of Management and Social Communication, Institute of Culture, Department of Cultural Management, prof. S. Łojasiewicza 4, 30-348 Kraków, Poland, e-mail: anna.pluszynska@uj.edu.pl, ORCID: https://orcid.org/0000-0003-0271-5176

[2] Jagiellonian University in Kraków, Faculty of Management and Social Communication, Institute of Culture, Department of Cultural Management, prof. S. Łojasiewicza 4, 30-348 Kraków, Poland, e-mail: agn.konior@uj.edu.pl, ORCID: https://orcid.org/0000-0003-2338-6594

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Pluszyńska, A., & Konior, A. (2026). Accessibility Coordinator: Manager and Leader of Change. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 143–160. https://doi.org/10.15678/krem.18697

ABSTRACT

Objective: The article attempts to answer whether we may call the accessibility coordinator a manager and what role they play in a cultural institution. Do coordinators indeed only undertake coordinating actions, as suggested by the position's name, or do they manage the accessibility implementation process in public cultural institutions?
Research Design & Methods: To collect data, we used narrative collages. We obtained fifty-seven narrative collages, which described, using creative metaphors, the managerial roles adopted by the accessibility coordinator in a cultural institution.
Findings: The authors of the collages mostly emphasised the importance of interpersonal roles (connector, leader) and informational roles (observer, propagator).
Implications/Recommendations: The research indicates that the accessibility coordinator serves as a manager in the organisation and is a change leader who creates conditions that enable the preparation and implementation of accessibility in a cultural institution.
Contribution: Research shows that the theory of managerial roles is still valid and can also be applied to new professions, such as accessibility coordinators in cultural institutions.

Article type: original article.
Keywords: accessibility coordinator, manager, change leader, cultural institution.
JEL Classification: J38, D63, M12, Z1.

1. Introduction

There are two common terms: accessibility coordinator and accessibility manager in the literature on the subject. Although both roles focus on implementing accessibility, they sometimes differ in terms of scope, responsibilities, and impact on the organisation or the context in which they operate (Orero, 2017; Remael *et al*., 2019). Usually, the coordinator is tasked with implementing policies and procedures in the organisation. Their role focused on ensuring compliance with accessibility standards (Bedford-Jack, 2023). The accessibility manager often has a broader and more strategic role. They are responsible for developing and supervising comprehensive accessibility programmes across the entire organisation (Zhang, 2019). In Poland, the applicable legal regulations and practice adopt the term "accessibility coordinator." However, when analysing the available literature and looking at practical solutions implemented in cultural institutions, one can get the impression that their role is broader than just coordinating activities. This observation was not a hypothesis, but rather a preliminary research assumption of the authors.

According to statistical data from Statistics Poland, in the first quarter of 2023, 4,703 cultural institutions were functioning in Poland (Główny Urząd Statystyczny, 2023). Since 2019, all public institutions, including cultural institutions, have had a statutory obligation to ensure accessibility for individuals with special needs (Ustawa z dnia 19 lipca 2019 r. o zapewnianiu dostępności osobom ze szczególnymi potrzebami, Dz.U. 2022, poz. 2240). According to the provisions of the law, appointing an accessibility coordinator is voluntary (Sobolewska & Wilk, 2021, p. 22); however, such a decision positively influences the cultural institutions' effectiveness and efficiency in terms of accessibility (Konior, Pluszyńska & Grabowska, 2021). Nationwide research reveals that 26% of institutions employ accessibility coordinators by creating separate positions, while 68% of institutions designate a person responsible for implementing accessibility-related activities (Pluszyńska & Konior, 2023). On social media, the Forum of Accessibility Coordinators group (Forum Koordynatorów i Koordynatorek Dostępności, 2021) has 5,500 members, and the open group Network of Accessibility Leaders (Sieć Liderów i Liderek Dostępności, 2020) consists of 1,600 individuals. The new law has influenced the implementation of accessibility activities by public institutions and has also expanded the circle of individuals interested in this topic.

We may define the role of accessibility coordinator/manager as a profession involving "a set of tasks (a set of activities) identified as a result of the social division of labour, performed consistently or with minor changes by individual persons and requiring appropriate qualifications (knowledge and skills) acquired through education or practice" (Reduta, 2015, p. 101). In response to market needs, there now exist documents specifying qualifications and outlining the scope of knowledge and skills that a person responsible for implementing accessibility in an organisation should possess (Orero, 2017; Remael *et al*., 2019; Zintegrowany System Kwalifikacji, 2020). A synthetic characterisation of learning outcomes indicates that the coordinator "is responsible for implementing accessibility as well as legal provisions and best practices in the organisation, including architectural, digital, and informational-communicative standards" (Zintegrowany System Kwalifikacji, 2020). Such formulated tasks do not diminish the director's responsibility in a public institution, but the coordinator takes on the majority of duties related to implementing accessibility (Pasterak & Studziński, 2023, p. 53), and the success of the institution depends on the coordinator's real influence on decisions in this area (Gov.pl, 2020). This is a starting point for further considerations of the role of accessibility coordinator in a cultural institution in Poland. In response to the existing cognitive gap, the following research problem was posed: Can an accessibility coordinator be called a manager? Do coordinators indeed only undertake coordinating actions, as suggested by the position's name, or do they manage the accessibility implementation process in public cultural institutions?

2. Theoretical Background

According to the current regulations (Ustawa o dostępności, Dz.U. 2022, poz. 2240), accessibility coordinators prepare, coordinate, and monitor the implementation of action plans to improve accessibility by public entities. Moreover, they support individuals with special needs in accessing services provided by these entities.

Having analysed the results of the research conducted in the cultural sector (Pasterak & Studziński, 2023; Pluszyńska & Konior, 2023), the content of recommendations and guides (Gov.pl, 2020), and the cited law, the job title does not seem adequate to the performed functions. The name "coordinator" suggests that this person is only involved in coordinating activities within a specific project or process, and their main task is to ensure synchronisation and that everything adheres to the plan. However, in the context of an accessibility coordinator in a cultural institution, the role involves not only coordination but also planning, control, and ensuring effective communication of the organisation with individuals with special needs. Therefore, they function as a manager, specifically a functional manager, as they are responsible for a particular type of activity (Zakrzewska-Bielawska,

2020, p. 143), namely the process of implementing accessibility. Coordinators are also mid-level managers, as they implement the policies and strategic plans of the director (Koźmiński *et al*., 2023, p. 29) or the cultural institution. Formally, such a coordinator is responsible for the organisation's accessibility. However, because of the terminology established in practice, we will use the term "accessibility coordinator" to refer to a manager responsible for implementing the accessibility process and taking actions to achieve the main goal, which is architectural, digital, and communication-information accessibility of a cultural institution.

The accessibility coordinator at a cultural institution managing the accessibility implementation process plays various roles in the organisation. The literature most often cites the list of ten roles developed by Mintzberg (1971, p. 98), which we can group into three categories: interpersonal, informational, and decisional roles. Observing the work of accessibility coordinators, we should note that they, too, are involved in various activities. Moreover, the roles they play in the organisation correspond to the categories of managerial behaviour developed by Mintzberg (1971). Table 1 presents a detailed summary of the managerial roles that accessibility coordinators perform in cultural institutions.

Table 1. Accessibility Coordinators' Managerial Roles in Cultural Institutions

Category	Role	Sample Activities
Interpersonal	Figurehead	Represents the institution in dealing with recipients (such as people with special needs); participates in conferences and public meetings
	Leader	Accessibility leader sets goals in this area and mobilises colleagues to achieve them
	Liaison	Establishes cooperation with the external environment, including a group of people or non-governmental organisations for people with special needs or working on their behalf
Informational	Nerve centre	Monitors legal changes, analyses information from the environment regarding the accessibility implementation process, observes technical innovations supporting accessibility
	Disseminator	Shares acquired knowledge with colleagues and supports new initiatives of the institution with their experience
	Spokesperson	Communicates to the outside of the institution its accessibility decisions and mediates between the institution and, for example, the organiser, centre of competence, or Statistics Poland

Table 1 cnt'd

Category	Role	Sample Activities
Decisional	Entrepreneur	Encourages colleagues to create accessible cultural activities, initiates such activities, consciously makes changes, and takes risks
	Disturbance handler	Eliminates barriers or proposes alternatives
	Resource allocator	Participates in and helps draft the institution's accessibility budget
	Negotiator	Negotiates with the institution's managing director and department heads, sets the terms of problems to be solved, makes decisions on concessions and compromises

Source: the authors, based on Mintzberg (1971).

Depending on the accessibility coordinator's position in the institution's hierarchy, the coordinator may implement and draw attention to various roles in different ways. This differentiation may also stem from the individual preferences of a given coordinator, their personality traits, temperament, and intelligence (Zakrzewska-Bielawska, 2020, p. 149).

Previous research shows (Pluszyńska & Konior, 2023) that only 36% of public cultural institutions create a separate position for an accessibility coordinator in the organisational structure. The majority of institutions (68%) merely designate a person responsible for conducting activities related to accessibility implementation. Simultaneously, accessibility coordinators usually work in the administrative or educational department. Thus, they also perform other tasks not related to accessibility. Although this phenomenon of "multitasking" is common in the cultural sector, it is worrisome (see Waczyński, 2020; Maciejewska, 2024). A coordinator in a cultural institution should perform multiple roles, but having other duties as well means that they will only be able to perform selected, most urgent accessibility tasks.

3. Material and Methods

We aimed to determine whether we may call the accessibility coordinator a manager. What is the accessibility coordinator's role in a cultural institution? To collect data, we employed the narrative collage method. It serves to study social phenomena focusing on the sphere of perceptions about an issue (in this case, the role of the accessibility coordinator). We can use this method to present the organisation's cultural context. The task of the authors/respondents is to create stories that begin with the words that the researcher provides. In turn, the researcher plays

the role of an active editor. They select, arrange, and interpret the research material (Kostera, 2015, p. 81). Moreover, in narrative collages, respondents also often use metaphors. Their use in management science can be a way to look at organisational reality from a different perspective and provide an opportunity to better understand this reality. Simultaneously, the use of creative metaphors can unveil new meanings previously hidden by the interpreter (Sułkowski, 2004, pp. 7–10).

We asked graduate students with cultural and media management fields of study to complete the sentence: "The accessibility coordinator should be like…". The choice of this research group is justified for several reasons. The students participated in the Managing Diversity in Organisations class, where they gained basic knowledge about theoretical and legal issues related to diversity and accessibility. They also participated in practical classes teaching the necessary skills required of accessibility coordinators: writing alternative texts, preparing audio descriptions, using the Polish sign language, and learning etiquette towards people with disabilities. An important part of the classes was study visits to cultural institutions, during which students met with accessibility coordinators who talked about their work in such institutions as cultural centers, museums, theaters, or accessibility centres. Thus, the students acquired the necessary knowledge, competencies, and skills to become accessibility coordinators in the future. Moreover, their perceptions of this position deepened during interviews with accessibility coordinators conducted in class. At the same time, the students were a group that looked at the work of accessibility coordinators from the sidelines, so to speak, and thus, their perspective seemed interesting to us. We conducted the study from 14 December 2023 to 19 January 2024, via an online form.

We obtained 57 narrative collages that creatively answered the question posed. Students used metaphors more than once in their answers, comparing accessibility coordinators to various characters or objects. We coded all narrative collages in the Maxqda software. As both of us did it, we achieved the triangulation of researchers. In coding, we used both concepts derived from management theory (Mintzberg's managerial roles) and in-vivo codes derived directly from the subjects (metaphors, coordinators characteristics) (Creswell, 2013, p. 202).

The justification for the chosen concept is that Henry Mintzberg's managerial role theory, despite its popularity, has not been used as a conceptual framework for creating scientific articles. The EBSCO database, after entering the phrase "mintzberg managerial roles," indicates 26 scientific articles in which it was used (a search was used in all fields, without a time limit). Previous publications using Mintzberg's theory as a theoretical framework referred to the education sector (Mech, 1990; Anderson, Murray & Olivarez, 2002; Güleryüz & Duygulu, 2020), health care (Guo, 2002; Bartelings *et al*., 2017; Alanazi & Falqi, 2023), sports (Quarterman, 1994; Horch & Schütte, 2003), or entrepreneurship (Zabid, 1987;

Durowoju & Tijani, 2021). They analysed managerial roles in professions that were relatively new at the time of the analysis, such as audit manager (Wolf, 1981), Chief Information Officer (CIO) (Grover *et al*., 1993), Chief Academic Officers (CAO) (Anderson, Murray & Olivarez, 2002). Researchers also related the roles created by Mintzberg to cultural contexts other than the original, American one – they indicated managerial roles undertaken in Asian culture (Pearson & Chatterjee, 2003). They also wondered to what extent roles and skills would change with the advent of industry 4.0 (Güleryüz & Duygulu, 2020). Based on the classification created, they also tried to develop an office automation system (McLeod & Jones, 1987) or word processing and management information system integration (McLeod & Jones, 1987). Only two of the analysed articles concerned culture (Mech, 1990; Labaronne & Müller, 2024). There is an obvious research gap in this area. Other studies suggest that Mintzberg's concept is well suited to analysing managerial roles in arts and cultural organisation (Kurke & Aldrich, 1983).

4. Analysis Results

4.1. Leadership Roles Undertaken by Accessibility Coordinators

Analysis of the narrative collages shows that, according to students, accessibility coordinators perform each of the managerial roles defined in the theory. Respondents strongly emphasised interpersonal and informational roles, while roles of a decision-making nature were assessed as less important. The most frequently emphasised role of the accessibility coordinator was that of a liaison who is handling disturbances, nerve centre, leader, and disseminator. When describing what an accessibility coordinator should be like, students often used creative metaphors that aptly conveyed the nature of the activities undertaken by the coordinator.

4.2. Leader

As a leader, the accessibility coordinator sets clear goals and motivates others to achieve them. It is also important for the coordinator to manage the team efficiently, recognise the potential of team members, and use them to implement joint activities. It was also emphasised that the accessibility coordinator should be part of the team and interact with others. Comparisons of the accessibility coordinator to a leader appeared most often in this context:

> However, above all, the accessibility coordinator should be a leader who can inspire and motivate others to work for accessibility [K121].

> The coordinator should be a leader who actively supports initiatives to create an environment friendly to people with different types of disabilities. This requires identifying existing problems, planning, and implementing effective solutions [K30].

The leader's clear statement of purpose also resonated in this engaging metaphor:

> Like Ariadne's thread giving hope to get out of the most difficult situations [K02].

Moreover, students used the metaphor of a coach ("running coach that prepares you for a marathon" [K06]) or the ship captain. In both metaphors, it was important to constantly monitor the situation and adapt actions to the changing environment to achieve the set goal:

> During the marathon, the coordinator motivates people, responds to changes, and thus adapts themselves and the participants to new conditions, helping them survive moments of weakness [K06].
>
> When thinking of an accessibility coordinator, I also see the captain of a ship, who primarily aims to take care of the crew so that everyone feels confident and comfortable on the journey. Their job is to constantly monitor the sea and the changing situations to minimise the impact of unfavourable conditions that will naturally arise [K53].

Respondents also used the conductor metaphor, meaning a person who harmonises the team's actions and gives it rhythm:

> Such a conductor should be able to handle stressful situations and direct people so that even if they make mistakes, they will reach a great finale together. Such a conductor should strive to build lasting relationships with their orchestra based on mutual trust and support. They should create a place where musicians cooperate among themselves instead of running an unhealthy rat race to achieve their benefits. Furthermore, the conductor should, by their example, encourage the audience to frequently use the repertoire they have prepared and talk about it to musical laymen as well [K45].

4.3. Liaison

Respondents related the liaison's role primarily to communication between the organisation's inner structure, namely its employees, and the environment, which mainly involves recipients with special needs. In fulfilling this role, the coordinator should focus on identifying and meeting recipients' special needs and on communicating about them to the organisation's employees. Coordinators should do so to broaden the employees' perspectives, open them up to diversity, and point to issues that the employees have not yet considered but which are extremely important for the recipients. From this perspective, it is important to involve a wide range of stakeholders, namely experts, activists, community organisations, the organiser, or other audiences, and work together for accessibility. Interestingly, some students directly defined the accessibility coordinator as a "liaison" [K01, K24, K48]. Others did not define this role in such a direct way but used other metaphors to do so. The most popular metaphor was that of a bridge or its builder:

> By creating accessibility bridges, this builder not only makes life easier for people with disabilities but also inspires a change in mentality and attitudes toward diversity [K03].
>
> An accessibility coordinator should be like a builder of bridges, in this case, social bridges, who actively seeks not only to create lasting connections between diverse groups but also to transform the environment into a place where everyone can freely participate and take advantage of available resources [K51].

Others compared the coordinator to a binding element, translator, mediator, baker, golden mean, guide, or a knot that joins two ends of a rope.

> The accessibility coordinator should be like a knot joining together the two ends of the "rope." One is the world, institutions, and public places, and the other – is the part of society with unique needs [K04].
>
> An accessibility coordinator should be like an interpreter for different communities, helping them understand each other and feel comfortable [K15].
>
> An accessibility coordinator should be like a guide who leads one social group into the world of another group and makes sure that the first group does not enter into a conflict with the other group but instead supports it, creating a new and unique reality without hate [K16].
>
> An accessibility coordinator, like a baker, must pay attention, first and foremost, to the needs of the team (the dough) and the stakeholders (the customers) [K52].

4.4. Nerve Centre

On the other hand, the nerve centre was a person with extensive knowledge of the applicable accessibility requirements but also of the technologies that support their implementation. This knowledge must be up-to-date. It is also a person who constantly analyses situations and tries to identify areas of possible improvement. One respondent directly used the term "nerve centre" [K09].

Students using metaphors to describe the role of the nerve centre tended to use them from two perspectives. The first referred to the fact that an accessibility coordinator should have an extremely broad knowledge of accessibility, be an expert on the subject, and a person to turn to for advice. Hence, respondents used metaphors related to an oracle, a sage, or a master craftsman (tailor, cook):

> He must be like an oracle, anticipating all possible scenarios and eventualities while trying to prevent them [K32].
>
> Moreover, the solid craftsmanship skills that define an experienced tailor are also indispensable for an accessibility coordinator. The coordinator must be proficient in the various aspects of shaping an accessible environment for different groups, where each group has its own individual needs. (…) An accessibility coordinator often deals with multiple areas of accessibility at the same time, such as architectural accessibility and web accessibility. This requires a tremendous amount of knowledge and skill [K37].

Respondents also emphasised the necessity of constantly improving one's competences, being open to new knowledge, and having curiosity about the world. We noticed metaphors related to education: a student, a child, or a detective finding new clues to solve a mystery:

> The accessibility coordinator should also be a learner, as they need to be aware of the need for continuous improvement through learning. Their willingness to acquire knowledge will enable them to learn more quickly about emerging innovations, as well as to understand the ever-changing legislation related to accessibility. As a participant in the continuous learning process, they will be better prepared to respond effectively to new challenges and keep the organisation at the forefront of accessibility efforts [K09].

> A good investigator is constantly expanding their knowledge in various fields because even issues that at first glance are not related to their work may turn out to be the key to solving certain cases – this is also how an accessibility coordinator should act, who, in addition to practical knowledge, obviously extremely important in this field, should also acquire theoretical knowledge, which is the basis of their activity [K50].

One person used the metaphor of an athlete who should continuously work on their physical fitness through regular training:

> An accessibility coordinator should also be like an athlete. Athletes train and develop their skills all their lives to strive for mastery in their field. The person in charge of accessibility should also be training all the time, increasing their knowledge and skills. Very often, people use modern technology for this [K26].

4.5. Disseminator

In the role of a disseminator, the accessibility coordinator should convey their knowledge about accessibility to their colleagues – both during training and workshops and by developing individual solutions. The coordinator should make colleagues aware of the possible needs of the institution's recipients. The role of the disseminator was also evident in the creation of action plans for improving accessibility and developing relevant guidelines and standards. Metaphors comparing the accessibility coordinator to an inspirer or advocate were given:

> The accessibility coordinator should be like an inspirer who will motivate and influence the rest of the team/institution/environment [K19].

> Their task resembles the role of a sage who shares experience and organises training to raise awareness and teach about accessibility. The ability to educate is crucial to include others in the process of creating more accessible solutions and inclusive space for all [K38].

4.6. Disturbance Handler

Respondents understood the coordinator's role as a person who counteracts disruptions primarily in the context of removing barriers that arise when a person with special needs wants to use the services provided by a cultural institution. Therefore, the coordinator's role is to adjust the institution in such a way that the institution can achieve this independently. When writing about the barriers present in the organisation, the students also emphasised those of a mental nature, which is related to the need to sensitise the public to the needs of people with disabilities. Referring to the role of handling disturbances, the authors of collages compared the coordinator to a ninja, a warrior, a map expert, or a detective:

> The coordinator is like a ninja, eliminating current obstacles and seeking the best path without barriers [K13].
>
> As a warrior, the coordinator is a person who fights against the barriers present in their organisation. Their task should be to minimise the number of such obstacles and preferably remove them altogether [K47].
>
> Like an expert in topographical maps, the accessibility coordinator should keep a close eye on the "landscape of differences and needs" within the organisation. Their role is not only to identify difficulties but, more importantly, to lay out clear paths that will allow all team members to move freely [K53].
>
> The accessibility coordinator should be like a detective who analyses each piece of the puzzle, uncovers hidden barriers, and determines accessible paths for everyone [K55].

In this context, respondents used the metaphor of a gatekeeper several times:

> The coordinator's ability to anticipate possible obstacles and think on the spot gives them a resemblance to a guardian of galactic highways, constantly patrolling to make sure everyone can travel without hindrance [K38].
>
> An accessibility coordinator should be like a Texas Ranger, only instead of fighting crime, they should help overcome barriers but with the same efficiency [K56].

4.7. Other Managerial Roles

Students were far less likely to refer to other managerial roles played by accessibility coordinators, and no such elaborate metaphors were used as for the roles of leader, liaison, nerve centre, disseminator, and disturbance handler.

The role of the *figurehead* belongs to the group of interpersonal roles. Therefore, by performing it, accessibility coordinators should contribute to the development of good relations with various stakeholder groups, especially people with disabilities. Interestingly, the authors of narrative collages characterising this role often used the name "spokesperson," which is a term for another managerial role. In their understanding, the accessibility coordinator should not only be a representative of the

cultural institution but, first and foremost, an ambassador for people with special needs within the organisation:

> The accessibility coordinator simultaneously serves as a spokesperson for people with needs that are generally overlooked or ignored, so it is the coordinator's responsibility to ensure that their voices are heard and taken into account not only on the scale of a single organisation but also in the larger social discourse [K43].

When assuming the *spokesperson* role, which is an informational role, accessibility coordinators should communicate the implemented accessibility activities externally and share information about these activities not only with the recipients but also with the organiser:

> This role makes the coordinator not only a doer but also a reporter, gathering information on the progress and challenges in the accessibility area [K22].
>
> They must maintain an active dialogue with the community and strive to apply the best possible solutions. Their ability to provide balanced information and inspiringly mobilise the community is the key to success in achieving the accessibility mission [K51].

The *negotiator's* role involves mainly a dialogue regarding the scope of the changes to be undertaken between members of the organisation, groups of customers with special needs, and providers of various types of products and services. Accessibility issues cover a wide variety of issues and apply to the work of various departments. Hence, it is necessary to negotiate the scope of the required transformations, but also to bring about an understanding of why they are needed:

> The coordinator should become a conversation mediator, helping to find compromises and solutions that are beneficial to everyone. Their role is not only to eliminate barriers but also to build partnerships and create an atmosphere of mutual respect, understanding, and acceptance between different social groups [K43].

As the *resource allocator*, the accessibility coordinator first tries to manage the existing capital (human, material, information, financial) in the best possible way. They must monitor the state of the infrastructure on an ongoing basis and react if any deficiencies arise. In practice, this role involves adapting space (including online space) for people with special needs, providing support of assistants, or raising funds for additional solutions. One person pointed out a crucial aspect related to the role of the accessibility coordinator as the resource allocator – since these resources are always limited, the accessibility coordinator must also have the ability to select key activities and rationally dispose of the entrusted resources:

> Due to the existing constraints in organisations (financial or architectural, among others), the accessibility coordinator should also have the ability to prioritise not only their tasks but also the planned changes to find the best solution adapted to the organisation's capabilities [K46].

Finally, respondents referred to the last role of an *entrepreneur*, especially in the context of implementing change and innovation in organisations. They highlighted the need to adapt to new challenges and the need to create as inclusive an environment as possible for employees and audiences, initiate new activities, and actively collaborate with the environment. Students described the accessibility coordinator as a "catalyst for change" [K25, K30]:

> Therefore, the accessibility coordinator should act as a catalyst for change that introduces new principles of equality and equity in place of established habits and exclusions [K25].

5. Results

In the narrative collages, students most often emphasised the importance of interpersonal (liaison, leader) and informational (nerve centre, disseminator) roles. Decisional roles (disturbance handler) were of lesser importance. In the eyes of those being prepared for the job, an accessibility coordinator should, first and foremost, lead the team in the organisational change of increasing accessibility for people with special needs, setting clear goals, and motivating the team to make changes. Moreover, the coordinator should be a liaison between people with special needs and the organisation's employees, taking into account the viewpoints of both groups and identifying solutions that will be most beneficial to all. An accessibility coordinator has up-to-date knowledge of accessibility and conveys it to other employees. They remove barriers to accessing cultural products and services to create the most inclusive environment possible.

The research shows that the effectiveness of the implementation of accessibility in a cultural institution depends, to a large degree, on accessibility coordinators because they are the causal agents in the process of implementing change. This special role of accessibility coordinators is related to the need to decide what changes are possible or necessary and the need to manage the process of change, that is, to take such actions that lead to the achievement of specific goals (cf. Osbert-Pociecha, 2009, pp. 324–325; Trenkner, 2014, p. 595).

Analysing the obtained narrative collages, we may trace the roles of coordinators in the process of implementing accessibility in a cultural institution by referring to the well-known three-phase model of the course of change, the so-called K. Lewin model (Clarke, 1997, p. 104). It includes:

– the unfreeze phase, i.e. preparing employees for change. In this phase, the accessibility coordinator explains the essence of the change and its benefits. At this stage, the accessibility coordinator can assume the role of a leader, disturbance handler, negotiator, or liaison;

– the change phase, i.e. implementing new solutions and creating conditions for the emergence of desired attitudes or behaviours of employees. At this stage,

the accessibility coordinator can act in the role of a disseminator, entrepreneur, or resource allocator;

– the refreeze phase, i.e., the consolidation of changes through activities that support or reinforce the newly introduced changes. At this stage, the accessibility coordinator can step into the role of a spokesperson, observer, or figurehead.

The change process of implementing accessibility in a cultural institution and the activities required to conduct this process testify to how big a role the accessibility coordinator plays. Managing the process of accessibility implementation is a highly humanised management concept, dependent largely on the social capacity of the cultural institution. The right attitude, empathy, understanding of the need to implement accessibility, and motivation are extremely important. On the other hand, as a leader of change, the accessibility coordinator creates the conditions for preparing and implementing accessibility. Taking a proactive stance in the various stages of implementing change, they perform a variety of roles. Recalling the metaphors created by the students, the accessibility coordinator can be a bridge of accessibility, a guide or mediator, a warrior, detective or guardian, a master craftsman, coach or captain, or even a conductor and inspirer.

6. Discussion

Based on the roles and responsibilities of accessibility coordinators in public cultural institutions in Poland, it should be acknowledged that they perform many managerial functions, such as: making decisions related to accessibility, supervising work in this area, developing strategic solutions and managing processes, implementing accessibility policy and cooperating with a wide range of internal and external stakeholders. According to the applicable legal system in Poland, the director is responsible for accessibility in public cultural institutions. Nevertheless, the coordinator is the leader of change. Due to the knowledge and competences he is responsible for implementing strategy to increase accessibility and inclusiveness.

Previous research shows that in many countries (in Poland as well), "staff members responsible for accessibility rarely hold roles that are purely dedicated to access, and usually work in education or marketing departments with some accessibility duties" (Remael *et al*., 2019, p. 145; see: Pluszyńska & Konior, 2023). It is therefore hardly surprising that accessibility coordination is currently regarded as a set of ancillary tasks rather than as a management role. However, the research indicates that the accessibility coordinator is a new and highly responsible profession and the skills defined for the role are intended to serve as a starting point which is to be tested and improved in practice in the years to come (Zhang, 2019, p. 85) not only in Poland but also internationally. Therefore there is an urgent need to strengthen the role of accessibility coordinators in cultural institutions, as managers and leaders of change.

According to the authors, it would be worthwhile to conduct further research on the role of accessibility coordinators from the perspective of recipients. As Remael *et al*. (2019, pp. 143–144) rightly note "the principal actors and actors generating the need for this new profile of the arts accessibility manager are the audiences themselves, who increasingly depend on and expect greater accessibility." The challenge for the future is therefore to remain open to further developments in the profession, to accept the complexity of this role, and to monitor the impact on the implementation of accessibility in the cultural sector.

Authors' Contribution

The authors' individual contribution is as follows: Each contributed 50%.

Conflict of Interest

The authors declare no conflict of interest.

References

Alanazi, N. H., & Falqi, T. A. (2023). Healthcare Managers' Perception on Patient Safety Culture. *Global Journal on Quality and Safety in Healthcare*, *6*(1), 6–14. https://doi.org/10.36401/JQSH-22-13

Anderson, P., Murray, J. P., & Olivarez, A., Jr. (2002). The Managerial Roles of Public Community College Chief Academic Officers. *Community College Review*, *30*(2), 1–26. https://doi.org/10.1177/009155210203000201

Bartelings, J. A., Goedee, J., Raab, J., & Bijl, R. (2017). The Nature of Orchestrational Work. *Public Management Review*, *19*(3), 342–360. https://doi.org/10.1080/14719037.2016.1209233

Bedford-Jack, A. (2023). Development and Implementation of an Electronic and Information Technology Accessibility Policy. In: R. Mancilla, B. A. Frey (Eds), *Guide to Digital Accessibility. Policies, Practices, and Professional Development* (pp. 75–90). Routledge

Clarke, L. (1997). *Zarządzanie zmianą*. Gebethner i Ska.

Creswell, J. W. (2013). *Projektowanie badań naukowych. Metody jakościowe, ilościowe i mieszane*. Wydawnictwo Uniwersytetu Jagiellońskiego.

Durowoju, S. T., & Tijani, A. A. (2021). Managing Roles in Entrepreneurial Organisation. *Acta Universitatis Danubius. Œconomica*, *17*(2), 52–66.

Forum Koordynatorów i Koordynatorek Dostępności. (2021). https://www.facebook.com/groups/forumkoordynatorowdostepnosci (accessed: 10.02.2024).

Główny Urząd Statystyczny. (2023). Wyniki finansowe instytucji kultury w okresie styczeń–wrzesień 2023 [Dataset]. Retrieved from: https://stat.gov.pl/obszary-tematyczne/kultura-turystyka-sport/kultura/wyniki-finansowe-instytucji-kultury-w-okresie-styczen-wrzesien-dane-wstepne-2023-roku,8,27.html (accessed: 10.02.2024).

Gov.pl. (2020). *Niezbędnik koordynatora dostępności*. Retrieved from: https://www.gov.pl/web/sluzbacywilna/niezbednik-koordynatora-dostepnosci (accessed: 10.02.2024).

Grover, V., Jeong, S.-R., Kettinger, W. J., & Lee, C. C. (1993). The Chief Information Officer: A Study of Managerial Roles. *Journal of Management Information Systems, 10*(2), 107–130. https://doi.org/10.1080/07421222.1993.11518002

Guo, K. L. (2002). Roles of Managers in Academic Health Centers: Strategies for the Managed Care Environment. *Health Care Manager*, *20*(3), 43–58. https://doi.org/10.1097/00126450-200203000-00007

Güleryüz, Ö., & Duygulu, E. (2020). Can Managerial Roles and Skills Change? An Exploratory Study in the Context of Industry 4.0. *Celal Bayar Üniversitesi Sosyal Bilimler Dergisi*, *18*(4), 33–48. https://doi.org/10.18026/cbayarsos.694644

Horch, H.-D., & Schütte, N. (2003). Competencies of Sport Managers in German Sport Clubs and Sport Federations. *Managing Leisure*, *8*(2), 70–84. https://doi.org/10.1080/1360671032000085684

Konior, A., Pluszyńska, A., & Grabowska, A. (2021). *Dostępność cyfrowa, architektoniczna i informacyjno-komunikacyjna w publicznych instytucjach kultury. Małopolska*. Instytut Kultury Uniwersytetu Jagiellońskiego. Retrieved from: https://kultura.uj.edu.pl/nauka/badania/dostepnosc (accessed: 10.02.2024).

Kostera, M. (2015). Collage narracyjny. In: M. Kostera (Ed.), *Metody badawcze w zarządzaniu humanistycznym* (pp. 81–92). Wydawnictwo Akademickie Sedno.

Koźmiński, A. K., Jemielniak, D., Latusek-Jurczak, D., & Pikos, A. (2023). *Zarządzanie. Nowe otwarcie*. Poltext.

Kurke, L. B., & Aldrich, H. E. (1983). Note – Mintzberg Was Right! A Replication and Extension of the Nature of Managerial Work. *Management Science*, *29*(8), 975–984. https://doi.org/10.1287/mnsc.29.8.975

Labaronne, L., & Müller, A. (2024). Mapping out the Roles of Top Management in Nonprofit Arts and Cultural Organizations. *The Journal of Arts Management, Law, and Society*, *54*(1), 1–16. https://doi.org/10.1080/10632921.2023.2285476

Maciejewska, K. (2024). *Inteligenci skazani na biedę. O pracownikach publicznych instytucji kultury*. Retrieved from: http://miejmiejsce.com/sztuka/inteligenci-skazani-na-biede-o-pracownikach-publicznych-instytucji-kultury/ (accessed: 10.02.2024).

McLeod, R., Jr., & Jones, J. W. (1987). A Framework for Office Automation. *MIS Quarterly*, *11*(1), 87–104. https://doi.org/10.2307/248830

Mech, T. F. (1990). Academic Library Directors: A Managerial Role Profile. *College & Research Libraries*, *51*(5), 415–428. https://doi.org/10.5860/crl_51_05_415

Mintzberg, H. (1971). Managerial Work: Analysis from Observation. *Management Science*, *18*(2). https://doi.org/10.1287/mnsc.18.2.B97

Orero, P. (2017). The Professional Profile of the Expert in Media Accessibility for the Scenic Arts. *International Journal of Translation*, *19*, 143–161. https://doi.org/10.13137/2421-6763/17356

Osbert-Pociecha, G. (2009). Dualna rola człowieka jako źródła kreatywności i oporu w zarządzaniu zmianami w przedsiębiorstwie. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *4*(43), 323–331.

Pasterak, B., & Studziński, J. (2023). *Inkluzywna kultuRRRa – o instytucjach kultury jeszcze bardziej otwartych*. Małopolski Instytut Kultury w Krakowie.

Pearson, C. A. L., & Chatterjee, S. R. (2003). Managerial Work Roles in Asia: An Empirical Study of Mintzberg's Role Formulation in Four Asian Countries. *Journal of Management Development*, *22*(8), 694–707. https://doi.org/10.1108/02621710310487864

Pluszyńska, A., & Konior, A. (2023). *Wdrażanie dostępności w publicznych instytucjach kultury w Polsce. Raport z badań*. Instytut Kultury Uniwersytetu Jagiellońskiego. Retrieved from: https://kultura.uj.edu.pl/nauka/badania/dostepnosc (accessed: 10.02.2024).

Quarterman, J. (1994). Managerial Role Profiles of Intercollegiate Athletic Conference Commissioners. *Journal of Sport Management*, *8*(2), 129–139. https://doi.org/10.1123/jsm.8.2.129

Reduta, M. (2015). Zawód, profesja i kultura profesjonalna. *Optimum. Studia Ekonomiczne*, *2*(74), 100–118.

Remael, A., Orero, P., Black, S., & Jankowska A. (2019). From Translators to Accessibility Managers: How Did We Get There and How Do We Train Them? In: M. Tolosa Igualada, A. Echeverri (Eds), *Porque Algo Tiene Que Cambiar. La Formación de Traductores e Intérpretes: Presente & Futuro / Because Something Should Change: Present & Future Training of Translators and Interpreters* (pp. 131–154). https://doi.org/10.6035/MonTI.2019.11.5

Sieć Liderów i Liderek Dostępności. (2020). https://www.facebook.com/groups/liderki.liderzy.dostepnosci (accessed: 10.02.2024).

Sobolewska, A., & Wilk, B. (2021). *Zapewnianie i finansowanie dostępności. Praktyczny przewodnik dla sektora publicznego*. C.H. Beck.

Sułkowski, Ł. (2004). Metafory w życiu organizacji. *Przegląd Organizacji*, *6*, 7–10. https://doi.org/10.33141/po.2004.06.01

Trenkner, M. (2014). Menedżer jako lider zmiany na przykładzie implementacji systemów zarządzania jakością. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *340*, 595–606.

Ustawa z dnia 19 lipca 2019 r. o zapewnianiu dostępności osobom ze szczególnymi potrzebami (Dz.U. 2022, poz. 2240).

Waczyński, P. (2020). *Potrzeba jedności*. Retrieved from: https://pwkulturalnie.pl/2020/09/13/potrzeba-jednosci/ (accessed: 10.02.2024).

Wolf, F. M. (1981). The Nature of Managerial Work: An Investigation of the Work of the Audit Manager. *The Accounting Review*, *56*(4), 861–881.

Zabid, A. R. M. (1987). The Nature of Managerial Work Roles in Malaysian Public Enterprises. *Asia Pacific Journal of Management*, *5*(1), 16–27. https://doi.org/10.1007/BF01712572

Zakrzewska-Bielawska, A. (Ed.). (2020). *Podstawy zarządzania. Teoria i ćwiczenia*. Wydawnictwo Nieoczywiste.

Zhang, X. (2019). Accessibility Manager: Creating a Profile of a New Profession. *Linguistica Antverpiensia*, *New Series – Themes in Translation Studies*, *18*, 73–86. https://doi.org/10.52034/lanstts.v18i0.510

Zintegrowany System Kwalifikacji. (2020). *Wdrażanie dostępności w organizacji*. Retrieved from: https://kwalifikacje.gov.pl/k?id_kw=13495 (accessed: 10.02.2024).

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 161–178
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18694

Governance Mechanisms in Business--to-Business Relationships: Analysis and Systematisation

Aleksandra Hauke-Lopes[1], **Milena Ratajczak-Mrozek**[2]

[1] Poznań University of Economics and Business, Department of Business Relationships and International Marketing, Niepodległości 10, 61-895 Poznań, Poland, e-mail: aleksandra.hauke-lopes@ue.poznan.pl, ORCID: https://orcid.org/0000-0002-0879-5499

[2] Poznań University of Economics and Business, Department of Business Relationships and International Marketing, Niepodległości 10, 61-895 Poznań, Poland, e-mail: milena.ratajczak-mrozek@ue.poznan.pl, ORCID: https://orcid.org/0000-0003-4432-5459

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Hauke-Lopes, A., & Ratajczak-Mrozek, M. (2026). Governance Mechanisms in Business-to-Business Relationships: Analysis and Systematisation. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 161–178. https://doi.org/10.15678/krem.18694

ABSTRACT

Objective: As the increased number of studies on governance mechanisms is accompanied by a similarly increased lack of terminological consistency, the paper aims to propose a systematisation of the governance mechanisms in B2B relationships based on a systematic literature review.
Research Design & Methods: The paper is based on a systematic literature review of 53 papers from Scopus and Google Scholar databases.
Findings: Based on the detailed governance mechanisms identified in the literature, the own classification of governance mechanisms applied in B2B relationships is proposed. Concurrently with the process of analysing the detailed mechanisms in B2B relationships, the factors influencing the mix of relational, contractual and virtual governance mechanisms were investigated.
Implications/Recommendations: The paper contributes to the theoretical development by providing systematisation of governance mechanisms. The proposed implications are also

important for managerial practice as they systematically present the mix of available detailed mechanisms to be applied in B2B relationships depending on the company's goal and situation.
Contribution: The paper contributes to the theoretical development by providing the systematisation of governance mechanisms in B2B relationships. We have divided broad types of governance mechanisms into detailed types and in some cases additional subtypes. Thus, relational governance mechanisms include mutual trust, social norms and values and day-to-day contact between B2B actors. Contractual governance mechanisms cover written contracts, formal control of activities, formalisation of activities and resource investments in B2B relationships. Finally, virtual governance mechanisms include electronic integration, IT policies and procedures and handling social relationships and norms through IT.

Article type: original article.

Keywords: governance mechanisms, business-to-business relationships, systematic literature review.

JEL Classification: L14, L21, L22.

1. Introduction

In order to establish, develop and end business-to-business (B2B) relationships, companies need to apply specific governance mechanisms, that is a set of organisational or structural arrangements used to shape, manage, and control the business partner's behaviours, business exchanges and interactions (Shahzad *et al*., 2020; Cantù *et al*., 2021).

In the dominant body of research on B2B relationships two main types of governance mechanisms are discussed: contractual (formal, transactional) and relational (informal) (Cao & Lumineau, 2015; Aagaard & Rezac, 2022; Ratajczak-Mrozek, Hauke-Lopes & Harrison, 2024). Contractual governance is based on short or long--term legal documents that enumerate the obligations, responsibilities, and compensations of each B2B actor (Cao & Lumineau, 2015; Bicen, Hunt & Madhavaram, 2021). Relational governance mechanisms are based among others on mutual trust and relational norms (Aagaard & Rezac, 2022; Rouyre, Fernandez & Estrada, 2024). Additionally, with the development of managerial digital solutions, a new governance mechanism was recently proposed, namely virtual (digital) governance (Jean *et al*., 2021; Taylor, 2023) covering the extent to which inter-organisational information systems are used to coordinate business exchanges (Jean *et al*., 2021).

In a fast-changing business environment, the choice of a particular mix of mechanisms is crucial for B2B relationship development (Shahzad *et al*., 2020), impacting further cooperation and performance. The importance of this problem is confirmed by the rapidly growing vast research addressing it (Roehrich *et al*., 2020). However, the increased number of studies on governance mechanisms is

accompanied by a similarly increased lack of terminological consistency, especially regarding the plethora of diverse types of detailed mechanisms and thus incoherence of the classifications used to identify and systematise them. As stated by Roehrich *et al*. (2020, p. 453), "although the concepts of relational and contractual governance in inter-organizational relationships have attracted academic and practitioner interest over the last decades, to date there have been limited comprehensive and systematic efforts to review, analyse and synthesise extant literature." Many authors follow the well-established division into relational or contractual governance mechanisms (e.g., Cao & Lumineau, 2015; Aagaard & Rezac, 2022), while others propose their systematisations or specific types of governance mechanisms (e.g., Shahzad *et al*., 2018; Panda *et al*., 2023). Even when applying the division into relational and contractual governance mechanisms there is no unanimity in terms of the detailed mechanisms within these broad two types. Additionally, as argued by Rai and Surana (2022), despite research on governance mechanisms, the specifics of the interplay between them and their "proper mix" remain ambiguous. This is crucial as "different governance structures are required for different transaction goals in governing relationship(s)" (Shahzad *et al*., 2018, p. 139). This insufficient systematisation of previous research on governance mechanisms (Roehrich *et al*., 2020) is important as coherent classifications are needed for the sake of the comparability of research, to support analysis and theorising (Allen, Wood & Demirbag, 2022, p. 2136) and thus, to ensure methodological correctness.

To address the above-mentioned fragmentation of research and the lack of coherence in the applied classification of governance mechanisms, this paper proposes a systematisation of the governance mechanisms in B2B relationships based on a systematic literature review. Additionally, it discusses the mix of diverse types of governance mechanisms that can be used to facilitate the development of B2B relationships.

The remaining part of the paper is structured as follows. First, we present the method of our study followed by the results of a literature review on contractual, relational and virtual governance mechanisms where we discuss the identified main detailed types of each mechanism. Next, we move to our proposition of the systematisation of governance mechanisms. Finally, we explore the mix of diverse types of governance mechanisms that can facilitate the development of B2B relationships, thus forming the managerial implications.

2. Method of the Study

The paper is based on a systematic literature review (Linnenluecke, Marrone & Singh, 2020; Paul & Criado, 2020) to assess the state of knowledge existing in the governance mechanisms literature. In the research procedure, we followed a three-step process including the selection of 1) the primary database, 2) keywords,

and 3) inclusion and elimination criteria (Snyder, 2019). The search was conducted using the Scopus database as it is the largest database of peer-reviewed literature. Additionally, we applied a snowball method and performed a supplementary search in Google Scholar to access the broadest scope of papers. This search was especially helpful in finding the newest papers on virtual governance mechanisms. In both searches, we used five keywords ("governance" or "mechanism" and "business-to-business" or "B2B" or "network relationship") in the title, and/or abstract, and/or keywords of the papers. We have decided to use separately "governance" and "mechanism" for two reasons. Firstly, searching for "governance mechanism" as a single item only rendered 51 papers, most of them not linked with B2B literature. Secondly, it allowed us to identify papers addressing governance mechanisms in the text, but not highlighting it in the title, abstract or keywords. The search resulted in 1,350 papers. Next, we limited the search to the subject area of business management and accounting as well as to journal articles. This resulted in 513 papers. The following inclusion criteria covered the governance mechanisms as an important focus of the analysis (e.g., not mentioning it just once or twice) as well as the B2B focus of the paper. We have deliberately excluded papers focusing on related yet distant problems, like corporate governance or B2C governance mechanisms. Both conceptual and empirical papers were accepted. The search resulted in 53 papers for the analysis.

As part of the analysis, we identified detailed governance mechanisms discussed and/or proposed in the literature. From the beginning of the analysis, the mechanisms were grouped into relational, contractual, and virtual ones. The division into relational and contractual mechanisms is dominant within the research on B2B relationships (Cao & Lumineau, 2015; Aagaard & Rezac, 2022; Ratajczak-Mrozek, Hauke-Lopes & Harrison, 2024). Although a relatively new category, virtual governance should be distinguished because nowadays almost all business actors apply some form of IT solutions (Kamalaldin *et al*., 2020; Jean *et al*., 2021; Mei, Zheng & Zhu, 2022). For this stage of the analysis, we used verbatim terms for the particular names of the mechanisms used in the literature. Next, to propose a systematisation of the governance mechanisms in B2B relationships (presented in Fig. 1) we adopted the basic principle of creating classifications, meaning "order(ing) phenomena into mutually exclusive and exhaustive categories" (Allen, Wood & Demirbag, 2022, p. 2135). We clustered all the detailed mechanisms found in the literature into detailed subtypes based on the analysis of their content and definitions. In the next classification stage, some subtypes were further grouped into broader categories, called types of mechanisms. The decision to adopt a two-level classification was driven by the varying levels of detail at which these mechanisms are framed in the literature. For instance, information sharing, open communication, and informal information exchange could be clustered under the broader category

of information sharing. However, information sharing itself can also be considered a key component of social norms and values.

3. Results of the Analysis

3.1. Classification of Governance Mechanisms Applied in B2B Relationships

In Tables 1–3 we present detailed subtypes of three broad types of governance mechanisms (relational, contractual and virtual) investigated in the existing literature. Below we summarise the main findings.

Relational governance mechanisms are based "on the informal self-enforcement of those involved and deployed via shared norms and social relations" (Aagaard & Rezac, 2022, p. 133). These mechanisms aim at developing cooperation and lowering the risks of conflicts (Bonatto, de Resende & Pontes, 2020; Ashiru *et al*., 2022).

Based on the literature review (see Table 1), mutual trust is the most commonly proposed detailed relational governance mechanism (Rai & Surana, 2022; Lu, Jiang & Wang, 2024). The second most commonly proposed detailed relational governance mechanism is shared social or relational norms (e.g., Aagaard & Rezac, 2022; Tannir *et al*., 2024). Some authors distinguish additional subtypes of social norms, including information sharing, flexibility and solidarity (e.g., Poppo & Zenger, 2002; Rai & Surana, 2022). It needs to be noted that such a broad understanding and categorisation of social norms means that they cover almost all aspects of more informal cooperation within B2B relationships. This is even more crucial considering that other authors independently (from social norms), refer to such mechanisms as, open communication or informal information exchange (Lu, Jiang & Wang, 2024), which are actually linked with information sharing, idea exchange and problem-solving (e.g., Lee *et al*., 2018; Barbieri *et al*., 2022).

Likewise, solidarity named a social norm (e.g., Poppo & Zenger, 2002; Rai & Surana, 2022) is similar in its idea to commitment (e.g., Melander & Lakemond, 2015; Bicen, Hunt & Madhavaram, 2021), cooperative norms for improving buyers' commitment to suppliers (Vieira *et al*., 2023), contractual fairness (Vanpoucke *et al*., 2022), participation (Lumineau & Henderson, 2012), cooperation and actions (e.g., Bonatto, de Resende & Pontes, 2020; Zhang *et al*., 2020), joint planning (Mukherjee, Musarra & Banerjee, 2023), and alignment of goals and expectations of different organizational actors (e.g., Lu, Jiang & Wang, 2024; Tannir *et al*., 2024). These detailed relational governance mechanisms facilitate the achievement of similar goals, and mutual adaptation (Barbieri *et al*., 2022). Social or relational norms (e.g., Bonatto, de Resende & Pontes, 2022; Mukherjee, Musarra & Banerjee, 2023) can be also linked to shared values (e.g., Lumineau & Henderson, 2012) or relationship culture (Tannir *et al*., 2024).

Table 1. Relational Governance Mechanisms – Results of the Literature Analysis

Authors	Mutual trust	Shared relational/ social norms	Shared values	Social relations	Social norms: information sharing	Social norms: flexibility	Social norms: solidarity	Participation	Open communication	Cooperation/joint actions	Culture	Commitment	Frequent transactions	Contractual fairness	Goal/expectations alignment	Joint planning	Expectations of behaviours	Reputation	Leadership	Informal information exchange	Cooperative norms
Aagaard & Rezac (2022)		✓		✓																	
Agndal, Arvidsson & Nilsson (2023)	✓				✓																
Barbieri *et al.* (2022)	✓						✓		✓	✓											
Bicen, Hunt & Madhavaram (2021)	✓											✓									
Bonatto, de Resende & Pontes (2020)	✓	✓			✓	✓	✓		✓	✓											
Bonatto, de Resende & Pontes (2022)	✓	✓			✓	✓	✓														
Cao & Lumineau (2015)	✓	✓		✓																	
Gulati & Nickerson (2008)	✓														✓						
Lee *et al.* (2018)	✓	✓			✓				✓												
Lu, Jiang & Wang (2024)	✓	✓	✓												✓					✓	
Lumineau & Henderson (2012)			✓			✓	✓	✓													
Melander & Lakemond (2015)	✓	✓										✓	✓		✓		✓				
Mukherjee, Musarra & Banerjee (2023)	✓	✓								✓		✓				✓					
Poppo & Zenger (2002)	✓	✓	✓		✓	✓	✓														

Table 1 cnt'd

Authors	Mutual trust	Shared relational/ social norms	Shared values	Social relations	Social norms: information sharing	Social norms: flexibility	Social norms: solidarity	Participation	Open communication	Cooperation/joint actions	Culture	Commitment	Frequent transactions	Contractual fairness	Goal/expectations alignment	Joint planning	Expectations of behaviours	Reputation	Leadership	Informal information exchange	Cooperative norms
Rai & Surana (2022)	✓				✓	✓	✓														
Rouyre, Fernandez & Estrada (2024)	✓	✓		✓																	
Sven Ivens (2004)		✓																			
Tannir *et al.* (2024)		✓		✓							✓				✓				✓		
Wang, Fang & Li (2019)	✓				✓	✓	✓			✓								✓			
Wegner, Sarturi & Klein (2022)	✓	✓			✓																
Vanpoucke *et al.* (2022)	✓													✓							
Vieira *et al.* (2023)																					✓

Source: the authors.

Some authors, pointing to detailed types of relational governance mechanisms, emphasise aspects related more to the day-to-day contact between B2B actors. These include the importance of social relations (e.g., Cao & Lumineau, 2015; Rouyre, Fernandez & Estrada, 2024), frequent transactions, expectations of other actors' behaviours (Melander & Lakemond, 2015), leadership (Tannir *et al*., 2024) and reputation (Wang, Fang & Li, 2019).

Table 2. Formal Governance Mechanisms – Results of the Literature Analysis

Authors	Written contracts	Centralised control	Formalisation of cooperation	Incentives and sanctions	Specific investments	Formal information integration	Roles and responsibilities	Decision-making and structure	Articulation and alignment of goals	Resource allocation
Aagaard & Rezac (2022)	✓	✓								
Barbieri *et al*. (2022)	✓									
Bonatto, de Resende & Pontes (2022)	✓	✓								
Cao & Lumineau (2015)	✓									
Lee *et al*. (2018)	✓	✓								
Lu, Jiang & Wang (2024)	✓					✓	✓			
Lumineau & Henderson (2012)	✓									
Melander & Lakemond (2015)	✓				✓					
Mukherjee, Musarra & Banerjee (2023)	✓	✓								
Poppo & Zenger (2002)	✓									
Rai & Surana (2022)	✓									
Rouyre, Fernandez & Estrada (2024)	✓									
Tannir *et al*. (2024)							✓	✓	✓	✓
Wang, Fang & Li (2019)	✓									
Wang *et al*. (2024)	✓									
Wegner, Sarturi & Klein (2022)	✓	✓	✓	✓						

Source: the authors.

The contractual governance mechanisms rely on formal contracts or written agreements (e.g., Rai & Surana, 2022; Lu, Jiang & Wang, 2024), thus allowing to minimize risks, control exchange hazards, maximize work efficiency and lower the propensity for opportunistic behaviours (Aagaard & Rezac, 2022; Mukherjee, Musarra & Banerjee, 2023). Therefore, written contracts are named as a major detailed contractual governance mechanism (e.g., Wang, Fang & Li, 2019; Rouyre, Fernandez & Estrada, 2024) (see Table 2). It is noteworthy that contacts may be

associated with other detailed contractual mechanisms which include articulation and alignment of goals (Tannir *et al*., 2024) or formal roles and responsibilities (usually set in contracts) (Lu, Jiang & Wang, 2024; Tannir *et al*., 2024). The second commonly acknowledged contractual governance mechanism in B2B relationships is the centralised control performed by one of the business actors (e.g., Lee *et al*., 2018; Aagaard & Rezac, 2022). Looking at the actual activities associated with control, this mechanism can be linked to the incentives and sanctions (Wegner, Sarturi & Klein, 2022).

As an additional detailed contractual governance mechanism formalisation of cooperation is proposed (Wegner, Sarturi & Klein, 2022). This can be further discussed as formal information integration that relies on codified, structured data and rules for swift decision-making (Lu, Jiang & Wang, 2024) and is thus associated with formal decision-making and structure (Tannir *et al*., 2024). As further detailed contractual governance mechanism Tannir *et al*. (2024) point to resource allocation and Melander and Lakemond (2015, p. 117) to transaction-specific investments that "are made when a firm has little or no use of the assets outside of a specific relationship."

Table 3. Virtual Governance Mechanisms – Results of the Literature Analysis

Authors	Electronic/ virtual integration	Access granting	Regulation of interactions	Community building	Relational norms to enhance commitment to electronic integration	IT policies and standards	Implementation of IT processes and budget controls
Hagiu (2014)		✓	✓				
Jean *et al*. (2020)	✓						
Jean *et al*. (2021)	✓						
Li, Li & Wang (2018)				✓			
Taylor (2023)	✓				✓		
Wu *et al*. (2024)						✓	✓

Source: the authors.

A third broad type of governance mechanism, namely virtual (digital) governance (Jean *et al*., 2020; Taylor, 2023) is a response to the digitalisation of business contexts. Taylor (2023, p. 788) defines virtual governance as "a distinct form of governance that exists when two channel partners are electronically integrated via the adoption and deployment of inter-organizational technologies." As it is a relatively new governance mechanism, the number of studies addressing this problem is limited (see Table 3). As the main detailed mechanism, electronic (virtual) integra-

tion is proposed and realised by the distribution and implementation of electronic solutions (e.g., Jean *et al*., 2021; Taylor, 2023). Another group of detailed virtual governance mechanisms is associated with defined rules, standards and processes gained through IT tools. Here one can mention access granting and rules regulating interactions among different actors through IT tools (Hagiu, 2014), as well as IT policies and standards or implementation of IT processes and budgets (Wu *et al*., 2024). The last group of detailed virtual governance mechanisms pays attention to the development of direct, informal relationships through IT solutions and points to community building (Li, Li & Wang, 2018) or relational norms to enhance commitment to electronic integration (Taylor, 2023).

It should be noted that not every study refers to the common distinction between contractual and relational governance mechanisms in B2B relationships, and instead, analyse them in more general terms or propose their own categorisation of mechanisms (Madhok, 1996; Jell-Ojobor, Hajdini & Windsperger, 2022; Gong, Jiang & Jia, 2023). For example, Shahzad *et al*. (2018) discuss economic and sociological (e.g., trust and communication) governance mechanisms. However, the thorough analysis shows that every above-mentioned detailed governance mechanism can be traced back to the division into relational and contractual mechanisms.

3.2. Governance Mechanisms in B2B Relationships – Systematisation

The conducted analysis of the literature has shown that despite using mostly the same broad types of governance mechanisms in B2B relationships, there is no agreement as to their detailed classification and thus to the array of possible mechanisms actually available to managers. There is a great lack of terminological coherence and often the same phenomena are named by different concepts and types. In Figure 1, based on the presented findings of the systematic literature review, we propose the classification of governance mechanisms. For the sake of comparability with the earlier research, we also present written in italics corresponding types of detailed governance mechanisms from the earlier literature review.

3.3. Applying the Governance Mechanisms – the Managerial Implications

To successfully manage B2B relationships, companies cannot rely on a single governance mechanism and need a whole mix of diverse interdependent contractual, relational and virtual mechanisms. In a similar vein, Rouyre, Fernandez and Estrada (2024) claim that the mix of chosen, specific to the B2B relationship, governance mechanisms is needed to allow its further development.

Composing "the optimal" mix of different mechanisms is demanding because "in certain situations, formal arrangements (i.e., explicit contracts) seem to have greater validity, whereas, in other situations, relational governance arrangements

are crucial" (Sjödin, Parida & Kohtamäki, 2019, p. 908). The most suitable types of governance mechanisms depend on a vast array of factors, including business environment (Sjödin, Parida & Kohtamäki, 2019), B2B relationship characteristics (Agndal, Arvidsson & Nilsson, 2023), transaction goals (Shahzad *et al*., 2018), or the level of conflict and cooperation among B2B actors (Ashiru *et al*., 2022).

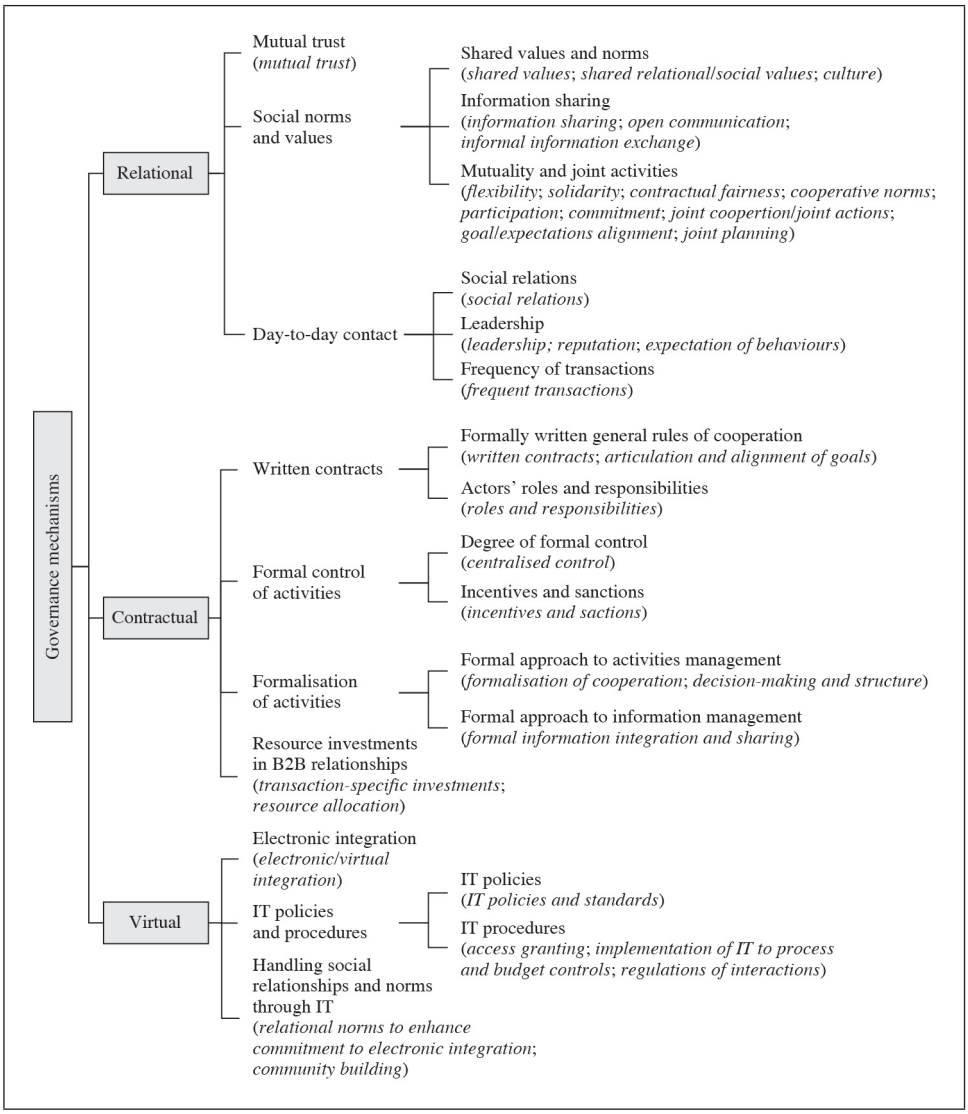

Fig. 1. Classification of Governance Mechanisms

Source: the authors.

Research shows that in turbulent, complex or conflictual environments, relational governance mechanisms should be preferred for a company's development (Sjödin, Parida & Kohtamäki, 2019) as they allow for a more flexible and collaborative approach (Bicen, Hunt & Madhavaram, 2021). Using more of a relational set of governance mechanisms, like social norms (e.g., mutuality) or trust empowered by day-to-day contact allows to improve cooperation and to better handle conflictual situations. Relying on social relations allows for quick reaction to turbulences and complexity of the external environment as relational governance mechanisms can help overcome the limitations of inflexibility inherent in contractual governance (Bonatto, de Resende & Pontes, 2022). In certain situations, B2B actors may depend on relational governance mechanisms as contracts may lack precision or may not be applicable (Poppo & Zenger, 2002; Lee *et al*., 2018).

The mix of the most beneficial governance mechanisms depends also on the development stage and age of the business relationship. For example, Olander *et al*. (2010) found that both relational and contractual governance mechanisms impact R&D cooperation, their mix is similar in the development phase, while in the implementation phase, the contractual governance mechanism prevails. In a similar vein, the findings on asymmetrical relationships showed that young and small strategic networks use high levels of both formal and relational governance mechanisms. Conversely, larger and older strategic networks were observed to have high levels of relational governance mechanisms and low levels of formal governance (Wegner, Sarturi & Klein, 2022).

Additionally, when choosing the suitable mix of governance mechanisms, mutual reinforcement of relational and contractual governance mechanisms should be taken into account by managers. Contractual governance mechanisms are the source of relational governance mechanisms and vice versa. For example, Lu *et al*. (2015) found that an increased focus on contractual governance results in better relational governance and the level of relational governance grows in parallel with the extent of contractual governance. Similarly, Leischnig, Ivens and Kammerlander (2017) revealed that detailed contracts lead to enduring business relationships based on trust. A different interdependence was found by Solinas *et al*. (2022) who claim that trust, as an informal governance mechanism, complements formal governance. Finally, Aagaard and Rezac (2022) in their research showed that contractual governance mechanisms may compensate for the dysfunctionalities of relational governance mechanisms.

The aim of the cooperation is another factor affecting the mix of applied governance mechanisms. It may be assumed that in a short-term, project-oriented horizon, the managers are more likely to rely on formal governance mechanisms, e.g., contracts or control of activities. Still, managers may face challenges as other B2B actors may not be willing to follow demands for joint flexibility, efficiency and

adaptation of activities (Agndal, Arvidsson & Nilsson, 2023). Also, when choosing preferred governance mechanisms, the balance between the scope of coordination of partners, and the desired level of organisational openness and control are major elements the managers need to take into account (Coskun-Setirek *et al*., 2024).

From a managerial perspective, determining access to digital solutions and the implementation of IT solutions (Jean *et al*., 2021; Taylor, 2023) should be seen as distinct governance mechanisms introduced to manage B2B cooperation. By deciding on the distribution and access to IT infrastructure through digital solutions (Hagiu, 2014), managers resolve the scope of the cooperation with B2B partners. However, virtual governance mechanisms also may endorse the relational or contractual governance mechanisms (Li *et al*., 2018; Jean *et al*., 2020). In this case using IT solutions to improve the development of social networks or community building (Li *et al*. 2018) empowers relational governance mechanisms. In terms of contractual governance mechanisms, virtual ones may be used to supervise the formal procedures, processes and standards (Wu *et al*., 2024).

4. Conclusions

The mix of applied governance mechanisms is crucial for each B2B relationship. As the cooperation and interactions are specific to every B2B relationship characteristic as well as external market conditions, managers should consciously choose among the particular mix of relational, contractual and virtual governance mechanisms. The performed systematic literature review shows that the growing interest in the governance mechanisms results in the lack of a coherent approach towards their systematisation. Therefore, the first contribution of the paper lies in proposing, based on the existing typologies, a new and simplified systematisation of the up-to--date relational, contractual and virtual governance mechanisms. The paper's second contribution is found in the managerial recommendations on the mix of governance mechanisms to be used taking into account the dynamics or development stage and age of the business relationship, the macro-environmental factors, the mutual reinforcement between relational and contractual governance mechanisms as well as the impact of the digitalisation on the cooperation.

The paper presents the outcomes of the systematic literature review and as such, lacks empirical validation. Therefore, we invite to develop our systematisation through qualitative and quantitative studies.

Despite the burgeoning research on digital business models, like digital platforms, the existing analysis of virtual governance mechanisms is scarce resulting in a significantly lower number of identified governance mechanisms. Further studies should focus on these specific mechanisms and analyse both theoretical and empirical aspects of the virtual governance.

Authors' Contribution

The authors' individual contribution is as follows: Each contributed 50%.

Conflict of Interest

The authors declare no conflict of interest.

References

Aagaard, A., & Rezac, F. (2022). Governing the Interplay of Inter-organizational Relationship Mechanisms in Open Innovation Projects across Ecosystems. *Industrial Marketing Management*, *105*, 131–146. https://doi.org/10.1016/j.indmarman.2022.06.003

Agndal, H., Arvidsson, A., & Nilsson, U. (2023). Managing Appropriation Concerns and Coordination Costs in Complex Vendor Relationships: Integration and Isolation as Governance Strategies. *Industrial Marketing Management*, *113*, 116–127. https://doi.org/10.1016/j.indmarman.2023.05.023

Allen, M. M. C., Wood, G., & Demirbag, M. (2022). Developing Theoretically Informed Typologies in International Business: Why We Need Them, and How to Do It. *Journal of International Business Studies*, *53*(9), 2133–2146. https://doi.org/10.1057/s41267-022-00529-3

Ashiru, F., Adegbite, E., Nakpodia, F., & Koporcic, N. (2022). Relational Governance Mechanisms as Enablers of Dynamic Capabilities in Nigerian SMEs during the COVID-19 Crisis. *Industrial Marketing Management*, *105*, 18–32. https://doi.org/10.1016/j.indmarman.2022.05.011

Barbieri, P., Paulraj, A., Eltantawy, R., & Prodi, G. (2022). Understanding the Governance of High-performing International Buyer-supplier Relationships in China Using Complexity-based Contingencies. *Journal of Purchasing and Supply Management*, *28*(4), 100794. https://doi.org/10.1016/j.pursup.2022.100794

Bicen, P., Hunt, S. D., & Madhavaram, S. (2021). Coopetitive Innovation Alliance Performance: Alliance Competence, Alliance's Market Orientation, and Relational Governance. *Journal of Business Research*, *123*, 23–31. https://doi.org/10.1016/j.jbusres.2020.09.040

Bonatto, F., de Resende, L. M. M., & Pontes, J. (2020). Relational Governance in Supply Chain: A Systematic Literature Review. *Benchmarking: An International Journal*, *27*(6), 1711–1741. https://doi.org/10.1108/BIJ-01-2019-0033

Bonatto, F., de Resende, L. M. M., & Pontes, J. (2022). Supply Chain Governance: A Conceptual Model. *Journal of Business & Industrial Marketing*, *37*(2), 309–325. https://doi.org/10.1108/JBIM-09-2019-0418

Cantù, C. L., Schepis, D., Minunno, R., & Morrison, G. (2021). The Role of Relational Governance in Innovation Platform Growth: The Context of Living Labs. *Journal of Business and Industrial Marketing*, *36*(13), 236–249. https://doi.org/10.1108/JBIM-02-2020-0114

Cao, Z., & Lumineau, F. (2015). Revisiting the Interplay between Contractual and Relational Governance: A Qualitative and Meta-analytic Investigation. *Journal of Operations Management*, *33–34*(1), 15–42. https://doi.org/10.1016/j.jom.2014.09.009

Coskun-Setirek, A., Carmela Annosi, M., Hurst, W., Dolfsma, W., & Tekinerdogan, B. (2024). Architecture and Governance of Digital Business Ecosystems: A Systematic Literature Review. *Information Systems Management*, *41*(1), 58–90. https://doi.org/10.1080/10580530.2023.2194063

Gong, Y., Jiang, Y., & Jia, F. (2023). Multiple Multi-tier Sustainable Supply Chain Management: A Social System Theory Perspective. *International Journal of Production Research*, *61*(14), 4684–4701. https://doi.org/10.1080/00207543.2021.1930238

Gulati, R., & Nickerson, J. A. (2008). Interorganizational Trust, Governance Choice, and Exchange Performance. *Organization Science*, *19*(5), 688–708. https://doi.org/10.1287/orsc.1070.0345

Hagiu, A. (2014). Strategic Decisions for Multisided Platforms. *MIT Sloan Management Review*, *55*(2), 71–80.

Jean, R.-J. B., Kim, D., Lien, Y.-C., & Ro, S. (2020). The Moderating Effect of Virtual Integration on Intergenerational Governance and Relationship Performance in International Customer–supplier Relationships. *International Marketing Review*, *37*(3), 579–592. https://doi.org/10.1108/IMR-03-2019-0102

Jean, R.-J. B., Kim, D., Shin, G.-C., & Hult, T. (2021). Enhancing Performance in Emerging-market-supplier/MNE-buyer Relationships: An Examination of the Interplay between Virtual and Relational Governance. *Industrial Marketing Management*, *93*, 101–114. https://doi.org/10.1016/j.indmarman.2020.12.007

Jell-Ojobor, M., Hajdini, I., & Windsperger, J. (2022). Governance of International Franchise Networks: Combining Value Creation and Value Appropriation Perspectives. *Journal of Business Research*, *139*, 267–279. https://doi.org/10.1016/j.jbusres.2021.09.001

Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). Transforming Provider-customer Relationships in Digital Servitization: A Relational View on Digitalization. *Industrial Marketing Management*, *89*, 306–325. https://doi.org/10.1016/j.indmarman.2020.02.004

Lee, G., Shin, G.-C., Hwang, D. W., Kuper, P., & Kang, M. (2018). How Manufacturers' Long-term Orientation toward Suppliers Influences Outsourcing Performance. *Industrial Marketing Management*, *74*, 288–297. https://doi.org/10.1016/j.indmarman.2018.07.003

Leischnig, A., Ivens, B. S., & Kammerlander, N. (2017). A New Conceptual Lens for Marketing: A Configurational Perspective Based on the Business Model Concept. *AMS Review*, *7*(3–4), 138–153. https://doi.org/10.1007/s13162-017-0107-6

Li, L., Su, F., Zhang, W., & Mao, J.-Y. (2018). Digital Transformation by SME Entrepreneurs: A Capability Perspective. *Information Systems Journal*, *28*(6), 1129–1157. http://doi.wiley.com/10.1111/isj.12153

Li, X., Li, X., & Wang, R. (2018). An Investigation on Incentive Strategies in Community Building in Business-to-Business Electronic Markets. *Journal of Business-to-Business Marketing*, *25*(4), 261–272. https://doi.org/10.1080/1051712X.2018.1519966

Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting Systematic Literature Reviews and Bibliometric Analyses. *Australian Journal of Management*, *45*(2), 175–194. https://doi.org/10.1177/0312896219877678

Lu, P., Guo, S., Qian, L., He, P., & Xu, X. (2015). The Effectiveness of Contractual and Relational Governances in Construction Projects in China. *International Journal of Project Management*, *33*(1), 212–222. https://doi.org/10.1016/j.ijproman.2014.03.004

Lu, Q., Jiang, Y., & Wang, Y. (2024). The Effects of Supply Chain Governance on Supply Chain Resilience Based on Information Processing Theory. *Industrial Management & Data Systems*, *124*(1), 291–318. https://doi.org/10.1108/IMDS-01-2023-0007

Lumineau, F., & Henderson, J. E. (2012). The Influence of Relational Experience and Contractual Governance on the Negotiation Strategy in Buyer-supplier Disputes. *Journal of Operations Management*, *30*(5), 382–395. https://doi.org/10.1016/j.jom.2012.03.005

Madhok, A. (1996). The Organization of Economic Activity: Transaction Costs, Firm Capabilities, and the Nature of Governance. *Organization Science*, *7*(5), 577–590. https://doi.org/10.1287/orsc.7.5.577

Mei, J., Zheng, G., & Zhu, L. (2022). Governance Mechanisms Implementation in the Evolution of Digital Platforms: A Case Study of the Internet of Things Platform. *R&D Management*, *52*(3), 498–516. https://doi.org/10.1111/radm.12494

Melander, L., & Lakemond, N. (2015). Governance of Supplier Collaboration in Technologically Uncertain NPD Projects. *Industrial Marketing Management*, *49*, 116–127. https://doi.org/10.1016/j.indmarman.2015.04.006

Mukherjee, S., Musarra, G., & Banerjee, S. (2023). Contract Length and Buyer Satisfaction with the Supplier in B2B Partnerships: Evidence from an Experiment. *Industrial Marketing Management*, *112*, 40–50. https://doi.org/10.1016/j.indmarman.2023.04.014

Olander, H., Hurmelinna-Laukkanen, P., Blomqvist, K., & Ritala, P. (2010). The Dynamics of Relational and Contractual Governance Mechanisms in Knowledge Sharing of Collaborative R&D Projects. *Knowledge and Process Management*, *17*(4), 188–204. https://doi.org/10.1002/kpm.356

Panda, S., Pandey, S. C., Paswan, A. K., & Pelton, L. E. (2023). Opportunism in an Emerging Market – Franchisee Perspective. *Journal of Business and Industrial Marketing*, *38*(10), 2092–2106. https://doi.org/10.1108/JBIM-06-2021-0297

Paul, J., & Criado, A. R. (2020). The Art of Writing Literature Review: What Do We Know and What Do We Need to Know? *International Business Review*, *29*(4), 101717. https://doi.org/10.1016/j.ibusrev.2020.101717

Poppo, L., & Zenger, T. (2002). Do Formal Contracts and Relational Governance Function as Substitutes or Complements? *Strategic Management Journal*, *23*(8), 707–725. https://doi.org/10.1002/smj.249

Rai, R., & Surana, M. (2022). Neither Complements nor Substitutes: Examining the Case for Coalignment of Contract-based and Relation-based Alliance Governance Mechanisms in Coopetition Contexts. *Long Range Planning*, *55*(6), 102199. https://doi.org/10.1016/j.lrp.2022.102199

Ratajczak-Mrozek, M., Hauke-Lopes, A., & Harrison, D. (2024). The Evolution of Contractual and Relational Governance Mechanisms When Platforms Are Actors in Networks. *Industrial Marketing Management*, *121*, 198–212. https://doi.org/10.1016/j.indmarman.2024.07.013

Roehrich, J. K., Selviaridis, K., Kalra, J., Van der Valk, W., & Fang, F. (2020). Inter-organizational Governance: A Review, Conceptualisation and Extension. *Production Planning & Control*, *31*(6), 453–469. https://doi.org/10.1080/09537287.2019.1647364

Rouyre, A., Fernandez, A.-S., & Estrada, I. (2024). Co-evolution of Governance Mechanisms and Coopetition in Public-private Projects. *Journal of Operations Management*, *70*(1), 50–79. https://doi.org/10.1002/joom.1281

Shahzad, K., Ali, T., Kohtamäki, M., & Takala, J. (2020). Enabling Roles of Relationship Governance Mechanisms in the Choice of Inter-firm Conflict Resolution Strategies. *Journal of Business & Industrial Marketing*, *35*(6), 957–969. https://doi.org/10.1108/JBIM-06-2019-0309

Shahzad, K., Ali, T., Takala, J., Helo, P., & Zaefarian, G. (2018). The Varying Roles of Governance Mechanisms on Ex-post Transaction Costs and Relationship Commitment in Buyer-supplier Relationships. *Industrial Marketing Management*, *71*, 135–146. https://doi.org/10.1016/j.indmarman.2017.12.012

Sjödin, D., Parida, V., & Kohtamäki, M. (2019). Relational Governance Strategies for Advanced Service Provision: Multiple Paths to Superior Financial Performance in Servitization. *Journal of Business Research*, *101*, 906–915. https://doi.org/10.1016/j.jbusres.2019.02.042

Snyder, H. (2019). Literature Review as a Research Methodology: An Overview and Guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Solinas, G., Meloso, D., Banal-Estañol, A., Seldeslachts, J., & Kretschmer, T. (2022). Competition, Formal Governance and Trust in Alliances: An Experimental Study. *Long Range Planning*, *55*(5), 102240. https://doi.org/10.1016/j.lrp.2022.102240

Sven Ivens, B. (2004). How Relevant Are Different Forms of Relational Behavior? An Empirical Test Based on Macneil's Exchange Framework. *Journal of Business & Industrial Marketing*, *19*(5), 300–309. https://doi.org/10.1108/08858620410549929

Tannir, M., Mills, G., Krystallis, I., & Kalra, J. (2024). Governance, Cooperation and Coordination in Large Inter-organisational Project Networks: A Viable System Perspective. *International Journal of Operations & Production Management*, *44*(3), 617–642. https://doi.org/10.1108/IJOPM-08-2022-0485

Taylor, J. F. (2023). The Role of Relational and Transactional Factors in the Adoption of Virtual Governance Strategies. *Journal of Business & Industrial Marketing*, *38*(4), 788–801. https://doi.org/10.1108/JBIM-08-2021-0393

Vanpoucke, E., Wetzels, M., Rozemeijer, F., & Pilzak-Blonska, M. (2022). The Impact of Asymmetric Perceptions of Buyer-supplier Governance Mechanisms on Relational Rents. *International Journal of Operations & Production Management*, *42*(1), 91–121. https://doi.org/10.1108/IJOPM-05-2021-0296

Vieira, V. A., Mayberry, R., Boles, J., Johnson-Busbin, J., & Pereira, R. C. (2023). The Mediating Role of Cooperative Norms in the Formation of Buyer Commitment in the Buyer-seller Relationship. *Journal of Business and Industrial Marketing*, *38*(7), 1409–1423. https://doi.org/10.1108/JBIM-01-2021-0044

Wang, D., Fang, S., & Li, K. (2019). Dynamic Changes of Governance Mechanisms in Mega Construction Projects in China: The Mediating Role of Opportunism. *Engineering, Construction and Architectural Management*, *26*(4), 723–735. https://doi.org/10.1108/ECAM-03-2018-0137

Wang, Y., Liang, H., Sun, S., & Xue, Y. (2024). How Distance Influences Contractual Governance in Buyer-seller Relationships. *Industrial Marketing Management*, *116*, 1–11. https://doi.org/10.1016/j.indmarman.2023.09.004

Wegner, D., Sarturi, G., & Klein, L. L. (2022). The Governance of Strategic Networks: How Do Different Configurations Influence the Performance of Member Firms? *Journal of Management and Governance*, *26*(3), 1063–1087. https://doi.org/10.1007/s10997-020-09553-7

Wu, T.-H., Huang, S. Y., Chiu, A.-A., & Yen, D. C. (2024). IT Governance and IT Controls: Analysis from an Internal Auditing Perspective. *International Journal of Accounting Information Systems*, *52*, 100663. https://doi.org/10.1016/j.accinf.2023.100663

Zhang, X., Duan, K., Zhao, H., Zhao, Y., Wang, X., & de Pablos, P. O. (2020). Can Cooperation Drive the Success of Suppliers in B2B Crowdsourcing Innovation Projects? A Large Scale Data Perspective. *Industrial Marketing Management*, *90*, 570–580. https://doi.org/10.1016/j.indmarman.2019.09.011

Krakow Review of Economics and Management
Zeszyty Naukowe Uniwersytet Ekonomiczny w Krakowie
1 (1011)
2026

KREM, 2026, 1(1011): 179–200
ISSN 1898-6447
e-ISSN 2545-3238
https://doi.org/10.15678/krem.18693

Forms of Employment and Green Project Management in Non-profit Organisations

Anna Zabłocka-Kluczka[1], **Anna Marciszewska**[2], **Renata Brajer-Marczak**[3]

[1] Wrocław University of Science and Technology, Faculty of Management, Department of Management Systems and Organizational Development, Wybrzeże Stanisława Wyspiańskiego 27, 50-370 Wrocław, Poland, e-mail: anna.zablocka-kluczka@pwr.edu.pl, ORCID: https://orcid.org/0000-0002-4743-2375

[2] Wrocław University of Economics and Business, Faculty of Business and Management, Department of Economics and Organization of Enterprise, Komandorska 118/120, 53-345 Wrocław, Poland, e-mail: anna.marciszewska@ue.wroc.pl, ORCID: https://orcid.org/0000-0001-6182-5821

[3] Wrocław University of Economics and Business, Faculty of Business and Management, Department of Economics and Organization of Enterprise, Komandorska 118/120, 53-345 Wrocław, Poland, e-mail: renata.brajer-marczak@ue.wroc.pl, ORCID: https://orcid.org/0000-0003-3920-2016

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY 4.0); https://creativecommons.org/licenses/by/4.0/

Suggested citation: Zabłocka-Kluczka, A., Marciszewska, A., & Brajer-Marczak, R. (2026). Forms of Employment and Green Project Management in Non-profit Organisations. *Krakow Review of Economics and Management / Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 1(1011), 179–200. https://doi.org/10.15678/krem.18693

ABSTRACT

Objective: The paper discusses the topic of non-profit organisations (NPO) with a particular emphasis on the relationship between Green (Sustainable) Project Management (GPM) and the forms of employment. NPOs strive to meet both social and business requirements, which makes them a unique type of organisation. The specific nature of their functioning, the scope of application of various types of project management concepts, methods and techniques, and especially the application of sustainable approach is still unclear. The aim of the paper is to determine the relationship between the way work is performed in a non-profit organisation and the frequency of using green project management practices (People, Planet, and Prosperity).

Research Design & Methods: To verify the hypotheses, quantitative research was carried out and the CAWI technique was used. Respondents were people representing non-profit organisations in Poland with project experience.

Findings: As a result of the research, it was found that the form of employment has little relationship with the frequency of application of green project management solutions. Statistically significant differences appear mainly in the People area (in particular in the areas of Work practices and decent work, and Training and Education).
Implications/Recommendations: The configuration of employment structures in NPOs is a complex process requiring flexibility and strong relationship-building from managers. It results from formal and informal actions and operates under specific funding conditions. The research shows that employment form has little link to the frequency of GPM use. However, implementing GPM in NPOs demands more effort than in companies, as most funds are allocated to statutory goals, limiting incentives. Therefore, sustainable management culture and continuous stakeholder communication are essential.
Contribution: The topic of the article should be considered important and current because in the literature on the subject, despite research in the area of green (sustainable) project management, the issue of NPOs has not been discussed very often so far. This study is the first to explore the relationship between forms of employment provision and the use of GPM practices.

Article type: original article.

Keywords: project management, green project management, non-profit organisation, sustainable project management, volunteering, forms of employment.

JEL Classification: L31, Q56.

1. Introduction

Organisations, including non-profit organisations (NPOs), need resources to achieve their goals. Among these, people and their knowledge, skills and commitment play a key role. The variability of projects, as well as their uniqueness, size, specificity and duration, determine the variable demand for human labour. In addition to implementing various projects, non-profit organisations also need people to undertake activities to ensure the continuity of such organisations, performing management, administrative, project acquisition, billing and supervision activities, etc. In hiring such people, they have a wide range of employment options (employment contracts, commission contracts and voluntary work), and use these according to the roles the people fulfil in the organisation and in projects.

NPOs should have a high degree of flexibility, openness to new, hitherto unrealised ventures, the willingness to take on challenges, and the creativity. At the same time, consistency in action and, above all, the ability to set goals and find ways to achieve them are essential. Understanding the objectives and nature of the work can help with the management of projects in NPOs. This is all the more so because NPOs tend to operate with social objectives that are complex, multidimensional and context-dependent (Gee *et al*., 2023). Despite the popularity of NPOs as a research topic, a relatively small proportion of these studies deal with project management

and sustainability issues. At the same time, it should be noted that NPOs usually work for the benefit of the community, and have an ethical obligation to conduct their activities responsibly and transparently (Gazzola, Ratti & Amelio, 2017), which fits in with green (sustainable) project management practices.

The ecological and social sensitivity that underpins sustainable practices in project management is inherently close to the values shared by NPOs. Respect for the rights of employees and other stakeholder groups providing work and services to NPOs should be reflected, among other things, in the forms of employment or how relationships between colleagues are formed. Therefore, the study aimed to determine the relationship between the form of work provision in NPOs and the frequency of green (sustainable) project management practices. In adopting such an objective, the authors considered that by delving more deeply into the study of such relationships, new circumstances could be identified and results obtained that could expand knowledge in the area indicated.

2. Theoretical Approach

2.1. Green (Sustainable) Project Management

Green (Sustainable) Project Management is a current trend in project management (Pollack & Adler, 2015; Wawak & Woźniak, 2020). It is founded on the thinking that the needs of the present generation can be met without detracting from the chances of future generations meeting their needs (Trocki, 2019). It is defined as "the planning, monitoring, and controlling of project delivery and support processes, with consideration of the environmental, economic and social aspects of the life--cycle of the project's resources, processes, deliverables, and effects, aimed at realising benefits for stakeholders, and performed in a transparent, fair and ethical way that includes proactive stakeholder participation" (Silvius & Schipper, 2014, p. 79). This view of project management considers responsibility for a project's long-term impact and its outcome on society and the environment. This, in turn, requires the rational pursuit of a specified goal at all stages of the project management cycle, from a project's initiation to its delivery of a product for use (Jakubczyk & Kitowski, 2015). Green (sustainable) project management is a values-based concept based on a community built around a specific idea (Ćwikła, 2023). The issues of responsibility and the pursuit of sustainable positive project outcomes relate to three pillars: People, Planet and Profit, with their extension to include Process and Product. A fundamental tenet of green (sustainable) project management is that project success should be evaluated based on the triple bottom line (economic, social and environmental dimensions) (Baba, Mohammad & Young, 2021). GPM Global, an organisation that has been working since 2009 for company economic development that does not have a negative impact on society and the environment, has proposed

an integrated approach to project implementation, calling it Green Project Management (GPM). It has also developed tools to determine the sustainability impact of the project process and the project product (GPM, 2023). Among these, one can point to the P5 Standard for Sustainability in Project Management (Carboni *et al*., 2022). Its implementation makes it possible to understand the impact of projects with regard to achieving the UN Sustainable Development Goals. The standard provides information on how and why to implement sustainable practices in ongoing projects. It considers the social dimension of sustainability, the environmental aspect of sustainability, and guidance related to the financial dimension. In the remainder of this article, the term GPM will be used to refer to the subject matter covered.

2.2. Specificities of Working in Non-profit Organisations

NPOs are often described as organisations that focus on fulfilling a specific mission rather than generating profit (Gee *et al*., 2023), serving people with different preferences and perceptions of the world (Cabral *et al*., 2019). The value they create can only be identified in relation to the processes that give rise to it (Cabral *et al*., 2019).

Among these processes, one can point to the processes of human resource acquisition and labour provision. This involves people working for the organisation at different levels and with different statuses (e.g., paid staff, unpaid volunteer work). Both paid employees and volunteers tend to be guided by certain personal values, such as commitment, altruism, public service and working for others (Powell & Bromley, 2020), which correspond to the organisation's goals (Egri & Herman, 2000). NPOs attract the attention of individuals who believe in the qualitative goals of the organisation (Rothschild & Milofsky, 2006). These individuals determine the goals of these organisations, whereas in business organisations, human capital is acquired and developed in order to achieve the goals. Thus, it can be concluded that human capital creates opportunities to meet societal needs through the use of knowledge, skills, motivation, abilities, health and professed values (Pauli & Pocztowski, 2008).

There are three very different groups in the staff structure of NPOs: employees (persons employed under a contract of employment, contract for specific work or commission), members (e.g., associations), and volunteers (persons working voluntarily and without remuneration for the benefit of a specific organisation) (Bogacz-Wojtanowska, 2005; Zawadzki, 2007; Wronka-Pośpiech, 2016).

In NPOs, the career path most often starts with volunteer work. This offers the volunteer the opportunity to become, after a certain period of time, part of a project team (work based on a contract for a specific task or commission). The person can also become a project coordinator, who manages the work of a team of several people. Project coordinators are better paid and can participate in the management

of the organisation's activities. However, this requires knowledge of the specific functioning of this type of organisation. In addition, it is worth noting that volunteers can support the operation of NPOs at different levels and to different extents. They may be people performing basic duties or high-level specialists in the organisation's management. Their importance is high, which is why it is becoming increasingly important to define rules of conduct and precisely define and formalise their rights and responsibilities (Gach, 2019; Almas, Chacón-Fuertes & Pérez-Muñoz, 2020).

Volunteers help to achieve the goals of NPOs (e.g., reduce poverty, increase educational support). Therefore, volunteering is largely value-oriented work (Boezeman & Ellemers, 2014). Borzaga and Tortia (2006) showed that volunteer satisfaction is related to intrinsic motives (e.g., opportunities for self-fulfilment and social contribution) and the building of relational capital (e.g., opportunities for new relationships), and has little to do with economic incentives. Compared to paid employees, volunteers are more independent and relatively free to decide when to join and when to withdraw from projects (Boezeman & Ellemers, 2014; Hopkins & Dowell, 2022).

Due to limited resources in NPOs, both staff and management perform multiple functions at the same time. Employees can be at the same time volunteers, project coordinators, people representing the organisation externally to gain public support for their activities, or people coordinating the work of the whole organisation (Marciszewska, 2019).

2.3. The Specifics of Forming Project Teams in Non-profit Organisations

In NPOs, project teams are primarily formed by and made up of people, sometimes very young people, who are often only at the beginning of their career path. They choose to work for NPOs primarily because of the values they share, a good atmosphere, a close-knit team, a high degree of freedom of action, independence or the opportunity to gain professional experience in a relatively short time. They are often empathetic, loyal, open to challenges and committed to stakeholders. NPOs tend to have a less hierarchical structure and are primarily driven by the needs of their colleagues in their activities. They are characterised by their attention to interpersonal relations, rapid employee development, work flexibility or the subjective treatment of employees. In the case of such organisations, one of the main reasons for creating new jobs is to start new projects. Project implementation is based primarily on human capital, not financial capital. It therefore becomes necessary to have the ability to use volunteers to attract and involve cooperation partners, build trust, build strong relationships, have positive attitudes and emotions towards their actions, and to react quickly. On the other hand, this diversity of forms of action, variability and the task-based nature of the work are the cause of employment instability in these organisations. Moreover, this results in situations where

people involved in projects decide to leave due to the lack of guarantee of further participation in projects, or the desire for further professional development in business or public organisations (Marciszewska, 2019; Klafke *et al*., 2021). The majority of NPOs operate based on projects funded by grants or subsidies obtained through competitions.

In practice, still a lack of access to funding the project team has to deal with unstable salaries and irregular working hours (Szmyt-Boguniewicz & Romanowski, 2012). In 2022, the average salary per full-time employee of NPOs was 5.3 thousand PLN, compared to 7.2 thousand PLN in the national economy as a whole. In contrast, 26.3% of registered NPOs with contracted employees indicated a salary size of 3.0 thousand PLN, which was the level of the minimum wage in 2022. Foundations (31%) were paying the minimum salary the most often, followed by associations and similar social organisations (25.6%). In these entities, the number of employees receiving the lowest salary was also higher than average (8.7% and 7.3%, respectively) (GUS, 2024)

2.4. Forms of Employment and Frequency of GPM Practices

Contract based on the legal regulations of the Labour Code secures the interests of employees to the greatest extent, ensuring stability of employment and dignity. Using various forms of fixed-term employment allows the employer to test the employee before tying him or her to the organisation permanently, and an open-ended contract is the perfect tool for retaining valuable employees and building their loyalty (Piwowar-Sulej, 2016). From a social perspective, the use of this form of employment should go hand in hand with the increased use of GPM practices. This relationship appears to be two-way: On the one hand, adopting a sustainability ethos means putting into practice solutions in the project management process that mitigate adverse impacts on human rights, e.g., through employment contracting; on the other hand, employment contracting forces organisations to comply with the Labour Code and thus translates into a better assessment of the organisation from the People perspective in terms of applying GPM practices (Ćwikła *et al*., 2020). However, the high cost of maintaining an employee due to the need to pay various social contributions, combined with the high variability of tasks carried out in project form, is probably why this is the least common form of employment in NPOs (GUS, 2023). GPM starts at the planning stage but is also present at the implementation stage of projects, and requires constant monitoring of the cost-benefit ratio of the projects implemented. One of the main factors to be monitored here are labour costs. From a purely economic perspective, the limited access to financial resources and the high variability of implemented projects mean that the employment contract, as the most cost-intensive form of employment, is not preferred (Charycka, Gumkowska & Bednarek, 2022; Bogacz-Wojtanowska, 2024).

On the other hand, the need to include non-financial costs and benefits, which are difficult to express in monetary terms, is increasingly emphasised in these calculations. The benefits behind the employment contract taken into account in GPM practices, in terms of the possibility for the long-term commitment to the organisation of more engaged employees, and the overall positive impact on the economy (e.g., job creation, reduction of unemployment) may argue in favour of an employment contract (Ćwikła *et al*., 2020; Bogacz-Wojtanowska, 2024). Therefore, the following hypothesis may be formulated:

H1(a–c): The frequency of the use of GPM practices (including in particular People (a), Planet (b), Prosperity (c)) in NPOs with contracted employees differs from the frequency of the use of such practices in NPOs without hired employees.

The specific nature of the operation of not-for-profit organisations is the creation and implementation of the projects, the launch of which is often contingent on obtaining funding but also on finding project contractors. However, the variable, often unique and task-orientated nature of project work, as well as limited financial resources, results in employment instability and a high turnover of project contractors. In such situations, civil law contracts (contracts of mandate or contracts for specific work) work well. Their limited duration, the greater freedom to terminate them than in the case of an employment contract, and the guarantee of a very high degree of freedom in the manner in which the work is carried out, are ideally suited to the needs of not-for-profit organisations. They are also often desirable for project contractors themselves, as they enable them to carry out their work at their convenience and thus combine it in a balanced way with other professional activities or leisure time (Ilyas *et al*., 2020; Bogacz-Wojtanowska, 2024). On the other hand, civil law contracts do not guarantee the employee a workstation that, for example, meets spatial and legal requirements or health and safety regulations, nor do they provide the privileges inherent in employment contracts (e.g., paid holidays or days off). Therefore, questions arise as to whether such forms of procuring project team members take into account the safeguarding of their interests, e.g., security or stability of employment and remuneration adequate to requirements. In terms of its nature, each of these contracts has its specificities. While a contract of mandate (if paid) guarantees the contractor a minimum hourly rate, a contract of specific work does not. In addition, the high turnover of co-workers in fluctuating projects on the one hand necessitates the retraining of new team members, but on the other also fosters knowledge sharing and knowledge acquisition from newly recruited co-workers. It seems, therefore, that in the case of the forms of employment discussed, the frequency of the use of GPM solutions in the area of People may be higher, especially if training and education or organisational learning is taken into account. Labour practices, however, indicate the opposite relationship (Ćwikła *et al*., 2020; Hopkins & Dowell, 2022). Therefore, the following hypothesis may be formulated:

H2(a–c): The frequency of the use of GPM practices (including in particular People (a), Planet (b), Prosperity (c)) in NPOs with employees on a civil law contract differs from the frequency of the use of such practices in NPOs without employees on a civil law contract.

In order to operate effectively, NPOs rely on volunteers besides regular staff to deliver sustainable service to the community (Ilyas *et al*., 2020). NPOs work with limited resoures. The salaries they offer are much lower than in other sectors, and the career or promotion path is not very extensive. Consequently, these organisations are limited in their ability to attract highly qualified staff with project management experience. This is usually compensated by a less restrictive approach to work or by rarely subjecting work to performance evaluation. In such conditions volunteer engagement become the driver of NPOs success. "Volunteerism can be defined as long-term, planned, prosocial behaviours that benefit strangers and occur within an organizational setting" (Penner, 2002, p. 448). By definition this is the work provided without remuneration by members and non-members of an organisation. From an economic perspective, this situation is ideal for non-profit organisations. They have a valuable resource at their disposal for which they do not have to pay a fee, while at the same time they are not de facto obliged to provide the working conditions imposed by Labour Code contracts. Among other things, this raises the risk of unequal treatment of project participants based on their status (form of employment). However, any such "insincerity" on the part of the organisation is a reason for terminating the cooperation. Therefore, the frequency of GPM practices in the context of equal opportunities (Diversity and Equal Opportunity) should be at least the same as in the case of Labour Code-based modes of employment. In terms of turnover rates, volunteers are a group very similar in their characteristics to team members employed under civil law contracts. They are often associated with multiple organisations, which may favour the diffusion of knowledge about GPM practices, but they also require further training (Almas, Chacón-Fuertes & Pérez--Muñoz, 2020; Bogacz-Wojtanowska, 2024). In this context, very similar results can be expected here. Therefore, the following hypothesis was formulated:

H3(a–c): The frequency of the use of GPM practices (including in particular People (a), Planet (b), Prosperity (c)) in NPOs using volunteers differs from the frequency of the use of such practices in NPOs not using volunteers.

The most exciting research perspective would be to compare the frequency of GPM practices in NPOs using the different forms of employment. However, this is not possible because they are not used in isolation but co-occur. For this reason, the adopted research perspective was decided upon. A diagram illustrating the adopted research hypotheses is presented in Figure 1.

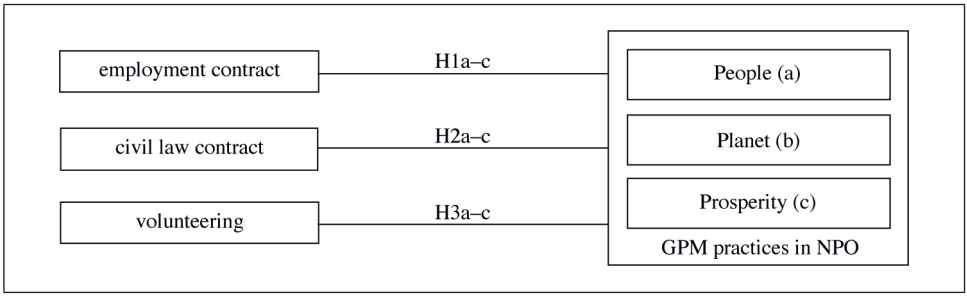

Fig. 1. Forms of Employment in NPOs vs. Frequency of Use of GPM
Source: the authors.

3. Methodology

3.1. General Remarks

The research aimed to identify the relationship between the frequency of the use of green project management solutions and the form of employment in NPOs. The quantitative study was preceded by a literature search, which was conducted with Polish- and English-language keywords: "project management, sustainable project management, green project management, nonprofit organisations, forms of work provision, forms of employment, volunteering" in the Scopus, WoS and Polish BazEkon databases. The review was limited to 10 years, and scientific publications from 2013–2023 were analysed. Boolean operators were applied during the search. The study confirmed that a relatively small number of publications address issues linking GPM to non-profit organisations' project activities, particularly regarding the forms of employment and the type of work provided in these entities. The literature survey results allowed for development of the research hypotheses outlined above and the design of the quantitative study.

3.2. Description of the Research Sample

The results presented in this article are part of a broader study whose topic was Green Project Management in NPOs. The survey was conducted using the CAWI method. A research platform was used in the data collection process, which enabled the e-form to be completed online. The respondents were nonprofit organisations in Poland. The research was focused on a combination of two topics: Green Project Management and methodologies used in project management.

The research process was carried out in three stages between January and May 2023. Purposeful sampling was used. In the first part, an invitation to participate in the survey was sent to publicly available e-mail addresses of foundations and

associations operating in Poland that met the conditions of the project experience. The invitation to participate in the survey was sent to 684 organisations. Twenty-two completed questionnaires were received. The survey return rate was therefore 3.2%. In the second stage – using the LinkedIn Sales Navigator tool – project managers/project coordinators/project leaders and people managing projects and performing one of the above functions in non-profit organisations operating in Poland were reached directly with an invitation to participate in the survey. The list covered 94 organisations. Eighteen questionnaires were received in return. In this case, the return rate was much higher at 19.15%. Next five questionnaires was achiewed due to snowball sampling. Finally, the survey was conducted on a group of 45 non-profit organisations. With 88.4 thousand foundations and associations operating as NPOs and registered in Poland in 2022 (GUS, 2024, p. 27), unknown distribution of characteristics (use of specific project management solutions: Green Project Management and methodologies of project management) and the assumed significance level of 0.05, such a sample size gives an acceptable measurement error of less than 15%.

Table 1. Description of the Research Sample

Characteristics of the Organisation in the Research Sample		Associations (*N*)	Foundations (*N*)	Together	
				N	%
Public benefit organisation	yes	14	12	26	57.78
	no	8	11	19	42.22
Employment contract	not used	13	5	18	40.00
	used	9	18	27	60.00
Civil law agreement	not used	7	7	14	31.11
	used	15	16	31	68.89
Voluntary work	not used	5	5	10	22.22
	used	17	18	35	77.78

Source: the authors.

The questionnaire was addressed to and completed by people who have the widest possible knowledge of project management in NPOs. Respondents were individuals with project management expertise (62.2% were board members, 22.2% were project coordinators/managers, and 15.6% were other organisation members). Detailed information on the surveyed NPOs is presented in Table 1 and differences in the forms of employment used in the general population in Poland in 2022 and the surveyed sample are presented in Figure 2. It must be added that in 2022, 64.7% of registered non-profit organisations in Poland did not use paid work at all, while 95.1% of them declared that they used social work, with approx. 3.1 million volunteers (GUS, 2024, p. 27).

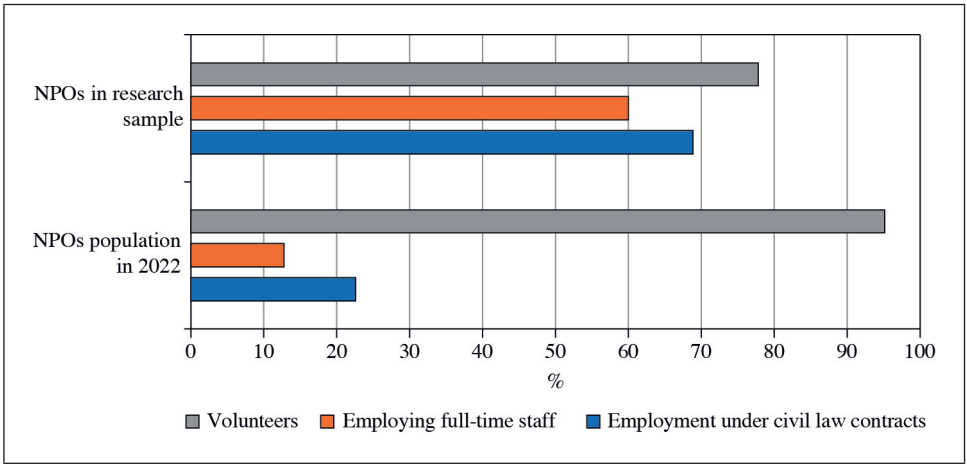

Fig. 2. Forms of Employment in the Population (in Poland in 2022) and in the Research Sample
Source: the authors.

Less than 5% of the organisations (in research sample) operate on the international market, with the overwhelming majority operating in Poland (58% on the local market or regional market, and approx. 38% on the national market). In this respect, the structure of the sample is quite similar to the structure of the population of NGOs operating in Poland (where approx. 5.5% operates on the international market, 18.4% – on the national one, and 76.1% – on the local or regional one) (GUS, 2024, p. 20). The overwhelming majority of the organisations (60%) have operated on the market for 15 years or more. There is a slightly lower percentage of organisations operating solely based on voluntary work (48.8%). In contrast, there is a higher percentage of organisations offering paid work under civil law contracts (approx. 69%) and employment contracts (60%), with the latter form of employment being encountered least frequently. The organisations have varied experience in project implementation. Almost half of them (49%) declare that they implement several individual projects, while the others implement many projects continuously and in parallel.

3.3. Characteristics of Research Variables

To assess the frequency of GPM practices in the NPOs studied, the variable GPM Practices was constructed. The items comprising the variable and the scale by which they were assessed were taken from the literature (Juchniewicz, 2019) and adapted for NPOs. The variable *GPM practices* is constructed using a 3-point scale (never, usually, always) as an average of three auxiliary variables: *People*, *Planet*

and *Prosperity*. The *People* variable was constructed from 41 questions grouped into 16 sub-variables describing the organisation's behaviour toward different stakeholder groups (employees, colleagues, customers). In relation to employees and co-workers, solutions were assessed in areas such as working practices, employee-management relations, project health and safety, training and education, organisational learning and equal treatment. The *Planet* variable was constructed from 12 questions grouped into three sub-variables: *Transport*, *Energy* and *Consumption*.

The variables describing the ways of work provision (employment contract, civil contract, volunteering) are nominally zero-one, where one indicates that the organisation uses the form of work provision referred to in the question, while 0 means that it does not.

3.4. Descriptive Statistics and Scale Reliability Analysis

The description of the research results was preceded by an assessment of the reliability of the scales. Analysis was performed using PS Imago Pro ver. 7.0. For all variables studied, Cronbach's α value was acceptable (over 0.7) or high (over 0.8), indicating high internal reliability of the scales and measurements. In the next step of the analysis, the normality of the distribution of variables was examined. Due to the sample size, the Shapiro-Wilk test was used, which turned out to be statistically insignificant for the variables *GPM practices* ($W(41) = 0.976$; $p = 0.522$), *Planet* ($W(41) = 0.949$; $p = 0.063$) and *Prosperity* ($W(41) = 0.950$; $p = 0.071$). This means that the distribution of the variables studied does not differ from the normal distribution. For the *People* variable, the test results turned out to be statistically significant ($W(41) = 0.908$; $p = 0.003$), however the standard error of kurtosis and skewness is in the range <–2, 2>, which means that the distribution of this variable is close to normal. This is a left-skewed, lepotkurtic distribution. For the remaining variables studied, there are no grounds to reject the assumption of normality of distribution. The results of this analysis are presented in the Table 2.

Table 2. Defined Variables along with Descriptive Statistics and Scale Reliability Analysis

Variable Characteristics	GPM Practices	People	Planet	Prosperity
Number of scales	3	16	3	5
Cronbach's α	0.726	0.906	0.847	0.914
% var	66.754	85.958	78.114	75.148
M	2.331	2.541	2.217	2.167
SD	0.409	0.329	0.506	0.594
Skewness	–0.038	–1.027	–0.018	–0.223

Table 2 cnt'd

Variable Characteristics	GPM Practices	People	Planet	Prosperity
SE skewness	0.354	0.354	0.361	0.365
Kurtosis	–0.600	1.132	–0.668	–0.736
SE kurtosis	0.695	0.965	0.709	0.717

Source: the authors.

4. Description of the Research Results

In order to verify hypotheses H1(a–c)–H3(a–c), a relationship was sought between the frequency of using GPM practices and the choice of a specific method of "employment." In all cases, the variable related to the way work is provided is nominal, and the variable describing the frequency of GPM practices is quantitative. Due to the unequal number of responses in the studied groups (as well as $n < 30$ in each group), in all cases the nonparametric equivalent of the *t*-Student test for independent samples was used – the *U* Mann-Whitney test. Additionally, to assess the size of the effect, the Eta-squared correlation was calculated. The results of this analysis are presented in the Table 3.

Table 3. The Results of Nonparametric *U* Mann-Whitney Test and Eta-squared Correlation (η^2)

Variable	People (a)	Planet (b)	Prosperity (c)	GPM Practices
	$N = 45$	$N = 43$	$N = 42$	$N = 45$
Employment contract (H1)	$\eta^2 = 0.003$	$\eta^2 = 0.145$	$\eta^2 = 0.027$	$\eta^2 = 0.036$
	$U = 240.5$ $p = 0.954$	$U = 119.5$ $p = 0.011$	$U = 170.0$ $p = 0.240$	$U = 187.0$ $p = 0.194$
Civil law contract (H2)	$\eta^2 = 0.013$	$\eta^2 = 0.036$	$\eta^2 = 0.032$	$\eta^2 = 0.013$
	$U = 240.5$ $p = 0.564$	$U = 146.5$ $p = 0.202$	$U = 155.0$ $p = 0.284$	$U = 178.0$ $p = 0.339$
Volunteering (H3)	$\eta^2 = 0.011$	$\eta^2 = 0.188$	$\eta^2 = 0.030$	$\eta^2 = 0.094$
	$U = 126.0$ $p = 0.189$	$U = 65.0$ $p = 0.007$	$U = 106.0$ $p = 0.202$	$U = 104.0$ $p = 0.053$

Source: the authors.

The results obtained show that there are no statistically significant relationships between employment under an employment contract and the frequency of using *GPM practices* (in general), as well as in relation to the areas of *People* and *Prosperity*, although the frequency of using *GPM practices* is generally lower in NPOs that employ employees under an employment contract. Therefore, there are no grounds to accept hypotheses H1, H1a and H1c, however H1b hypothesis can be accepted.

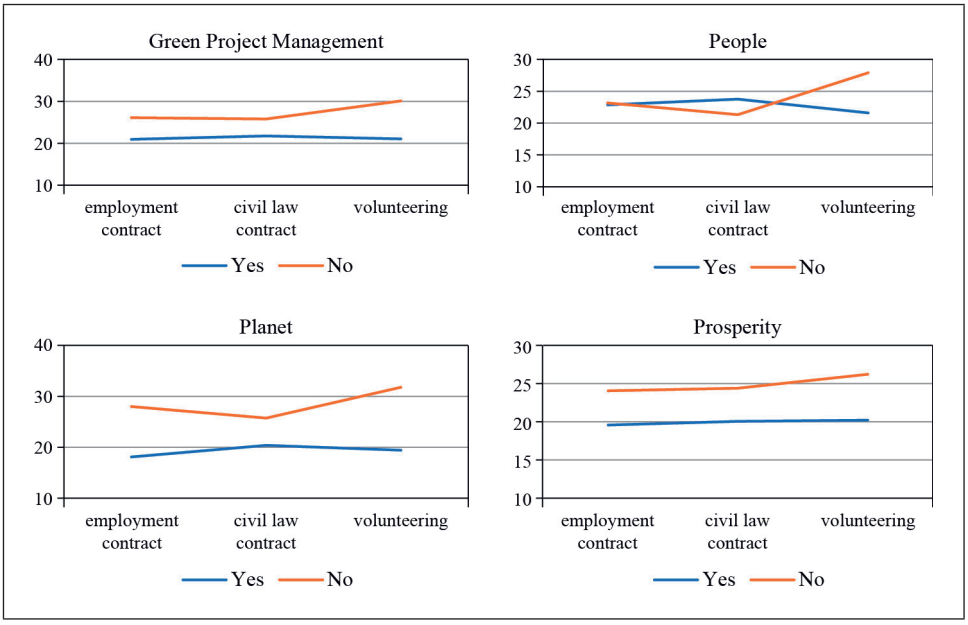

Fig. 3. The Average Ranks in the Groups for the Tested Variables
Source: the authors.

The research results show that the frequency of using *GPM practices* in the *Planet* area is lower in NPOs employing employees under an employment contract (see Fig. 3 showing the average ranks in the groups for the tested variables), and the analysis with the Mann-Whitney *U* rank test showed that the differences between the groups were statistically significant ($U = 119.5$; $p = 0.011$). The Eta-squared measure also confirmed the existence of a strong effect between the studied variables ($\eta^2 = 0.145$). The results are similar when the variable under study is volunteering, perceived as a way of doing work. Again, there are no grounds to accept hypotheses H3 (although here the results are on the verge of statistical significance), H3a and H3c, and at the same time the H3b hypothesis can be accepted (the frequency of using *GPM practices* in the *Planet* area is lower in non-profit organisations using the work of volunteers, and the analysis with the *U* Mann-Whitney test showed that the differences between the groups are statistically significant ($U = 65.0$; $p = 0.007$). The existence of a strong effect between the variables studied is also confirmed by the Eta-square measure ($\eta^2 = 0.188$). Moreover, it should be emphasised that the frequency of using solutions in the field of GPM in general and in the areas of *Planet* and *Prosperity* is higher in the case of NPOs that do not employ employees under civil law contracts (while in the area of *People* the relationship is reverse), but

these are not statistically significant differences. Therefore, there are no grounds to accept hypotheses H2(a–c).

Solutions in the areas of *People*, *Planet* and *Prosperity* constitute the overall GPM practices in the surveyed non-profit organisations, but they are so diverse that it is worthy of delving deeper into each sphere in the research. Solutions in the areas of *Planet* (*Transport*, *Energy* and *Consumption*) and *People* are particularly noteworthy. Therefore, in a manner analogous to the above, partial hypotheses were tested verifying whether a specific form of "employment" was related to the frequency of using GPM practices. The research was preceded by an analysis of the internal consistency of the partial scales (in all cases, the Cronbach's α value exceeded 0.7). The results of these analyses are presented in the Table 4. It is limited to showing only those variables for which statistically significantly different results were obtained.

Table 4. The Results of Nonparametric *U* Mann-Whitney Test and Eta-squared Correlation (η^2)

Variable	Area				
	Planet (b)			People (a)	
	Transport	Energy	Consumption	Work practices and decent work	Training and education
	$N = 42$	$N = 34$	$N = 40$	$N = 45$	$N = 43$
Employment contract (H1)	$\eta^2 = 0.137$	$\eta^2 = 0.061$	$\eta^2 = 0.149$	$\eta^2 = 0.143$	$\eta^2 = 0.147$
	$U = 121.0$ $p = 0.021$	$U = 89.5$ $p = 0.127$	$U = 104.5$ $p = 0.019$	$U = 338.5$ $p = 0.024$	$U = 122.5$ $p = 0.013$
Civil law contract (H2)	$\eta^2 = 0.000$	$\eta^2 = 0.188$	$\eta^2 = 0.004$	$\eta^2 = 0.062$	$\eta^2 = 0.045$
	$U = 183.5$ $p = 0.923$	$U = 45.5$ $p = 0.007$	$U = 157.0$ $p = 0.760$	$U = 257.5$ $p = 0.311$	$U = 149.0$ $p = 0.232$
Volunteering (H3)	$\eta^2 = 0.068$	$\eta^2 = 0.278$	$\eta^2 = 0.194$	$\eta^2 = 0.010$	$\eta^2 = 0.019$
	$U = 86.5$ $p = 0.114$	$U = 16.0$ $p = 0.004$	$U = 38.0$ $p = 0.004$	$U = 193.0$ $p = 0.638$	$U = 118.5$ $p = 0.510$

Source: the authors.

In the *People* area, the subject of analysis was the practices of non-profit organisations in the field of: work practices and decent work, relations between employees and management, occupational health and safety in the project, training and education, organisational learning and equal treatment. Statistically significant differences were obtained only in two cases: *Work practices and decent work*, and *Training and education*. In the surveyed organisations using employment contracts, the frequency of *GPM practices* in the area of *Work practices and decent work* is statistically significantly higher than in organisations that prefer other forms of work

($U = 338.5$; $p = 0.024$; $\eta^2 = 0.143$) and lower in the area of *Training and education* ($U = 122.5$; $p = 0.013$; $\eta^2 = 0.147$).

In the surveyed organisations using employment contracts, the frequency of using *GPM practices* in the areas of *Transport* and *Consumption* is statistically significantly lower than in the organisations preferring other forms of work ($U = 121.0$; $p = 0.021$; $\eta^2 = 0.137$ and $U = 104.5$; $p = 0.019$; $\eta^2 = 0.149$, respectively). However, in relation to the *Energy* area, it is lower in the case of organisations employing under a civil law contract ($U = 45.5$; $p = 0.007$; $\eta^2 = 0.188$) and using unpaid work in the form of volunteering ($U = 16.0$; $p = 0.004$; $\eta^2 = 0.278$).

5. Discussion

The purpose of the presented study was to verify whether there is a relationship between employment methods in NPOs in Poland and the frequency of using GPM practices. In the course of the research, GPM practices were both treated as one overall variable and considered separately in three main dimensions considering the social dimension of sustainability (*People*), the environmental aspect of sustainability (*Planet*) and guidelines related to the financial dimension of sustainability (*Prosperity*) (GPM, 2023). The results obtained indicate the lack of a significant relationship between the employment method in NPOs and the frequency of applying *GPM practices* in general (overall variable), however, going into the particular dimensions constituting the *GPM practices* variable provided interesting results. GPM practices are used less frequently in organisations that use the services of volunteers (although it must be underlined that the results are on the verge of statistical significance here and a tendency toward negative correlation is observed). Perhaps this is related to the informal relationship of volunteers with the organisation, their high turnover, and the lack of greater influence of managers on their attitudes and behaviours. Volunteers focus on assigned tasks; the most important thing for them is the implementation of the project in accordance with the set goals, and they are often not sufficiently prepared to take actions according to a specific project management methodology. They may also want to demonstrate their effectiveness so that they can eventually have paid employment. Perhaps when they stop providing unpaid work, their attention can be redirected to aspects of GPM. It was expected that a greater frequency of GPM practices in the *Prosperity* area would be associated with a preference for forms of employment other than an employment contract. However, although the frequency of GPM solutions is higher in organisations that prefer other forms of employment, the results turned out to be statistically insignificant and did not confirm this relationship.

In general, in the *People* area there was also no statistically significant relationship with the frequency of using GPM practices. However, due to the diverse nature and large number of partial variables that constitute this variable, in-depth

analyses were carried out, which revealed some differences between various forms of work. It was noticed that in the case of employment contracts in the surveyed organisations in the area of *Work practices and decent work*, the frequency of using GPM practices is higher than in organisations preferring other forms of work, but lower (in comparision to other forms of employment) in the area of *Training and education*. And these are statistically significant relationships. This is confirmed by studies indicating that many non-profit organisations, due to financial constraints, do not invest in training and development of project competencies of their employees (Hassan, Bashir & Abbas, 2017; Jałocha & Bogacz-Wojtanowska, 2017). In Poland, many non-profit organisations base their activities on volunteer labour, only 41% of them have paid project teams, and only 22% of them have employees under employment contracts. As a result, project competencies are often not recognised, and it is difficult to invest in their development, as the work in these organisations tends to be action-oriented or temporary (Charycka, Gumkowska & Bednarek, 2022). Additionally, a phenomenon known as "project-free time" is observed: A period when the organisation is not implementing any projects but is instead focused on applying for new ones, waiting for the launch of new funding opportunities or programmes. Undoubtedly, this affects the organisation's activity levels and hinders the implementation of training processes.

Nowadays, attention is increasingly drawn to the fact that without effective project teams, these organisations will not be able to effectively manage projects, which will translate into limited opportunities to obtain external financial resources to achieve their statutory goals. Without the ability to manage projects, especially teams within ongoing projects, donors will be reluctant to co-finance even noble social goals. Pressure from external funders forces non-profit organisations to increase the professionalisation of project management (Anderson & Lannon, 2018). This leads to the organisation of processes, knowledge generation within organisations, stabilisation of finances, strategic shaping, and the fostering of innovative processes (Bogacz-Wojtanowska, 2024).

One of the solutions, and also a necessity nowadays, is to employ people with project experience gained in the private sector. And this is related to the signed employment contract, the level of remuneration, exposure to a different management culture, thinking, and motivation to work. According to Jałocha *et al*. (2023), projects introduce a new institutional logic to non-profit organisations. They foster relationships with the external environment, cultivate a project-oriented culture, and, at the operational level, contribute to the development of a management system. As LeRoux and Wright (2010) note, the gradual increase in managerial skills observed over time can contribute to the enhancement of project management competence.

However, the result in the areas of *Consumption* and *Energy*, which shows that the frequency of using GPM practices is significantly lower in NPOs using employment contracts than in the organisations preferring other forms of work (especially volunteering), is surprising. Perhaps this is the result of focusing a lot of attention on projects that concern the so-called soft aspects (e.g., education, fighting poverty). This is confirmed by research conducted by the Klon/Jawor Association (Charycka, Gumkowska & Bednarek, 2022), which shows that in 2022, the most common activities among non-profit organisations included conducting training and courses, as well as providing counseling and expert advice. Additionally, these organisations offered free services to mobilise and educate the public. One in three foundations (30.3%) also engaged in activities aimed at providing social and humanitarian assistance. Furthermore, 27.9% of non-profit organisations undertook additional initiatives to support those affected by the war in Ukraine (Charycka, Gumkowska & Bednarek, 2022).

6. Summary

Project management is a concept that is widely used in NPOs around the world, regardless of their nature and focus of operations (Golini, Kalchschmidt & Landoni, 2015). This article attempted to determine the links between the forms of employment in NPOs and the frequency of GPM practices. It was noted that the provision of work in NPOs is a complex process that requires a great deal of flexibility and relationship-building on the part of managers. This process results from specific formal and informal managerial actions, and takes place under conditions of specific access to funding sources. Based on the quantitative research, it can be concluded that the form of employment used in the organisations studied has little connection with the frequency of the use of GPM solutions. However, it is worth noting that for NPOs, taking action in this area requires much more effort than in the case of business entities. This is because these organisations allocate a significant portion of the funds they generate to statutory purposes, and there are limited opportunities for their use in influencing those employed on projects. In the case of GPM, it seems necessary to rely on the instruments of sustainable management culture to influence those employed and volunteers. These assumptions must be constantly disseminated to an organisation's internal stakeholders so that they are aware of them and make decisions based on them aimed at a sustainable approach to project implementation. On the other hand, the goals adopted by NPOs and the projects undertaken by them are largely driven by the values recognised by their managers, which are often based on a high degree of social and environmental sensitivity, which one might think could translate into greater implementation of GPM practices.

The authors recognise the limitations of the study, which relate primarily to the size of the research sample. Therefore, the study's conclusions can only be applied

to the study population. Another limitation was the adoption of a 3-point response scale. Its use was due to the adopted research tool described in the literature, which referred to business organisations. Investigating more interdependencies between areas of GPM in NPOs may require modification of this scale. A final limitation was that the survey was conducted in NPOs operating in Poland, where the professionalisation of project management is still at an insufficient level.

Further research into the relationship between employment types and the frequency of green project management solutions could focus on meaningful green projects implemented by non-profit organisations. Project managers play a key role in project implementation. Therefore, research among non-profit organisations employing project managers with a high degree of environmental awareness, particularly those under formal employment contracts, seems promising. In this case, qualitative research, especially using structured interviews, could be useful.

Authors' Contribution

The authors' individual contribution is as follows: Each contributed a third.

Conflict of Interest

The authors declare no conflict of interest.

References

Almas, S., Chacón-Fuertes, F., & Pérez-Muñoz, A. (2020). Direct and Indirect Effects of Transformational Leadership on Volunteers' Intention to Remain at Non-profit Organizations. *Psychosocial Intervention*, *29*(3), 125–132. https://doi.org/10.5093/pi2020a17

Anderson, K., & Lannon, J. (2018). Project Management Performance Assessment in the Non-profit Sector. *Project Management Research and Practice*, *5*, 5910. https://doi.org/10.5130/pmrp.v5i0.5910

Baba, S., Mohammad, S., & Young, C. (2021). Managing Project Sustainability in the Extractive Industries: Towards a Reciprocity Framework for Community Engagement. *International Journal of Project Management*, *39*(8), 887–901. https://doi.org/10.1016/j.ijproman.2021.09.002

Boezeman, E. J., & Ellemers, N. (2014). Volunteer Leadership: The Role of Pride and Respect in Organizational Identification and Leadership Satisfaction. *Leadership*, *10*(2), 160–173. https://doi.org/10.1177/1742715012467487

Bogacz-Wojtanowska, E. (2005). *Wzory zatrudnienia w organizacjach pozarządowych*. Instytut Spraw Publicznych.

Bogacz-Wojtanowska, E. (2024). *Druga twarz trzeciego sektora. Współczesne wyzwania zarządzania organizacjami pozarządowymi*. PWE.

Borzaga, C., & Tortia, E. (2006). Worker Motivations, Job Satisfaction, and Loyalty in Public and Nonprofit Social Services. *Nonprofit and Voluntary Sector Quarterly*, *35*(2), 225–248. https://doi.org/10.1177/0899764006287207

Cabral, S., Mahoney, J. T., McGahan, A. M., & Potoski, M. (2019). Value Creation and Value Appropriation in Public and Nonprofit Organizations. *Strategic Management Journal*, *40*(4), 465–475. https://doi.org/10.1002/smj.3008

Carboni, J., Duncan, W., Gonzalez, M., Milsom, P., & Young, M. (2022). *The GPM P5™ Standard for Sustainability in Project Management*. GPM Global. Version 2.0. Retrieved from: https://greenprojectmanagement.org/images/PDF/P5/The%20GPM%20P5%20Standard%20for%20Sustainability%20in%20Project%20Management%20v2.0.pdf (accessed: 23.05.2024).

Charycka, B., Gumkowska, M., & Bednarek, J. (2022). *Kondycja organizacji pozarządowych – najważniejsze fakty 2021*. Stowarzyszenie Klon/Jawor.

Ćwikła, M. (2023). Zrównoważone zarządzanie projektami. Krytyczny przegląd literatury. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *67*(5), 87–100. https://doi.org/10.15611/pn.2023.5.08

Ćwikła, M., Góral, A., Bogacz-Wojtanowska, E., & Dudkiewicz, M. (2020). Project-based Work and Sustainable Development – a Comparative Case Study of Cultural Animation Projects. *Sustainability*, *12*(16), 6519. https://doi.org/10.3390/su12166519

Egri, C. P., & Herman, S. (2000). Leadership in the North American Environmental Sector: Values, Leadership Styles, and Contexts of Environmental Leaders and Their Organizations. *The Academy of Management Journal*, *43*(4), 571–604. https://doi.org/10.2307/1556356

Gach, D. (2019). Wybrane praktyki zarządzania zasobami ludzkimi w przedsiębiorstwach społecznych. *Edukacja Ekonomistów i Menedżerów*, *53*(3), 52–71. https://doi.org/10.5604/01.3001.0013.5254

Gazzola, P., Ratti, M., & Amelio, S. (2017). CSR and Sustainability Report for Nonprofit Organizations. An Italian Best Practice. *Management Dynamics in the Knowledge Economy*, *5*(3), 355–376. https://doi.org/10.25019/MDKE/5.3.03

Gee, I. H., Nahm, P. I., Yu, T., & Cannella, A. A. (2023). Not-for-Profit Organizations: A Multi-disciplinary Review and Assessment from a Strategic Management Perspective. *Journal of Management*, *49*(1). https://doi.org/10.1177/01492063221116581

Golini, R., Kalchschmidt, M., & Landoni, P. (2015). Adoption of Project Management Practices: The Impact on International Development Projects of Non-governmental Organizations. *International Journal of Project Management*, *33*(3), 650–663. https://doi.org/10.1016/j.ijproman.2014.09.006

GPM. (2023). *The GPM® P5™ Standard for Sustainability in Project Management*, ver. 3.0. Retrieved from: https://gpm-emea.org/pl/gpm/standard-p5/ (accessed: 5.02.2024).

GUS. (2023). *Działalność stowarzyszeń i podobnych organizacji społecznych, fundacji, społecznych podmiotów wyznaniowych oraz samorządu gospodarczego i zawodowego w 2022 r. – wyniki wstępne*. Retrieved from: https://stat.gov.pl/obszary-tematyczne/gospodarka-spoleczna-wolontariat/gospodarka-spoleczna-trzeci-sektor/dzialalnosc-stowarzy-

szen-i-podobnych-organizacji-spolecznych-fundacji-spolecznych-podmiotow-wyznaniowych-oraz-samorzadu-gospodarczego-i-zawodowego-w-2022-r-wyniki-wstepne,3,10.html (accessed: 5.02.2024).

GUS. (2024). *The Non-profit Sector in 2022*. Statistics Poland, Statistical Office in Kraków.

Hassan, M. M., Bashir, S., & Abbas, S. M. (2017). The Impact of Project Managers' Personality on Project Success in NGOs: The Mediating Role of Transformational Leadership. *Project Management Journal*, *48*(2), 74–87. https://doi.org/10.1177/875697281704800206

Hopkins, B., & Dowell, D. (2022). Recruitment and Retention in Not-for-profit Organisations: Tailored Strategies for Younger and Older Volunteers. *Employee Relations: The International Journal*, *44*(1), 259–273. https://doi.org/10.1108/ER-10-2020-0450

Ilyas, S., Butt, M., Ashfaq, F., & Acquadro Maran, D. (2020). Drivers for Non-profits' Success: Volunteer Engagement and Financial Sustainability Practices through the Resource Dependence Theory. *Economies*, *8*(4), 101. https://doi.org/10.3390/economies8040101

Jakubczyk, K., & Kitowski, P. (2015). Społecznie odpowiedzialny projekt – opracowanie definicji na podstawie przeglądu literatury z zakresu społecznej odpowiedzialności i zarządzania projektami. *e-mentor*, *5*(62), 50–64. https://www.doi.org/10.15219/em62.1210

Jałocha, B., & Bogacz-Wojtanowska, E. (2017). Project Portfolio Management: Tool for Strategy Implementation in Non-Governmental Organizations. In: L. L. West, A. Worthington (Eds), *Handbook of Research on Emerging Business Models and Managerial Strategies in the Nonprofit Sector* (pp. 87–103). IGI Global. https://doi.org/10.4018/978-1-5225-2537-0.ch006

Jałocha, B., Bogacz-Wojtanowska, E., Góral, A., Jedynak, P., & Prawelska-Skrzypek, G. (2023). Conflicting or Co-existing Logics – Doing Action Research within the Framework of a Project in a University. *International Journal of Management Projects in Business*, *16*(1), 45–66. https://doi.org/10.1108/IJMPB-08-2021-0213

Juchniewicz, M. (2019). *Doskonalenie działalności projektowej w organizacji*. Oficyna Wydawnicza SGH. Szkoła Główna Handlowa.

Klafke, R. V., Gomes, P. M., Junior, D. M., Didonet, S. R., & Toaldo, A. M. (2021). Engagement in Social Networks: A Multi-method Study in Non-profits Organizations. *International Review on Public and Nonprofit Marketing*, *18*, 295–315. https://doi.org/10.1007/s12208-020-00273-0

LeRoux, K., & Wright, N. S. (2010). Does Performance Measurement Improve Strategic Decision Making? Findings from a National Survey of Nonprofit Social Service Agencies. *Nonprofit and Voluntary Sector Quarterly*, *39*(4), 571–587. https://doi.org/10.1177/0899764009359942

Marciszewska, A. (2019). *Dojrzałość projektowa organizacji non-profit*. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Pauli, U., & Pocztowski, A. (2008). Zarządzanie personelem w organizacjach sektora ekonomii społecznej. In: J. Hausner (Ed.), *Zarządzanie podmiotami ekonomii społecznej* (pp. 61–82). Małopolska Szkoła Administracji Publicznej Uniwersytetu Ekonomicznego w Krakowie.

Penner, L. A. (2002). Dispositional and Organizational Influences on Sustained Volunteerism: An Interactionist Perspective. *Journal of Social Issues*, *58*(3), 447–467. https://doi.org/10.1111/1540-4560.00270

Piwowar-Sulej, K. (2016). Formy bezpośredniego zatrudniania kierowników projektu – dylematy stosowania w polskiej praktyce gospodarczej. *Marketing i Rynek*, *3*, 736–745.

Pollack, J., & Adler, D. (2015). Emergent Trends and Passing Fads in Project Management Research: A Scientometric Analysis of Changes in the Field. *International Journal of Project Management*, *33*(1), 236–248. https://doi.org/10.1016/j.ijproman.2014.04.011

Powell, W. W., & Bromley, P. (Eds). (2020). *The Nonprofit Sector: A Research Handbook* (3rd ed.). Stanford University Press.

Rothschild, J., & Milofsky, C. (2006). The Centrality of Values, Passions, and Ethics in the Nonprofit Sector. *Nonprofit Management & Leadership*, *17*(2), 137–143. https://doi.org/10.1002/nml.139

Silvius, A. J. G., & Schipper, R. P. J. (2014). Sustainability in Project Management: A Literature Review and Impact Analysis. *Social Business*, *4*(1), 63–96. https://doi.org/10.1362/204440814X13948909253866

Szmyt-Boguniewicz, A., & Romanowski, M. (2012). *Zarządzanie w NGO. Zarządzanie zasobami ludzkimi w organizacjach pozarządowych*.

Trocki, M. (Ed.). (2019). *Społeczna odpowiedzialność działalności projektowej*. Oficyna Wydawnicza SGH. Szkoła Główna Handlowa w Warszawie.

Wawak, S., & Woźniak, K. (2020). Evolution of Project Management Studies in the XXI Century. *International Journal of Managing Projects in Business*, *13*(4), 867–888. https://doi.org/10.1108/IJMPB-01-2020-0002

Wronka-Pośpiech, M. (2016). The Identification of Skills and Competencies for Effective Management in Social Enterprises. A Managerial Perspective. *Management*, *20*(1), 40–57. https://doi.org/10.1515/manment-2015-0023

Zawadzki, J. (2007). *Zarządzanie organizacjami non-profit. Zagadnienia wybrane*. Wydawnictwo Forum Naukowe.

ISSN 1898-6447
e-ISSN 2545-3238

KRAKOW UNIVERSITY OF ECONOMICS
Rakowicka 27, 31-510 Kraków, Poland

The journal is available at krem.uek.krakow.pl