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IMPROVING THE METHODOLOGY FOR ASSESSING AND MINIMIZING THE RISK OF AN INVESTMENT PROJECT OF AN INDUSTRIAL ENTERPRISE

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Abstract: Risk assessment of an investment project is an urgent task for industrial enterprises. The main mechanism for implementing the development strategy of an industrial enterprise is the development and implementation of a feasibility study for investment projects. In these conditions, it is important to assess possible risks and minimize them at the development stage. To this end, the authors, based on the analysis of existing classifications, proposed their own set of external risks and risks related to the investment project. External in relation to the project are the risks of macroeconomics, the country and the enterprise itself. Internal risks are traditional project risks at all stages of its life cycle. One of the most effective tools for minimizing risks and associated losses is simulation. To implement it, it is necessary to correctly identify and assess the impact of risk events on the project implementation phases. The authors consider the development phase of the project and suggest minimizing risks using an original methodology. The essence of this technique is as follows: assessment of the impact of risk on the main project indicators; comparison of the cost of risk prevention measures with the possible losses of the entire project; management decision making.

Keywords: risk, assessment, investment project, business, investment, industrial enterprise, simulation.

INTRODUCTION

A preliminary analysis of risk minimization methods carried out by the authors revealed their common drawback: poor use of mathematical methods to stop the consequences of potential risk events. In this work, the authors use simulation to minimize risks even at the investment project development stage.

TEXT OF ARTICLE

The methodology is improved based on the classification of investment project risks. To assess risks, we propose to use the classification criterion "in relation to the project", according to which all risks can be divided into: external (or risks of the project's environment) and risks of the project itself.

External risks include:

1) Macroeconomic risks: the unstable state of the global financial and credit system; the closeness of the stagnation phase of the world economy.

2) Country, regional risks: the crisis state of the economy of the country, region; unfavorable climate; instability of the political system; high inflation rate; underdevelopment of the banking system; negative trade balance; insufficient level of resource provision (natural resources, human resources); high labor costs. Separately, it is necessary to highlight industry risks in the regional ones: high rate of return in related industries; high level of competition in the industry; high level of monopolization in the industry; lack of state support for industry enterprises; small capacity of sales markets.

3) Risks of the enterprise include: financial crisis of the enterprise; unreliability of suppliers, consumers; negative dynamics of the company's business activity and market quotations of the company's shares; insufficient provision of personnel and their low qualifications. In addition, it is necessary to consider the applied enterprise management technologies (9; 13; 2; 11; 3; 1; 12; 14; 10; 8; 7; 6; 8).

Project risks include:

1) traditional risks: credit; commercial; insurance; legal; and social.

2) risks at the project life cycle phases: at the pre-investment phase: losses in the form of pre-investment costs (in case of refusal to implement the project in the pre-investment phase); at the investment phase: the risk of increased investment costs for works; the risk of increasing the terms of work; at the operational phase: risk of downtime; risk of contract failure; risk of increased operating costs; risk of product quality violation; risks associated with project personnel.

3) others - specific risks of a specific project, or other risks identified by the project developer. The risks external to the project will be used mainly to describe the project environment. The exception will be inflation, which is always considered at the quantity risk assessment.

Stages of the improved author's methodology for assessing and minimizing risk:

1. Quantitative analysis and risk assessment.
2. Probability calculation.
3. Assessment of the risk impact on an investment project.

All risk events that may occur affect the project as follows:

1) Increase the duration of the project investment stage. In this case, the project payback schedule will shift to the right, thereby reducing the project operation phase and its economic indicators, accordingly.

2) Increase implementation costs. In this case, the NPV will decrease by the amount of an increase in investment costs. It is necessary to consider the possibility of such a situation when the risk implementation will lead to an increase in the duration of the investment stage and costs at the same time.

Potential damage is determined according to the formula:

$Risk^d = \Delta NPV = NPV_{pl} - NPV_a$

$Risk^d$ - potential damage:

NPV_{pl} - initially planned net present value;

NPV_a - estimated net present value in case of a risk event.

Comparison of the estimated net present value in case of a risk event and the threshold minimum value of the net present value at which the investor agrees to invest in the project (NPV_b).

Let us analyze two possible options:

1) $NPV_a > NPV_b$.

In this case, the investor is interested in the following points: possibility of approaching NPV_a to NPV_{pl} by additional investments; feasibilty of the specified additional costs.

2) $NPV_a < NPV_b$.

In this case, the following points are interesting: feasibility of the project; attitude to potential risk, which may be as follows: accept the risk; refuse to implement the project (resources spent on pre-investment research will be lost); minimize risks.

Analysis of operations of the project investment stage.

The cost of work acceleration at the project implementation stages will increase investment costs, but it is the phase where the indicated increase is appropriate, since a decrease in the duration of the operational phase will lead to incomparably large losses. The investment stage duration can be shortened by increasing the number of contractors; shift ratio; organizing overtime work, revising the operation performance technology.

Application of simulation.

The essence of simulation is a continuous enumeration of all combinations of possible interesting parameters of an investment project. Having received information about the high probability of the occurrence of risk events and an increase in the investment phase (and, accordingly, a decrease in the operational phase), it is possible to make decisions on intensifying the works of the critical path of the investment phase in order to stay within the planned time frame:

$T_{cr} = t_{iph}^p - t_{pi}$

where T_{cr} - shortened critical path duration, minimizing possible risks.

t_{iph}^p - initially planned duration of the critical path at the investment stage;

t_{pi} - time of the potential increase in the critical path duration under the influence of risk events.

The duration of each work performed at the critical path can be reduced. To select the optimal combination of work duration and costs, which would reduce the critical path with minimal costs, it is necessary to enumerate a large number thereof. For convenience, we consider it appropriate to present the potential duration of the critical path works in the form of a table:

Table 1. Potential duration of critical path works

No. of operation	Possible duration of operation
1	$(a_{min1};\ T_{cr} - a_2 - a_3 - \cdots - a_n)$
2	$(a_{min2};\ T_{cr} - a_1 - a_3 - \cdots - a_n)$
3	$(a_{min3};\ T_{cr} - a_1 - a_2 - \cdots - a_n)$
⋮	⋮
n	$(a_{min\,n};\ T_{cr} - a_1 - a_2 - \cdots - a_{n-1})$

where $a_{\min i}$ – minimum duration of the -th operation;

a_i - potential duration of the -th operation;

n - number of critical path operations.

The following conditions shall be met:

$$\sum_{i=1}^{n} t_i \leq t_{pi}$$

$C^R_{min} \rightarrow min$, where C^R_{min} – a set of costs for the critical path, considering the acceleration of operations.

Simulation allows finding a combination of the duration of critical path operations and their costs, which would satisfy the specified conditions. The following advantages of the simulation method can be distinguished: allows assessing the planned results of an investment project, considering possible risks in the categories of statistics and probability theory; the formation of optimal scenarios for the project implementation gives a complete picture of possible changes in costs in the investment phase of the project; the use of forecasting methods allows highlighting the most significant factors and substantiate this choice using the existing statistical apparatus.

The disadvantages of the simulation method are: increased requirements for the knowledge and skills of a business plan manager in the field of statistics and econometrics; increased requirements for the programming skills of the manager for the development of a feasibility study for an investment project, since the results shall be modeled in the special software environments; high complexity of the method, which significantly limits its practical application in projects.

The changes in investment costs to reduce the critical path duration are assessed according to the formula:

$$\Delta C^R_{min} = C^R_{min} - C_p$$

where C_p – initial project costs.

Analysis of the ratio of increased costs to potential damage and management decision making.

a) At $NPV_a > NPV_b$, it is necessary to compare an increase in the risk reduction costs with the potential losses in its implementation:

The risk should be accepted, if $C^R_{min} > \Delta NPV \times P$.

where P – likelihood of a risk event.

It is more expedient to accept the risk at $C^R_{min} = \Delta NPV \times P$, since its implementation is comparable to the possible costs for its reduction. One should also consider the possibility of risk non-implementation.

It is necessary to reduce the critical path duration, if $C^R_{min} < \Delta NPV \times P$.

b) At $NPV_a < NPV_b$, it is necessary to estimate the change in the actual value NPV_a^{min}.

NPV_a^{min} is the NPV calculated value in case of implementation of measures to reduce the project critical path duration. This indicator is calculated by the formula:

$$NPV_a^{min} = NPV_a - \Delta C^R_{min}$$

It is advisable to increase investments in minimizing the critical path duration, if $NPV_a^{min} - \Delta C^R_{min} > NPV_b$. Otherwise, one should refuse to implement the investment project.

METHODS

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 risk factors of the investment project.
2. The formed array of information was systematized for the purpose of further analysis. In particular, it was planned to use it in an improved technique.
3. We improved the methodology for assessing and minimizing the risk of an investment project.
4. The study results were given the author's interpretation, and we made the respective conclusions.

RESULTS AND DISCUSSION

The proposed set of external risks and project risks facilitates the work of developers using the proposed methodology. The improved technique uses simulation, which is the most time-consuming operation in risk assessment.

SUMMARY

The analysis of the project payback schedule became the basis for the methodology improvement. All risk events either increase investment costs or investment phase of the project, which affects the performance indicators of the project. To minimize the risks of increasing investment costs, which are associated mainly with market conditions, it is enough to reserve additional resources and conduct marketing research. The investment stage duration can be shortened by increasing the number of contractors; shift ratio; organizing overtime work, revising the operation performance technology.

Based on information about the possibility of increasing the project investment phase by several days or weeks, it is possible, by intensifying labor efforts, to reduce the project duration by the same number of days. If risk events occur, they will not have a significant impact on the operational phase duration, and therefore on the project's performance indicators. Here it is important to correctly assess the costs of intensifying labor efforts so that they do not exceed the probabilistic risk damage from an increase in the project investment phase.

CONCLUSIONS

The investor and the project manager have alternative options: either to accept the project risk and agree with its possible consequences, or to spend additional resources to intensify labor efforts and minimize the possible risk consequences.

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