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SCENARIO APPROACH IN THE PROCESSES OF DIGITAL TRANSFORMATION OF INDUSTRIAL ENTERPRISES

Abstract. *The article is devoted to development of scenarios for activating digital transformation of industrial enterprises in the face of modern challenges. It is proven that digital transformation is a continuous process that requires flexibility and strategic thinking, and taking risks into account will allow industrial enterprises not only to achieve short-term goals, but also to ensure long-term development. It is substantiated that detection and identification of key risks is an important step in ensuring successful digital transformation of industrial enterprises, as it allows to identify the main threats and potential challenges that can affect implementation of new technologies, change business processes and adaptation to changing market conditions. A matrix of risks and opportunities for the digital transformation of industrial enterprises is presented. Threats and benefits of digital transformation of these enterprises are studied. A basic, optimistic and pessimistic scenario of digital transformation is proposed, which allows assessing various options for the impact of external and internal factors on business processes of the enterprise.*

Key words: *digitalization, digital transformation, scenario approach, industrial enterprises, risks, strategy, economic instability, innovative development, innovative decision-making, investment projects.*
Fig.: 2. Table: 3. References: 10.

Problem statement. Digital transformation is a strategic imperative for industrial enterprises that seek to remain competitive in the face of rapid technological development. Digital transformation is accompanied by significant challenges and risks that can affect achievement of transformation goals that industrial enterprises set for themselves. Detection and identification of risks is a key factor in success, as it allows you to avoid negative consequences, ensure efficiency of functioning and development of the enterprise, and increase its resilience to changes in the external and internal environment.

Taking risks into account in digital transformation allows you to plan the use of resources more effectively. This applies not only to financial costs, but also to time, human resources and technical infrastructure. Ignoring risks can lead to excessive concentration of resources on projects that do not bring value, or to insufficient funding of promising initiatives, which will be negatively reflected primarily in the medium and long term.

Analysis of recent research and publications. Publications by domestic and foreign scientists are devoted to current trends in digital transformation of industrial enterprises, including features of formation of development scenarios, among which it is worth noting: Cox Jr. L. Anthony (Tony), B. Anyanwu, M. Birgonul, I. Dikmen, D. Drljača, D. Hillson, M. Hopkinson, V. Ilchuk, J. Jia, I. Nwaogazie, A. Qazi, O. Shishkina et al.

Highlighting unexplored parts of the general problem. Given significant contribution of scientists to this area of research, the issue of forming scenarios for digital transformation of industrial enterprises, taking into account modern risks requires further analysis and in-depth research.

The purpose of the article is to develop scenarios for activating digital transformation of industrial enterprises in the face of modern challenges.

Presentation of the main material. The conducted research allowed us to identify the main groups of risks of digital transformation of industrial enterprises. Thus, significant risks of industrial enterprises are associated with inability to minimize financial costs. Among other things, this is due to the fact that digital transformation risks are generated by a significant amount of investment, which is necessary for development and / or implementation of new technologies, equipment modernization, personnel training, etc. Ignoring these risks can lead to significant financial losses, especially if investment projects turn out to be unprofitable or do not provide the expected return. For example, the industrial enterprise can invest significant funds in implementation of automated control systems, but at the same time not take into account incompatibility of equipment or insufficient training of employees who are to be involved in production processes. As a result, due to failures or improper use of new production systems, instead of increasing efficiency, there may be the decrease in productivity, which will be reflected in the results of the enterprise's activities. At the same time, taking risks into account will allow you to assess economic feasibility of the project in advance, identify weaknesses, avoid misuse of resources, and prevent losses.

Risks associated with the economic instability of the modern business environment, changes in legislation, fluctuations in demand for industrial products, and technological disruptions can significantly affect the success of digital transformation. Such a negative impact of risk-forming factors determines the need for enterprises to adapt to rapid changes. Industrial enterprises that ignore these risks may find themselves in a situation where their investments in technological innovations become impractical due to changing market conditions. For example, a planned introduction of a new product may lose relevance due to the emergence of a more innovative solution from competing enterprises. Forecasting possible changes and taking risks into account allows enterprises to be prepared for different scenarios of operation and development and quickly adapt their strategic plans.

Possible disruptions in operation of the enterprise during transition to new technologies form another significant group of risks related to ensuring the continuity of business processes. Integration, configuration and training of personnel can temporarily reduce productivity, and in case of serious errors - lead to stoppage of production or loss of data. Understanding and taking into account these risks allows you to develop and implement anti-crisis measures in advance. The example of these anti-crisis measures can be a pilot launch of technologies in the separate production area, to test their effectiveness and avoid disruptions and losses on the scale of the entire enterprise.

Digital transformation affects interests of the wide range of stakeholders, including owners, managers, employees, investors, customers, and partners. Taking into account risks of complying with interests of stakeholders and being careful about change management will help build trust in transformation process, which minimizes the threat of resistance to digitalization. For example, investors will be willing to invest in transformation if they see that the company has analyzed possible risks and developed the plan to minimize them. Similarly, employees will be more loyal to change process if they understand that digital transformation will positively affect their work, and that the company is taking the system of measures to reduce negative consequences for staff.

The above allows us to establish specific properties of digital transformation risks inherent in industrial enterprises, which, in our opinion, should include as follows:

– complexity of changes, which is due to comprehensive nature of digital transformation, affecting all aspects of the enterprise's activities from production to interaction with customers, which increases the number of potential threats;

– speed of change associated with rapid development of technological innovations, as a result of which enterprises may not have time to adapt to new conditions, which increases the likelihood of risks;

– dependence on the external environment, which directly or indirectly affects digital transformation plans, increasing uncertainty of consequences.

Therefore, digital transformation is the ongoing process that requires flexibility and strategic thinking, and taking risks into account will allow industrial enterprises not only to achieve short-term goals, but also to ensure long-term development.

Identifying and identifying key risks is an important first step in ensuring successful digital transformation of industrial enterprises, as it allows you to identify the main threats and potential challenges that can affect implementation of new technologies, change business processes, and adapt to changing market conditions.

The next important stage is development of the key tool for forecasting and analyzing potential challenges and benefits from digital transformation, prioritizing management activities, and finding balance between negative and positive aspects of the strategic decision, which is called the risk and opportunity matrix. In essence, the matrix is a two-dimensional model that allows you to systematize risks and opportunities depending on their impact and probability of implementation. The process of building the matrix is presented in Fig. 1.

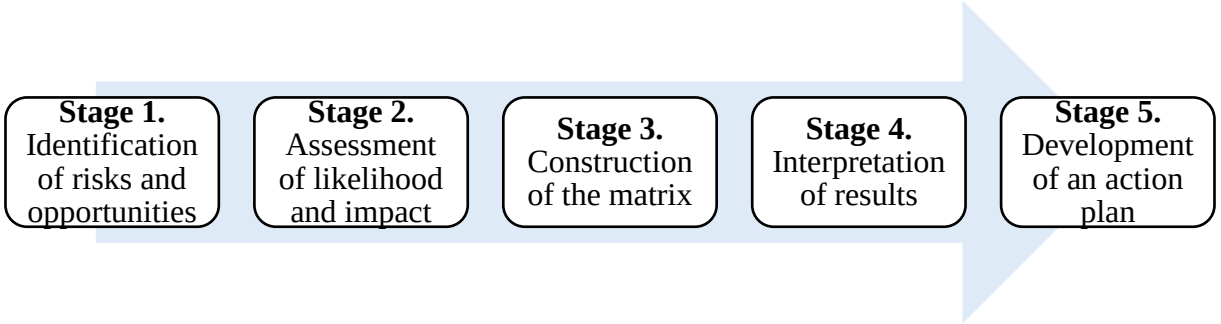

Fig. 1. The process of building the matrix of risks and opportunities

Source: *developed by the authors based on [1-7].*

At the stage of identifying risks and opportunities, it is important to collect the most complete list of risks and opportunities arising in the process of digital transformation. For this, you can use the following: expert surveys and interviews with company leaders, industry specialists, the SWOT analysis, the PESTEL analysis.

Assessment of the probability and impact of risks should be carried out according to probability criteria and can be determined in quantitative (percentage) or qualitative indicators (high, medium, low probability) and in terms of impact, the level of which can be assessed on the scale from “minor” to “critical” or in financial or operational indicators (for example, the amount of losses/ benefits).

Assessment results are placed in the matrix consisting of four main sectors (Table 1), with each risk and opportunity being placed in the corresponding square of the matrix depending on values of the probability and impact parameters.

Table 1

Visualization of the Risk and Opportunity Matrix

Probability	**Influence**		
	Low	Average	High
Low	(1) Insignificant	(2) Acceptable	(3) Potential
Medium	(4) Minor	(5) Important	(6) Critical
High	(7) Unique	(8) Risky	(9) Strategic

***Source**: developed by the authors based on [1-7].*

In Quadrant 1, one can find reflection of insignificant risks or opportunities that can be left without active management. In Quadrants 2-3,potential risks and opportunities that need to be monitored are placed. Quadrants 4-6 are important for analyzing the event, so you should prepare for them. Quadrants 7-9 contain strategically important risks or opportunities that require priority attention.

The risk and opportunity matrix allows you to develop the action plan and develop practical recommendations for minimizing risks and ways to use identified opportunities.

The conducted research allows us to summarize the main features of constructing the matrix of risks and opportunities, to which we consider it appropriate to include the following:

– individualization for the specific enterprise (adaptation of the matrix to the specifics of the industry, the scale of the enterprise and the external environment);

– dynamic matrix update, which is especially important in conditions of rapid change in technologies and market conditions;

– combination of quantitative and qualitative assessment methods, which will allow achieving not only accuracy of the analysis, but also taking into account non-financial aspects;

– integration with other tools and in the context of considering the matrix as part of the strategic toolkit of industrial enterprise.

The study of industrial enterprises of various types of activity allowed us to construct the generalized matrix of risks and opportunities for their digital transformation (Table 2).

Table 2

Risk and opportunity matrix for digital transformation of industrial enterprises

Probability	Influence		
	Low	Average	High
Low	(1) Minor delays in technology implementation	(2) Local production disruptions	(3) Experimental projects without large-scale impact
Medium	(4) Increasing costs for infrastructure upgrades	(5) Lack of qualified personnel	(6) Partial automation of processes
High	(7) Rapid technology obsolescence	(8) Cyberattacks, data loss	(9) Massive productivity and cost savings

***Source**: developed by the authors based on [2-7].*

Risks of minor delays in the technology implementation (1) arise from administrative or organizational barriers. They are usually local in nature and do not affect overall success of the project, and therefore their impact is insignificant.

Local production disruption risks (2) are associated with implementation of new systems in limited production areas. They have medium impact, as these disruptions may cause temporary inconvenience but do not pose the critical threat.

Experimental projects without scale (3) – these are opportunities that have low probability of creating significant impact, but can serve as a source of new ideas for scaling in the future.

The increase in infrastructure upgrade costs (4) should be considered as medium-probability risk related to the need to upgrade equipment to support digital technologies. These costs can reduce profitability of projects in the short term.

In our opinion, the lack of qualified personnel (5) is one of the key risks of digital transformation, which complicates implementation of new systems and requires time to train employees, and therefore can be classified as having the medium impact.

The possibility of partial automation of processes (6) has medium impact and medium probability and allows to reduce costs and increase productivity at individual stages of production, but does not cover the entire cycle of work of the industrial enterprise.

The risk of rapid technology obsolescence (7) is, in our opinion, one of the high ones, since the pace of development of digital technologies is currently extremely high. Given this, untimely updating of equipment can lead to the loss of competitive advantages of the industrial enterprise in all areas of its activity.

The risk of cyberattacks and data loss (8) is the most critical risk of digital transformation, which can cause significant financial and reputational losses for the enterprise. At the same time, high level of probability and significance of its impact requires urgent measures to minimize it.

Scalable productivity and cost savings (9) are the key and most impactful opportunity of digital transformation, allowing enterprises to significantly improve operational efficiency, reduce costs, and increase production volumes.

The matrix allows enterprises to assess threats and benefits in more structured way, providing the basis for making informed management decisions. The matrix allows:

– first, identify priorities by highlighting quadrants that require special attention, i.e. quadrants (8), (9) with high probability and high impact;

– second, allocate resources to monitor and manage risks in medium-impact quadrants (items (4), (5), (6));

– third, focus on periodic monitoring of less critical risks (1), (2), (3), the impact of which is low, given that they can be left without active intervention.

In addition, it is worth evaluating opportunities in high-impact quadrants to maximize benefits.

Based on the developed matrix of risks and opportunities, we can systematize threats and benefits of digital transformation of industrial enterprises (Table 3).

Table 3

Threats and benefits of digital transformation of industrial enterprises

Category	Threats (risks)	Benefits (opportunities)
1	2	3
Economic	- Increasing costs for infrastructure upgrades	- Reduction of production costs through automation
	- High cost of implementing new technologies	- Increased profitability through improved efficiency
	- Uncertainty of return on investment in digital projects	- Optimization of resource usage
Technologic	- Rapid technology obsolescence	- Ability to implement advanced automation solutions
	- Low compatibility with existing infrastructure	- Improvement of technological processes
	- Growing cyber risks and data loss risk	- Access to innovations that help scale your business
Organizational	- Employee resistance to change	- Improving production process management
	- Insufficient staff qualifications	- Improving skills of employees, which enhances competitiveness
	- Coordination problems between departments during transformation	- Creating flexible and adaptive business models
Market	- Increased competition from innovative companies	- Market share growth through rapid innovation
	- Change in demand for traditional products or services	- Entering new markets thanks to digital tools
	- Risks of new products not meeting market expectations	- Increasing customer focus through data analysis.
Social	- Social tension due to job cuts	- Improving working conditions through automation of routine operations
	- Loss of some qualified personnel due to automation	- Attracting young professionals with digital skills

End of table 3

1	2	3
Environmental	- Increase in energy consumption due to the introduction of new technologies	- Reduced environmental impact through more precise resource management
	- Risk of non-compliance of new technologies with environmental standards	- Ability to develop sustainable and environmentally friendly processes

***Source**: developed by the authors based on [1; 8-10].*

Table 3 clearly shows the balance between risks and benefits of digital transformation. It highlights the need to consider risks as increased cyber threats, infrastructure costs, and social tensions, and points to significant benefits including cost reduction, productivity gains, market penetration, and improved governance, as well as opportunities that can enhance competitiveness of the industrial enterprise.

However, to effectively apply results of this analysis, it is necessary to proceed to modeling possible scenarios of development of events. Scenario modeling allows assessing possible trajectories of digital transformation of industrial enterprises depending on external conditions, the level of risks and use of opportunities. Formation of basic, optimistic and pessimistic scenarios of digital transformation allows assessing various options of influence of external and internal factors on business processes of the enterprise (Fig. 2). These scenarios are the foundation for strategic planning, as they allow to prepare the enterprise for any development of events, to minimize negative consequences and to maximize potential benefits.

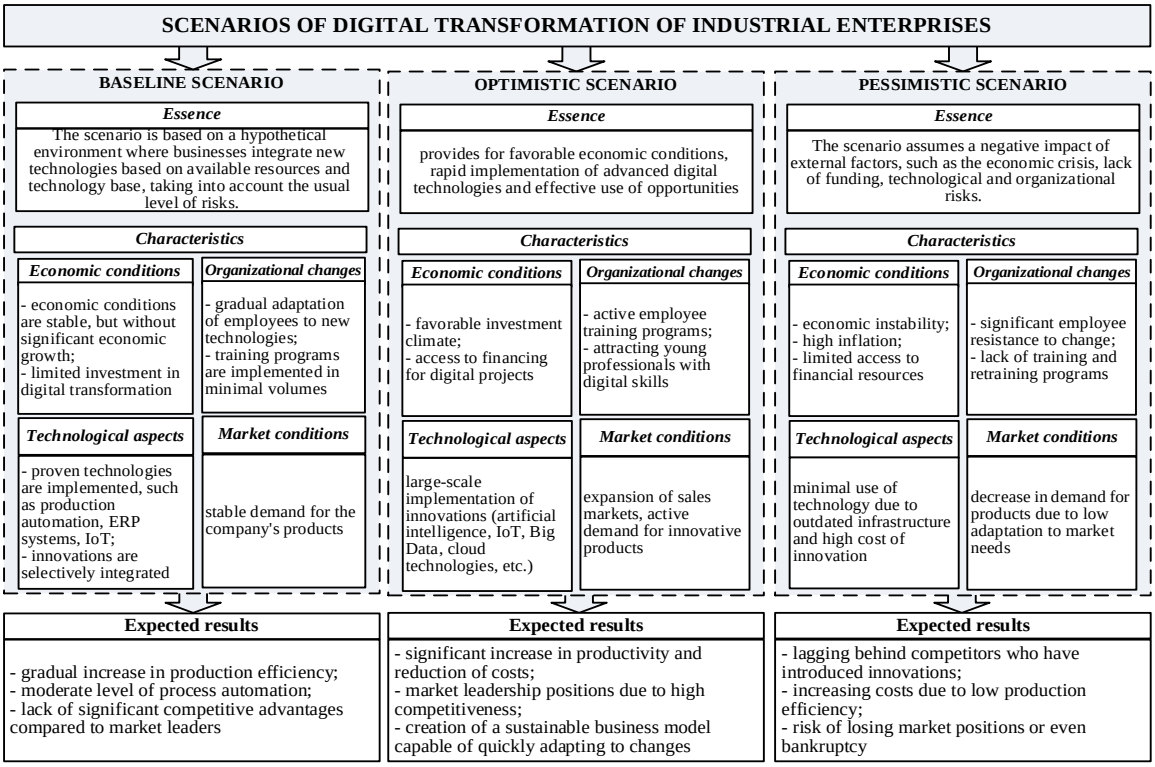

Fig. 2. Scenarios for digital transformation of industrial enterprises

***Source**: developed by the authors.*

The baseline scenario assumes gradual introduction of digital technologies without significant disruptions or threats and is based on predictable environment where enterprises integrate new technologies based on available resources and technology base, taking into account the usual level of risks.

The optimistic scenario assumes favorable economic conditions, rapid implementation of advanced digital technologies, and effective use of opportunities. Under this scenario, the company becomes the industry leader through innovation and active adaptation to change.

The pessimistic scenario assumes intensification of negative impact of external factors (increasing economic crisis, lack of financing, technological and organizational risks, etc.). In this scenario, digital transformation faces numerous obstacles, and probability of its implementation is minimal.

These scenarios show possible development trajectories depending on conditions and management decisions. For successful digital transformation, it is important to strive for implementation of the optimistic scenario, but at the same time it is necessary to prepare for the base scenario and have a plan for pessimistic development of events. Using the scenario approach allows enterprises to act more flexibly, effectively allocate resources and minimize risks.

Summarizing the analysis of digital transformation scenarios, we'd like to note that the baseline scenario is suitable for enterprises that seek to minimize risks, but require additional measures to ensure long-term competitiveness. The optimistic scenario is the most promising, but requires involvement of significant financial resources and effective risk management. The pessimistic scenario can maintain short-term stability, but causes long-term losses due to the lack of innovation. Results of this analysis emphasized that none of the scenarios is ideal in itself: each of them requires careful planning, risk management and effective use of opportunities. In view of this, the best approach is to adapt the strategy that combines advantages of the baseline and optimistic scenarios with minimizing risks of pessimistic development.

However, to achieve successful digital transformation, it is important to move from the diagnostic stage to formulation of practical measures that will allow enterprises to minimize risks inherent in each scenario and maximize benefits offered by modern technologies. It is the formulation of specific, actionable recommendations that becomes the key step in transforming analytical conclusions into real management decisions.

Developing the digital transformation strategy involves:

– clear definition of goals that focus on the key areas of digital transformation that are consistent with the overall strategy of the enterprise;

– development of the transformation roadmap with stages of technology implementation;

– regular review of the strategy taking into account changes in the external environment.

Clearly formulated goals focus attention on the key areas and help avoid misallocation of resources, while the roadmap allows for gradual implementation of changes, reducing the risk of failures.

To increase efficiency of the financial risk management, we consider it advisable to:

– distribute investments in digital transformation into several stages to reduce financial burden on the industrial enterprise and reduce the risk of budget overruns;

– constantly conduct the analysis of the investments profitability based on factual data, which allows you to determine effectiveness of costs and make informed decisions about their adjustment;

– use various sources of funding, including government programs, grants, and credit resources.

To reduce technological risks, the following recommendations should be followed:

– implement proven technologies that reduce the risk of errors at the early stages, and gradually experiment with innovations;

– ensure compatibility of new technologies with existing infrastructure, minimizing delays and additional costs;

– Regularly update cybersecurity systems to protect data and prevent cyber threats and financial losses.

Managing organizational change requires:

– creating the culture of change through open communication with employees about goals and benefits of digital transformation, which helps reduce their resistance;

– organization of continuous training and retraining of personnel, which will allow for effective use of new technologies.

Using analytical data helps to identify growth points, assess risks and adjust the strategy, which allows you to respond to external changes in the timely manner. In view of this, we consider it advisable to:

– implement data collection and analysis systems to make informed decisions;

– use forecasting tools to assess market trends and changes in demand;

– constantly analyze effectiveness of new technologies and business processes.

Building partnerships allows you to gain access to advanced technologies, expand your staff's knowledge, and implement innovations at lower costs. Considering this, it is worth to:

– collaborate with technology providers to obtain modern solutions;

– enter into partnerships with educational institutions for staff training;

– interact with other enterprises to share digital transformation experiences.

Developing anti-crisis plans that, among other things, help avoid disruptions and maintain operational efficiency helps ensure sustainability of the enterprise in times of uncertainty. With this in mind, we'd like to recommend to:

– identify critical processes and develop backup plans to ensure their continuity;

– include rapid response mechanisms to external risks, including economic crisis or the change in the regulatory environment;

– test plans regularly resumption of work.

Maximizing benefits through scaling provides long-term benefits, allowing the enterprise to adapt to market changes and expand its activities. This requires:

– creating the system of scalable solutions that can be applied to other production sites;

– using the business management platform that allows you to integrate new modules without significant costs;

– constantly assessing opportunities to enter new markets or segments through digital solutions.

We believe that the above recommendations will provide the comprehensive approach to risk management and use of digital transformation opportunities, and their implementation will minimize financial, technological, organizational and market risks, thereby ensuring stable development and increased competitiveness of industrial enterprises in modern business conditions.

Taking risks into account in digital transformation of industrial enterprises is critical, as it allows to avoid financial losses, ensure business continuity, increase resilience to uncertainty and efficiency of resource management. In addition, it contributes to formation of trust among stakeholders and creates the basis for the long-term development. Ignoring risks can lead to significant losses and the decrease in competitiveness, so enterprises should consider risks as an integral element of strategic planning for digital transformation.

The Risk and Opportunity Matrix is a powerful tool for managing uncertainty in digital transformation. It helps to systematize threats and benefits, focus attention on the most critical aspects and make informed decisions. Its use provides more flexible and effective planning, contributing to achievement of strategic goals of the enterprise.

Conclusions. Construction of the basic, optimistic and pessimistic scenarios of digital transformation demonstrated as follows: the basic scenario is characterized by stability and risk minimization, but has limited speed of change; the optimistic scenario opens up wide opportunities for innovation and market leadership, but requires significant investments and effective threat management; the pessimistic scenario maintains short-term stability, but carries high long-term risks of losing competitiveness.

Changes in key business processes (production management, supply chain, customer interaction, human resources management, and innovation) depend on the chosen scenario. The optimistic scenario assumes a high level of automation, personalized customer interaction, and active innovation development. The baseline scenario focuses on partial automation and stable development. The pessimistic scenario is limited to maintaining the status quo with minimal innovation.

It has been proven that none of the scenarios is a universal solution; therefore the enterprise strategy must be adaptive, taking into account the specifics of the industry and capabilities of the enterprise. The most effective is combination of the gradual approach of the baseline scenario and innovative focus of the optimistic scenario.

Thus, digital transformation is the challenge and at the same time an opportunity for industrial enterprises. Its success depends on readiness of enterprises for change, effective risk management and using strengths and opportunities. Implementation of practical recommendations based on scenario modeling and SWOT analysis will allow enterprises to minimize risks, achieve strategic goals and ensure competitiveness in the digital economy.

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СЦЕНАРНИЙ ПІДХІД У ПРОЦЕСАХ ЦИФРОВОЇ ТРАНСФОРМАЦІЇ ПРОМИСЛОВИХ ПІДПРИЄМСТВ

Анотація. *Доведено, що цифрова трансформація є постійним процесом, що вимагає гнучкості та стратегічного мислення, а врахування ризиків дозволить промисловим підприємствам не лише досягти короткострокових цілей, але й забезпечити довгостроковий розвиток. Обґрунтовано, що виявлення та ідентифікація ключових ризиків є важливим кроком у забезпеченні успішної цифрової трансформації промислових підприємств, оскільки дозволяє виявити основні загрози та потенційні виклики, які можуть вплинути на впровадження нових технологій, зміну бізнес-процесів та адаптацію до мінливих ринкових умов. Наведено матрицю ризиків і можливостей для цифрової трансформації промислових підприємств. Досліджено загрози та вигоди цифрової трансформації таких підприємств. Запропоновано базовий, оптимістичний та песимістичний сценарії цифрової трансформації, що дозволяє оцінити різні варіанти впливу зовнішніх і внутрішніх факторів на бізнес-процеси підприємства. Базовий сценарій передбачає поступове впровадження цифрових технологій без значних проривів чи загроз й базується на передбачуваному середовищі, де підприємства інтегрують нові технології на основі доступних ресурсів і технологічної бази, враховуючи звичайний рівень ризиків. Оптимістичний сценарій передбачає сприятливі економічні умови, швидке впровадження передових цифрових технологій та ефективне використання можливостей. За умови реалізації даного сценарію підприємство стає лідером галузі завдяки інноваціям та активній адаптації до змін. Песимістичний сценарій передбачає активізацію негативного впливу зовнішніх факторів (посилення економічної кризи, відсутність фінансування, технологічні та організаційні ризики тощо). За цього сценарію цифрова трансформація стикається з численними перешкодами, а ймовірність її впровадження є мінімальною. Зазначено, що запропоновані сценарії показують можливі траєкторії розвитку залежно від умов та управлінських рішень. Акцентується увага на тому, що для успішної цифрової трансформації важливо прагнути реалізації оптимістичного сценарію, проте водночас необхідно готуватися до базового сценарію і мати план на випадок песимістичного розвитку подій. Обґрунтовано, що використання сценарного підходу дозволяє підприємствам діяти більш гнучко, ефективно розподіляти ресурси та мінімізувати ризики.*

Ключові слова: *цифровізація; цифрова трансформація; сценарний підхід; промислові підприємства; ризики, стратегія; економічна нестабільність; інноваційний розвиток; інноваційне прийняття рішень; інвестиційні проєкти.*

Рис.: 2. Табл.: 3. Бібл.: 10.

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