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Управление рисками на этапах жизненного цикла инвестиционно-строительного проекта

Аннотация. Современные условия развития строительной отрасли характеризуются высокой скоростью изменений и непредсказуемостью, что выражается в появлении ситуаций неопределенности для реализации проектной деятельности отрасли, в частности, реализации инвестиционно-строительных проектов. В этой связи вопросы управления рисками инвестиционно-строительного проекта являются актуальными и востребованными в современных реалиях. Вместе с тем, учет рисков инвестиционно-строительных проектов имеет свои особенности, включая их значительное количество, которое определяет специфику процессов оценки и управления ими, и требует необходимости рассматривать риски на этапах жизненного цикла проекта. В этой связи в работе представлена попытка сформировать методические положения по управлению рисками инвестиционно-строительного проекта на этапах его жизненного цикла, для чего проведена идентификация, группировка и оценка рисков проекта на этапах его жизненного цикла и предложен комплекс мероприятий по уменьшению негативного воздействия основных из них.

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Risk management at the life cycle stages of an investment and construction project

Annotation. Modern conditions for the development of the construction industry are characterized by a high rate of change and unpredictability. This phenomenon is reflected in the uncertainty of situations for the implementation of projects in the industry, in particular, the implementation of investment and construction projects. In this regard, the issues of risk management of an investment and construction project are relevant and in demand in modern realities. At the same time, the risks of investment and construction projects should be examined taking into account their significant number, which determines the specifics of the assessment and management processes, and requires consideration at the stages of the project lifecycle. In this regard, the paper represents an attempt to form methodological provisions on risk management of an investment and construction project at the stages of its life cycle. The identification, grouping and assessment of project risks at all stages of its life cycle was carried out and a set of measures was proposed to reduce the negative impact of the main ones.

Keywords: project, investment and construction project, project lifecycle, risks, risk management

Introduction

In the current conditions of the Russian economy development, the construction industry occupies a key position, influencing the functioning of various sectors of the national economy of Russia. Construction constitutes an important part of the Gross Domestic Product (hereinafter referred to as GPD), whose share in Russia's GDP has been almost 5% in recent years, including as of January 2025 (Figure 1).

The construction industry also provides up to 16% of jobs, which makes it one of the largest employers in the country and determines the significant multiplicative and social effect that the development of the industry brings, ensuring the development of the infrastructure and improving the comfort of living and quality of life of the population. Construction of housing and infrastructure facilities is a key element in achieving national goals, such as increasing housing availability and development of urban environment [1]. The volume of tax revenues from the construction industry in 2024 is also significant and amounts to about 7 trillion rubles, which corresponds to almost 13% of all taxes in the country.

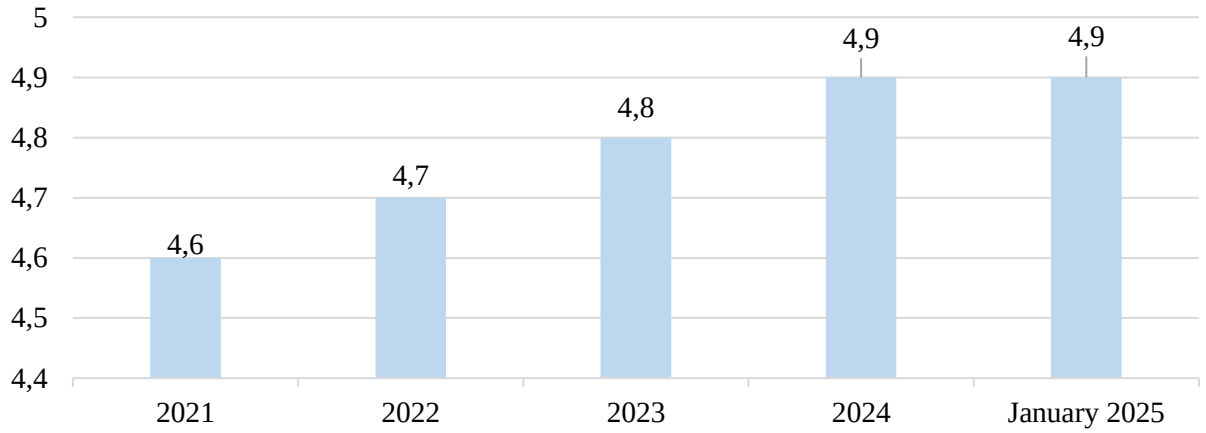

Fig. 1. Dynamics of the construction industry share in Russia's GDP for the years 2021 to 2025 (compiled on the basis of data from the Ministry of Economic Development of Russia).

The construction industry demonstrates steady growth (Figure 2) due to government support measures, as well as the implementation of national projects and programs [2] in construction and related industries. The most important of the national projects are 'Housing and Urban Environment' [3] and 'Infrastructure for Life' [4]. It is expected that the positive dynamics of the volume of work of the construction industry, the increase in the area of erected facilities, which are reflected in Figures 2,3, will further increase the industry's contribution to the county's GPD.

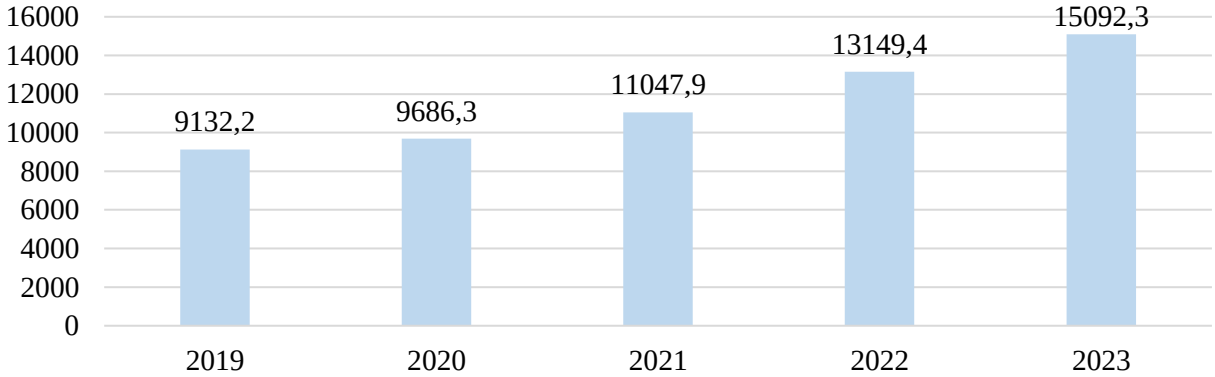

Fig.2. Dynamics of the volume of work performed by the type of activity 'Construction' for the years 2019 to 2023, billion rubles (compiled on the basis of Rosstat data [15]).

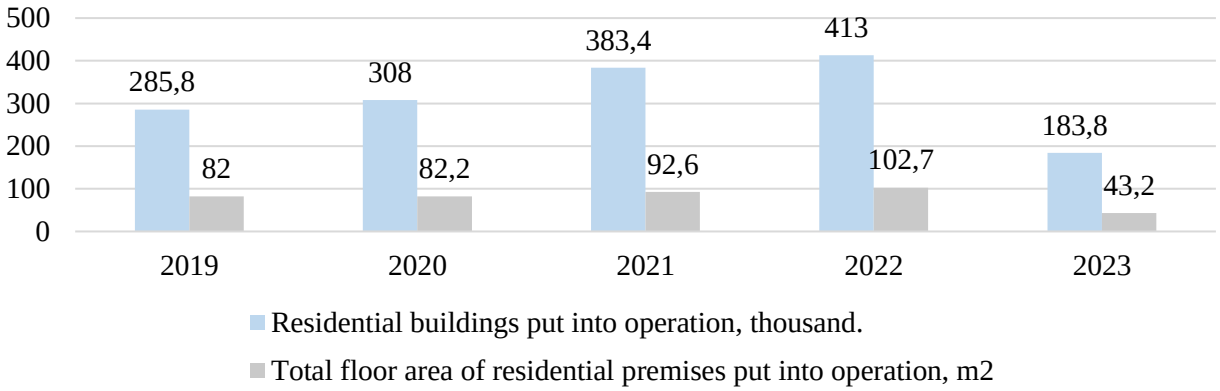

Fig.3. Dynamics of commissioned residential buildings and living space for the years 2019 to 2023 (compiled on the basis of Rosstat data [15]).

During the construction of a construction project, a set of activities aimed at its implementation is accomplished, which is generally represented in the investment and construction project (hereinafter referred to as ICP). It should be said that the construction industry is one of the few sectors in which project activities are developed. At the same time, even though the construction industry is developing dynamically, there is a number of conditions that creates barriers to the development of the industry and the implementation of the ICP (Figure 4).

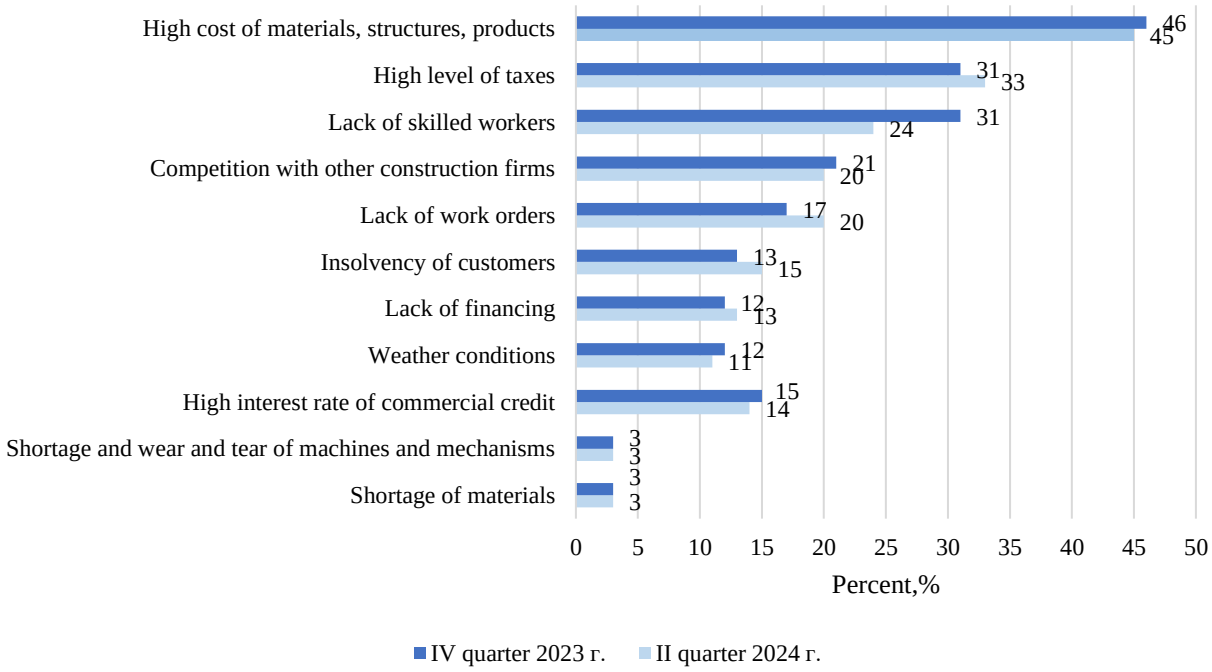

Fig.4. Barriers to the development of the construction industry (based on Rosstat data [15]).

Most of the barriers listed in Figure 4 form the conditions of uncertainty and risks for the ICP. The volatility of the economy caused by the current sanctions policy affects the supply of raw materials, equipment and technical solutions. In view of the high turbulence and low predictability in the construction market, modern organisations are increasingly turning to ICP risk management expertise that can reduce the uncertainty of their implementation, thereby increasing their efficiency. It defines the purpose of this study, which consists in the formation of methodological provisions for risk management of an investment and construction project at the stages of its life cycle. To achieve the target goal, the study solves several tasks:

- carrying out identification and grouping of ICP risks at the stages of its life cycle;
- assessing the identified risks of the ICP at the stages of its life cycle;
- proposing a set of measures to reduce the negative impact of ICP risks at the stages of its life cycle.

The object of the research is ICP; the subject of the research is ICP risk management processes.

Materials and research methods

In order to achieve the research objective, it is necessary to consider the methodological basis of risk management, including from the perspetive of considering the specifics of ICP risk management, which requires the use of the analytical method, the method of the comparison and classification. The listed methods are used to solve risk management problems, which are summarized in Figure 5.

Fig.5. ICP risks management tasks (compiled by the authors)

To solve the tasks of identifying ICP risks, one should refer to established approaches in the economic and management literature for their identification: checklists, expert judgement, including the use of brainstorming and the Delphi method. The stage of risks assessment involves determining their significance and importance in terms of the consequences they may bring in case of their occurrence. The established practice of risk assessment shows that two main groups of methods have emerged: qualitive and quantitative assessment methods. Qualitative assessment also includes the use of expert methods, rating assessment and construction of Ishikawa diagram. Quantitative methods of risk assessment include probabilistic analysis, method of analogues, sensitivity analysis and scenarios of project development, Monte Carlo method [5,7,12]. The result of risk assessment is the identification and grouping of risks from the position of their impact and probability of occurrence. For those risks that fall into the category of the most significant, it is necessary to form directions and measures aimed at reducing their negative impact.

Results

Many researchers agree that ICP risk consideration has its own peculiarities [10,13,16]. This is due to the fact that ICP is a complex system that includes resource, technological, organisational, managerial, informational and temporal elements. The functioning of each can be carried out with risk. In addition, the investment process is realized in a dynamically changing external environment, which also creates a situation of uncertainty for ICP system in general. Due to the number of ICP risks, industry experts [10,14] believe that risk assessment and risk management processes should be carried out not just for ICP as a whole, but at each stage of its life cycle (hereinafter LC), which includes pre-investment, investment and operation (Table 1).

Table 1: Identification and grouping of risks at the stages of the ICP life cycle (compiled by the authors) pre-investment, investment and operational (Table 1).

Phases of the ICP Life Cycle	**Types of risks**
Pre-investment	- errors in assessing of the market potential; - failure of partners to fulfil their financial obligations; - incorrect timing of the pre-investment stage; - unplanned growth of resource price.
Investment	- errors during construction and installation works; - larceny on the construction site; - insufficient quality of resources; - risk of below proof materials and structures; - equipment failure;

	- failure of the participants to fulfil the terms and conditions of the contract; - errors in the development of design specifications and estimates; - unplanned growth of resource price (materials, equipment); - termination of investment; - rise in price of construction projects; - incorrect timing of the stage
Operational	- failure of customers to fulfil their obligations; - errors in sales plans and estimation of supply and demand; - increased payback period of the project; - unplanned operating costs; - unplanned increase in resource prices

The risks presented in Table 1 can be considered not only from the point of view of their occurrence in the stages of the life cycle of ICP, but can also be grouped according to a common characteristic related to the cause of their occurrence in particular:

- technological risks include construction and installation errors, the risk of defective construction materials, the risk of accidents and breakdowns of production equipment, unfairness of suppliers and work personnel, as well as non-compliance with the technological map during construction and installation works. The consequences of the occurrence of this group of risks will be the need of alteration of the work done, increase the cost of construction and delay the commissioning of the facility.

- organisational and management risks include risk of larceny at the construction site, risk of quality work reduction, delay in commissioning of the facility, insufficient qualification level of the personnel, insufficient control over the construction site by the organisational and management personnel. These risks may lead to a decrease in the quality of construction products, an increase in the cost of construction and the time required to erect the facility.

- marketing risks include errors in market research, failure to take into account macroeconomic factors in market research due to limited resources to collect and analyze constantly changing market conditions which leads to an incorrect assessment of supply and demand and a decrease in ICP efficiency.

- investment risks are primarily related to the risk of exceeding the cost of ICP and financial losses, as well as insufficient investment opportunities, which may lead to delays in construction or even freezing of ICP.

- economic risks are related to the risk of restricted market access, sanctions restrictions, higher electricity tariffs, higher prices for raw materials and equipment, unstable economic situation. All these aspects may lead to a significant increase of construction costs and a decrease in ICP efficiency index.

- project risks include errors in the development of design specifications and estimates, inattention and inconsistency of the designer and project manager in the preparation and verification of design and estimate documentation, which may lead to a significant increase in construction costs and the occurrence of construction errors.

Based on the data in Table 1, it can be concluded that the pre-investment stage of the life cycle of ICP is primarily associated with the risks of an incompletely thought-out investment concept and ICP planning errors. In addition, as a rule, at this stage of the ICP life cycle, independent subcontracting organisations are hired to carry out the design part of the ICP. Their organisation and coordination is the responsibility of the project manager. In case of poorly organised co-operation between the different independent participants, there is a responsibility of making mistakes and thus risky situations, the cost of correcting them during ICP implementation will be considerable.

The investment stage of the ICP life cycle is characterised by the possibility of risks associated with construction and installation works and related processes, including disruption of delivery dates, incorrect determination of the required number of employees at the construction

site, errors in the design documentation, which lead to structural changes, cost increases and longer construction periods. These issues ultimately lead to a decrease in the efficiency of ICP realisation.

At the operational stage of the ICP life cycle, which is the final stage, ICP risks based, as a rule, on the risks of the previous stages of the life cycle arise. If the previous stages are properly organised, the possibility of occurrence of risks at the operational stage is significantly lowered. The main problem that the ICP may face at this stage is a violation of payment and contract terms by the ICP consumer.

Once ICP risks have been identified, the risks assessment phase follows, which involves determining their relevance and importance in terms of the consequences they may bring as well as the likelihood of risk occurrence. Risk assessment is therefore a mandatory part of all stages of the ICP life cycle. Improper consideration of the impact of the potential risks occurrence probability can cause great damage to the project. Based on research of works devoted to the issues of ICP risk management (M.Z. Bakhovskaya and N.A. Alekseeva. [6], M.A. Gureeva and E.N. Dukhanin, Y.S. Bulenov and K.R. Smirnova [11], etc.). [11] and others), the main ICP risks, including those highlighted in Table 1, were assessed from a 'probability-influence' perspective. The ICP risk assessment is presented in Table 2.

Table 2. ICP risk assessment (compiled by the authors)

Probability	**High**	1. Errors in construction and installation work	1.Risk of restricted access to markets and sanctions restrictions 2. Exceeding the project cost and risk of financial loses	1. Increase in prices for materials and equipment
	Middle	1. Risk of larceny at the construction site	1. Risk of lower quality of work 2. Risk of insufficient investment opportunities	1. Errors in the development of design specifications and estimates. 2. Insufficient level of qualified personnel.
	Low	1.Risk of defective construction materials. 2. Risk of poor market research and project planning	1. Risk of accidents and breakdown of production equipment	1. Irrational use of resources
		Weak	**Middle**	**High**
		Impact		

Based on the ICP risk assessment, we can identify the key risks that are most likely to arise during construction and have the greatest impact on ICP results: rising prices for materials and equipment, errors in the development of design and estimate documentation, insufficient level of qualified personnel, risk of market access and sanctions restrictions, project cost overruns and risk of financial losses. Further on the listed essential ICP risks are identified by the areas that contribute to their mitigation (Table 3).

Table 3. Measures to minimise the negative impact of significant ICP risks (compiled by the authors)

Risk	**Measures to mitigate the negative impact of the risk**
Increase in prices for materials and equipment	- economic management measures: development of forecasting, planning and control system for the market of construction materials and equipment;

	- conclusion of long-term contracts with suppliers; - development of import substitution; - development of a plan for co-operation with several suppliers
Errors in the development of design and estimate documentation	- thorough checking of the scope of work; - regular updating of material costs and relevant quotations; - continuous monitoring of changes if the regulatory; - independent expertise of design and estimate documentation; - creation of a reserve for unforeseen expenses
Insufficient level of qualified personnel	- provide training and professional development for staff; - promote education of the staff; - attracting specialists from other spheres of activity; - formation of competence centers-verification of counterparties
Risk of restricted access to markets and sanctions restrictions	- counterparty audit; - compliance
Project cost overruns and risk of financial losses	- conclusion of an insurance contract; - thorough check of design and estimate documentation; - inclusion of a warranty section in the contract

The logical conclusion of the ICP risk management process should be the stage of controlling the already identified risks and the implementation of continuous monitoring to identify newly emerging risks, after which a system of measures for their management is also formed [8].

Conclusion

Thus, the study has developed methodological provisions for ICP risk management at the stages of its life cycle, which define the processes of identification, grouping and assessment of ICP risks, as well as of measures to reduce the negative impact of ICP risks. As a result of applying the proposed methodological provisions, ICP risks are assessed and prioritised. For the most significant risks, directions to deal with them are presented, which will improve the efficiency of ICP realization.

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