Adaptive Control of an Investment Project Risks Based on the Prediction Approach

Abstract
The paper analyzes functioning of an enterprise risk control system in conditions of high uncertainty and influence of the external environment. A mechanism for forming knowledge on risks and cause-and-effect relations for a current moment of realization of an investment project is demonstrated. A prediction approach to project risk evaluation including a process of the current (continued) identification is introduced. A database structure presenting a data array in a table (matrix) format is developed. The structure is thoroughly described; on its basis the process of systematizing and actualizing the data, renewed formulation of project risks containing information on preceding and current statuses and forecasts are described.

Key Words
external environment, investment project, uncertainty, prediction approach, risk control system, current (continued) identification

JEL Classification: C13, D24, L10, L23, L25, M11, O31

Introduction

In modern conditions a company functions in a complex system of interactions with other business representatives of the world and domestic markets. A company as a control object performs certain actions to execute its competitive strategy efficiently and successfully. During the functioning process the control object is exposed to influence of the external environment which may facilitate or hinder achievement of set goals. Resolution of different economic tasks developed within the competitive strategy is carried out in conditions of increasing political and socio-economic risks, in a favorable or unfavorable market situation, and also with formed prices and harsh competition. These tasks are related to functioning of control objects and systems, performance evaluation and forecasting their activities. In order to realize the goals set within the competitive strategy it is necessary to take into consideration uncertainty of the source information. Solving the task of risk identification under effect of controllable and uncontrollable disturbances from the external environment may serve as an example [1, 2, 3, 4].

Methods of system analysis basing on ideal models of control objects do not enable to solve this task fully due to the fact that such models simplify initial systems. The typical simplification is to substitute a part of the source information with determined, i.e.
stochastic processes are substituted with mean. Such an approach leads to false practical conclusions.

1. Forming knowledge about risks of an investment project in conditions of high uncertainty

The main aim of a risk-controlling system is to decrease uncertainty within external and internal environments of an enterprise in order to accumulate information about conditions in which an investment project is realized. The initial step in the process of controlling and analyzing risks is to identify them. On the basis of the identification all the risks should be not only revealed, but also documented. The process of risk identification requires gathering reliable information which will later facilitate a detailed analysis of the determined risks – quantitative and qualitative evaluations. Based on the results of the evaluations, it is possible to carry out ranking to demonstrate sources, probabilities and weight of consequences of the risk emergence. Risk identification and the following ranking enable to develop and implement measures to counteract risks that may occur during realization of other heterogeneous projects securing execution of the competitive strategy of an enterprise.

![Fig. 1 A mechanism for forming knowledge on risks and the cause-and-effect relation for the current moment of realization of an investment project](image)

However, an enterprise that carries out its activities in conditions of uncertainty and high turbulence of the external environment may lack reliable information on conditions of realizing an investment project in a specific point of time and also on related expenses and financial and economic results. For this reason it is necessary to develop a mechanism that enables to carry out continued risk identification. By means of this approach formulations and evaluations of the risks would be specified for the current (measured) moment. To realize the suggested process of the current identification it is necessary to use the information obtained after revealing risks during the previous stages of a project, available knowledge on risks for the current moment and forecasts of
further development of risks. A mechanism for forming knowledge on risks and the cause-and-effect relation for the current moment of realization of an investment project is demonstrated by Figure 1.

In order to formulate reliable flows of information on changes in the external environment and deviations in actual parameters from design values for a specific moment of time we will use the proposed mechanism for forming knowledge on risks (Fig. 1). These deviations should be identified and compensated in time to minimize investment losses, because during the course of the project realization (especially – an innovative project) they may pose a serious threat for an enterprise. Emergence of such deviations is linked in the first place to uncontrollable effect on the project formed as a result of influence of negative factors of uncertainty within the external and internal environments. Positive deviations of project performance indicators from design values should also be identified and realized with maximum benefit for an enterprise [5, 6, 7].

2. The prediction approach to controlling an investment project with continued risk identification.

In order to effectively control deviations emerging during the project realization a suitable approach that can systematize, rank and compensate effects of the external environment on different stages of the project realization is required. This means that effective interconnections and opportunities to continuously evaluate risks in the monitoring mode should be provided within the project control structure in conditions of high uncertainty.

![Fig. 2 The prediction approach to controlling risks of an investment project](image-url)

Source: author's plotting

629
Use of such an approach enables to adapt the project control to effects of the external environment. In order to realize the above-mentioned tasks the structure of prediction approach to controlling an investment project is proposed (see Fig. 2).

This approach requires use of current results of an investment project and information about the current status of risks. The model of an investment project (the ideal model) is included into the structure of the prediction approach to obtain calculation data on forecasted values of the project indicators with current resource injections. This model characterizes realization of the project with the set target indicators with current resource injections. Thereby forecasts can be carried out in such conditions where influences of transfer lags in data channels, uncertainty and other uncontrollable (non-measurable) disturbances on realization of a project are eliminated. Taking into account all dangers, this enables to evaluate separately the extent of influence of every negative factor on investment activities of an enterprise in the current moment [8, 9].

Use of the prediction approach increases the amount of more reliable data during the project realization, while actualization of results of observing the project risks provides an opportunity to form in time a rational preventing action to resist risks. Thereby, during determination of the value of expected earnings and weight of a risk it is necessary to identify emerging risks using:

- input indicators of the project (material, financial, intellectual and other types of resources, as well as information on influences of the internal environment);
- output indicators of the project (cash flows, net discounted earnings, internal rate of return and other performance indicators);
- the value of the lag in data channels of input/output indicators of the project;
- controllable and uncontrollable influences of the external environment.

3. The algorithm for the method of current (continued) risk identification

On the basis of the prediction approach the emergence of the risk of nonreceipt of expected earnings may be forecasted in conditions of high uncertainty and turbulence of the external environment by means of such element as “Current (continued) risk identification” (Fig. 2) with use of a respective method [4]. Carrying out continued identification requires use of information obtained during revealing risks on the previous stages of a project and its comparison with available knowledge on current risks obtained during the observation process (Fig. 1).

Comparison of these results and forecasts for future risks development specifies the cause-and-effect relation in the current moment of time between a risk factor, an event that may occur as a results of the risk and a consequence of the event. Increasing precision of cause-and-effect relations leads to actualization of the results of observations of the project risks. The flowchart characterizing the method of current
identification within the structure of the risk control of an investment project is shown in Figure 3.

The prediction approach to risk evaluation in the process of controlling an investment project enables to create a new formulation for a risk which contains such elements as retrospection (data on the preceding status), current status and forecast. Thereby, experts or project groups having more current and antecedent information. This information is prepared and systematized on the basis of the proposed approach and the method of current identification for the management of an enterprise on a short deadline the database that presents the data array in a table (matrix):

1. Data on correlations between a risk factor and causes for its emergence (specification of the cause of the risk emergence with description of an existing project factor that leads to the risk). Matrix: [Risk factor (i) / Cause (j)].
2. Data on correlations between occurrence of a risk factor and emergence of undesired events (determination of origins of undesired events that may lead to the risk occurrence). Matrix: [Risk factor (i) / Event (j)].
3. Data on correlations between a risk factor and emergence of negative consequences (instantiation of negative consequences cause by the risk emergence). Matrix: [Risk factor (i) / Consequence (j)].

Data on correlations of a risk factor with the probability of the event occurrence, the weight of consequences and countermeasures (granting full information on dynamics of changes within the risks structure, probability of emergence of risk events and weight of their consequences for taking countermeasures against risks). Matrix: [Risk factor (i) / Probability of risk events occurrence (j); Weight of consequences caused by the occurred event (i); Risks countermeasures (j)].

where: i – number of a risk factor (i = 1, ..., l); l – number of risk factors on a specified stage (interval) of a project; j – number of an analyzed (evaluated, design) factor correlated with a risk factor (j = 1, ..., f); f – number of analyzed (evaluated, design) factors on a specified stage (interval) of a project.

Tables (matrixes) of data are formed via comparison of knowledge on risk development at different project intervals and application of data on preceding status, current status and forecasts for each stage t of a project and for each identified risk i and correlated factors j. Depending on unique features of an investment project, experts have an opportunity to develop on each stage of a project (t = 1, ..., T; where T – duration of a project in intervals or stages) recommendations both on the basis of the tables (matrixes) and by means of the risk observation vector \( X_t(i = 1, ..., l) \) that we propose. The vector looks as follows: e.g., for \( t = 1 \), \( X_t = [\text{Cause (1), ... , Cause (j); Event (1), ... , Event (l); Consequence (1), ... , Consequence (j); Probability of risk event occurrence (i); Weight of consequence (i); Risks countermeasures (i)]. \)

During realization of the following stage (time interval) of a project the sequence of the actions of the continued identification process within the structure of risk control for the current stage (t = 2) is repeated (iteration is carried out) be means of the suggested approach. On the basis of the newly-acquired identification data the observation vector \( X_t \) is actualized, a new formulation for a project risk containing information about
preceding and current statuses as well as forecasts is defined. The procedure of the method is iterated until the end of the project realization. The structural scheme of the method of the current (continued) risk identification is shown in Figure 3.

**Fig. 3 The structure of the algorithm for the current (continued) risk identification**

![Diagram](image)

*Source: author's plotting*

**Conclusion**

The proposed predictor approach to controlling risks enables executives to design an adaptive enterprise management system for the situation of high uncertainty. As this risk control system creates effective information supply, decrease in uncertainty enhances characteristics of an investment strategy of an enterprise. It is achieved through an opportunity to obtain information on risk development on the early stage of their occurrence.

It is crucial that risks are ranked according to results of qualitative analysis. Therefore, excluding negligible risks and risks that are uncontrollable in the current moment of time, experts reduce by means of the proposed approach and qualitative analysis the number of risks to be analyzed quantitatively with complex mathematical calculations. Due to a feedback system integrated into the risk control system the prediction approach enables experts to receive early signals on emergence of cause-and-effect relations not only between stages of a single project, but also between a number of investment projects sharing interrelated indicators.
References


