

Risk analyses (in theory)

The economic assessment of the project requires the consideration of risks that are natural for the current economic environment. In the present time of uncertainties, risks became an inherent component in the design of any system. The concept of risk can be linked to uncertainties associated with events. Within the context of projects, risk is commonly associated with an uncertain event or condition that, if it occurs, has a positive or a negative effect on project's objectives (Ayyub and Klir).

There are different methods for assessing the failure probabilities and consequences that can be based on expert estimations, method of analogies (*qualitative methods*), simulation techniques, Monte-Carlo analyses (*quantitative methods*) or semi-quantitative approaches.

Risk assessment is a technical and scientific process, by which the risks of a given situation for a system are modelled and quantified (Shapkin and Shapkin, 2013). For the development of the application for the traffic jams estimation, the proper risk estimations might be the main prerequisite of the project successful realisation. Meanwhile, not all of the methods for risk assessment can be beneficial for the project due to their shortcomings.

Qualitative risk analyses employ judgment and sometimes expert opinion to evaluate probability and consequence values while quantitative analyses rely on probabilistic and statistical methods.

The *qualitative method of expert estimates* is based on the experience of experts in the management of investment projects. The calculations often are based on the systematic Delphi method (Koptelov and Guseva, 2014). The analysis begins with an exhaustive list of risks in all phases of the project. Each expert working separately, is provided with a list of primary risks in the form of questionnaires and asked to evaluate the probability of their occurrence, guided by a special system of estimates.

After determining the probability for a simple risk, the question of the choice of method for bringing the variety of indicators to a single integrated assessment arises. One of the most usually used is the traditional method of rating indicators, e.g. weighing. This method involves determining the weights for each type of risks.

The maximum value of the weighting factor is assigned to a primary risks in the regarded situation, while minimum weight is assigned to the risks in the least grades. Risks with equal significance receive the identical weights. While using this method, it is important to ensure the compliance with the general requirements, such as non-negativity of weighting coefficients and equating of their sum to figure one.

Apart from expert estimations, not less common in the qualitative assessment of investment risk is *the method of analogies*. The essence this method is to analyse all available data on no less risky similar projects, the study of the effects of exposure to adverse factors in order to determine the potential risk of the implementation of a the new project.

The main difficulty with this method is correct selection of the analogy because there are no formal criteria in order to establish the degree of similarity of situations. Even if one can select an analogy, usually it is very difficult to formulate the reasoning for the risks. The problem stems from the complexity of the case studies.

It is also quite difficult to assess the degree of accuracy with which the level of risk of a similar project can be taken as the degree of the risk within considered project. Moreover, there are no methodological developments, detailing the logic and principles of such risk assessment analyses. Qualitative methods offer analyses without detailed information, but the intuitive and subjective process that may results in deference in

outcomes by those who use them. That is why qualitative methods, which do not allow to determine the numerical magnitude of the risk of the investment project, can be the basis for further research with the use of quantitative methods. The latter methods are widely based on mathematical apparatus of the theory of probability, mathematical statistics, and theory of operations research. The main objective of the quantitative approach is to figure out the impact of risk factors on the behavior of the criteria of the efficiency of the investment project. Therefore, the quantitative analyses are more desirable for economic assessment of the developed project (soft application for traffic jam indication) due to the ability of receiving accurate results.

The most widely used in the risk assessment of investment projects (especially productive investment) received *quantitative methods*, such as:

- A statistical method;
- Sensitivity analysis (method of variation of parameters);
- A method of checking the stability of (calculation of critical points);
- Scenario method (the method of formalized description uncertainties);
- Simulation (statistical method);
- Test Monte Carlo method);
- Method of adjusting the discount rate.

The use of quantitative methods enables to obtain numerical estimate of the riskiness of the project, to determine the degree of influence of risk factors for its effectiveness. The disadvantages of these methods are the necessity of having a large volume source information over a long period of time (statistical method); difficulty in determining the laws of distribution of the test parameters (factors) and the resulting criteria (statistical method, Monte Carlo method), and etc.

The Monte Carlo analysis can be regarded a compound of the sensitivity analysis and the method of scenario analysis based on the probability theory. Instead of creating separate scenarios (best, worst), in the simulation method computer generates hundreds of possible combinations of parameters (factors) of the project with regard to their probability distributions. Each combination gives its value of the performance criteria, and in the aggregate analyst gets probability distribution of possible outcomes of the project.

Based on the analysis of the accuracy and reliability of the methods provided in the previous section, the research proposes the leading techniques that include simulation. The Monte Carlo method is a powerful tool for the analysis of risks, allowing to take into account the maximum possible number of environmental factors that increases the accuracy of the analyses, and therefore, enhances the ability of making appropriate decisions (Ayyub, and Klir, 2006).

References

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