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Identification of risk types in innovation projects

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Abstract ***Purpose.*** *The purpose of the article is an attempt to fill a research gap in the field of issues re-lated to innovation projects and, in particular, to identify the types of risks associated with their implementation in organizations.*
Current identification and monitoring of the level of occurrence of various types of risk in in-novative projects is a key task for project managers in order to make effective decisions on how to eliminate or reduce them.
Design/methodology/approach. *The empirical verification is based on the methodology of our own research. The study developed and used a questionnaire for owners and managers imple-menting innovative projects.*
Findings. *This research, and the results we obtained, make it possible to answer how innovation projects are treated in organizations, what the dynamics of the implementing various types of innovation projects in recent years has been, and the level at which various types of risk in in-novation projects have been assessed and identified.*
Practical implications. *The literature review and research results show that the issue of risk in innovation projects is timely and important for many organizations, even more so for project managers looking for effective methods of identifying and managing it. Identifying the level of risk is crucial for the success of innovation projects because it reduces the negative impact of risk factors on a project's timeliness and budget, as well as its economic and technical-technological effects. The authors emphasize that it will be worth continuing the undertaken research and work towards identifying and evaluating all components of risk management sys-tems. Proper identification of risks in projects, and understanding their nature, is a kind of guar-antee of security for the organization implementing them.*
Originality/value. *For the purpose of carrying out this empirical research, we adopted our own classification system of the types of risk associated with various innovation projects undertaken by organizations. Risk categories should be well-defined, corresponding to typical sources of risks for a type of innovation project in a given industry and the specificity of company's activi-ty. The types of risk most frequently named by respondents across six types of projects were time, personnel and cost.*

Keywords innovation project, project risk, types of risks, risks in innovation projects, identification of risk

INTRODUCTION

The new, complex and unique challenges of modern civilization create justifications for the implementation of innovative projects, thus giving them a practical dimension. Humanity is becoming an observer, as it were, of the synergy resulting from the power of technology, gigantic financial expenditures, efficient organization, and perfect cooperation, as well as the integration of systems and processes into ongoing projects. All this proves that "the impossible becomes possible", and "the limit is only imagination" (Łapuńka & Pisz, 2015, p. 800).

Innovation projects are of high importance, and occupy a special place in organizations (Catto & Maccari, 2021). An innovative project can be defined as a set of measures aimed at achieving an economic effect through implementation of innovations, including commercialization of novel scientific and (or) technology-driven results (Kozlov et al., 2021, p. 2). Innovation projects, as one of the crucial types of projects undertaken to add value in an organization, require large expenditures both before and during the implementation process.

There are several key characteristics associated with innovation projects. One of them is their hard-to-define scope. The other is that the goal of the project is very often described at a very high level, with details that are hard or even impossible to define upfront at the planning phase (Spałek, 2015, p. 8). Those projects also frequently operate in a turbulent, dynamic environment with a high level of competition. Teams work under strict time pressure, which generates additional problems in the flow of communication, such as increased tension (Jacobs & Rodrigues, 2007). A company's success is determined by the results of

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its innovation projects (Spałek, 2016, p. 132). The danger of incurring a loss, or the possibility of not achieving the intended goal, is a risk of implementing an innovation (Salerno et al., 2015). Innovation projects tend to be high-risk projects and their outcomes are uncertain. Thus, risk management of innovation projects seems to play a key role in their execution (Bowers & Khorakian, 2013; Browning, 2019; Willumsen et al, 2019; Qazi et al., 2020).

This article is an attempt to fill a research gap in the field of issues related to innovation projects and, in particular, to identify the types of risks associated with their implementation in organizations (Salerno et al., 2015). Risk identification is an important step in the process of risk management, involving detecting and categorizing sources of risk (Willumsen et al., 2019; Qazi et al., 2020; Oehmen et al., 2020). It is an iterative process, meaning that it is carried out repeatedly at each stage of a project's life cycle (Deptuła & Knosala, 2015). Innovative projects carry the risk that the company will incur losses, such as additional costs in excess of the forecast; exceeding the planned implementation time of the project stages; losing time associated with the commercialization of the innovation in the market; or receiving income below what was expected (Gorokhovatskyi et al., 2021).

This article is structured in four sections. The first section explains the theoretical aspects of innovation projects, the risk involved, and the importance of the risk identification stage in projects. The second section shows our research methodology. The next section shows the results of the research. The article ends with the discussion and conclusion section, where the main study contributions, limitations, and suggestions for future studies are presented.

THEORETICAL BACKGROUND

The concept of an innovation project and its classification

Addressing the issue of innovation projects, the following question should be asked: what are innovations? Innovations are identified as something new—a change that might result in new products, technologies, non-standard services or management methods (Dodgson et al., 2008; Kisielnicki, 2013; Koźmiński et al., 2014; Pearce et al., 2011, etc.).

Innovations undertaken by organizations may concern several areas: research and experimental development; engineering, design and other creative work; marketing and brand equity; activities related to intellectual property; employee training; software development and database activities; and/or the acquisition or lease of tangible assets and innovation management (Oslo/Eurostat, 2018).

It should also be emphasized that innovation is an interesting area of research that has been taken up by researchers from various scientific centers in recent years (Jasiński, 2006; Kozarkiewicz, 2010; Świtalski, 2005; Stabryła, 2015; Brook & Pagnanelli, 2014; Horbach et al., 2013; Shu et al., 2015, etc.). Taking into account the complexity and variability of the conditions in which modern enterprises operate, undertaking innovation-oriented activities, in particular innovation projects, should be regarded as an opportunity leading to increasing, or strengthening, competitive advantage in the market.

Therefore, it is important to clarify the term "innovation project". An innovation project is a temporary endeavor with a separate organizational structure, implemented in accordance with an adopted plan of activities, based on allocated resources, and aimed at achieving specific business benefits through the effective commercialization of the innovation or its application within the organization (Łopaciński, 2018, p. 73). Innovation projects can be any activity of a novel nature or unprecedented approach, and they are distinguished by a higher degree of difficulty and increased chance of achieving the project's goals and products. They may be implemented according to a scope that is modified on an ongoing basis (Janasz, 2011, p. 187). Innovation projects are defined as a set of activities that are organized and managed for a specific purpose and with their own objectives, resources and expected outcomes (Oslo/Eurostat, 2018). Innovation projects are marked by unprecedented approaches, a higher degree of difficulty, and an increased risk of not achieving the project's goal and products, which may be implemented with an unspecified scope (Goździewska-Nowicka & Brodnicki, 2016, p. 1695).

According to M. Wirkus, an innovation venture (project) should be distinguishable from other types of ventures primarily by the element of novelty, the hallmarks of which should appear in the end result of the venture (2006, p. 18). Taking into account the characteristics of projects, it can be said that an innovation project is a kind of process that is characterized by complexity, limited in both time and resources, and that leads to the achievement of a specific objective. The purpose of an innovation project can be the implementation of new or significantly improved products, processes or methods in a particular organization, and is often considered to be an opportunity to use knowledge to solve practical business problems within a company. According to A. Sulejewicz, the proper use of knowledge significantly reduces uncertainty in doing business (2006, p. 12).

In an attempt to classify innovation projects, the following types can be distinguished: technological/technical projects, research

projects, and product development projects (Entekhabi & Arabshahi, 2012, p. 618-621). S.C. Wheelwright and K.B. Clark (1992) divided innovation projects into four types: research and development, radical, platform and derivative (Entekhabi & Arabshahi, 2012, p. 621). Two of the four types of project defined by A. Matczewski (2010), organizational and developmental, by their scope refer to innovation.

On the other hand, J. Kisielnicki (2013) categorizes all innovation projects under one term – "research and development projects". Depending on their scope, he divides them into soft projects (usually concerning an invention, concept or theory) and hard projects (introduction of a finished product or service to the market). In the Oslo Manual (Oslo/Eurostat, 2018), innovation projects are categorized by the target of the change: product, process, marketing or organizational. R. Jacoby and D. Rodrigues (2007) distinguish three types of innovative project: incremental innovation, evolutionary innovation, and revolutionary (radical) innovation (Keizera & Halmana, 2009, p. 500).

The above literature review shows the lack of clarity in the definition of the concept of an "innovation project". This variation is a consequence of the existence of different types of innovation projects in organizations, varying in size, originality, scope, and their need for management. Innovation projects have multiple overlapping qualities and fall into multiple classification categories. For example, a project concerning a new product may be simultaneously categorized as all of the following: an R&D project, a strategic project, a large (complex) projects, a project implemented independently or jointly with other entities, and an original project.

Table 1 shows the general classifications of innovation projects, and their usual outcomes based on various criteria and examples in the indicated literature.

Table 1. General classification of innovation projects

Classification criterion	Types of innovation projects	Results/Outcomes/Examples
1. Project orientation in the area	Product innovation	The introduction of a new or improved product to the market. This term refers to the novelty and modernity of the manufactured product, which may be created using new designs or raw materials, a new prototype, an enhanced technical specification, or state-of-the-art built-in software.
	Process innovation	The introduction of new ways and methods of production, which may concern advances in strict technology or in production technology (e.g. infrastructure, informatic systems, or production).
	Organizational innovation	The results of innovation projects within an organization are new solutions introduced to increase the efficiency of operations, such as new management methods – for example, just-in-time (JIT) implementation, quality control, business models, implementation methods, organizational structure, or a new salary system.
	Marketing	The results of innovation projects within marketing include marketing strategy, packaging design, ad design, website projects, joint advertising projects, implementation of new methods or concepts, and marketing information systems, such as project customer relationship management (CRM).
2. The originality of changes	Creative (original, inventive, rudimentary, pioneering)	Creative innovations refer to inventions and discoveries that are independent creations of an individual or group, such as the design of a new product, a new technology project, or a new business model. They are equated (associated) with conquering terra incognito (the land of the unknown), paving the main paths of technical civilization and pressing into the gaps of development, i.e. mastering undiscovered fields.
	Secondary (imitating, modifying, adaptive, reproductive, imitative)	Secondary innovations are "borrowed" innovations, already in use elsewhere. Their methods are reproducible and involve imitation of pre-existing precedents in order to achieve certain benefits (e.g., product or IT system design improvements).
3. Extent of the effects caused	Strategic innovation	Strategic innovation refers to innovative ventures of a longer-term nature that serve to achieve the strategic goals of the business entity (e.g., radical changes in management, entering a new market, a company merger project, crisis exit strategy projects, diligent business planning, etc.).
	Tactical or operational innovation	These refer to ongoing changes in products, production technology and work organization, allowing for increased management efficiency in a short period of time (e.g., in a budgeted project, a new website design, etc).

Classification criterion	Types of innovation projects	Results/Outcomes/Examples
4. The degree of product change and the degree of manufacturing process change (types of product development projects)	Research or advanced development projects	These projects aim at inventing new science or capturing new know-how for the organization. These projects are precursors to commercial development projects.
	Breakthrough development projects	These projects create the first generation of an entirely new product and involve significant changes compared to previous products and processes. These projects are likely to create a whole new product family for the organization.
	Platform or next generation development projects	These projects provide a basis for a product and process family, and thus establish the basic architecture for derivative follow-up projects.
	Derivative development projects	These projects refine and improve select performance dimensions, creating, for example, lower-cost versions of existing products and processes.
5. The level of technological uncertainty at the time of the project's initiation	Low-tech projects	These projects are those projects that rely on existing and well- established base technologies to which all industry players have equal access. Although such projects may be very large in scale, no new technology is employed at any stage. There is little or no technological uncertainty prior to the project's initiation. Most projects in the construction and road-building industries belong to this category.
	Medium-tech projects	These projects rest mainly on existing base technologies, but incorporate some new technology or feature. Such projects are characterized by a relatively low level of technological uncertainty. The new technology or feature is what usually provides the source of the project's advantage, thus serving as its key technology. Examples include many industrial projects of incremental innovation, as well as improvements and modifications of existing products.
	High-tech projects	These projects are defined as projects in which most of the technologies employed are new, but already in existence, having been developed prior to the project's initiation. Integrating several new technologies for the first time leads to a high level of technological uncertainty. Many, though not all, projects in the tech industry or the defense industry would normally be characterized as incorporating radically new technologies, thus making these industries the natural home for such projects.
	Super High-Tech projects	These projects are based primarily on new, not entirely existent technologies. Some of these technologies are emerging; others are even unknown at the time of the project's initiation.
6. Reason for undertaking projects	Demand-driven (ordered, initiated by the market)	Demand-driven innovation is driven by market and non-market needs. An innovation project, in this case, is a response to an existing demand (a new packaging design, a product improvement project, a new communication channel for a project, etc).
	Supply (not ordered, initiated by science and technology)	Supply-side innovations follow discoveries, inventions and ideas, made by creators (scholars) under the influence of their own curiosity and creative aptitude and individual need for achievement (self-realization). This may include new production technology design or product commercialization projects for markets.
7. Number of creators	Uncoupled innovations	These are the result of both creative and imitative activities performed by individual rationalizers, who use only their own knowledge and their own financial resources to introduce them. Examples include organizational structure designs and quality policy (quality book).
	Coupled innovation projects	These are the result of the joint efforts and cooperation of a larger number of people, teams and even multiple institutions, which may collaborate on new product of designs, strategic alliance projects, cooperation network projects, and the like.
8. Complexity and size of the project	Large Medium Small	Determining whether a project should be considered large, medium or small depends on the measures adopted and the quantifiable assessment of its creators. This measure could include be the scope of component activities, project duration, number of contractors involved and/or the size of financial outlay.

Classification criterion	Types of innovation projects	Results/Outcomes/Examples
9. Need for project management	Profitable	Including small B and large R (i.e., limited research and extensive development works). Such projects build on already existing knowledge and are primarily focused on application, with any economic effects achieved in the area of cost savings (e.g., new products from the project, engineering projects, technological projects, and the like).
	Radical	Associated with both "big B and big R", these types of projects enrich both theoretical and practical knowledge and involve high industrial research costs and a higher degree of creativity in the results obtained. They may result in a new method for a project, restructuring projects, new business models, etc.
	Fundamental	"Big B and small R" – this group includes innovations in the realm of theory, providing the basis for technology development, but only in the future. Such initiatives involve high costs and uncertainty about future economic benefits. Examples include new models of organization, using new ingredients in medicine, new technology in the energy sector, or new diagnostic device designs.

Source: own elaboration based on: Francik (2003, p. 48); Świtalski (2005, pp. 98-99); Wirkus (2006, p. 18); Grudzewski & Hejduk (2008, p. 58); Entekhabi & Arabshahi **(**2012, pp. 619-622); OECD/Eurostat (2018); Dyduch (2019); Wang et al. (2020); Catto & Maccari (2021).

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

Overview of types of risks in innovation projects

Treating innovation projects as a kind of response to change (Dudek, 2011, p. 109), it should be emphasized that they carry a certain degree of risk, and inadequate management of them can cause failure in their implementation (Kaczmarek, 2008). It has been recognized that the most common reasons for such projects' failure or success is the knowledge or skills and aptitude of those who manage them (Trzeciak & Spałek, 2016, p. 484). There are many more reasons for failures in the implementation of innovative projects. External reasons may include changes in regulations; changes in stakeholder expectations; changes in technology; or mismatch of the project concept to the client's needs. Internal ones may include insufficient funds to complete the project; poor communication and team cooperation; lack of timely completion; underestimating costs; and organizational factors (Thamhain, 2013; Kadereja, 2013; D'Este et al., 2014; Amara et al, 2016; Gohar et al., 2021).

Risk can be defined as any uncertain event that might fail to serve the interests of stakeholders as stated in the project design (Sanchez-Cazorla et al., 2017, p. 77). For example, engineering projects have more inherent risk, as many contracting parties are involved, including contractors, owners, designers, suppliers, etc. (Alkaissy et al., 2020; Agarwal & Kansal, 2020). The implementation and success of innovation projects are highly dependent on the level of risk involved (Shahmansouri et al., 2019).

Therefore, an important issue to be presented is risk in innovation projects and its management. This is a topic that has been discussed for many years (Hottenstein & Dean, 1992, pp. 112-126; Wyrozębski et al. 2012), that remains relevant (Thamhain, 2013, pp. 20-35; Yim et al, 2015). Literature on the problems encountered in innovative project research and its development under the conditions of risk are enumerated in the papers of scientists such as A.A. Abdalah (2004), N.N. Lepa, (2005), O.E. Grigorieva (2008), O.M. Zborovskaya (2016), T. Bugas, I.V. Stepanova & A.V. Skrypka (2019), and L. Guryanova (2020). Risk is a combination of internal and external factors that limit or cause disruptions to the achievement of a project's stated goals and significantly affect its profitability, and thus the performance of the entire organization (Siewiera, 2016, p. 606).

Considering the nature of innovation projects, according to D. Hillson (2016, p. 5), a modern approach to risk should be adopted, categorizing risks as either:

- threats – the current approach to risk in projects (Dandage et al., 2018; Browning, 2019) or
- opportunities – an innovative approach to risk in projects (Farooq et al., 2018; Escord et al., 2018, Denney, 2021).

The problem of risk in innovation projects is more important and timely than ever, as it is one of the key factors affecting their success (Deptuła & Knosala, 2015, p. 15-16; Spałek, 2016, p. 137; Farooq et al., 2018; Oehmen et al., 2020).

In project management methodologies (PRINCE2, 2009; AgilePM, 2012; PMBoK, 2017; PMI, 2019), project risk is defined as the probability of the occurrence of a phenomenon or activity that may have a negative or positive impact on the implementation of an entire project and/or on its individual parts. Project risk means the risk of the project failing to meet technical and/or economic (financial) conditions (Kieruzel, 2012, p. 7). Project risk can be defined as a project's possibility of failure to achieve its stated objectives. It can be treated as the probability of the occurrence of a phenomenon or activity outside the sphere of

influence of the project team that may have positive or negative consequences for the project (Chapman & Ward, 2015; Małkus & Sołtysik, 2016, p. 203; Zinn, 2017). Risk in innovation projects is "the pursuit of opportunities expected under given conditions of uncertainty" (Berglund, 2007, p. 500). Other interpretations of the term "project risk" have been made in Ward & Chapman (2003); Uhlig (2012); IEC (2013); Osipova & Eriksson (2013); Kendrick (2015); Walaszczyk (2016); Eskerod et al. (2018); Willumsen et al. (2019); and Qazi et al. (2020).

Precise identification of risks is an integral part of analyzing the effectiveness of an innovation project. The management of an innovation project is more complex compared to the implementation of standard projects. This is mainly due to the fact that these are activities implemented under conditions of high risk and uncertainty. Moreover, the scope of such projects is impossible to define in detail, so new challenges may constantly arise during their implementation. That is why risk management of an innovation project requires proper preparation on the part of the project manager and the entire team (Sulejewicz, 2006, p. 12; Stosic et al., 2016). Project risk identification is one of the most important steps in project risk management (Segal, 2008, p. 29; Oehmen et al., 2020), because all other steps depend on it (Jędrych et al., 2012, p.101). Risk identification typically involves three types of activities: defining and categorizing risks; conducting internal qualitative surveys on the frequency and severity of each risk; and scanning the external environment for emerging risks (Segal, 2008, p. 29; Oehmen et al., 2020).

The purpose of risk management in innovation projects is to identify sources of risk. Effectively managing risks relies on their identification, particularly at the front end, before the project concept has been finalized (Sanchez-Cazorla et al., 2017, p. 77). It is also important to identify possible areas of risk occurrence and then measure them, as well as develop appropriate strategies to safeguard against the identified risks (Rogowski, Michalczewski, 2005, p. 15). During risk identification, a risk manager must determine potential threats and opportunities that could occur. Three aspects are central to identifying a potential risk event: who (the affected stakeholders), when (at what point it occurs in the project's life cycle), and what (its impact) (Akram & Pilbeam, 2015; Mabelo, 2023). Considering stakeholder interests during risk identification is considered a best practice (Willumsen et al., 2019).

The high significance of risk in achieving the assumed effectiveness of an innovation project necessitates using a variety of complex, often costly methods and techniques for identification and assessment (Browning, 2019, p. 72-73). The multidimensionality and multifaceted nature of this issue requires am appropriately multifaceted approach. Effective management of an innovation project also means proper selection and appropriate use of tools to facilitate the elimination of the potential effects of risk (Adler et al., 2016, p. 916; Siewiera, 2016, p. 614).

Risks in an innovation project may be related to: the product; the use of new technologies; the use of design methods; the protection of intellectual property; the uniqueness of the project within the organization; the organizational culture; and the required competencies of the project manager (Becker & Smidt, 2015, p. 889; Łopaciński, 2018, p. 76).

The types of risks depend upon the type of project (Oehmen et al, 2020, p. 659-660; Yuan et al., 2020; Catto & Maccari, 2021). For example, the PMI (Project Management Institute) methodology distinguishes the following categories of risks for research projects: intercultural risk, communication risk, personnel risk, risk of non-acceptance of results, financial risk, management risk, technological risk, and market risk (Muniak, 2012, p. 148-150). For informatic projects, the following categories can be distinguished: risk due to the size of the project; business risk; customer risk; risk in the definition of the construction/ implementation process; development environment risks; technological risk; human resources risk (Kieruzel, 2012, p. 11); data protection risk; intellectual property risk; communication risk; and risk of changing requirements (Yim et al., 2015). For management projects, categories include risk of management incompetence; risk of choosing the wrong methodology; organizational risk; risk related to organizational culture; communication risk; and personal risk.

Table 2 contains the general classification of risks in an innovation project based on the indicated literature.

Table 2. The general classification of risks in innovation projects

Author	Types of risk in the innovation projects
J. Łunarski (2007)	The author distinguishes risk based on its cause: objective risk (limited to the inability to predict certain phenomena and their probability), subjective risk (results from human estimation of the probability of occurrence of a given event, which is thus subject to human error) and/or intrinsic risk (associated with the functioning of the theory of large numbers).
J.A. Keizer, J.I.M. Halman (2009)	The ten most frequently identified categories of risks in the radical innovation project (product) are: product technology (parity in performance compared to other products); commercial viability (clear and reliable volume estimates, sales perspectives being realistic); supply chain (contingency options for suppliers, and appropriate contract arrangements with them); intellectual property (knowledge of relevant patent issues, patent-crossing potential, and trademark registration potential); organization and project management (project mission and goals being clearly specified and feasible); and/or competitors (the new product creating potential barriers for competitors).

Author	Types of risk in the innovation projects
Ericsson, A. Kastensson (2011), R.F. Miorando et al. (2014)	The researchers distinguish types of risk based on origin: internal and external risk. Internal risks may be related to the project management methodology adopted in the organization; the strategy of implementing innovations in the organization; human resources; organizational culture; and knowledge management. External risks include those related to project stakeholders; the market and competitors; cooperators; and legal changes.
R. Muniak (2012)	The author distinguishes the following categories of risk: managerial risk – timely project completion while maintaining other project parameters; technological risk – developing new technological solutions and shortening the time of their implementation; market risk – whether the manufactured product will be accepted and generate revenue as a result
Nasalski et al. (2014)	Based on risk sources in innovative projects, the following risk areas can be distinguished: resources; decision-making process; organization; methodology; business; external partners; technology; and finance. Within the category of resources, for example, risk types can include competencies, team motivation, risk of losing key people, and allocation or utilization of resources.
Y.V. Lityuga, A. Revutska (2012)	Researchers distinguish the risks of: wrong choices; not providing the innovative project with a sufficient funding level; non-fulfillment of economic agreements (contracts); increased competition; insufficient staffing. They also address marketing risks and risks associated with securing property rights to an innovative project.
W. Janasz (2015)	Author distinguishes risks based on their source (area): risk of research and development activities (resulting from uncertainty and postponing effects in time, while also incurring current costs); market risk (as a consequence of the inability to predict how the new project will be received by the market); investment risk (difficulty in determining the correct level of funds allocated to project implementation); and financial risk (regarding the level and speed of circulation of current assets; of particular importance in a global or industry crisis, as the demand for a new project may suddenly collapse).
T. Nawrocki (2016)	Author distinguishes risk based on its source: economic risk (identified with the sources of financing an innovative project); time risk (related to continuous technological progress and unlimited global communication, translating into a significant shortening of the life cycle of an innovative project); organizational risk (identified with the way of organizing the work of a team implementing an innovative project); and competition risk.
K. Becker, M. Smidt (2015) T. Łopaciński (2018)	Researchers distinguishes risks related to: the product itself, the use of new technologies, the use of design methods, the protection of intellectual property, the uniqueness of the project within the organization, the organizational culture, and the required competencies of the project manager.

Source: Own elaboration based on Belassi et al. (2007); Łada (2007); Łunarski (ed.) (2007, p. 81); Shenhar & Dvir (2008); Kosaroglu & Hunt (2009); Day (2009); Biedenbach (2011); Ericsson & Kastensson (2011); Muniak (2012); Satarek & Zalewska-Traczyk (2013); Miorando et al. (2014); Nasalski et al. (2014); Yim et al. (2015); Becker & Smidt (2015); Janasz (2015); Adner & Kapoor (2016); Nawrocki (2016); Łopaciński (2018); Oehmen et al. (2020); and Catto & Maccari (2021).

The above classifications of risk in innovation projects (Table 2) were developed based on a literature review and differ from the classifications of risk adopted in our subsequent empirical studies. The level and types of risks in an innovation project are highly dependent on the type of project, the degree of market maturity for the new technology used, the adaptability of technologies previously used by customers, the ability to cope with the challenges posed by the transparency of the patent process, the experience of the company in successfully implementing intra-organizational changes, and the managerial and technical competence of the person appointed to play the role of innovation project manager. Therefore, this empirical research has adopted a classification of risks in relation to the six discrete types of projects (research and development, organizational, technical-technological, investment, information technology, and management systems).

RESEARCH METHODOLOGY

The adopted research methodology does not differ from those presented in the literature and used in the study of problems in management sciences (Apanowicz, 2005; Skarbek, 2013; Czakon, 2015; Matejun, 2021). Due to their specificity, management sciences are of a practical nature and usually refer to empirical research (Januszkiewicz, 2016). The research methodology making it possible to achieve the goal set in the article has been selected in relation to the topic and consisted of several stages. The first stage consisted of conducting a review of Polish and foreign literature on this topic in three publicly available databases: EBSCO, Scopus, Web of Science and Emerald. A literature review is the basis for determining research questions, i.e., the formulation of research problems to which answers are sought. The search for these answers becomes the aim of the work and determines further stages of the research procedure (Zdonek et al., 2016).

The review of the literature concerned three issues (topics): innovation projects, types of risk in innovation projects and the identification stage in the risk management process (Bourgault & Daoudi, 2014; Bowers & Khorakian, 2014; Zinn, 2017; Mammadov, et al, 2018; Jissink et al., 2019; Zaynullinal, 2020; Yuan, 2020). The basic research method at this stage is the analysis of available scientific papers in leading Polish and foreign journals. The analysis of available articles and studies made it possible to determine the type of research problems undertaken so far by various authors, and to identify the existing research gap with regard to risk in innovation projects (Apanowicz, 2005; Babbie, 2005; Ciesielski, 2011; Czakon, 2015).

The literature review we conducted will also enable the development of individual organizations' own classifications of risk types. This classification was used when creating questions in the survey questionnaire during the empirical research phase, and surveys are one of the most popular quantitative research methods (Lisiński, 2016; Matejun, 2021).

An important element of conducting research is defining its purpose clearly. Research objectives establish a project's intended effects and help answer specific questions posed by the researcher (Nowosielski, 2016, p. 470; Stańczyk-Hugiet, 2021). The main research goal here was to show current trends in Polish organizations in the field of risk management with regard to innovation projects – in particular, one of the key stages of risk management, the identification of types of risk.

This article is also an attempt to fill a research gap concerning innovative projects, and in particular to identify key features and types of risks occurring in these projects in various organizations. Its practical goal is to develop conclusions and recommendations that can be used by management for more effectively identifying types of risks.

Having established a specific topic and purpose for the research, the research problems can then be outlined in the next stage. It is assumed that research problems are questions to which the researcher wants to obtain answers by carrying out research, so they are a specification of the research goal (Jeszka, 2013; Czakon, 2015). A problem deserves the name of "research" when the matters it concerns are crucial and timely for theory and/or practice (Stańczyk-Hugiet, 2021).

For the purpose of achieving the goal, the following research problems were formulated (Apanowicz, 2005; Babbie, 2005; Saunders et al., 2009; Ciesielski, 2011; Niemczyk 2011; Jeszka, 2013; Zdonek & Hysa, 2017):

- What are the key features of various types of innovative projects implemented in the surveyed organizations?
- What is the number and the dynamics of activities undertaken in innovation projects implemented in the surveyed organizations?
- What risk categories are most common in particular types of projects?
- What are the level and types of risk in the innovation projects undertaken by the surveyed organizations?
- What key factors determine the level of risk in innovation projects?
- What is the importance of the risk identification stage in the risk-management process of innovation projects?

Defining these research problems allowed for the selection of the appropriate type of research tools (Frankfort-Nochnias & Nochnias, 2000; Colllis & Hussey, 2013; Czakon, 2015; Zdonek & Hysa, 2017).

The research method of the diagnostic survey (Januszkiewicz, 2016) was chosen for the study. This allowed for collecting information on the phenomenon of interest, examining the views and beliefs of respondents, and assessing their state of knowledge (Apanowicz, 2005; Dźwigoł, 2015). A questionnaire was used as a technique for collecting information (Czakon, 2015; Matejun, 2016; Januszkiewicz, 2016).

The survey consisted of a metric with detailed questions regarding the subject of the research. The relevance of these questions was verified using pilot studies (Nowak, 2007; Grzeszkiewicz-Radulska, 2012; Dźwigoł, 2015; Januszkiewicz, 2016) and interviews with three project management experts and three risk-management experts (Saunders et al., 2012; Denzin & Lincoln, 2013; Żelazo, 2013). Suggestions made by these experts for some questions helped improve the questionnaire as a research instrument (Sandberg & Alvesson, 2011). The revised questionnaire has already been used in the implementation of the so-called "proper quantitative research" (Staniec, 2012; Czakon, 2016).

The actual research was carried out in April-May 2023 using a questionnaire with the CAWI (Computer Assisted Web Interviewing) method. The questions were mostly closed-ended, and were addressed to a deliberately chosen research sample, which included owners of small organizations and managers who participated in the process of developing, implementing and evaluating innovative projects. The research sample consisted entirely of organizations operating in Poland. These choices were based on previous research on the type of value generated by projects, where an increasing interest in and implementation of various projects, including innovative ones, was noticed (Bartusik & Walas-Trębacz, 2019; Walas-Trębacz & Bartusik, 2021). The respondents were not chosen with any regard to the nature of their business or size; their organizations be producing or providing services or trade in any industry.

Based on the data collected, an analysis of the survey results obtained was conducted (Stopher, 2012; Baran, 2021) and conclusions were formulated in the context of the research problems (Flick, 2020; Piórkowska, 2021). The findings made it possible to propose recommendations for the management of organizations, and to indicate further directions in the implementation of empirical research on this topic (Zdonek & Hysa, 2017; Lenart-Gansiniec, 2021).

The results presented in the article are a consequence of this research methodology, which allowed the authors find answers to the problems that bothered them.

Characteristics of the organizations researched

The research covered 45 organizations, with respondents representing both management positions and business owners. Figure 1 shows the characteristics of respondents' organizations. The most common characteristics were: organizations that had been operating for 26–35 years (33%); service providers (48%); medium-sized organizations with 50–249 employees (29%) and very large organizations with more than 500 employees (29%); companies serving the domestic market (40%); and companies primarily providing assistance primarily to service companies (20%) and manufacturing companies (19%).

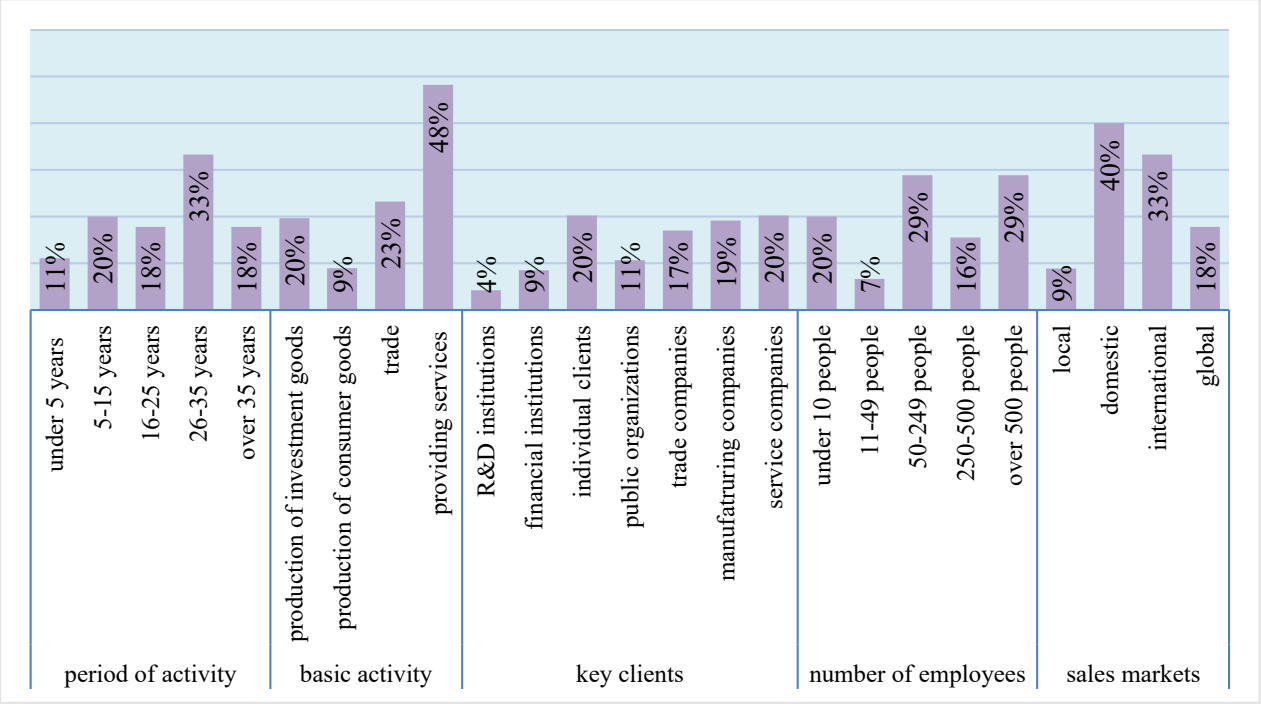


Figure 1. Characteristics of the organizations researched
Source: own study based on research results.

RESEARCH RESULTS

The main research tasks were identifying key features of innovation projects, and determining the number and dynamics of innovation projects that were carried out during two discrete time frames, 2017–2019 and 2020–2022. Projects were classified as: research and development, organizational, technical-technological, investment, information technology, or projects involving management systems. Another important research task was to identify the level and the types of risks present in each type of innovation project.

Figure 2 shows the seven features of innovation projects (IP) most frequently selected by respondents out of the 12 proposed in the survey questionnaire.

The statement "innovation projects are interdisciplinary in nature" (19%) emerged as the most common feature. This is an important feature, capturing the essence of innovation projects, as they require the cooperation of people with different skills and knowledge using research methods that correspond to the disciplines they represent.

The next most commonly highlighted feature was "an innovative project is something new, rare and unique" (17%). Many

respondents also held the opinions that each innovation project generates value for both stakeholders and the organization itself (17%) and that these projects are characterized by complexity and numerous interdependencies (15%). The value generated by innovation projects is a consequence of the characteristic most frequently named by respondents, which is their interdisciplinarity.

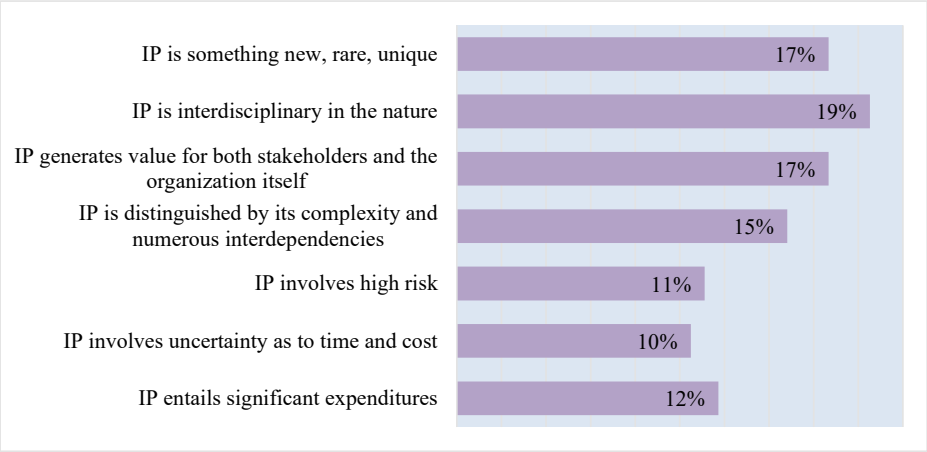


Figure 2. Main features of innovation projects indicated by the respondents
Source: own study based on research results.

In the next part of the survey, respondents assessed the perceived level of risk in innovation project types implemented during two periods: 2017–2019 and 2020–2022. They used a scale of 0–3 in their assessment, with 0 = no projects, 1 = low activity (one project), 2 = average (two or three projects) and 3 = high activity (more than three projects). Figure 3 shows the activity of the surveyed organizations in implementing the six types of innovation projects for the two periods indicated earlier.

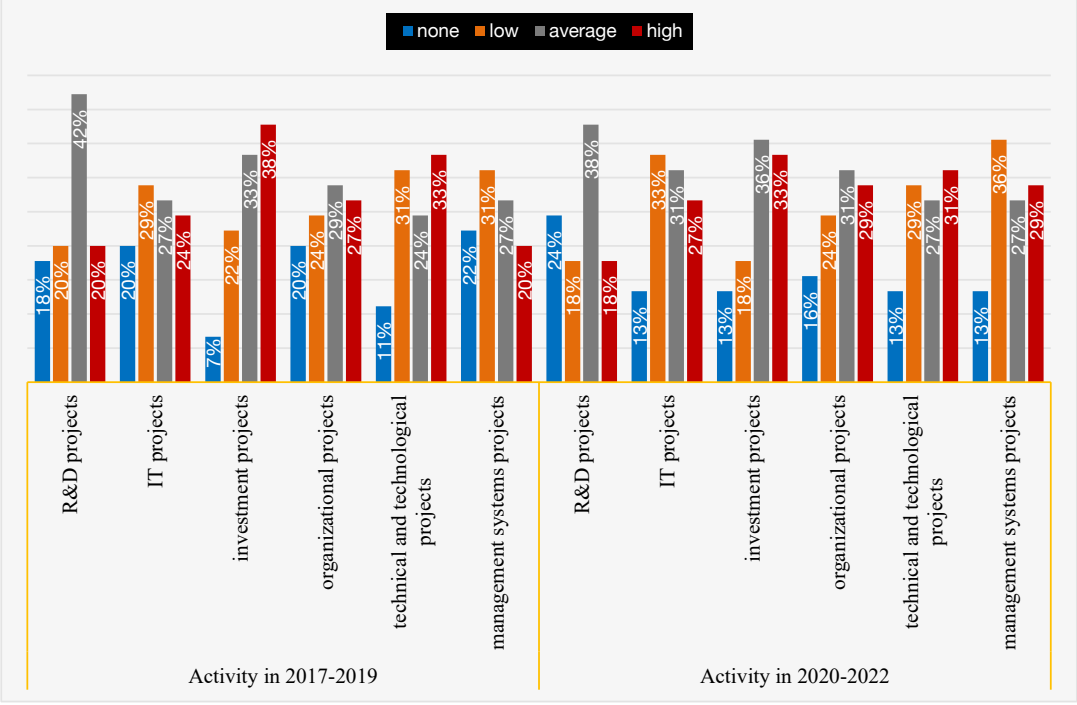


Figure 3. Implementation activity of projects (in 2017–2019 and 2020–2022) in the surveyed organizations
Source: own study based on research results.

From the data in Figure 3, it can be observed that in the researched organizations, the greatest amount of activity was undertaken in the 2017–2019 period, in the area of investment projects (38% at "level 3", a large number of projects) and technical-technological projects (33% at level 3). In the 2020–2022 period, the greatest interest was in investment projects (33% at level 3) and technical-technological projects (31% at level 3). The data also show that the greatest increase of interest between the two periods studied was in projects in management systems (from 20% to 29%) and in IT projects (from 24% to 27%). The greatest decrease in interest can be seen in the implementation of investment projects (from 38% to 33%), technical-technological projects (from 33% to 31%) and research and development projects (from 20% to 18% at level 3, and from 42% to 38% at level 2). This may have been due to the difficulties caused by the occurrence of the Covid-19 pandemic during this period, which contributed to a decline in interest in implementing certain types of projects (investment or R&D), with a greater impact on the implementation of various IT, organizational or management system projects, including performing work remotely. This saved many jobs, improved the organization of the work process, and led to better time management and implementation of automation.

The types of risks occurring in innovation projects were identified from an analysis of the literature and from our own experience. For the purposes of the research, an extensive list of risk categories was proposed in relation to each distinct type of innovation project. The survey questionnaire included a list of risk categories for each project. Respondents evaluated the level of risk present in each type of innovation project on a scale of 0-5, with 1 being a very low level of risk and 5 being a very high level of risk. Tables 3–8 summarize the respondents' responses in assessing the level of risk in each type of project.

Table 3. Types of risk in R&D projects

Types of risk	0	1	2	3	4	5	average
market	4	7	11	9	9	5	2.925
technical and technological	4	5	6	13	12	5	3.225
regulatory	4	12	8	10	9	2	2.6
personal	5	3	9	13	13	2	3.05
organizational	4	8	10	13	9	1	2.7
material	4	8	9	12	9	3	2.825
time	5	1	7	15	13	4	3.3
implementation difficulties	5	5	7	18	8	2	2.875
financial	5	9	4	6	16	5	3.1

Resource: own elaboration

Table 4. Types of risk in organizational projects

Types of risk	0	1	2	3	4	5	average
formal and legal	3	8	9	15	10	0	2.775
personal	3	3	10	14	12	3	3.2
coordination	4	1	18	12	8	2	2.875
financial	4	7	10	14	7	3	2.8
time	2	6	9	10	12	6	3.3
implementation difficulties	3	4	7	13	14	4	3.325
communication	2	1	14	16	10	2	3.175
quality	4	3	15	15	5	3	2.825
security	6	8	9	11	9	2	2.625

Resource: own elaboration

Table 5. Types of risk in technical projects

Types of risk	0	1	2	3	4	5	average
quality	2	7	12	9	11	4	3.05
time	1	3	13	13	8	7	3.375
cost	1	6	6	9	16	7	3.6
market	2	7	9	8	15	4	3.225
regulatory	2	13	8	10	10	2	2.725
intellectual property protection	4	7	9	9	12	4	3
personal	3	4	14	10	11	3	3.025
limited access	4	5	13	13	10	0	2.75
implementation difficulties	1	5	10	19	4	6	3.2
technological	2	6	10	8	12	7	3.325
security	4	9	8	13	9	2	2.75
material	2	7	14	10	11	1	2.85

Source: own elaboration

Table 6. Types of risk in investment projects

Types of risk	0	1	2	3	4	5	average
quality	3	8	8	13	9	4	2.975
time	3	5	6	11	12	8	3.45
cost	2	2	7	11	14	9	3.75
market	2	2	12	14	10	5	3.325
legal	2	6	12	8	15	2	3.1
personal	2	2	13	14	10	4	3.25
material	2	4	14	15	8	2	2.975
technological	2	5	13	13	10	2	3
security	4	9	7	17	5	3	2.725
financial	2	6	4	9	15	9	3.65
weather conditions	11	7	9	7	10	1	2.275
coordination	5	6	14	14	5	1	2.525
inappropriate selection of partners	5	6	10	14	8	2	2.75
environmental (threats)	7	9	10	12	6	1	2.35
social (protests)	12	13	8	8	2	2	1.775

Source: own elaboration

Table 7. Types of risk w IT projects

Types of risk	0	1	2	3	4	5	weighted average
quality	3	7	8	15	8	4	3
time	2	5	8	9	15	6	3.45
cost	4	4	7	12	12	6	3.3
regulatory and legal	7	8	10	9	10	1	2.5
personal	3	4	9	10	15	4	3.3
material	2	10	10	10	11	2	2.85
technological	3	11	5	9	13	4	3
security	7	7	7	13	8	3	2.675
financial	4	8	7	10	13	3	2.975
incompatibility	3	6	12	15	6	3	2.85
related to the requirements	3	6	10	10	15	1	3.025
complexity	2	3	4	17	13	6	3.6
organizational	3	3	12	17	9	1	2.975

Source: own elaboration

Table 8. Types of risk in management systems of projects

Types of risk	0	1	2	3	4	5	weighted average
quality	4	8	10	13	5	5	2.8
time	2	6	11	11	11	4	3.125
cost	3	12	7	11	9	3	2.75
formal and legal	4	14	5	9	10	3	2.65
personal	3	1	11	10	15	5	3.45
security	4	10	10	11	8	2	2.625
financial	4	8	5	14	14	0	2.9
coordination	2	4	9	14	12	4	3.3
implementation difficulties	4	4	11	14	10	2	2.95
organizational	3	4	9	13	14	2	3.175
technological	5	9	10	11	9	1	2.575

Source: own elaboration

Within the established project types, the respondents rated the levels of occurrence for the following risks as particularly high: time risk, cost risk, personnel risk and technical-technological risk. Respondents also named inadequate competence of the project manager to be the most significant risk in ongoing innovation projects, especially when it was due to the lack or low level of required knowledge, experience, and decision-making, or a lack of coordination in implementation. Detailed results are provided in Tables 3–8. A. Kadareja obtained similar results in his research (2013).

Respondents were also asked to assess the importance of individual stages in the risk management process. Using a 6-point scale (1 = the least important, 6 = the most important), they assessed each stage of the risk management process. Figure 4 shows the structure of the answers.

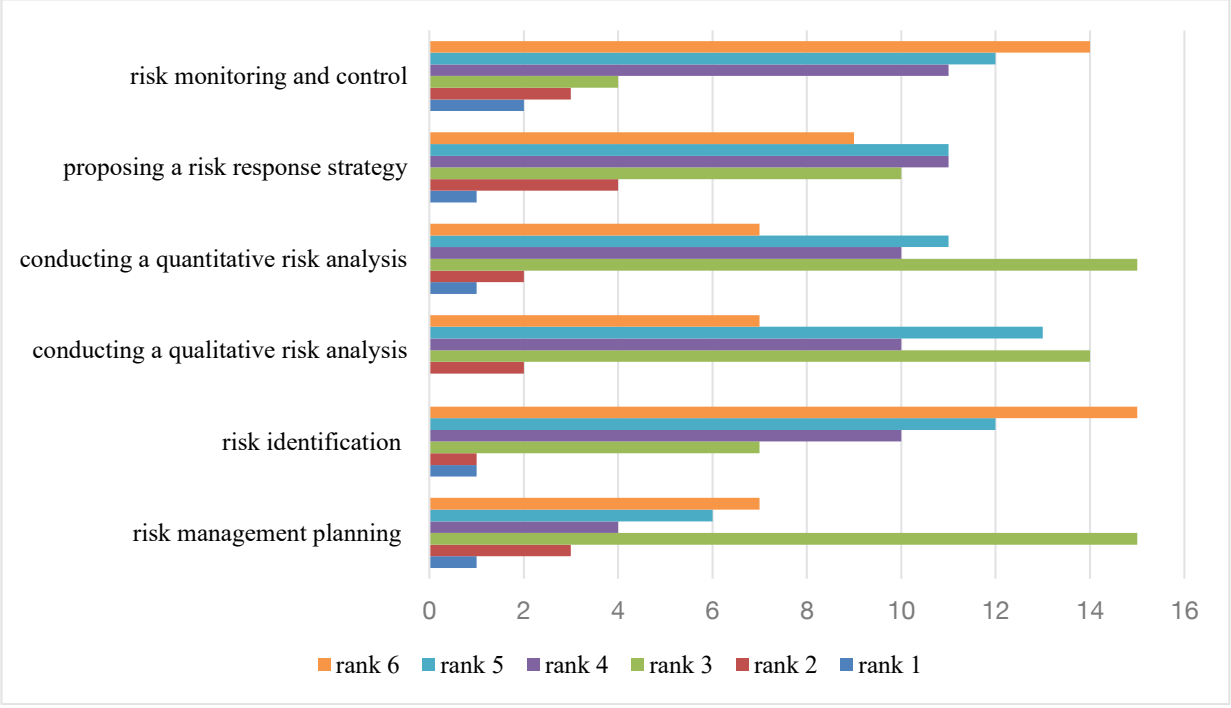


Figure 4. Assessment of the importance of the stages of the risk management process in innovative projects.
Resource: own analysis based on research results.

Respondents considered the risk identification stage to be the most important in the risk management process (average score 4.65), while the next most important turned out to be the stage of risk monitoring and control (average score 4.52). This fact is corroborated by other researchers such as Salerno (2008), Stosic et al. (2017), and Oehmen et al. (2020).

CONCLUSION AND RECOMENDATIONS

The issues presented in this article show that in different approaches, both in theory and in practice, to the interpretation of the terms “innovation project” and “innovation project risk”. A major reason is the existence of different types of innovation projects and the many categories of risk within them. The research problems addressed in the article are not among the easily recognizable ones, since the very definitions of “innovation project” and “risk in an innovation project” are not fully explicitly agreed upon, and depend on many different points of view.
The most important conclusions from the empirical research are:
• The key features of innovation projects were considered by respondents to be: their interdisciplinary nature; their novelty, uniqueness, and distinctiveness; their generation of value for external stakeholders as well as the organization itself; and their complexity and numerous interdependencies during implementation.
• The highest level of activity, in terms of the number of innovation projects implemented, in the two analyzed periods at the surveyed organizations occurred in the following areas: investment, technical-technological, and research and development.
• The greatest increase in interest (dynamics) in the implementation of innovation projects between the periods researched (2017–2019 and 2020–2022) occurred in management systems, information technology, and organizational systems.
• The greatest decrease in interest occurred in the implementation of projects: investment, or research and development.
• Respondents most frequently rated time, cost, personnel and technical-technological risks as most significant for innovation projects.

The risk-identification stage was considered by the surveyed project managers to be the most critical in the process of managing the risk of an innovative project.

In conclusion, there is a need to help all actors involved in the preparation and implementation of innovation projects, particularly managers, by better supporting their understanding and identification of risk. This, along with risk management, create a kind of guarantee of security for the organization implementing the project. Assessing risk ensures stable growth and creates conditions for the conscious building of competitive advantage.

It should also be noted that risk identification plays an important role in weathering dynamic changes in the business environment. One can see an increasing number of factors whose impact can be either positive or negative. This situation is causing a continuous increase in the importance of risk management. Many risks that were not present a few years earlier can, today, significantly affect projects and the organizations. Risk management is therefore a forward-looking area, and organizations need to become better and more effective at identifying, analyzing the impact of, and developing solutions to reduce the impact of risks.

The issues addressed in the article do not exhaust such a vast and continuously explored topic by both researchers and practitioners in many organizations. The authors are aware that the scope of the types of research methods used (especially qualitative methods) and the size of the research sample were not fully sufficient, which could have influenced the formulated conclusions. This issue of innovation project risk is constantly developing in the context of changes in the environment and the emergence of new risk categories and factors determining them. Hence, the authors intend to undertake further empirical research in this area on a much wider scale, using both statistical analysis and qualitative methods (e.g., case studies). These will allow for a more in-depth and broader examination and learning about the issues of identifying types of risk. The combined use of various methods (quantitative, qualitative) can contribute to a greater expansion of knowledge on a specific topic (Czarnik, 2020; Klimas, 2021) and provide more comprehensive answers to specific questions (Dźwigoł, 2015). It should also be mentioned that the selection of research methods was conditioned by a specific research problem and research effort. In the opinion of the authors, it will be worth continuing empirical research about the risk of innovation projects, and to set further research goals, including determining the role of cooperation in the process of implementation; what types of internal and external factors affect the failure of implemented projects; the level of formalization for the system of risk management in innovation projects; the level of protection against the occurrence of high risk; and the scope of methods and techniques used in risk management in innovation projects.

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