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Modeling Financial Activity of Companies with Due Regard to Risks of Investment Projects

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ABSTRACT

Objective. To investigate the role of investment risk management. The main objective was to identify key patterns that determine the specific features of risk assessment in business as a fundamental element contributing to an organization's economic security. **Methodology.** Authors conduct a comparative analysis of risk assessment and management methods in

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enterprise investment activities. **Results.** The article examined modeling tools for accounting for risk and uncertainty when evaluating the effectiveness of investment projects. **Conclusion.** Conclude that to prevent negative financial results of investment projects, it is necessary to apply different methods of forecasting, risk analysis, and modeling of the final indicators.

KEY WORDS: Model, Investment, Risk, Risk management, Investment project.

Introduction

In the modern global economy, the efficiency of a company's investment activities is largely determined by the quality of its risk management. Financial instability, market volatility, and high levels of uncertainty necessitate the development of effective methods for forecasting and mitigating risks (Rostova, 2013). A key tool ensuring sustainable business growth is financial modeling that incorporates risk factors.

Accounting for risk and uncertainty in the evaluation of investment project effectiveness allows businesses to reduce their exposure without engaging in high-risk activities.

While it is impossible to eliminate all risks, a well-designed risk prevention strategy can help mitigate certain losses. This is a crucial component of any risk management plan and a means of protecting an organization's assets from potential financial setbacks.

Despite the existence of various investment risk management methodologies, many companies struggle with their implementation. One of the main challenges is the insufficient use of models considering the dynamics of internal and external factors. A lack of a comprehensive approach to risk analysis can result in significant financial losses, reduced investment attractiveness, and weakened economic security. Therefore, it is essential to develop and adapt effective modeling

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tools capable of addressing the multi-layered and interconnected aspects of investment activities.

The study's objective is to examine and substantiate financial modeling methods that incorporate investment project risks.

Methodology

We employed the method of scientific literature analysis in our research. The literature search was conducted using Scopus, Web of Science, and Google Scholar. The search was performed using the following keywords: investments, risk management, investment project. As a result of the literature analysis, 30 relevant sources were identified that met the selection criteria. The sources were selected based on the following criteria: they had to be relevant to the research topic "Financial Activity Modeling of Companies Considering Investment Project Risks". They had to be in English or Russian; full-text access had to be available. They had to contain approaches to the research problem and/or an analysis of these approaches. Publications that did not meet these criteria were excluded from the selection.

Results

Forecasting as a model of risk accounting

Entrepreneurial activity is aimed at maximizing profit from the resources available. The generated profit can be used for the entrepreneur's personal needs or reinvested into new ventures to generate additional revenue and expand operations through new financial flows.

According to Tepman and Eriashvili (2017), the investment of free financial assets and funds into various areas of entrepreneurial activity constitutes investments.

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A company's investment activity focuses on maximizing profit from resources not currently engaged in its operational and financial activities. In other words, investments are made using funds that are either the result of the company's operations or temporarily unutilized financial resources available to the enterprise (Golubeva, 2018; Konstantinov, 2013).

Mathematical models allow for the planning of different scenarios for organizing a company's investment activities based on the business environment. For example, the cost of raw materials impacts the outcome in a manufacturing enterprise. During planning, raw material costs are projected based on overhead expenses. In mathematical modeling, multiple scenarios are developed: an optimistic scenario, where raw material costs are assumed to be lower than expected; a realistic scenario, where costs are based on overhead expenses; a pessimistic scenario, where raw material costs are higher than anticipated.

The next step is to determine the financial outcome that would meet the interests of the company's owners.

Based on these three possible development scenarios, additional parameters are determined. Maximizing profit in financial modeling is the most desirable outcome. However, under certain circumstances, simply avoiding losses (assuming a normal distribution of parameters) can already be considered a positive result. This implies that the higher the projected profitability incorporated into the financial model, the greater the risk of failing to achieve the expected outcome given the allocated resources. This increases the likelihood of a negative result or financial losses (Figure 1).

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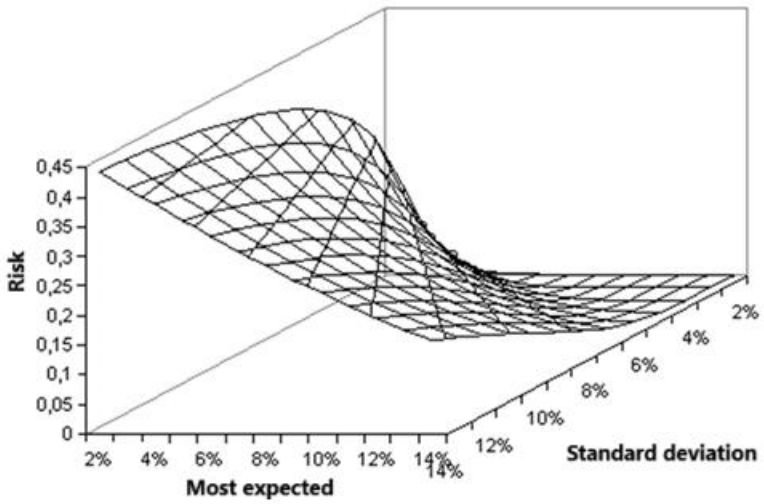

Figure 1. Risk function dependence graph for normal distribution

Source: based on Dolganova et al. (2021)

Investment risk management is a methodology that takes a strategic, organization-wide approach to risk management. It follows a top-down strategy aimed at identifying, assessing, and preparing for potential losses, hazards, and other threats that could disrupt the organization's operations and objectives or lead to financial losses. The importance of decision-making in this context is determined by the expected outcomes that must be achieved within the designated time frame of planned changes (Figure 2).

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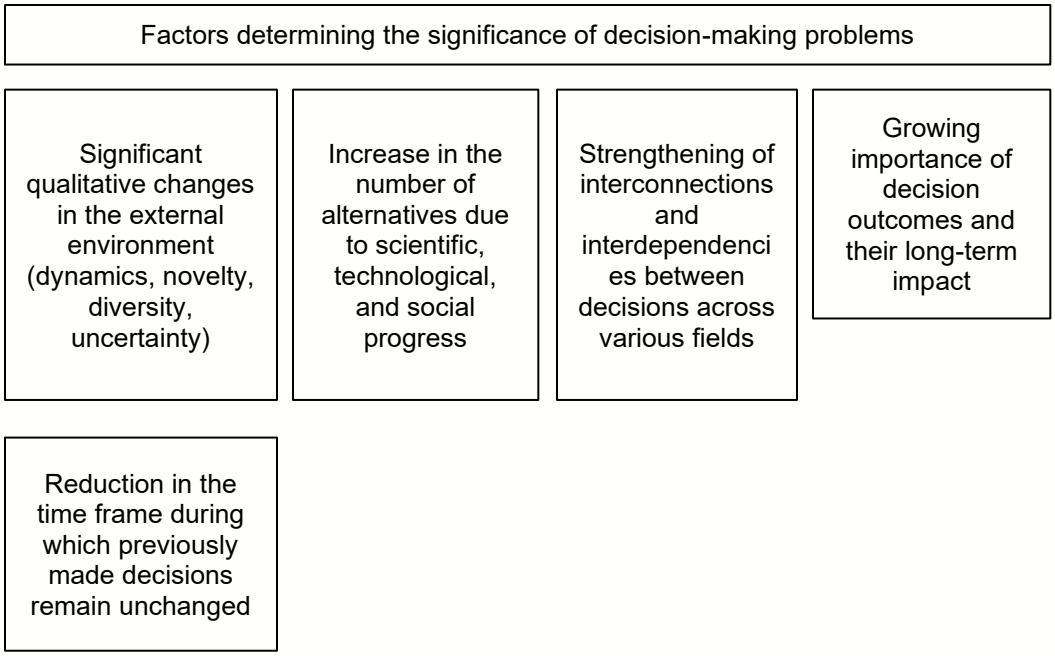

Figure 2. Factors determining the significance of decision-making problems

A strategic problem refers to the impact of previously unaccounted factors on a company's strategy. Alternatively, it can be understood as a misalignment between internal business processes and changes in the external environment, leading to deviations in achieved results from strategic objectives. Identifying the problem helps determine its root cause, develop a detailed problem description, and implement an optimal solution (Golubkov, 2020).

Problem identification is a straightforward method for recognizing an existing obstacle to better understand the goal that needs to be achieved or the issue that must be resolved. Identifying a problem allows one to delve into its essence, assess its impact on individuals or organizations, and find an effective solution (Litvak, 2019).

The economy is a sphere of activity involving interactions among participants for the redistribution of finances, goods, services, and other resources. The large number of

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participants and the uncertainty of interaction outcomes contribute to a high level of risk (Nevezhin, 2022).

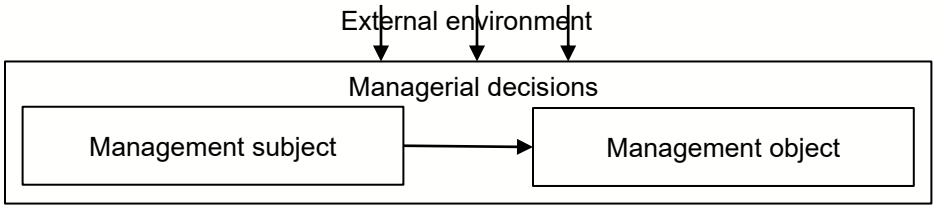

Figure 3. Decision-making scheme
Source: based on Ivanov, Tkachenko (2019)

The foundation of uncertainty lies in the nature of socioeconomic relationships characterized by complexity and multidimensionality. While economic theory is inherently based on uncertainty, all interactions and phenomena follow patterns that can be represented through mathematical values. Examples include the demand and supply curve, the indifference curve, utility theories, the multiplier effect, etc.

Investment can be made using one's own funds and through borrowed capital, provided that the expected return exceeds the cost of using these borrowed financial resources.

Any financial investment has the risk of non-repayment. If an investor uses their own funds, they risk losing the full amount invested. However, if borrowed funds are used, the potential loss includes the invested amount and the cost of borrowing, i.e., the interest payments. The risk of non-repayment can be defined as the occurrence of a possible event that, under the influence of various factors, leads to the failure to return invested funds on time. Some events can result in losses due to a decline in the value of the invested asset, inflation growth, or an increase in the cost of borrowing. Since multiple possible events can occur, mathematical modeling is used to estimate their likelihood, assess the impact of risk on outcomes, and determine the expected return.

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Market event forecasting is conducted over a specific time frame, known as a forecasting period. There are four main types of forecasting periods:

- Current period is a timeframe covering one month, a quarter, half a year, or a full year;

- Short-term period is up to one and a half years;

- Medium-term period is up to five years;

- Long-term period ranges from 10 to 15 years.

Forecasting over longer periods is generally impractical as market conditions do not change with a constant probability and are influenced by trends, industry cycles, and larger systemic factors.

Modeling tools for risk and uncertainty accounting in investment project evaluation

Modern business conditions represent a sequence of events previously forecasted in terms of their occurrence but not necessarily in terms of their ultimate impact on economic entities. A high degree of uncertainty is still connected to the future development of factors that can significantly influence the growth and stability of business enterprises. In such conditions, traditional planning cannot account for all the elements that affect a company's performance. The solution lies in determining the probability of events occurring based on predefined parameters while considering the time interval as a key factor. The main forecasting periods include short-term, medium-term, current, and long-term periods. The process of simulating consumer behavior under market conditions is known as modeling.

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There are several types of modeling. Computer modeling is based on software algorithms. Mathematical modeling relies on mathematical relationships, formulas, and patterns. Computer modeling is often expensive and financially inaccessible to most enterprises. In contrast, mathematical modeling, when combined with the necessary expertise, can be effectively implemented using tools like Excel, provided there is a qualified specialist.

A financial model of an enterprise represents a scenario-based structure that interconnects all its financial elements. Such a model may include financial indicators and physical parameters, including changes in volume (in units), capacity expansion (in units), and other quantitative measures. Figure 3 demonstrates the key functions performed by an enterprise's financial model.

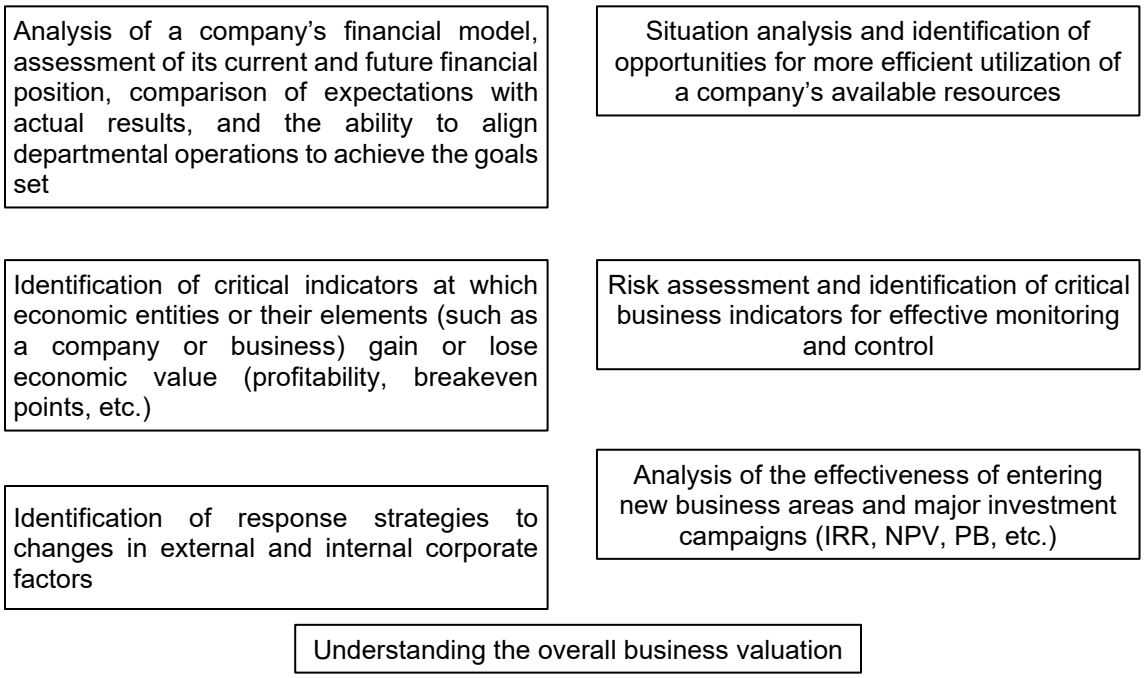

Figure 4. Functions of modeling the financial activity of an enterprise

Source: based on Lukasevich (2021)

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Thus, modeling the financial activities of an enterprise provides insights for future strategic development. In other words, a financial model serves as a foundation for managerial decision-making.

One of the key financial models is the Miller-Orr model developed by M. Miller and D. Orr in 1966. This model describes the dynamics of cash management under conditions where cash inflows and outflows do not follow a strict, predictable pattern. The graphical representation of the Miller-Orr model is shown in Figure 4.

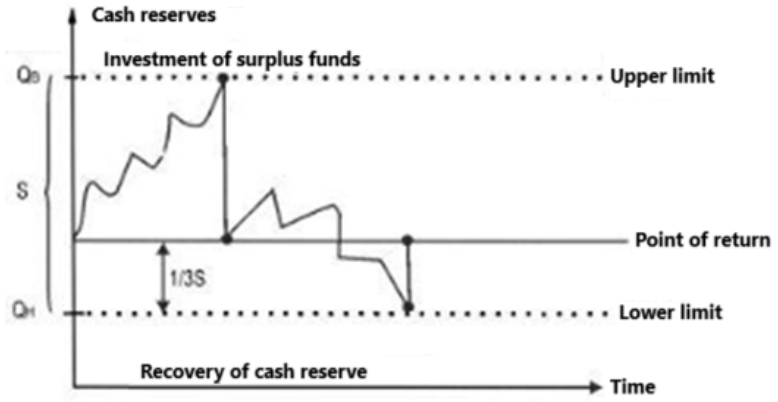

Figure 5. The Miller-Orr model
Source: based on Lukasevich (2021)

The key distinguishing feature of the presented model is the presence of a return point, i.e., a threshold at which the company adjusts the cash balance in its account when reaching the upper or lower cash reserve limit (Shilovskaya, 2021).

Thus, the financial modeling of an enterprise is aimed at solving specific tasks related to the organization of business processes.

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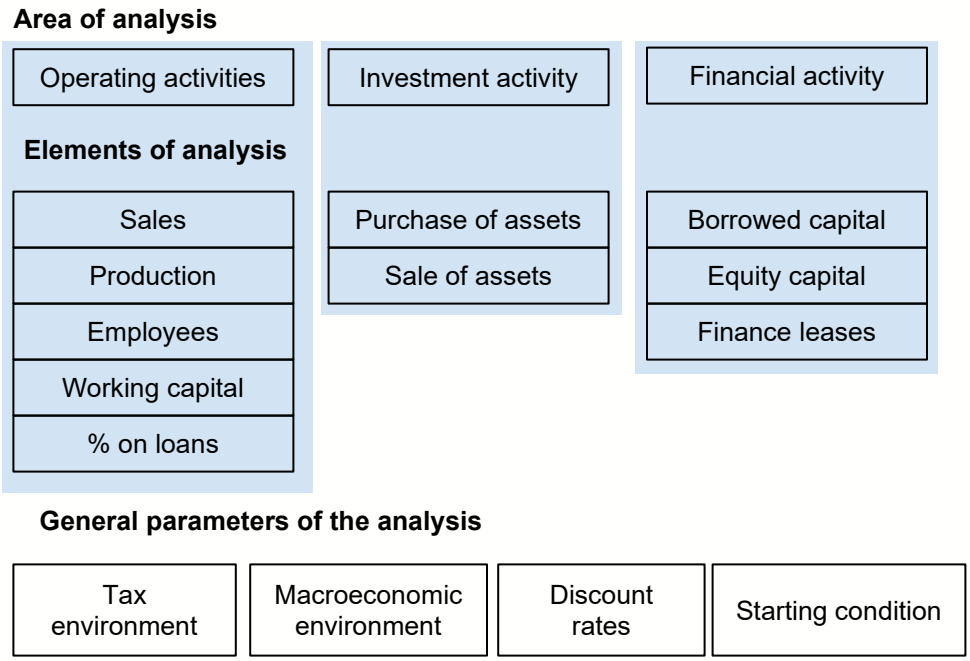

Figure 6. Structure of the financial model in an aggregate plan

Source: based on Lukasevich (2021)

To accelerate data processing, various software solutions are used, enabling automatic calculations of all possible variations based on predefined mathematical models.

Besides risk forecasting, a financial model can incorporate various parameters relevant to modern enterprises. In 1952, W. Baumol developed a model for managing a company's cash assets. The graphical representation of this model is shown in Figure 6.

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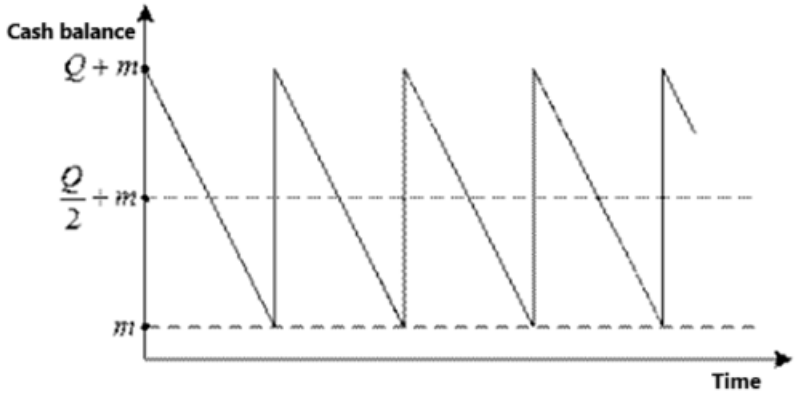

Figure 7. Baumol's model

Modeling financial activities serves as a tool for forecasting and strategic management. The object of modeling can be any process, such as sales modeling under given conditions, supply chain modeling to maintain production rhythm, or ensuring the continuity of trade and technological processes.

The modeling tool helps identify the strengths and weaknesses of business process organization within an enterprise. This information is subsequently used for managerial decision-making. When defining the role of financial modeling in enterprise management, it is worth mentioning that the success of any activity depends on planning and goal setting. A targeted approach yields better results by defining the main development vector. Simply identifying the desired outcomes does not guarantee their achievement. To reach the goals set, it is necessary to allocate sufficient resources and develop an optimal utilization scheme. Structuring business processes while considering factors that significantly impact the outcome allows an enterprise to sustain its financial and operational activities. A striking example of the influence of unpredictable factors is the COVID-19 pandemic, which led to the reorientation and redistribution of business priorities in 2020. Enterprises equipped with modeling tools managed to adapt by changing their operational format or entering new markets. In contrast, companies

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that could not anticipate probabilistic events ceased operations without attempting to adjust their business processes to the new conditions.

Thus, modeling the financial activities of an enterprise enables the modernization of its business model and business processes to adapt to new entrepreneurial conditions. Indicators should be presented in a specific format, preferably in the most convenient form.

Based on purpose and approach, financial models can be classified into several categories: resource-based, evaluative, scenario-based, organizational, financial, and complex models.

Some of the most widely used forecasting methods are referred to as time series models. These models rely on historical data to predict future demand. This forecasting method is important for continuously ordered items as these techniques can be largely automated within computerized information systems.

Models assume that each observed data point of demand consists of a certain systematic component and a random component. A time series model is designed to forecast the systematic component but not the random one (Chernova, Kudryavtsev, 2003). The concept is similar to the logic of quality control charts in the sense that one does not attempt to react to process variability if it remains within control limits. Reacting to or adjusting the forecasting model based on random errors is likely to increase forecasting errors in the future. Instead, efforts should focus on predicting the range or variation of this random error. Models can be designed for almost any type of systematic change in demand, but there is a significant risk in attempting to forecast the random component (Redhead, Hughes, 2005).

Investment project risks

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At the core of any investment project lies an economic component for which the concept of risk plays a crucial role. Risk represents the deviation of the planned result from the actual project implementation, which may occur with a certain probability (Vlasov, 2013; Shapkin, Shapkin, 2013). In economic and financial assessments, three possible outcomes are considered:

- Negative (loss),
- Neutral (no profit or loss),
- Positive (profit).

For this reason, risk assessment is an essential element for implementing innovation-investment projects. The nature of an innovation project is closely linked to uncertainty and risk across various domains, including resources, external and internal events and challenges, project cash flows, and investor behavior. The volume of investment in a project and its effectiveness are directly proportional to the level of financial risk and potential financial losses. The specifics of this type of risk lie in the fact that investments aimed at innovation projects can have long-term effects on all aspects of an enterprise's financial and economic activities. In some cases, this may even lead to financial deterioration and negatively impact business operations (Morrow et al., 2007; Foss, 2007; Konstantinov, 2013). Therefore, the structure of business plans for investment projects involving innovations must include supplementary information on factors contributing to increased risk and uncertainty during project execution. It should outline how these factors influence changes in the risk-free discount rate and their impact on the key return characteristics of innovation projects.

Approaches to investment risk assessment

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Qualitative methods for investment risk assessment

The initial stage of investing in an innovative project involves analyzing the risks associated with the project through the application of qualitative methods (Gitman, Joehnk, 2004).

The qualitative approach does not provide a numerical characterization of risks but serves as the foundation for subsequent research on the innovation-investment project. Its essence lies in identifying and recognizing potential losses, risk factors, and sources, studying their characteristics, and describing the probable damage, its monetary equivalent, and measures for minimizing or fully eliminating negative outcomes.
The most commonly used qualitative methods for investment risk assessment include:

- Cost-effectiveness analysis;
- Analogy method;
- Expert evaluation method.

The analysis of cost-effectiveness prioritizes the assessment of budget overruns, which may arise due to the following factors:

- Errors in initial cost estimates for the project or its components;

- Changes in project scope caused by unforeseen external or internal circumstances;

- Discrepancies between actual and planned labor productivity or equipment efficiency;

- Cost increases due to inflation or changes in tax legislation.

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As a result, a final breakdown of cost overruns for individual expense categories and project stages is compiled. If an investor provides partial funding, they can assess further risks and decide whether to continue financing or terminate the investment.

The analogy method has gained widespread acceptance worldwide (Porter, 2016). This method involves analyzing existing data from similar projects within the same industry and with comparable risk levels. The objective is to examine the impact of potential unforeseen circumstances and adverse factors on project outcomes. This analysis is conducted by ranking the reliability of companies, studying market trends in demand and pricing, and evaluating financial indicators based on the results of similar projects.

However, a significant drawback of the analogy method is the difficulty in accurately assessing how closely the risk level of a similar project corresponds to that of the project under consideration.

The expert evaluation method relies on the professional skills and experience of specialists in investment project management (Konstantinov, 2013).

Initially, experts individually analyze the likelihood of risks based on a comprehensive set of project data. The results are then consolidated into an integrated assessment. This approach involves ranking individual risks by priority and assigning weighting coefficients (k) according to their significance. The weighting process typically uses arithmetic mean weighting, where the weights assigned to adjacent ranks differ by a constant value; geometric mean weighting, where the weights assigned to adjacent ranks differ by a constant ratio.

Quantitative methods for investment risk assessment

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Unlike qualitative methods, quantitative methods are more precise as they provide numerical estimates of risk levels. This accuracy has contributed to their widespread adoption and credibility. The key quantitative methods include (Kiseleva et al., 2019):

- Statistical method,
- Sensitivity analysis,
- Stability testing method,
- Scenario analysis,
- Simulation modeling (statistical testing method, Monte Carlo method),
- Discount rate adjustment method.

Risk management has never been more relevant than it is today. Given the wide range of factors influencing investment projects, both internal (arising within a specific company or industry) and external (related to global economic changes), it is essential to minimize or mitigate risks effectively. For this reason, a thorough analysis of the current market situation and a forecast of its future state should be conducted before making any investment decisions (Khrustalev, Slavyanov, 2011).

Alongside this analysis, it is crucial to possess risk management skills and apply appropriate methods to each type of risk. One of the most important stages of investment planning is risk assessment, which involves identifying the probability of various scenarios occurring. Without these steps, effective investment activity is not feasible.

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Conclusion

After reviewing various approaches to risk assessment, we conclude that there is no universal method of conducting a comprehensive analysis and accurately evaluating the investment risk of a specific project. Qualitative methods allow for an in-depth examination of all potential risk scenarios and provide a detailed description of the diverse risks associated with an investment project. In contrast, quantitative methods offer a numerical assessment of the project's risk level and help determine the extent to which risk factors impact its effectiveness. However, combining these methods can yield the most accurate results for a well-founded evaluation of the project's investment risk and its expected return.

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