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GENERALIZATION OF THE THEORETICAL APPROACHES TO THE RISK ASSESSMENT OF INNOVATIVE ACTIVITIES IN DEPENDENCE ON THE STAGE OF THE LIFE CYCLE OF THE INNOVATION PROJECT

In this article the author analyzes the advantages and disadvantages of using qualitative and quantitative assessment methods, as well as describes in detail the characteristics, advantages and disadvantages of specific methods of qualitative and quantitative risk assessment. The author also analyzes in detail the approaches of various scientists to the stages of the lifecycle of innovative projects, and on the basis of the analysis 10 main stages are identified: Fundamental research, Applied research, Development Work, Implementation, Start of market entry, Growth ƒ Improvement, Maturity, Deceleration, Decline and Leaving the market. Based on the analysis, the author provides recommendations on the possibility and feasibility of using appropriate methods of qualitative and quantitative risk assessment at each of the stages considered in the life cycle of the innovation project.

Keywords: risk, risk of innovative activity, qualitative risk assessment; quantitative risk assessment; stages of the life cycle of an innovation project.

Introduction. When designing and implementing innovative projects, the enterprise is faced with uncertainty caused by the risk factors of the external and internal environment of the enterprise. In order to improve the effectiveness of strategic planning for enterprise development, it is necessary to pay attention to the evaluation of available information, which can lead to a risky situation. These situations are associated with the emergence of innovative projects, on the one hand, the loss of the effects of innovation and potential losses, and on the other hand, can lead to additional competitive advantages in the future and growth of the enterprise. This information is corroborated by research from consulting companies. For example, according to a research by The Standish Group International (the research analyzed 7,400 innovation and investment projects), 31% of projects ended or were out of time, or overruns planned resources, 53% of projects failed and goals were not met or modified. Only 16% of all projects can be considered successful, completed on time and without exceeding budget[1].

That is why timely identification and evaluation of possible risk factors for innovative projects (the probability of their occurrence and the magnitude of possible losses) will allow to further improve the efficiency of risk management of innovation activities and increase the percentage of successfully implemented innovation projects.

The aim. The main purpose of this article is to summarize theoretical approaches to the possibility of using qualitative and quantitative risk assessment methods, depending on the life cycle stage of an innovation project.

Analysis of latest publications. The improvement of theoretical, methodological and applied aspects of risk has been the subject of research by such world-renowned scientists as F. Knight, J. Neumann, G. Markovitz, O. Morgenstern, F. Modigliani, F. Ruth, J. Tobin, J. Hicks, V. Sharp and more. Nowadays, such scientists as O. Algin, I. Balabanov, I. Blank, E. Brigham, V. Vitlinsky, B. Gardiner, P. Grabovy, V. Granaturov, I. Ivchenko, S. Ilyashenko I. Zhuravleva, R. Kachalov, V. Kovalev, V. Lukyanova, Z. Lytvyn, A. Matviichuk, L. Rishchuk, L. Taranyuk, O. Ustenko, V. Cherkasov, D. Stefanych, O. Yastremsky and others pay attention to risk issues.

However, despite active research and significant advances in this area, the issue of risk assessment of innovation activity, depending on the life cycle stage of the innovation project, has not been given enough attention.

[1] Exceeding value (chaos report) (2014). *The Standish Group International Inc.* <http://www.standishgroup.com/sample_research_files/Exceeding%20Value_Layout.pdf> (2019, October, 25).

Research Results. Risk assessment is one of the steps in the risk management process. It lies in the quantitative or quantitative estimation of the possible losses and the possibility of their occurrence. Qualitative risk assessment is carried out by predominantly expert methods in the minds of uncertainty and is used when comparing a limited number of alternatives to the decisions taken. Quantitative risk assessment involves a mathematical assessment of the degree and extent of risk. The acquired knowledge is included in the calculation that substantiates the economic effectiveness of the approved decisions.

The advantages of qualitative risk assessment include: providing visibility and a simplified understanding of the risk ranking process; finding a solution that takes into account the opinion of each expert; no need for accurate primary data, the ability to use it to solve all kinds of problems. However, the methods of qualitative risk assessment have their disadvantages, which should be attributed: the results are subjective and depend on the qualifications of the expert group created; low accuracy of calculations regarding the magnitude of the risk and the likelihood of their occurrence, which may lead to the choice of an inefficient method of risk management.

In turn, quantitative risk assessment methods make it possible to evaluate the mathematical assessment of the extent and degree of risk that can be used in further developing risk management; are more accurate than qualitative risk assessment methods. However, calculations using quantitative risk assessment methods are quite complex and time consuming; some methods require a large amount of accurate statistical information that can not always be used to assess the risks of innovation.

Let us consider in more detail the characteristics of qualitative and quantitative risk assessment methods, as well as the advantages and disadvantages of using them. Summarized information on the use of risk assessment methods is presented in Table 1.

Considering the advantages and disadvantages of each method, it is advisable to consider their use at each stage of the life cycle of the innovation project, which will further improve the effectiveness of risk assessment of innovation activity in the enterprise.

Currently, there is no single approach among scientists to identify the major stages of the innovation project's life cycle. Some scientists highlight five major phases of the innovation life cycle, namely the emergence of innovation, the introduction into the field of exploitation, the expansion, improvement and cessation of production[1], which is an adaptation of the classic product life cycle provisions to the features of innovation and innovation processes. Some current scientists define the lifecycle of innovation in terms of product life cycle and identify the stages of emergence, growth, maturity and decline[2]. F. Kotler[3], M. Baker[4], J. Evans, B. Berman[5], A. Vichevich, T. Vaidanych, I. Didovich, A. Didovich[6], S. Garkavenko[7], L. Basowski[8], Abdallah Ali Ahmad[9] define the life cycle of innovations from the point of view of the product life cycle and distinguish such phases as production (development), market launch (introduction), growth, maturity and exit from market (decline), but some consider the phase of production (development) as a zero stage, and some – as a separate process. However, this approach does not reflect the specifics of the innovation process and the differences between the innovation and the product (product). C. Wasson and G. Day supplement the product life cycle with a stage of competitive volatility between growth and maturity[10]. In turn, B. Carloff divides the stage of growth into two stages: initial growth and further growth[11].

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Table 1

Advantages and disadvantages of risk assessment methods

¼	Method	Characteristic	Advantages	Disadvantages
1	*2*	*3*	*4*	*5*
1.	Method of brainstorming	Used to generate possible solutions to problems by stimulating creative activity (separated from criticism)	Search for non-standard approaches, generate a large number of options for solving the problem	The complexity of selecting the right expert team
2	Methods of expert assessments	Using the experience of experts in the risk analysis process, taking into account the impact of various factors	Estimates of those types of risk that cannot be estimated by other methods, calculation percentage, no need for accurate primary data	The results obtained are subjective, the accuracy of the estimate is low
3	Methods associations and analogies	Used to generate new ideas and suggestions by comparing the object under study with similar	Utilization of the previous experience of operation in the absence of a clear base for comparison, used to assess the risks of a recurring project	Ignoring the fact of development of any activity, low accuracy, a large database of information about previously started projects
4	Delphi method	It is characterized by the anonymity of the findings of the members of the expert group and the managed feedback	Allows you to make forecasts for which there is not enough theoretical basis at the time of making forecasts	Processing a large volume of questionnaires, takes a long period of time
5	Method of control questions	Used to activate the creative process by answering pre-made questions	The versatility of the method	The results obtained are subjective, the accuracy of the estimate is low
6	Method of morphological analysis	Used to generate ideas for possible solutions	Possible structural relationships and relationships between constituents are considered a system	The results obtained are subjective, the accuracy of the estimate is low
7	Method of critical values	Used to calculate project critical values	Identification of risk factors that bring the calculated value of the corresponding value of the performance criterion to the critical limit	The need for accurate primary data
8	Sensitivity analysis (vulnerability)	The impact of each risk factor on the performance criterion used is considered	Allows you to analyze what the risk will be under the influence of various factors	It is not possible to estimate what the value of the risk really is
9	Monte Carlo method	It is a synthesis of the methods of sensitivity analysis and script analysis	Allows you to consider the distribution of the likely outcomes of the project	Complexity of calculations, computer realization only

Continuation of the table 1

1	*2*	*3*	*4*	*5*
10	Script analysis method	It is a development of the technique of sensitivity analysis of the project	Provides an opportunity to evaluate the impact of a project on the possible simultaneous change of several variables due to the probability of each scenario	Complexity, takes a long time
11	Analytical method	It is based on calculation of payback period, rate of return, profitability index and further comparison of projects by calculated indicators.	The possibility of conducting a factorial analysis of parameters that affect risk and identifying the most influential	The method is not yet sufficiently developed at the theoretical level, the complexity of the calculations
12	Method of using decision trees	Possible scenarios are considered as the probability of certain situations occurring sequentially	Allows you to view and analyze different scenarios events	Complexity of estimation of probability of origin of unfavorable minds, possibility of wrong choice of scenario of development of events
13	Method for assessing financial stability	oriented to the identification of potential zones of financial stability and the corresponding risk zones in the sphere of production and financial activity of the enterprise	Allows one to enter into one of the zones of financial stability and the corresponding risk	Does not take into account the impact of specific risk factors on the growth or reduction of the degree of project risk
14	Normative method	Based on the calculation of the system of financial ratios (autonomy, coverage, liquidity, etc.)	Easy to calculate and prompt	Does not allow to take into account the nuances of a specific situation
15	Method of using analogues	It is based on comparison with similar projects	Utilization of the previous experience of operation in the absence of a clear base for comparison	Ignoring the fact of development of any activity, low accuracy
16	Statistical method	It is based on the theory of probability distribution of random variables	Possibility of obtaining the most complete picture at risk level	The sources of risk origin are not analyzed, a large amount of static information is required, the accuracy of estimates is low, the complexity of calculations

Source: Elaborated by the author from[1,2,3]

[1] Балджи, М. Д. (2015). *Економічний ризик та методи його вимірювання: навч. посібник*. Харків: Промарт.
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A. Gubenko[1], S. Illyashenko[2], O. Kizim[3], V. Grinyov[4], M. Konovalenko[5] in their works consider the life cycle of innovations more widely, whereas in addition to the phases of the innovation lifecycle, the classical approach (introduction, growth, deceleration and decline) take into account the innovation cycle phases (fundamental research, applied research, development work). The author agrees with this approach, since it allows to consider the peculiarities of innovation activity and to consider in more detail the risks that may arise at each stage of the innovation life cycle.

In S. Illyashenko's monograph[6] detailed analysis of the concept of "life cycle of innovation" from the standpoint of traditional (product), productive, process systematic and cyclical approach. The analysis concludes that the lifecycle of innovation should be considered as a system that gradually changes from technical to economic and covers two interconnected cycles: innovation ("materialization" of ideas) and market ("commercialization" of innovation, which transforms them into a source revenue) that overlap each other in the time interval. According to this approach, the lifecycle of innovation consists of the innovation cycle (analytical-search phase, R&D and market testing, commercial production deployment, market launch) and market cycle (market launch, growth (distribution), maturity, saturation, exit market). It should be noted that the launch phase is the end of the innovation cycle and the beginning of the market cycle.

Chorna M. and Glukhova S. continued their research based on the above approach and highlighted complete and small life cycles of innovation[7]. A complete cycle involves the creation of a fundamentally new type of production, and a small one – an analog product. The complete innovation life cycle consists of the preparatory phase (marketing research, analytical research), the design and operational phase (fundamental research, applied research, production), implementation phases (implementation, diffusion, operation) and the decline / development phase (saturation, aging, replacement). The small lifecycle of innovation consists of the preparatory phase (marketing research, analytical research), the design-work phase (fundamental research, applied research, production), the implementation phase (implementation, diffusion, operation) and the decline / development phase (saturation, aging, replacement)

Since the phases of the innovation life cycle of innovation are more risky compared to the phases of the market life cycle of innovation (as they are defined from the point of view of the life cycle of the product) because of the peculiarities of innovation activity in the enterprise, the author considers it expedient to consider in more detail the stages of the innovation process and their components. A. Grinev[8], A. Koyuda[9], T. Lepeyko[10], C. Ilyenkov[11] and others view the innovation process as a sequence of such stages: fundamental research, applied research, development work and implementation. A. Gubenko, S. Ilyashenko, O. Kizim, V. Grinyov, M. Konovalenko will identify the following stages of the innovation process within the life cycle of innovation: fundamental research, applied research, development works. Sometimes the implementation stage is the initial stage of the market cycle (which is a continuation of the innovation process).

The generalization of the considered approaches is presented in Table 2.

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Table 2

Approaches to defining the main stages of the innovation lifecycle

¼	Author	Stages of innovation lifecycle											
		Fundamental research	Applied research	Development Work	Production (Development)	Market Launch (Implementation)	Dissemination	Growth	Improvement	Maturity	Deceleration	Decline	Leaving the market
1.	A. Chukhno				+	+	+		+				+
2	H. Kundeeva				+			+		+		+	
3	F. Kotler				+	+		+		+			+
4	M. Baker				+	+		+		+			+
5	J. Evans, B. Berman				+	+		+		+			+
6	A. Vichevych, T. Vaydanych, I. Didovych, A. Didovych				+	+		+		+			+
7	S. Garkavenko				+	+		+		+			+
8	L. Basovsky				+	+		+		+			+
9	Abdalakh Ali Akhmad				+	+		+		+			+
10	A. Gubenko	+	+	+		+		+			+	+	
11	S. Illyashenko	+	+	+		+		+			+	+	
12	O. Kizim	+	+	+		+		+			+	+	
13	V. Grinyov	+	+	+		+		+			+	+	
14	M. Konovalenko	+	+	+		+		+			+	+	

Source: Elaborated by the author

Summarizing the approaches of scientists to the stages of the innovation lifecycle, the author proposes to identify the following stages of the innovation project lifecycle in the study, which will allow to consider the peculiarities of assessing the risks of innovation activity for each of them: Fundamental research, Applied research, Development Work, Implementation, Start of market entry, Growth / Improvement, Maturity, Deceleration, Decline and Leaving the market.

Taking into account the advantages and disadvantages of each of the considered methods and the selected stages of the life cycle of the innovation project, we can conclude on the possibility and feasibility of using certain considered methods of risk assessment at each stage of the innovation project, which is presented in Table 3.

It should be noted that although most risk assessment methods can be used at all stages of the innovation project lifecycle, however, they may not produce the intended results and can only be used as one of the risk assessment steps at the relevant stage. Quantification methods, in their turn, cannot be used in the first stages of the life cycle of an innovation project (fundamental research, applied research and development work), since they require a large amount of accurate primary information for calculations, which is almost impossible to develop. innovative project. It should also be noted that although we can theoretically use methods to quantify the risks of innovation in the next stages, it is significantly dependent on the innovation project and how similar the next stages of this project will be to similar projects already implemented by a particular enterprise. Therefore, the feasibility and effectiveness of using each of the methods considered depends significantly on the characteristics and features of the particular innovation project.

Table 3

Ability to apply risk assessment methods depending on the life cycle stage of the innovation project

¼	Method	Stages of the life cycle of an innovative project								
		Fundamental research	Applied research	Development Work	Implementation	Start of market entry	Growth / Improvement	Maturity	Deceleration	Decline	Leaving the market
1.	Method of brainstorming	+	+	+	+	+	+	+	+	+	+
2	Methods of expert assessments	+	+	+	+	+	+	+	+	+	+
3	Methods associations and analogies					+	+	+	+	+	+
4	Delphi method	+	+	+	+	+	+	+	+	+	+
5	Method of control questions	+	+	+	+	+	+	+	+	+	+
6	Method of morphological analysis	+	+	+	+	+	+	+	+	+	+
7	Method of critical values				+	+	+	+	+	+	+
8	Sensitivity analysis (vulnerability)	+	+	+	+	+	+	+	+	+	+
9	Monte Carlo method	+	+	+	+	+	+	+	+	+	+
10	Script analysis method	+	+	+	+	+	+	+	+	+	+
11	Analytical method				+	+	+	+	+	+	+
12	Method of using decision trees	+	+	+	+	+	+	+	+	+	+
13	Method for assessing financial stability				+	+	+	+	+	+	+
14	Normative method				+	+	+	+	+	+	+
15	Method of using analogues					+	+	+	+	+	+
16	Statistical method					+	+	+	+	+	+

Source: Elaborated by the author

However, the foregoing illustrates only the general principles of multiple risk analysis, in many cases it is very difficult to determine both the probabilities of the possible outcomes and the quantitative assessment of the results themselves. In these cases, they use other, more specific methods[1], which include in the various combinations the elements of the theory of games, theories of optimization, fuzzy logic, etc.

Conclusions. It can be concluded that the use of different methods of assessing the risks of innovation, depending on the stage of the life cycle of innovative projects will increase the efficiency of the risk assessment process in enterprises implementing innovative projects. Since each of these methods has advantages and disadvantages, it is advisable to use several methods in practice. Although the results of studies by different methods may produce different results, the study of differences between them will reveal the whole set of factors, which can significantly affect the accuracy and reliability of the assessment.

The scientific novelty of the results obtained is to summarize theoretical approaches to risk assessment in strategic planning of enterprise development, which, unlike the known ones, takes into account the possibility of using risk assessment methods at each stage of the project life cycle; and makes it possible to choose, taking into account the advantages and disadvantages of the methods considered, the most effective method in view of the life cycle of an innovative project.

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