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STRATEGIC APPROACHES TO MANAGING PRODUCTION PROCESSES IN THE CONTEXT OF INDUSTRY 4.0 AND DIGITAL TRANSFORMATION

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The article was dedicated to the topical problem of forming strategic approaches to managing production processes of industrial enterprises in the era of the fourth industrial revolution. The analysis conducted of the current state of digital transformation of Ukrainian production enterprises confirmed significant technological lag in the field of automation and robotisation compared to global indicators, which actualised the necessity of developing adapted strategic solutions. The research conducted of classical concepts of strategic management and modern approaches to digital transformation allowed theoretical and methodological foundations of managing production processes in the conditions of Industry 4.0 to be substantiated. A conceptual model was proposed that integrated three key directions: formation of a digital ecosystem, transformation of organisational architecture, and development of the enterprise's digital culture. The systematisation conducted of strategic approaches allowed three critical groups of factors of successful transformation to be distinguished: technological, organisational, and economic. A comprehensive model of strategic management was presented that encompassed four interconnected levels (strategic, tactical, operational, and evaluative) with an embedded feedback mechanism for strategy adaptation. A phased implementation strategy was developed that took into account specific challenges of Ukrainian enterprises: limited financial resources, technological lag, and conditions of martial law. Substantiated adaptation mechanisms included the use of cloud technologies, modular solutions, and partnership cooperation models. A formed system of effectiveness evaluation criteria integrated quantitative and qualitative indicators, which allowed comprehensive monitoring of digitalisation processes to be carried out. The proposed enterprise digital maturity index ensured the possibility of determining the current state of transformation and developing a development strategy. The research results could be used by industrial enterprises of various sectors for forming their own programmes of digital transformation of production processes.

Keywords: strategic management, production processes, digital transformation, Industry 4.0, digital maturity, strategic approaches, effectiveness evaluation, optimisation.

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Introduction and problem statement

Contemporary economic reality was characterised by profound structural changes caused by the fourth industrial revolution. Digital transformation of production processes was becoming a critical factor of enterprise competitiveness in the global economic space. The transition to Industry 4.0 presupposed a fundamental change in the paradigm

of managing production processes, which was based on the integration of cyber-physical systems, the Internet of Things, artificial intelligence, and advanced data analytics.

Ukrainian enterprises faced unique challenges in the process of digital transformation, related to limited resources and the need to adapt to global standards. In particular, they were characterised by significant technological lag in the field of automation and robotisation of production, which created a critical necessity for developing specific strategic approaches to managing production processes in the conditions of digitalisation. At the same time, the war became a catalyst for accelerating the digital transformation of many Ukrainian enterprises, demonstrating the adaptability of business in crisis conditions.

Despite the significant volume of research in the field of digital transformation, questions of developing comprehensive strategic approaches to managing production processes remained insufficiently researched, which would take into account the specifics of Ukrainian enterprises, integrate different levels of management, and ensure systematic evaluation of the effectiveness of transformation processes. The relevance of the research was intensified by the necessity of adapting digitalisation strategies to the conditions of martial law and limited resources of Ukrainian enterprises.

The theoretical significance of the research lay in the development of conceptual foundations of strategic management of production processes through the integration of classical theories of strategic management with modern approaches to digital transformation. The practical significance was determined by the possibility of using the developed strategic approaches by enterprises of various sectors for effective management of production processes in the conditions of digital transformation and increasing their competitiveness in the global market.

Analysis and research of publications

Theoretical and methodological foundations of strategic management of production processes in the context of digital transformation were based on classical concepts of strategic management and their modern interpretations. A fundamental contribution to understanding strategic management was made by H. I. Ansoff [1], who substantiated the concept of managing strategic issues as a systematic process of identifying, analysing, and resolving strategic problems of the enterprise. His approach to forming corporate strategy through the prism of strategic issues remained relevant for enterprises implementing digital transformation of production processes.

M. E. Porter [2] developed the understanding of the essence of strategy, clearly distinguishing operational effectiveness and strategic positioning. In the context of digital transformation, this distinction acquired special significance, since the implementation of digital technologies could both provide temporary operational advantage and create unique strategic positioning of the enterprise in the market. H. Mintzberg [3] proposed five definitions of strategy (plan, pattern, position, perspective, ploy), which allowed a comprehensive approach to forming a strategy of digital transformation of production processes taking into account different aspects of strategic thinking.

The theoretical foundation for understanding knowledge management in the conditions of digitalisation was laid by I. Nonaka [4], who developed the dynamic theory of creating organisational knowledge. The SECI model (socialisation-externalisation-combination-internalisation) was especially relevant for digital transformation, since digital technologies fundamentally changed the mechanisms of creating, transferring, and using knowledge in production processes. L. von Bertalanffy [5] substantiated the general systems theory, which became the methodological foundation for understanding the enterprise as an open system that interacted with the external environment through multiple connections and dependencies. This systematic approach was critically important for understanding the complexity of digital transformation of production processes.

Empirical studies of digital transformation demonstrated both its potential and risks. A fundamental study conducted by H. De la Boutetiere, A. Montagner, A. Reich [6] established that 70% of digital transformations ended in failure, which actualised the necessity of developing effective strategic approaches to managing digitalisation processes. The authors identified four key success factors of digital transformations: involvement of top management, development of personnel capabilities, renewal of tools and processes, and effective communication. Modern research on dynamic capabilities of enterprises in the context of Industry 4.0 [7] substantiated the necessity of developing adaptive abilities of the organisation for successful integration of digital technologies into production processes.

Research on the specifics of digital transformation of production enterprises in Ukraine was conducted in several directions. H. Kryshtal, L. Zgalat-Lozynska, O. Denysiuk, H. Skyba, Ye. Panin [8] established that the possibility of robotised production at Ukrainian enterprises was more than 20 times lower than global indicators, which created a critical necessity for accelerating digital transformation. The authors

distinguished eight main levers of creating value through the implementation of Industry 4.0 technologies: optimisation of equipment operating modes, optimisation of equipment loading, increasing labour productivity and safety, logistics optimisation, improving product quality, improving demand forecasting, reducing time to market, and improving after-sales service.

O. V. Myronenko, O. V. Byvsheva, O. O. Kondratenko, Yu. V. Shulin [9] developed a conceptual model of forming a production strategy in the management system of industrial enterprises, substantiating the relationship between corporate strategy, business strategy, and functional strategies of the enterprise. The authors established that the production strategy had to correspond to the overall strategy of the enterprise and ensure competitive advantages through optimisation of production processes. A. A. Nechyporuk, O. V. Taranych [10] researched the management of production activity effectiveness of the enterprise, defining a system of effectiveness evaluation indicators and mechanisms for their monitoring in the conditions of digitalisation of production processes.

Strategic aspects of digital transformation of enterprises were analysed by M. O. Akulyushyna, O. M. Lukyanchuk, A. V. Hinkova [11], who substantiated specific development strategies of enterprises in the conditions of crisis phenomena. The authors established that in conditions of high uncertainty of the external environment, digital transformation could become a critical factor of survival and development of the enterprise. Digital transformation management of the enterprise was researched by I. O. Hubarieva, N. V. Bielikova, O. A. Yaholnytskyi [12], who developed a comprehensive model of managing transformation processes that included five main stages: diagnosis of the current state, strategy formation, roadmap development, implementation of changes, and evaluation of results. The authors substantiated the critical role of leadership and organisational culture in ensuring the success of digital transformation.

The analysis of industry development in Ukraine conducted by S. V. Shyshkovskyi, R. T. Yavorskyi [13] established key trends and challenges facing Ukrainian industrial enterprises in the context of global digitalisation. The authors determined that the technological lag of Ukrainian enterprises created both risks and opportunities for rapid implementation of the most modern Industry 4.0 technologies without the need to modernise obsolete infrastructure.

D. O. Barabas, D. O. Ilnytskyi, P. H. Banshchykov [14] analysed the specifics of digitalisation of Ukrainian companies' activities in wartime conditions, establishing that the war became a catalyst for accelerating the digital transformation of many enterprises. The authors revealed that enterprises that actively implemented digital technologies before the start of the full-scale invasion proved to be more adaptive to crisis conditions and were able to rebuild their activities more quickly.

Despite the significant volume of research in the field of digital transformation of production processes, the following questions remained insufficiently researched. Firstly, existing studies focused mainly on individual technological aspects of digitalisation, not revealing comprehensive strategic approaches to managing production processes in the conditions of transformation. Secondly, there was an absence of studies that took into account the peculiarities of the institutional environment, resource constraints, and technological lag of Ukrainian enterprises in the context of global digital transformation. Thirdly, mechanisms of integrating strategic, tactical, and operational levels of managing production processes in the conditions of digital transformation were insufficiently developed. Fourthly, there was an absence of comprehensive systems for evaluating the effectiveness of strategic approaches to digital transformation of production processes. It was precisely these aspects that constituted the subject of this research.

Purpose of the article

The aim of the article was the development of a comprehensive system of strategic approaches to managing production processes in the context of Industry 4.0 and digital transformation, which took into account the specifics of Ukrainian enterprises and ensured an increase in their competitiveness in the global economic space.

Achieving the set aim required solving the following tasks. Firstly, to systematise and generalise modern approaches to managing production processes in the conditions of digital transformation. Secondly, to determine key strategic factors of successful digital transformation of production processes and develop a comprehensive model of strategic approaches to managing production processes in the context of Industry 4.0. Thirdly, to substantiate specific approaches to adapting digital strategies for Ukrainian enterprises. Fourthly, to determine criteria for evaluating the effectiveness of strategic approaches to digital transformation of production processes.

Presentation of the main material

The modern paradigm of managing production processes in the conditions of digital transformation was based on the integration of several key concepts.

The first concept was related to the formation of the enterprise's digital ecosystem, which included interaction between different digital components: cyber-physical systems, the Internet of Things, cloud computing, and artificial intelligence [8].

The second concept concerned the transformation of the enterprise's organisational structure. According to systems theory [5], the enterprise was an open system that interacted with the external environment. In the conditions of digitalisation, this systematic approach acquired special significance, since digital technologies created new possibilities for integrating internal and external processes of the enterprise [12]. The third concept was related to the formation of the enterprise's digital culture, which included the development of digital competencies of personnel, creation of an innovative environment, and implementation of a culture of continuous learning [4].

Classical approaches to strategic management [1; 2; 3] remained relevant in the context of digital transformation, but required adaptation to new realities. In particular, the concept of managing strategic issues [1] was especially relevant for enterprises implementing digital transformation, since it allowed strategic problems to be systematically identified and resolved in conditions of rapid changes in the external environment.

Based on the analysis of modern literature and practice, it was established that effective strategic approaches to managing production processes in the conditions of digital transformation had to include [9; 12]:

Integrated approach to planning: The system of relationships between an integrated planning platform in digital supply chains and demand-supply factors of industrial enterprises had to be based on the principles of real time and predictive analytics. This approach allowed additional value to be created for all participants of the logistics chain through increasing transparency and speed of response to changes in market conditions.

Multilevel transformation strategy: The implementation of digital technologies had to occur simultaneously at three levels: strategic (formation of digital strategy), tactical (optimisation of business processes), and operational (automation of production operations). Multilevel integration ensured the systematic nature of transformation processes [7].

Adaptive change management: Digital transformation required the creation of mechanisms for rapid adaptation to changes in market conditions and technological innovations [11]. In conditions of crisis phenomena, in particular martial law, this adaptability was a critical factor of enterprise survival [14].

The analysis of studies [6; 8; 12] allowed three groups of factors of successful digital transformation to be distinguished.

The first group was constituted by technological factors that provided the technical foundation of digital transformation. These included the integration of cyber-physical systems into production processes [8], implementation of the Internet of Things for equipment monitoring in real time, use of artificial intelligence for optimising production decisions, application of big data analytics for demand forecasting, and creation of digital twins of production processes. These technologies formed the infrastructural base for transformation of production processes and ensured the possibility of implementing Industry 4.0 technologies.

The second group was represented by organisational factors that determined the ability of the enterprise to adapt to changes [6]. Central place among them was occupied by the formation of the enterprise's digital culture, which presupposed the development of personnel competencies in the field of digital technologies and creation of an innovative environment. Important elements were the creation of flexible organisational structures capable of quickly responding to changes, implementation of a change management system [12], and formation of a team of digital leaders who ensured coordination of transformation processes at all levels of management.

The third group was composed of economic factors that determined the financial capability and economic feasibility of digital transformation. These included optimisation of investments in digital technologies taking into account resource constraints, creation of mechanisms for evaluating ROI of digital initiatives [10] to ensure control of investment effectiveness, development of partnership relations with technology companies to reduce costs, formation of an ecosystem of digital innovations, and creation of mechanisms for financing digital projects. The integration of these three groups of factors ensured a comprehensive approach to digital transformation of production processes.

A developed comprehensive model of strategic approaches to managing production processes was based on the integration of classical theories of strategic management [1; 2; 3] with modern approaches to digital transformation [7; 12] and included four interconnected components (Fig. 1).

The strategic level of the model encompassed the formation of the enterprise's digital vision based on the analysis of strategic issues [1], which allowed key directions of transformation to be identified. At this level, the determination of priority directions of

digital transformation was carried out taking into account the strategic positioning of the enterprise in the market [2], development of a roadmap for implementing Industry 4.0 technologies [7], and creation of a risk management strategy for digital transformation. This level ensured strategic vision and general direction of transformation processes.

The tactical level presupposed optimisation of business processes taking into account digital capabilities and integration of planning and resource management systems to ensure coordination between different functional divisions of the enterprise. Important elements of this level were the creation of digital twins of production processes, which allowed changes to be modelled and tested before their real implementation, as well as implementation of a knowledge management system based on the SECI model [4], which ensured systematisation and dissemination of organisational knowledge.

The operational level focused on automation of production operations through the implementation of eight levers of creating value [8], which included optimisation of equipment operating modes, increasing labour productivity, improving product quality, and other aspects of production activity. At this level, monitoring of product quality in real time was carried out, optimisation of use of production resources, and implementation of predictive equipment maintenance, which minimised the risks of production failures.

The evaluation system integrated key performance indicators of digital transformation [10], metrics of operational effectiveness, and indicators of quality and reliability of production processes. A critical element of the evaluation system was indicators of digital maturity of the enterprise, which allowed the current state of transformation to be determined and a plan of further actions to be developed. The evaluation system ensured feedback between all levels of the model and allowed the strategy to be adapted according to obtained results.

The scheme (Fig. 1) reflected the author's hierarchical structure of strategic management of production processes in the conditions of digital transformation. The hierarchical model was chosen based on classical concepts of strategic management, which emphasised the necessity of distinguishing management levels to ensure the effectiveness of organisational activity. In the conditions of digital transformation, this need was intensified through the growth of process complexity and the necessity of coordination between different levels of management. Feedback ensured the adaptability of the management system to changes in the external environment and results of implementing digital technologies.

Taking into account the technological lag of Ukrainian enterprises [8] and challenges of martial law [14], specific approaches to digital transformation were substantiated in the article.

A phased strategy for implementing digital technologies [12] presupposed four sequential stages with clearly defined timeframes and priorities. The first stage (6-12 months) focused on preparation of infrastructure and personnel, as well as formation of digital strategy that took into account the specifics of the enterprise and its resource capabilities. The second stage (3-6 months) presupposed pilot implementation of digital technologies on separate production lines with the aim of testing their effectiveness and identifying potential problems. The third stage (6-18 months) encompassed scaling successful solutions to the entire production complex and integration of different digital systems into a unified ecosystem. The fourth stage (12-24 months) was directed at integration with global digital ecosystems and ensuring continuous improvement of processes.

Adaptation to resource constraints [13] was critically important for Ukrainian enterprises in conditions of limited access to capital. A key direction was the use of cloud technologies, which allowed capital expenditures on creating and maintaining IT infrastructure to be significantly reduced. Implementation of modular solutions ensured the possibility of gradual modernisation of production processes according to the financial capabilities of the enterprise. Development of partnership relations with international technology companies opened access to advanced technologies and expertise, and use of state programmes supporting digital transformation allowed costs of implementing innovations to be partially compensated.

Taking into account the context of martial law [14] required special attention to ensuring business process continuity in conditions of increased risks. A priority was the implementation of remote production management technologies, which allowed operational activity to be maintained even with the physical impossibility of personnel presence at the enterprise. Creation of backup management and data storage systems ensured protection of critically important information and the possibility of rapid activity recovery after possible incidents. Development of digital competencies of personnel increased the flexibility of the organisation and the ability to quickly adapt to changing conditions. Integration of cybersecurity systems at all management levels was critically important for protection against growing cyber threats in conditions of martial law.

The scheme (Fig. 2) illustrated a comprehensive

model of digital transformation of production processes of the enterprise with four sequential implementation stages. The phased approach was substantiated by the necessity of gradual adaptation of the organisation to changes and minimisation of risks of digital transformation failure. The cycle of continuous improvement was based on systems theory and ensured the adaptability of the model to changes in the external environment, which was critically important for Ukrainian enterprises in conditions of martial law.

The development of a system of criteria for evaluating the effectiveness of strategic approaches to digital transformation was critically important for ensuring objective monitoring of implementation results and timely strategy correction. The absence of clear evaluation criteria was one of the main reasons for the failure of digital transformations, since enterprises did not have the possibility to determine whether they were moving in the right direction and whether investments in digital technologies justified expected results.

The system of effectiveness evaluation proposed in the article was based on studies [10] and integrated two complementary blocks of indicators: quantitative and qualitative (Fig. 3).

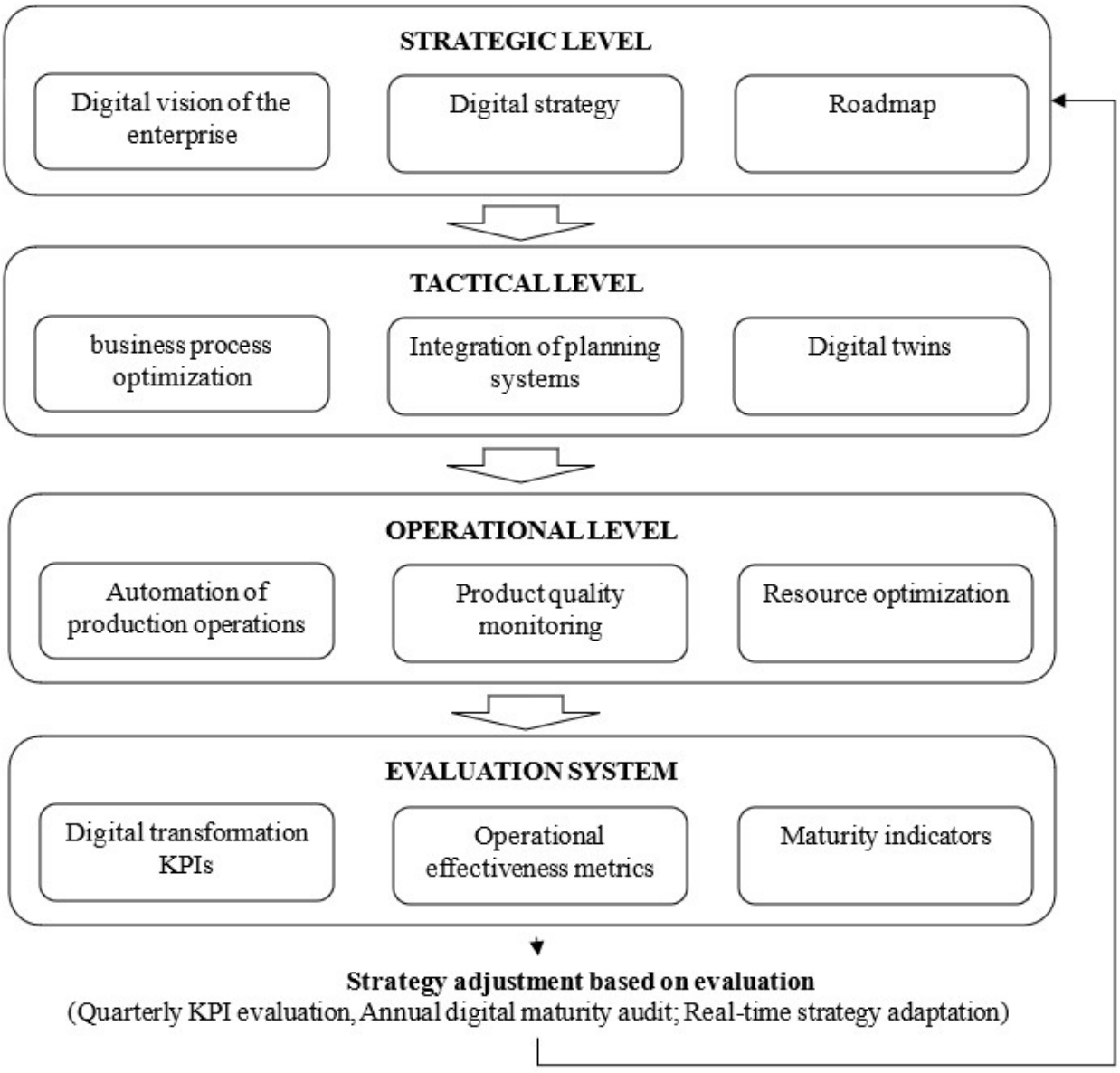

Fig. 1. Strategic management of production processes in the conditions of digital transformation
Source: developed by the author based on [1; 2; 3; 5; 7]

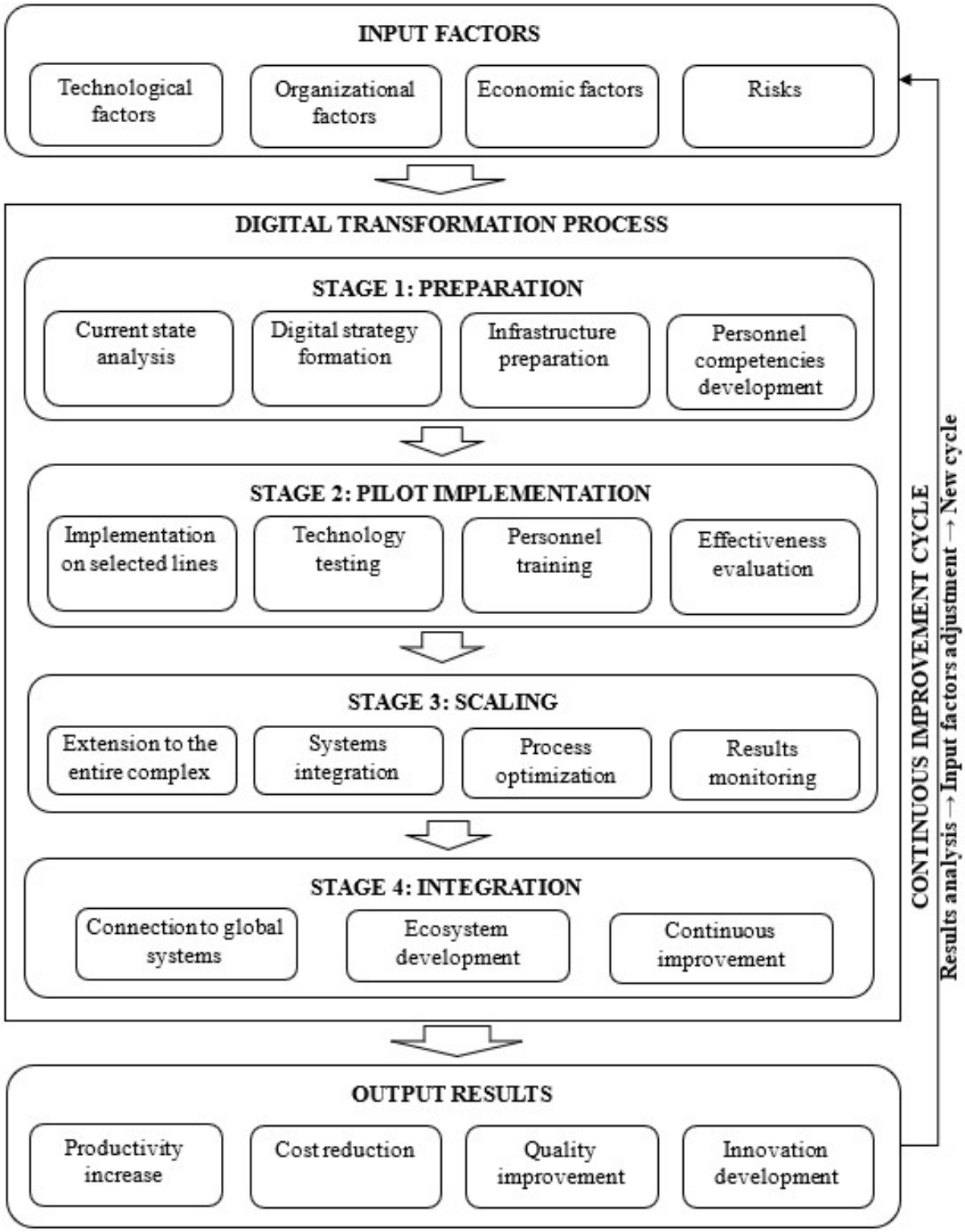

Fig. 2. Comprehensive model of digital transformation of production processes of the enterprise
Source: developed by the author based on [5; 7; 12]

The proposed system of criteria allowed enterprises not only to evaluate the current state of digital transformation, but also to determine priority directions of further development, compare their own results with industry benchmarks, and substantiate investment decisions regarding the implementation of digital technologies. Regular monitoring of these indicators ensured feedback for strategy correction and increasing the effectiveness of transformation processes.

The scheme (Fig. 3) presented a comprehensive system of evaluating the effectiveness of digital transformation that included quantitative and qualitative indicators. Integral evaluation in the form of a digital transformation index allowed the level of digital maturity of the enterprise to be determined and a strategy of further development to be developed. The system of indicators took into account the specifics of Ukrainian enterprises, in particular the necessity of evaluating the level of data security and process stability in conditions of martial law.

Conclusions

Theoretical and methodological foundations of strategic management of production processes in the conditions of digital transformation were based on the integration of classical concepts of strategic management with modern approaches to knowledge management and a systematic approach. A proposed conceptual model integrated three key concepts: formation of the enterprise's digital ecosystem, transformation of organisational structure, and creation of digital culture. Ukrainian enterprises had unique opportunities for rapidly closing the technological gap with world leaders due to the absence of unambiguous leaders in implementing Industry 4.0 technologies

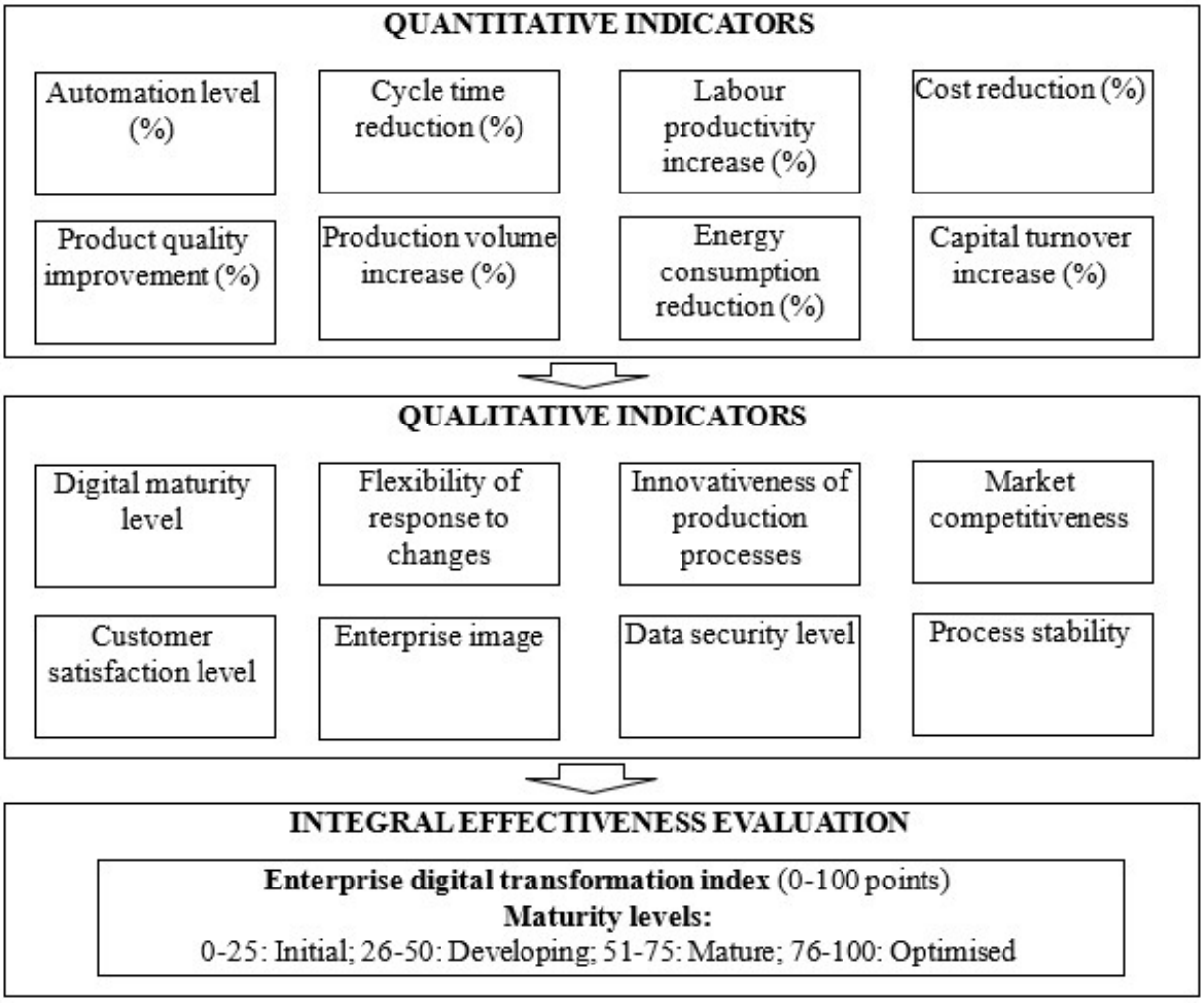

Fig. 3. System of evaluating the effectiveness of digital transformation of production processes
Source: developed by the author based on [7, 10]

and the possibility of implementing the most modern technologies without the need to modernise obsolete infrastructure.

Strategic approaches to managing production processes in the conditions of digital transformation were systematised, which included an integrated approach to planning, a multilevel transformation strategy, and adaptive change management. Three groups of factors of successful digital transformation were determined: technological, organisational, and economic. It was established that most digital transformations ended in failure due to insufficient attention to organisational factors, in particular involvement of top management, development of personnel capabilities, and effective communication.

A developed comprehensive author's model of strategic approaches to managing production processes included four interconnected levels: strategic, tactical, operational, and an effectiveness evaluation system. The model integrated eight main levers of creating value [8], which encompassed equipment optimisation, increasing productivity and quality, logistics optimisation, and after-sales service. The systematic nature of transformation processes was ensured through a feedback mechanism between management levels, which allowed the strategy to be adapted according to obtained results.

Specific approaches to adapting digital strategies for Ukrainian enterprises were substantiated, which took into account technological lag, resource constraints, and challenges of martial law. A developed phased strategy for implementing digital technologies included four sequential stages: preparation, pilot implementation, scaling, and integration with global ecosystems. Proposed mechanisms for adapting to resource constraints through the use of cloud technologies, implementation of modular solutions, and development of partnership relations allowed financial barriers to digitalisation to be reduced. In conditions of martial law, remote production management technologies and cybersecurity provision were determined as priorities.

A developed comprehensive system of criteria for evaluating the effectiveness of strategic approaches included quantitative and qualitative indicators, which allowed comprehensive monitoring of digital transformation results to be carried out. The proposed enterprise digital transformation index allowed the level of digital maturity to be determined and a strategy of further development to be developed. The system of indicators took into account the specifics of Ukrainian enterprises, in particular the necessity of evaluating the level of data security and process stability in conditions of martial law.

The practical value of the research lay in the possibility of using the developed strategic approaches by enterprises of various sectors for effective management of production processes in the conditions of digital transformation. The proposed model could serve as a foundation for developing specific programmes of digital transformation taking into account the specifics of individual enterprises. Directions of further research included empirical testing of the developed model on real enterprises, development of detailed methodologies for evaluating the effectiveness of digital transformation, and research on the impact of digital technologies on socio-economic aspects of enterprise development.

REFERENCES

1. Ansoff, H. I. (1980). Strategic issue management. *Strategic Management Journal, 1(2),* 131–148. DOI: https://doi.org/10.1002/smj.4250010204 [in English].

2. Porter, M. E. (1996). What is strategy? *Harvard Business Review, 74(6),* 61–78. Retrieved from https://hbr.org/1996/11/what-is-strategy [in English].

3. Mintzberg, H. (1987). The strategy concept I: Five Ps for strategy. *California Management Review, 30(1),* 11–24. DOI: https://doi.org/10.2307/41165263 [in English].

4. Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5(1),* 14–37. DOI: https://doi.org/10.1287/orsc.5.1.14 [in English].

5. von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of Management Journal, 15(4),* 407–426. Retrieved from https://journals.aom.org/doi/10.5465/255139 [in English].

6. De la Boutetiere, H., Montagner, A., & Reich, A. (2018). Unlocking success in digital transformations. *McKinsey & Company*. Retrieved from https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/unlocking-success-in-digital-transformations [in English].

7. Ostadi, B., Barrani, L., & Aghdasi, M. (2024). Developing a strategic roadmap towards integration in Industry 4.0: A dynamic capabilities theory perspective. *Technological Forecasting and Social Change, 208,* 123679. DOI: https://doi.org/10.1016/j.techfore.2024.123679 [in English].

8. Kryshtal, H., Zgalat-Lozynska, L., Denysiuk, O., Skyba, H., & Panin, Ye. (2023). Vplyv Industrii 4.0 na tsyfrovu transformatsiiu vyrobnychykh pidpryiemstv v Ukraini [The impact of Industry 4.0 on digital transformation of production enterprises in Ukraine]. *Naukovyi visnyk NHU – Scientific Bulletin of the National Mining University, 2,* 149–153. DOI: https://doi.org/10.33271/nvngu/2023-2/149 [in Ukrainian].

9. Myronenko, O. V., Byvsheva, O. V., Kondratenko, O. O., & Shulin, Yu. V. (2021). Formuvannia vyrobnychoi stratehii v systemi upravlinnia promyslovykh pidpryiemstv [Formation of production strategy in the management system of industrial enterprises]. *Ekonomichnyi visnyk Donbasu – Economic Herald of the Donbas, 3(65),* 131–136. DOI: https://doi.org/10.12958/1817-3772-2021-3(65)-131-136 [in Ukrainian].

10. Nechyporuk, A. A., & Taranych, O. V. (2023). Upravlinnia efektyvnistiu vyrobnychoi diialnosti pidpryiemstva: sutnist ta znachennia [Management of production activity effectiveness of the enterprise: essence and significance]. *Ekonomika ta suspilstvo – Economy and Society, 56,* 902–907. DOI: https://doi.org/10.32782/2524-0072/2023-56-161 [in Ukrainian].

11. Akuliushyna, M. O., Lukyanchuk, O. M., & Hinkova, A. V. (2024). Stratehii rozvytku pidpryiemstv v umovakh kryzovykh yavyshch [Development strategies of enterprises in the conditions of crisis phenomena]. *Ekonomika ta suspilstvo – Economy and Society, 61,* 744–750. DOI: https://doi.org/10.32782/2524-0072/2024-61-126 [in Ukrainian].

12. Hubarieva, I. O., Bielikova, N. V., & Yaholnytskyi, O. A. (2024). Upravlinnia tsyfrovoiu transformatsiieiu pidpryiemstva [Management of digital transformation of the enterprise]. *Ekonomika ta suspilstvo – Economy and Society, 64,* 354–361. DOI: https://doi.org/10.32782/2524-0072/2024-64-46 [in Ukrainian].

13. Shyshkovskyi, S. V., & Yavorskyi, R. T. (2024). Biznes-analizuvannia rozvytku promyslovosti v Ukraini [Business analysis of industry development in Ukraine]. *Problemy suchasnykh transformatsii. Seriia: ekonomika ta upravlinnia – Problems of Modern Transformations. Series: Economics and Management, 13.* DOI: https://doi.org/10.54929/2786-5738-2024-13-03-06 [in Ukrainian].

14. Barabas, D. O., Ilnytskyi, D. O., & Banshchykov, P. H. (2024). Digitalization of Ukrainian companies' activities in war conditions: Challenges vs opportunities. *Visnyk DonNUET (Ekonomichni nauky) – Herald of Donetsk National University of Economics and Trade (Economic Sciences), 81(2),* 63–72. DOI: https://doi.org/10.33274/2079-4819-2024-81-2-63-72 [in Ukrainian].

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СТРАТЕГІЧНІ ПІДХОДИ ДО УПРАВЛІННЯ ВИРОБНИЧИМИ ПРОЦЕСАМИ В КОНТЕКСТІ ІНДУСТРІЇ 4.0 ТА ЦИФРОВОЇ ТРАНСФОРМАЦІЇ

Лоза С.

Стаття присвячена актуальній проблемі формування стратегічних підходів до управління виробничими процесами промислових підприємств в епоху четвертої промислової революції. Виконаний аналіз сучасного стану цифрової трансформації виробничих підприємств України засвідчив значне технологічне відставання у сфері автоматизації та роботизації порівняно зі світовими показниками, що актуалізує необхідність розробки адаптованих стратегічних рішень. Здійснене дослідження класичних концепцій стратегічного менеджменту та сучасних підходів до цифрової трансформації дозволило обґрунтувати теоретико-методологічні основи управління виробничими процесами в умовах Індустрії 4.0. Запропоновано концептуальну модель, що інтегрує три ключові напрями: формування цифрової екосистеми, трансформацію організаційної архітектури та розвиток цифрової культури підприємства. Проведена систематизація стратегічних підходів дозволила виокремити три критичні групи факторів успішної трансформації: технологічні, організаційні та економічні. Надана комплексна модель стратегічного управління охоплює чотири взаємопов'язані рівні (стратегічний, тактичний, операційний та оціночний) із вбудованим механізмом зворотного зв'язку для адаптації стратегії. Розроблена поетапна стратегія впровадження враховує специфічні виклики українських підприємств: обмежені фінансові ресурси, технологічне відставання та умови воєнного стану. Обґрунтовані механізми адаптації включають використання хмарних технологій, модульні рішення та партнерські моделі співпраці. Сформована система критеріїв оцінювання ефективності інтегрує кількісні та якісні показники, що дозволяє здійснювати комплексний моніторинг процесів цифровізації. Запропонований індекс цифрової зрілості підприємства забезпечує можливість визначення поточного стану трансформації та розробки стратегії розвитку. Результати дослідження можуть бути використані промисловими підприємствами різних галузей для формування власних програм цифрової трансформації виробничих процесів.

Ключові слова: стратегічне управління, виробничі процеси, цифрова трансформація, Індустрія 4.0, цифрова зрілість, стратегічні підходи, оцінювання ефективності, оптимізація.

Strategic approaches to managing production processes in the context of Industry 4.0 and digital transformation

STRATEGIC APPROACHES TO MANAGING PRODUCTION PROCESSES IN THE CONTEXT OF INDUSTRY 4.0 AND DIGITAL TRANSFORMATION

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The article was dedicated to the topical problem of forming strategic approaches to managing production processes of industrial enterprises in the era of the fourth industrial revolution. The analysis conducted of the current state of digital transformation of Ukrainian production enterprises confirmed significant technological lag in the field of automation and robotisation compared to global indicators, which actualised the necessity of developing adapted strategic solutions. The research conducted of classical concepts of strategic management and modern approaches to digital transformation allowed theoretical and methodological foundations of managing production processes in the conditions of Industry 4.0 to be substantiated. A conceptual model was proposed that integrated three key directions: formation of a digital ecosystem, transformation of organisational architecture, and development of the enterprise's digital culture. The systematisation conducted of strategic approaches allowed three critical groups of factors of successful transformation to be distinguished: technological, organisational, and economic. A comprehensive model of strategic management was presented that encompassed four interconnected levels (strategic, tactical, operational, and evaluative) with an embedded feedback mechanism for strategy adaptation. A phased implementation strategy was developed that took into account specific challenges of Ukrainian enterprises: limited financial resources, technological lag, and conditions of martial law. Substantiated adaptation mechanisms included the use of cloud technologies, modular solutions, and partnership cooperation models. A formed system of effectiveness evaluation criteria integrated quantitative and qualitative indicators, which allowed comprehensive monitoring of digitalisation processes to be carried out. The proposed enterprise digital maturity index ensured the possibility of determining the current state of transformation and developing a development strategy. The research results could be used by industrial enterprises of various sectors for forming their own programmes of digital transformation of production processes.

Keywords: strategic management, production processes, digital transformation, Industry 4.0, digital maturity, strategic approaches, effectiveness evaluation, optimisation.

REFERENCES

1. Ansoff, H. I. (1980). Strategic issue management. *Strategic Management Journal, 1(2),* 131–148. DOI: https://doi.org/10.1002/smj.4250010204 [in English].

2. Porter, M. E. (1996). What is strategy? *Harvard Business Review, 74(6),* 61–78. Retrieved from https://hbr.org/1996/11/what-is-strategy [in English].

3. Mintzberg, H. (1987). The strategy concept I: Five Ps for strategy. *California Management Review, 30(1),* 11–24. DOI: https://doi.org/10.2307/41165263 [in English].

4. Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5(1),* 14–37. DOI: https://doi.org/10.1287/orsc.5.1.14 [in English].

5. von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of Management Journal, 15(4),* 407–426. Retrieved from https://journals.aom.org/doi/10.5465/255139 [in English].

6. De la Boutetiere, H., Montagner, A., & Reich, A. (2018). Unlocking success in digital transformations. *McKinsey & Company*. Retrieved from https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/unlocking-success-in-digital-transformations [in English].

7. Ostadi, B., Barrani, L., & Aghdasi, M. (2024). Developing a strategic roadmap towards integration in Industry 4.0: A dynamic capabilities theory perspective. *Technological Forecasting and Social Change, 208,* 123679. DOI: https://doi.org/10.1016/j.techfore.2024.123679 [in English].

8. Kryshtal, H., Zgalat-Lozynska, L., Denysiuk, O., Skyba, H., & Panin, Ye. (2023). Vplyv Industrii 4.0 na tsyfrovu transformatsiiu vyrobnychykh pidpryiemstv v Ukraini [The impact of Industry 4.0 on digital transformation of production enterprises in Ukraine]. *Naukovyi visnyk NHU – Scientific Bulletin of the National Mining University, 2,* 149–153. DOI: https://doi.org/10.33271/nvngu/2023-2/149 [in Ukrainian].

9. Myronenko, O. V., Byvsheva, O. V., Kondratenko, O. O., & Shulin, Yu. V. (2021). Formuvannia vyrobnychoi stratehii v systemi upravlinnia promyslovykh pidpryiemstv [Formation of production strategy in the management system of industrial enterprises]. *Ekonomichnyi visnyk Donbasu – Economic Herald of the Donbas, 3(65),* 131–136. DOI: https://doi.org/10.12958/1817-3772-2021-3(65)-131-136 [in Ukrainian].

10. Nechyporuk, A. A., & Taranych, O. V. (2023). Upravlinnia efektyvnistiu vyrobnychoi diialnosti pidpryiemstva: sutnist ta znachennia [Management of production activity effectiveness of the enterprise: essence and significance]. *Ekonomika ta suspilstvo – Economy and Society, 56,* 902–907. DOI: https://doi.org/10.32782/2524-0072/2023-56-161 [in Ukrainian].

11. Akuliushyna, M. O., Lukyanchuk, O. M., & Hinkova, A. V. (2024). Stratehii rozvytku pidpryiemstv v umovakh kryzovykh yavyshch [Development strategies of enterprises in the conditions of crisis phenomena]. *Ekonomika ta suspilstvo – Economy and Society, 61,* 744–750. DOI: https://doi.org/10.32782/2524-0072/2024-61-126 [in Ukrainian].

12. Hubarieva, I. O., Bielikova, N. V., & Yaholnytskyi, O. A. (2024). Upravlinnia tsyfrovoiu transformatsiieiu pidpryiemstva [Management of digital transformation of the enterprise]. *Ekonomika ta suspilstvo – Economy and Society, 64,* 354–361. DOI: https://doi.org/10.32782/2524-0072/2024-64-46 [in Ukrainian].

13. Shyshkovskyi, S. V., & Yavorskyi, R. T. (2024). Biznes-analizuvannia rozvytku promyslovosti v Ukraini [Business analysis of industry development in Ukraine]. *Problemy suchasnykh transformatsii. Seriia: ekonomika ta upravlinnia – Problems of Modern Transformations. Series: Economics and Management, 13.* DOI: https://doi.org/10.54929/2786-5738-2024-13-03-06 [in Ukrainian].

14. Barabas, D. O., Ilnytskyi, D. O., & Banshchykov, P. H. (2024). Digitalization of Ukrainian companies' activities in war conditions: Challenges vs opportunities. *Visnyk DonNUET (Ekonomichni nauky) – Herald of Donetsk National University of Economics and Trade (Economic Sciences), 81(2),* 63–72. DOI: https://doi.org/10.33274/2079-4819-2024-81-2-63-72 [in Ukrainian].