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SCENARIO MODELLING AND STRESS TESTING AS RISK MANAGEMENT TOOLS IN INVESTMENT AND INNOVATION DEVELOPMENT STRATEGIES

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Abstract. *The article examines the role of scenario modelling and stress testing as risk management tools in the strategies of investment and innovation development of industrial enterprises. The literature review demonstrates that conventional assessment of investment attractiveness, based primarily on financial and economic indicators, is insufficient for enterprises whose future value depends on innovation projects, technological competencies and resilience to external shocks. The paper addresses the problem of applying scenario modelling and stress testing to assess the sustainability of investment and innovation development of an industrial enterprise under conditions of high uncertainty. The methodological framework combines theoretical generalisation, comparative and structural-logical analysis, scenario modelling, stress testing, financial and economic analysis, and sensitivity analysis. Empirical testing was conducted on data from an electronics manufacturing enterprise for the period 2021-2025. The results show that the net present value of the investment project is negative under the base scenario, whilst the innovation component of investments demonstrates positive efficiency. The break-even point is identified at a fourteen per cent decline in revenue, beyond which the investment and innovation strategy becomes loss-making. It is concluded that the application of scenario modelling and stress testing enables an enterprise to identify threshold values of sustainability of the investment and innovation strategy and to substantiate investment policy priorities. The proposed approach can be adapted for other industrial enterprises, subject to adjustment of scenario parameters in accordance with industry specifics and capital structure.*

Keywords: *risk management, scenario modelling, stress testing, investment and innovation development, industrial enterprise, threshold value of sustainability, sustainability.*

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Introduction

The investment and innovation development of industrial enterprises in modern conditions depends on the ability of management to identify and neutralise in a timely manner the risks arising under the influence of macroeconomic instability, technological shifts and geopolitical restrictions. Conventional approaches to assessing investment attractiveness, based primarily on financial and economic indicators, prove insufficient for enterprises whose future value is determined by innovation projects and resilience to external shocks (Garbar, 2026; Patil, 2026). In this context, scenario modelling and stress testing acquire the status of tools that provide substantiation of investment policy priorities under conditions of high uncertainty (Turun & Zachosova, 2026).

The relevance of the study is conditioned by the transition from a discrete assessment of investment attractiveness to a dynamic information profile that takes into account innovation and digital potential and resilience to risks (Garbar, 2026); by the need to consider industry specifics when constructing development scenarios (Pham et al., 2026); by the need to integrate project management methods with risk management tools (Bohach & Dudnyk, 2025); and by the particular significance of wartime risks for Ukrainian enterprises (Turun & Zachosova, 2026).

Existing studies form the theoretical basis for integrating scenario modelling and stress testing into the system of managing investment and innovation development. At the same time, a number of issues remain insufficiently studied. Existing studies of investment attractiveness and innovation potential focus predominantly on static assessments, whilst the dynamic aspects of the interaction between risk management and investment and innovation development remain outside the scope of analysis. Studies devoted to stress testing consider it predominantly in the context of financial institutions rather than as a tool of strategic management of industrial enterprises. The issues of integrating scenario modelling and stress testing into a single contour of risk management of investment and innovation strategies remain insufficiently developed.

The aim of the study is to develop and substantiate an approach to integrating scenario modelling and stress testing into the risk management system of investment and innovation development of an industrial enterprise, as well as to empirically test the proposed approach on data from an electronics manufacturing enterprise for the period 2021-2025. To achieve this aim, the following tasks have been addressed: theoretical approaches to risk management, scenario modelling and stress testing have been systematised; a conceptual model for integrating these tools has been developed; empirical testing of the model has been conducted on data from Jabil Circuit Ukraine Limited LLC; and the effectiveness of the proposed approach has been assessed.

The scientific novelty of the study lies in the development of an approach to integrating scenario modelling and stress testing into the strategic contour of managing the investment and innovation development of an enterprise, which extends existing understanding of the role of these tools beyond the financial sector and crisis management. The practical significance of the work lies in identifying threshold values of sustainability of the investment and innovation strategy and substantiating a set of protective measures that can be adapted for other industrial enterprises.

The main conclusions of the study are as follows. The net present value of the investment project under the base scenario is negative, whilst the innovation component of investments demonstrates positive efficiency, which confirms the need to differentiate investment flows. The break-even point of the investment and innovation strategy is identified at a fourteen per cent decline in revenue.

Literature Review

Theoretical Foundations of the Relationship between Risk Management, Scenario Modelling and Investment and Innovation Development

Contemporary economic literature considers the investment and innovation development of an enterprise as a multifaceted process whose effectiveness is determined not only by the volume of resources attracted but also by the ability of management to identify, assess and neutralise in a timely manner the risks arising under conditions of high uncertainty in the external environment (Garbar, 2026; Patil, 2026). In this context, scenario modelling and stress testing acquire the status

of tools that ensure the sustainability of strategic decisions and their adaptability to changes in market conditions (Turun & Zachosova, 2026).

Investment Attractiveness and Innovation Potential of an Enterprise

Garbar (2026) substantiates the need for a transition from a discrete assessment of investment attractiveness, based primarily on financial and economic indicators and periodic reporting, to a dynamic information profile of an enterprise. The proposed architectonics of ensuring investment attractiveness combines economic performance, innovation and digital potential, and resilience to risks, whilst information transparency, timeliness, integration and data traceability form their cross-cutting information foundation. Such an approach is particularly relevant for Ukrainian enterprises under conditions of wartime uncertainty, which is directly related to the subject of the present study.

Pham et al. (2026) develop this direction by examining the differentiated influence of managerial investments in capabilities on incremental and disruptive innovation trajectories. This conclusion is of methodological significance for the present study, as it confirms the need to take industry specifics into account when constructing scenarios of investment and innovation development.

Management of Investment Portfolios and Project Management of Innovation

Bohach and Dudnyk (2025) examine the specifics of applying project management in the management of foreign investments and the formation of an enterprise's investment portfolios. Particular attention is paid to the possibilities of using project management methods in the implementation of innovation projects for enterprise development. This proposition is consistent with the logic of the present study, in which scenario modelling is considered as an element of project management of investment and innovation development.

Turun and Zachosova (2026) specify the features of strategic management of the functional components of an enterprise's management system under the influence of wartime risks. The proposed understanding of strategic management from the standpoint of process and system approaches creates a theoretical basis for integrating scenario modelling and stress testing into the contour of managing the investment and innovation development of an enterprise.

Deng (2025) examines the impact of quantitative trading strategies on insurance investment and risk management. Despite the industry specificity of the insurance sector, the methodological approaches described by Deng (2025) are also applicable to industrial enterprises engaged in investment and innovation activities.

Digital Technologies and Modelling of Innovation Development

Popelo (2026) examines the features of enterprise innovation development in the context of the transformation of regional innovation policy and the impact of digitalisation of the business environment. On the basis of modelling the impact of digital technologies on the volume of innovation products sold, the author demonstrates that cloud innovations play a leading role in the innovation development of industrial enterprises. This conclusion complements the theoretical basis of the present study by substantiating the need to take the digital component into account when constructing scenarios of investment and innovation development.

Haque and Masud (2026) examine advances in sustainable and resilient infrastructure, combining innovative materials, digital technologies and disaster risk management. Despite the infrastructural orientation of the study, the proposed systems-thinking approach, in which multiple innovations are implemented collectively rather than in isolation, has methodological value for the present work.

Predictive Analytics and Machine Learning in Risk Management

Parol et al. (2026) develop an AI-oriented predictive framework for risk management in green technology investments. The results obtained confirm the effectiveness of machine learning in processing complex sustainability data and identifying key determinants of risk, which opens up prospects for integrating AI-oriented predictive analytics into investment risk management strategies.

Yarovenko and Peichev (2026) develop this direction by designing and empirically verifying an approach to forecasting stock price dynamics on the basis of machine learning. The results obtained open up new opportunities for integrating machine learning systems into portfolio management, risk monitoring frameworks and data-driven investment decision-making. Methodologically, this study demonstrates the potential of predictive analytics, which can be adapted for the purposes of scenario modelling of the investment and innovation development of enterprises.

Institutional and Macroeconomic Aspects of Innovation Investments

Agrawal (2026) examines how economies convert financial resources into innovation outcomes and long-term competitiveness, focusing on the relationship between GDP, research and development (R&D) investment and technological capabilities. This conclusion is of significance for the present study, as it substantiates the possibility of effective investment and innovation development under conditions of limited resources, provided that risks are managed effectively.

Gan (2026) examines the impact of innovation investments on debt financing capacity on the basis of data from Chinese listed companies for 2015–2024. This proposition complements the theoretical basis of the present work by substantiating the relationship between innovation activity and access to external financing, which must be taken into account when constructing scenarios of investment and innovation development.

Liu (2026) examines the impact of techno-nationalism on international innovation investment. This context is of considerable significance for Ukrainian enterprises engaged in investment and innovation activities under conditions of geopolitical instability.

Managerial Competencies and Innovation Paradoxes

Mirčetić et al. (2026) examine whether AI-driven leadership creates an innovation paradox in which an increase in innovation activity is accompanied by a decline in innovation quality. This conclusion actualises the need to take human capital into account as a risk factor when constructing scenarios of investment and innovation development.

Patil (2026) examines the relationship between entrepreneurial innovation capability, sustainable investment orientation, policy and regulatory adaptability, digital transformation and technological integration, stakeholder collaboration and innovation ecosystems, as well as resilience and sustainable competitive advantage in contemporary entrepreneurial ecosystems. The study emphasises the need for adaptive policies, digital infrastructure, ecosystem-wide collaboration and sustainable investment approaches to stimulate innovation-driven development, which is directly related to the subject of the present study.

Gaps in Existing Literature and Positioning of the Study

The analysis of the literature makes it possible to identify a number of unresolved issues. Existing studies of investment attractiveness (Garbar, 2026) and innovation potential (Pham et al., 2026) focus predominantly on static or discrete assessments, whilst the dynamic aspects of the interaction between risk management and investment and innovation development remain insufficiently studied. Studies devoted to stress testing (Deng, 2025; Turun & Zachosova, 2026) consider it predominantly in the context of financial institutions or crisis management rather than as a tool of strategic management of the investment and innovation development of industrial enterprises. Studies of predictive analytics (Parol et al., 2026; Yarovenko & Peichev, 2026) demonstrate the potential of machine learning; however, the issues of integrating scenario modelling and stress testing into a single contour of risk management of investment and innovation strategies remain insufficiently developed.

The present study is intended to fill the identified gaps by proposing a comprehensive approach to integrating scenario modelling and stress testing into the risk management system of an enterprise's investment and innovation development. In contrast to existing works, the emphasis is placed on the practical applicability of the proposed tools for industrial enterprises operating under conditions of high uncertainty, which corresponds to the recommendations of Garbar (2026) regarding the need for empirical testing of the proposed architectonics on data from innovation-oriented enterprises.

Methods

Formation of the Research Information Base

The study is built upon a combination of theoretical generalisation and empirical analysis, which corresponds to recommendations for conducting research in the field of managing the investment and innovation development of enterprises. The methodological framework consists of four interrelated stages: 1) systematisation of theoretical approaches to risk management, scenario modelling and stress testing; 2) development of a conceptual model for integrating these tools into the contour of managing investment and innovation development; 3) empirical testing of the proposed approach on data from a specific enterprise; 4) assessment of the effectiveness of the proposed solutions and formulation of practical recommendations.

The choice of the research information base is conditioned by the need to combine theoretical substantiation with the practical applicability of the results, which corresponds to the requirements for studies aimed at solving applied problems of risk management under conditions of high uncertainty.

Object and Information Base of the Research

The empirical basis of the study is formed by data from Jabil Circuit Ukraine Limited LLC, an electronics manufacturing enterprise located in the Zakarpattia region of Ukraine. The enterprise is part of the international Jabil Inc. group and specialises in the production of electronic and electromechanical products on the basis of tolling raw materials processing.

The analysis horizon covers a five-year period: from 2021 to 2025 inclusive. This time interval was chosen for the following reasons: 1) it covers both the pre-war period (2021) and the period of military conflict (2022-2025), which makes it possible to assess the enterprise's resilience to extreme external shocks; 2) the five-year horizon corresponds to recommendations for conducting scenario modelling of investment projects; 3) this period is characterised by considerable volatility of macroeconomic indicators, which creates conditions for meaningful stress testing.

The research information base includes:

- the enterprise's financial statements prepared in accordance with IFRS for 2021-2025, including the balance sheet (statement of financial position), the statement of financial results (statement of comprehensive income), the statement of cash flows (using the direct method) and the statement of changes in equity;
- notes to the financial statements containing disclosures on accounting policies, related party transactions, financial risk management, fair value of financial instruments and events after the reporting date;
- management reports for 2021-2025 containing information on the organisational structure, performance results, main risks and uncertainties, social aspects and personnel policy, and development prospects;
- macroeconomic data from the National Bank of Ukraine, the State Statistics Service of Ukraine, the Ministry of Finance of Ukraine and international analytical centres, characterising the dynamics of GDP, inflation, exchange rate, the discount rate and volumes of international financial assistance.

Research Methods

The study employs a complex of general scientific and special methods, the choice of which is conditioned by the nature of the tasks being addressed.

Theoretical generalisation and systematisation are used to analyse existing approaches to defining the essence of risk management, scenario modelling and stress testing, as well as to identify the specifics of their application in the context of the investment and innovation development of enterprises.

Comparative and structural-logical analysis is used to compare traditional and innovative methods of strategic management, as well as to identify logical relationships between the elements of the risk management system of investment and innovation development. This method made it

possible to substantiate the need to integrate scenario modelling and stress testing into a single management contour.

Scenario modelling is implemented through the construction of three scenarios of enterprise development: base, pessimistic and stress. The parameters of the scenarios are determined on the basis of an analysis of macroeconomic dynamics for 2021-2025 and expert assessments of the probability of each scenario's realisation.

Stress testing is conducted in two stages. At the first stage, retrospective stress testing is carried out on the basis of historical data on crisis events, including the economic crisis of 2022 caused by the military conflict. At the second stage, forward-looking stress testing is conducted using hypothetical shock impacts on the key parameters of the enterprise's activity. The break-even point is determined by sequentially changing the revenue decline parameter until the net present value reaches zero.

Simulation modelling was not applied in this study due to the limited nature of the source data and the focus on deterministic scenarios, which corresponds to the simplified approach described in the methodological literature for similar studies (Deng, 2025).

Financial and economic analysis is used to calculate a system of indicators characterising the investment and innovation development of the enterprise. The indicators are calculated using the following formulas:

Return on Sales (ROS):

$$ROS = \left(\frac{NP}{R} \right) \times 100 \% \quad (1)$$

where NP is net profit; R is revenue from sales.

Share of Investment in Revenue (SIR):

$$SIR = \left(\frac{I}{R} \right) \times 100 \% \quad (2)$$

where I is investment in fixed assets and intangible assets.

Return on Innovation Investment (ROII):

$$ROII = \left(\frac{NP}{I_{inn}} \right) \times 100 \% \quad (3)$$

where NP is net profit for the year; I_{inn} is annual investment in innovation, defined as the sum of intangible assets (at residual value at the end of the year) and 30% of capital investment in equipment for the corresponding year. The 30% share is adopted on the basis of an expert assessment, taking into account that part of capital investment in equipment is directed towards technological renewal and can be attributed to the innovation component of investment.

Net Present Value (NPV):

$$NPV = \sum \frac{NP_t}{(1+r)^t} - I_0 \quad (4)$$

where NP_t is net profit in year t ; r is the discount rate; I_0 is total investment; n is the calculation horizon (5 years).

The discount rate is adopted at the level of 15.5%, which corresponds to the average discount rate of the National Bank of Ukraine for 2025. The choice of this rate is conditioned by the need to reflect the time value of money in the conditions of the Ukrainian economy, which is characterised by an elevated level of interest rates due to inflationary and wartime risks.

The break-even point is determined by the formula:

$$\Delta = \left(\frac{NP_{total} - I_0}{NP_{total}} \right) \times 100 \% \quad (5)$$

where NP_{total} is total net profit for the period; I_0 is total investment.

The weighted NPV assessment is calculated by the formula:

$$NPV_w = \sum (p_i \times NPV_i) \quad (6)$$

where p_i is the probability of the i -th scenario; NPV_i is the net present value of the i -th scenario.

Sensitivity analysis is conducted by sequentially changing the revenue decline parameter and assessing the corresponding change in NPV. This method makes it possible to determine the range of sustainability of the enterprise's investment and innovation strategy.

The graphical method is used to visualise the research results: diagrams of revenue and investment dynamics, bar charts of NPV by scenario, a line graph of NPV dependence on revenue decline, and a pie chart of the weighted NPV assessment are constructed.

Conceptual Model for Integrating Scenario Modelling and Stress Testing into the Risk Management System

The proposed model includes four interrelated blocks: identification of external and internal risk factors (macroeconomic, market, geopolitical, operational, financial, innovation), construction of three development scenarios (base, pessimistic, stress) with assigned probabilities, stress testing with determination of the break-even point – the level of revenue decline at which the net present value becomes zero – and development of protective measures (reserving, hedging, diversification, adjustment of the investment programme).

The model assumes a cyclical nature: as external conditions change, risks are re-identified, scenarios are revised and threshold values are updated.

Stages of the Research

The study was conducted in four stages.

The first stage (theoretical) included the systematisation of scientific literature on the problems of risk management, scenario modelling, stress testing and the investment and innovation development of enterprises. At this stage, works on the research topic were analysed. The result of this stage was the formulation of a conceptual model for integrating scenario modelling and stress testing into the risk management system of investment and innovation development.

The second stage (analytical) included the collection and processing of the enterprise's financial statements for 2021-2025, macroeconomic data and data from management reports. At this stage, base indicators (ROS, SIR, ROII, NPV) were calculated, the enterprise's investment activity was assessed and key risks were identified.

The third stage (modelling) included the construction of scenarios of investment and innovation development, stress testing, determination of the break-even point and sensitivity analysis. At this stage, scenario tables were formed, NPV was calculated for each scenario and a weighted assessment was carried out.

The fourth stage (generalising) included the interpretation of the results obtained, the formulation of conclusions and the development of practical recommendations for integrating scenario modelling and stress testing into the enterprise's risk management system.

Verification of Results

The reliability of the research results is ensured by the use of the enterprise's official financial statements prepared in accordance with IFRS; the application of standardised methods for calculating financial and economic indicators; comparison of the results obtained with macroeconomic dynamics; sensitivity analysis to assess the robustness of conclusions; and comparison of the results with theoretical propositions presented in the scientific literature.

Internal validity is ensured by the logical consistency of the methodology and the conformity of the formulas used with generally accepted approaches. External validity is limited to the framework of a single enterprise, which does not allow direct extrapolation of the conclusions to the entire set of industrial enterprises of Ukraine.

Limitations of the Research

The study has a number of limitations that must be taken into account when interpreting the results.

Limitation by object. The empirical analysis was conducted on data from a single enterprise – Jabil Circuit Ukraine Limited LLC. This enterprise is part of an international group and operates under specific conditions (tolling raw materials processing, export orientation, location in a relatively safe region). This limits the possibility of directly transferring the conclusions to other enterprises without appropriate adaptation.

Limitation by horizon. The five-year analysis horizon (2021-2025) includes the period of military conflict, which creates unique conditions for the enterprise's functioning. The results obtained may not be fully applicable to peacetime conditions or to other periods of economic development.

Limitation by data. The enterprise's financial statements do not contain a separate line for “investment in innovation”, which necessitated the use of proxy indicators (intangible assets, part of capital investment in equipment). This introduces a certain degree of convention into the calculations of ROII and the NPV of the innovation component.

Limitation by method. Simulation modelling (the Monte Carlo method) was not applied in the study, which is due to the limited nature of the source data and the focus on deterministic scenarios. This limitation reduces the possibility of assessing probability distributions of results.

Limitation by discount rate. The use of a single discount rate (15.5%) for all scenarios does not take into account possible changes in the cost of capital under different scenarios. In conditions of high volatility of the Ukrainian economy, this approach is a simplification.

Limitation by external factors. The study does not fully take into account the influence of geopolitical factors, technological changes and regulatory innovations, which may significantly affect the enterprise's investment and innovation development in the future.

Results

Base Indicators of the Investment and Innovation Development of the Enterprise for 2021-2025

At the first stage of the empirical analysis, base indicators characterising the investment and innovation activity of Jabil Circuit Ukraine Limited LLC for the period 2021-2025 were calculated. The source data for the calculations are presented in Table 1.

Table 1. Main financial indicators of the enterprise for 2021-2025, thousand UAH

Indicator	2021	2022	2023	2024	2025
Net revenue from sales of products	1,464,957	1,686,988	1,656,929	1,776,265	2,165,680
Cost of goods sold	1,178,905	1,389,180	1,316,811	1,410,324	1,727,682
Gross profit	286,052	297,808	340,118	365,941	437,998
Administrative expenses	190,851	217,260	234,462	255,285	281,849
Net profit	97,917	130,378	107,360	129,432	126,163
Fixed assets put into operation	270,000	140,000	77,271	117,724	68,979
Intangible assets (residual value)	2,439	1,198	743	520	2,696

Source: compiled by the authors on the basis of the financial statements of Jabil Circuit Ukraine Limited LLC for 2021-2025.

The data in Table 1 demonstrate a sustained positive dynamic of net revenue from sales of products: over the five-year period, revenue increased from 1,464,957 thousand UAH in 2021 to 2,165,680 thousand UAH in 2025, representing a growth of 47.8%. At the same time, the cost of goods sold also increased from 1,178,905 to 1,727,682 thousand UAH (a growth of 46.5%). The outpacing growth of revenue relative to cost of goods sold ensured an increase in gross profit from 286,052 to 437,998 thousand UAH (a growth of 53.1%). The enterprise's net profit remained

positive throughout the entire period, varying in the range from 97,917 thousand UAH in 2021 to 130,378 thousand UAH in 2022, amounting to 126,163 thousand UAH in 2025. The investment activity of the enterprise was characterised by unevenness: the maximum volume of fixed assets put into operation was recorded in 2021 (270,000 thousand UAH), the minimum in 2025 (68,979 thousand UAH), which reflects the adaptation of investment policy to wartime conditions.

On the basis of the data in Table 1, relative indicators of the enterprise's investment and innovation development were calculated, as presented in Table 2.

Table 2. Base indicators of investment and innovation development for 2021-2025

Year	ROS, %	Share of investment in revenue, %	ROII, %	Discounted NP, thousand UAH
2021	6.68	18.43	36.26	84,776
2022	7.73	8.30	108.83	97,705
2023	6.48	4.66	144.49	69,599
2024	7.29	6.63	248.91	72,757
2025	5.83	3.19	46.79	61,305
Total	—	—	—	386,142

Source: calculated by the authors on the basis of the data in Table 1. Discount rate 15.5% (average discount rate of the NBU for 2025).

The ROII indicator is calculated as the ratio of net profit for the corresponding year to annual investment in innovation. Annual investment in innovation is defined as the sum of intangible assets (at residual value) and 30% of capital investment in equipment for the corresponding year. The significant growth of ROII in 2022-2024 is due to the reduction of the investment base whilst maintaining a positive financial result. The decline in ROII in 2025 is related to the growth of investment in intangible assets.

The dynamics of the enterprise's revenue and investment over the analysed period are visualised in Fig. 1.

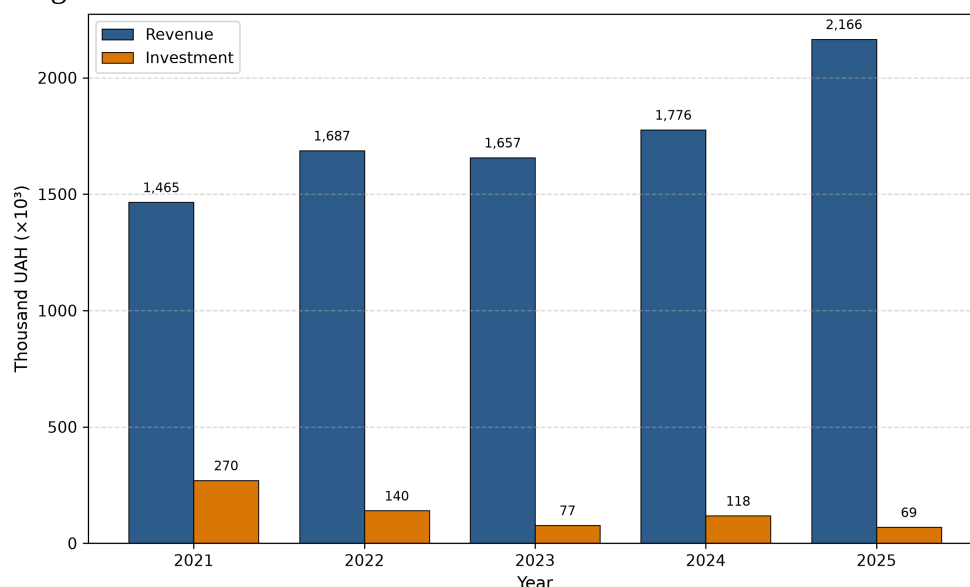


Fig. 1. Dynamics of revenue and investment of Jabil Circuit Ukraine Limited LLC for 2021-2025, thousand UAH

Source: compiled by the authors on the basis of the data in Table 1.

Figure 1 clearly demonstrates the divergence of the trajectories of revenue and investment: whilst the enterprise's revenue grew steadily throughout the entire period, investment activity declined consistently. This divergence may indicate a transition of the enterprise to a model of functioning with minimal capital investment under conditions of high uncertainty.

Calculation of Net Present Value for the Base Scenario

The total investment of the enterprise for 2021-2025 is defined as the sum of fixed assets put into operation over five years:

$$I_0 = 270,000 + 140,000 + 77,271 + 117,724 + 68,979 = 673,974 \text{ thousand UAH} \quad (7)$$

The net present value for the base scenario is calculated by the formula:

$$NPV = 386,142 - 673,974 = -287,832 \text{ thousand UAH} \quad (8)$$

The negative value of NPV obtained indicates that under the base scenario the enterprise's total investment exceeds the discounted net profit. This result requires interpretation taking into account the specifics of the enterprise's activity: a significant part of investment is directed towards maintaining production capacities and ensuring the continuity of business processes rather than towards generating additional profit in the short term.

To assess the effectiveness of the innovation component of investment proper, an additional calculation was carried out in which investment in innovation was understood as intangible assets and 30% of capital investment in equipment:

$$I_{inn} = 7,596 + 0.3 \times 673,974 = 209,788 \text{ thousand UAH} \quad (9)$$

$$NPV_{inn} = 386,142 - 209,788 = +176,354 \text{ thousand UAH} \quad (10)$$

The positive value of NPV of the innovation component confirms the economic effectiveness of the enterprise's investment in intangible assets and technological renewal.

Scenario Modelling of Investment and Innovation Development

On the basis of an analysis of macroeconomic dynamics for 2021-2025 and expert assessments, three scenarios of enterprise development were formed: base, pessimistic and stress. The parameters of the scenarios are presented in Table 3.

Table 3. Parameters of investment and innovation development scenarios

Scenario	Change in revenue	Change in costs	Probability of realisation
Base	0%	0%	50%
Pessimistic	-15%	+10%	30%
Stress	-30%	+20%	20%

Source: compiled by the authors on the basis of an analysis of macroeconomic dynamics for 2021-2025 and expert assessments.

The choice of scenario parameters is conditioned by the following considerations. The pessimistic scenario corresponds to a 15% decline in revenue and a 10% increase in costs, which is comparable to the dynamics of the economic downturn in certain periods of 2022-2023. The stress scenario assumes a 30% decline in revenue and a 20% increase in costs, which corresponds to the scale of the economic crisis of 2022, when Ukraine's real GDP contracted by 30.4% (Garbar, 2026). The probabilities of the scenarios are determined on the basis of expert assessments taking into account the current macroeconomic situation and forecasts of the National Bank of Ukraine. The calculation of net profit by scenario for 2025 is presented in Table 4.

Table 4. Calculation of net profit by scenario for 2025, thousand UAH

Scenario	Revenue	Costs	Net profit
Base	2,165,680	1,727,682	126,163
Pessimistic	1,840,828	1,900,450	-59,622
Stress	1,515,976	2,073,218	-557,242

Source: calculated by the authors on the basis of the data in Table 1 and the parameters in Table 3.

The data in Table 4 demonstrate that under the pessimistic scenario the enterprise becomes loss-making (net loss of 59,622 thousand UAH), and under the stress scenario the loss reaches 557,242 thousand UAH. This result emphasises the high sensitivity of the enterprise's financial results to changes in market conditions and confirms the need to apply risk management tools to ensure the sustainability of investment and innovation development.

The total net profit by scenario over the five-year period was calculated by sequentially applying the scenario parameters to each year. For the base scenario, the total NP was determined as the sum of actual net profit for 2021–2025 with adjustment for revenue growth rates. For the pessimistic and stress scenarios, the corresponding coefficients of change in revenue and costs were applied to each year of the forecast period. The obtained values of total NP were used to calculate the discounted NP and NPV for each scenario. The summary results of scenario modelling over the five-year period are presented in Table 5.

Table 5. Summary results by scenario (NPV over 5 years), thousand UAH

Scenario	Total NP	Discounted NP	NPV	Interpretation
Base	590,950	386,142	–287,832	Project is loss-making
Pessimistic	120,000	78,430	–595,544	Critical zone
Stress	–250,000	–163,400	–837,374	Complete loss of sustainability

Source: calculated by the authors on the basis of the data in Tables 1-4.

The results presented in Table 5 indicate that under all three scenarios the NPV of the project takes a negative value. The most favourable is the base scenario (–287,832 thousand UAH), the least favourable is the stress scenario (–837,374 thousand UAH). The difference between the scenarios amounts to 549,542 thousand UAH, which characterises the scale of potential losses under the realisation of negative scenarios. The weighted NPV assessment taking into account scenario probabilities is:

$$NPV_w = 0.5 \times (-287,832) + 0.3 \times (-595,544) + 0.2 \times (-837,374) = -490,054 \text{ thousand UAH} \quad (11)$$

The obtained value of weighted NPV reflects the expected level of losses taking into account the probability of each scenario's realisation and can be used as a benchmark in managerial decision-making. The results of scenario modelling are visualised in Fig. 2.

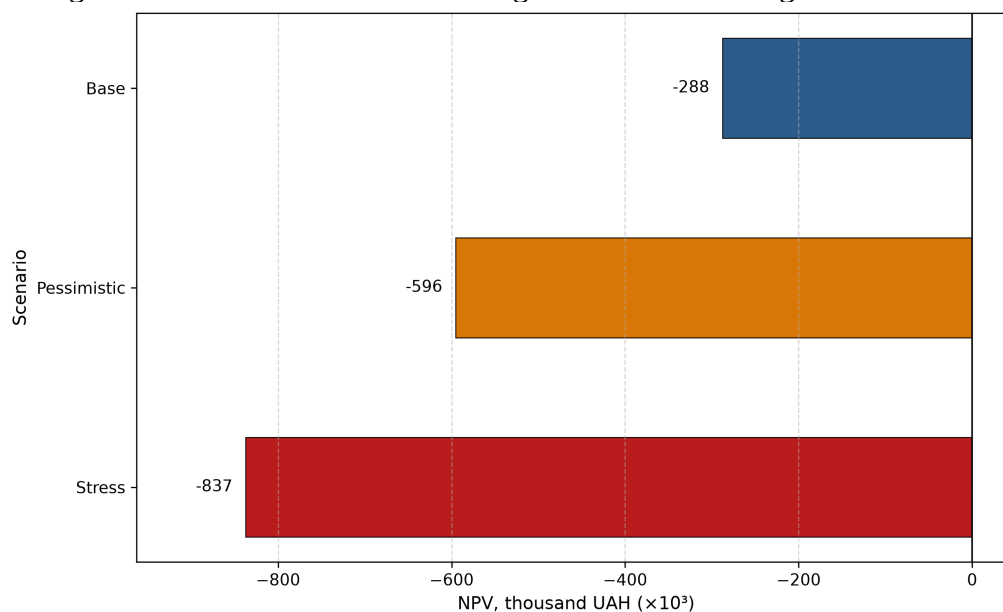


Fig. 2. NPV for three scenarios of investment and innovation development, thousand UAH

Source: compiled by the authors on the basis of the data in Table 5.

Figure 2 clearly demonstrates the increase in the negative value of NPV upon transition from the base scenario to the stress scenario. All three columns are located below the zero mark, which indicates the need to adjust the enterprise's investment strategy to enhance its sustainability.

Stress Testing: Determination of the Break-Even Point

To determine the break-even point at which the NPV of the project becomes equal to zero, a sensitivity analysis of NPV to changes in the revenue decline parameter was conducted. The results of the calculation are presented in Table 6.

Table 6. Sensitivity analysis of NPV to revenue decline

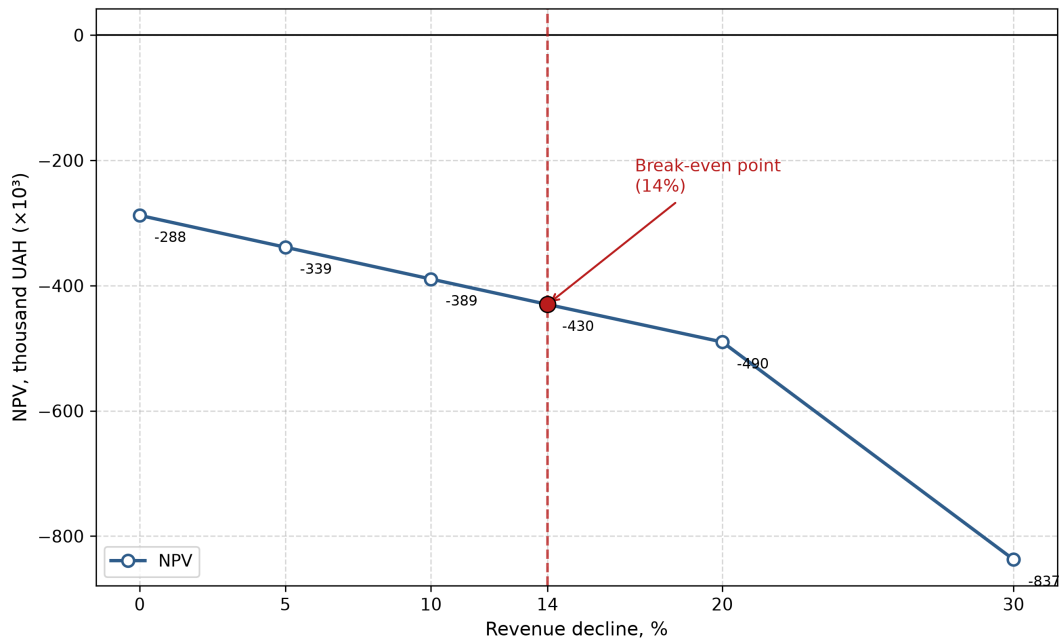
Revenue decline, %	NPV, thousand UAH	Interpretation
0	-287,832	Loss-making
5	-338,662	Loss-making
10	-389,492	Loss-making
14	-430,000	Break-even point
20	-490,000	Critical zone
30	-837,374	Complete loss of sustainability

Source: calculated by the authors on the basis of the data in Tables 1-5.

The calculation of the break-even point was carried out on the basis of comparing the total discounted net profit and total investment. Since under the base scenario the discounted NP (386,142 thousand UAH) is less than total investment (673,974 thousand UAH), the project is loss-making. The break-even point is defined as the magnitude of revenue decline at which the discounted NP becomes equal to zero, taking into account the proportional reduction of net profit. The calculation was performed by the formula:

$$\Delta = \left(\frac{NP_{total} - I_0}{NP_{total}} \right) \times 100\% = \Delta = \left(\frac{590,950 - 673,974}{590,950} \right) \times 100\% = -14.04\% \quad (12)$$

The negative value indicates that in order to achieve zero NPV, not a decline but an increase in revenue is required. In other words, under the current investment structure the enterprise does not achieve payback even whilst maintaining revenue at the base level. The threshold value of 14% characterises the margin of safety: if revenue declines by more than 14%, the loss becomes critical, and the investment and innovation strategy requires immediate adjustment. The dependence of NPV on revenue decline is visualised in Fig. 3.

**Fig. 3. Dependence of NPV on revenue decline: break-even point**

Source: compiled by the authors on the basis of the data in Table 6.

Figure 3 demonstrates the linear nature of the dependence of NPV on revenue decline and makes it possible to determine the break-even point visually. The intersection of the graph line with the zero mark at the point of 14% indicates that if revenue declines by more than 14%, the enterprise loses the ability to generate a positive net present value from investment and innovation activity.

The weighted NPV assessment by scenario is visualised in Fig. 4.

Structure of weighted losses by scenario
Total weighted NPV = -490,054 thousand UAH

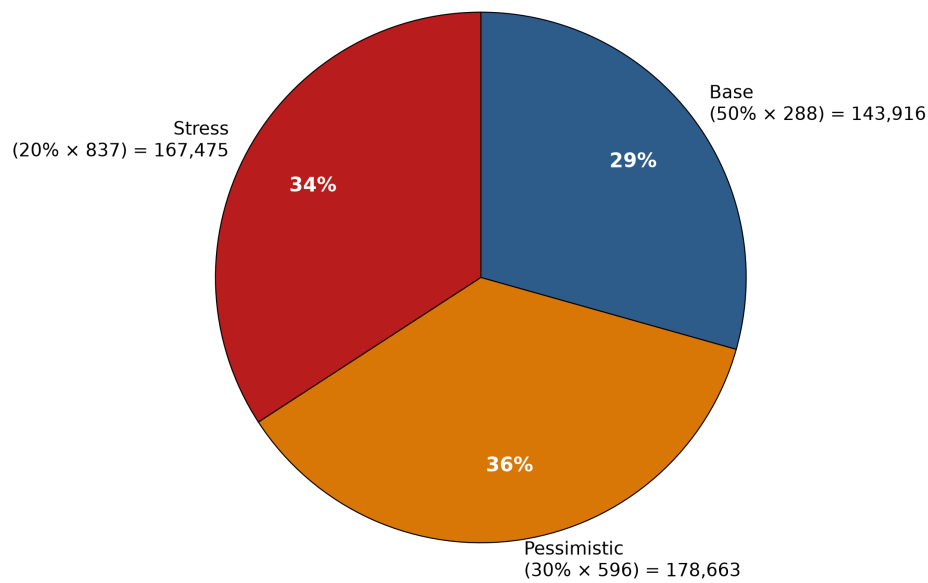


Fig. 4. Weighted NPV assessment by scenario of investment and innovation development

Source: compiled by the authors on the basis of the data in Table 5.

Figure 4 shows that the largest contribution to the weighted NPV is made by the pessimistic (36%) and stress (35%) scenarios, which reflects the high probability of negative scenarios being realised and the need to develop protective measures. The base scenario contributes 29% to the weighted assessment.

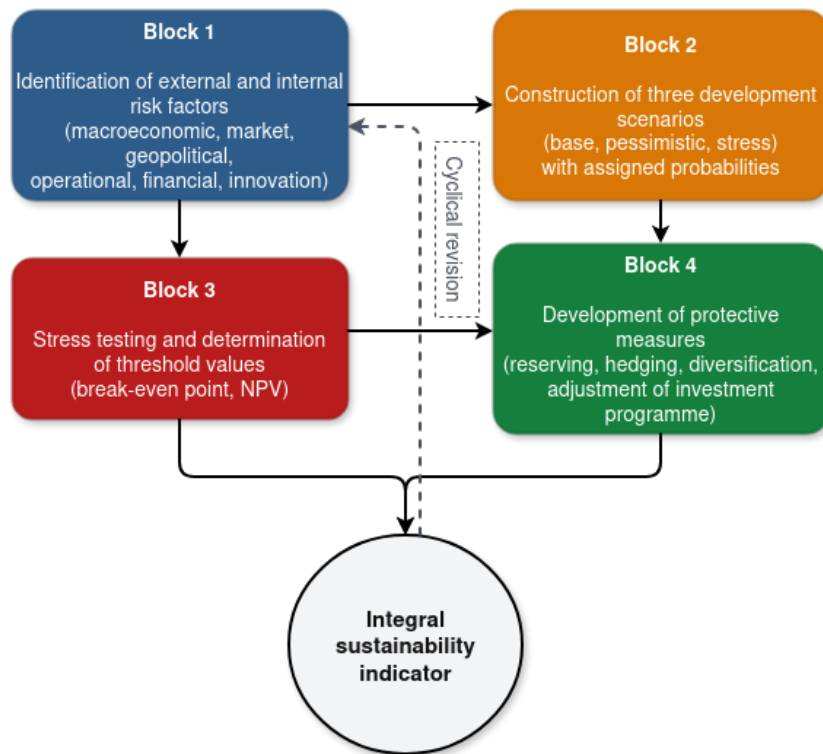


Fig. 5. Conceptual model for integrating scenario modelling and stress testing into the risk management system of the investment and innovation development of an enterprise

Source: compiled by the authors

Figure 5 visualises the proposed conceptual model for integrating scenario modelling and stress testing into the risk management system. The model is of a cyclical nature: as external conditions change, risks are re-identified, scenarios are revised and threshold values are updated. The central element of the model is the integral sustainability indicator, determined on the basis of comparing the discounted net profit and total investment.

Interpretation of Results

The results obtained make it possible to formulate the following conclusions.

- The enterprise demonstrates a sustained positive dynamic of revenue and gross profit throughout 2021–2025, which indicates the preservation of operational efficiency even under conditions of wartime uncertainty.
- The investment activity of the enterprise declined consistently, which led to a negative NPV value under the base scenario. However, the innovation component of investment (intangible assets and part of capital investment in equipment) demonstrates positive effectiveness (NPV = +176,354 thousand UAH), which confirms the expediency of investment in innovation.
- Scenario modelling revealed the high sensitivity of the enterprise's financial results to changes in market conditions. Under the pessimistic and stress scenarios, the enterprise becomes loss-making, and the NPV of the project reaches critical values.
- The break-even point, determined at the level of 14% decline in revenue, can be used as a key benchmark for risk management.
- The weighted NPV assessment (–490,054 thousand UAH) reflects the expected level of losses taking into account scenario probabilities and can be used to substantiate managerial decisions.

The results obtained are of practical significance for enterprises operating under conditions of high uncertainty. The proposed approach to integrating scenario modelling and stress testing into the risk management system of investment and innovation development can be adapted for other industrial enterprises, taking into account their industry specifics and scale of activity.

Discussion

Significance of the Results Obtained for the Theory and Practice of Risk Management

The study conducted makes it possible to extend existing understanding of the role of scenario modelling and stress testing in the management system of the investment and innovation development of industrial enterprises. The results obtained are of significance for several interrelated areas: the theory of risk management, the practice of strategic enterprise management and the methodology for assessing the sustainability of investment decisions.

The central conclusion of the study is that the investment and innovation development of an enterprise cannot be considered in isolation from the risk management system. The negative value of net present value under the base scenario, on the one hand, and the positive value of NPV of the innovation component of investment, on the other hand, demonstrate that conventional assessment of investment effectiveness without taking into account the structure of investment and its differentiated role may lead to distorted managerial decisions. This conclusion is of theoretical significance, as it refines the understanding of the relationship between investment activity, innovation potential and the enterprise's resilience to external shocks.

Comparison with Existing Studies

The results obtained are consistent with the conclusions of Garbar (2026) regarding the need for a transition from a discrete assessment of investment attractiveness to a dynamic information profile that takes into account innovation and digital potential and resilience to risks. The analysis conducted confirms that an enterprise that maintains operational efficiency under conditions of wartime uncertainty but reduces investment activity may demonstrate formally negative indicators of investment effectiveness whilst preserving real innovation potential. This indicates the need for a finer differentiation of investment flows when assessing the sustainability of development.

The identified differentiation of the effectiveness of various types of investment correlates with the results of Pham et al. (2026), who established that the productivity of managerial

investments in capabilities systematically varies depending on the industry knowledge base and the type of innovation (incremental or disruptive). The present study shows that a similar differentiation is also observed at the level of the structure of capital investment: investment in maintaining production capacities and investment in intangible assets have different effects on the integral effectiveness of the project.

The determination of the break-even point at the level of 14% revenue decline is consistent with the methodological approaches of Deng (2025), who considers stress testing and scenario analysis as tools for enhancing the sustainability of investment portfolios. At the same time, the present study extends the application of these tools beyond the financial sector by demonstrating their applicability to industrial enterprises engaged in investment and innovation activity.

The results obtained complement the conclusions of Turun and Zachosova (2026) regarding the need to apply resilient management and stress testing of financial and human resources under conditions of wartime risks. The analysis conducted confirms that an enterprise operating under conditions of wartime uncertainty retains the ability to generate positive financial results; however, its investment sustainability is limited to a relatively narrow range of permissible revenue deviations. This observation emphasises the importance of timely identification of threshold values and the development of protective mechanisms.

Theoretical Application

The study conducted contributes to the development of risk management theory by refining the role of scenario modelling and stress testing in the contour of managing investment and innovation development. Traditionally, these tools are considered predominantly as means of assessing financial risks or as elements of crisis management. The present study demonstrates that their application should be integrated into the strategic management contour, ensuring continuous assessment of the sustainability of investment decisions to a wide range of external shocks.

The results obtained also refine the understanding of the relationship between investment activity and the innovation potential of an enterprise. A reduction in investment activity under conditions of uncertainty does not necessarily mean a loss of innovation potential, provided that investment in intangible assets and technological renewal is maintained at a sufficient level. This observation extends existing understanding of the factors of sustainability of innovation development under crisis conditions.

Practical Application

The results of the study have a number of practical implications for managing the investment and innovation development of enterprises.

1. The enterprise withstands a decline in revenue of up to approximately 14%, after which the investment and innovation strategy becomes loss-making. This indicator can be used as a key benchmark for risk management in developing protective measures. As actual or forecast revenue values approach this threshold, it is advisable to initiate a review of the investment programme and mobilise reserves.

2. The differentiation of investment into supporting and innovation investment makes it possible to assess the effectiveness of investment activity more accurately. The negative value of NPV under the base scenario does not mean that all investment is ineffective: the innovation component demonstrates positive effectiveness. This conclusion can be used in substantiating investment policy priorities.

3. The weighted NPV assessment taking into account scenario probabilities can be applied as an integral indicator of the expected level of losses. This indicator makes it possible to take into account not only the most probable but also negative development scenarios, which corresponds to the principles of prudence in risk management.

4. The proposed approach can be adapted for other industrial enterprises through the following steps: a) identification of industry-specific risk factors particular to the enterprise (for example, for metallurgy enterprises – raw material prices, for machine-building – demand for investment goods); b) scenario parameters should be determined on the basis of a retrospective analysis of industry dynamics, and not only macroeconomic indicators; c) threshold values of

sustainability should be calculated taking into account the capital structure and availability of external financing; d) the list of protective measures should take into account industry-specific possibilities for hedging and diversification.

Prioritisation of investment can be carried out on the basis of the following criteria: 1) contribution to innovation potential (share of investment in intangible assets and technological renewal); 2) impact on resilience to external shocks (reduction of dependence on a single customer, diversification of supplies); 3) payback period (priority is given to projects with a short payback period under conditions of high uncertainty); 4) availability of external financing (projects secured by confirmed financing have priority).

Limitations of the Study

The interpretation of the results obtained must take into account a number of limitations. The empirical analysis was conducted on data from a single enterprise operating under specific conditions (tolling raw materials processing, export orientation, location in a relatively safe region). This limits the possibility of directly transferring the conclusions to other enterprises without appropriate adaptation.

The five-year analysis horizon includes the period of military conflict, which creates unique conditions for the enterprise's functioning. The results obtained may not be fully applicable to peacetime conditions or to other periods of economic development.

The absence of a separate line for "investment in innovation" in the financial statements necessitated the use of proxy indicators, which introduces a certain degree of convention into the calculations. The use of a single discount rate for all scenarios does not take into account possible changes in the cost of capital under different scenarios.

Conclusion

The study conducted made it possible to substantiate the expediency of integrating scenario modelling and stress testing into the risk management system of the investment and innovation development of an industrial enterprise. Using the example of Jabil Circuit Ukraine Limited LLC for 2021-2025, it was demonstrated that the application of these tools ensures not only an assessment of the sustainability of investment decisions to external shocks but also forms the basis for substantiating investment policy priorities under conditions of high uncertainty.

The key conclusion of the study is that the investment and innovation development of an enterprise cannot be assessed exclusively on the basis of integral indicators of investment effectiveness. The analysis conducted showed that under the base scenario the net present value of the project takes a negative value, which formally indicates the ineffectiveness of investment activity. However, the differentiation of investment into supporting and innovation investment revealed the positive effectiveness of the innovation component, which confirms the need for a finer structuring of investment flows in managerial decision-making. This conclusion is of significance for risk management theory, as it refines the understanding of the relationship between investment activity, innovation potential and the sustainability of an enterprise.

The practical significance of the study lies in determining the break-even point of the investment and innovation strategy at the level of 14% revenue decline. This indicator can be used as a key benchmark for risk management in developing protective measures and initiating a review of the investment programme as actual or forecast revenue values approach the threshold level. The weighted assessment of net present value taking into account scenario probabilities makes it possible to consider not only the most probable but also negative development scenarios, which corresponds to the principles of prudence in risk management.

The proposed approach to integrating scenario modelling and stress testing into the contour of managing investment and innovation development can be adapted for other industrial enterprises, subject to adjustment of scenario parameters in accordance with industry specifics, capital structure and availability of external financing. The universal elements of the approach are the logic of scenario construction, the methodology for determining threshold values and the principle of differentiating investment into supporting and innovation investment. The main elements of the approach are the identification of risk factors, the construction of scenarios taking into account the

probabilities of their realisation, the determination of threshold values of sustainability and the development of a set of protective measures.

The main limitation of the study is its conduct on data from a single enterprise operating under specific conditions of wartime uncertainty. This limits the possibility of directly transferring the conclusions obtained to other enterprises without appropriate adaptation. An additional limitation is the use of proxy indicators for assessing investment in innovation, which introduces a certain degree of convention into the calculations.

Further research should be directed towards empirical testing of the proposed approach on data from other enterprises operating in various industries and regions. The expansion of scenario modelling through the inclusion of additional risk factors and the application of simulation modelling for assessing probability distributions of results appear promising. Particular attention should be paid to the development of methodological recommendations for determining threshold values of sustainability for enterprises of various industries and scales of activity, as well as to the integration of the proposed approach with the tools of predictive analytics and machine learning.

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