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Valentyn ZHYVTSOV
Postgraduate Student of Management and Finance Department, Ukrainian State University of Science and Technology, Dnipro, Ukraine, e-mail: v.zhivtsov@gmail.com, ORCID: https://orcid.org/0009-0000-0181-9489

THE LOGISTICS SYSTEM OF AN INDUSTRIAL ENTERPRISE AS A SOCIO-ECONOMIC STRUCTURE: THEORETICAL FOUNDATIONS OF FUNCTIONING AND DEVELOPMENT

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Abstract. *The article considers the logistics system of an industrial enterprise as a complex socio-economic mechanism within which material, information, organizational, and social processes interact. The subject of the study is the processes of formation and functioning of the logistics system with due regard to behavioral, cultural, and cognitive factors. The purpose of the article is to provide a theoretical substantiation of an extended approach to interpreting the logistics system and to identify the regularities of its adaptive behavior under conditions of environmental instability. The research methodology is based on the systems and institutional-economic approaches, the provisions of behavioral economics, organizational theory, social capital theory, and synergetic, as well as the application of structural-functional and process analysis. In the course of the study, the influence of the human factor on the coordination of logistics processes and the effectiveness of managerial decisions is analyzed. The role of motivation, organizational culture, and formal and informal communications in ensuring the stability of the logistics system is investigated. The concept of economic rationality in logistics is уточнено (refined) by shifting from a cost-centered approach to the concept of extended rationality, which takes into account social relations and behavioral constraints. The results of the analysis of digital transformation of logistics systems are generalized, and it is demonstrated that the effectiveness of digital innovations is determined by the level of digital competencies of personnel and the alignment of technological solutions with the organizational culture of the enterprise. It is substantiated that the logistics system represents an open dynamic structure characterized by self-organization and nonlinear responses to external and internal impulses. A multilevel model of socio-economic interaction in logistics is proposed, encompassing the micro-, meso-, and macro-levels, which makes it possible to explain the emergence of hidden logistics dysfunctions. The originality of the study lies in the integrated combination of social, behavioral, and economic approaches to the analysis of logistics systems of industrial enterprises. The practical value of the obtained results consists in the possibility of applying the proposed theoretical provisions to improve logistics management systems, enhance adaptability, and reduce the risks of destabilization of logistics processes. The conclusions formulate recommendations for the application of the proposed model of socio-economic interaction in logistics aimed at increasing the resilience and efficiency of industrial enterprises under conditions of uncertainty.*

Keywords: *logistics system; industrial enterprise; socio-economic mechanism; supply chains; human factor; organizational culture; sustainability of logistics systems; digital transformation; behavioral factors.*

Валентин Олегович ЖИВЦОВ
аспірант кафедри менеджменту та фінансів, Український державний університет науки і технологій, м. Дніпро, Україна, e-mail: v.zhivtsov@gmail.com, ORCID: https://orcid.org/0009-0000-0181-9489

ЛОГІСТИЧНА СИСТЕМА ПРОМИСЛОВОГО ПІДПРИЄМСТВА ЯК СОЦІАЛЬНО-ЕКОНОМІЧНА СТРУКТУРА: ТЕОРЕТИЧНІ ЗАСАДИ ФУНКЦІОНУВАННЯ ТА РОЗВИТКУ

Живцов, В. О. Логістична система промислового підприємства як соціально-економічна структура: теоретичні засади функціонування та розвитку. *Вісник соціально-економічних досліджень.* Одеса : Одеський національний економічний університет. 2025. № 3-4 (94-95). С. 169–182.

Анотація. *У статті розглянуто логістичну систему промислового підприємства як складний соціально-економічний механізм, у межах якого взаємодіють матеріальні, інформаційні, організаційні та соціальні процеси. Предметом дослідження є процеси формування та функціонування логістичної системи з урахуванням поведінкових, культурних і когнітивних чинників. Метою статті є теоретичне обґрунтування розширеного підходу до трактування логістичної системи та виявлення закономірностей її адаптивної поведінки в умовах нестабільного середовища. Методологія дослідження ґрунтується на системному та інституційно-економічному підходах, положеннях поведінкової економіки, організаційної теорії, теорії соціального капіталу та синергетики, а також на застосуванні структурно-функціонального і процесного аналізу. У ході дослідження проаналізовано вплив людського фактора на узгодженість логістичних процесів та ефективність управлінських рішень. Досліджено роль мотивації, організаційної культури, формальних і неформальних комунікацій у забезпеченні стійкості логістичної системи. Уточнено зміст економічної раціональності логістики шляхом переходу від витратного підходу до концепції розширеної раціональності, що враховує соціальні взаємини та поведінкові обмеження. Узагальнено результати аналізу цифрової трансформації логістичних систем і доведено, що ефективність цифрових інновацій визначається рівнем цифрової компетентності персоналу та відповідністю технологій організаційній культурі підприємства. Обґрунтовано, що логістична система є відкритою динамічною структурою з властивостями самоорганізації та нелінійної реакції на зовнішні й внутрішні імпульси. Запропоновано багаторівневу модель соціально-економічної взаємодії в логістиці, яка охоплює мікро-, мезо- та макрорівні та дозволяє пояснити виникнення прихованих логістичних дисфункцій. Оригінальність дослідження полягає у комплексному поєднанні соціальних, поведінкових і економічних підходів до аналізу логістичних систем промислових підприємств. Практична цінність отриманих результатів полягає у можливості використання запропонованих положень для вдосконалення системи управління логістикою, підвищення адаптивності та зниження ризиків дестабілізації логістичних процесів. У висновках сформульовано рекомендації щодо застосування запропонованої моделі соціально-економічної взаємодії в логістиці для підвищення стійкості та ефективності функціонування промислових підприємств в умовах невизначеності.*

Ключові слова: *логістична система; промислове підприємство; соціально-економічний механізм; ланцюги постачання; людський фактор; організаційна культура; стійкість логістичних систем; цифрова трансформація; поведінкові фактори.*

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1. Introduction

In today's environment, where market conditions are constantly changing – often abruptly and unpredictably – industrial enterprises increasingly face a profoundly human challenge: how to preserve the coherence of logistics processes while maintaining the resilience of supply chains. Conventional views of logistics as a clearly defined set of operations that supposedly function according to prescribed instructions prove to be insufficient. Real production follows its own rhythm, shaped by team morale, the speed and quality of communication, the level of trust between departments, and people's willingness to assume responsibility.

It becomes evident that logistics is not merely a technological function, but to a large extent a socio-economic structure in which managerial decisions emerges at the intersection of organizational culture, motivational incentives, informal arrangements, and institutional constraints. Within this environment, human behavior – along with the ability to interact, negotiate, and support one another – often has a stronger impact on the effectiveness of logistics processes than any formal rules or regulations.

For this reason, logistics systems require a deeper conceptual rethinking – from a technocratic focus on "flows and schemes" toward a multidimensional analysis that incorporates economic logic, behavioral responses, organizational culture, and social relationships among people. Such an approach reveals logistics as a living space of collaboration, where technologies, interactions, trust, and knowledge intertwine to shape real outcomes.

The relevance of this perspective is driven by the need to develop a new theoretical and methodological framework capable of helping industrial enterprises sustain resilience and rapidly adapt under conditions of uncertainty, institutional change, and digital transformation. Ultimately, this makes it possible to view the logistics system not only as an economic model, but as a socio-organizational mechanism grounded in human interaction and serving as a key source of an enterprise's strategic flexibility.

2. Literature review

Chen, L. et al. [1, Sections 2–5] argues that logistics corporate social responsibility (LCSR) exerts a systematically positive influence on supply chain alignment and overall supply chain performance. Through enhanced coordination mechanisms, LCSR contributes directly to improved performance outcomes. This finding confirms that social and ethical practices in logistics are not merely optional initiatives, but rather a valuable strategic resource that should be explicitly incorporated into models of logistics systems as socio-economic structures.

Nguyen Thi, M. A. and Dinh, Kh. Vu [2] substantiate that social capital – encompassing structural, relational, and cognitive dimensions – constitutes a key factor in strengthening supply chain resilience. In turn, resilience fosters sustainable development and long-term supply chain effectiveness. These conclusions are fully consistent with the present study's view of the logistics system as an open, adaptive socio-economic structure.

Alghababsheh, M. and Gallear, D. [3] advance the idea that enhancing social responsibility and social performance in supply chains requires more than formal supplier assessment procedures; it fundamentally depends on collaboration. Such collaboration

becomes effective only in the presence of well-developed social capital, including trust, shared values, and stable relational ties. This highlights that, in logistics, behavioral and social factors may outweigh formal control mechanisms in shaping real performance.

Ismayilov, V. and Karpenko, A. [4] emphasizes that the growing role of digital technologies and the intellectualization of supply chain management and logistics processes pave the way for a new level of management. At this level, critical resources extend beyond material and information flows to include knowledge, intellectual capabilities, and the organizational capacity to integrate technological and social resources. This perspective provides a conceptual foundation for models in which digital tools are organically combined with the socio-economic components of logistics.

Barsky, M. [5, pp. 451–455] demonstrates, using the example of the Polissia region, that logistics systems supporting regional development must be designed with explicit consideration of environmental, social, and economic parameters. In this sense, logistics emerges as a systemic structure in which technology, social networks, and environmental policy interact. These findings support the thesis of logistics multidimensionality, particularly within the framework of sustainable development.

Akulyushina, M. and Piterov, V. [6] examines supply chain optimization under conditions of global crises, proposing diversification strategies alongside enhanced coordination, flexibility, and adaptability. These approaches align closely with the concept of the logistics system as a socio-economic structure that requires the integration of technological, organizational, and behavioral components.

Md. Rasidul et al. [7, pp. 2505–2524] underscores that under globalization and intensifying competition, strategic logistics alliances and inter-firm integration become decisive factors of competitiveness. This reinforces the argument that logistics systems must evolve from auxiliary operational tools into strategic socio-economic structures that organize interaction at multiple levels – internal, interorganizational, and international.

Liao, F. et al. [8, Sections 3–5] show that internal corporate social responsibility – directed toward employees, partners, and suppliers – positively affects the performance of green supply chains, whereas external CSR demonstrates a more ambiguous impact. Moreover, their findings reveal dependence on the personal traits of CEOs, particularly narcissism. This underscores the necessity of incorporating social, psychological, and structural factors into logistics system models, further strengthening the argument for a multidimensional approach.

Smith, H. K. [9] systematizes the relationship between sustainable supply chain management, CSR, and corporate reputation, demonstrating that integrated social responsibility can generate long-term competitive advantages. This adds weight to the view that logistics systems should be considered not only as internal organizational structures, but also as integral elements of broader socio-economic networks.

Ebrahimzadeh-Afrouzi, M. and Ahmadchali, M. A. [10] propose a supply chain coordination model that integrates social investments and marketing strategies, illustrating how economic and social incentives can be combined within a single management framework. This model exemplifies the effectiveness of such integration and aligns with the concept of the logistics system as a socio-economic structure with interconnected components.

Pang, Y. et al. [11] applies robust optimization methods to assess the resilience of multimodal logistics networks, providing a technical and mathematical foundation for analyzing logistics systems as adaptive structures. Their work demonstrates how technological solutions complement social and organizational mechanisms, thereby extending and complicating the classical logistics paradigm.

Khaleghi, M. et al. [12] introduce an innovative AI-based model (GraphSAGE network) for logistics management involving multiple objectives, including shipment types, delays, and status tracking. This illustrates how advanced digital tools can be integrated into contemporary logistics systems, enhancing their adaptability and operational effectiveness and reinforcing the relevance of digital transformation within a socio-economic framework.

Aghaei, R. et al. [13] point out that large language models (LLMs) and other AI technologies can substantially enhance the analytical, forecasting, and coordination capabilities of supply chains. This creates a new level of integration between technology, human capital, and data – an essential dimension of a multidimensional logistics system model.

Mishchenko, M. [14, pp. 34–40] formulates an integrated model of personnel formation and motivation that accounts for managerial, economic, and psychological aspects. This approach directly resonates with the present concept, demonstrating that motivation, organizational behavior, and psychological climate are integral elements of an enterprise's socio-economic mechanism, without which a logistics system cannot function effectively. In publication [15] considers motivational and organizational factors in personnel management within the context of e-government and institutional change, further reinforcing the idea that social and motivational mechanisms are critical determinants of adaptability and resilience in logistics systems.

3. Highlighting previously unresolved parts of the overall problem

Despite notable progress in scholarly research on logistics, social capital, and supply chain resilience, many aspects of these phenomena remain marked by clear "blind spots." Most existing studies focus either on external inter-firm relationships or on isolated thematic areas – such as corporate social responsibility [1; 3], supply chain sustainability and resilience [2; 4; 6], logistics digitalization [4; 11], or personnel management and motivational mechanisms [14; 15]. While these strands of research are undoubtedly valuable, they address only partially how logistics actually lives inside an enterprise – among people, their decisions, interactions, and everyday operational practices.

To date, there is a striking lack of comprehensive approaches that conceptualize the logistics system of an industrial enterprise as an integrated socio-economic structure, in which not only material and information flows interact, but also employees' values, managerial mindsets, informal interdepartmental ties, organizational culture, and recurring behavioral patterns. It is precisely these human-centered factors that often determine how quickly information circulates, how coherently teams act, how decisions are made, and whether the logistics system is capable of withstanding stress or abrupt changes in operating conditions.

Insufficient attention has also been paid to the internal architecture of logistics systems: how departments actually interact in practice, how formal regulations coexist with

informal routines, who serves as the real carriers of knowledge within processes, how information spreads across the organization, and how managers' value orientations shape logistics-related decisions. Equally underexplored is the behavior of logistics systems during periods of turbulence – when markets shift on a daily basis, institutional environments remain unstable, and teams operate under heightened psychological pressure.

These issues – concerned with the real, lived substance of logistics at the level of internal interactions, behavioral decision-making, and organizational practices – remain insufficiently conceptualized in the existing literature. Addressing these gaps constitutes the foundation of this article, whose purpose is to advance both theoretical and applied understanding of the logistics system as a complex socio-economic structure of an industrial enterprise.

The purpose of this article is not merely to describe the logistics system of an industrial enterprise, but to reveal it as a living, multidimensional socio-economic space in which people – their motivations, interactions, and ways of thinking – play a role no less significant than material flows or digital systems. The study seeks to provide a theoretical explanation of how such a system actually functions, why it behaves in certain ways, and which underlying patterns determine its resilience and capacity for adaptation.

To achieve this purpose, the research addresses a set of interrelated objectives. First, it aims to reconceptualize the essence of the logistics system within a socio-economic framework – moving beyond schematic representations of resource flows to include people, their values, and their interactions. Second, it seeks to identify how material, information, and social flows are intertwined, collectively shaping the enterprise's real logistics behavior. Third, the study highlights the role of the human factor – trust, a culture of collaboration, and the willingness to support one another – in the formation of coordinated logistics decisions. A separate objective is to uncover the mechanisms that enable the logistics system to respond to emerging challenges, including abrupt external changes and internal organizational impulses.

The final objective is to develop the theoretical foundations for constructing a socio-economic mechanism for managing the logistics system – one that integrates economic rationality with human motivation and organizational culture. The stated purpose and objectives not only clarify the internal logic of the research, but also create a coherent bridge between its relevance and the structure of the subsequent presentation of findings.

4. The main material research

Within the framework of this study, the logistics system of an industrial enterprise is conceptualized not as a formal scheme or a set of regulated operations, but as a complex, multidimensional socio-economic space. It is a space in which people's interests, decisions, and actions intersect on a daily basis; where material and information flows circulate; where managerial influences take shape; where communication links are built; and where organizational values are continuously reproduced. Such an approach makes it possible to view logistics from the inside – as a living system that functions not only according to algorithms and instructions, but also under the influence of trust, experience, emotions, established habits, and the culture of interaction among employees. It is precisely this multilayered nature and the quality of human relationships that largely

determine the actual behavior of the logistics system, the speed of its responses, and its capacity to withstand external challenges.

Under contemporary conditions, the traditional technocratic approach – which reduces logistics to the optimization of flows and the minimization of costs – reveals its limitations with increasing clarity. This study proposes an alternative analytical perspective by interpreting logistics as an open socio-economic subsystem that evolves not only in response to technological change or market signals, but also under the influence of behavioral factors, the institutional environment, the psychological climate within teams, the quality of interpersonal interaction, and the organization's ability to accumulate and reflect upon its own experience. In this context, the logistics system emerges as a dynamic mechanism that is highly sensitive to social and cultural shifts within the enterprise.

The methodological foundation of the research is built on an integrated application of systems analysis, the institutional-economic approach, behavioral economics, organizational theory, social capital theory, sociometry, as well as structural-functional and process analysis. The combined use of these approaches made it possible to examine the logistics system from multiple analytical perspectives. The systems approach enabled its interpretation as a set of interrelated technological, organizational, informational, motivational, and cultural elements. The institutional perspective helped explain how formal rules, corporate standards, and regulatory requirements shape the behavior of participants in logistics processes. Tools drawn from behavioral economics, in turn, provided deeper insight into the logic of decision-making, the role of cognitive biases, and the influence of internal motivational drivers. Organizational theory highlighted the importance of cross-functional coordination, informal communication, and cultural norms in maintaining the integrity and stability of logistics processes.

The results obtained convincingly demonstrate that the logistics system of an industrial enterprise is deeply socially embedded. Its effectiveness is determined not only by technical parameters or the quality of planning, but above all by the nature of human interaction – levels of trust, the willingness of departments to act in a coordinated manner, the capacity for open communication, and the extent to which employees understand shared goals and feel personally involved in achieving them. From this perspective, logistics appears not merely as a process of resource movement, but as a mechanism for coordinating socio-organizational interactions. Each participant in the logistics process – regardless of position – brings their own experience, value system, motivational attitudes, and individual perception of the situation, all of which directly affect the quality of decisions made.

In this light, it becomes clear why even the most advanced technical innovations – digital platforms, ERP systems, and analytical optimization tools – do not always deliver the expected results. In the absence of a well-developed culture of interaction, stable horizontal ties, and a shared sense of the value of individual contributions, technology cannot compensate for deficits in trust, psychological safety, or motivation. Technical solutions tend to amplify the social processes already present within the organization, but they cannot replace them.

Special attention in the study is devoted to the human factor as a key source of logistics system adaptability. The findings show that employees' sense of responsibility, openness

to dialogue, willingness to share information, and ability to align individual actions with collective goals form the foundation of resilient logistics processes. In enterprises characterized by high levels of social capital, logistics functions more flexibly, more rapidly, and with greater coherence. Employees do not avoid communication, they signal risks in a timely manner, and they jointly seek solutions, enabling the system to respond effectively to non-standard situations. By contrast, a low level of communication integration leads to delays, conflicts, duplication of functions, and an increase in unproductive transaction costs.

Equally significant was the role of organizational culture, which shapes not only formal rules of interaction but also the ways information is interpreted, expectations regarding others' behavior, and the boundaries of acceptable managerial decisions. A culture grounded in openness, collaboration, and mutual support creates favorable conditions for rapid responses to change, facilitates the timely identification of emerging problems, and fosters an environment of psychological safety. It is precisely within such an environment that a logistics system is able to maintain stability and functional integrity even under conditions of heightened uncertainty.

The study also demonstrates that the response of a logistics system to external and internal impulses is largely determined by the collective's behavioral logic, the nature of managerial decision-making, and the mechanisms through which responsibility is distributed. In this sense, logistics emerges as a dynamic social construct capable of self-organization and adaptation. During periods of crisis and turbulence, particular importance is attached to practices of team building, adaptive management, and collective leadership, which enable the rapid restoration of disrupted logistics processes and support system resilience in the long term.

Special attention is devoted to motivation and incentive mechanisms as the foundation of everyday logistics behavior. The findings confirm that while material incentives remain important, their real effectiveness is revealed only when combined with non-material factors – such as recognition of work results, opportunities to be heard, a perceived fairness in workload distribution, and autonomy in decision-making. Employees who experience trust, support, and respect for their professional contribution act more quickly, more accurately, and with greater responsibility. It is precisely such a comprehensive motivational system that creates the conditions for sustaining operational resilience in logistics, even during periods of peak workload and heightened uncertainty.

The scientific novelty of the study lies in the fact that the logistics system is conceptualized for the first time as a fully-fledged socio-economic mechanism in which personnel values, managerial cognitive models, organizational social capital, structural configuration, digital platforms, and economic interests interact simultaneously. This approach makes it possible to identify and explain hidden logistics dysfunctions – those "zones of tension" that are virtually impossible to detect using traditional engineering or purely quantitative methods, yet become evident through the analysis of social and behavioral factors.

In the final part of the study, a theoretical model of the logistics system is developed that encompasses five interrelated dimensions: technological, organizational, social, behavioral, and economic. Their coordinated interaction determines an enterprise's ability to adapt to external challenges, respond promptly to environmental changes, formulate

balanced managerial decisions, and preserve the stability of logistics processes even during crisis periods. Within this perspective, logistics effectiveness is understood not as the outcome of isolated optimization of individual elements, but as the result of holistic socio-economic interaction.

Deepening the theoretical foundations of the logistics system required moving beyond classical models and turning toward an analysis of its internal logic of functioning. As a result, logistics is revealed not as a mechanical system reacting to commands, but as a living social environment in which employees, departments, professional groups, managers at different levels, and digital management tools continuously interact. It is this interaction that gives logistics decisions their real substance, determining their quality, speed of adoption, and alignment with the enterprise's actual needs.

Considerable attention is also paid to the analysis of informal practices, which in practice often play a role no less important than formalized regulations. In industrial enterprises, it is frequently the "invisible part of the iceberg" – informal communication channels, personal agreements, unofficial coordination rules, and internal informal centers of influence – that shapes an alternative contour of logistics interaction. Although this contour is not documented in official regulations, it significantly affects the speed of problem-solving, the quality of information exchange, and the system's ability to respond to non-standard and unpredictable situations. The study shows that under crisis conditions, the informal component often acts as a shock absorber: when formal procedures become overloaded or excessively slow, personal relationships and unofficial channels sustain the viability of logistics processes.

Within the theoretical analysis, the pivotal role of the communication architecture of the logistics system is also revealed. Communication is interpreted not as a simple transfer of information from one unit to another, but as a process of jointly constructing meaning and coordinating a shared logic of action. Through communication, employees develop a coherent understanding of the current situation, sense the emotional climate among colleagues, adjust priorities, and reduce uncertainty. Conversely, insufficient transparency of information flows, fragmentation of exchange channels, or the dominance of a rigid vertical "command-execution" model generate information gaps. These gaps become sources of errors, delays, duplication of actions, increased stress on personnel, and a decline in the quality of managerial decisions. The study formulates a conceptual proposition that effective logistics is impossible without horizontal information integration – when departments and teams do not merely receive directives from above, but actively interact with one another.

A distinct emphasis is placed on the cognitive dimension of logistics management. It is established that logistics decisions in real-world conditions are rarely made on the basis of "pure" data alone. More often, they rely on individual mental models, prior experience, intuitive judgments, and managers' personal thinking styles. Cognitive biases play a substantial role – such as overconfidence in one's own decisions, a tendency to rely on readily available information, anchoring effects, and groupthink. These psychological mechanisms influence which risks managers notice, which alternatives they consider acceptable, and which data they deem trustworthy. The study demonstrates that persistent cognitive distortions can generate hidden systemic dysfunctions that remain invisible within purely technical analyses, yet exert a significant impact on the overall effectiveness of the logistics system.

Table 1

Comparative Logistics Indicators of Ukraine and the EU (2020–2024)

Indicator	Region	2020	2021	2022	2023	2024*	Source
Freight transport turnover (bln. tonne-km)	EU-27	3 450	3 610	3 520	3 580	3 600	Eurostat [16]
	Ukraine	287	305	198	214	225	Ukrstat [17]
Logistics & transport services (% of GDP)	EU-27	4.8	4.9	5.1	5.0	5.0	World Bank [18]
	Ukraine	6.1	6.3	7.8	7.2	6.9	World Bank
Supply Chain Pressure Index (avg.)	EU-27	0.9	1.8	2.3	1.1	0.7	NY Fed [19]
	Ukraine	1.4	2.1	3.6	2.4	1.9	NY Fed
Digital Economy Index / DESI	EU-27	52.6	54.0	55.5	57.1	58.0	European Commission [20]
Enterprises using ERP / SCM (%)	EU-27	36	38	41	43	45	Eurostat
	Ukraine	18	20	16	19	22	Ukrstat, WB

**2024 – latest available / provisional estimates*

5. Research results

The data presented in the table indicate that, despite lower absolute volumes of logistics activity, Ukraine is characterized by a higher share of logistics and transport services in GDP, which reflects an increased burden of logistics on the overall economic system. The rise in the supply chain pressure index during 2022–2023 captures not only infrastructural constraints but also socio-organizational challenges, highlighting the need for adaptive and human-centered managerial solutions.

A substantial component of the study is devoted to rethinking the digital transformation of logistics systems through the lens of human interaction. The findings demonstrate that digital technologies transform logistics not only at the technical level – by automating warehouse operations, accelerating data processing, and improving forecasting accuracy – but also by profoundly reshaping the ways in which people collaborate with one another. Digital tools reconfigure communication networks, alter access to information, reshape managerial decision-making styles, and redefine the distribution of responsibility. At the same time, the study establishes that the mere introduction of digital instruments does not automatically lead to higher efficiency. Decisive factors include the level of digital competence among employees, their readiness to reconsider established practices, and the organization's ability to embed technologies into the real processes of logistics interaction. When digital innovations are misaligned with organizational culture, they do not modernize the system but instead generate additional zones of tension and disorder.

A separate part of the research examines the institutional factors that shape the development opportunities of logistics systems. The legal and regulatory environment, industry standards, government incentives, and the availability of infrastructure collectively define the framework within which enterprises can implement logistics transformations. The Ukrainian industrial sector is characterized by heightened institutional instability, which significantly complicates long-term planning and amplifies the importance of internal organizational resources. Under such conditions, social cohesion within teams, the quality of internal communication, managerial flexibility, and

the maturity of logistics culture perform a compensatory function, enabling the system to remain operational even in unfavorable external circumstances.

An in-depth analysis of the synergistic nature of logistics systems reveals that they possess properties of self-organization, sensitivity to initial conditions, and nonlinear developmental dynamics. The application of a synergistic approach makes it possible to explain why seemingly minor changes in the external environment or in the behavior of individual actors can trigger large-scale transformations of the entire logistics system. The study shows that such systems are capable of moving from one state of quasi-stability to another, adapting through internal reconfiguration of resources, communication patterns, and managerial algorithms. This leads to a fundamentally important managerial conclusion: logistics systems should not be governed exclusively through rigid regulations; rather, they should be maintained within parameters that allow them to respond autonomously to change and restore balance.

Within the research framework, a multilevel model of socio-economic interaction in logistics is proposed. At the micro level, it captures individual motivations, expectations, levels of trust, and the quality of communication between employees. At the meso level, it reflects patterns of interaction among departments, the nature of organizational culture, and established rules of managerial decision-making. At the macro level, it focuses on the aggregated outcomes of logistics system performance and its impact on enterprise competitiveness and overall resilience. The model convincingly demonstrates that changes in the behavior of individual employees can initiate cascading effects that transform the entire logistics architecture of the enterprise.

Special attention is given to the analysis of logistics system adaptability. The study shows that adaptability is determined not only by technical parameters – such as the availability of backup routes or alternative supply channels – but to a large extent by the organization's capacity to learn, exchange knowledge, experiment with managerial approaches, and involve employees in decision-making processes. Enterprises that cultivate a culture of learning, reflection, and open discussion of mistakes exhibit significantly higher resilience to external shocks and recover disrupted logistics processes more rapidly.

An important outcome of the study is the refinement of the concept of economic rationality in logistics. While classical approaches equate rationality with cost minimization, the proposed framework advances the notion of "extended rationality," which incorporates social relationships, behavioral factors, cultural norms, and organizational dynamics. This perspective makes it possible to explain a common practical paradox: logistics decisions are often not mathematically optimal, but "humanly optimal" – that is, they function most effectively within a specific social context and ultimately ensure the real resilience of the system.

6. Conclusions

The conducted study made it possible to conceptualize the logistics system of an industrial enterprise as a multidimensional socio-economic structure whose functioning is determined not only by technological characteristics and organizational regulations, but also by employees' behavioral models, the culture of interaction, the level of social capital, and the quality of communication links. The research provides a theoretical justification for viewing the logistics system as an open subsystem of the enterprise,

capable of responding to external and internal impulses through changes in managerial practices, transformations of communication architecture, and adaptation of motivational mechanisms. This approach made it possible to overcome the reductionist perspective inherent in classical logistics models and to identify a new scientific lens in which logistics management emerges as a combination of technological rationality and socio-organizational dynamics.

The results demonstrate that the resilience and coherence of logistics processes largely depend on the synergy between the enterprise's economic interests and behavioral factors – such as employee motivation, trust, organizational culture, psychological climate, and willingness to cooperate. It is established that social capital acts as a key regulator of logistics interaction: at higher levels of social capital, enterprises exhibit a greater capacity to respond to change, formulate coordinated decisions, and reduce internal transaction costs. The study substantiates that the effectiveness of a logistics system is shaped not by isolated technical or organizational tools, but by the alignment of technological, social, organizational, and behavioral dimensions that together form integrated logistics architecture.

The practical significance of the findings lies in the possibility of applying the developed theoretical provisions to design mechanisms for adapting logistics systems to crisis impacts, optimizing communication processes, improving personnel motivation structures, and cultivating an effective organizational culture. The conclusions may be used to diagnose internal logistics dysfunctions, develop personnel development programs, and implement digital platforms that take into account both technological and socio-economic aspects of logistics management.

Prospects for further research include an in-depth examination of:

– mechanisms for building social capital within logistics units and their impact on the speed and quality of managerial decision-making;

– managerial cognitive biases that influence logistics decisions under conditions of uncertainty;

– the role of digital technologies, particularly artificial intelligence systems, in modeling behavioral factors and forecasting logistics scenarios;

– organizational configurations of logistics systems capable of ensuring resilience and strategic flexibility in turbulent environments;

– institutional frameworks that shape the evolution of logistics practices at the industry and national economy levels.

Thus, the logistics system of an industrial enterprise emerges not merely as a tool for flow optimization, but as an integrated socio-economic construct formed at the intersection of technologies, human interactions, and organizational norms. Further research in this direction will contribute to the development of more flexible, adaptive, and human-centered models of logistics management capable of ensuring enterprise resilience under complex economic conditions.

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