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Risk factors determination of enterprise external and internal environment during project implementation

Abstract. A significant part of new enterprises of various forms of ownership and in different sectors of the economy ceases to exist within the first five years. This tendency to close enterprises indicates the need for strategic planning of enterprise development and the implementation of a risk factor identification, evaluation, and management process in the strategic management of enterprise development. The purpose of the research is to develop a methodological approach that would allow identifying the risk factors that may have the greatest impact at each life cycle stage of analysed project. To achieve the goal set within the framework of the research, structural and logical analysis, methods of systematisation, generalisation, scientific abstraction and hierarchy analysis were used. The article proposes methodological approach to determining the risk factors of enterprise external and internal environment, which makes it possible to identify the risk factors that have the greatest impact at each stage of the project life cycle. Mathematical models have been obtained which allow for the identification of those risk factors that can have the most negative impact (both in terms of frequency of occurrence and potential losses), which will enable the enterprise to increase the efficiency of managing these risks at all stages of project implementation. The impact of risk factors has been assessed in conditions of incomplete certainty and lack of sufficient statistical information. The practical significance of the results obtained lies in the possibility of increasing the efficiency of using available resources in risk management

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processes. The proposed methodological approach can be used to assess the impact of project risks in a certain industry, which will increase the accuracy of the results obtained

Keywords: life cycle; method of expert assessments; method of hierarchy analysis; mathematical model; concordance coefficient

INTRODUCTION

In modern economic conditions, enterprises operate in conditions of incomplete certainty, caused by the rapid change in the influence of factors of the external and internal environment. In order to ensure competitive development, enterprises should systematically monitor changes in their macro- and microenvironment and quickly adapt to them, as well as take into account available resources and prospects for further development.

The implementation of strategic planning in enterprise activities will ensure the enterprise development in a strategic perspective and the effective use of available opportunities and resources through constant monitoring of the impact of risk factors of the external and internal environment, as well as enable the enterprise to pay sufficient attention to the stage of identifying and assessing risks, which will allow expanding the feasibility criteria and the possibility of implementing certain strategic decisions (Fedulova, 2019).

The process of strategic planning of enterprise development is often associated with the development and implementation of certain ideas, activities, projects, etc. (Shtal *et al.*, 2020). For the most efficient use of available resources, it is advisable for the enterprise to choose the most promising ones, taking into account the current situation, strategic goals and available internal resources. It is also advisable to allow for the possibility of implementing the planned measures in a certain perspective, i.e., to take into account the possibility of change in the influence of enterprise external and internal environment. That is why the possibility of assessing the influence of factors (measure and degree) at different stages of the idea, project, event implementation is relevant both among scientists and business executives.

T. Shtal *et al.* (2018), A. Spoiala *et al.* (2020) dedicated their works to assessing the risks of the external and internal environment of enterprises.

In their work, S. Ogunlana & P. Kumar Dey (2019) consider modern tools for assessing the risks of the enterprise external and internal environment in project implementation, however, insufficient attention is paid to the peculiarities of using certain methods depending on the stage of the project life cycle. N.R. Chakim *et al.* (2021) analyse 24 risk factors of the enterprise external and internal environment, suggest using the residual risk map for its assessment, as well as the introduction of risk management into the organisational structure of enterprise, but no attention is paid to the quantitative assessment of risks. H. Bolat *et al.* (2022) pay attention to technological (technical) start-ups and the analysis of the risk of failure of such projects using a fuzzy failure mode and effect analysis (FMEA), which makes it possible to identify the main reasons for the failure of start-up projects, however, this study focuses on the research and development stage and does not consider the impact of risk factors after the project enters the market. K. Verhal & I. Ishchenko (2020) investigate the stages of risk management of an investment project, where for each of the selected stages (risk identification, risk assessment, risk response planning, risk monitoring) they propose a certain set of methods that can be used, however, practical recommendations for choosing the most effective method depending on the peculiarities of the project or enterprise are not considered. I. Riepina *et al.* (2019) consider the possibility of choosing an investment project based on NPV (Net present value), PI (Profitability index), PBP (Payback period) indicators and define the risk modelling method as the most universal for quantitative risk assessment, however, the specified approach cannot be used in conditions of uncertainty of enterprise business environment and lack of sufficient statistical or analytical information. S. Illiashenko *et al.* (2022) proposed an approach to quantifying the risks of innovative projects in the context of COVID-19, which excludes the double risk of calculations, and the fuzzy logic apparatus makes it possible to assess risk factors and their combinations, which allows justifying decisions in conditions of inaccurate, incomplete or contradictory information. In her article, N. Shandova (2018) proposed the main stages of anticipatory analysis of risk factors, however, most attention was paid to risk factors of the external environment.

The purpose of the research was to develop a methodological approach to assessing the impact of risk factors on the enterprise external and internal environment.

To achieve the goal, the following tasks were identified: to determine the list of risk factors and stages of the project life cycle for which calculations will be made; conduct an expert survey to assess the impact of enterprise risk factors on the probability of project implementation, taking into account the stages of the project life cycle; identify the most risk-generating factors at each of the selected stages of the project life cycle.

MATERIALS AND METHODS

As a basis for research, scientific works of Ukrainian and foreign scientists on the assessment of the impact of risk factors of the enterprise external and internal environment in project implementation were used. To achieve the goal set within the framework of the research and the solution of the tasks set, the following methods of scientific knowledge were used in the research: structural and logical analysis – in order to determine the logic and structure of the research; systematisation, generalisation, grouping – to identify types and groups of risk factors, depending on the life cycle of the analysed project; systems analysis and scientific abstraction – to identify risk factors of the enterprise external and internal environment, depending on the stage of the life cycle of the analysed project; method of hierarchy analysis – to increase the level of objectivity of assessing the impact of risk factors depending on the appropriate stage of the project life cycle. To solve the tasks set in the research, the Microsoft Excel application package was used.

The proposed methodological approach to the assessment of enterprise risk factors at each stage of the project life cycle consists in performing the following sequence of actions:

1. Selection of project life cycle stages. At this stage, the stages of the life cycle that are characteristic of the analysed projects are selected. Also, the enterprise can make appropriate calculations for all stages of the life cycle that may occur in the future, since these risks primarily reveal the peculiarities of the enterprise economic conditions.

2. Identification of the main risk factors of the enterprise external environment. Considering the available resources and goals of an enterprise, it is possible to choose a different number of factors, because on the one hand, the more factors, the more detailed analysis can be conducted and relevant risks can be identified, and on the other hand, it can significantly increase the complexity of assessing the data obtained.

3. Determination of the main constituent factors of the enterprise internal environment. The list of factors should also be formed based on the current state of the enterprise and the complexity of processing further results.

4. Selection of a group of experts. Depending on the field of operation, it is necessary to form groups of experts so that there are enough experts to make further conclusions and their qualifications enable them to assess the impact of the selected factors on a particular project.

5. Conducting a survey through a pairwise comparison of the impact of risks of the enterprise external and internal environment at each of stage of the analysed project.

The survey was conducted in 2019. With the help of Google Forms software, an anonymous questionnaire was developed, which was then sent to the e-mail addresses of more than 400 enterprises engaged in the development and implementation of projects at the research stages. Based on the results obtained, the coefficients of the model were determined. This survey was conducted in order to show the possibility of using the proposed methodological approach.

Suppose that $C_1, C^2 \dots C_n$ is a set of objects (in this case – risk factors of the enterprise external and internal environment). Then the quantification of the pair of objects (C_i, C_j) can be represented by constructing an n×n matrix.

$$A = (a_{ij}), (i, j = 1, 2 \dots n). \quad (1)$$

At the same time, it should be noted that the following rules apply to elements a_{ij}:

1) If $a_{ij} = \alpha$, then $a_{ij} = \frac{1}{\alpha}$, $\alpha \neq 0$.

2) If the experts established the same importance of judgments C_i and C_j, then $a_{ij} = 1$, $a_{ji} = 1$, $a_{ii} = 1$ for all i.

Matrix A will generally look as follows (Pasichnyk *et al.*, 2022):

$$A = \begin{bmatrix} 1 & \alpha_{12} & \dots & \alpha_{1n} \\ 1/\alpha_{12} & 1 & \dots & \alpha_{2n} \\ \dots & \dots & \dots & \dots \\ 1/\alpha_{1n} & 1/\alpha_{2n} & \dots & 1 \end{bmatrix}. \quad (2)$$

In order to conduct and evaluate the results of pairwise comparisons of experts, the Saaty's scale was used to increase the objectivity of subjective judgments (Pasichnyk *et al.*, 2022; Moore & Weatherford, 2001).

To use the matrix of pairwise comparisons for further calculations, it must be normalised.

6. Calculation of weight coefficients of risk factors of the external and internal environment based on the survey of each expert at each stage of the project life cycle using the method of hierarchy analysis, as well as checking the consistency coefficient for each of the calculations in order to assess the consistency of the expert's response and the possibility of using the obtained results in further research.

The consistency coefficient is calculated in three stages (Moore & Weatherford, 2001):

1) first, the consistency measure is calculated for each analysed criterion (CC);

2) the consistency index (*CI*) is calculated according to the formula:

$$CI = \frac{\overline{CC} - n}{n - 1}, \quad (3)$$

where $(\overline{CC})$ is the average measure of consistency of all criteria; n is the number of considered criteria.

3) the consistency ratio (*CR*) is calculated according to the formula:

$$CR = \frac{CI}{RI}, \quad (4)$$

where *CI* is the consistency index; *RI* is the randomisation index.

7. Calculation of the concordance coefficient for each of the analysed groups of risk factors (including macroenvironment, microenvironment and internal environment of the enterprise) at each of the analysed stages of the project life cycle. Consistency of expert opinions is calculated using the formula (Traskovetska *et al.*, 2013):

$$w = \frac{S}{\frac{1}{12}(m^2(n^3 - n) - m \sum_{j=1}^{m} T_j}, \quad (5)$$

where S is the sum of squared deviations of all rank estimates of each examination object from the average value; n is the number of examination objects; m is the number of experts; T_j is an indicator that takes into account the coincidence of ranks and is calculated according to the formula (Traskovetska *et al.*, 2013):

$$T_j = \sum_{k=1}^{n} (t_k^3 - t_k), \quad (6)$$

where t_k is the number of repetitions of rank k when ranking factors by the j expert.

The analysis of this indicator will make it possible to determine the degree of consistency of expert opinions, as well as identify the expert responses that differ significantly, which will allow identifying the causes of a significant deviation and exclude them.

8. Calculation of the arithmetic mean of the received values of weights of each factor of each expert in order to determine the total weights of groups of risk factors, as well as each risk factor of the enterprise external and internal environment at each of the analysed stages of the project life cycle.

9. Obtaining mathematical models to identify the influence of groups of risk factors and risk factors of the enterprise external and internal environment at each stage of the project life cycle.

The general form of the objective function can be represented as:

$$R = \sum_{i=1}^{n} w_i \times R_i, \quad (7)$$

where w_i is the weight of the i-factor; $w_i > 0$; R_i is value of the i-factor; n is the number of factors.

It is advisable to present the mathematical model of the overall risk assessment of the enterprise as follows:

$$R = K_{1s} \times R_{1s} + K_{2s} \times R_{2s} + K_{3s} \times R_{3s} \quad (8)$$

where R_{1s} is the risk of the enterprise macroenvironment; R_{2s} is the risk of enterprise microenvironment; R_{3s} is the risk of enterprise internal environment; K_{1s}, K_{2s}, K_{3s} are corresponding weights of each risk group, calculated by using the method of hierarchy analysis; s is the corresponding stage of the project life cycle.

10. Identification of risk factors of the macroenvironment, microenvironment and internal environment of the enterprise, which have the greatest impact on the project at the appropriate stage of the project life cycle in order to effectively manage them and evaluate the implementation of the project as a whole.

Identification of risk factors that have the most negative impact will increase the effectiveness of risk management and will also increase the probability of the analysed project implementation at all planned stages of its life cycle.

RESULTS AND DISCUSSION

Much attention was paid to the issue of the project life cycle in the works of Ukrainian and foreign scientists (Kotler, 1984; Chorna & Glukhova, 2012; Fedorovych, 2012). Summarising different approaches, it is possible to distinguish the stages of market entry, growth/improvement, maturity, slowdown, decline and exit from the market. However, the authors consider it expedient to additionally consider the life cycle stages of the innovation stage of the project, since the enterprise may try to introduce innovations to ensure its development and maintain competitive position. In their works, some scientists involved in life cycle research of innovative projects (Ilyashenko, 2008; Kyzim & Ivanov, 2007) additionally distinguish basic research, applied research, development work and market launch. Summarising these approaches, the authors propose to distinguish the following 10 stages within the framework of the research: basic research, applied research, R&D work, implementation, market entry, growth/improvement, maturity, slowdown, decline, and exit from the market (Vereshchahina & Pliekhanova, 2020). This does not mean that every project will go through all the stages, since it depends on its features and goals, but such a division makes it possible to fully consider the existing stages of life cycle of projects, including innovative ones.

Ukrainian and foreign scientists pay a lot of attention to the study of risk factors of the enterprise internal and external environment. In addition, many scientists distinguish microenvironmental risk factors (risk factors of direct influence) and macroenvironmental factors (risk factors of indirect influence) within the external environment of the enterprise (Kovbatyuk & Benyk, 2016; Porter, 2020). On the basis of the analysis of approaches to identifying enterprise risk factors, the authors selected for further analysis factors of the macroenvironment (socio-cultural, scientific and technological, demographic, economic, political and legal, international, ecological, natural and geographical), microenvironment (clients, competitors, suppliers, intermediaries, contact audiences) and the internal environment (marketing, production, information, innovation, financial, time, labour, technological, spatial, management) of the enterprise (Pliekhanova, 2017a; Pliekhanova, 2017b). These risk factors (or the most significant for each analysed project, depending on the industry and set goals) can be used in the future when conducting an expert assessment using the method of hierarchy analysis to obtain appropriate mathematical models.

The risk factors of the macroenvironment have the greatest uncertainty due to the impossibility for the enterprise to influence them directly. The following model is proposed for risk assessment of the enterprise macroenvironment:

$$R_{1s} = H_{1s} \times V_{1s} + H_{2s} \times V_{2s} + H_{3s} \times V_{3s} + H_{4s} \times V_{4s} + H_{5s} \times V_{5s} + H_{6s} \times V_{6s} + H_{7s} \times V_{7s} + H_{8s} \times V_{8s}, \quad (9)$$

where V_{1s} are socio-cultural risk factors; V_{2s} are scientific and technological risk factors; V_{3s} are demographic risk factors; V_{4s} are economic risk factors; V_{5s} are political and legal risk factors; V_{6s} are international risk factors; V_{7s} are environmental risk factors; V_{8s} are natural and geographical risk factors; H_{1s}, H_{2s}, H_{3s}, H_{4s}, H_{5s}, H_{6s}, H_{7s}, H_{8s} are weights of the risk factor of the macro- environment of the enterprise, obtained on the basis of hierarchy analysis; s is the stage of project life cycle.

The following model is proposed for risk assessment of the enterprise microenvironment:

$$R_{2s} = G_{1s} \times Y_{1s} + G_{2s} \times Y_{2s} + G_{3s} \times Y_{3s} + G_{4s} \times Y_{4s} + G_{5s} \times Y_{5s}, \quad (10)$$

where Y_{1s} are risk factors of customers; Y_{2s} are risk factors of competitors; Y_{3s} are risk factors of suppliers; Y_{4s} are risk factors of intermediaries; Y_{5s} are risk factors of contact audiences; G_{1s}, G_{2s}, G_{3s}, G_{4s}, G_{5s} are weights of the risk factor of the macroenvironment of the enterprise, obtained on the basis of hierarchy analysis; s is the stage of project life cycle.

The following model is proposed for risk assessment of the enterprise internal environment:

$$R_{3s} = O_{1s} \times Z_{1s} + O_{2s} \times Z_{2s} + O_{3s} \times Z_{3s} + O_{4s} \times Z_{4s} + O_{5s} \times Z_{5s} + O_{6s} \times Z_{6s} + O=_{7s} \times Z_{7s} + O_{8s} \times Z_{8s} + O_{9s} \times Z_{9s} + O_{10s} \times Z_{10s}, \quad (11)$$

where Z_{1s} are marketing risk factors; Z_{2s} are production risk factors; Z_{3s} are informational risk factors; Z_{4s} are innovative risk factors; Z_{5s} are financial risk factors; Z_{6s} are time risk factors; Z_{7s} are labour risk factors; Z_{8s} are technological risk factors; Z_{9s} are spatial risk factors; Z_{10s} are management risk factors; O_{1s}, O_{2s}, O_{3s}, O_{4s}, O_{5s}, O_{6s}, O_{7s}, O_{8s}, O_{9s}, O_{10s} are weights of the risk factor of the enterprise macroenvironment, obtained on the basis of hierarchy analysis; s is the stage of project life cycle.

In order to obtain substantiated results, it is necessary to determine the minimum number of experts who should be involved in the research with the corresponding error of results. For this, it is advisable to use formula 9 (Geets, 2005):

$$n_{min} = 0{,}5 \times \left(\frac{3}{E} + 5\right), \quad (12)$$

where E is the selected average error when including (excluding) an expert from the survey process.

It was determined that to ensure the validity of the results with an error of 5%, the minimum number of experts with agreed answers is 33 people. The study received agreed answers from 34-42 experts, depending on the stage of the project life cycle. An example of calculations is presented based on the results of a survey of one of the experts regarding the stage of fundamental research. The results of making a matrix of pairwise comparisons for risk groups are presented in Table 1.

The next step is matrix normalisation, the results of which are presented in Table 2.

Table 1. Comparison of groups of risk factors at the stage of fundamental research by an expert

	Macroenvironment	Microenvironment	Internal environment
Macroenvironment	1	4	0.2
Microenvironment	0.25	1	0.125
Internal environment	5	8	1

Source: made by the author

Table 2. Standardised data of groups of risk factors at the stage of fundamental research of one of the experts

	Macro-environment	Micro-environment	Internal environment	Average	Consistency measure
Macroenvironment	0.160	0.308	0.151	0.206	3.068
Microenvironment	0.040	0.077	0.094	0.070	3.016
Internal environment	0.800	0.615	0.755	0.724	3.204
CI = 0.048					
RI = 0.580					
CR = 0.083					

Source: made by the author

According to the results of the calculations, the consistency index is 0.048. The calculated consistency ratio is 0.083, which is less than the normative value of 0.10. From the obtained calculations, it can be concluded that the expert is consistent in their answers and there are no contradictions when filling out the table of pairwise comparisons.

According to the results of the calculations given in Table 2, it can be concluded that at the stage of fundamental research, according to one of the experts, the risk factors of the enterprise internal environment play the most important role.

Thus, the mathematical model of the overall risk assessment of the enterprise activity based on the results of the survey of one of the experts can be presented in the following form:

$$R = 0.206 \times R_{11} + 0.070 \times R_{21} + 0.724 \times R_{31}. \quad (13)$$

One of the experts proposes to calculate the influence of factors of macroenvironment, microenvironment and internal environment of the enterprise at the stage of fundamental research using a similar sequence of actions.

Thus, a mathematical model based on the results of the survey of one of the experts at the stage of fundamental research can be presented in the following form:

- the risk of the macroenvironment of the enterprise:

$$R_{11} = 0.023 \times V_{11} + 0.325 \times V_{21} + 0.033 \times V_{31} + 0.226 \times V_{41} + 0.160 \times V_{51} + 0.073 \times V_{61} + 0.049 \times V_{71} + 0.111 \times V_{81} \quad (14)$$

- the risk of the microenvironment of the enterprise:

$$R_{21} = 0.281 \times Y_{11} + 0.433 \times Y_{21} + 0.110 \times Y_{31} + 0.066 \times Y_{41} + 0.110 \times Y_{51} \quad (15)$$

- the risk of the internal environment of the enterprise:

$$R_{31} = 0.064 \times Z_{11} + 0.113 \times Z_{21} + 0.041 \times Z_{31} + 0.135 \times Z_{41} + 0.064 \times Z_{51} + 0.044 \times Z_{61} + 0.293 \times Z_{71} + 0.203 \times Z_{81} + 0.025 \times Z_{91} + 0.018 \times Z_{101}. \quad (16)$$

Thus, according to one of the experts, scientific and technological risk factors, economic risk factors, and political and legal risk factors can be identified as the most influential factors of the macroenvironment at the stage of fundamental research; risk factors of competitors and customers can be identified as the most influential factors of the microenvironment; labour, technological, innovation and production risk factors can be identified as the most influential factors of the internal environment.

The mathematical model of the overall risk assessment of the enterprise (taking into account all factors of influence) based on the results of the survey of one of the experts can be presented in the following form:

$$R = 0.004 \times V_{11} + 0.067 \times V_{21} + 0.007 \times V_{31} + 0.047 \times V_{41} + 0.033 \times V_{51} + 0.015 \times V_{61} + 0.010 \times V_{71} + 0.023 \times V_{81} + 0.020 \times Y_{11} + 0.030 \times Y_{21} + 0.008 \times Y_{31} + 0.004 \times Y_{41} + 0.008 \times Y_{51} + 0.046 \times Z_{11} + 0.082 \times Z_{21} + 0.030 \times Z_{31} + 0.098 \times Z_{41} + 0.046 \times Z_{51} + 0.032 \times Z_{61} + 0.212 \times Z_{71} + 0.147 \times Z_{81} + 0.018 \times Z_{91} + 0.013 \times Z_{101}. \quad (17)$$

According to the results of the mathematical model of general risk, built on the basis of the answers of the 1st expert at the stage of fundamental research, it is possible to distinguish labour, technological, production and scientific and technological risk factors.

After all calculations have been carried out at each stage of the project life cycle, it is necessary to check the consistency of expert opinions using the concordance coefficient. The concordance coefficient of the research is in the range of 70.91%-85.38%, depending on the group of factors for which this indicator was calculated, as well as the corresponding stage of the project life cycle. The obtained calculations indicate a significant consistency of expert opinions and the possibility of using the obtained results for further generalisation.

The results of the survey can be presented in Table 3.

Table 3. Key risk factors at the stages of project life cycle

Project life cycle stage	Key risk factors
Fundamental research stage	labour, technological, production, innovation and economic risk-generating factors
Applied research stage	customer-related risk factors, as well as technological and labour risk factors
Research and development stage	risk factors related to customers, competitors and contact audiences, as well as labour and technological risk-generating factors
Implementation stage	risk factors related to customers, competitors and contact audiences, as well as marketing and managerial risk-generating factors
The initial stage of market entry	risk factors related to customers, competitors and contact audiences, as well as marketing and managerial risk-generating factors
Growth/improvement stage	risk factors related to customers, as well as scientific and technological and socio-cultural risk-generating factors
Maturity stage	socio-cultural, economic and international risk factors
Slowdown stage	risk factors related to customers, competitors and contact audiences, as well as marketing and innovation risk factors
Decline stage	risk factors related to customers, competitors, as well as marketing and managerial risk factors
Exit from market stage	financial, managerial, production and labour risk factors

Source: made by the author

A large number of methods are used for risk assessment, which V. Lukyanova & T. Golovach (2007) combined into 4 groups: expert methods, economic and statistical methods, calculation and analytical methods, and analogue methods. Each of these groups has its advantages and disadvantages. The use of economic and statistical and calculation and analytical methods requires a significant amount of statistical information, but there is often a lack of relevant information for a detailed study of not only the risk measure, but also the assessment of each of its components. For analogue methods, it is necessary to have examples of the implementation of relevant projects, but this information is not always freely available if the enterprise failed to implement the project. On the other hand, if the relevant information is available, the presented methods are quite easy to use. Expert methods are most widely used in the absence of sufficient statistical and analytical information, but they are mostly subjective in nature. That is why the methodological approach proposed by the authors using the method of hierarchy analysis makes it possible to increase the objectivity of the results obtained and use it in conditions of limited information.

Many scientists propose different approaches to risk assessment in different areas of business, because in the conditions of rapid changes and the lack of sufficient statistical information, it is increasingly difficult to use standard approaches to risk assessment. In their article, B. Bakhtawar *et al*. (2022) consider the possibility of using the Monte Carlo modelling method for public-private partnership projects using financial, social and environmental sustainability indicators to ensure risk management in conditions of sustainable development. In their article, Yu. Kolyada *et al*. (2020) consider the possibility of using the system of Volterra-Lotka equations to quantify the risk behaviour of the decision-making subject. T. Bielialov (2022), in his article, investigates the risk management system of innovative products, and also identifies the sequence of actions for making managerial decisions while implementing the strategy of promoting innovative products. These works also consider the possibility of risk assessment in conditions of insufficient information, however, the approach proposed by the authors makes it possible to consider in more detail the constituent factors of risk at each stage of the project life cycle.

In their work, I. Berezyuk-Rybak & N. Ilchenko (2019) proposed to use NPV and IRR indicators to evaluate the effectiveness of innovative projects, and consider the risk from the standpoint of deviation of actual data from the calculated ones. However, it is advisable to use this approach with available information on the implementation of previous projects, as well as the ability to estimate the total costs of the entire project, which is quite difficult to accurately estimate, taking into account the uncertainty of the economic conditions of the enterprise and the project implementation. In the proposed project risk assessment model, O. Halytskyi *et al*. (2021) also use the NPV indicator, but vector algebra and fuzzy logic methods are additionally used to estimate the probability of each selected risk indicator. However, this approach does not provide an opportunity to analyse the impact of various risk factors depending on the peculiarities of the project. The NPV indicator is also used in the article by O. Tsesliv & A. Kolomiiets (2020) as the basis of the proposed methodology, which presents fuzzy indicators in the form of a triangular membership function for profit. This methodology makes it possible to evaluate the project step by step and terminate its implementation if the efficiency criterion falls below the established limit norms, but the result is closely related to the definition of indicators of possible profit, which is quite difficult to assess in conditions of incomplete certainty.

In their article, I. Babii *et al*. (2022) proposed the use of an expert method with a point score to assess risk groups related to the external environment, marketing activity, use of financial resources, strategic development and competencies of enterprise specialists. This approach makes it possible to determine the risks with the greatest impact, however, unlike the approach proposed by the previous authors, it does not provide an opportunity to check the correctness and consistency of the expert assessments, but only the degree of consistency in opinions of experts with each other.

CONCLUSIONS

Within the framework of the research, a methodological approach has been proposed to identify internal and external risk factors that most affect projects of the analysed enterprise. The list of risk factors of the macro- and microenvironment, and internal environment of the enterprise is summarised, which will allow further use of the proposed methodological approach with the possibility of studying exactly those risk factors that correspond to the specifics of enterprise activity or the field of its operation. An extended list of the stages of the project life cycle is given (so that it could be used for innovative projects as for the most promising), and besides, the project can start and end its life cycle at any stage, depending on the specifics of the project and the set goals. Identifying the riskiness of each stage will give an opportunity to consider the chances of reducing risks of these stages by inviting relevant experts or outsourcing some work (in the absence of the necessary personnel qualifications or capacities / capabilities of equipment). The process of building a mathematical model of general risk assessment based on the example of the expert answers at the stage of fundamental research is considered in detail. The possibility of assessing the consistency of expert answers to identify their sequence and the possibility of using them in the further construction of mathematical models, as well as the calculation of the concordance coefficient for assessing the consistency of expert answers are considered. The proposed sequence of actions will make it possible to build a mathematical model at any stage and for any group of risk factors, depending on the enterprise goals. In further studies, it is planned to consider the possibility of applying the specified methodological approach to calculate the overall project risk in order to compare projects with each other and to make the most effective use of the enterprise available resources in the strategic planning of its development, as well as to use this approach to calculate the risk factors at different stages of the project life cycle in various fields of enterprise operation in order to increase the accuracy of the obtained mathematical models.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Визначення факторів ризику зовнішнього і внутрішнього середовища підприємства при реалізації проєктів

Анотація. Значна частка нових підприємств різних форм власності та у різних сферах господарювання припиняє своє існування протягом перших п’яти років. Така тенденція до закриття підприємств свідчить про необхідність стратегічного планування розвитку підприємства та імплементації процесу виявлення факторів ризику, їх оцінювання та управління ними в процесі стратегічного управління розвитком підприємства. Мета дослідження полягала в розробці методичного підходу, що дозволить виявити фактори ризику, які можуть мати найбільший вплив, на кожному з етапів життєвого циклу аналізованого проєкту. Для досягнення поставленої в рамках дослідження мети було використано структурно-логічний аналіз, методи систематизації, узагальнення, наукової абстракції та аналізу ієрархій. У статті було запропоновано методичний підхід до визначення факторів ризику зовнішнього та внутрішнього середовища підприємства, що дає змогу виявити фактори ризику, які мають найбільший вплив, на кожному етапі життєвого циклу проєкту. Отримано математичні моделі, які дають змогу виділити саме ті фактори ризику, які можуть мати найбільш негативний вплив (як по частоті виникнення, так і по величині можливих збитків), що дасть змогу підприємству підвищити ефективність управління саме цими ризиками впродовж усіх етапів реалізації відповідного проєкту. Було оцінено вплив факторів ризику в умовах неповної визначеності та відсутності необхідної кількості статистичної інформації. Практичне значення отриманих результатів полягає у можливості підвищення ефективності використання наявних ресурсів в процесі управління ризиками. Запропонований методичний підхід може бути використаний для оцінювання впливу ризиків проєктів певної галузі, що підвищить точність отриманих результатів

Ключові слова: життєвий цикл; метод експертних оцінок; метод аналізу ієрархій; математична модель; коефіцієнт конкордації