

Lomachynska I., Skoruk A., Liventsov R. Toolkit for evaluating the effectiveness of digital transformation of business models. Journal of Education, Health and Sport. 2026;88:69946. e-ISSN 2391-8306.
<https://dx.doi.org/10.12775/JEHS.2026.88.69946>
<https://apcz.umk.pl/JEHS/article/view/69945>
<https://zenodo.org/records/19097904>

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences). Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przepisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu). © The Authors 2026;

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The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 20.01.2026. Revised: 27.01.2026. Accepted: 11.02.2026. Published: 26.02.2026.

TOOLKIT FOR EVALUATING THE EFFECTIVENESS OF DIGITAL TRANSFORMATION OF BUSINESS MODELS

I. Lomachynska, A. Skoruk, R. Liventsov

Odesa I. I. Mechnikov National University

Lomachynska Iryna, Doctor of Economics, Professor, Professor of the Department of Economics and Entrepreneurship, Odesa I. I. Mechnikov National University, Odesa, Ukraine
ORCID ID: <https://orcid.org/0000-0002-6112-6884>
e-mail: i.lomachynska@onu.edu.ua

Skoruk Alina, student of the third (educational and scientific) level of higher education, Odesa I.I. Mechnikov National University, Odesa, Ukraine
ORCID ID: <https://orcid.org/0009-0002-2652-4454>
e-mail: alina.voitsekhovska@onu.edu.ua

Liventsov Roman, student of the third (educational and scientific) level of higher education, Odesa I.I. Mechnikov National University, Odesa, Ukraine
ORCID ID: <https://orcid.org/0009-0008-7246-6199>
e-mail: liventsov@onu.edu.ua

Abstract

The article proposes an integral indicator of the digital readiness of the business model, the structure of which is based on a combination of four key sub-indices: technological development, competence, process and customer experience. On the basis of the proposed approach, a matrix of levels of digital maturity was formed, which allows identifying the current

state of the enterprise and determining the strategic directions of digital transformation. A cyclical model of the formation of a digital strategy for the transformation of the business model has been developed, which ensures the consistency and continuity of digital changes. A methodical approach to evaluating the effectiveness of digital transformation has been improved by proposing a modified indicator of digital return on investment, which takes into account both direct economic and strategic effects of digitalization. A scenario forecast of the development of the business model depending on the pace of implementation of digital transformation has been developed, which includes optimistic, realistic and pessimistic options. For each of the scenarios, the expected results of digital changes are determined and practical recommendations are provided to increase the effectiveness of digital strategy implementation.

Keywords: digital technologies; digital readiness; comprehensive digital readiness index; digital transformation; digital maturity; digital return on investment; business model.

Statement of the problem in a general form. In the modern scientific and practical plane, the problem of evaluating the effectiveness of the digital transformation of business models is becoming especially relevant, since the existing approaches are mainly focused on evaluating individual financial results or the level of implementation of digital technologies and do not ensure comprehensive consideration of economic effects, strategic results and the level of digital maturity of the enterprise. The lack of a holistic evaluation toolkit complicates the process of making management decisions regarding the feasibility of digital investments and the choice of directions for the transformation of business models. In this regard, there is a need to develop scientific and methodological tools for evaluating the effectiveness of digital transformation of business models, which will allow to comprehensively determine its results and increase the validity of management decisions in the field of digital development.

Analysis of research and publications. In the scientific literature, the problems of digital transformation of business models and the formation of effective mechanisms for its implementation occupy an important place among modern economic research. Among the domestic scientific works, it is worth highlighting the research of Lomachynska and co-authors [1; 2], who analyzed the transformation of business strategies in the conditions of the digital

economy and the dynamics of the digital transformation of the national economy. The authors emphasize the international experience and the impact of digitalization on the competitiveness of enterprises. In particular, Zinyuk [3] notes that despite the active adoption of digital technologies, a significant number of organizations are implementing digital initiatives without a systematic approach to measuring, analyzing and improving them. At the same time, it is emphasized that digital transformation can significantly increase the efficiency of the enterprise, but the effectiveness of such changes largely depends on the quality of management of the transformation process and the use of appropriate tools for evaluating its effectiveness.

An important contribution to the development of methodical approaches to the assessment of digital transformation of business processes was made by Lysenko [4], who proposed a comprehensive methodical approach to evaluating the effectiveness of digital transformation of business process management of agro-industrial enterprises. Within the framework of this approach, the expediency of integrating key performance indicators with the maturity model of business process management is substantiated, which allows quantitative measurement of the level of digital maturity of the enterprise. The author considers digital transformation as a continuous multidimensional process covering the technological, organizational and cultural components of management. At the same time, the key factors that form the basis of digital changes are identified, including: automation of business processes, effective data management, development of leadership potential, formation of digital culture and orientation to the principles of sustainable development. This approach emphasizes the need for a comprehensive assessment of digital transformation.

The purpose of the article is the development of tools for evaluating the effectiveness of digital transformation of business models of enterprises based on the formation of a comprehensive approach that allows determining the effectiveness of the implementation of digital technologies and justifying management decisions regarding their use.

Presentation of the main material. According to the IBM Institute for Business Value [5], 74% of executives consider geopolitical and economic uncertainty as a source of new opportunities, and 93% emphasize the imperative of AI sovereignty in the 2026 strategy. Gartner [6] identifies the top trends of 2026: AI-powered development platforms, multi-agent systems, sensitive computing, and agent-based AI. Deloitte Tech Trends 2026. Deloitte Tech Trends 2026 [7] hlights the shift from experimentation to real impact through AI-native organizations.

In Ukraine, the strategic reference point is the Strategy for the Digital Development of Innovative Activities until 2030 [8] and the draft Strategy for the Development of Artificial Intelligence until 2030 [9], which emphasize the practical application of AI in the economy, defense and recovery.

Diagnosis of enterprise readiness is the first and mandatory stage of any digital transformation, as it allows you to objectively assess the current state of the business model, identify «bottlenecks» and form a sound strategy for further changes. Without systemic diagnostics, transformation often translates into the chaotic adoption of individual technologies, leading to low investment efficiency and a growing digital divide with competitors.

Existing digital maturity assessment models (Deloitte Digital Maturity Index 2025 [10], BCG Digital Acceleration Index (DAI) [11], TM Forum Digital Maturity Model v5.0 [12], OECD Digital Transformation Maturity Model [13]) have significant limitations: they either focus only on specific aspects (technologies or processes) or do not take into account the competitive context of the industry, especially in high uncertainty settings.

Without a reliable diagnostic tool, transformation risks turning into fragmented technology adoption without systemic impact on the business model.

To address this issue, the Integral Digital Readiness Index (I_{DR}) is proposed – a new composite indicator that eliminates the aforementioned drawbacks. The I_{DR} is a weighted average of several sub-indices, providing a single numerical value from 0 to 1, and introduces for the first time an innovative «Digital Gap» Coefficient (DGC). This allows not only for an assessment of the internal state but also for the quantification of the enterprise's competitive position and a benchmarking of business models.

$$I_{DR} = \sum_{i=1}^n w_i \cdot K_i, \quad (1)$$

where:

I_{DR} – Integral Digital Readiness Index;

n – number of sub-indices;

w_i – weighting factor of the i-th sub-index ($\sum_{i=1}^n w_i = 1$);

K_i – value of the i-th sub-index.

Basically, it is proposed to use four sub-indices that will most fully cover the key elements of the digital transformation of the business model: technological base, human capital, operational processes and customer experience (table 1; formulas 2-5). It is this kind of structure

that we believe will be able to ensure a balance between the technical, organisational and market aspects.

However, the number of sub-indices is not rigidly fixed. It can be increased depending on industry specifics, enterprise size, strategic goals, and the required level of diagnostic detail.

For example:

- for large industrial holdings, it is advisable to add a fifth sub-index, such as «Data as an Asset» or «Ecosystem Integration»;
- for service sector enterprises – a sub-index «Digital Marketing and Personalization»;
- for companies with high environmental responsibility – a «Green Digital Transformation» sub-index.

The flexibility of this technique is adaptive and suitable for enterprises of any scale.

Table 1

Detailed composition of sub-indices of the Integral Digital Readiness Index

	Charact.	Normalization method	Detail of indicators	Source for data
sub-index	K_1			
Component name	TECHNOLOGICAL			
Formula	$K_1 = \frac{K_{SS} + K_{Ce} + K_{API} + K_{RT}}{4}, \quad (2)$			
	Reflects the level of the technological base of the enterprise	Arithmetic mean	K_{SS} – share of software with an update cycle of less than 12 months; K_{Ce} – share of data and processes hosted in cloud environments (considering digital sovereignty requirements); K_{API} – share of business processes with open APIs for external integration; K_{RT} – share of data available in real-time (edge computing, IoT sensors)	Data are collected through an inventory of IT assets and an IT director survey

	Charact.	Normalization method	Detail of indicators	Source for data
sub-index	K_2			
Component name	COMPETENT			
Formula	$K_2 = \frac{N_{Intermediate+}}{N_{total}}, \quad (3)$			
	Assesses the level of digital skills of the staff	Direct share	$N_{Intermediate+}$ – number of employees who have confirmed Intermediate+ level (or higher) under the DigComp 2.2 / 3.0 (testing or certification)	The assessment is carried out through internal testing (online platforms Coursera, LinkedIn Learning, Ukrainian platforms Prometheus and Diya.Education); BPMN map, process execution or certification log.
	Charact.	Normalization method	Detail of indicators	Source for data
sub-index	K_3			
Component name	PROCESS			
Formula	$K_3 = \frac{\sum P_{automatically}}{P_{total}}, \quad (4)$			
	Evaluates the degree of automation of business processes	Direct share	$P_{automatically}$ – number of automated business processes P_{total} – total number of business processes	Data is obtained from the company's process map. A process documented in BPMN 2.0 with an automation level of more than 80% is considered automated

	Charact.	Normalization method	Detail of indicators	Source for data
sub-index	K_4			
Component name	CLIENT			
Formula	$K_4 = \frac{K_{channels} + K_{NPS}}{2}, \quad (5)$			
	Evaluates the quality of digital interaction with customers	Arithmetic mean	$K_{channels}$ – share of sales, communications and service operations through digital channels (site, mobile application, chatbots, messengers); K_{NPS} – Net Promoter Score digital channels, converted to scale [0; 1]	CRM-system, customer survey

Source: formed by the authors.

Determining the weighting factors w_i is one of the key steps in constructing a composite index, as they will reflect the relative significance of each sub-index.

However, the choice of a specific method for determining weights is not strictly regulated and depends on the specific nature of the object of study, sectoral features, availability of expert data and strategic priorities of the enterprise. The researcher or management can choose alternative scientifically based approaches, in particular: the MAI method, expert evaluations using the Delphi method, statistical methods (factor or component analysis) or combined hybrid models.

The following weighting coefficients are proposed for enterprises of the real sector of the economy of Ukraine in modern conditions:

- w_1 (technological component) = 0,30;
- w_2 (competence component) = 0,25;
- w_3 (process component) = 0,25;
- w_4 (client component) = 0,20.

The proposed coefficients provide an optimal balance between technological infrastructure and human capital as the main drivers of digital transformation.

The next stage is the construction of a matrix of digital maturity levels. The official Matrix of Digital Maturity (table 2), developed by the Ministry of Digital Transformation of

Ukraine as part of the national project Diya.Business [14], is taken as a basis.

The official Action matrix covers nine key areas of assessment (strategy, internal processes, customer work, team and competencies, data analytics, cyber security, innovation, business model and others) and is designed to independently assess the level of digital development of small and medium-sized businesses. It allows entrepreneurs to determine the current level of maturity and receive personalized recommendations for further development.

Let's simplify and adapt this matrix significantly: we will reduce the number of directions to four basic sub-indices I_{DR} , unify the scale to five well-defined maturity levels, integrate the matrix with the composite index and complement it with quantitative limits, typical problems and key KPIs.

Table 2

Matrix of levels of digital maturity of the enterprise for I_{DR}

Maturity level	Range I_{DR}	Characteristics of the business model (key features)	Typical problems and limitations	Key level KPIs	Recommended actions
1	2	3	4	5	6
1. FRAGMENTARY DIGITALIZATION	0,00-0,25	Use of separate digital tools (e-mail, basic CRM/ERP modules), predominance of manual processes, lack of integration of systems, low level of digital literacy of personnel	Isolated IT initiatives, high operating costs, lack of real-time data, significant digital divide with competitors	$I_{DR} \leq 0,25$; share of automated processes < 15%; share of digital sales < 10%; NPS of digital channels is not measured	Conducting a comprehensive digital audit; launch of pilot projects; calculation of the basic I_{DR}
2. PARTIAL INTEGRATION	0,26-0,50	Automation of individual functions (finance, accounting, sales), partial implementation of cloud solutions, the beginning of using Big Data, the presence of elementary analytics	Lack of a single digital platform, «automation islands», low staff engagement, weak integration with client channels	$I_{DR} 0,26-0,50$; share of automated processes 15-40%; share of digital sales 10-30%; 20-40% of staff with basic digital skills	Formation and approval of a digital strategy for the development of a business model; implementation of MVP testing

1	2	3	4	5	6
3. SYSTEM DIGITALIZATION	0,51-0,70	Integration of basic business systems (ERP + CRM + MES), use of Big Data and analytics elements, more than 50% of key processes are automated, active training of personnel in digital skills	Insufficient speed of data-based decision-making, partial integration with partners, average level of digital culture	I_{DR} 0,51–0,70; share of automated processes > 50%; share of digital sales 30-60%; $\geq 50\%$ of personnel with Intermediate+ level; reduction of operating costs by 15-25%	MVP testing and scaling of key processes using agentic AI; transition to full integration
4. DIGITAL PLATFORM	0,71-0,90	Full platform business model, AI and IoT integration, single digital ecosystem with partners, data-driven decision-making, active data monetization	The need to ensure digital data sovereignty, management of complex ecosystems, high requirements for cyber security	I_{DR} 0,71-0,90; share of automated processes >75%; share of digital sales >60%; $\geq 75\%$ of personnel with Intermediate+ level; customer LTV growth by 30-50%	Full integration and orchestration of the digital ecosystem; implementation of AI-governance
5. DIGITAL ECOSYSTEM	0,91-1,00	Self-optimized open digital ecosystem, agent AI, full data monetization, predictive analytics, constant self-evolution of the business model	The need to constantly update the strategy in conditions of high uncertainty, network risk management	I_{DR} 0,91-1,00; share of automated processes >90%; share of digital sales >80%; 90%+ personnel with a high level of digital competencies; growth in profit from new digital models >40%	Continuing strategic iteration and monitoring of the I_{DR} ; development of an open ecosystem

Source: matrix adapted by the authors on the basis of [14].

On the basis of the proposed methodical approach to the assessment of digital maturity, it is expedient to form a scientific and applied algorithm for the transformation of business models, which ensures the systematic transition of the enterprise to the digital format of functioning (Fig. 1).

The proposed algorithm involves the sequential implementation of interrelated stages, each of which is aimed at forming the appropriate organizational, technological and economic prerequisites for digital transformation.

The main stages of the algorithm include:

Stage 1. Strategic digital audit (1-2 months).

A comprehensive diagnosis of the current business model is performed using the Integral Digital Readiness Index (I_{DR}). «bottlenecks» is determined and the digital gap ratio compared to industry leaders is calculated.

Stage 2. Conceptualization of digital strategy (3-6 weeks).

Based on the results of the digital audit, a strategic vision of the transformation of the business model is formed, which includes determining the target level of digital maturity, justifying the directions of digital transformation and developing the concept of a new business model [1]. Special attention is paid to the identification of key sources of value creation, mechanisms of interaction with stakeholders and the formation of competitive advantages based on the use of digital technologies.

Stage 3. MVP testing and validation of hypotheses (3-6 months)

At this stage, the pilot implementation of digital solutions in the format of a Minimally Viable Process is carried out, which will allow to check the effectiveness of the proposed transformational changes in the real conditions of the enterprise's operation. At the same time, a special role is assigned to the use of artificial intelligence technologies, in particular autonomous intelligent agents to optimize business processes, manage operational activities or increase the level of personalization of interaction with customers. The implementation of this stage ensures a reduction in risks and an increase in the validity of further scaling.

Stage 4. Integration and orchestration of the digital ecosystem (6-12 months)

This stage involves the systematic integration of tested digital solutions into all key business processes of the enterprise and the formation of a single digital management platform. There is a transformation of the traditional value chain into a network ecosystem model, which

ensures a higher level of flexibility, adaptability and efficiency of functioning. An important organizational element is the formation of a specialized digital transformation management unit, which ensures the coordination of digital initiatives, data management and control of the effectiveness of implemented solutions.

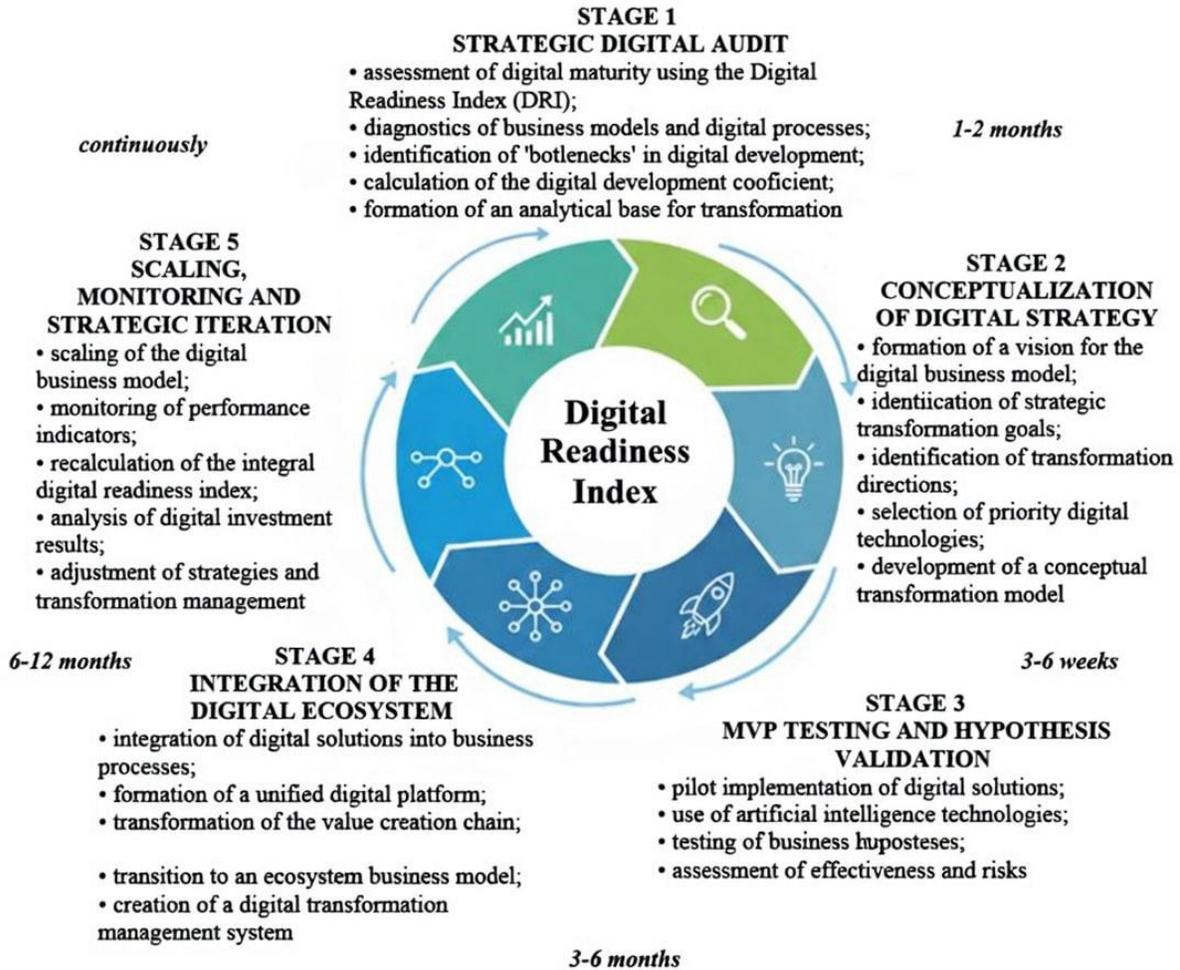


Fig. 1. A cyclical model for the development of a digital strategy for the transformation of a business model

Source: developed by the authors.

Stage 5. Scaling, monitoring and strategic iteration.

The final stage involves the large-scale implementation of the digital business model and ensuring its continuous improvement. For this purpose, a strategic monitoring system is being implemented, based on regular evaluation of the integral index of digital readiness and indicators

of the economic efficiency of digital investments. The use of modern data analytics and forecasting tools allows timely detection of deviations from 0 planned parameters and ensuring adaptation of the business model to changes in the external environment. In the event of a significant deviation of the actual results from the target values, a re-conduct of the digital audit and an adjustment of the transformation strategy is initiated.

To quantitatively justify the economic feasibility and evaluate the effectiveness of the implementation of the proposed business model transformation algorithm, we will develop a special evaluation methodology that is integrated directly into the stage of scaling, monitoring and strategic iteration (Stage 5) as a mandatory tool for supporting management decisions regarding the continuation, adjustment or termination of transformational measures.

The need to develop such a methodology is due to the fact that the traditional return on investment (ROI) indicator, despite its wide application in economic analysis, has significant limitations in the context of evaluating the effectiveness of the digital transformation of the business model. In particular, the classic approach to the calculation of ROI is focused mainly on the assessment of short-term financial results and does not take into account the strategic effects of digitalization, which shape the long-term competitiveness of the enterprise.

Such effects, first of all, include the increase in the value of the company's digital assets, in particular accumulated data, the increase in the customer's lifetime value, the reduction of the time to bring the product to the market, the increase in the level of customer loyalty, as well as the increase in the intangible value of the brand and the market capitalization of the company. These results are key drivers of value added creation in the digital economy, but are not adequately reflected in traditional methods of financial analysis.

In order to eliminate these restrictions, a modified indicator of digital Return On Investment (dROI) is proposed, which will allow a comprehensive assessment of the effectiveness of digital transformation, taking into account both direct financial results and strategic effects of digitalization (formula 6).

$$dROI = \frac{(V_{direct} - V_{strategic}) - C_{DX}}{C_{DX}} \cdot 100\%, \quad (6)$$

where:

V_{direct} – direct profit from digital transformation (increase in sales, savings on personnel

through automation, reduction of transaction costs);

$V_{strategic}$ – strategic value (cost of collected data, increase in customer LTV, reduction of Time-to-Market and increase in brand capitalization);

C_{DX} – digital transformation costs (licenses, infrastructure, training, consulting).

We will provide detailed calculations of dROI components.

Direct profit (formula 7).

$$V_{direct} = Revenue + E_{personnel} + R_{transaction}, \quad (7)$$

where:

$Revenue$ – revenue growth due to the growth of conversion, expansion of digital sales channels and personalization of offers;

$E_{personnel}$ – savings on the wage fund thanks to the automation of routine processes (RPA, agentic AI);

$R_{transaction}$ – reduction of transaction costs (electronic document flow, API integration, blockchain for supply chains).

Strategic value ($V_{strategic}$) – a key author element that was not previously included in standard ROI models (formula 8).

$$V_{strategic} = V_{data} + LTV \cdot N + (TTM_{old} - TTM_{new}) \cdot K, \quad (8)$$

where:

V_{data} – monetized value of collected data (according to the Gartner methodology: 1 TB of quality data = 50-200 thousand. USD depending on industry);

LTV – increase in the client's lifetime value;

N – number of active customers;

$TTM_{old} - TTM_{new}$ – reduction of the time of product/service entry into the market (in months);

K – brand capitalization ratio (calculated as the ratio of market capitalization to the book value of assets).

Digital transformation costs (C_{DX}) take into account capital and operating costs for the transformation period, discounted at the enterprise rate.

In order to justify the economic feasibility of implementing the proposed algorithm and determine the effectiveness of digital transformation depending on the level of its

implementation, a scenario calculation of the digital return on investment (dROI) indicator was carried out. For this, pessimistic, realistic and optimistic scenarios have been formed (table 3).

Table 3

Scenario forecast of the development of the business model depending on the speed of implementation of digital transformation

Script	The speed of innovation implementation	Target level of digital maturity (I_{DR} end of the 3rd year)	dROI for 3 years, %	NPV	Characteristics of the business model at the end of the forecast period
Optimistic	High (over 90% implementation of the plan)	0,91-1,00 (level 5 – digital ecosystem)	over 300	High	Self-optimized open digital ecosystem with data monetization as the main source of income
Realistic	Medium (60-90% implementation of the plan)	0,71-0,90 (level 4 – digital platform)	150–300	Medium	Platform business model with AI and IoT integration, strong growth of customer LTV and reduced operating costs
Pessimistic	Low (less than 60% of plan execution)	0,51-0,70 (level 3 – system digitization)	50–150	Low	System automation of key processes without full ecosystem integration

Source: developed by the authors.

In particular, the pessimistic scenario involves the partial implementation of digital initiatives, a limited level of automation and low efficiency of the use of digital assets, which leads to a slight increase in income and strategic value. At the same time, the costs of digital transformation remain substantial, limiting the overall economic effect. Under such conditions, it is advisable to review the digital strategy, optimize the cost structure and focus on implementing the most effective digital solutions with a short payback period. It is recommended to limit the scaling of the transformation until the digital readiness indicators of the enterprise increase.

The realistic scenario is based on the assumption of successful implementation of the main stages of the proposed business model transformation algorithm, including the implementation of digital platforms, automation of business processes and the use of data analytics. This ensures significant growth of income, improvement of activity efficiency and

formation of strategic digital assets. In this case, it is recommended to continue the phased implementation of digital technologies, expand the use of data analytics and direct investments to the integration of digital solutions into the key business processes of the enterprise.

The optimistic scenario involves a complex digital transformation of the enterprise with the formation of a digital ecosystem, active monetization of data, the introduction of artificial intelligence technologies and the creation of new digital products, which ensures the maximum economic effect. Under such conditions, accelerated scaling of the digital business model, development of digital platforms, implementation of artificial intelligence technologies and active monetization of digital assets are appropriate, which will ensure the formation of long-term competitive advantages [2Error! Reference source not found.].

Conclusion

As a result of the conducted research, the need to apply a comprehensive methodical approach to the formation and implementation of a digital strategy for the transformation of the enterprise's business model, which ensures the consistency of strategic goals, digital tools and expected results, is substantiated. A key prerequisite for effective digital transformation is an objective assessment of the current level of digital development of the enterprise, which is implemented through the proposed integral index of digital maturity and the developed matrix of levels of digital maturity. Their use will allow to identify the stage of digital transformation, identify problem areas and form well-founded directions for further changes.

Active and systemic digitalization ensures an increase in the efficiency of the business model and forms long-term competitive advantages, while the slowdown of digital changes leads to the loss of potential economic benefits and a decrease in the adaptability of the enterprise.

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