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*Illiashenko Sergii^{a, b}, Shypulina Yuliia^a, Illiashenko Nataliia^c, Golysheva Ievgeniia^d***LOGISTICS RISKS OF COMMERCIALIZATION OF INNOVATIONS OF INDUSTRIAL ENTERPRISES**^a National Technical University “Kharkiv Polytechnic Institute”, Kharkiv, Ukraine^b University of Economics and Humanities, Bielsko-Biala, Poland^c Sumy State Pedagogical University named after A. S. Makarenko, Sumy, Ukraine^d Wrocław University of Science and Technology, Wrocław, Poland

The article is devoted to the definition and systematization of logistical risks of innovations commercialization of industrial enterprises, as well as the development of approaches to quantitative assessment and consideration of these risks when justifying innovative projects. From the point of view of the logistic approach, the essence and content of the commercialization stage for various options of the innovation process, separated by the type of innovative business, the degree of radicalization of innovative activity, and the size of the industrial enterprise-innovator, have been clarified. The role of logistical support for the commercialization of innovations during the implementation of the specified options of the innovation process is revealed. The content of logistics support measures concerning procurement, production, and distribution logistics is detailed. The systematization (by environment of occurrence and factors of influence) of logistics risks of commercialization of innovative products of industrial enterprises has been carried out: risks of the macro environment (caused by the impact of its components), risks of external logistics systems (caused by the influence of their links), risks of the internal logistics system (caused by the impact of its elements), risks logistic support management systems (caused by incomplete certainty regarding the subject, conditions and consequences of management decisions). The nature of the manifestation, the degree of influence, and the possibilities of managing the selected risks are determined. A systematic approach to the quantitative assessment of logistics risks of commercialization of innovations of industrial enterprises, particularly those that have a more significant influence on the results of commercialization (risks of external and internal logistics systems), is proposed. The essence of risk management measures based on assessment results, in particular, aimed at reducing their level, is outlined. The results of the study develop and deepen the fundamental aspects of risk management of innovative projects in terms of identification, determination of the causes of manifestation, influencing factors, quantitative assessment, and minimization of logistical risks of commercialization of innovations of industrial enterprises in the permanently unstable conditions of the modern economy, caused by the fourth industrial revolution and the transformation of technological systems.

Keywords: innovative development, logistics risks, commercialization of innovations, innovation process, industrial enterprises, technological transformations.

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Introduction

Commercialization is the final stage of the innovation process. Based on its results, the effectiveness of the innovative activity of an industrial enterprise is evaluated. The efficacy of the commercialization of innovations has a probabilistic nature, which is caused by elements of incomplete certainty when making relevant management decisions. The result needs to be completed determination of the results of these innovative solutions, that is, risk. The rational behavior of managers and specialists of an industrial enterprise who develop and implement innovation commercialization strategies is to identify existing risks, assess the possible consequences of their manifestation, and develop measures to avoid, reduce, or compensate for them. Among the set of risks that exist at the stage of commercialization of innovation, one should highlight the risks associated with the logistical support of commercialization (after this referred to as the logistical risks of commercialization), which are rather significant in the constantly changing conditions of the modern economy, caused by the unfolding of the fourth industrial revolution (Industry 4.0) and changes in technological systems. Accordingly, the problem of analyzing and taking into account logistical risks in the strategies of commercialization of innovations of industrial enterprises becomes more acute. Its solution will make it possible to increase the efficiency of the commercialization of innovative products and the innovation process at the enterprise as a whole.

Analysis of research and publications

The problems of the article are studied in the works of many scientists. Thus, O. Yaremenko and S. Matiukh [15] singled out the types of logistics risks, outlined the factors that cause them, and proposed an approach to risk management of logistics systems. I. Kryvoviazuk et al. [7] proposed a generalized classification of the risks of the logistics system of a machine-building enterprise. They performed a quantitative analysis of the risks of the logistics systems of several machine-building enterprises in Ukraine regarding the components of these systems. The theoretical principles of risk management of logistics systems of enterprises are revealed, and recommendations for improving management approaches are offered. In the work of V. Vitlinskyi and V. Skitsko [14], the author's definition of logistics risk is proposed, as well as original classifications of logistics risks of enterprises: by types of flows, as well as by components of the logistics system of different levels. An approach to enterprise logistics risk management is proposed. S. Sinytsia et al. [13] outlined the types and specified the specifics of logistical risks,

proposed an algorithm for their analysis, and structured modern methods of assessing logistical risks. D. Yashkin [16] proposed classifying logistics risks depending on the stages of the enterprise's logistics activity, outlining the reasons for their occurrence. For each of the stages of logistics activity, he identified approaches to avoiding or reducing the inherent risks. P. Pererva et al. [11] considered the risk management system in an enterprise operating based on logistics from the standpoint of ensuring its economic security. At the same time, the logistic approach to managing the enterprise's activities is considered in the context of providing high efficiency of its functioning in the conditions of the modern economy. R. Abderrazak and D. Youssef [1] highlighted an approximate list of risks companies may face in innovative projects in supply chains. The dilemma of innovations is considered: forming competitive advantages based on them is a high level of risk.

N. Myroshchenko et al. [8] indicated specific problems (risk situations) of the commercialization process of innovative products of industrial enterprises and proposed recommendations for their solution. O. Olefirenko [10] systematized problems (risk situations) according to the spheres of their manifestation, which are related to the conflicts of participants in the commercialization of innovative products of industrial enterprises. T. Hrynko and T. Hviniasvili [4] substantiated that the most appropriate approach to determining the essence and classification of risks of innovative activity should be considered a systematic approach based on determining the life cycle stages of innovations. From these positions, the main types of risks of innovative activity at various stages of the life cycle of innovations are summarized, including at the commercialization stage. The set of risks of commercialization of innovations of industrial enterprises is singled out. O. Nesterenko [9] identified risks that are characteristic of innovative projects. He proposed an approach to analyzing and managing the risks of innovative projects at the stages of their implementation. Y. Sun et al. [12] investigated the risks of environmental innovations in the manufacturing industry, performed their ranking, and proposed measures to prevent or reduce them. O. Bilovodska et al. [3] note the high risk of innovative projects, which requires developing a system of measures for their identification, analysis, and reduction. The peculiarities of applying marketing and legal methods and tools for reducing innovation risks at the stages of the innovation process are considered.

Summarizing the results of the analysis of literary sources, we want to note that publications that are devoted to the problems of evaluating and taking into

account logistical risks do not consider the logistical risks of commercialization of innovations practically (as well as the innovation process as a whole); publications related to the commercialization of innovations, in turn, do not consider their logistical risks (risks of logistical support of commercialization). Thus, the issues of identification, analysis, and consideration of logistical risks of commercialization of innovations of industrial enterprises still need to be explored. It complicates the management of the risks of commercializing innovative products of industrial enterprises, reduces the efficiency of their innovative activities, and hinders their transition to innovative development.

The purpose of the article

The article's purpose is to single out the complex logistical risks of commercialization of innovations, determine the reasons that cause them, develop recommendations for their analysis, and take them into account when justifying innovative projects of industrial enterprises.

Main material

To achieve the set goal, we formed a set of research tasks, which include:

- clarification of the essence and content of commercialization as the final stage of various options for the innovation process of industrial enterprises;
- determination of the place and role of logistics

in the process of commercialization of innovative products of industrial enterprises;

- systematization of logistic risks of commercialization of innovations of industrial enterprises;

- development of the principles of the logistics risk management system of innovations of industrial enterprises.

Table 1 presents options for the innovation process of an industrial enterprise with an indication of the innovation strategy it implements. The letters *s*, *m*, and *l* denote small, medium, and large enterprises.

Based on the data in the Table 1 defines the essence and content of the work of the commercialization stage of each selected innovation process option. The obtained results are presented according to the scheme: the number of variants of the innovation process, the essence of the commercialization of innovations according to this variant, and the content of the works on commercialization.

Firstly, commercialization occurs through selling a patent for innovative technical or technological solutions. Accordingly, measures are being taken to find enterprises or institutions (target consumers) interested in knowledge about technical or technological innovative solutions embodied in a patent. Measures are being taken to promote it on the market.

Table 1

Variants of the innovation process and types of innovation strategies (modified of [6])

The variant number of the innovation process and its corresponding type of innovative strategy	Type of innovative business	Stages of the innovation cycle				Life cycle stages			
		Idea generation and product concept development	Business analysis	Product development	Market tests	Introduction	Growth	Maturity	Decline
		1. Licensing	Venturesome	s					
2. Imitation		s							
3. Licensing	s								
4. Imitation	Explorant				s				
5. Nisher	The patient					s			
6. Traditional (protective)	Violent						m, l		
7. Nisher	Commuter							s	
8. Imitation	Combined			m, l					
9. Offensive				m, l					
10. Protective								m, l	

Secondly and thirdly, commercialization takes place through the sale of a license for a proven technology to produce a new product and/or a tested innovative product. Measures are being taken to find potential buyers of the license and measures to promote it on the market.

Fourthly, deployment of commercial production of an innovative product (based on a purchased license) in partnership with a product-producing enterprise. The search for such a partner and the conclusion of appropriate agreements with him are preliminary. Measures are being taken to create a new market (market segment) or radical transformation of the existing one, including clarifying the circle of target consumers, forming and implementing measures of the marketing complex, etc.

Fifthly, commercialization of modifications of innovative products created based on purchased developments of venture enterprises. These modifications consider consumers' specific requests in narrow market segments, mainly where there is unsatisfied demand or uninteresting for the leading competitors. It allows us to avoid direct competition with the leading «players» on the market. Refinement of the circle of consumers (actual and/or potential), implement measures of the marketing complex to develop new market segments.

Sixthly, commercializing modifications of mass-produced products to expand their sales volume or maintain satisfactory market positions. Implement measures to modify the product (modification of its technical characteristics, quality, and design); market (expansion of market boundaries, entry into new markets or segments); and marketing (improvement of the marketing complex).

Seventhly, commercialize a modification of a well-known product (its substitute) that satisfies the specific requests of outsider consumers. Implement measures of the marketing complex to promote innovation in the market.

Eighthly, deployment of commercial production of an innovative product created based on the purchased patent, with independently developed technology of its production and its characteristics adjusted to market requirements. Measures are being taken to create a new market or radically transform the existing one, which includes clarifying the circle of target consumers, forming and implementing measures of the marketing complex, etc.

Ninthly, deployment of commercial production of an independently developed innovative product, with the implementation of all stages of the innovation cycle. Measures are being taken to create a new market

or radically transform the existing one, which includes clarifying the circle of target consumers, forming and implementing measures of the marketing complex, etc.

Tenthly, commercializing modifications (analogs) of the innovative product that appeared on the market and received consumer recognition. Measures aimed at taking into account the specifics of the requests of certain groups of consumers, forming (developing) new markets, their segments or niches – at the stage of growth of sales volumes; modification of the product, market, or marketing to increase sales volumes or maintain existing satisfactory market positions – at the stage of maturity; modification of the product and/or the marketing complex to take into account the requests of outsider consumers to exhaust the possibilities of the innovative product – at the stage of leaving the market.

Table 2 indicates the types of logistical support for the considered ten options for commercialization of the results of the innovation process (see Table 1).

When determining the types of logistical support, the results of the above analysis were taken into account. As indicated in Table 2, types of logistics also include procurement – transport (external transport), warehouse, stocks; intra-production (production) – warehouse, stock, transport (in-plant transport); sales (distribution) – warehouse, transport (external transport), and intermediary. Table 2 shows the most significant logistics flows of a specific variant of the technological process from the point of view of this study: material logistics. However, along with it, there are also financial, service streams, etc.

Based on the results of clarifying the essence and content of commercialization as the final stage of selected options of the innovation process, as well as determining the place and role of logistics in the process of commercialization of innovative products of industrial enterprises, authors proposed to highlight the following types of logistical risks of commercialization of innovations.

Group 1. Risks caused by possible changes in the conditions of the external macro environment, particularly its components: political and legal, economic, technical and technological, socio-demographic, natural and ecological, etc.

Group 2. Risks caused by links (legal entities or natural persons, subjects of the logistics process) of the external logistics system of the industrial enterprise-innovator (procurement, distribution, etc.):

– supply-related, caused by a possible change in supply (terms, quantity, characteristics, quality, prices, etc.) of raw materials, materials, or components;

Table 2

Characteristics of logistic support options for commercialization of the innovation process (authors' development)

Commercialization option number	Types of logistics		
	Procurement	Internal Production	Sales
1	–	–	Information support for patent promotion and sales
2	Informational and material support for the production and testing of a prototype innovation		Information support for the promotion and sale of the license
3	Material support for the manufacture and testing of a prototype of the innovation		Information support for the promotion and sale of the license
4	–	–	Information support of a business partner deploying commercial production and sales of innovation
5	Provision of production with raw materials, materials, and components	Ensuring the continuity of the technological process of manufacturing innovation	Distribution (sales) of innovative products
6	Provision of production with raw materials, materials, and components	Ensuring the continuity of the technological process of manufacturing innovation	Distribution (sales) of innovative products
7	Provision of production with raw materials, materials, and components	Ensuring the continuity of the technological process of manufacturing innovation	Distribution (sales) of innovative products
8	Informational and material support for the production and testing of a prototype innovation		Distribution (sales) of innovative products
	Provision of production with raw materials, materials, and components	Ensuring the continuity of the technological process of manufacturing innovation	
9	Material support for the manufacture and testing of a prototype of the innovation		Distribution (sales) of innovative products
	Provision of production with raw materials, materials, and components	Ensuring the continuity of the technological process of manufacturing innovation	
10	Provision of production with raw materials, materials, and components	Ensuring the continuity of the technological process of manufacturing innovation	Distribution (sales) of innovative products

by changing the activity profile; refusal of supply (economic sanctions, embargoes, etc.);

– transportation caused by possible changes in transportation conditions (terms, prices, volumes, etc.); spoilage or loss of transported products;

– warehouse caused by possible changes in storage conditions (prices, terms, volumes, service, etc.);

– mediation caused by possible changes in interaction conditions with sales and trading intermediaries;

– consumer, caused by possible changes in consumer requests regarding the characteristics of the logistics service.

– information caused by possible changes in

the conditions of interaction with organizations of information and service services and communication: violation of the terms of providing information, the quality and completeness of its processing and provision, indicators of information coverage of the target audience, service prices, etc.

Group 3. Risks caused by elements of the internal logistics system of the innovator's industrial enterprise (production logistics): storage of raw materials, materials, and components; stock formation; movement of work-in-progress products between the company's divisions, their sections, and individual workplaces; storage of finished products; shipment of finished products, etc.

Group 4. Risks are caused by incomplete, inaccurate, and/or contradictory information when making decisions regarding logistical support for the commercialization of innovations (innovation process as a whole).

Group 1 risks are objective, that is, uncontrollable. The conditions of permanent economic and technological transformations caused by Industry 4.0 and changes in technical systems negatively impact the readiness of industrial enterprises to create, implement, and commercialize innovations. These risks affect all subjects of the innovation process, in particular, links to the logistics system of the innovator enterprise. It is possible to reduce their impact by diversifying products and types of activities (creation and commercialization of innovations), forecasting possible scenarios of the development of events, and developing innovative development strategies for each. Practice shows that the motivating reasons for innovative activity in these conditions are the desire of industrial enterprises to adapt to changes, avoid negative consequences associated with the collapse of existing industries and markets, strengthen their competitive advantages, and participate in the formation of new industries and markets, and in the ideal is to get on the path of anticipatory innovative development, which will allow us to use the competitive advantages of the pioneer of the market.

The risks of group 2 are partially manageable. Their level can be reduced by forming and maintaining a system of mutually beneficial relations with the specified links (organizations and individuals) of the logistics system of the industrial enterprise-innovator.

Risks of groups 3 and 4 are more subjective and, accordingly, manageable. Their influence can be minimized by increasing the level of awareness of the persons who make managerial decisions regarding the logistical support of the innovation process, also by the introduction of a system of organizational and economic measures: formation and improvement of the level of intellectual capital and innovative culture of an industrial enterprise as drivers of its innovative growth; modernization and renewal of technologies and production facilities, etc.

It should be noted that the selected risks of groups 1-4 in each specific case can be independent (a change in the level of one does not necessarily affect the others) and dependent (they have a mutual influence on each other). Any quantitative analysis method [5] can calculate these risks: statistical, analytical, financial stability assessment, regulatory, project sensitivity assessment, decision tree analysis, analogies, expert assessments, etc.

The analysis of the practice of logistics support of the innovation process at the stage of commercialization of innovations shows that the risks caused by the links of the external logistics system (group 2), as well as the risks caused by elements of the internal logistics system (group 3), have the most significant impact on its effectiveness. The authors proposed the following approach for their preliminary analysis.

The risk or reliability of interaction with individual links (individual economic counterparties) of the external logistics system of the innovator enterprise is proposed to be assessed using confidence coefficients [2]: numbers characterizing the degree of confidence (of the person or persons conducting the analysis) in the reliability or riskiness of the interaction. The corresponding evaluation verbal-numerical scale is presented in the Table 3. With its use, estimates of individual links are made, relying on the experience of previous interaction with comparable conditions and, in its absence – by the expert method. Experts can be leading specialists, managers of the innovator enterprise, and persons involved from outside.

Table 3
A scale for assessing the risk or reliability of interaction with the links of the logistics system (built by the authors based on data [2, 5])

The value of the confidence coefficient	Risk level	Level of reliability
$-1.0 \leq K < -0.8$	Inadmissible	-
$-0.8 \leq K < -0.6$	Disastrous	-
$-0.6 \leq K < -0.4$	Increased	-
$-0.4 \leq K < -0.2$	Minimum	-
$-0.2 \leq K \leq +0.2$	Undefined	
$+0.2 < K \leq +0.4$	-	Minimum
$+0.4 < K \leq +0.6$	-	Average
$+0.6 < K \leq +0.8$	-	High
$+0.8 < K \leq +1.0$	-	Very high

The risks of external logistics chains as a whole (procurement logistics, distribution logistics) in the case of independent risks of their links should be determined by the formula (disjunction):

$$R_{\text{SUM}} = (R_1 \vee R_2 \vee \dots \vee R_N) = \max(R_1, R_2, \dots, R_N), \quad (1)$$

where R_i – the risk assessment module of the i -link; $R_i = |r_i|$, r_i – evaluation of the i -link according to the Table 3.

Risks caused by elements of the internal logistics system can be considered as independent evidence of

the riskiness or reliability of the internal logistics system of the innovative enterprise. Their estimates given in Table 3 are combined in pairs using the formulas [2]:

$$R_{1,2} = R_1 + R_2(1 - R_1), \quad \text{if } R_1 > 0 \text{ and } R_2 > 0, \quad (2)$$

$$R_{1,2} = -[|R_1| + |R_2| (1 - |R_1|)], \quad \text{if } R_1 < 0 \text{ and } R_2 < 0, \quad (3)$$

$$R_{1,2} = \frac{R_1 + R_2}{1 - \min(|R_1|, |R_2|)}, \quad \text{if } R_1 \text{ and } R_2 \text{ have}$$

different signs. (4)

When combining evidence with coefficients +1 and -1, it is believed that $R_{1,2} = +1$.

The value calculated according to formulas (2, 3, or 4) is combined with the following until their entire list is exhausted. The obtained result (the risk of the internal logistics chain) is interpreted considering the data in the Table 3.

It should be noted that the analysis and assessment of logistical risks of commercialization is not an end but the basis for making and implementing management decisions aimed at their prevention, reduction, or compensation.

For this purpose, the following sets of measures are carried out:

- for the risks of external logistics chains, the composition of their links is adjusted, in particular, organizations that perform the functions of procurement or distribution logistics, as well as the motivation system of their relationships;

- for the risk of the internal logistics chain: improve the informational, organizational, economic, and material base of its elements, as well as the procedures for ensuring their joint coordinated interaction;

- for both types of risks: increase awareness regarding management decisions, the conditions in which they are made and implemented, and possible results.

Conclusions

The following conclusions can be drawn to summarize the above.

First. The essence and content of commercialization as a final innovation process has been clarified in terms of its options, which are distinguished by the type of innovative business, the degree of radicalization of innovative activity, and the size of the industrial enterprise, which made it possible to more precisely outline the essence of strategic approaches to the commercialization of its innovative

products.

Second. The role and place, as well as the content of logistical support of the selected options for commercialization of innovative products of innovative industrial enterprises, were determined, which made it possible to outline the characteristics of their procurement, internal production, and distribution (sales) logistics.

Third. The proposed systematization of logistical risks of commercialization of innovative products of industrial enterprises, in particular, four groups of the specified risks are distinguished: caused by the influence of factors of the external macro-environment; caused by the impact of links (subjects of the logistics process) of external logistics systems (procurement, distribution logistics); caused by the influence of elements of the internal (internal production) logistics system; caused by the impact of elements of incomplete certainty when making decisions regarding the management of logistical support for the commercialization of innovations. The nature of the manifestation of selected groups of risks, the degree of their influence on the effectiveness of the innovation process, and its final stage – commercialization are outlined, and the possibilities of managing these risks are indicated.

Fourth. An approach to the analysis and quantitative assessment of logistic risks of commercialization of innovations of industrial enterprises, which have a more significant influence on commercialization results, is proposed. Risk management measures based on the results of their assessment have been determined.

The obtained results, in aggregate, deepen the principles of risk management of innovative projects, in particular, in terms of identification, determination of motivating reasons and influencing factors, quantitative assessment of logistical risks of commercialization of innovations of industrial enterprises, as well as justification of measures aimed at reducing them. Their practical implementation will contribute to increasing the validity and effectiveness of the implementation of innovative projects of industrial enterprises and the formation of prerequisites for their transition to sustainable, innovative development in the conditions of technological transformations caused by Industry 4.0 and changes in technical systems.

Further research should improve the methodical support of the organizational and economic risk management mechanism of logistical support of innovative products of industrial enterprises.

REFERENCES

1. Abderrazak, R., & Youssef, D. (2022). Supply Chain Innovation Between Risk and Competitive Advantage. In *2022 14th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA)*, EL JADIDA, Morocco (pp. 1-6). DOI: <https://doi.org/10.1109/LOGISTIQUA55056.2022.9938087> [in English].
2. Bakaiev, A.A., Hrytsenko, V.Y., & Kozlov, D.N. (1992). *Ekspertnye systemy i lohycheskoie prohrammyrovaniie [Expert systems and logical programming]*. Kyiv: Naukova dumka [in Russian].
3. Bilovodska, O., Melnyk, Yu., Alenin, Yu., & Arkusha, L. (2020). Implementation of Marketing and Legal Tools in the Process of Commercialization for Innovative Products in Strategic Management and Entrepreneurship. *International Journal for Quality Research*, 14(4), 1261-1278. DOI: <https://doi.org/10.24874/IJQR14.04-18> [in English].
4. Hrynko, T.V., & Hviniashevili, T.Z. (2017). Naukovometodychne zabezpechennia upravlinnia ryzykamy innovatsiinoi diialnosti na promyslovykh pidpriemstvakh [Scientific and methodical support of risk management of innovative activity at industrial enterprises]. *Ekonomika ta pidpriemnytstvo – Economy and entrepreneurship*, 39, 267–278. Retrieved from <https://core.ac.uk/reader/197267790> [in Ukrainian].
5. Illiashenko, S., Bilovodska, O., Tsalko, T., Tomchuk, O., Nevmerzhytska, S., & Buhas, N. (2022). Opportunities, Threats and Risks of Implementation the Innovative Business Management Technologies in the Post-Pandemic Period COVID-19. *WSEAS Transactions on Business and Economics*, 19, 1215-1229. DOI: <https://doi.org/10.37394/23207.2022.19.107> [in English].
6. Illiashenko, S. M. (2015). Innovative process rational choice grounding in organization. *Marketing and Management of Innovation*, 2, 11-20. Retrieved from https://armgpublishing.com/wp-content/uploads/mmi/volume-6-issue-2/mmi2015_2_11_20.pdf [in English].
7. Kryvoviazuk, I. V., Smerichevskyi, S. F., & Kulyk, Yu. M. (2018). *Ryzhik-menedzhment lohistychnoi systemy mashynobudivnykh pidpriemstv [Risk management of the logistics system of machine-building enterprises]*. Kyiv: Vydavnychiy dim “Kondor”. Retrieved from <https://core.ac.uk/download/pdf/286628329.pdf> [in Ukrainian].
8. Myroshchenko, N. Yu., Zaritska, O. L., & Symak, A. V. (2019). Problemy komertsializatsii innovatsiinoi produktsii promyslovykh pidpriemstv [Problems of commercialization of innovative products of industrial enterprises]. *Ekonomika. Finansy. Pravo – Economy. Finances. Law*, 12, 35-40. Retrieved from http://efp.in.ua/public_html/uploads/journals/250/efp_12-0_2019.pdf#page=35 [in Ukrainian].
9. Nesterenko, O. V. (2018). Tekhnolohiia upravlinnia ryzykamy innovatsiinoi diialnosti promysloвого pidpriemstva [Risk management technology of innovative activity of an industrial enterprise]. *Ekonomichnyi zhurnal Odeskoho politekhnichnogo universytetu – Economic journal Odessa polytechnic university*, 1(3), 40–48. DOI: <https://doi.org/10.5281/zenodo.1304047> [in Ukrainian].
10. Olefirenko, O. M. (2016). Komertsializatsiia innovatsii yak obiektyvnyi chynnyk efektyvnoho funktsionuvannia promysloвого pidpriemstva [Commercialization of innovations as an objective factor in the effective functioning of an industrial enterprise]. *Skhidna Yevropa: ekonomika, biznes ta upravlinnia – Eastern Europe: Economy, Business and Management*, 5, 185-189. Retrieved from http://www.easterneurope-ebm.in.ua/journal/5_2016/5_2016.pdf#page=186 [in Ukrainian].
11. Pererva, P., Cherep, A., Romanych, T., & Diakova, N. (2022). Optyimizatsiia ryzykiv ekonomichnoi bezpeky pidpriemstva na zasadakh lohistyky [Optimizing risks of economic security of the enterprise on the basis of logistics]. *Visnyk Natsionalnoho tekhnichnogo universytetu “Kharkivskiy politekhnichnyi instytut” (ekonomichni nauky) – Bulletin of the National Technical University “Kharkiv Polytechnic Institute” (economic sciences)*, 2, 81–87. DOI: <https://doi.org/10.20998/2519-4461.2022.2.81> [in Ukrainian].
12. Sun, Y., Bi, K., & Yin, S. (2020). Measuring and integrating risk management into green innovation practices for green manufacturing under the global value chain. *Sustainability*, 12(2), 545. DOI: <https://doi.org/10.3390/su12020545> [in English].
13. Synytsia, S.M., Vakun, O.V., & Danylyshyn, V.I. (2020). Upravlinnia ryzykamy u lohistychnii diialnosti pidpriemstva [Risk management in the logistics activities of the enterprise]. *Naukovyi visnyk Mizhnarodnoho humanitarnoho universytetu. Seriiia “Ekonomika i menedzhment” – Scientific Bulletin of the International Humanitarian University. “Economics and Management” series*, 42, 78-83. DOI: <https://doi.org/10.32841/2413-2675/2020-42-14> [in Ukrainian].
14. Vitlinskyi, V.V., & Skitsko, V.I. (2016). Kontseptualni zasady modeliuvannia ta upravlinnia lohistychnym ryzykom pidpriemstva [Conceptual principles of modeling and management of enterprise logistics risk]. *Problemy ekonomiky – Problems of the economy*, 4, 246–253. Retrieved from https://www.problecon.com/export_pdf/problems-of-economy-2016-4_0-pages-231_237.pdf [in Ukrainian].
15. Yaremenko, O.F., & Matiukh, S.A. (2019). Ryzhiky lohistychnykh system [Risks of logistics systems]. *Visnyk Khmelnytskoho natsionalnoho universytetu. Ekonomichni nauky – Bulletin of the Khmelnytskyi National University. Economic sciences*, 6(1), 231-236. DOI: <https://doi.org/10.31891/2307-5740-2019-276-6-244-249> [in Ukrainian].
16. Yashkin, D.S. (2016). Metody optyimizatsii v upravlinni lohistychnymy ryzykamy promyslovykh pidpriemstv [Optimization methods in logistics risk management of industrial enterprises]. *Ekonomika: realii chasu – Economy: realities of time*, 5(27), 52-58. Retrieved from <https://economics.net.ua/files/archive/2016/No5/52.pdf> [in Ukrainian].

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ЛОГІСТИЧНІ РИЗИКИ КОМЕРЦІАЛІЗАЦІЇ ІННОВАЦІЙ ПРОМИСЛОВИХ ПІДПРИЄМСТВ

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Статтю присвячено визначенню та систематизації логістичних ризиків комерціалізації інновацій промислових підприємств, а також розробленню підходів до кількісної оцінки і урахування цих ризиків при обґрунтуванні інноваційних проектів. З позицій логістичного підходу уточнено сутність і зміст етапу комерціалізації для різних варіантів інноваційного процесу, виділених за типом інноваційного бізнесу, ступенем радикалізації інноваційної діяльності та величиною промислового підприємства-інноватора. Розкрито роль логістичного супроводу комерціалізації інновацій при реалізації зазначених варіантів інноваційного процесу. Деталізовано зміст заходів логістичного супроводу стосовно особливостей заготівельної, виробничої і розподільчої логістики. Виконана систематизація (за середовищем виникнення і факторами впливу) логістичних ризиків комерціалізації інноваційної продукції промислових підприємств: ризики макросередовища (спричинені впливом його складових), ризики зовнішніх логістичних систем (спричинені впливом їх ланок), ризики внутрішньої логістичної системи (спричинені впливом її елементів), ризики системи управління логістичним супроводом (спричинені неповною визначеністю щодо предмету, умов і наслідків управлінських рішень). Визначено характер прояву, ступінь впливу, можливості управління виділеними ризиками. Запропоновано методичний підхід до кількісного оцінювання логістичних ризиків комерціалізації інновацій промислових підприємств, зокрема тих, що більшою мірою впливають на результати комерціалізації (ризики зовнішніх і внутрішньої логістичних систем). Окреслено сутність заходів щодо управління ризиками за результатами оцінювання, зокрема, спрямованих на зниження їх рівня. Результати дослідження розвивають і поглиблюють засадничі аспекти управління ризиками інноваційних проектів в частині ідентифікації, визначення причин прояву, факторів впливу, кількісного оцінювання та мінімізації логістичних ризиків комерціалізації інновацій промислових підприємств в перманентно нестабільних умовах сучасної економіки, спричиненими четвертою промисловою революцією і трансформацією технологічних укладів.

Ключові слова: інноваційний розвиток, логістичні ризики, комерціалізація інновацій, інноваційний процес, промислові підприємства, технологічні трансформації.

LOGISTICS RISKS OF COMMERCIALIZATION OF INNOVATIONS OF INDUSTRIAL ENTERPRISES

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The article is devoted to the definition and systematization of logistical risks of innovations commercialization of industrial enterprises, as well as the development of approaches to quantitative assessment and consideration of these risks when justifying innovative projects. From the point of view of the logistic approach, the essence and content of the commercialization stage for various options of the innovation process, separated by the type of innovative business, the degree of radicalization of innovative activity, and the size of the industrial enterprise-innovator, have been clarified. The role of logistical support for the commercialization of innovations during the implementation of the specified options of the innovation process is revealed. The content of logistics support measures concerning procurement, production, and distribution logistics is detailed. The systematization (by environment of occurrence and factors of influence) of logistics risks of commercialization of innovative products of industrial enterprises has been carried out: risks of the macro environment (caused by the impact of its components), risks of external logistics systems (caused by the influence of their links), risks of the internal logistics system (caused by the impact of its elements), risks logistic support management systems (caused by incomplete certainty regarding the subject, conditions and consequences of management decisions). The nature of the manifestation, the degree of influence, and the possibilities of managing the selected risks are determined. A systematic approach to the quantitative assessment of logistics risks of commercialization of innovations of industrial enterprises, particularly those that have a more significant influence on the results of commercialization (risks of external and internal logistics systems), is proposed. The essence of risk management measures based on assessment results, in particular, aimed at reducing their level, is outlined. The results of the study develop and deepen the fundamental aspects of risk management of innovative projects in terms of identification, determination of the causes of manifestation, influencing factors, quantitative assessment, and minimization of logistical risks of commercialization of innovations of industrial enterprises in the permanently unstable conditions of the modern economy, caused by the fourth industrial revolution and the transformation of technological systems.

Keywords: innovative development, logistics risks, commercialization of innovations, innovation process, industrial enterprises, technological transformations.

REFERENCES

1. Abderrazak, R., & Youssef, D. (2022). Supply Chain Innovation Between Risk and Competitive Advantage. In *2022 14th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA)*, EL JADIDA, Morocco (pp. 1-6). DOI: <https://doi.org/10.1109/LOGISTIQUA55056.2022.9938087> [in English].
2. Bakaiev, A.A., Hrytsenko, V.Y., & Kozlov, D.N. (1992). *Ekspertnyie systemy i lohycheskoie prohrammyrovaniie [Expert systems and logical programming]*. Kyiv: Naukova dumka [in Russian].
3. Bilovodska, O., Melnyk, Yu., Alenin, Yu., & Arkusha, L. (2020). Implementation of Marketing and Legal Tools in the Process of Commercialization for Innovative Products in Strategic Management and Entrepreneurship. *International Journal for Quality Research*, 14(4), 1261-1278. DOI: <https://doi.org/10.24874/IJQR14.04-18> [in English].
4. Hryenko, T.V., & Hviyashvili, T.Z. (2017). Naukovometodychne zabezpechennia upravlinnia ryzykamy innovatsiinoi diialnosti na promyslovykh pidpriemstvakh [Scientific and methodical support of risk management of innovative activity at industrial enterprises]. *Ekonomika ta pidpriemnytstvo – Economy and entrepreneurship*, 39, 267–278. Retrieved from <https://core.ac.uk/reader/197267790> [in Ukrainian].
5. Illiashenko, S., Bilovodska, O., Tsalko, T., Tomchuk, O., Nevmerzhytska, S., & Buhas, N. (2022). Opportunities, Threats and Risks of Implementation the Innovative Business Management Technologies in the Post-Pandemic Period COVID-19. *WSEAS Transactions on Business and Economics*, 19, 1215-1229. DOI: <https://doi.org/10.37394/23207.2022.19.107> [in English].
6. Illiashenko, S. M. (2015). Innovative process rational choice grounding in organization. *Marketing and Management of Innovation*, 2, 11-20. Retrieved from https://armgpublishing.com/wp-content/uploads/mmi/volume-6-issue-2/mmi2015_2_11_20.pdf [in English].
7. Kryvoviazuk, I. V., Smerichevskiy, S. F., & Kulyk, Yu. M. (2018). *Ryzyk-menedzhment lohistychnoi systemy mashynobudivnykh pidpriemstv [Risk management of the logistics system of machine-building enterprises]*. Kyiv: Vydavnychiy dim “Kondor”. Retrieved from <https://core.ac.uk/download/pdf/286628329.pdf> [in Ukrainian].
8. Myroshchenko, N. Yu., Zaritska, O. L., & Symak, A. V. (2019). Problemy komertsializatsii innovatsiinoi produktsii promyslovykh pidpriemstv [Problems of commercialization of innovative products of industrial enterprises]. *Ekonomika. Finansy. Pravo – Economy. Finances. Law*, 12, 35-40. Retrieved from http://efp.in.ua/public_html/uploads/journals/250/efp_12-0_2019.pdf#page=35 [in Ukrainian].
9. Nesterenko, O. V. (2018). Tekhnolohiia upravlinnia ryzykamy innovatsiinoi diialnosti promysloвого pidpriemstva [Risk management technology of innovative activity of an industrial enterprise]. *Ekonomichnyi zhurnal Odeskoho politekhnichnoho universytetu – Economic journal Odessa polytechnic university*, 1(3), 40–48. DOI: <https://doi.org/10.5281/zenodo.1304047> [in Ukrainian].
10. Olefirenko, O. M. (2016). Komertsializatsiia innovatsii yak obiektyvnyi chynnnyk efektyvnoho funktsionuvannia promysloвого pidpriemstva [Commercialization of innovations as an objective factor in the effective functioning of an industrial enterprise]. *Skhidna Yevropa: ekonomika, biznes ta upravlinnia – Eastern Europe: Economy, Business and Management*, 5, 185-189. Retrieved from http://www.easterneurope-ebm.in.ua/journal/5_2016/5_2016.pdf#page=186 [in Ukrainian].
11. Pererva, P., Cherep, A., Romanchyk, T., & Diakova, N. (2022). Optyimizatsiia ryzykiv ekonomichnoi bezpeky pidpriemstva na zasadakh lohistyky [Optimizing risks of economic security of the enterprise on the basis of logistics]. *Visnyk Natsionalnoho tekhnichnoho universytetu “Kharkivskiy politekhnichnyi instytut” (ekonomichni nauky) – Bulletin of the National Technical University “Kharkiv Polytechnic Institute” (economic sciences)*, 2, 81–87. DOI: <https://doi.org/10.20998/2519-4461.2022.2.81> [in Ukrainian].
12. Sun, Y., Bi, K., & Yin, S. (2020). Measuring and integrating risk management into green innovation practices for green manufacturing under the global value chain. *Sustainability*, 12(2), 545. DOI: <https://doi.org/10.3390/su12020545> [in English].
13. Synytsia, S.M., Vakun, O.V., & Danylyshyn, V.I. (2020). Upravlinnia ryzykamy u lohistychnii diialnosti pidpriemstva [Risk management in the logistics activities of the enterprise]. *Naukovyi visnyk Mizhnarodnoho humanitarnoho universytetu. Seriya “Ekonomika i menedzhment” – Scientific Bulletin of the International Humanitarian University. “Economics and Management” series*, 42, 78-83. DOI: <https://doi.org/10.32841/2413-2675/2020-42-14> [in Ukrainian].
14. Vitlinskyi, V.V., & Skitsko, V.I. (2016). Kontseptualni zasady modeliuвання ta upravlinnia lohistychnym ryzykom pidpriemstva [Conceptual principles of modeling and management of enterprise logistics risk]. *Problemy ekonomiky – Problems of the economy*, 4, 246–253. Retrieved from https://www.problecon.com/export_pdf/problems-of-economy-2016-4_0-pages-231_237.pdf [in Ukrainian].
15. Yaremenko, O.F., & Matiukh, S.A. (2019). Ryziky lohistychnykh system [Risks of logistics systems]. *Visnyk Khmelnytskoho natsionalnoho universytetu. Ekonomichni nauky – Bulletin of the Khmelnytskyi National University. Economic sciences*, 6(1), 231-236. DOI: <https://doi.org/10.31891/2307-5740-2019-276-6-244-249> [in Ukrainian].
16. Yashkin, D.S. (2016). Metody optyimizatsii v upravlinni lohistychnymy ryzykamy promyslovykh pidpriemstv [Optimization methods in logistics risk management of industrial enterprises]. *Ekonomika: realii chasu – Economy: realities of time*, 5(27), 52-58. Retrieved from <https://economics.net.ua/files/archive/2016/No5/52.pdf> [in Ukrainian].