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RISK MANAGEMENT IN THE INTRODUCTION OF INNOVATIVE PRODUCTS AT INDUSTRIAL ENTERPRISES

Innovation activities of industrial enterprises involve considerable uncertainty and require systematic risk management throughout new product implementation. The issue becomes particularly important under rapid technological change, market instability, increasing competition and limited investment resources. The article considers theoretical and methodological aspects of managing technological, production, financial and investment, market, personnel and organisational, and information risks. Attention is paid to changes in the risk profile at different stages of innovation implementation, risk identification and prioritisation, early warning indicators and residual risk assessment. Risk management is considered an integral part of managerial decision-making that requires continuous monitoring, coordination between functional units and timely adjustment of responses to changing internal and external conditions.

Keywords: *innovative products, risk management, industrial enterprise, innovation process, risk-oriented management.*

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УПРАВЛІННЯ РИЗИКАМИ ВПРОВАДЖЕННЯ ІННОВАЦІЙНОЇ ПРОДУКЦІЇ НА ПРОМИСЛОВИХ ПІДПРИЄМСТВАХ

Інноваційна діяльність промислових підприємств супроводжується високим рівнем невизначеності, що зумовлює необхідність системного врахування ризиків під час розроблення, освоєння та виведення на ринок нової продукції. Особливої актуальності ця проблематика набуває в умовах прискорення технологічних змін, скорочення життєвих циклів продукції, посилення конкуренції, нестабільності ринкового середовища та обмеженості інвестиційних ресурсів. Упровадження інноваційної продукції потребує значних фінансових, матеріальних, технологічних та інтелектуальних ресурсів, тоді як очікувані результати не завжди можуть бути достовірно визначені на початкових етапах інноваційного процесу. Це підвищує значення ризик-орієнтованого управління як складової системи обґрунтування управлінських рішень промислового підприємства. У статті розглядаються теоретико-методичні аспекти управління ризиками впровадження інноваційної продукції з урахуванням стадійності інноваційного процесу та взаємозалежності різних джерел невизначеності. Особливу увагу приділено технологічним, виробничим, фінансово-інвестиційним, ринковим, кадрово-організаційним та інформаційним ризикам, які можуть виникати в процесі переходу від обґрунтування інноваційної ідеї до промислового освоєння та ринкової реалізації нової продукції. Розглянуто необхідність поєднання процедур ідентифікації ризиків, визначення їх рівня, пріоритизації та вибору відповідних способів управлінського реагування. Акцентовано увагу на динамічності ризикового профілю інноваційного проєкту та необхідності його перегляду в міру отримання нової технологічної, виробничої, фінансової та ринкової інформації. Важливе місце відведено використанню індикаторів раннього попередження, які дають змогу виявляти ознаки зростання ризику до моменту реалізації негативної події. Розглянуто значення оцінювання залишкового ризику для визначення достатності застосованих заходів та необхідності подальшого коригування управлінських рішень. Наголошено на доцільності інтеграції ризик-менеджменту в загальну систему управління інноваційною діяльністю підприємства, забезпечення взаємодії функціональних підрозділів та безперервного моніторингу внутрішніх і зовнішніх чинників. Ризик-орієнтований підхід розглядається як передумова підвищення обґрунтованості управлінських рішень та забезпечення керованості процесу впровадження інноваційної продукції в умовах невизначеності.

Ключові слова: *інноваційна продукція, управління ризиками, промислове підприємство, інноваційний процес, ризик-орієнтоване управління.*

Formulation of the problem. Boosting innovation is a key prerequisite for ensuring the competitiveness of industrial enterprises, improving resource efficiency and adapting production to technological and market changes. At the same time, the introduction of innovative products is accompanied by heightened uncertainty, as it involves decision-making regarding new technologies, production processes, sources of funding and the prospects for market acceptance of the products. Consequently, innovation gives rise to a range of risks, the realisation of which may lead to increased costs, delays in implementation, failure to achieve planned product specifications, or insufficient market demand.

The issue of managing such risks is of particular importance for industrial enterprises, where the introduction of

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innovative products often requires the modernisation of the technological and production base, significant investment, the involvement of specialised expertise, and the restructuring of established business processes. At the same time, these risks do not occur in isolation: technological problems can cause production and financial losses; a shortage of necessary expertise can delay the implementation of an innovation project; and errors in assessing market prospects can reduce the economic effectiveness of introducing new products. Therefore, a piecemeal response to individual threats does not ensure adequate control over the innovation process.

The complexity of risk management is compounded by the fact that the nature and level of risks vary at different stages of introducing an innovative product. The risks associated with justifying an innovative idea and selecting a technological solution differ from those involved in pilot production, scaling up production or bringing the product to market. Accordingly, the management system must ensure not only the identification and assessment of risks, but also the selection of appropriate response measures, taking into account the stage of the innovation process, the enterprise's resource capabilities and the potential consequences of risk events.

Under such conditions, it becomes essential to apply a risk-oriented approach to managing the introduction of innovative products, which involves the systematic consideration of technological, production, financial and investment, market, human resources and organisational, and information risks when making management decisions. Its application should be aimed not at the complete elimination of risk – which is practically impossible in the context of innovation – but at determining an acceptable level of risk, the timely identification of critical threats, and the informed selection of measures to prevent, mitigate, transfer or accept them.

Consequently, the research problem lies in the need to deepen the theoretical and methodological foundations for managing the risks associated with the introduction of innovative products at industrial enterprises and to develop a comprehensive approach to their identification, assessment and the selection of appropriate management measures. Resolving this problem lays the groundwork for improving the soundness of management decisions at various stages of the introduction of innovative products and for reducing the negative impact of uncertainty on the outcomes of the enterprise's innovation activities.

Analysis of recent achievements and publications. Contemporary research examines the issue of risk management in innovation in close connection with the uncertainty inherent in the processes of creating, developing and bringing new products to market. The methodological basis for the study of innovation is provided by the provisions of the Oslo Manual 2018, in which innovation is regarded as a set of interrelated activities undertaken by an organisation, and its assessment involves taking into account internal capabilities, external factors and the outcomes of innovation [1]. OECD The general principles of risk management are systematised in ISO 31000:2018, according to which risk management encompasses the identification, analysis, assessment, treatment, monitoring and communication of risks and must be integrated into management decision-making processes [2]. J. Mu, G. Peng and D. McLachlan have made a significant contribution to research into the risks associated with new product development; they identified technological, organisational and marketing dimensions of risk management and demonstrated the need to take these into account comprehensively when managing new product development processes [3]. ScienceDirect R. Cooper, in his examination of the Stage-Gate system, emphasises the phased management of the product innovation process from idea generation to product launch, which provides a basis for risk control and decision-making at critical stages of the innovation process [4]. The issue of risk identification specifically within innovation projects was investigated by B. Stosić, M. Mišić, R. Milutinović and S. Islamović, who proposed the use of a structured approach – the Risk Breakdown Structure – for a more systematic identification of sources of risk in product innovation [5]. Tandfonline D. Peljan and M. Marz, for their part, draw attention to the interconnection between risk management, strategic management and the effectiveness of new product development, which confirms the need to integrate risk management into the overall enterprise management system [6]. A contemporary synthesis of scientific approaches has been carried out by M. Orellano and D. Gurko based on a systematic review of 98 studies on innovation projects. The authors have systematised the specific risks of innovation development and the methods and tools for managing them, whilst emphasising the importance of taking risks into account at an early stage in the decision-making process [7]. ScienceDirect The latest study by M. Akram and co-authors builds on this line of research by proposing a stage-based classification of risks associated with new product development, based on the premise that the nature and significance of risks vary depending on the stage of the innovation process [8]. At the same time, an analysis of the scientific literature indicates that a comprehensive risk-oriented approach specifically to the implementation of innovative products at industrial enterprises requires further development, one that would combine the identification of different risk groups, their assessment taking into account the stage of the innovation process, and the selection of appropriate management responses. This highlights the need to systematise the risks associated with the implementation of innovative products and to establish the interrelationship "implementation stage – type of risk – assessment – response method", which will form the subject of further research.

The purpose of this article is to further develop the theoretical and methodological foundations for managing the risks associated with the introduction of innovative products at industrial enterprises by systematising the main types of risk, identifying the specific ways in which they manifest at different stages of the innovation process, and justifying appropriate management responses.

Presentation of the main material. The introduction of innovative products at industrial enterprises is a complex process, the success of which depends not only on the technical excellence of the new product, but also on the enterprise's ability to identify and manage risks arising at various stages of its development in a timely manner. Innovative activity is objectively characterised by uncertainty, linked to incomplete information regarding technological parameters, future costs, the duration of the project, and the behaviour of consumers and competitors. It is therefore advisable to view risk not merely as the possibility of losses, but as a measure of uncertainty that affects the

achievement of the planned objectives of innovation activities [1; 2].

Risk management for the introduction of innovative products must be integrated into the enterprise's overall management decision-making process. In accordance with the general principles of risk management, this involves the systematic identification of risks, their analysis and assessment, the selection of response strategies, the implementation of appropriate measures and subsequent monitoring [2]. However, the specific nature of innovative products necessitates supplementing this sequence by taking into account the phased nature of the innovation process, as the nature, sources and consequences of risks change as the process progresses from the justification of an innovative idea to industrial development and market launch of the product [4; 8].

In this study, the management of risks associated with the introduction of innovative products at an industrial enterprise is proposed to be viewed as a continuous process of identifying, assessing, prioritising and controlling risks at various stages of implementation, aimed at ensuring an acceptable balance between the level of uncertainty, resource expenditure and the expected outcomes of innovation activities.

The primary task in developing such an approach is the systematisation of risks. A review of existing approaches [3; 5; 7; 8] allows us to identify six main groups of risks that are most characteristic of the process of introducing innovative products at industrial enterprises (Table 1).

The risk groups listed are not isolated. The materialisation of one risk may lead to the emergence or intensification of others. For example, technical difficulties may require additional funding, disrupt the production schedule and delay the product's market launch. At the same time, inaccurate demand forecasting can turn a technically successful innovation project into an economically unviable one. It is precisely this interdependence of risks that necessitates their comprehensive, rather than isolated, assessment.

It is also important to take into account the dynamic nature of the risk profile of innovative products. In the initial stages, uncertainty regarding the technical feasibility and economic viability of the idea predominates. During the preparation and ramp-up of production, the significance of technological, manufacturing, human resources and financial risks increases, whilst at the market launch stage, demand, consumer response, the competitive environment and the enterprise's ability to ensure the necessary production volumes become critical [4; 8]. Therefore, applying the same set of risk management procedures to all stages of implementation is not sufficiently justified.

With this in mind, it is proposed to link the risk management process to the main stages of innovative product implementation (Table 2).

The proposed approach allows the focus to be shifted from responding to negative events that have already occurred to their early detection. In doing so, it is advisable not to assess all identified risks in equal detail, but rather to prioritise those that are most likely to have a significant impact on the achievement of implementation objectives. To this end, a combination of assessing the probability of a risk occurring and the scale of its potential consequences may be used, which is consistent with the general logic of risk-based management [2].

Table 1

Systematisation of risks associated with the introduction of innovative products at industrial enterprises

Risk Group	Main Sources of Risk	Possible Consequences
Technological	Insufficient testing of the technology, technical incompatibility, product specifications not meeting planned parameters	Need for further development of the technology, delays in implementation, additional costs
Production-related	Lack of readiness of production facilities, supply disruptions, difficulty in scaling up production	Missed deadlines, increased production costs, inconsistent quality
Financial and investment-related	Underestimation of costs, lack of funding, changes in the cost of resources	Budget overruns, shortage of financial resources, reduced return on investment
Market-related	Uncertainties regarding demand, changing consumer needs, increased competition	Insufficient sales volumes, extended payback period
Human resources and organisational	Skills gaps, resistance to change, insufficient coordination among stakeholders	Slower implementation, errors and organisational losses
Information-related	Incomplete or untimely information, forecasting errors, insufficient analytical support	Unsubstantiated management decisions, delayed response to changes

Source: compiled by the author based on [3; 5; 7; 8]

Table 2

Risks by stage of innovative product implementation and areas for managerial response

Stage	Priority risks	Key response areas
Justification of the innovative idea	Information, market, technological	Market needs analysis, technological expertise, preliminary feasibility assessment
Development and testing	Technological, financial, human resources	Testing, prototyping, resource allocation, securing the necessary expertise
Production preparation	Manufacturing, technological, financial and investment	Production readiness audit, resource planning, budget control
Industrial roll-out	Production, HR and organisational, financial	Phased scaling-up, quality control, staff training, operational monitoring
Market launch	Market, financial, information	Monitoring demand, adjusting market supply, analysing feedback

Source: developed by the author, drawing on [4; 7; 8]

For practical application at an industrial enterprise, it is advisable to use a three-level risk classification: low, medium and high. Low risks may be accepted by the enterprise provided they are regularly monitored; medium risks require the development of preventive measures and the identification of responsible persons; high risks demand an immediate response and, where necessary, a review of the parameters of the innovation project [9]. This approach allows management and financial resources to be directed primarily towards critical risk areas.

It is advisable to supplement risk assessment with a system of early warning indicators, which signal an increased likelihood of a negative event even before it actually occurs. For technological risks, such indicators may include an increase in the number of technical deviations and retests; for production risks – an increase in defects, downtime or the length of the production cycle; for financial risks – exceeding budgeted expenditure and a funding shortfall; for market risks – a deviation of actual demand from the forecast; and for human resources risks – a lack of necessary skills or an increase in the number of errors when learning new operations [10].

The next element of risk management is choosing a response strategy. Depending on the level and nature of the risk, an organisation may opt to avoid, mitigate, transfer or accept it [2]. However, for innovation activities, the most constructive approach is not the mechanical avoidance of uncertainty – as this may lead to the rejection of promising innovations – but the controlled mitigation of critical risks whilst retaining the potential economic benefits of the innovation.

At the same time, the level of risk should not be determined on a one-off basis. During the roll-out of innovative products, initial assessments require regular review, as new information, test results, changes in production parameters or market reactions can significantly alter the project's risk profile. Monitoring should therefore serve as a feedback mechanism between the actual course of the innovation process and management decisions.

It is particularly important to determine the residual risk following the implementation of appropriate measures. The mere fact that preventive measures have been implemented does not mean that the threat has been completely eliminated. If the residual risk exceeds the level deemed acceptable by the organisation, it becomes necessary to make further adjustments to the decision, change the response strategy or revise the implementation parameters. This helps to avoid a situation where the formal implementation of risk management measures fails to deliver an actual reduction in uncertainty.

A key organisational prerequisite for the effectiveness of the proposed approach is a clear division of responsibilities amongst those involved in the implementation process. Technological risks should be assessed with the involvement of technical specialists; production risks by the relevant production departments; financial risks by financial and economic departments; and market risks by marketing and sales departments. At the same time, the final management decision must be based on a comprehensive view of the risks, as their local optimisation within a single department may give rise to additional risks for the enterprise as a whole.

Thus, risk-oriented management of the introduction of innovative products should be structured as a cyclical process: risk identification → assessment and prioritisation → selection of a response strategy → implementation of measures → assessment of residual risk → monitoring and adjustment. Repeating this cycle at each stage of implementation ensures that management decisions are adapted to changes in internal and external conditions.

Conclusions. As a result of the research carried out, the theoretical and methodological foundations for managing the risks associated with the introduction of innovative products at industrial enterprises have been further developed. The necessity of applying a risk-oriented approach has been substantiated; this approach involves the integration of procedures for identifying, assessing, prioritising and controlling risks into the overall process of managerial decision-making regarding the introduction of innovative products.

The main risks associated with the introduction of innovative products have been systematised according to their technological, production, financial and investment, market, human resources and organisational, and information components. It has been established that their composition and significance vary depending on the stage of the innovation process, which necessitates the differentiation of managerial response strategies and the continuous review of an innovation project's risk profile.

It is proposed to combine risk assessment using early-warning indicators with the determination of residual risk following the implementation of appropriate management measures. Risk management should be carried out as a cyclical process, ensuring the timely adjustment of decisions in line with changes in technological, production, financial and market conditions.

The scientific outcome of the study lies in establishing the interrelationship "stage of innovative product implementation – risk group – risk level – management response method – monitoring of residual risk", the application of which contributes to a systematic approach to risk management and enhances the soundness of management decisions at industrial enterprises.

Prospects for further research relate to the development of a methodological toolkit for the quantitative assessment of the overall level of risk associated with the introduction of innovative products and its testing at industrial enterprises.

Table 3

Matrix of management responses to the risks of introducing innovative products

Risk level	Management response	Key measures
Low	Acceptance and monitoring	Monitoring of indicators, periodic checks
Medium	Mitigation	Preventive measures, setting aside resources, tightening controls
High	Priority mitigation / transfer / avoidance	Adjusting technology or plans, additional testing, insurance, engaging partners
Critical	Review of management decision	Suspending a specific stage, changing project parameters or abandoning the risky decision

Source: developed by the author based on the provisions of [2; 3; 7]

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