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EVOLUTION OF LOGISTICS DEFINITIONS AND CONCEPTS: BETWEEN FUNCTIONALITY, INTEGRATION AND GLOBALITY

Mariia Hryhorak. «Evolution of logistics definitions and concepts: between functionality, integration and globality». *This article explores the evolution of logistics from a narrow functional activity focused on the movement of material flows to a comprehensive interdisciplinary science that addresses the management of diverse flows -material, informational, financial, and human - within and across economic systems. The study highlights the need to update the conceptual and terminological framework of logistics in response to the challenges of digital transformation, sustainable development, and the growing role of human and social dimensions in logistics. The authors propose a revised definition of logistics that reflects its scientific essence, strategic nature, and societal value. A structured model of logistics as a science is developed, including its object of study, hypotheses, laws, principles, and methodological approaches. The paper identifies five stages of the historical development of logistics concepts and categorizes them into traditional, SCM-oriented, and digitally- and sustainability-driven concepts. It is argued that logistics not only integrates knowledge from economics, management, informatics, cybernetics, and social sciences, but is also increasingly capable of contributing its own scientific tools and approaches to these fields. Future research directions are outlined, including the development of logistics for virtual systems, the expansion of humanitarian-oriented practices, and the growing application of logistics in crisis and recovery contexts.*

Keywords*:* Logistics as a science, flow management, logistics systems, supply chain concepts, digital transformation, human-centric logistics, interdisciplinary approach, logistics methodology

Марія Григорак. «Еволюція визначень і концепцій логістики: між функціональністю, інтеграцією та глобальністю». *У статті досліджено логістику як самостійну міждисциплінарну наукову галузь, що еволюціонувала від функціональної сфери управління матеріальними потоками до системного підходу до управління потоками різної природи: матеріальними, інформаційними, фінансовими та людськими. Обґрунтовано актуальність оновлення понятійно-категоріального апарату логістики з урахуванням викликів цифрової трансформації, сталого розвитку, гуманітаризації управлінських практик та розвитку логістики 5.0. Запропоновано авторське* *визначення логістики, яке узгоджується з сучасними вимогами до системності, інтегрованості, стратегічного бачення та соціальної орієнтації логістичної діяльності. Представлено структурну модель логістики як науки, що включає об'єкт, гіпотези, закони, принципи та методологічні підходи. Визначено етапи еволюції логістичних концепцій, виокремлено традиційні, SCM-орієнтовані та сучасні цифрово-орієнтовані концепції. Обґрунтовано, що логістика не лише інтегрує знання з економіки, менеджменту, інформатики, кібернетики та соціальних наук, але й починає формувати власний науковий інструментарій, придатний до зворотного перенесення в інші наукові дисципліни. Встановлено перспективи подальших досліджень у напрямі формування логістики віртуальних систем, посилення гуманітарного виміру логістичних практик та розширення прикладного потенціалу логістики в кризових і посткризових умовах.*

Ключові слова: логістика як наука, управління потоками, логістичні системи, концепції ланцюгів постачання, цифрова трансформація, людиноцентрична логістика, міждисциплінарний підхід, методологія логістики.

Intraduction. Over the past few decades, the concept of logistics has undergone significant transformations, reflecting the evolution of its role in socio-economic systems at various levels. From the initial understanding of logistics as a purely operational function that ensures the movement of material resources, this field has gradually evolved into an interdisciplinary, strategically important tool for managing flows within and beyond organizations. This transformation is driven by a complex set of factors, among which the globalization of the economy, the dynamic development of information and communication technologies, intensified competition, increasing complexity of supply chains, and the growing importance of sustainable development principles play a key role.

The relevance of the study is due to a noticeable gap between the theoretical understanding of logistics, as presented in academic and scientific literature, and its practical application in the real business sector. In the national educational practice, logistics is often presented as a tool for managing material flows or as a functional discipline within economic science. In contrast, the logistics business – especially in the fields of transport, warehousing, distribution, and outsourcing – operates with a practical understanding of logistics as a complex of processes related to movement, storage, customer service, and ensuring the continuity of supply chains.

The increasing importance of logistics in the context of globalization, Ukraine's integration into global logistics networks, the development of transport infrastructure, and the formation of the state's ambitions as a potential logistics hub of the Black Sea-Baltic region reinforce the need to review the theoretical foundations of logistics. An interdisciplinary approach becomes particularly relevant, allowing logistics to be understood not only as an applied economic function but as a scientific category that integrates economics, management, informatics, engineering, and social sciences.

An analysis of academic and scientific literature shows that most definitions of logistics boil down to managing material, information, and financial flows to increase the efficiency of economic entities. In particular, one of the leading Ukrainian researchers, Y.V. Krykavsky, considers logistics as a branch of economic science that studies flow management in adaptive economic systems with synergistic connections [1, c.199]. In subsequent works, he identifies three approaches to defining logistics: focused on movement (transformation of resources in space and time), focused on the product life cycle, and focused on providing logistics services [2, c.6]. Similar interpretations are present in the works of other authors who emphasize logistics as a tool for optimizing supply, distribution, inventory, and internal flows [3, 4, 5, 6].

Despite the variety of approaches, most of them do not take into account new contexts of logistics functioning – in particular, its impact on the environment, the social sphere, digital transformation, global integration, and its humanitarian role in crisis situations. As a result, there is a need to formulate an updated scientific vision of logistics as a systemic, interdisciplinary, and dynamic science of flow management.

Thus, the formation of a modern methodological basis for logistics requires not only a rethinking of its basic definitions but also a deeper understanding of its evolution, strategic function in socio-economic systems, and integrative potential with other scientific disciplines.

Literature review. The establishment of logistics as an integrated, strategic, and global discipline has been accompanied not only by changes in practical application but also by a revision of theoretical approaches to its essence, functional tasks, and key concepts. Historical analysis of scientific sources indicates a gradual transition from narrow functional interpretations of logistics to a systemic, inter-functional, and strategic understanding of it.

It should be noted that the evolution of logistics as a theoretical category and an applied discipline is the subject of research by numerous national and foreign scientists. Modern scientific literature reflects the complex and multifaceted nature of logistics transformation, which necessitates the systematization of approaches to its interpretation at various stages of development.

One of the first formalized approaches to defining logistics is considered to be the concept formulated in the military sphere, where logistics was seen as an activity for providing troops with material resources, their transportation, and storage [7]. For centuries, military logistics developed in two dimensions: as an art and as a science, applying, according to its nature, various historically proven concepts that were useful for supporting armies. The most complete analysis of the evolution of military logistics is the work [8], whose authors proposed the concept of target logistics, defining it as a science that continuously studies, plans, manages, and systematically executes the process of timely supply of necessary resources for the functioning of armed forces in war zones, using available technologies and means to dynamically facilitate the development of operations and maneuverability of units.

In commercial practice until the middle of the 20th century, logistics was understood primarily as a set of operations for transportation, warehousing, and inventory management, which corresponded to the concept of physical distribution [9]. This approach was fragmented and mostly operational. During the same period in the military sphere, logistics was already acquiring a strategic character, being considered as integrated management of resource provision for troops, which involved the coordination of supply, transport, accounting, and storage. It was military logistics that laid the foundation for the further transformation of commercial logistics [10, 11].

From the 1970s, under the influence of information technology development, globalization, and the increasing complexity of the market environment, a systemic vision of logistics as an integrated activity began to form. In the works of leading researchers, including D. Bowersox, D. Closs, J.R. Stock, D.M. Lambert, logistics is considered as an inter-functional system that combines the processes of supply, production, sales, financial services, and information support [12, 13, 14]. This approach allowed for a shift from individual operations to the management of logistics systems and networks.

In the second half of the 1990s, a formal conceptual distinction between logistics and Supply Chain Management (SCM) was observed. SCM encompasses a broader range of tasks, including strategic planning, coordination of all supply chain participants – from raw material suppliers to end consumers, integration of business processes, building partnerships, and synchronization of flows at an inter-organizational level [15]. Authors such as M. Christopher, L. Mentzer, R. Ballou emphasize that logistics is a component of SCM, focused on the execution and optimization of physical flows, while SCM also covers strategic interaction and value-added management throughout the entire chain [16, 17, 18]. Investigating the evolution of logistics from physical distribution to supply chain management, the authors [19] concluded that material flow theory is an option for solving the problem of the extreme complexity of material flow systems in the global economy of the twenty-first century.

From the beginning of the 21st century, the scientific community began to realize that logistics – as a discipline concerned with the management of material, information, financial, and resource flows – has not only economic but also significant environmental and social consequences. The increase in global flows, the intensification of transport activities, and the expansion of logistics networks have led to increased energy consumption, greenhouse gas emissions, and waste generation, which, in turn, became the subject of critical analysis by researchers. One of the first significant steps in this direction was the formation of the "green logistics" concept, which focuses on minimizing the negative impact of logistics processes on the environment [20, 21]. Researchers such as J. Rodrigue [22], Alan McKinnon [23, 24] and Joseph Sarkis [25], played a key role in popularizing the idea that environmental efficiency should be as important as economic efficiency.

During the same period, the theory of Sustainable Supply Chain Management began to form. Important stages in its development were the works of Seuring & Müller [26], who proposed an integrative framework for researching the sustainable supply chain, covering three key dimensions: economic, environmental, and social. Their article in the Journal of Cleaner Production became a foundational document for further research in this field. Other scientists drew attention to ethical issues, labor conditions, and community impact, which spurred the inclusion of the social dimension of sustainability in logistics research [27, 28]. Furthermore, the introduction of the "Circular Economy" concept into logistics increased interest in reverse logistics, recycling, reuse, and extending the life cycle of goods [29, 30].

Thus, the beginning of the 21st century marked a significant shift in the paradigm of logistics research – from focusing solely on efficiency to seeking balanced solutions that consider the interests of the environment, society, and business. This necessitated the development of new models, principles, and approaches that form the scientific basis of sustainability in logistics and supply chain management.

A separate area of research is related to the impact of digital technologies on the development of logistics. Modern concepts, including Logistics 4.0, Smart Logistics, and Digital Logistics, have emerged as a response to the growing complexity of logistics networks, the need to process large volumes of data in real-time, and the integration of digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), cloud computing, blockchain, and so on. One of the pioneers in the development of digital logistics theory is E. Hofmann in co-authorship with M. Rüsch. In their article "Industry 4.0 and the current status as well as future prospects on logistics" (2017), they formalized the concept of "Logistics 4.0" as the integration of cyber-physical systems, IoT, and cloud solutions into logistics networks and emphasized a turning point: logistics became not just an operational function, but a system of smart, interconnected, and automated flows [31]. No less influential is the contribution of J. Sarkis, who analyzes digital logistics in the context of sustainable development, emphasizing the role of data analytics and AI in decision-making aimed at efficiency and environmental responsibility [32]. The focus of modern research is the integration of digital technologies into logistics processes – from mobile sensors and warehouse automation to autonomous vehicles, blockchain, and digital twins, which opens up new functions of logistics – not only planning the movement of goods but also managing data, forecasting, and real-time analysis [34, 35]. Modern logistics goes beyond transportation and warehousing and encompasses managing data flows, demand forecasting, real-time resource management, adaptive planning, and modeling complex scenarios. Data analytics becomes a central element of decision-making in logistics, allowing for a higher level of accuracy, speed, and flexibility [36]. Furthermore, digital logistics is closely integrated with ERP systems, SCM platforms, and CRM, forming a unified information environment for enterprise management [37]. This integration ensures the transparency of logistics processes, improves control, and creates a basis for implementing sustainable development concepts, as it allows for precisely tracking the impact of logistics solutions on environmental, economic, and social aspects.

Thus, the development of digital technologies transforms logistics from an operational function into a strategic, interdisciplinary, and technologically intelligent field of activity that is at the heart of modern supply chain management and plays an important role in achieving sustainable development.

This brief overview of literary sources demonstrates that approaches to defining and conceptualizing logistics have changed significantly over the past decades. Initially, logistics was perceived as a purely operational function focused on the physical movement of goods and inventory management. However, with the development of the economy, the complication of production and trade links, the introduction of information technologies, and the formation of global supply chains, logistics gradually transformed into an inter-functional, interdisciplinary, and strategic tool for managing flow processes.

Modern scientific approaches view logistics not only as a practical activity but as a scientific discipline with its own methodology, object, and subject of research. Accordingly, the definitions of logistics are also changing, increasingly emphasizing not only material flows but also information, financial, and human resources, as well as the need to ensure the sustainability, flexibility, and value orientation of logistics solutions.

It is important to emphasize that such a re-evaluation of the scientific foundations of logistics has already taken place at the level of authoritative international organizations. For example, after the Council of Supply Chain Management Professionals (CSCMP) clearly distinguished logistics as a separate discipline from supply chain management, other professional associations, including the European Logistics Association (ELA) and the German Logistics Association (BVL), also revised their interpretations of logistics, including a wider range of processes, levels, and goals. Of particular interest to our research were publications by the working group of the Scientific Advisory Board of the German Logistics Association (BVL), which emphasized the need to design flows in logistics networks and proposed a definition of logistics that reflects the balanced achievement of economic, environmental, and social goals [38]. It is worth noting the conclusion of B. Fisher-Holloway and M. Mokhele that, as a science, logistics should integrate more theoretical (including non-obvious) approaches from other disciplines to strengthen its own theoretical foundation. This particularly refers to human geography, which studies the human spatial behavior, mobility, and the spatial differentiation of economic activity [39].

Thus, in the conditions of profound transformations in the socio-economic environment, digitalization, globalization, and the challenges of sustainable development, there is an objective need to update the general theory of logistics as a science that must respond to new demands of practice and scientific knowledge.

Aim and Objectives of the Study. The aim of this work is to systematize the stages of logistics' evolution as a scientific discipline, substantiate the changes in its conceptual content, object, and subject of research in the context of the development of logistics concepts, and to refine the methodological foundations of logistics in accordance with contemporary challenges of digital transformation, sustainable development, and the humanization of logistics practices. To achieve this aim, the following objectives have been formulated:

1. To compare definitions of logistics by various authoritative organizations (CSCMP, ELA, and BVL) and propose an original definition that encompasses current trends in its development.
2. To define the logical structure of scientific inquiry in logistics through the sequence: hypotheses → laws → principles → methodology.
3. To analyze the development of logistics concepts and strategies in relation to transformations in the economic, technological, and social environment.
4. To refine the methodology of logistics as an interdisciplinary science that combines knowledge from various fields and is capable of modeling complex virtual systems.

Methodology for writing this article is based on a combination of theoretical-analytical and conceptual approaches, which allows for examining logistics as a scientific discipline in its evolution, content, structure, and contemporary transformations. The choice of methodology is determined by the research aim – to conduct a critical analysis of existing definitions of logistics, to comprehend its object of study, principles, laws, methodological foundations, and to present an original interpretation of logistics that meets the current challenges of digitalization, sustainable development, and humanization. The following methods were used in the research process:

– Systemic approach that allowed for considering logistics as a holistic system of knowledge, including concepts, principles, methods and areas of application. This approach enabled the identification of interconnections between flows of various natures (material, informational, financial, and human) and reflected the complex multi-level structure of logistics systems.

– Comparative-analytical method applied to compare the author's definition of logistics with definitions used by leading international organizations (CSCMP, ELA, BVL), with the aim of identifying common and distinctive features, strengths, and limitations.

– Historical-logical method allowed for a stage-by-stage analysis of the development of logistics concepts – from its inception as an applied field to its modern interdisciplinary and strategic approach. Within this method, the periodization of logistics development and its concepts was substantiated.

– Elements of an axiological approach used to account for the social, humanitarian, and environmental value of logistics in the context of its evolution from an operational function to a tool for sustainable management.

– Conceptual modeling method applied to construct a generalized systemic model of logistics development as a science, in which definitions, hypotheses, laws, principles, approaches, and methodology are considered in their interrelationship.

Since the article's aim is not purely empirical, the main source is analytical work with scientific publications, international standards, programmatic documents, and logistics practices, which allowed for generalizing current knowledge, formulating an original conceptual framework, and outlining directions for further research.

Main Text. The current stage of economic and business environment development is accompanied by a growing volume of theoretical knowledge and practical experience in the field of enterprise logistics and supply chain management. This applies to both traditional aspects of logistics related to the management of material flows, information, finance, and human resources, as well as the latest trends in the transformation of logistics activities under the influence of digital technologies, sustainable development concepts, process intellectualization, and corporate social responsibility.

Over the past decades, logistics has gradually moved beyond being solely an applied function of operational flow management and has transformed into a complex, interdisciplinary field that requires not only practical solutions but also a thorough theoretical understanding. The expansion of logistics concepts' application areas, particularly in public administration, the humanitarian sphere, security, tourism, and human flow management, indicates the growing societal importance of logistics and its gradual integration into broader socio-economic systems.

In accordance with the classical understanding of science as a systematized, structured body of knowledge about the world, obtained as a result of scientific research, observations, experiments, and analysis of facts, the accumulated theoretical and empirical material in the field of logistics forms the objective prerequisites for its further establishment and development as an independent, interdisciplinary scientific field. In view of this, it is appropriate not only to analyze existing theoretical approaches but also to formulate an original vision of logistics as a theory and practice at the current stage of its evolution, taking into account new technological, economic, and social challenges.

Modern logistics has long transcended a narrow operational understanding that limited it to managing transport, warehousing, or inventory. The accumulated scientific and practical experience, the digitalization of economic processes, the increasing complexity of global supply chains, growing social expectations for business, and the integration of sustainable development principles necessitate viewing logistics as a comprehensive, interdisciplinary field that combines both applied and scientific components. In this regard, we propose the following definition: "Logistics is an interdisciplinary applied scientific and practical activity that investigates, models, plans, organizes, implements, and controls flows of material resources, information, finances, people, and related services in space and time within and between economic systems and networks, with the aim of effectively creating value for business and society, ensuring competitiveness, achieving a balanced fulfillment of economic, social, and environmental goals, and fostering harmonious interaction between people, technology, and the environment".

Comparison allows us to assess how our definition aligns with current scientific standards, identify its strengths and potential weaknesses, and highlight the specifics and unique aspects of our approach. The following definitions of logistics were taken as a basis:

– ***CSCMP***: the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements [40];

– ***ELA***: the implementation, plan and control of transportation and arrangement of goods and personal and the corresponding support tasks in a system to attain specific need [41];

– ***BVL***: an applications-oriented scientific discipline. It models and analyses economic systems as networks and flows of objects through time and space (specifically goods, information, money, and people) which create value for people. It aims to supply recommendations for action on the design, implementation, and mobilization of such networks and flows through accepted scientific methods [42].

The results of the comparative analysis of the proposed author's definition with the definitions of recognized leaders in the field of logistics and supply chain management at the international level (CSCMP, ELA, and BVL) are presented in Table 1.

Table 1. Comparative analysis of definitions of logistics as a science and practice

Criteria	Author's definition	The most common and generally accepted definitions		
		CSCMP (Council of Supply Chain Management Professionals)	ELA (European Logistics Association)	BVL (Bundesvereinigung Logistik)
Type of definition	Interdisciplinary, scientific and practical	Applied, functional, focused on flow management	Applied, focused on movement and placement	Application-oriented, scientific, with an emphasis on network modeling and sustainable development
Objects of management / research	Flows of material resources, information, finance, people, and related services; the logistics systems or networks within which these flows arise, function, and interact	Flows of goods and materials, services, information from source to consumer	Moving and placing goods and/or people, related activities	Economic systems as networks and flows of objects in space and time: goods, information, money, people
Focus, goal setting	Efficiency, creation of consumer value, competitiveness, sustainable development, interaction of people and technology	Satisfying customer requirements through effective flow management	Achieving the goals of the economic system	Design, analysis of networks and flows for the balanced achievement of economic, environmental and social goals
Level of coverage	Intra-organizational, inter-organizational, national, global, network	From the source of raw materials to the end consumer	Within a certain economic system	Within and between economic systems; emphasis on networks
Presence of the human aspect	Yes, people are among the objects of flows and as a key participant in interaction with technologies	No, emphasis on goods, services, information	Yes, people among the objects of displacement	Yes, people among the objects of flows
Strategic component	Directly stated: competitiveness, value creation, sustainable development	Partly stated: efficiency and satisfaction of needs, but strategicity is not directly emphasized	Depends on the context of the economic system, the strategic level is not detailed	Clearly expressed: network design, balanced development

The conducted comparative analysis allows us to state that the modern author's definition of logistics comprehensively combines key theoretical and practical aspects inherent in both classical and contemporary approaches to understanding this discipline. Unlike the traditional CSCMP definition, which primarily focuses on the applied level of managing flows of material resources, services, and information, the new interpretation of logistics views it as an interdisciplinary scientific and practical activity with a clearly expressed strategic orientation. The definition by the European Logistics Association (ELA) partially accounts for the human aspect, but its concept is limited to the confines of a single economic system and does not sufficiently emphasize the scientific and social components of logistics. The BVL definition is closest in meaning, positioning logistics as an application-oriented scientific discipline that models and analyzes economic systems as networks and flows of objects through time and space (specifically goods, information, money, and people) which create value for people. However, the new interpretation additionally emphasizes the role of the human element, interaction with technologies, and ensuring competitiveness in the context of globalization and sustainable development. Thus, the proposed definition of logistics reflects the current stage of this field's evolution, integrates approaches from classical schools, and aligns with the Logistics 5.0 concept.

Let's examine in more detail the object of research in logistics – flows as key components of logistics systems and networks, reflecting the movement and transformation of resources in space and time. We support the view that it is expedient to use the concept of a logistics flow as a system of interconnected and coordinated sub-flows of material resources, information, finances, and people, where each sub-flow has its own specific characteristics, parameters, and management mechanisms. Depending on the context of activity, one of these sub-flows may act as dominant, determining priorities in the planning, control, and optimization of logistics processes. This approach ensures flexibility in choosing management methods and tools, while maintaining the integrity of the logistics system or network as a single organism.

A logistics flow, as an integrated set of interconnected flows of material resources, information, finances, and people, is a dynamic system that constantly changes, transforms, and adapts according to the needs of the economic environment. The development of a logistics flow is accompanied by changes in its form, structure, and state, which manifest in:

– a transition from individual flow elements to integrated systemic interaction;

– the transformation of the primary (basic) flow form into a secondary (derivative) form, which arises from the interaction of sub-flows of different natures;

– the complication of the flow structure in the process of its development and the integration of new elements;

– a change in the functional state of the flow – from an active movement phase to a placement or accumulation stage, creating prerequisites for further efficient movement and use of resources.

A logistics flow has the following properties:

– multi-flow nature, meaning the inclusion of diverse sub-flows in its structure by nature and content (material, informational, financial, human);

– heterogeneity of elements, reflecting the variety of resources and information involved in the logistics process;

– spatial-temporal localization, meaning the defined spatial and temporal boundaries of the flow's functioning;

– goal orientation, as all flows are aimed at achieving a specific economic, social, or strategic goal;

– process consistency, which ensures the sequence, logic, and effectiveness of logistics operations;

– systemic organization, which implies the interconnection and interdependence of all components of the logistics flow and its integration into broader economic systems.

Under a traditional (non-logistical) approach, each link in the logistics flow has its own management system, oriented towards its own goals and efficiency criteria. The output flow of each preceding link, formed under the influence of that link's management system with its goals and criteria, serves as the input for the subsequent link. The resulting flow is the output flow of the last link, whose parameters are formed sequentially as a result of independent management influences. Under a logistical approach, management influences are exercised by a unified management system regarding the end-to-end main flow from the perspective of common goals and efficiency criteria. In this flow process, the following parameters can be managed: nomenclature of flow substance units (what needs to be delivered), flow volume (how much to deliver), destination (to whom to deliver), specified flow speed (when to deliver), fixed waiting intervals, and the conduct of intermediate and final control and regulation of flow processes at nodal points of movement.

The modern understanding of a logistics flow as an integrated set of interconnected material, informational, financial, and human flows, functioning in space and time, forms the basis for the development of logistics as an independent interdisciplinary science. The dynamic nature of flows, their ability to change structure, form, and functional state in response to external and internal influences, necessitates the application of scientifically sound approaches to their research and management.

Defining logistics as a science is a fundamental step towards understanding its essence, scope, and research boundaries. However, considering the complexity and multi-level nature of logistics flows, systems, and networks, it is important to consider logistics not only as a single whole but also in the context of different levels of aggregation and scales of functioning. This allows for a more precise analysis of the peculiarities of flow management and the interaction of elements of logistics systems at micro, meso, and macro levels. Therefore, the next logical step is a detailed consideration of the levels of logistics that define the scope of its application and the specifics of management processes in different contexts.

Based on the proposed definition of logistics and the presented thesis about the networked structure of flows, several levels of aggregation of logistical systems and networks can be clearly identified, corresponding to different scales of economic activity and complexities of logistical processes:

1. Micro-level (local level), which covers the logistics systems of individual enterprises, organizations, or very small business entities. Here, the management of flows of material resources, information, finance, and people occurs within a single organization or in a local market. Logistics networks at this level are characterized by a relatively simple structure, where the focus is on optimizing internal processes – procurement, production, warehousing, transportation, and delivery to the end consumer. The micro-level provides the basic functionality of logistics and serves as the foundation for more complex networks.

2. Meso-level (supply chains and constellations of interacting subjects) – this is the level where logistics networks are formed by integrating several enterprises, partners, or business units that interact within supply chains and value creation. At the meso-level, coordination of flows between subjects, relationship management, process synchronization, and optimization of the overall efficiency of the chain occur. It is at this level that the concepts of integrated logistics, supply chain management, and cooperation among market participants are implemented. The meso-level encompasses regional, inter-firm, or industry-specific logistics systems.

3. Macro-level – these are logistics networks that cover large-scale economic systems – entire economic sectors, regions, national economies, and global supply chains. Logistics at the macro-level is associated with the coordination and regulation of flows between different countries, continents, industries, ensuring infrastructural support, transport corridors, policies, and standards. Here, strategic planning, sustainable development, international cooperation, and global supply security are important issues.

Each of these levels is part of a higher-order network – local networks (micro-level) integrate into larger supply chains (meso-level), which, in turn, are elements of global economic systems (macro-level). Effective logistics management requires considering the specifics of each level and coordinating their interaction, which is critically important for achieving strategic, economic, and sustainable goals.

Logistics as a scientific approach finds wide application in various fields of activity, including military affairs, business, and emergency management. The generalized areas of use are presented in Fig. 2. Each of these areas has its specific requirements and features that determine the specifics of logistical support.

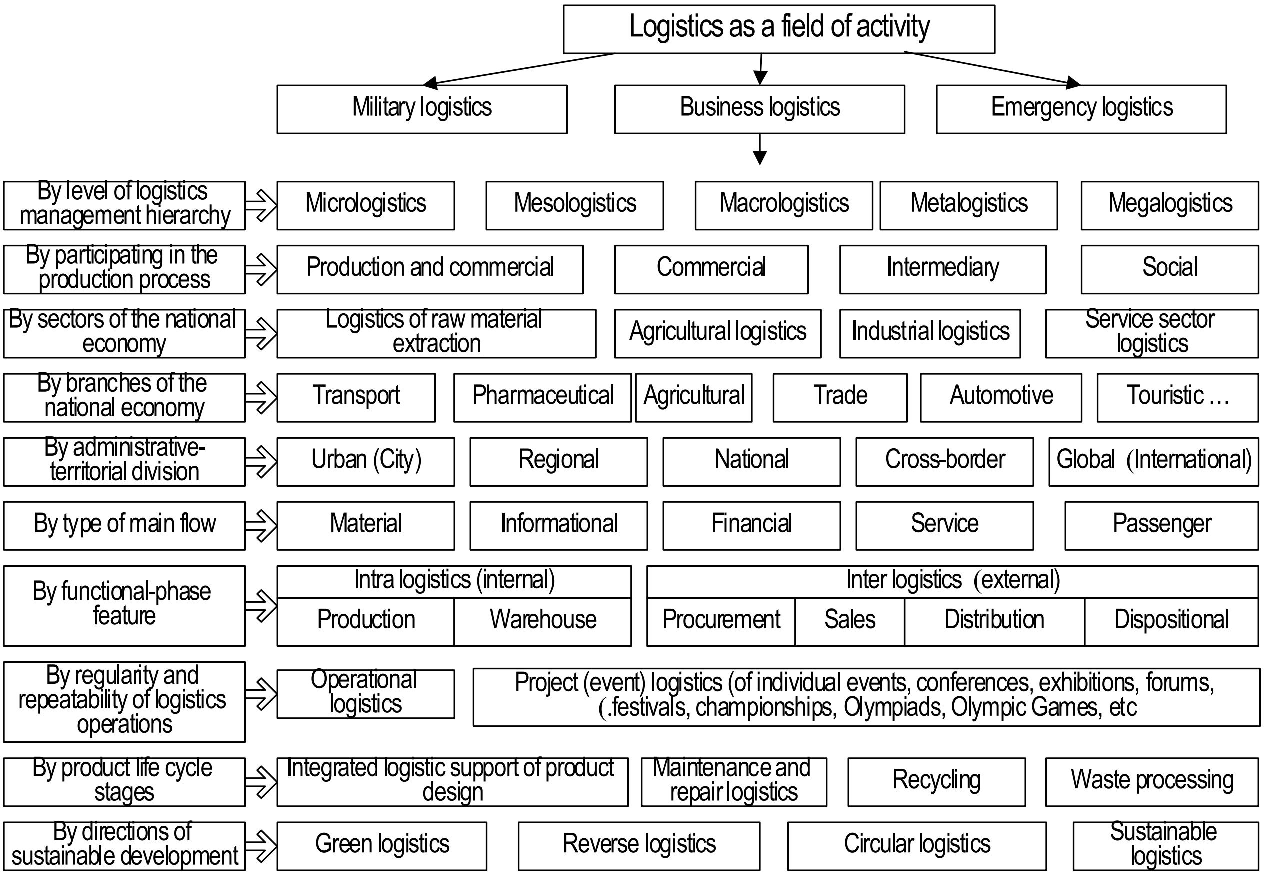

Figure 1 – Areas of application of logistics as a science and practice (designed by the author)

In the military field, logistics is a critically important component of ensuring combat readiness and successful execution of operations. It covers the planning, organization, and management of supplies of materials, armaments, fuel, medicines, and provisions, as well as the evacuation of the wounded and personnel rotation. Military logistics is characterized by high dynamism, the need for rapid adaptation to changes in the tactical situation, and strict requirements for reliability and security. It uses methods of comprehensive planning, coordination of transport and warehousing operations, and information systems for operational monitoring and resource management.

In business, logistics acts as a key element of supply chain management, ensuring the competitiveness of enterprises. It includes planning and controlling the movement of materials, goods, information, and financial flows from suppliers to end consumers. Business logistics aims to optimize costs, improve service levels, reduce inventory, and shorten order fulfillment times. It applies a wide range of methods and technologies, such as demand forecasting, automation of warehouse processes, transport optimization, and the use of ERP and SCM information systems.

In emergency management, logistics ensures rapid and effective response to crisis events, such as natural disasters, man-made accidents, epidemics, etc. Its main task is the quick mobilization, transportation, and distribution of humanitarian aid, medical supplies, equipment, and personnel to affected regions. The peculiarity of this area is the high unpredictability of situations, limited resources, and the need to coordinate numerous participants – government services, international organizations, and volunteer movements. Logistics in emergency situations applies adaptive planning, mobile warehouses, crisis information systems, and modern communication technologies to ensure timely and effective support.

Thus, logistics as a science provides a systemic, comprehensive, and adaptive approach to managing resource flows in various areas, considering their specific conditions and goals, which is a key factor in increasing the efficiency of activities in military affairs, business and crisis management.

Scientific research in logistics begins with the formulation of hypotheses – assumptions about the nature of interconnections and regularities in the functioning of logistics systems that are subject to empirical verification. Hypotheses act as working models that allow for directing research, structuring the problem, and defining the scope of analysis. In the context of the modern interpretation of logistics, a set of hypotheses, laws, and principles of logistics is proposed, which is presented in Fig. 2.

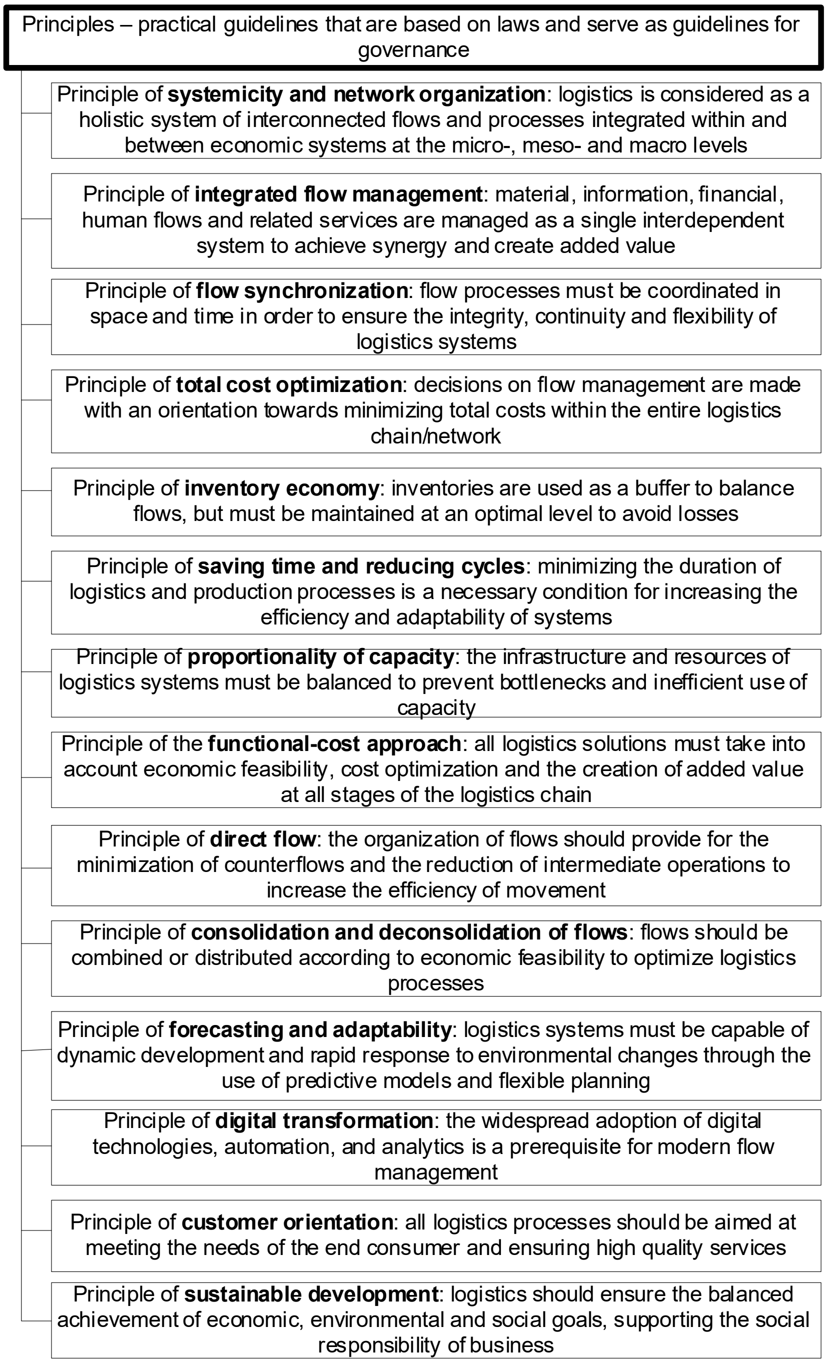

Figure 2 – Hierarchy of scientific concepts in logistics: from hypotheses to laws and principles of managing flows, systems, and networks (author's development)

The verification of identified hypotheses in logistics research allows for revealing objective regularities that determine the nature and limits of the functioning of logistics systems and networks. The laws of logistics as a science are based on a system of objective regularities that reflect essential and recurring connections between elements and processes of logistics systems and networks. These laws have a socio-economic character, so their operation depends on the specific context, technological level, scale, and structure of the system. However, it is precisely these laws that form the theoretical basis for the development of logistics concepts, the definition of key principles, and the selection of adequate management methods.

Within the scientific approach to logistics, it is advisable to distinguish groups of laws by their subject focus and functions. In particular, this work considers:

– laws of economy, which set fundamental rules for the rational use of resources and time within logistics systems or networks. They determine the need for comprehensive optimization of supply chains, minimization of inventory, reduction of logistics cycles, and selection of economically feasible flow routes;

– laws of organization, which define the structural and functional features of building and managing logistics networks and flows. They highlight the importance of flow consolidation, adequate infrastructure throughput, direct flow movement, and customer orientation as the basis for effective logistics activities;

– laws of digital transformation and sustainable development, which reflect modern trends and requirements for logistics systems, focusing on technological modernization, automation, environmental, and social responsibility.

The laws of logistics are interdisciplinary and apply to material, information, financial, and human flows, reflecting the complexity and strategic nature of the modern vision of logistics. It is on their basis that the principles of logistics process management are formed, detailing the ways of practical implementation of theoretical knowledge in the activities of enterprises, regions, and global economic systems.

Modern logistics is based on a system of principles that reflect the complex and multi-level nature of flow management in economic systems. System-integrative principles emphasize the integrity and interdependence of different types of flows, as well as the need for their synchronization to ensure the continuity and flexibility of logistics processes. Economic and optimization principles are aimed at minimizing total costs, effective inventory management, and reducing cycle times, which increases the adaptability and competitiveness of systems. Organizational and technological principles define the rules for building effective flows, considering direct flow, consolidation, and adaptability, as well as the implementation of digital technologies to increase transparency and operational efficiency. Socio-marketing principles emphasize the customer orientation of logistics services and the need to consider sustainable development, which ensures a balanced combination of economic, environmental, and social goals. Collectively, these principles create a reliable basis for the theoretical substantiation and practical implementation of modern logistics as a science and management function.

Based on laws and principles, a set of methods, tools, and technologies is formed that allows for effectively solving specific logistics tasks at various management levels – from operational to strategic. The sequence "laws → principles → methods" reflects the logical chain of transition from scientific knowledge to the practical implementation of management in logistics, ensuring the systematic nature, efficiency, and adaptability of logistics systems in modern conditions.

The complexity of logistics systems, manifested in multi-level organization, multi-flow nature, spatial-temporal localization, and systemic interdependence, requires the application of a comprehensive methodology. The methodology of logistics is not limited to the framework of a single discipline but integrates knowledge from various scientific fields for a comprehensive solution of logistics tasks. It combines knowledge from economics, management, informatics, mathematics, cybernetics, and social sciences. Specifically, from economics, it borrows principles of efficient resource utilization and cost analysis; from management – approaches to organizing, planning, and controlling processes; from informatics – methods of data processing, transfer, and protection; from mathematics – tools for modeling, optimization, and statistical analysis; from cybernetics – theories of managing complex systems and feedback; from social sciences – understanding of human behavior, organizational cultures, and social interactions. Such a multidisciplinary approach allows for comprehensively considering all aspects of logistics processes and increasing the efficiency of flow management in complex and dynamic conditions.

Thus, the methodology of logistics is considered as a set of conceptual approaches, principles, methods, and models applied to the analysis, design, organization, and optimization of logistics systems, networks, processes, and flows with the aim of increasing their efficiency, flexibility, and sustainable development of economic systems.

The methodology of logistics is based on three fundamental approaches – systemic, process, and flow – which form the basis for the analysis, design, and management of logistics flows, systems, and networks. The systemic approach in logistics is based on understanding logistics systems as complex, holistic entities consisting of interconnected elements, processes, resources, and participants. This approach allows for not considering individual logistics functions – transportation, warehousing, order management, cargo handling, last-mile delivery, returns management, information support – in isolation, but rather viewing them as parts of a single system, where changes or disruptions in one element inevitably affect the functioning of the entire system. The systemic approach involves a hierarchical structure of logistics systems (micro-, meso-, macro-levels), consideration of the external environment, goals, constraints, and interrelationships. This allows for a comprehensive analysis of logistics problems, building effective flow management models, and considering economic, technical, social, and environmental factors. The process approach focuses on logistics as a set of interconnected processes that have a clear sequence of execution, inputs, outputs, resources, and performance criteria. It ensures transparency, predictability, and manageability of logistics operations, allows for avoiding duplication of functions, loss of time and resources. The process approach is the basis for describing, optimizing, and standardizing logistics processes, implementing quality management systems, building process maps, and performance indicator (KPI) control systems. It orientates logistics towards achieving the final result – satisfying consumer needs and creating added customer value. The flow approach is a fundamental component of logistical thinking, as it allows for viewing economic systems and enterprises as networks through which various types of flows – material, informational, financial, and human – continuously move. This approach allows for modeling the structure, parameters, interaction, and dynamics of flows, as well as identifying "bottlenecks," imbalances, and potential for optimization. The flow approach ensures consistency and synchronization of different types of flows, allows for reducing inventory, cycle times, costs, and increasing service levels. It is precisely due to the flow approach that logistics acts as an integrating function of the economy, combining production, distribution, service, and consumption into a single managed system.

Thus, the combination of systemic, process, and flow approaches forms the conceptual basis of modern logistics as a science and practice, ensuring effective management of complex flow-network structures in conditions of increasing globalization, digitalization, and sustainable development. The defined methodological approaches – systemic, process, and flow – create the foundation for forming various concepts of logistics, which concretize and adapt general management principles to the specifics of different levels, industries, and operating conditions. The consideration of logistics concepts allows for a better understanding of how the science and practice of logistics have evolved under the influence of technological, economic, and social changes, and how they respond to modern challenges of globalization, digitalization, and sustainable development.

In modern academic and scientific literature, the definition of "logistics concept" is interpreted at two interrelated but distinct levels – theoretical and applied. At the theoretical level, a logistics concept is understood as a systemic model (paradigm) that reflects a fundamental vision of the role, structure, and tasks of logistics as a sphere of management within a specific historical, socio-economic, and technological context. Such concepts define logistics activities as a component of integrated enterprise management, supply chains, or economic systems of various levels. They lay the theoretical foundation for forming principles, methods, and approaches to organizing flows of material resources, information, finances, and people. Table 2 presents the author's vision of the evolution of the systemic model of logistics as a science, that is, as a sequential change in the scientific vision of the role, tasks, and boundaries of logistics in accordance with the development of economics, technologies, and societal needs.

Table 2. Stages of evolution of logistics as a science and applied discipline (author's development)

Stage	Characteristics of the system model	Object of management	Level of coverage	Key emphases of science and practice	Dominant laws and principles of logistics	Human role	Technological background
1. Stage of logistics conceptualization (1950–1970)	The emergence of theoretical ideas about logistics as an activity of moving and placing resources	Material flows	Enterprise, local level	Rationalization of transport, warehouse, costs, and organization of flows	Law of economic efficiency of flow movement (embryonic level), Principle of process organization	Human - physical performer, operator	Basic mechanization, initial information systems
2. Stage of logistics development and integration (1970–mid-1990s)	The formation of integrated logistics as a set of interconnected flows and processes	Material and information flows	Intra-firm and cross-functional	Integration of warehouse, transport and production processes; optimization of stocks; JIT, DRP concepts	Law of inventory saving, Law of time saving, Principle of systematicity, integration, process approach	Human - coordinator, manager, analyst	MRP, MRP II, first ERP systems
3. Stage of logistics separation and supply chain management (mid-1990s–2010)	Logistics as a component of SCM, focused on managing flows within interorganizational networks	Material, information and financial flows	Inter-organizational, inter-regional	Strategic integration, globalization, supply chain management, partnership and flexibility	Law of time saving, flow efficiency, consolidation, capacity proportionality; Principle of variability, integration, customer orientation	Human - key competence of the system, coordinator, strategic partner	ERP, EDI, SCM systems, analytics
4. Stage of logistics digital transformation (2010–2020)	Intellectualization of logistics systems, active digitalization of processes and management	Material, information, financial and human flows	From local to global	Digital platforms, transparency, analytics, automation and data integration	Strengthening the effect of the laws of flow efficiency, time saving, capacity proportionality; Principle of sustainable development, functional-value, digital approach	Human - analyst, user of digital technologies, operator of complex systems	Big Data, IoT, AI, blockchain, robotics
5. Stage of logistics intellectualization (from 2020)	Logistics as an interdisciplinary, global science and practice, focused on the	Material, information, financial and	Global, inter-industry, inter-regional	Human-centricity, sustainability, adaptability, ethics, social responsibility, integration of human	Synergistic effect of all laws of economy and organization; Principles of sustainable	Human - co-creator of the system, key beneficiary, bearer of	Industry 5.0, intelligent networks, Green

	balance of technology, sustainable development and people	human flows		and technological potential	development, systematicity, integration, customer orientation, human-centricity	knowledge and creativity	Logistics, ethical and social standards

The presented evolution of logistics as a science and practice reflects the gradual increase in the complexity of management objects and methods, as well as the rising level of integration and globalization of logistics systems. At the initial stage of conceptualization (1950–1970s), logistics was primarily viewed as a function of moving material resources within individual enterprises. During this period, basic laws of efficient flow movement dominated, and management mostly focused on rationalizing transport and warehousing. Humans performed physical executive functions, and technologies were limited to mechanization and rudimentary information systems.

During the period of logistics development and integration (1970s – mid-1990s), there was a significant expansion of the management object by including information flows and integrating inter-functional processes. Here, the laws of inventory and time economy gained strength, and systemic and integrated management principles were reinforced. Humans transformed into coordinators and analysts, and with the advent of technologies like MRP and ERP, optimization capabilities significantly increased.

From the mid-1990s to 2010, logistics formally separated from supply chain management, with the latter becoming key in globalization and inter-organizational coordination. Management encompassed material, information, and financial flows, emphasizing partnership, flexibility, and strategy. Laws of consolidation, proportionality of capacities, and customer orientation became critically important, and the human role transformed into a strategic partner capable of effectively managing complex networks with the help of SCM systems.

The stage of digital transformation (2010–2020) is characterized by the intensive use of innovative IT solutions – Big Data, artificial intelligence, Internet of Things, and robotization. This period deepens the application of sustainable development principles and the functional-value approach, ensuring flexibility, transparency, and accuracy in flow management. Humans remain key analysts and operators of complex automated systems.

Finally, the stage of intellectual logistics begins from 2020 and opens a new era, where technological progress combines with human-centricity, ethical standards, and social responsibility. Intellectual logistics means not only automation and digitalization of processes but also adaptability, self-learning, forecasting, and strategic decision-making, considering complex interrelationships between flows of materials, information, finance, and people. It harmoniously combines technological potential with a human-centric approach, sustainable development, and ethics, which is the essence of Logistics 5.0. This stage embodies systemic, integrated, and sustainable approaches, balancing economic efficiency with environmental and social aspects. Humans become not only users but also active creators of new-generation logistics systems, ensuring a balance between technologies and societal needs.

Thus, the presented model (paradigm) of logistics demonstrates not only technical-technological and organizational development, but also the gradual formation of a multi-dimensional scientific discipline, at the heart of which is effective, adaptive, and responsible management of resources, information, financial, and human flows in complex economic systems at various levels.

It should be noted that the evolution of logistics as a science and applied field is accompanied by the continuous development of concepts, strategies, management models, and practices that reflect changes in the technological environment, market conditions, and societal needs. From the perspective of a modern scientific vision, it is appropriate to distinguish three main groups of logistics concepts that characterize different stages and approaches to organizing logistics activities:

1. Traditional logistics concepts.

This group formed in the second half of the 20th century during the establishment of logistics as a separate management function and science. The main focus of traditional concepts is on managing material flows, optimizing costs, and ensuring the efficiency of resource provision. Among the key concepts of this period, the following should be highlighted:

– "Just-in-Time" (JIT) concept, which is focused on minimizing inventories and ensuring the supply of resources at a precisely defined time, which allows reducing storage costs and increasing turnover;

– "Just-in-Case" concept, which involves the formation of strategic reserves to reduce the risks of supply disruptions;

– Lean logistics, aimed at eliminating all types of losses in logistics processes and ensuring maximum value for the consumer at minimum costs;

– Outsourcing of logistics functions, i.e., transferring part of logistics processes to specialized companies to increase efficiency and flexibility. These concepts allowed for significant optimization of material flows, cost reduction, and increased productivity, but mostly did not take into account complex inter-system interconnections, social, and environmental aspects.

2. Integrated logistics concepts or SCM-oriented concepts:

– Quick Response (QR) and Continuous Replenishment (CR), which aim to shorten delivery times and ensure continuous replenishment of inventory based on up-to-date information on product sales levels;

– Efficient Consumer Response (ECR) – a concept aimed at increasing the efficiency of the entire supply chain through cooperation between manufacturers, wholesalers, and retailers for rapid response to consumer demand;

– Vendor-Managed Inventory (VMI) – an inventory management model where the supplier takes responsibility for planning and replenishing the consumer's inventory based on up-to-date inventory levels;

– Collaborative Planning, Forecasting, and Replenishment (CPFR) – a concept of joint demand planning, forecasting, and inventory replenishment, which involves deep cooperation between supply chain participants, information exchange, and coordination of actions to ensure the stability and efficiency of flows;

– Agile Logistics – a concept that focuses on the ability of the supply chain to quickly, efficiently, and with minimal cost adapt to changing market conditions, unpredictable demand changes, supply disruptions, and external crises.

Thus, SCM-oriented concepts demonstrate a transition from isolated management of individual flows to comprehensive (integrated) management of value chains.

3. Modern logistics concepts.

Starting from the 2010s, under the influence of digital transformations, globalization, and growing societal demands for sustainable development, there has been a qualitative change in approaches to logistics. Modern concepts integrate digital technologies, sustainability, social responsibility, and human-centricity. The main concepts of this stage include:

– Reverse Logistics – the concept emerged earlier but fully integrated into logistics only during the transition to sustainable development and responsible consumption;

– Circular Logistics – formed as a tool for implementing the circular economy and corresponds to the values of Logistics 5.0;

– Sustainable Logistics – oriented towards minimizing the negative impact of logistics processes on the environment, optimizing resource consumption, and developing a circular economy;

– Green Logistics – involves reducing greenhouse gas emissions, using environmentally friendly modes of transport, and ensuring energy efficiency of warehouses and logistics infrastructure;

– Digital Logistics – implemented through the introduction of information systems and digital technologies, including artificial intelligence, Internet of Things (IoT), blockchain, and big data to increase the transparency, flexibility, and accuracy of logistics operations;

– Smart Logistics – involves the integration of intelligent digital technologies (IoT, artificial intelligence, big data, automation, blockchain, etc.) into all elements of logistics systems to achieve maximum transparency of logistics processes in real-time;

– E-commerce Logistics – stimulates the development of quick, personalized, and convenient logistics services for online retail.

Thus, modern concepts go beyond exclusively economic efficiency, take into account environmental, social, and ethical aspects, and also focused on the integrated management of various types of flows (material, informational, financial, and human) in global logistics networks.

4. Logistics of the future: combining innovative technologies and a humanitarian approach.

Current trends in the development of science and practice allow us to predict the further transformation of logistics towards intellectual and human-centric logistics (Logistics 5.0). This approach combines the potential of technological innovations with the priority of humanitarian values. Key characteristics of future logistics:

– use of artificial intelligence, autonomous transport, robotic warehouses, digital twins for automation and optimization of processes;

– development of adaptive and self-learning logistics systems capable of responding to environmental changes in real-time;

– orientation towards human needs and safety, manifested in personalized logistics services, socially responsible management, and consideration of employee well-being;

– active integration of logistics into achieving Sustainable Development Goals (SDGs), particularly through supporting regional economies, circularity, and social inclusivity.

Thus, the described evolution of logistics concepts demonstrates a transition from narrow functional optimization to systemic, comprehensive flow management in a complex world where efficiency, technological advancement, and social responsibility act as a single integrated foundation. It clearly reflects the growing importance of the human factor, which makes the inclusion of human flows in the object of logistical analysis not only justified but also conceptually necessary. In the early stages of logistics development, particularly during the 1950s–1970s, the main focus was on managing material flows – goods, cargo, and inventory. Subsequently, during the period of integration of logistics functions (1970s–1990s), the idea of logistics as a system emerged, including not only material but also informational flows. Starting from the mid-1990s, with the spread of the supply chain management concept, logistics began to focus on inter-functional interaction, which is impossible without considering the movement, involvement, and interaction of people. In the era of digital transformation and the transition to Logistics 5.0, the importance of the human factor has grown even more: the object of logistical management now includes personnel, consumers, and users of logistics services, refugees, patients, and city residents – that is, all subjects whose movement in space and time requires logistical support. Applied fields confirm this expansion: military logistics has always considered personnel movement; in business logistics, the role of human resources logistics is growing; in humanitarian logistics – evacuation, resettlement, and support of people in emergency situations; in urban logistics – the organization of population mobility. Even leading logistics organizations, particularly BVL, explicitly include people in the list of objects of logistical modeling alongside goods, information, and finance. Thus, the inclusion of human flows in the modern definition of logistics corresponds to both applied practice and the scientific logic of logistics development as an interdisciplinary, human-oriented field of knowledge within the framework of Logistics 5.0.

The future development of logistics methodology as a science demonstrates its gradual transformation into an integrated, flexible, and predictive knowledge system that can not only accumulate approaches from other sciences but also influence their further development. As an interdisciplinary scientific field, logistics has from its very beginning relied on research results in the fields of economics, management, informatics, mathematics, cybernetics, engineering, sociology, and psychology. At the same time, the specificity of logistical thinking, namely the focus on flows, networks, interconnections, and goal orientation, allows for creating unique models capable of adequately reflecting the complex reality of modern dynamic systems.

In the near future, a key direction for the evolution of logistics methodology will be the development of virtual systems logistics. Modern logistics models are traditionally built on assumptions about the structuredness of economic systems, where roles, interconnections, and configurations are relatively stable. However, with the spread of digitalization, automation, and intellectualization of logistical activities in conditions of rapid change, these assumptions lose relevance. A new reality is forming – virtual logistics systems – in which elements and connections constantly change, boundaries between physical and digital space blur, and temporary, situational interaction networks emerge. For effective management of such systems, logistics must develop new methods for modeling, forecasting, and synchronizing flows, adapted to dynamic, non-linear, weakly structured environments.

Furthermore, logistics as a science is entering a phase of reverse influence on those scientific fields from which it drew knowledge. The specific paradigm formed in logistics, oriented towards managing flows in networks with consideration of multiple criteria, spatial-temporal coordination, and emergence, can be applied to the further development of business management, strategic planning, macroeconomic analysis, and also to fundamental disciplines. For example, in operations research, systems theory, and engineering sciences, logistical optimization and synchronization models already play a significant role. In the field of behavioral sciences, particularly psychology and sociology, logistics can offer approaches to modeling collective behavior in crisis conditions or in mass mobility systems. Thus, the logistics of the future is not just a science of flow management but also an integrative platform for mutual enrichment of various fields of knowledge, combining computational rigor, engineering precision, and socio-humanitarian sensitivity in the context of the complex challenges of the global world.

Conclusions. As a result of the conducted research, it is substantiated that logistics has transformed from an applied function related to the movement of material resources into a fully-fledged interdisciplinary scientific field. The modern interpretation of logistics goes beyond just operational management, encompassing strategic, social, and humanitarian dimensions. The refined definition of logistics within the article as the science of managing material, information, financial, and human flows within and between economic systems allows for uniting various approaches – from classical to digital and sustainable – into a single logical system.

In summary, it can be argued that the uniqueness of logistics as a science lies in its focus on the comprehensive study and management of integrated flows of material resources, information, finances, and human resources in space and time. Unlike other scientific disciplines that study individual types of flows in isolation (for instance, physics examines fluid and gas flows, economics analyzes financial flows, and information technologies investigate data flows), logistics views them as interconnected and dynamic systems that require specialized methods of analysis, planning, and management. This interdisciplinary and systemic approach defines logistics as an independent scientific discipline with a unique object and subject of research, which has significant practical importance for the effective functioning of complex economic systems.

The article proposes an original structure for the scientific foundation of logistics, encompassing the object of research, hypotheses, laws, principles, and methodological approaches. A system of logistics hypotheses has been formulated, consistent with the identified laws of economy and flow organization, as well as the principles of systematicity, process orientation, flow orientation, and adaptability. The proposed methodological basis combines the tools of economics, management, informatics, cybernetics, mathematics, and social sciences, confirming the interdisciplinary nature of logistics as a scientific field.

Five key stages of logistics development have been identified: from conceptualization in the mid-20th century to the current stage of Logistics 5.0, which is based on digitalization, service orientation, sustainable development, and consideration of the human factor. The content of traditional, SCM-oriented, and modern logistics concepts has been revealed, reflecting the shift in focus from managing physical flows to integrated management of complex, multifaceted logistics systems.

It is shown that the evolution of logistics as a science is accompanied by an increasing significance of the human factor, the emergence of virtual logistics networks, and the development of logistics in the fields of business, defense, and emergency management. It is emphasized that logistics approaches and models are increasingly becoming the basis for research and solutions in other scientific disciplines, indicating the growing reverse influence of logistics as a science.

The scientific novelty of the study lies in generalizing and conceptualizing the modern definition of logistics as a science, forming a structural-logical model of logistics from a scientific approach perspective, and proposing logic for the evolution of logistics concepts in connection with digitalization, sustainable development, and the humanization of flow management.

The practical significance lies in the fact that the obtained results can be used for updating educational programs in logistics and SCM, developing strategic logistics solutions in companies, and forming a new paradigm of logistical thinking in the context of the digital transformation of the economy.

Prospects for further research in the field of logistics should be based on the empirical verification of the identified principles and laws, which will allow for confirming their practical applicability and effectiveness in various contexts of logistics process management. Special attention should be paid to studying the formation and functioning of virtual logistics systems, which are becoming increasingly relevant in the conditions of digital transformation and a rapidly changing global environment. This research will help to develop new methodological approaches and tools for optimizing complex multi-level logistics networks. Furthermore, an important direction is the analysis of the humanitarian potential of logistics, especially in the context of crisis situations and recovery processes, which will increase the effectiveness of emergency response and promote the sustainable development of affected regions. Thus, further scientific research will contribute not only to the theoretical deepening of the discipline, but also to the practical adaptation of logistics concepts to contemporary challenges.

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