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EVOLUTION OF LOGISTICS MANAGEMENT CONCEPTS IN THE CONTEXT OF THE DIGITAL ECONOMY

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ЕВОЛЮЦІЯ КОНЦЕПЦІЙ ЛОГІСТИЧНОГО МЕНЕДЖМЕНТУ В УМОВАХ ЦИФРОВОЇ ЕКОНОМІКИ

The evolution of logistics management concepts is a complex and multifaceted process that reflects the transformation of economic systems, technological development, and changing approaches to the management of resource flows. These transformations are largely driven by digitalization processes, which, gradually intensifying, lead to significant changes in the functioning of logistics systems and determine the transition from traditional models of material flow management to integrated digital supply chain management systems. Accordingly, the purpose of the article is to identify the specific features of the evolution of logistics management concepts and to determine the key trends in their transformation in the context of the digital economy. Within the framework of the study, attention is drawn to the fact that the evolution of logistics management concepts is a natural process in the development of the theory and practice of managing material, information, and financial flows. The research demonstrated that the development of logistics management follows a sequential pattern, reflecting a gradual transition from local management of individual operations to comprehensive management of integrated and digitized supply chains. It was established that the key triggers of logistics management evolution are economic, technological, and organizational factors. It was noted that several main stages of logistics concept development have emerged: traditional functional logistics, integrated logistics, supply chain management, and digital logistics. Currently, the stage of establishing digital logistics is ongoing. Each of these stages is characterized by a gradual increase in the level of integration of logistics processes, expansion of coordination among supply chain participants, and growing significance of information technologies in managerial decision-making. The significance of the study lies in substantiating the fact that the evolution of logistics management concepts reflects a gradual transition from fragmented management of individual logistics functions to integrated digital supply chain management systems. Further research can focus on the development of models for forecasting and optimizing digital supply chains.

Еволюція концепцій логістичного менеджменту є складним і багатограним процесом, що відбиває трансформації економічних систем, розвиток технологій та зміну підходів до управління потоками ресурсів. Ці трансформації значною мірою зумовлені цифровізацією, яка поглиблюючись, зумовлює суттєві зміни у функціонуванні логістичних систем та забезпечує перехід від традиційних моделей управління матеріальними потоками до інтегрованих цифрових систем управління ланцюгами постачання. Відтак метою статті є ідентифікація особливостей еволюції концепцій логістичного менеджменту та визначення ключових тенденцій їх трансформації в умовах цифрової економіки. У межах дослідження звернено увагу на той факт, що еволюція концепцій логістичного менеджменту є закономірним процесом розвитку теорії та практики управління матеріальними, інформаційними та фінансовими потоками. Проведене дослідження показало, що розвиток логістичного менеджменту має послідовний характер і відбиває поступовий перехід від локального управління окремими операціями до комплексного управління інтегрованими та цифровізованими ланцюгами постачання. Встановлено, що ключовими в еволюції логістичного менеджменту є економічні, технологічні та організаційні чинники. Констатовано, що у процесі еволюції сформувалося кілька основних етапів розвитку логістичних концепцій: традиційна функціональна логістика, інтегрована логістика, управління ланцюгами постачання та цифрова логістика. При цьому наразі триває етап становлення концепції цифрової логістики. Кожен із цих етапів характеризується поступовим підвищенням рівня інтеграції логістичних процесів, розширенням масштабів координації дій їх учасників та зростанням ролі інформаційних технологій у прийнятті управлінських рішень в сфері логістики. Значущість дослідження полягає в обґрунтуванні того факту, що еволюція концепцій управління логістикою відбиває поступовий перехід від фрагментованого управління окремими логістичними функціями до інтегрованих цифрових систем управління ланцюгами постачання. Подальші дослідження можуть бути зосереджені на розробці моделей для прогнозування та оптимізації цифрових ланцюгів постачання.

Key words: economic environment, supply chain management, supply chains, logistics functions, functional logistics, integrated logistics, digital logistics.

Ключові слова: економічне середовище, управління ланцюгами постачання, ланцюги постачання, логістичні функції, функціональна логістика, інтегрована логістика, цифрова логістика.

PROBLEM STATEMENT

The evolution of logistics management concepts is a complex and multifaceted process that reflects the transformation of economic systems, the development of technologies, and changes in approaches to managing resource flows. These transformations are largely driven by digitalization processes, which, as they gradually deepen, cause significant changes in the functioning of logistics systems and determine the transition from traditional models of material flow management to integrated digital supply chain management systems.

Evidence of this can be seen in the growing role of information technologies, the active development of digital platforms, and the widespread adoption of technological solutions such as Big Data, artificial intelligence, and the Internet of Things. These technologies contribute to the formation of digitally oriented approaches to organizing logistics processes based on the integration of information systems, automation of operations, and the use of data analytics. Within such approaches, logistics management

is transforming into a comprehensive management system that ensures the integration of material, information, and financial flows within global supply chains.

ANALYSIS OF RESEARCH AND PUBLICATIONS

The study of the main concepts of logistics management in the context of the digital economy has been addressed by scholars such as Kuzmenko A.V., Pilnev V.G. [3], Tataryn N.B., Klepanchuk O.Yu. [5], Kernychnyi B.Ya., Radynskyi S.V. [7], Yankovska V., Telepnieva O., and Kononov I. [8]. In particular, these researchers examined the content and effectiveness of logistics management concepts. At the same time, the evolution of these concepts and the associated logic of transitions between different stages of logistics management development amid the gradual deepening of digitalization in the economy has remained largely unstudied.

In this context, investigating the natural evolution of logistics management concepts becomes especially

relevant, as it allows for tracing new patterns in the development of logistics systems and identifying key trends in their transformation under the conditions of the digital economy.

FORMULATION OF THE ARTICLE'S OBJECTIVES

The article aims to examine the evolution of logistics management concepts and identify the key trends in their transformation within the context of the digital economy.

THE PAPER MAIN BODY

In the scientific literature, the concept of evolution (Latin: *evolutio* — unfolding, development; English: *evolution*) is generally understood as a regular process of gradual development of a particular phenomenon or system [2].

Thus, in a generalized form, within the context of logistics management, this process reflects the sequential transformation of approaches to managing logistics processes — from local management of individual operations such as transportation, warehousing, and resource distribution to comprehensive management of integrated supply chains at the global level [2; 3]. This aspect allows us to state that the evolution of logistics [3]:

- reflects the general patterns of development in the management of material, information, and financial flows;
- demonstrates the sequence and logic of logistics development, from simple local operations to complex integrated systems;
- provides a macro-level view of logistics as a system, without delving into specific methods or tools.

In a narrower sense, the evolution of logistics management concepts is understood as the gradual trans-

formation of theoretical approaches, methods, and tools for managing material, information, and financial flows. This transformation occurs under the influence of changes in the economic environment, technological progress, and the increasing complexity of interactions among supply chain participants [2; 3—4]. This aspect allows us to state that the evolution of logistics [2; 3—4; 7]:

- investigates the specific process of development of scientific concepts and methodologies;
- focuses on methods, tools, and approaches, i.e., what has actually changed in logistics management;
- explains why and how changes in the economy, technologies, and interactions among supply chain participants have influenced logistics.

Thus, considering that the evolution of logistics management concepts in the context of the digital economy encompasses both a macro perspective (general patterns of logistics transformation [8]) and a micro perspective (specific changes in theoretical concepts and management methods [8]), its triggers are a combination of economic, technological, and organizational factors.

Key economic factors include market globalization, intensified competition, and increasing consumer demands for speed and quality of product delivery [1]. Technological triggers are associated with the development of information and communication technologies, automation of production and warehousing processes, as well as the implementation of digital solutions such as Big Data, artificial intelligence, the Internet of Things, and cloud technologies [1; 7]. Organizational triggers, in turn, are related to the need to integrate the activities of various supply chain participants and to optimize inventory management, transportation, and resource distribution (see Table 1).

Table 1. Triggers of the evolution of logistics management concepts in the context of the digital economy

Trigger category	Characteristics of trigger action	Examples in the digital economy	Result of implementation
Economic	Driven by market globalization, intensified competition, and increasing consumer demands for speed, quality, and reliability of delivery.	- Global e-commerce platforms (Amazon, Alibaba) - Same-day delivery - Optimization of logistics costs	Formation of traditional functional logistics (management of individual operations independently)
Technological	Related to the development of ICT, automation of production and warehousing processes, and the implementation of digital solutions (Big Data, AI, IoT, cloud technologies).	- Demand forecasting using Big Data - IoT sensors for real-time cargo tracking - Automation of warehouses and transportation routes	Development of integrated logistics and formation of digitally integrated management systems
Organizational	Determined by the need to integrate the activities of various supply chain participants, and to optimize inventory management, transportation, and resource distribution.	- Implementation of ERP and SCM systems - Integration of suppliers, manufacturers, and distributors - Coordination of internal and external processes	Establishment of supply chain management (SCM) concepts and digital logistics with integration of global flows

Source: created by the authors based on [1—2; 3—4; 7]

As a result of the influence of the aforementioned factors, several key stages in the evolution of logistics management concepts have been identified. The first stage is characterized by the formation of traditional functional logistics, in which the management of individual logistics operations (transportation, warehousing, and inventory management) was carried out independently. The second stage is associated with the development of integrated logistics, which involves the coordination and alignment of core logistics functions within the enterprise. The third stage is marked by the establishment of the Supply Chain Management (SCM) concept, within which the activities of suppliers, manufacturers, distributors, and consumers are integrated. The fourth and contemporary stage of logistics management evolution is linked to the digitalization of logistics systems and the emergence of digital logistics, based on the use of information platforms, data analytics, and automated management systems to ensure effective interaction among participants in global supply chains.

As a result of the influence of the aforementioned triggers, several key stages in the evolution of logistics management have emerged, representing a sequence of transitions between concepts [2—3; 6]:

$$L1 \rightarrow L2 \rightarrow L3 \rightarrow L4 \quad (1);$$

where: L1 — traditional functional logistics; L2 — integrated logistics; L3 — Supply Chain Management (SCM); L4 — digital logistics

The transition between stages can be formalized as follows:

$$Li+1=Li+\alpha E+\beta T+\gamma O \quad (2);$$

where: α, β, γ are coefficients representing the influence of economic, technological, and organizational factors, respectively.

The presented algorithm demonstrates that the evolution of logistics management is a nonlinear process, in which each subsequent stage emerges as a result of the accumulation of changes in the technological, economic, and organizational environment. Let us consider each of the outlined concepts in more detail, including their key characteristics, functions, and current practices, in order to identify patterns in the development of logistics management and assess the impact of digitalization on its transformation (see Table 2).

The first stage in the development of logistics management is traditional functional logistics, which is characterized by detailed management of individual logistics operations-transportation, warehousing, and inventory management-without mutual integration or coordination. At this stage, the functions of traditional logistics were primarily operational and tactical, aimed at reducing costs within specific processes; however, the lack of integration limited the overall efficiency of supply chains. In practice, this entailed [5]:

— separate planning of transportation routes, warehousing, and inventory management;

Table 2. Key stages in the evolution of logistics management concepts in the context of the digital economy

Evolution stage	Timeframe	Characteristics	Core functions and approaches	Digitalization conditions
Traditional functional logistics	Pre-1980s	Management of individual operations independently of one another	Transportation, warehousing, inventory management	Initial use of computers for inventory accounting and bookkeeping
Integrated logistics	1980s–1990s	Coordination and alignment of core logistics functions within the enterprise	Interaction between warehousing, transportation, and production units; inventory planning and control	Implementation of ERP, WMS, and TMS systems for centralized data collection and processing
Supply chain management	1990s–2000s	Integration of activities among suppliers, manufacturers, distributors, and consumers	Support for coordination across the entire supply chain; optimization of material, information, and financial flows	Use of shared information platforms, demand forecasting, and data exchange among supply chain participants
Digital logistics	2010s–present	Use of digital platforms, data analytics, and automated systems for effective interaction among global supply chain participants	Big Data, IoT, AI, cloud systems; integration of global flows and process automation	Implementation of digital technologies for analytics, process automation, and integration of global supply chains

Source: created by the authors.

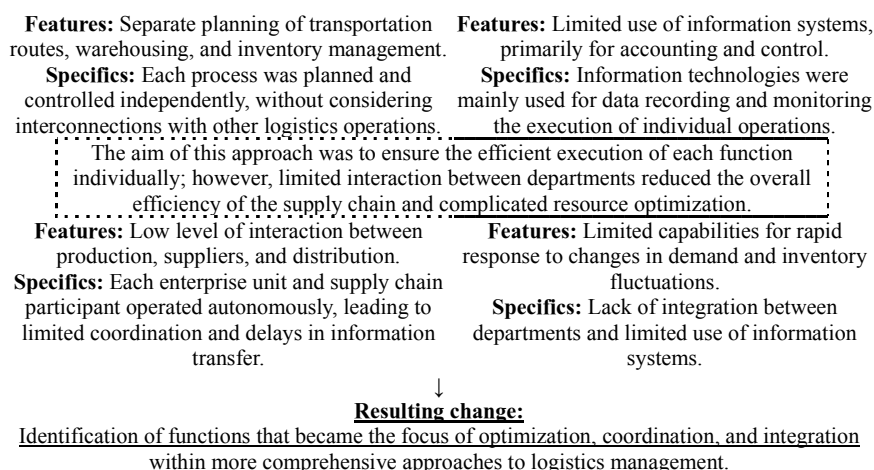


Figure 1. Development stage of traditional functional logistics in the context of the digital economy

Source: created by the authors based on [5–6].

- limited use of information systems, mainly for accounting and control purposes;
- a low level of interaction between production, suppliers, and distribution;
- restricted capabilities for rapid response to changes in demand and inventory fluctuations.

Despite these characteristics (see Fig. 1), traditional functional logistics laid the theoretical foundation for the subsequent integration of logistics processes by defining the key operational functions-transportation, warehousing, and inventory management.

These functions later became the focus of optimization, coordination, and integration within more comprehensive approaches to logistics management. In fact, at this stage, traditional functional logistics laid the foundation for the evolutionary development of logistics concepts, establishing the basic principles of organizing and controlling operations, which remain relevant in modern digital management systems [5].

Integrated logistics represents the second stage in the development of logistics management in the context of the digital economy, providing coordination and alignment of core logistics functions within the enterprise. In practice,

the management of individual logistics operations ceased to be isolated, as opportunities were created to account for interactions between transportation, warehousing, inventory management, and production, allowing the enterprise to improve efficiency and reduce overall costs. Specifically, this entailed [2; 6]:

- coordinated planning of transportation routes, warehousing, and inventory management, taking into account interdependencies between departments;
- implementation of information systems for centralized data collection and processing;
- coordination of activities among production, warehousing, and distribution units;
- standardization of inventory management procedures and transportation processes, reducing losses and improving order fulfillment accuracy.

Despite these characteristics (see Fig. 2), integrated logistics laid the foundation for a more comprehensive approach to supply chain management, ensuring systemic interaction among all logistics functions at the enterprise level.

This evolutionary stage allowed for the establishment of basic principles aimed at enhancing process trans-

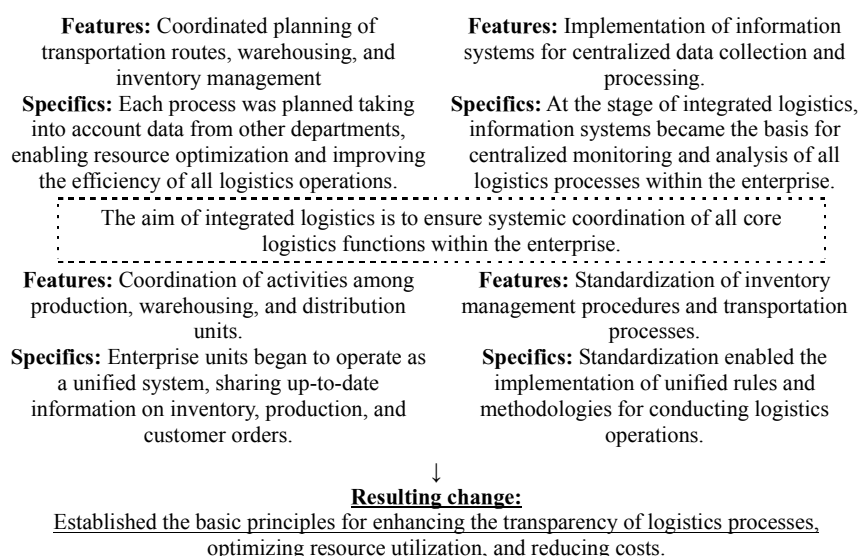


Figure 2. Development stage of integrated logistics in the context of the digital economy

Source: created by the authors based on [2; 6].

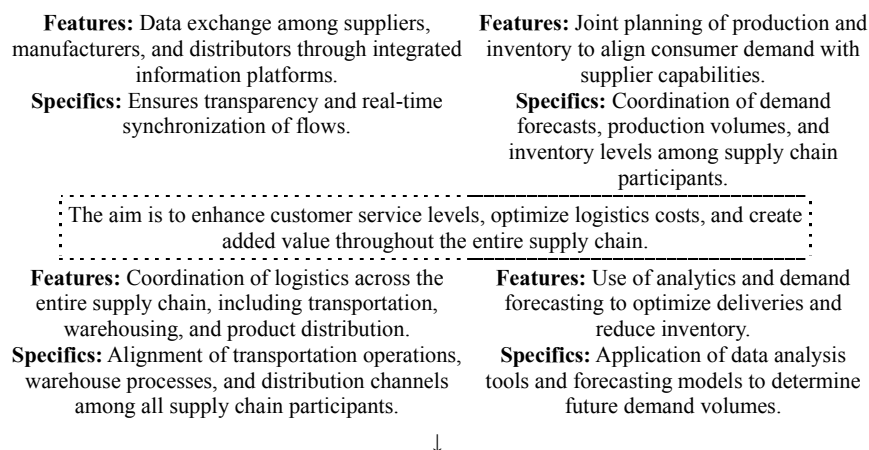


Figure 3. Development stage of SCM in the context of the digital economy

Source: created by the authors based on [2; 4; 6—7].

parency, optimizing resource utilization, and reducing costs, while simultaneously laying the groundwork for coordination principles that became critically important in subsequent stages of logistics management evolution. For example, established practices enabled manufacturing enterprises to rapidly redirect goods between warehouses according to regional demand, allowed retail companies to optimize delivery routes through the integration of warehouse and store data, and enabled suppliers to adjust raw material deliveries in response to changes in production plans [6].

This stage in logistics management gave rise to a reactive approach, which facilitated effective inventory planning and timely delivery of products to customers.

Supply Chain Management (or SCM) represents the third stage in the evolution of logistics management, characterized by the integration of activities among suppliers, manufacturers, distributors, and consumers. At this evolutionary stage, logistics management extends beyond the boundaries of a single enterprise to encompass the entire supply chain, ensuring effective interaction among all participants in the process. In practice, this entailed [2; 6—7]:

- data exchange among suppliers, manufacturers, and distributors through integrated information platforms;
- joint planning of production and inventory to align consumer demand with supplier capabilities;
- coordination of logistics across the entire supply chain, including transportation, warehousing, and product distribution;
- use of analytics and demand forecasting to optimize deliveries and reduce excess inventory.

Despite these characteristics (see Fig. 3), SCM extends integration across the entire supply chain, ensuring interaction and information exchange among all participants: suppliers, manufacturers, distributors, and consumers. For example, many international manufacturing companies, together with raw material suppliers and logistics operators, use SCM platforms for demand forecasting, production planning, and coordination of product deliveries to distributors. This enables timely fulfillment of customer needs in different regions and optimizes inventory at all stages of the supply chain.

In particular, this stage established the principles of systemic integration and interaction among supply chain

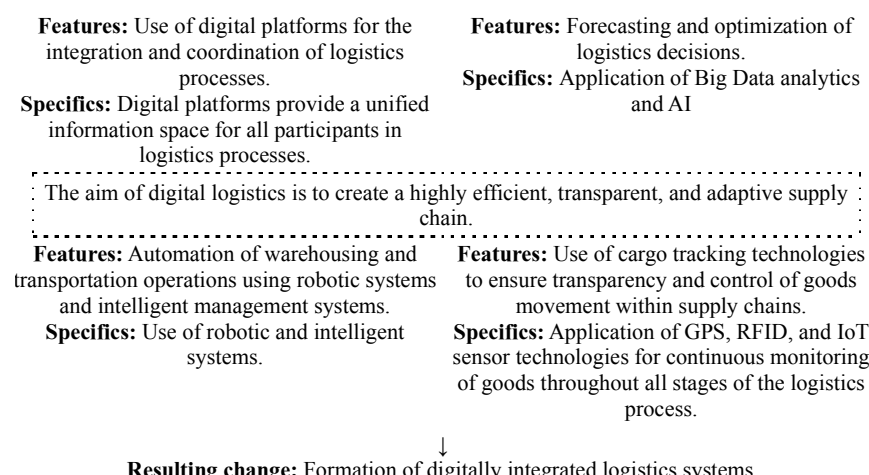


Figure 4. Development stage of digital logistics in the digital economy

Source: created by the authors based on [5—6].

participants, which still serve as the foundation for the development of modern digital logistics.

Digital logistics represents the final stage in the evolution of logistics management in the context of the digital economy, characterized by the extensive adoption of digital technologies. At this stage, logistics management is optimized through automation of logistics processes, use of Big Data, AI, and integrated information platforms to ensure transparency, flexibility, and responsiveness in supply chain management. In practice, this entails [6]:

- use of digital platforms to integrate and coordinate logistics processes;
- application of Big Data analytics and AI for demand forecasting and optimization of logistics decisions;
- automation of warehousing and transportation operations;
- use of cargo tracking technologies.

This evolution stage has already facilitated the transition from traditional management of logistics operations to intelligent, digitally integrated supply chain management (see Fig. 4).

In particular, this evolution stage is characterized by the emergence of digitally integrated logistics systems, within which continuous data exchange occurs among all supply chain participants. This ensures enhanced transparency of logistics processes, rapid decision-making, and increased overall efficiency of logistics system operations.

CONCLUSIONS

The study illustrated that the evolution of logistics management concepts is a consistent process that drives changes in the management of material, information, and financial flows. The research demonstrated that the development of logistics management follows a sequential pattern, reflecting a gradual transition from local management of individual operations to comprehensive management of integrated and digitized supply chains. It has been established that the key drivers of logistics management evolution are economic, technological, and organizational factors.

It was noted that several main stages of logistics concept development have emerged: traditional functional logistics, integrated logistics, supply chain management, and digital logistics. The process of establishing digital logistics is currently ongoing. Each of these stages is characterized by a gradual increase in the level of integration of logistics processes, expansion of coordination among supply chain participants, and growing significance of information technologies in managerial decision-making.

Thus, the evolution of logistics management concepts reflects a progressive shift from fragmented management of individual logistics functions to comprehensive digital supply chain management systems, forming a new paradigm for organizing logistics processes in the modern digital economy.

The results obtained have practical significance for managers and enterprises, as they demonstrate how process integration and the use of information technologies enhance the efficiency of managing material, information, and financial flows in modern supply chains.

Further research can focus on the development of models for forecasting and optimizing digital supply chains.

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