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RISK DETERMINATS IN INNOVATION PROJECTS –EMPIRICAL RESEARCH IN ORGANIZATIONS

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Purpose: The aim of the article is to identify and analyze the key factors determining risk in innovative projects. The research focuses on identifying significant risk categories for six types of innovative projects implemented in organizations.
Design/methodology/approach: The study was based on the analysis of surveys conducted among 87 organizations. The questionnaire included questions about the number and dynamics of implemented innovation projects during the indicated period, types of risks in innovation projects, and the most important external and internal factors determining risks in innovation projects. Data were collected using the CAWI technique. Respondents were owners and managers with knowledge and experience in implementing innovation projects within their organizations.
Findings: The results indicate that the greatest activity in implementing innovation projects occurred in the surveyed organizations during the two analyzed periods, especially in the investment, organizational, and technical-technological areas. The greatest increase in interest (dynamics) in innovation implementation was observed in projects related to management systems, research and development, and technical-technological areas. Respondents rated the levels of risk related to costs, time, finances, market, and technology particularly highly. Among external factors, changes in consumer requirements and market fluctuations had the most significant impact on risk in innovative projects, while among internal factors, financial-economic and personal factors were the most influential.
Research limitations/implications: The main limitations of the study concern the relatively small number of surveyed organizations, which may reduce the ability to generalize the results. Additionally, the analysis is based on subjective assessments by respondents, which may introduce some measurement errors.
Practical implications: The article provides practical guidelines for categorizing risks and identifying factors influencing risks in six types of innovative projects. It can be useful for managers and project leaders in identifying potential sources of risk. Particular emphasis is placed on the importance of identifying risk factors to develop effective risk minimization strategies in innovative projects.
Originality/value: The originality of the article lies in its comprehensive approach to risk analysis in innovative projects. The obtained results may inspire further research and support practical efforts to more effectively identify factors determining risks in innovative projects within organizations.

Keywords: innovation projects, types of innovation projects, risk, types of risk, risk determinants.
Category of the paper: Research paper.

1. Introduction

Innovation projects are a key element in the development of organizations operating in a dynamically changing economic environment. However, their implementation is associated with a high level of risk resulting from technological, market, and organizational uncertainties (Catto, Maccari, 2021). The literature emphasizes that risk management in innovation projects requires a comprehensive approach, including the identification, assessment, and mitigation of potential threats (Berglund, 2007; Willumsen et al., 2019; Oehmen et al., 2020). The process of risk identification is a crucial stage in risk management, as it enables the detection and categorization of sources of threats, thus facilitating the implementation of effective preventive measures (Deptuła, Knosala, 2015; Qazi et al., 2020).

The aim of this article is to address the research gap in the area of identifying types of risks and factors determining risk in innovation projects. In particular, it focuses on presenting categories of risks associated with various types of projects: research and development, technical-technological, investment, IT, organizational, and management systems (Salerno et al., 2015; Gorokhovatskyi et al., 2021). Furthermore, the importance of risk identification is highlighted, as it should be conducted at every stage of the project life cycle (Deptuła, Knosala, 2015; Kendrick, 2015). Identifying risk factors enables organizations to anticipate potential obstacles and plan preventive actions accordingly, helping to avoid financial losses resulting from budget overruns or project delays (Becker, Smidt, 2015; Gorokhovatskyi et al., 2021). Precisely determining the level of risk and the factors influencing risk in innovation projects allows for better resource and time management, which translates into project success (Sulejewicz, 2006; Stošić et al., 2016). Identifying risk factors supports informed decision-making regarding the acceptance, avoidance, or minimization of threats (Agarwal, Kansal, 2020). As a result, organizations can better adapt their strategies to changing market and technological conditions (Segal, 2008; Thamhain, 2013; Lou, Hu, 2015). The identification of risk factors is not only a protective tool for organizations but also a foundation for effective innovation project management.

This article consists of three sections, as well as an introduction and a conclusion. The first section discusses the theoretical aspects of innovation projects, risk in innovation projects, and the factors determining risk in such projects. Additionally, this section presents the research problem addressed in the article. The next section is empirical and contains the research methodology, research results, and their limitations. The article concludes with

a discussion and conclusion section, where the main contributions of the study, practical recommendations, and suggestions for future research are presented.

2. Theoretical background

2.1. Types of innovation project

In recent years, innovation has attracted significant attention from researchers across various fields due to its role in enhancing organizations' competitiveness in dynamic environments (Brook, Pagnanelli, 2014; Shu et al., 2015; Haneda, Ono, 2020; Pomaza-Pomarenko et al., 2023). By engaging in innovation projects, enterprises can strengthen their market position and achieve a competitive edge.

An innovation project is defined as a temporary initiative with a specific organizational structure and resource allocation, aimed at generating business value through the commercialization or application of innovations (Spałek, 2015; Łopaciński, 2018). Such projects often involve novel approaches and are characterized by greater complexity and risk, as well as the generation and implementation of new knowledge (Janasz, Wiśniewska, 2015; Goździewska-Nowicka et al., 2018; García-Quevedo et al., 2018). They may include activities focused on developing new or significantly improved products, processes, or methods within an organization (Wirkus, 2006; Keizer, Halman, 2009).

Barbic et al. define an innovation project as a temporary entity comprising a set of purposively planned and managed knowledge flows between organizational representatives to solve a specific innovation problem (Barbic et al., 2021; Lappalainen et al., 2023).

Innovation projects can be categorized according to their focus - such as technological, research-based, or product development projects - or by the type of change they target: product, process, marketing, or organizational innovations (Entekhabi, Arabshahi, 2012; Oslo/Eurostat, 2018). However, the literature reveals inconsistencies in defining innovation projects due to their diverse nature. These variations arise from factors such as project size, originality, scope, and management requirements. For example, a new product development project may simultaneously be classified as a research initiative or a strategic endeavor.

In summary, innovation projects represent structured efforts to address business challenges through creativity and novel solutions. They are essential for leveraging knowledge to solve practical problems and for achieving sustained growth in competitive markets.

Table 1 presents classifications of types of innovation projects based on the referenced literature and applied in empirical research.

Table 1.
Types of innovation projects

Type of innovation project	Explanation of the concept and scope
Research and Development (product-related)	Projects with goals that are not always precisely defined often lead to the acquisition of new knowledge about the surrounding reality. Based on the nature of the work conducted and the final outcomes, the following types of projects can be distinguished: soft projects (these include activities such as presenting reports or models and hard projects (these involve tangible results, such as a product represented by a prototype or a finished product). Within hard projects, further distinctions can be made into: scientific-research projects, development projects, implementation projects.
Organizational	They concern changes in the organization of the company, its functioning, and work systems. These changes are usually aimed at reorganizing the internal structure, altering work methods, improving efficiency, and streamlining the flow of information. Innovation projects within the organization include initiatives such as implementing JIT (Just-In-Time), controlling systems, new business models, change implementation projects, and designing organizational structures.
Technological (manufacturing technology)	Initiatives focus on introducing various technical and technological solutions into different areas of a company's operations, such as manufacturing processes, logistics processes, the introduction of new products and services, process optimization, and performance improvement.
Information system	This project aims to create an information system tailored to the organization's needs (hardware, software, human resources). It may involve the creation and implementation of software, the implementation of IT infrastructure, or a combination thereof.
Investment-related	An investment project pertains to a specific undertaking that "clearly defines the subject, scope, location, timeline, costs, and expected economic outcomes" and serves as the foundation for conducting investment activities. The goal of the project is to achieve an "optimal combination of all technical and economic elements while minimizing risk". An investment project consists of numerous tasks of varying nature and scope, which can function independently while simultaneously delivering tangible and measurable production or service outcomes.
Management systems	Innovation projects in this area aim to discover new, better, and more efficient ways to solve management problems, such as implementing new management concepts and methods, applying artificial intelligence in decision-making, implementing innovation project management methods, creating knowledge bases, and managing experiences.

Source: own elaboration based on: (Rogowski, Michalczewski, 2005; Belassi et al., 2007; Wojewnik-Filipkowska, 2008, p. 12; Spałek, 2016; Mandziuk et al., 2016; Siewiera, 2016; Kisielnicki, 2018; Nogalski, Niewiadomski, 2018; Müller et al., 2019; Kozlov et al., 2021; Cantarelli, Genovese, 2021; Pietruszyńska, Woźniak, 2021; Chaber, 2023; Matysiak, 2024; Wintage, 2025).

The general classification includes most of the innovation projects with different innovation degree. Taking into consideration the existence of different classifications of an innovation projects, it is reasonable to look at the types of risks involved in their implementation.

2.2. Risk and its context in an innovation projects

Innovation projects are inherently risky, as they involve responding to change and dealing with uncertainties that can lead to failure if poorly managed. The primary factors influencing project success or failure often lie in the knowledge, skills, and abilities of project managers. Risk is defined as any uncertain event that could negatively affect stakeholder interests or project outcomes (Sanchez-Cazorla et al., 2017). Engineering projects, for example, are particularly risky due to the involvement of multiple parties such as contractors and suppliers. The success of innovation projects heavily depends on effective risk management (Kupeshova et al., 2016; Alkaissy et al., 2020; Rachmiani et al., 2024).

Risk in innovation projects is influenced by both internal and external factors, which can disrupt goals and profitability. To manage risk effectively, it is essential to identify potential threats (Eskerod et al., 2018; Denney, 2022) and opportunities as early as possible during the project's lifecycle (Pomaza-Ponomarenko et al., 2023). This involves determining which stakeholders will be affected, when risks may emerge, and the potential consequences of such risks (Gorokhovatskyi et al., 2021). Engaging stakeholders during the risk identification phase is widely regarded as a highly effective strategy (Akram, Pilbeam, 2015; Siewiera, 2016; Willumsen et al., 2019).

Contemporary risk management strategies emphasize the importance of exploiting opportunities alongside the mitigation of threats. While traditional risk management focuses on reducing potential losses (threats), more progressive approaches consider risks as pathways for value creation (Hillson, 2016; Farooq et al., 2018). This dual perspective is especially relevant in innovation projects, where, if managed effectively, risks can pave the way for breakthroughs (Browning, 2018).

Risks in innovation projects can be categorized based on their sources and the specific type of project (Abdalah, 2004). Common categories include technical, financial, and market acceptance risks, as well as risks related to organizational culture. Certain project types, such as IT or research initiatives, face particular challenges, including risks associated with intellectual property or intercultural communication (Nasalski et al., 2014; Oehmen et al., 2020). Additionally, IT projects often encounter issues related to data security and shifting customer demands (Yim et al., 2015).

To address these complex issues, risk management methodologies such as PRINCE2 (2009) and PMBOK (PMI, 2017; PMI, 2019) characterize project risk as the likelihood of events that may either positively or negatively impact project objectives. Effective strategies involve early risk detection, continuous monitoring, and the use of advanced tools designed to mitigate or capitalize on these risks (AgilePM, 2012). Incorporating risk management into innovation processes allows organizations to proactively identify potential threats and ensure alignment with strategic goals (Chapman, Ward, 2015; Sanchez-Cazorla et al., 2017; Adler et al., 2016). Managing risk in innovation projects requires a comprehensive approach that balances threat mitigation with opportunity exploration (Deptuła, Knosala, 2015; Shahmansouri et al., 2019).

Table 2 presents a general classification of risks in innovation projects based on the referenced literature.

Table 2.
The general classification of risks in an innovation project

Author	Types of risk in the innovation projects
A. Ericsson, A. Kastensson (2011), R.F. Miorando, J.L. Duarte Ribeiro, M.N. Cortimiglia (2014)	– internal risk (project management methodology adopted in the organization, the strategy of implementing innovations in the organization, human resources, organizational culture, and knowledge management, business disputes, improper communication), – external risk (global environmental conditions, requirements of state institutions and agencies, environmental conditions, project stakeholders, market and competitors, cooperators, tax regulations, legal changes).
R. Muniak (2012)	– managerial risk – the risk of project completion on time and while maintaining other project parameters, – technological risk – the risk of developing new technological solutions and shortening the time of their implementation, – market risk – lack of acceptance for the manufactured product and, as a result, the possibility of generating revenue.
W. Janasz (2015)	– risk of research and development activities (in projects there is a high risk resulting from uncertainty and postponing effects in time while incurring current costs), – market risk (is a consequence of the inability to predict how the new project will be received by the market), – investment risk (there is difficulty in determining the correct level of funds allocated to project implementation), – financial risk (e.g. regarding the level and speed of circulation of current assets, it is of particular importance in a global and industry crisis, as the demand for a new project may suddenly collapse).
T. Nawrocki (2016)	– economic risk (identified with the sources of financing an innovation project), – time risk (related to continuous technological progress, global and unlimited communication, which translates into a significant shortening of the life cycle of an innovation project), – organizational risk (identified with the way of organizing the work of a team of people implementing an innovation project), – competition risk.
K. Becker, M. Smidt (2015) T. Łopaciński (2018) J. Tarapata, J. Woźniak (2022)	Researchers distinguish risks related to: the product, the use of new technologies, the application of design methods, the protection of intellectual property, the uniqueness of the project within the organization, organizational culture, and the required competencies of the project manager. Occupational safety and health during project implementation encompass issues such as product/solution safety, information and data security, the production process, and end-user safety. These risks are associated with potential threats to health and life, as well as cybersecurity concerns. Risks related to the coordination of activities within a project include managing processes and communication between various teams and stakeholders, collaboration with partners and subcontractors, coordination of different project elements, and effective communication.

Source: own elaboration based on: (Kosaroglu, Hunt, 2009; Ericsson, Kastensson, 2011; Muniak, 2012; Miorando et al., 2014; Janasz, 2015; Becker, Smidt, 2015; Kupeshova et al., 2016; Nawrocki, 2016; Deptuła, Knosala, 2017; Łopaciński, 2018; Bal-Woźniak, 2020; Gorokhovatskyi et al., 2021; Tarapata, Woźniak, 2022; Mannes, Beuren, 2023; Pomaza-Ponomarenko et al., 2023).

As shown in Table 2, various classifications have been presented, highlighting different types of risks occurring in innovation projects. The extent and nature of risk in an innovation project are significantly influenced by factors such as the specific type of innovation project, the market maturity of the new technology, the ease with which customers can adapt to previously used technologies, the capacity to navigate the complexities of patent process transparency, the organization's prior success in implementing internal changes, and the managerial and technical skills of the assigned innovation project manager (Yim et al., 2015).

2.3. Factors determining risk in innovation projects

Innovation projects, by their very nature, are subject to a high level of uncertainty and risk. Table 3 presents a comprehensive summary of groups of internal risk factors that should be considered when planning and implementing innovation projects, whereas Table 4 shows a comprehensive summary of groups of external risk factors in innovation projects.

Table 3.
Groups of internal risk factors in innovation projects

Group of factors	Description
Financial-economic	Risk arising from insufficient financial resources, improper budget allocation, costs exceeding planned expenses, and liquidity problems.
Personnel	Insufficient competencies of the project team, lack of motivation, interpersonal conflicts, and difficulties in recruiting suitable specialists.
Instrumental	Lack of appropriate tools and technical infrastructure, outdated technologies, or limited access to modern solutions supporting project implementation.
Organizational	Inefficient organizational structure, lack of clearly defined roles and responsibilities, communication issues, and absence of risk management procedures.
Technical-technological	Risks related to the implementation of new technologies, their integration with existing systems, and unpredictable technical problems during project execution.
Marketing	Problems related to communicating the value of innovation to the market, incorrect marketing strategies, or lack of acceptance of the product by target customers.
Managerial (leadership)	Insufficient qualifications of management staff, lack of experience in managing innovation projects, and ineffective decision-making processes.
Organizational culture	Lack of a pro-innovation organizational culture, low acceptance of change by employees, and insufficient support from leadership for innovation projects.
Business model	Inadequate business model for the implemented innovation or lack of a clear strategy for commercialization of the product or service.

Source: own study based on: (Janasz, Wiśniewska, 2015; Spałek, 2016; Kotler, Keller, 2016; Walaszczyk, 2016; Zhang, Hou, 2017; Spałek, Trzeciak, 2017; Deptuła, Rudnik, 2018; Pawelec, 2018; Sitek, 2019; Wereda, Woźniak, 2019; Taran et al., 2019; Wang et al., 2020; Rane et al., 2021; Pomaza-Ponomarenko et al., 2023; Duan et al., 2023; Richert et al., 2022; Othman, Hussein, 2023; Rachmiani et al., 2024; Zaman et al., 2024).

Table 4.
Group of external risk factors in innovation projects

Group of factors	Description
1. Political	Changes in government, political instability, and conflicts of interest affecting regulations, funding availability, and market stability.
2. Legal (regulatory)	Legal regulations governing innovation activities, such as licensing requirements, environmental standards, and tax incentives. Non-compliance may result in sanctions or delays.
3. Competitors	Competitive pressure driving the need for rapid innovation implementation and the risk of competitors gaining a technological advantage.
4. Customers	Risk stemming from difficulties in predicting customer expectations and behaviors toward new products or services.
5. Suppliers	Disruptions in the supply chain caused by financial problems of suppliers or their limited availability.
6. Investors	Investors' expectations for quick returns on investment may limit long-term research projects and affect capital availability.
7. Socio-cultural	Social norms and cultural values influencing the acceptance of innovations and how they are implemented. This also includes issues related to public image, corporate social responsibility, and potential social conflicts associated with the implemented innovation.

Cont. table 4.

8. Economic	Economic changes (e.g., recession, inflation) affecting companies' ability to invest and demand for innovation products and services.
9. Environmental (ecological)	Environmental protection requirements and growing expectations for sustainable development as challenges for innovation projects.
10. Technological	Rapid technological development and the risk of existing solutions being replaced by new technologies or substitutes.
11. International	Cultural, regulatory, and economic differences between countries affecting international expansion and the execution of innovation projects.
12. Force majeure	Unpredictable global events (e.g., pandemics, wars, natural disasters) disrupting the implementation of innovation projects.
13. Market	Market dynamics, changes in supply and demand, and market size affecting the success of an innovation project.
14. Business partners	Risks related to business partners' financial stability and their ability to fulfill contractual obligations in cooperative ventures.

Source: own study based on: (Luo, Hu, 2015; Kotler, Keller, 2016; Trzeciak 2017; Łopaciński, 2018; Goździewska-Nowicka et al., 2018; Chopra, Meindl, 2019; Samuelson, Nordhaus, 2020; Bal-Woźniak, 2020; Gorokhovatskyi et al., 2021; Wiedenmann, Größler, 2021; Wang et al., 2022; Suchacka, 2023; Liu et al., 2023; Owolabi et al., 2025).

Among external factors influencing innovation projects, regulatory and legal changes are particularly critical, as they often necessitate adjustments to project requirements, leading to delays, increased costs, or altered assumptions. Examples include environmental protection regulations and product certification standards. Dynamic market trends and competitive actions also play a significant role, impacting the value of innovation and requiring organizations to adapt swiftly to new conditions. Furthermore, geopolitical and climate risks - such as armed conflicts, economic sanctions, natural disasters, or climate change - can disrupt supply chains and limit resource availability, posing substantial challenges in the current era of global instability (Amara et al., 2016; Oehmen et al., 2020; Wiedenmann, Größler, 2021; Liu et al., 2023).

In the case of internal factors, the lack of sufficient financial resources plays a key role. This often results from underestimating the budget or lacking funds for subsequent project stages, which can prevent the achievement of planned objectives. Another significant issue is poor project management and team communication. Weak collaboration within the team, lack of competence in the project manager, and inadequate risk analysis can lead to delays and erroneous decisions. Overly ambitious goals and schedules are yet another factor increasing the likelihood of failure, as adopting unrealistic assumptions regarding timelines or project outcomes often ends in disappointment (Thamhain, 2013; Kadareja, 2013; Amara et al., 2016; Gorokhovatskyi et al., 2021; Abu Kwaik et al., 2023).

Both external factors and internal ones are crucial for the success of innovation projects. Their proper identification and management are essential for minimizing risks and achieving the project's objectives.

2.4. Context of the problem addressed

An analysis of the available literature on the determinants of risk in innovation projects reveals several research gaps that require deeper scientific investigation. The most significant identified areas insufficiently explored regarding risk factors influencing the execution of innovation projects include:

1. A gap in risk modeling for innovation projects, particularly the lack of a comprehensive risk management model specifically tailored to innovation projects in the service sector.
2. A gap in risk management methodologies for non-profit organizations, especially in cultural projects, along with a lack of analytical tools adapted to the specifics of such projects.
3. Insufficient integration of risk management processes with innovation processes.
4. Gaps in research on risk determinants across various types of innovation projects, including a lack of in-depth studies on factors influencing risk levels in each type of innovation project and how they do so.
5. Insufficient research on the impact of organizational culture on risk in innovation projects.
6. Methodological gaps in measuring and assessing risk in innovation projects, with a lack of standardized quantitative methods, existing publications predominantly focus on qualitative aspects of risk.
7. A shortage of studies addressing the differentiation of risk determinants depending on the industry, with a lack of comparative analyses between industries and specific risk determinants in particular sectors.
8. Insufficient research on the influence of external factors on risk in innovation projects, including a lack of in-depth studies on how external factors affect risk and how to manage them.
9. A lack of comprehensive research regarding the competencies necessary for effective risk management in innovation projects.

The identification of these research gaps underscores the need for further studies on risk determinants in innovation projects. In particular, there is a need to develop comprehensive risk management models tailored to the specifics of different innovation types and industries, to integrate risk management processes with innovation processes, to establish standardized quantitative methods for measuring and assessing risk, and to investigate the competencies required for effective risk management in innovation projects.

Future research should also consider the dynamic nature of risk determinants within the context of a changing economic and technological environment, which is especially important in the era of digital transformation and the increasing complexity of innovation projects.

3. Empirical studies

3.1. Methodology

The adopted research methodology aligns with those presented in the literature and commonly used in management sciences (Czakon, 2015; Sułkowski et al., 2021). Due to their practical nature, management sciences largely refer to empirical research (Januszkiewicz, 2016). The methodology was selected to achieve the objectives set in the article, considering the topic and encompassing several stages.

The first stage involved conducting a review of Polish and foreign literature available in four publicly accessible databases: EBSCO, Scopus, Web of Science, and Emerald. A literature review serves as the foundation for formulating research questions (the research problem), which guide the subsequent stages of the research process (Zdonek, Hysa, 2017). The review focused on three key issues (research subjects): innovation projects, types of risk in innovation projects, and risk determinants in innovation projects (Bowers, Khorakian, 2014; Zinn, 2017; Mammadov et al., 2018; Jissink et al., 2019; Zaynullina, 2020; Yuan, 2020). The primary research method at this stage was the analysis of scientific papers published in leading Polish and international journals. This analysis allowed for the identification of research problems addressed by various authors and the recognition of existing research gaps concerning risk in innovation projects (Czakon, 2015).

Additionally, the literature review facilitated the development of a proprietary classification of risk types related to different types of innovation projects. This classification was used to formulate questions in the survey questionnaire, which is one of the most popular quantitative research methods (Sułkowski et al., 2021).

A crucial element of conducting research is the clear definition of its purpose. Research objectives outline the expected outcomes and help address specific questions posed by the researcher (Sułkowski et al., 2021). The main goal of this study is to analyze current trends in Polish organizations regarding risk management in innovation projects, with particular emphasis on one of its key stages: the identification of external and internal determinants of project risks.

The aim of this article is to address research gaps concerning innovation projects, specifically by identifying the key characteristics and types of risks present in such projects across various organizations. The practical objective is to develop conclusions and recommendations that can be utilized by organizational management to enhance the effectiveness of identifying external and internal determinants of innovation project risks (Czakon, 2015; Sułkowski et al., 2021).

To achieve this objective, the following research problems were formulated (Zdonek, Hysa, 2017):

- what are the number and dynamics of activities undertaken in relation to the types of innovation projects implemented in the surveyed organizations?
- what is the level of risk associated with particular categories in the types of innovation projects undertaken by the surveyed organizations?
- what key internal and external factors determine the risks associated with innovation projects?

Defining these research problems enabled the selection of an appropriate research tool (Collis, Hussey, 2013; Zdonek, Hysa, 2017). A diagnostic survey method was chosen for the study (Januszkiewicz, 2016), as it allows for the collection of information on the phenomenon of interest, examination of respondents' views and beliefs, and assessment of their knowledge (Dźwigoł, 2015). A questionnaire was used as the main data collection technique (Czakon, 2015; Matejun, 2016).

The developed survey questionnaire (comprising a demographic section and detailed questions related to the research subject) was verified for the relevance of its questions through pilot studies (Dźwigoł, 2015; Januszkiewicz, 2016) involving interviews with three project management experts and three risk management experts (Denzin, Lincoln, 2013). Suggestions provided by the experts led to improvements in certain questions, enhancing the research instrument (Sandberg, Alvesson, 2011). The revised questionnaire was subsequently used in the main pilot study (Czakon, 2015).

The actual research was conducted from April to July 2023 using a questionnaire administered via the CAWI (Computer Assisted Web Interviewing) method. The sample was purposively selected. The questions targeted owners (in small organizations) and managers involved in the development, implementation, and evaluation of innovation projects. Most questions in the survey were closed-ended. The research was conducted in organizations operating in Poland. Previous research indicated a growing interest in and implementation of various projects, including innovative ones, in these organizations (Bartusik, Walas-Trębacz, 2019). The type of organization was not a significant variable in terms of business nature or size, as respondents could represent organizations engaged in production, services, or trade across any industry.

Based on the collected data, the results were analyzed using the survey method (Sułkowski et al., 2021), and conclusions were formulated in relation to the research problems (Flick, 2020). Additionally, the findings enabled the formulation of recommendations for organizational management and the identification of further directions for empirical research on the topic (Sułkowski et al., 2021).

The results presented in the article are a consequence of the research methodology developed and applied, which allowed the authors to address the research problems identified.

3.2. Research results

Characteristics of the organizations researched

The study covered 87 organizations, with respondents representing management positions and business owners. Figure 1 presents the basic characteristics of the organisations from which the respondents came, based on the following criteria: period of market activity, number of employees, core activity, sales market and key customers.

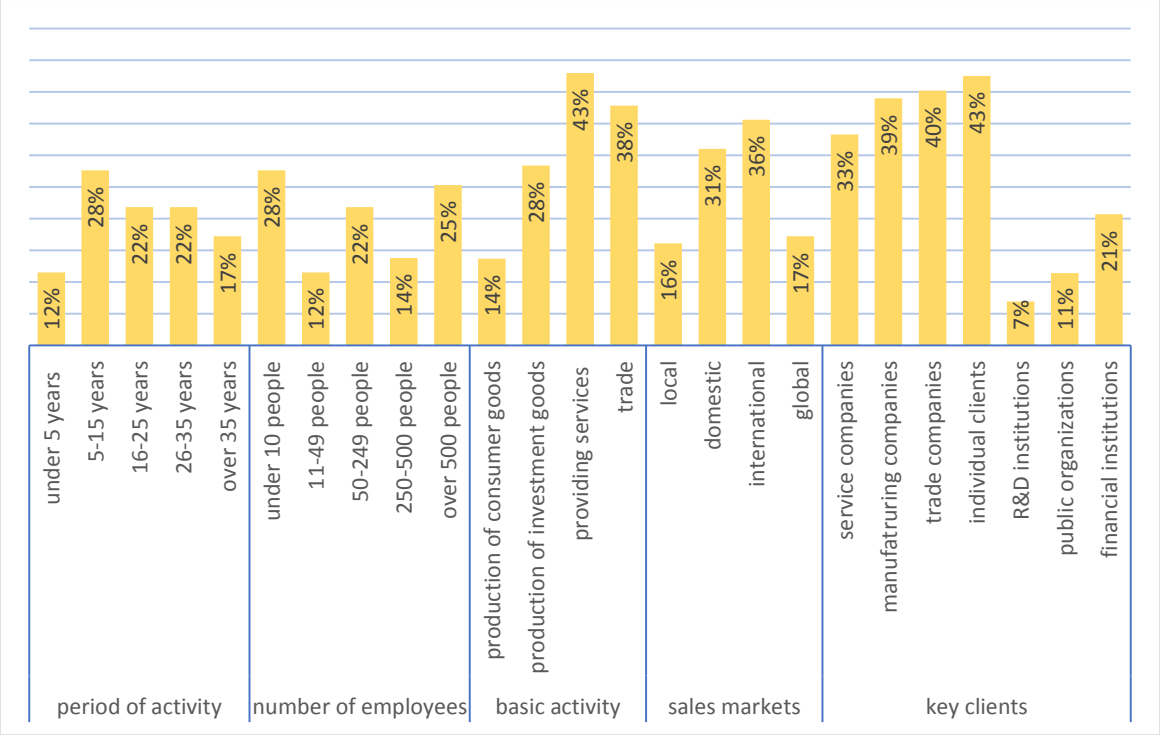


Figure 1. Characteristics of the organizations researched.

Source: own study based on research results.

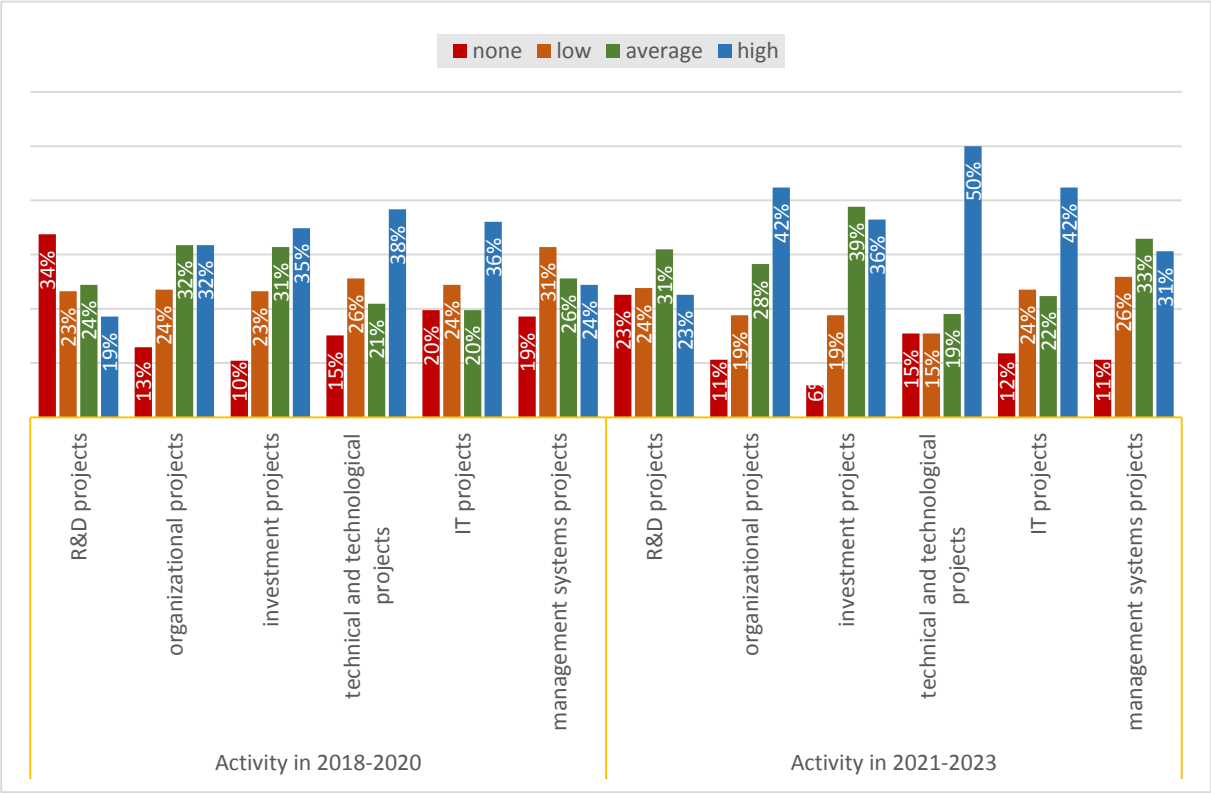
Among the surveyed organizations, the largest percentage shares were as follows (Figure 1): organizations operating on the market for 5-15 years (28%); organizations providing services (43%); small organizations with fewer than 10 employees (28%) and very large organizations with more than 500 employees (25%); organizations selling on the international market (36%) and to individual clients (43%); and trade companies (40%) as key clients.

Activity in implementing innovation projects

The research tasks, derived from the topic, included: identifying the key types of innovation projects; determining the activity related to the number and dynamics of innovation projects carried out over two time frames – 2018-2020 and 2021-2023 - in terms of six distinguished types: research and development, organizational, technical-technological, investment, information technology, and management systems. Additionally, an important research objective was to identify the types of risks present in each type of innovation project implemented in the surveyed organizations.

Respondents assessed the level of activity based on the number of each type of innovation project implemented in the two periods: 2018-2020 and 2021-2023.

Figure 2 illustrates the activity of the surveyed organizations in implementing these six types of innovation projects across the two indicated periods.



Scale: 0 – no projects, 1 – low activity (1 project), 2 – average (2-3 projects) and 3 – high activity (more than 3 projects).

Figure 2. Activity in the implementation of projects (in 2018-2020 and 2021-2023) in the surveyed organizations.

Source: own study based on research results.

From the data presented in Figure 2, it can be observed that in the researched organizations, the highest activity during the 2018-2020 period was recorded in investment projects (66% - a large number of projects at levels 2 and 3) and organizational projects (64% - a large number at levels 2 and 3). In the 2021-2023 period, the greatest interest was shown in investment projects (75% - a large number at levels 2 and 3), organizational projects (70% - a large number at levels 2 and 3), and technical-technological projects (69% - a large number at levels 2 and 3).

The data also indicate that the most significant increase in interest in implementing innovation projects between the two periods (2018-2020 and 2021-2023) occurred in management system projects (from 50% to 64%) and R&D projects (from 43% to 54%).

The growth in the number of innovation projects in the areas of management systems, research and development (R&D), and technical-technological fields during 2021-2023 (the pandemic period) was driven by accelerated digitization and technological transformation. This process necessitated the implementation of new technologies, process automation,

and adaptation of operational models to remote work. The pandemic also stimulated investments in R&D, particularly in medical technologies, diagnostic tools, and solutions supporting remote work, enabling organizations to address emerging challenges and seize new market opportunities.

Companies had to respond rapidly to changing conditions. Large enterprises (with over 500 employees) invested in projects aimed at enhancing their resilience to crises, while small businesses (with up to 10 employees) implemented flexible management systems to maintain competitiveness. Efforts to optimize costs and improve efficiency were reflected in the enhancement of internal processes and reduction of operational expenses through automation and integration of digital technologies—an especially important factor for companies operating in international markets.

Risk assessment in innovation projects

The identification of risk types occurring in innovation projects was based on an analysis of the literature and our own experience. For the purposes of the research conducted, an extensive list of risk categories was proposed for each type of distinguished innovation project. The survey questionnaire included a list of risk categories for each project. Respondents evaluated the level of risks present in each type of innovation project using a scale from 0 to 5, where 1 indicated a very low level of risk and 5 indicated a very high level.

Table 5 summarizes the respondents' responses regarding the assessment of risk levels in each project type.

Table 5.
The highest level of risk in each type of innovation project

Type of projects					
R&DP	**OP**	**TTP**	**ITP**	**INP**	**MSP**
– financial (2.86) – time (2.81) – technical and technological (2.69) – implementa-tion difficulties (2.54) – market (2.53)	– time (2.92) – comunnication (2.75) – implementa-tion difficulties (2.72) – financial (2.62) – personal (2.53)	– financial (3.22) – technological (2.92) – time (2.91) – market (2.86) – quality (2.77) – implementation difficulties (2.75)	– financial (3.36) – market (3.0) – time (2.92) – legal (2.81) – technological (2.77)	– financial (3.01) – complexity (3.01) – technological (2.91) – time (2.84) – related to the requirements (2.81) – quality (2.75)	– coordination (2.97) – personal (2.91) – organizational (2.83) – time (2.80) – implementa-tion difficulties (2.70) – financial (2.59) – quality (2.53)

Legend: research and development projects (R&DP), organizational projects (OP), technical and technological projects (TTP); IT projects (ITP), investment projects (INP), management system projects (MSP).

Resource: own elaboration.

Table 5 presents the highest levels of risk associated with different types of innovation projects. The risks linked to various types of innovation projects are determined by their specific characteristics and challenges, which influence the achievement of project goals. In research and development (R&D) projects, financial risks are the most significant due to the substantial investments required for developing new technologies or products that may not yield the expected results. Uncertainty regarding return on investment and difficulties in accurately estimating costs further amplify these financial risks. Technological risks are also critical, as they arise from

uncertainties about the effectiveness of new technologies and their integration with existing systems. In organizational (OP) projects, time-related risks are predominant because these projects require the coordination of multiple teams and processes. Delays often occur due to ineffective communication or organizational challenges. Communication issues and implementation difficulties are also significant, as they reflect the need for synchronized actions within the organization. For technological (TTP) projects, financial-related risks are paramount, as these initiatives often involve high expenses for implementing new solutions and materials, which may be subject to market price fluctuations. Technological risks are equally important due to the unpredictability of new technologies' performance and their impact on budgets and timelines.

In IT projects, financial-related risks are crucial because of the dynamic nature of technological advancements and market demands, which frequently lead to budget overruns. Market risks also play a key role, as the success of IT projects depends on end-user acceptance and product competitiveness. Investment projects (INP) face the highest risks related to costs and complexity due to their large scale, requiring precise resource and budget management. Technological risks are also significant because of the need to integrate advanced technical solutions. In management system projects (MSP), coordination issues are the most prominent risk factor, as these projects demand synchronization across numerous teams and processes to ensure system consistency. Organizational and personal risks are also critical, stemming from challenges in managing human resources and organizational structures.

It should be emphasized that the highest level of risk among the six types of innovation projects assessed was indicated by respondents in IT and technical and technological projects.

Overall, financial risks emerge as the most significant across multiple project types. Time-related risks are consistently important in all categories. Technological risks are prominent in technology-intensive projects, while coordination and organizational challenges dominate management system projects. These findings highlight the need for tailored risk management strategies depending on the specific type of innovation project.

Internal and external risk factors in innovation projects

Respondents were asked to assess the impact of the aforementioned groups of external risk factors in innovation projects using a 0-5 scale. The summarized results of the research are presented in Table 6.

Table 6.
Groupe of internal risk factors in innovation projects

Groupe of factors	0	1	2	3	4	5	Average rating
1. Financial-economic	4	7	16	11	23	26	3.379
2. Personnel-related	3	8	19	25	22	10	2.977
3. Instrumental	3	18	25	31	9	1	2.322
4. Organizational	3	10	18	25	26	5	2.874
5. Technical-technological	3	9	19	24	21	11	2.966

Cont. table 6.

6. Marketing-related	6	14	24	23	17	3	2.460
7. Managerial	2	15	17	16	24	13	2.966
8. Organizational culture	5	17	20	23	17	5	2.517
9. Business model	4	16	20	22	17	8	2.644

Scale: 0 – no impact; 1 – very low impact; 2 – low impact; 3 – average impact; 4 – high impact; 5 – very high impact (essential factor).

Source: Own work based on research results.

The results presented in Table 6 indicate a varied impact of external risk factors on innovation projects. Analyzing the results allows to identify which areas within an organization are perceived as the most significant sources of risk for the success of innovation projects.

The most important internal risk groups influencing innovation projects were identified by respondents as: financial-economic (3.379), personnel-related (2.977), technical-technological (2.966), managerial (2.966) and organizational (2.874).

The high rating of financial-economic factors reflects the crucial importance of financial stability, availability of funds, and effective budget management for the implementation of innovative ventures. These results are consistent with the literature, which indicates that financial and economic resources are most often cited as the primary condition for taking innovation risks and conducting R&D activities. Personnel, technical-technological, and managerial factors also received high ratings. This highlights the importance of the competence, experience, and engagement of the team, as well as the efficiency of project management and the implementation of new technologies. Staffing shortages, insufficient qualifications, or ineffective management can lead to delays, errors, and failures in the implementation of innovations. The high rating of organizational factors underscores the importance of an appropriate organizational structure, efficient decision-making processes, and flexibility in adapting to changing project conditions.

The risk factors with a medium impact on innovation projects were identified by respondents as: organizational culture (2.517), business model (2.644), marketing-related (2.460) and instrumental (2.322).

Factors related to organizational culture, although rated somewhat lower, remain important for innovativeness. An open culture that supports creativity and collaboration fosters effective innovation implementation. The business model, though rated slightly lower, affects the ability to commercialize innovations and adapt to market requirements. Marketing and instrumental factors (e.g., tools, infrastructure) have a moderate impact, which may result from the belief that while important, they do not directly determine project success if the other key areas are properly secured. Overall, the study emphasizes the critical role of financial and personnel aspects as the most significant risk factors in innovation projects.

Respondents were asked to assess the impact of the above-mentioned groups of external risk factors occurring in innovation projects using a 0-5 scale. The summary of the research results is presented in Table 7.

Table 7.
Groupe of external risk factors in innovation projects

Groupe of factors	0	1	2	3	4	5	Average rating
1. Political	13	18	26	15	10	5	2.069
2. Legal (regulatory)	6	10	17	24	23	7	2.793
3. Competitors	3	12	17	22	23	10	2.920
4. Consumers (expectations, behavior)	0	7	14	27	25	14	3.287
5. Suppliers	7	16	20	23	13	8	2.494
6. Investors	12	12	15	21	15	12	2.586
7. Socio-cultural	15	21	20	19	8	4	1.954
8. Economic (macroeconomic)	0	10	16	24	18	19	3.230
9. Environmental (ecological)	11	19	25	16	12	4	2.126
10. Technological (trends, substitutes)	4	11	21	18	20	13	2.897
11. International	16	21	16	14	14	6	2.080
12. Force majeure (COVID-19 pandemic, war, disasters)	4	6	22	20	20	15	3.046
13. Market-related (size, dynamics, demand, supply)	1	6	21	16	25	18	3.287
14. Business-related (partners)	5	18	17	19	21	7	2.621

Scale: 0 – no impact; 1 – very low impact; 2 – low impact; 3 – average impact; 4 – high impact; 5 – very high impact (essential factor).

Source: Own work based on research results.

The findings from Table 7 reveal the diverse impact of external risk factors on innovation projects. The risk factor groups influencing innovation projects that were rated the highest by respondents are: consumers (3.287), market-related factors (3.287), economic (macroeconomic) factors (3.230) and force majeure (COVID-19 pandemic, war, disasters) (3.046), competitors (2.920), technological (trends, substitutes) (2.897). High scores in these categories indicate that innovation projects are particularly sensitive to changes in consumer behavior and expectations, market conditions, and the broader macroeconomic environment. Macroeconomic risks and force majeure are difficult to predict but can have a drastic impact on project implementation—emergency scenarios and flexibility in planning are necessary. Risks related to unpredictable events (force majeure) are also considered very significant, reflecting recent experiences with the pandemic and armed conflicts. The importance of competition and technological pressure highlights how dynamic and demanding the environment for innovative ventures is.

The risk factors with a moderate impact on innovation projects were identified by respondents as: legal (regulatory) factors (2.793), suppliers (2.494), investors (2.586) and business partners (2.621). Legal and regulatory risks, although not the highest-rated, are still significant and often cited in the literature as a source of uncertainty for innovation, especially in the context of changing regulations and compliance requirements. Regulations and law remain important, though not dominant factors - their significance increases in highly regulated sectors (e.g., technology, health, energy). The impact of suppliers, investors, and business partners points to the importance of stable relationships in the value chain and the availability

of resources for implementing innovations. Collaboration with partners and investors and the stability of suppliers are important for the liquidity and security of innovation implementation.

On the other hand, the risk factors with the lowest impact on innovation projects were considered by respondents to be: socio-cultural factors (1.954), political factors (2.069), international factors (2.080), environmental (ecological) factors (2.126). Low ratings for socio-cultural and political factors may result from a relatively stable environment in the surveyed sample or from the belief that their impact on specific projects is less direct than, for example, market or technological changes. However, the literature indicates that, in the long term, political and social changes can significantly influence the innovation climate, especially through state policy and regulations.

In conclusion, the results emphasize the critical need to address consumer expectations, market dynamics, and macroeconomic conditions when managing external risks in innovation projects. Additionally, preparedness for force majeure events and technological advancements is essential for ensuring project success. These findings highlight the importance of strategic planning and adaptability in mitigating key external risks.

3.3. Research limitations

This study faces limitations related to the quantitative research paradigm. The research was conducted over a short period and had a pilot character, which did not allow for a comprehensive identification of external and internal factors influencing risks in various types of innovation projects. Empirical studies conducted through surveys have certain limitations, including:

1. Subjectivity of responses. Respondents evaluated risk categories and factors determining their levels in innovation projects based on their own judgments, which may lead to biased results.
2. Limited knowledge of respondents. Specialists and management staff from the studied organizations may not have had complete knowledge about risks in innovation projects, potentially affecting the quality of the collected data.
3. Small scale of empirical research. This may have impacted the representativeness of the results and limited the possibilities for generalization.
4. Provision of only general cross-sectional data. The study provides data at a specific point in time, whereas the identification and assessment of risks in innovation projects cover the entire project lifecycle.

Future research should be conducted on a larger sample and with greater contextual diversity (across different countries and sectors), which could contribute to a deeper analysis of the problem. Additionally, conducting research in various countries would enable comparisons, drawing conclusions, and increasing the potential for generalization. The use of mixed research methods, combining quantitative survey data with qualitative interviews or case studies, could allow for better identification and understanding of the impact of multiple internal and external factors on risk levels in various types of innovation projects.

4. Conclusions and recommendations

The issues presented in the article demonstrate that, in both theory and practice, there are different approaches to the interpretation of the terms: "innovation project" and "risk in an innovation project". This is due to the existence of various types of innovation projects and numerous categories of risk within these projects. The research problems addressed in the article are not easily recognizable, as the very definitions of an innovation project and risk in an innovation project are not fully explicitly explained and depend on many different perspectives.

The most important conclusions from the empirical research are:

- the highest activity in terms of the number of implemented innovation projects during the analyzed periods 2018-2020 and 2021-2023 occurred in the surveyed organizations in the following projects: investment, organizational, and technical-technological;
- the greatest increase in interest (dynamics) in implementing innovation projects between the periods studied (2018-2020 and 2021-2023) was observed in projects: management systems, research and development, and technical-technological;
- among the various risks to which all types of innovation projects are exposed, respondents rated the levels of financial, time, market, and technological risks as particularly high;
- among external factors, respondents considered consumer demands and market changes to have the strongest impact on risk in innovation projects, while internal factors such as financial-economic and personal factors were deemed most influential.

The highest activity in investment, organizational, and technical-technological projects was also confirmed by the findings presented by Rachmiani et al. (2024), who indicate that technological projects dominate the IT industry due to market dynamics and competition. Richert et al. (2022) emphasize the importance of technological projects in the metal industry. Meanwhile, Spałek (2016) believes that organizational projects are key to market success. The greatest growth in management systems, R&D, and technical-technological projects was confirmed in studies by Haneda and Ono (2020), who analyzed R&D management practices and their direct connection to the success of innovative projects. Sanchez-Cazorla et al. (2017) identified organizational factors as crucial in managing innovative projects. García-Quevedo et al. (2018) demonstrated that financial barriers increase the likelihood of abandoning innovative projects, while Kadareja (2013) listed time and financial risks as the main causes of failure. Rachmiani et al. (2024) identified market and technological risks as dominant in IT projects.

Trzeciak (2017) and Farooq et al. (2018) indicate that personal factors are key determinants influencing risk in innovative projects. Kadareja (2013) emphasizes the importance of customer requirements and market changes as primary external risk factors. García-Quevedo et al. (2018)

highlight budget constraints and lack of management support as internal barriers. Meanwhile, Rachmiani et al. (2024) add competitive pressure as a significant external factor influencing risk in innovative projects. Additionally, Spałek (2016) considers organizational culture to be a crucial internal factor affecting risk in innovative projects.

Based on the research findings, several actions can be proposed for management to more effectively identify risks in innovative projects:

I. Short-term actions include, for example:
   1. Utilizing advanced technologies (e.g., AI and machine learning for risk prediction based on large datasets such as market trend analysis or prototype failures; digital twins for simulating risk scenarios in a virtual environment before implementation; and visualization tools like risk matrices to prioritize threats based on their likelihood and impact). Example sectors: financial (AI and ML are widely used to predict market risks, analyze trends and detect anomalies in financial data), IT (digital twins and visualization tools help simulate cyber threats and test the resilience of systems), construction (IoT and digital twins are used to monitor the technical condition of equipment and predict failures in construction projects).
   2. Applying diverse analytical methods tailored to the specific nature of innovative projects, industry characteristics, and different stages of risk management. Example sectors: healthcare (analytical methods such as scenario analysis or clinical risk assessment are crucial for patient safety and regulatory compliance), industry (FMEA-type analyses or expert analyses are used to assess the risks of product and process innovations).
   3. Implementing monitoring and/or early warning systems, as well as collaborating with external experts to assess the impact of external and internal factors on risk levels in innovative projects. Example sectors: healthcare (monitoring epidemiological threats and cooperation with medical experts allow for a quick response to new risks).

II. Organizing training sessions for management and project teams to enhance competencies in using tools for identifying and assessing risks in innovative projects, fostering a proactive culture of prevention and reporting emerging threats during project execution. Example sectors: IT (building awareness of cyber threats and data security training), industry (training in the use of analytical tools and security protocols is key to reducing accidents and improving efficiency).

III. Long-term actions include, for example:
   1. Adopting an interdisciplinary and holistic approach during the development and implementation of innovative projects by leveraging diverse ideas and experiences through collaboration throughout the project lifecycle. Example sectors: public (innovative projects in public administration require cooperation between departments and external partners to effectively manage risk and implement new

solutions), multi-sector project teams in large infrastructure or IT projects increase the effectiveness of risk identification and management.

2. Developing and consolidating monitoring and early warning systems as a permanent element of innovation project management, with regular review and updating of procedures and tools. Example sectors: financial (monitoring and early warning systems for rapid detection of liquidity threats and market changes), industry (monitoring of equipment and cooperation with technical experts minimize the risk of failures and production downtime).
3. Implementation of programs for the development of managerial and expert competencies in the field of risk management, including long-term training, mentoring and building career paths related to innovation and risk management. Example sectors: financial (extended career paths and certifications, e.g. PRM, FRM, treasury risk management courses that focus on market, credit, operational and strategic risk management), IT (training and mentoring in digital and project risk management, e.g. PMI-RMP courses or specialist cyber risk management programs).
4. Implementing a risk mitigation strategy by establishing long-term strategic partnerships with universities, research institutes and other external entities, implementing phased investments and developing a culture of prototyping and testing solutions before their full implementation. Example sectors: manufacturing industry (partnerships with universities and research institutes support the implementation of innovations and testing of solutions before full implementation), public (public-private cooperation, e.g. in energy projects allows for sharing risks and knowledge), IT (prototyping and phased implementations minimize the risk of failure of large digital projects).

The issues addressed in the article do not exhaust the vast and continuously explored topic by both researchers and practitioners in many organizations. The authors are aware that the scope of the research methods used (especially qualitative methods) and the size of the research sample were not fully sufficient, which may have influenced the conclusions drawn. The topic of innovation project risk is constantly evolving in the context of environmental changes and the emergence of new risk categories and determining factors. Therefore, the authors intend to undertake further empirical research in this area on a much larger scale, also employing statistical analyses and qualitative methods (e.g., case studies), which will allow for a more in-depth and broader examination of the issues related to identifying types of risks and the factors determining risks in innovation projects within organizations (Dandage et al., 2018; Bugas et al., 2019). The combined use of various methods (quantitative and qualitative) can contribute to a better expansion of knowledge on a specific topic (Sułkowski et al., 2021) and provide comprehensive answers to specific questions (Dźwigoł, 2015). It should also be noted

that the selection of research methods depends on the specific research problem and research effort.

In the authors' opinion, it is worthwhile to continue empirical research related to the risks of innovation projects and to set further research objectives, which should include tasks such as: the level of formalization of the risk management system in innovation projects; the level of protection against the occurrence of high risk in innovation projects; the scope of methods and techniques used in risk management in innovation projects, etc.

5. Summary

Risk is an inherent element of innovation projects, stemming from their complexity, uncertainty, and dynamic environment. The aim of this study was to identify the key types of risks occurring in six types of innovation projects, as well as the factors that determine them. The research was based on an analysis of pilot study results obtained from 87 organizations.

The findings indicate that the highest activity in the implementation of innovation projects in the two analyzed periods occurred in the surveyed organizations, particularly in investment, organizational, and technical-technological areas. The greatest increase in interest (dynamics) in the implementation of innovations was observed in projects related to management systems, research and development, and technical-technological initiatives. Respondents rated the levels of risk associated with finances, time, market, and technology as particularly high. Among external factors, changes in consumer requirements and market fluctuations had the most significant impact on risk in innovation projects, while among internal factors, financial-economic and personal factors were identified as the most influential.

Therefore, effective identification of risk factors requires the use of appropriate tools and competencies within the project team.

The practical implications of the research highlight the importance of the risk identification process in innovation projects, emphasizing not only an analytical but also a holistic approach, as well as the integration of multiple methods to effectively identify and assess risk levels in order to minimize their impact. Particular attention should be paid to the necessity of building interdisciplinary teams, investing in collaboration, and utilizing modern technologies to support the recognition of various factors determining risks in innovation projects.

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