ANALYSIS OF RISK ASSESSMENT METHODS FOR AN INVESTMENT PROJECT AT AN INDUSTRIAL ENTERPRISE

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Abstract: The investment project risk can have qualitative and quantitative features. In this regard, we distinguished the groups of methods of its qualitative and quantitative assessment. The qualitative assessment involves a verbal description of the potential project risks and different responses to them. Quantitative assessment involves measuring the parameters of potential risks in the form of a certain quantitative value. One often uses the indicators of the risk occurrence probability, risk assessment scales, potential risk damage calculation, cost of risk minimization measures. The article discusses the most common qualitative and quantitative risk assessment methods for an investment project. One of the main methods of substantiating the feasibility of implementing the investment project is the development of its business plan.

Keywords: Risk, Assessment, Investment Project, Business, Investment, Industrial Enterprise.

1 Introduction

Quantitative and qualitative risk assessment is the most important task of the enterprise in projects devoted to the development of its technological base. As a rule, a qualitative analysis is carried out at the stage of an express assessment of the project's fundamental feasibility, and a quantitative assessment is carried out during the development of a full-fledged feasibility study.

Uncertainty is an integral and inevitable part of projects. Existence of risk and uncertainty in projects reduces the accuracy of proper estimation of objectives and reduces the efficiency of projects. In this regard, it is essential to have a tool that assesses the level of risk of the project and, consequently, estimates the actual deviation. Therefore, the need to recognize and manage risk in the project is quite clear. One of the problems of project managers is identifying and how to deal with risks in the project. Risk identification and prioritization is an important issue in risk management that needs to be done for successful risk management due to project constraints. The purpose of this study is to present a model based on multi-criteria best-worst decision-making method, which is one of the new multi-criteria decision-making techniques, in order to prioritize project risks and also the risk failure structure approach that facilitates the risk identification process. Structures and enhances the identification phase in terms of covering project features and characteristics. For this purpose, first, using the approach of risk failure structure and using known models in this field, project-related risk assessment indicators were extracted in the form of a case study in the Sikas Park project of Yazd Desert Pioneers Group, then using The best-worst method and the opinions of experts were evaluated and prioritized, and finally the risks related to each of the priority indicators were extracted and solutions were presented to manage them. Unpredictable conditions, the existence of various uncertainties and many changes in human life and, of course, in the new situation called projects have all led to the scientific emergence of relatively risk management; Risk management is a new branch of management science that is growing rapidly despite being young

Expansion and growth and has been welcomed by experts and managers in a variety of trends. Today, risk and related trends such as: risk studies, risk assessment in a wide range of topics such as finance and investment, trade, insurance, safety, health, industrial and development projects and even political, social and military issues have found their place. Construction projects, which often fall into the category of large projects, are carried out in a dynamic and complex environment in such a way that uncertainty and risk are among their inherent characteristics. This uncertainty has caused most of the country's development projects to not achieve significant success in achieving the predetermined goals. Projects are complex and dynamic and involve processes

Construction is inherently multiple feedback, so all large construction projects should have a section called risk management, as the lack of such a thing has made the industry inefficient. A dynamic environment is an environment in which the speed of change is high, the opposite of a dynamic environment is a static environment; In which the rate of change is negligible, dynamic environments create more uncertainty than static environments. The more stable and predictable the environment, the easier it will be to manage risk, and the more dynamic and unpredictable it will be, the more likely it is that unexpected events will occur, resulting in more risk and ultimately more difficult risk management. In the risk management literature, uncertainty is different from risk, and while in most cases the two words uncertainty and risk are used as equivalent and synonymous, but uncertainty, despite its close relationship with risk, is not equivalent to risk and in Risk management These two terms are used in a completely different way, the difference between risk and uncertainty in the degree of knowledge about an event. Risk is an uncertainty that can be measured, but uncertainty is a category that cannot be measured. There is a relationship between risk and uncertainty, as Hilson (2004) points out that: Uncertainty risk is measured and uncertainty is a risk that can not be measured. Concepts and generalities of project management knowledge "defines risk management as: the set of processes required to identify, analyze and react to project risk, in order to maximize the results of positive events and minimize the consequences of adverse events; However, one of the most practical and popular models available is the risk model based on the PMBOK standard.

2 Methods

I. Qualitative assessment of project risks.
The general algorithm of the methodology for the qualitative assessment of project risks includes the following sequential stages (Malashihina & Belokrylova, 2004; Bocharov, 2002):

- selection of the project risk classification, on the basis of which the analysis will be carried out;
- identification of all potential risk factors for a specific investment project;
- description of possible risk events generated by the selected factors;
- determination of the project stage that will be affected by a specific risk event;
- description of damage caused by the occurrence of risk events at each project stage;
- development of risk damage minimization measures.

If the express assessment and the primary economic feasibility study of the project gave a positive results, then it is developed a full feasibility study of the project, including application of the quantitative risk assessment methods.

II. Quantitative assessment of project risks.
The classifications according to the "information collection method" and "assessment algorithm" criteria are the most common in the scientific literature. Let's consider them.

1. Classification of the project risk quantitative assessment methods by the information collection method

a) On the basis of the "information collection method", we distinguished the expert assessment and the statistical methods (Malashihina & Belokrylova, 2004; Igonina, 2002).

The expert assessment method is based on expert assessments of the probability of risk events. As a rule, several experts take part in the expert information collection. The opinion of each expert is assessed using certain scales, after which it is formed a generalized probabilistic assessment of the occurrence of risk event and possible risk damage to the entire project.

The cumulative potential damage in case of all risk events makes it possible to assess the economic parameters of the project in the worst case scenario.

One of the possible algorithms for conducting the expert assessment method is as follows (Tepman, 2002; Shapkin, 2003):

- possible risks are determined for each stage of the investment project;
- each expert is provided with a list of risks;
- the probabilities of the risk event occurrence are estimated in accordance with the following scale: a) 0 - the risk is insignificant; b) 25 - the risk is unlikely; c) 50 - the risk may or may not occur; d) 75 - the risk is highly probable; e) 100 - the risk will be fully implemented;
- expert assessments are checked for consistency according to the following rules: a) the difference modulus between the risk assessments of two experts should not exceed 50; b) the expert assessments should be coordinated;
- in the absence of expert contradictions, the arithmetic mean of the risk should be calculated for each factor;
- the entire project is undergone the integrated risk assessment;
- a decision is made on each risk at different investment project stages, and possible responses are discussed thereafter.
- We distinguished the following advantages of the expert assessment method:
- method simplicity, which allows studying the risk in a very short time;
- low cost of the analysis, which makes it economically feasible to conduct a risk study by this method.
- We distinguished the following disadvantages of the expert assessment method:
- insufficient information, since only some of the risk factors identified by experts are analyzed;
- subjectivity in the risk analysis and assessment, which can lead to distortion of the risk impact on the investment project results.

The expert assessment method is often used in the initial development of a feasibility study for a project and risk analysis. As a rule, the expert project risk assessment method is used in conjunction with one or more quantitative methods.

The statistical method (Tepman, 2002; Voroncovskij, 2004; Mazur & Shapiro, 2004) involves the information collection and analysis according to similar projects at the considered enterprise or other enterprise in the industry for the purpose of their subsequent analysis.

1) The average expected net present value of the project is calculated as the weighted average of all possible outcomes.
2) The volatility (variability) of the possible net present value of the project is determined based on the variance.
3) Variation coefficient, the value of which directly characterizes the variability degree:

- from 0 to 10% - weak variability;
- from 11 to 25% - moderate variability;
- from 26% and more - high variability.

We distinguished the following advantages of the statistical method:

- ability to use the accumulated empirical material;
- relative simplicity of the method, since the computational algorithms of the method are simple.

We distinguished the following disadvantages of the method:

- increased requirements for the training of project managers and analysts in the field of statistics;
- only the same type projects can be analyzed by this method. When assessing the risk of a unique project, the application of this method is problematic.

b) Classification of the project risk quantitative assessment methods by the applied algorithm.

Depending on the applied project risk assessment algorithm, we distinguished the following quantitative methods:

- sensitivity analysis;
- scenario method;
- decision trees;

1) Sensitivity analysis

The essence of this method is to assess the degree of influence of the most important risk factors on the main economic indicators of the project (NPV, IRR). The selected risk factors are given a certain step of changes in physical, monetary or percentage terms (for example, an increase in the cost of raw materials by 5%, 10%, 15%, …, 80%, …), after which the main project indicators are calculated.

If the project sensitivity is carried out for one risk factor, then such an analysis is called one-parameter. If the sensitivity is assessed simultaneously by two or more factors - multiparametric analysis. The existing versions of the investment project indicator calculation program "Alt-Invest" allow one- and two-parameter sensitivity analyzes.

The existing literature (Gracheva, 1999) proposes the following more advanced risk assessment algorithm for the investment project based on the sensitivity analysis method:

1. There is a consistent study of the sensitivity of the influence of each variable on the main project indicators.
2. There is calculation of the change elasticity in the net present value of the project and the elasticity rating (the higher the value obtained and specified in column 4 of Table 1 is, the higher the elasticity rating is).

Table 1: Determination of the rating of the project factors tested for risk

Variable X_i	**ΔX_i, %**	**Δ NPV, %**	**$\frac{\Delta NPV, \%}{\Delta X_i, \%}$**	**Rating**
1	2	3	4	5
Variable1				
Variable2				
⋮				
Variable$n$				

3. There is an expert assessment of all variables in terms of sensitivity to them and the possibility of their prediction. The sensitivity is assessed by the criteria "low", "medium", and "high". The higher the rating is, the higher the sensitivity value is. The ability to predict the values of variables is also assessed by the criteria "low", "medium", "high" and is reflected in Table 2.

Table 2: Indicators of sensitivity to variables and their predictability in the project

Variable X_i	**Sensitivity to variable**	**Possibility of forecasting**
Variable1		
Variable2		
⋮		
Variable$n$		

4. Risk factor grouping according to the degree of influence on the investment project based on the sensitivity matrix (Table 3).

Table 3: Sensitivity and predictability matrix

Sensitivity to variable / Possibility of forecasting	**High**	**Average**	**Low**
Low	I	I	II
Average	I	II	III
High	II	III	III

Depending on the indicators of sensitivity to variable and predictability, each risk factor is assigned to one of three groups (I, II, or III) based on the sensitivity and predictability matrix. Each group of factors is dealt with in accordance with the following guidelines:

- Group I risk factors need to be further analyzed;
- Group II factors need be taken into account;
- Group III factors can be ignored.

We distinguished the following advantages of the sensitivity analysis method:

- based on this method, it is possible to assess the impact of each significant risk factor presented in the calculation model on the performance indicators of the project;
- simplicity and low cost of carrying out one- and two-parameter analysis of the sensitivity of project results to risk events;
- risk factor grouping according to the result impact increases the method clarity and simplifies the making of management decisions on project risks.
- We distinguished the following disadvantages of the sensitivity analysis method:
- practical application of this method is carried out using special commercial software products;
- the number of analyzed risk factors is limited (as a rule, by quantitative factors included in the financial model of the project).

2) Scenario method.

The essence of this method consists in the development of three possible scenarios for the project implementation, as well as the calculation of project performance indicators for each of them. The generalized algorithm for this method is as follows:

- the most significant risk factors are highlighted;
- the possible change limits in these factors are predicted;
- on the basis of the analysis carried out, three possible project implementation scenarios are drawn up: pessimistic, most probable and optimistic;
- the investment project efficiency indicators are calculated for each of the scenarios;
- a decision is made to invest resources in the project.

We distinguished the following advantages of the scenario method (Gracheva, 1999; Koltynyuk, 2000):

- the formation of implementation scenarios gives a fairly complete picture of possible fluctuations in the project results;
- the use of forecasting methods allows highlighting the most significant factors and substantiate this choice using the existing statistical apparatus.

The disadvantages of the scenario method are as follows:

- only the most significant factors for which the empirical information is available (i.e. quantitative ones) are highlighted in the risk factor analysis. And important qualitative factors that are difficult to assess and formalize can be ignored.
- increased requirements for the manager's qualifications for the development of a feasibility study for an investment project in the field of statistics and econometrics.

3) Decision tree method.

A feature of the method is graphical modeling of possible scenarios for the project implementation under the influence of risk events, as well as for the adoption of appropriate management decisions at each branch. Moreover, each subsequent project branching depends on its previous states. The generalized algorithm for this method is as follows:

- Collection of information for analysis. The most significant risk factors are highlighted; risk events corresponding to them are determined; the risk event probability is determined; a Gantt chart for the project implementation is being developed; project activities that may be affected by risk events are identified; as well as management decisions are developed to respond to risk events.
- Building a decision tree indicating the probabilities of the risk event occurrence and the possible reaction to them.
- Calculation of the investment project efficiency indicators for each of the scenarios.
- Making a decision on investing resources in a project.

We distinguished the following advantages of the decision tree method:

- the method gives a visual representation of possible scenarios for the project implementation;
- building a Gantt chart indicating possible risk events at certain jobs also increases the information content and clarity of the entire project as a whole.
- We distinguished the following main disadvantages of the decision tree method:
- The method complexity is very high, since dozens of risk factors can be identified, each of which can affect one or several project activities. When building the decision trees, a multidimensional matrix of decision trees can be obtained, containing hundreds or thousands of possible scenarios. In this case, the economic feasibility of using the decision tree method is questionable.
- The assessment algorithm of the impact of qualitative factors on the project is not presented.
- The probabilities of the occurrence of risk events are estimated by experts, which mean that subjective errors are possible.
- The implementation of this method requires the project developers to know special graphical editors to represent the decision trees.

During the study, we applied the following methods:

1. Selective analysis of specialized literature with a high citation index on the topics indicated in the article title. In particular, we collected the information on the investment project risks.
2. The formed array of information was systematized for the purpose of further analysis. In particular, we identified the most significant external and internal risk factors, methods of their qualitative and quantitative assessment.

3. The study results were given the author's interpretation, and we made the respective conclusions.

3 Results and Discussion

The analysis made it possible to identify the advantages and disadvantages of the quantitative risk assessment methods. The most common is the expert assessment method due to the problematic nature of calculating the exact impact of risk events on the achievement of project goals and the enterprise's performance as a whole.

4 Summary

Each of the considered methods has its own study subject. For a comprehensive and better accounting of risk factors, their potential impact on the achievement of project goals, we consider it expedient to use them in combination, taking into account the identified advantages and disadvantages. In addition, it is necessary to take into account the applied technologies of enterprise management (Karamyshev et al., 2019).

5 Conclusions

The article discusses the stages of qualitative and quantitative risk assessment for an investment project. The most important quantitative methods under the "information collection method" criterion are statistical and expert assessments, and according to the "assessment algorithm" criterion - decision tree, sensitivity analysis and scenario development.

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