

Mechanism for the digital transformation of an enterprise's logistics system

Liubov Kovalska¹, Roman Topalov²

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Abstract. The article develops a mechanism for the digital transformation of an enterprise's logistics system. The mechanism of digital transformation of an enterprise's logistics system is proposed to be understood as a set of elements (blocks) that are individualized depending on the levels of digital maturity of the enterprise's logistics system, the implementation of which, under the influence of environmental factors, makes it possible to form its SMART logistics system. Four structural blocks of the mechanism of digital transformations of an enterprise's logistics system are identified: Block 1 – diagnostic and target-oriented (diagnostics of the digital transformation of the enterprise's logistics system, determination of the mission and goals of digital transformation); Block 2 – managerial (identification of the subject, object, strategy, and vectors of digital transformation of the enterprise's logistics system); Block 3 – executive (tools for the digital transformation of the enterprise's logistics system); Block 4 – result-oriented (assessment of the results of strategy implementation, identification of the level of goal achievement, elimination of deviations). A matrix of the SMART logistics system of the enterprise has been constructed. A differentiated approach to selecting the goals of digital transformation of the enterprise's logistics system has been substantiated. The vectors of digital transformation of the enterprise's logistics system have been identified: creation of digital supply chains; development of digital business; formation of design thinking; implementation of digital future; development of logistics 5.0. The tools for the digital transformation of the enterprise's logistics system have been substantiated: development of digital literacy of management and logistics personnel of the enterprise; creation of a green supply chain; development of the enterprise's digital logistics infrastructure.

Keywords: mechanism, digital transformation, enterprise's logistics system, green supply chain, digital literacy, logistics goals.

¹ Lutsk National Technical University,
Doctor of Economics, Professor, Dean of the Faculty of Business and Law
Kovalska.lyuba@gmail.com
ORCID: <https://orcid.org/0000-0003-2924-9857>

² Lutsk National Technical University,
Ukraine,
postgraduate,
topalov.roman.jdev@gmail.com
ORCID: <https://orcid.org/0009-0001-4430-532X>

Introduction

The effective functioning of an enterprise's logistics system requires appropriate transformational changes, among which digital transformation occupies a special place, as it is capable of modifying the structure as well as the internal and external links of the logistics system, modernizing logistics business processes and logistics flows, and forming an integrated supply chain. For a long period of time, certain business entities were unable to carry out digital transformations of the enterprise's logistics system due to an insufficient level of readiness for such changes, resistance to the changes among the personnel and management, a lack of digital literacy, incentives to change, etc. Ultimately, this led to a decline in the efficiency of the enterprise's logistics system, loss of customers and markets, deterioration of competitive status, and, in some cases, business curtailment. At the same time, we believe that this may be the result of the absence of a well-balanced mechanism for the digital transformation of the enterprise's logistics system, which necessitates its development and which would be effective for implementation under conditions of martial law and post-war economic recovery.

Results

Taking into account the levels of digital maturity (digitization, digitalization, integration, optimization, transformation, maturity), the proposed mechanism is intended to ensure the formation of a SMART logistics system of the enterprise built on the basis of cloud services. As scholars note, "cloud services and e-commerce show a positive trend, but the digital potential of these technologies, in our view, is also used insufficiently" [1]. By the mechanism of digital transformation of the enterprise's logistics system, we shall understand a set of elements (blocks) that are individualized depending on the levels of digital maturity of the enterprise's logistics system, the implementation of which, under the influence of environmental factors, makes it possible to form its SMART logistics system.

The mechanism of digital transformations of the enterprise's logistics system is presented as follows (Fig. 1). The proposed mechanism of digital transformations of the enterprise's logistics system includes four blocks:

- Block 1 – diagnostic and target-oriented;
- Block 2 – managerial;
- Block 3 – executive;
- Block 4 – result-oriented.

Within the first block, diagnostics of the digital transformation of the enterprise's logistics system is carried out, the purpose is formulated, and the goals of digital transformation of the enterprise's logistics system are substantiated. Diagnostics of the digital transformation of the enterprise's logistics system is an important element of the proposed mechanism, as it serves as a "starting point" in selecting further directions for ensuring its digital maturity. At this stage, it is important to identify those strengths that form the enterprise's competitive advantages in the digital space, ensure a high competitive status, and its further financial capacity to invest in the digital development of the logistics system. At the same time, the weaknesses identified in the course of analytical research serve as guidelines on which the enterprise should "work" to ensure the digital transformation of its logistics system. The conducted analytical studies make it possible to identify and form types of digital transformation of the enterprise's logistics system, each of which has individualized characteristics that shape its strengths and weaknesses in the digital space, and, on this basis, to construct a matrix of the SMART logistics system of the enterprise (Table 1).

The purpose of the digital transformation of the enterprise's logistics system is to create a SMART logistics system of the enterprise. The main strategic goal is to ensure a high level of digital maturity of the enterprise. To substantiate a system of lower-level goals, we propose using a differentiated approach based on two criteria: the level of efficiency of the enterprise's logistics system functioning and the level of digital transformation of the enterprise (Table 2).

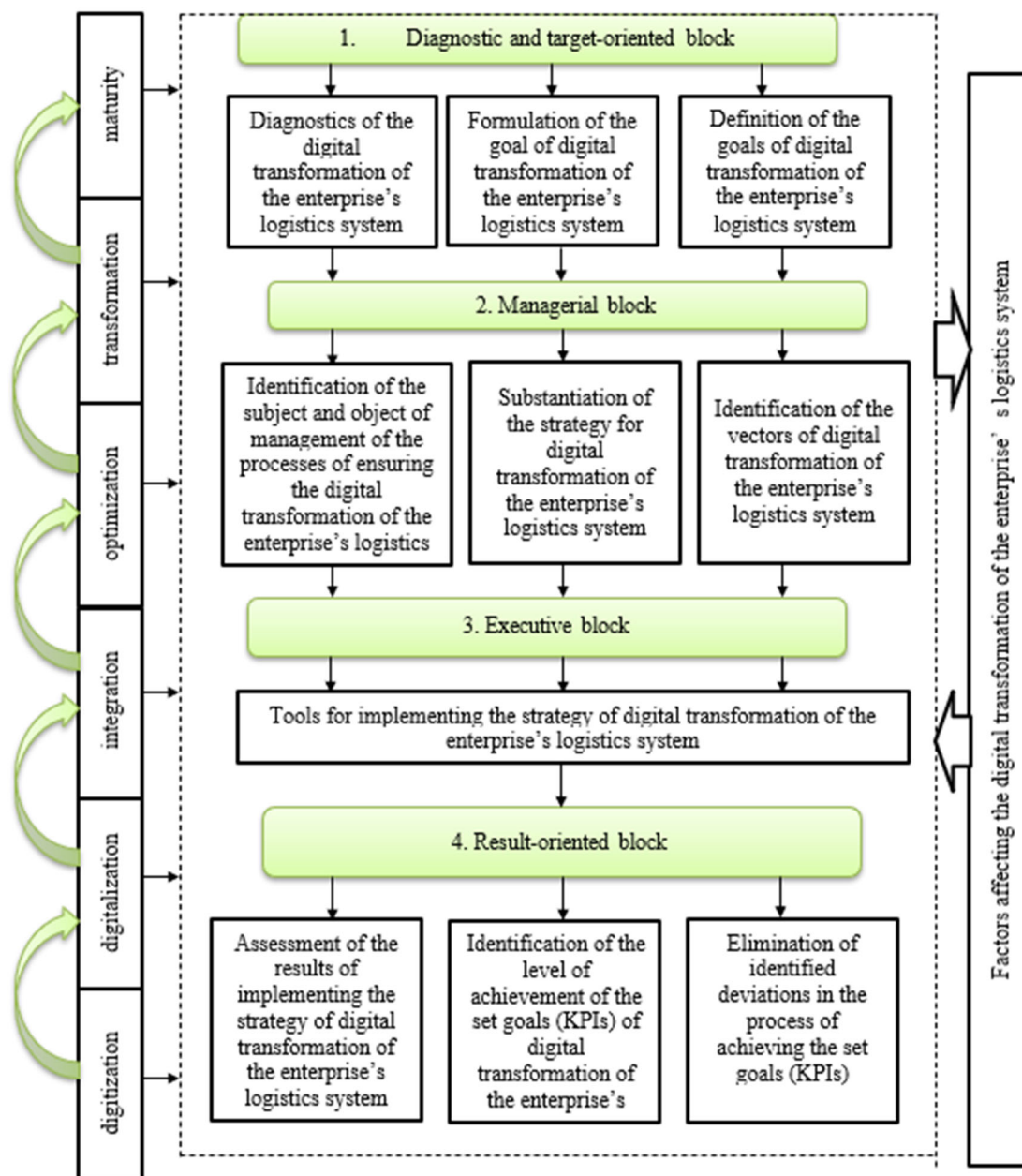


Fig. 1. Mechanism of digital transformations of the enterprise's logistics system

The managerial block provides for the identification of the subject and object of management of the processes of digital transformation of the enterprise's logistics system, as well as the substantiation of the strategy and vectors of digital transformation of the enterprise's logistics system.

Table 1. SMART logistics system matrix of the enterprise

Level of digital transformation of the enterprise's logistics system	Level of efficiency of the enterprise's logistics system functioning	
	low	high
digitization	unoptimized logistics system (due to the absence of digital processes at the enterprise and the lack of significant changes in logistics business processes)	digitized logistics system (use of electronic document management)
digitalization	partially digitalized elements of the logistics system (absence of a unified information system at the enterprise)	digitalized logistics system (use of IT elements in the logistics system, automation and mechanization of logistics business processes)
integration	partially integrated elements of the supply chain (absence of an integrated supply chain)	integrated logistics system (integration of supply chain elements, logistics functions, logistics operations, and logistics business processes)
optimization	partially optimized enterprise in terms of supply chain elements (without an optimized integrated supply chain)	digitally optimized logistics system (optimized logistics business processes, optimized logistics flows, an optimized supply chain, optimized logistics costs)
transformation	transformed enterprise with an unstable logistics system	digitally transformed logistics system (transformation of the supply chain, change in the digital mindset of personnel and management, transformation of the logistics concept)
maturity	digital enterprise without an integrated supply chain	SMART logistics system (digital maturity of the logistics system: AI, IoT, Big Data)

Table 2. Differentiated approach to selecting the goals of digital transformation of the enterprise's logistics system

Level of digital transformation of the enterprise's logistics system	Level of efficiency of the enterprise's logistics system functioning	
	low	high
digitization	Restructuring of the enterprise's logistics system	Promotion of the need to implement digital technologies
digitalization	Implementation of digital technologies in the logistics system	Improving staff digital literacy
integration	Formation of an integrated supply chain	Digital technology production
optimization	Ensuring the optimization of logistics business processes, logistics flows, and the supply chain as a whole	Development of a unified enterprise information system
transformation	Extension of digital transformation to the integrated logistics system of the enterprise	Facilitation of transformational changes of the enterprise within the digital space
maturity	Improvement of the efficiency of the enterprise's logistics system functioning	Maintaining a high level of efficiency of the enterprise's logistics system functioning and its digital maturity; retaining leadership positions in the digital space

The subjects of management of the processes of digital transformation of the enterprise's logistics system may be as follows:

- enterprise managers, for whom it is important to know the level of the enterprise's digital maturity over time and in comparison with enterprises operating in the market;
- logistics personnel of the enterprise, who are interested in the processes of digital transformation of the enterprise's logistics system, as these processes facilitate their work, increase labor productivity, and raise the level of remuneration;
- IT personnel, who implement the digital strategy and the directions of the enterprise's digital maturity;
- logistics companies, which, as stakeholders, cooperate with enterprises and are interested in the speed of performing logistics functions and logistics business processes;
- investors, who are potential financial partners of the enterprise in terms of investing in the processes of digital transformation of the enterprise's logistics system;
- consumers, who shape requirements for the digital service of logistics service provision.

The objects of digital transformation of the enterprise's logistics system are logistics business processes, logistics flows, and elements of the supply chain.

The conducted analytical studies make it possible to select a strategy for the digital transformation of the enterprise's logistics system. Such a strategy should correspond to the defined purpose and goals of digital transformation of the enterprise's logistics system, as well as to the levels of efficiency of the logistics system functioning and its digital maturity. Therefore, it is proposed to apply a differentiated approach to selecting a strategy for the digital transformation of the enterprise's logistics system. It is proposed to distinguish the following types of digital transformation of the enterprise's logistics system: digitization (D), digitalization (DG), integration (I), optimization (O), transformation (T), and maturity (M); and the levels of efficiency of the enterprise's logistics system utilization: low (L) and high (H). Accordingly, 12 types of relationships of digital transformation of the enterprise's logistics system have been formed: Type 1: (D) = (L); Type 2: (DG) = (L); Type 3: (I) = (L); Type 4: (O) = (L); Type 5: (T) = (L); Type 6: (M) = (L); Type 7: (D) = (H); Type 8: (DG) = (H); Type 9: (I) = (H); Type 10: (O) = (H); Type 11: (T) = (H); Type 12: (M) = (H). For each of these types, an individualized approach should be applied to selecting a strategy for the digital transformation of the enterprise's logistics system.

We propose to outline the following vectors of digital transformation of the enterprise's logistics system:

development of digital supply chains, which, according to scholars, represent “a dynamic integrated network characterized by a continuous flow of information that facilitates automation, adds value, improves workflow and analytics, and generates ideas, thereby enhancing customer service and the sustainable operation of the organization” [2]. This will make it possible to automate all its elements, optimize logistics flows occurring within the supply chain, and optimize logistics business processes arising within the enterprise's logistics system. At the same time, digital supply chains create additional advantages for ensuring the effective functioning of the enterprise's logistics system, such as flexibility and maneuverability of logistics flows and logistics decisions in response to challenges of the internal and external environments; customer individualization, which allows a differentiated approach to working with each customer and their needs, market segmentation, and the development of effective feedback communication; the possibility to predict the development of the enterprise's logistics system under the influence of digitalization processes (formation of a logistics strategy, a digital development strategy for the enterprise's logistics system, the volume, structure, and dynamics of product output, trends in market changes and consumer preferences, etc.); development of digital literacy and business culture, which makes it possible to change the mindset of management and personnel toward modernity and the challenges caused by the rapid digitalization of all economic phenomena and processes;

development of digital business, where “enterprises should build their digital initiatives around specific business strategies and goals” [3]. Ensuring the development of digital business enables enterprises to significantly increase the efficiency of their logistics systems by reducing time use for performing logistics business operations and making logistics decisions; optimizing enterprise personnel, and logistics personnel in particular; accelerating customer service and improving responsiveness to customer requests and preferences, information processing, etc. These processes are facilitated by the introduction of digital marketing, e-commerce, automation and mechanization of logistics business processes, and a clearly substantiated and well-developed digital strategy;

formation of design thinking, which is considered “an integral component of successful planning and conduct of digital entrepreneurship in the era of digitalization” [4]. It is the design thinking that serves as a tool that enables enterprises to solve complex logistics tasks and make non-standard logistics decisions, as well as to generate and apply innovative methods and approaches to managing the processes of digital transformation of the enterprise’s logistics system. Currently, an intensification of business digital transformation processes is observed, which requires a deeper analysis of the structure of the enterprise’s logistics system, logistics operations and logistics flows within it, as well as relationships with the external environment, changes in consumer preferences, and assessment of consumer value. Accordingly, this necessitates the application of design thinking, which is based on innovation, creativity, leadership, and a human-centered approach to managing the processes of digital transformation of the enterprise’s logistics system. At the same time, scholars note that “under wartime conditions, design thinking has become a key tool of innovative crisis management in the social sphere of Ukraine. This approach makes it possible to effectively solve complex problems and develop non-standard solutions under conditions of uncertainty and limited resources” [5];

introduction of digital future. The conducted studies have shown that “93% of managers believe that digitalization is crucial for achieving strategic goals” [6], which indicates the need to form strategic goals and plans for digital changes in the logistics system. In this context, it is important to possess strategic thinking and vision, the ability to forecast industry development trends and expected consumer values, as well as to anticipate how the industry will develop under the influence of digital technologies;

development of Logistics 5.0, which focuses on such key aspects as “human-centeredness, where the human is placed at the core of logistics business processes; social responsibility, which implies improving working conditions for personnel and quality of life; sustainable development aimed at ensuring economic efficiency, environmental safety, and social well-being; flexibility and adaptation to consumer needs” [7]. The application of this approach becomes particularly relevant for the post-war recovery of enterprise logistics systems, as it makes it possible to effectively combine digital technologies with human capabilities and ensure their effective integration within the logistics system itself.

The executive block is aimed at selecting tools for implementing the strategy of digital transformation of the enterprise’s logistics system. It is proposed to identify the following tools for the digital transformation of the enterprise’s logistics system:

Development of digital literacy of management and logistics personnel of the enterprise. In this area, it is important to develop such digital skills and competencies of personnel as “basic computer literacy, information literacy, communication and interaction, creation of digital content, problem solving in the digital environment and lifelong learning, and security in the digital environment” [8]. Enterprise personnel may possess basic, intermediate, or advanced levels of digital competencies [9]. Quite often, enterprises may face the problem of resistance to change, where personnel—especially the older generation—are unwilling to learn new skills or leave their “comfort zone.” Therefore, it is important for enterprises to develop programs for enhancing digital skills and to involve personnel in professional development and skills acquisition, stimulate the development of digital competencies, and the use and implementation of digital technologies and tools in the enterprise’s logistics

system. After all, the development of personnel's digital literacy is a strategic vector of the enterprise's development and ensuring its competitive advantages in the market. Ultimately, this will make it possible to ensure a high level of digital maturity of the enterprise and its effective functioning in the digital society.

Creation of a green supply chain. The use of digital tools contributes to the optimization of logistics flows, the development of "green" logistics, and the formation of "green" supply chains. Thus, the use of digital technologies makes it possible to develop optimized transportation routes with minimized negative environmental impact, ensure a transition to environmentally friendly transport, reduce resource consumption, apply green energy, form green "warehousing" of logistics products ("energy-efficient heating and lighting systems" [10]), implement green construction, and recycling ("the creation of effective systems for the collection, processing, and reuse of waste, returns of goods and packaging is an important element of the circular economy and 'green' logistics" [10]). In this context, it is necessary to form environmental awareness in society and to develop environmentally conscious business as a component of sustainable development. It should be noted that today consumers prefer products of manufacturers that are environmentally sustainable and responsible, whose products are subject to recycling, thereby ensuring a balance between responsible production and conscious consumption. Thus, a green supply chain will contribute to improving the enterprise's business reputation, attracting new environmentally conscious consumers, and creating additional value for the enterprise.

3. Development of the enterprise's digital logistics infrastructure, which should serve as a cross-cutting element of the entire integrated supply chain. Digital logistics infrastructure involves the application and support of digital technologies at the stage of goods supply to minimize delivery time; in warehouse complexes or logistics centers through automating product placement, order picking, and other types of internal warehouse logistics; and in transportation—through route optimization and automated dispatching [11]. It should be noted that the formation of this type of infrastructure requires qualified logistics personnel with sufficient digital skills, a high technical level and a strong financial position of the enterprise, as well as the development of an effective data protection (data security) system.

The result-oriented block comprises three components: assessment of the results of implementing the strategy of digital transformation of the enterprise's logistics system; identification of the level of achievement of the set goals (KPIs) of digital transformation of the enterprise's logistics system; and elimination of identified deviations in the process of achieving the set goals. Based on the results of strategy implementation, its effectiveness is assessed, which makes it possible to identify problem areas in the functioning of the logistics system, the degree of attainability of the set goals, and those strengths that will facilitate the further digital transformation of the enterprise.

Thus, the proposed mechanism for the digital transformation of the enterprise's logistics system will make it possible to improve the efficiency of the enterprise's logistics system functioning, increase its level of digital maturity, and individualize the goals and tools of digital transformation of the enterprise's logistics system depending on the level of its digital maturity. This will enable the selection of directions for ensuring the effective functioning of the enterprise's logistics system and promote its digitization, digitalization, integration, optimization, transformation, and overall digital maturity.

References

1. Raicheva, L. I., & Horbanova, V. O. Digital transformation of business processes as a key component of enterprise development strategy formation. *Economic Bulletin of NTUU "Igor Sikorsky Kyiv Polytechnic Institute"*, No. 30, 2024. URL:

- <https://ela.kpi.ua/server/api/core/bitstreams/acb59557-4126-4796-9778-968648c62351/content>
2. Digital supply chain: challenges and future directions. URL: <https://www.tandfonline.com/doi/full/10.1080/16258312.2020.1816361>
 3. Shchalukhina, V. V., Liashenko, V. M., Cherkaskyi, H. I., & Tomchuk, O. O. Current trends and vectors of digital transformation in Ukraine. *Ukrainian Journal of Applied Economics and Technology*, 2022, Vol. 7, No. 2. URL: <https://ujae.org.ua/suchasni-tendentsiyi-ta-vektory-tsyfrovyi-transformatsiyi-v-ukrayini/>
 4. Bey, H., & Panchenko, I. Design thinking and digital entrepreneurship: innovative approaches to business planning in the era of digitalization. *Bulletin of Khmelnytskyi National University*, 2024, No. 3. URL: <https://r2.donnu.edu.ua/server/api/core/bitstreams/087619bc-b013-47b7-be34-c28d8e699421/content>
 5. Lopushniak, H., Bondarenko, S., & Dmytruk, S. Design thinking as a tool for transforming approaches to leadership development in the social sphere. *Social Development and Security*, Vol. 14, No. 4, 2024.
 6. Digitalization: how not to fall behind on the path to the future. URL: <https://kmbs.ua/ua/article/digital-future>.
 7. Rudan, V. Ya., & Pidhaiets, S. V. Industry 5.0 as a tool for ensuring the effective development of Ukrainian enterprises during wartime challenges. *Problems of Modern Transformations. Series: Economics and Management*, No. 12, 2024.
 8. Digigram. URL: <https://osvita.diia.gov.ua/digigram>.
 9. Sytnyk, Y. S., & Tarkanii, M. V. Trends in the development of digital literacy of personnel in medical institutions. *Management and Entrepreneurship in Ukraine: Stages of Formation and Problems of Development*, No. 2 (12), 2024. URL: <https://science.lpnu.ua/sites/default/files/journal-paper/2024/dec/37258/menedzhmentnadoi-138-151.pdf>.
 10. Kuchkova, O. V., & Olefirenko, Y. S. Sustainable development and “green” logistics: innovative solutions for optimizing the environmental efficiency of supply chains. *Young Scientist*, No. 3 (134), 2025. URL: <https://molodyivchenyi.ua/index.php/journal/article/view/6402/6258>.
 11. Nechyporenko, T. D., & Narbut, A. R. Digital transformation of logistics infrastructure in the context of implementing SMART LOGISTICS. *Sustainable Development of the Economy*, No. 5 (56), 2025.