

Institutional foundations of innovative development of logistics enterprises in Ukraine

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Abstract. The relevance of the study was determined by the increasing role of the institutional environment in ensuring the innovative development of logistics enterprises under conditions of digital economic transformation and Ukraine's integration into global supply chains, where the misalignment between regulatory mechanisms and the requirements of the digital economy, high transaction costs, and restrictive currency regulation create systemic barriers to the implementation of innovations in logistics. The aim of the study was to assess the impact of the institutional environment, including digital transformation, transaction costs, and currency restrictions, including regulated cross-border payments and maximum settlement periods for export-import transactions, on the international competitiveness of Ukrainian logistics enterprises and to identify priority directions for improving the institutional framework under the conditions of digital economic transformation. The research employed systemic and comparative analysis, structural-logical modeling, generalisation methods, and elements of statistical analysis, while the empirical basis was formed by data from the World Bank, the Organisation for Economic Co-operation and Development, the European Commission, and national statistics for the period 2018-2024. The results revealed the presence of institutional asymmetry between the level of development of digital logistics technologies and their regulatory framework, as well as the dominance of constraining factors such as high transaction costs, insufficient digitalisation of administrative procedures, restrictive currency regulation, and weak institutional incentives for innovation. The findings indicated that these factors constrain the integration of Ukrainian logistics enterprises into global high-tech supply chains and reduce their international competitiveness. The practical value of the study lies in providing an analytical basis for improving institutional policy in logistics through the harmonisation of the regulatory framework with European standards, the digitalisation of regulatory processes, and the liberalisation of the currency environment to stimulate the innovative development of the sector

Keywords: ainstitutional asymmetry; logistics supply chains; transaction costs; digital logistics transformation; currency regulation; transport infrastructure; innovation capacity of enterprises

Introduction

The global logistics sector is undergoing a structural transformation driven by digitalisation, the diffusion of Industry 4.0 technologies, and increasing institutional complexity. The transition towards intelligent transport systems and digital supply chains is reshaping traditional

logistics models, requiring new approaches to coordination, governance, and performance management in international markets. Under these conditions, the interaction between technological development, institutional environments, and regulatory frameworks becomes a

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key determinant of the efficiency and competitiveness of logistics enterprises.

Recent studies demonstrate that digital transformation significantly enhances the adaptability and responsiveness of supply chains. In particular, C. Peng *et al.* (2025) note that digital technologies improve supply chain flexibility while simultaneously intensifying asymmetries in network power distribution. At the same time, J. Keller *et al.* (2024) emphasises that the development of digital supply networks requires new governance mechanisms that integrate technological and institutional dimensions. Furthermore, D. Herold & Ł. Marzantowicz (2023) highlighted that institutional complexity plays a crucial role in shaping supply chain resilience, especially in the context of global disruptions. The economic implications of digital transformation are widely explained through the lens of transaction cost theory. The adoption of advanced digital solutions, including blockchain technologies, contributes to reducing transaction costs and increasing transparency in supply chain operations (Queiroz & Wamba, 2019). However, these benefits are often constrained by institutional asymmetries and differences in regulatory environments across countries, which limit the effectiveness of digital integration in logistics systems.

An important direction of contemporary research is also related to supply chain resilience and risk management. D. Ivanov & A. Dolgui (2021) propose the concept of a digital supply chain twin as an innovative tool for real-time disruption management, while M. Christopher (2022) underlines the importance of resilience as a critical factor for maintaining the stability of global logistics networks under conditions of uncertainty. At the macroeconomic level, regulatory and financial factors exert a significant influence on logistics systems, particularly in the context of currency regulation and financial stability. International analytical reports confirm that monetary policy and financial regulation affect cross-border logistics operations and the development of global value chains (World Bank, 2023; IMF, 2024). In the case of Ukraine, currency regulation and institutional constraints create additional barriers for logistics enterprises seeking integration into international markets (NBU, 2022).

Despite the growing number of studies addressing digital transformation and supply chain management, there remains a research gap in understanding the combined impact of digitalisation, institutional asymmetry, and currency regulation within the framework of intelligent transport systems. Most existing studies consider these factors separately, which limits the development of a comprehensive analytical approach (Niemczyk & Szala, 2021). Therefore, the aim of this study was to assess the impact of the institutional environment, including digital transformation, transaction costs, and currency regulation, on the international competitiveness of Ukrainian logistics enterprises and to identify priority directions for improving the institutional framework under the conditions of digital economic transformation. To achieve this aim, the study

focuses on three interrelated objectives. First, it analyses the influence of digital transformation, Industry 4.0 technologies, and institutional asymmetry on the functioning and resilience of logistics systems and supply chains. Second, it evaluates the influence of institutional factors, transaction costs, and currency regulation in shaping the performance and international operations of logistics enterprises. Third, it identifies strategic directions for strengthening the international competitiveness of logistics enterprises through the integration of digital technologies and improvements in the institutional and regulatory environment.

Materials and Methods

The study was based on a combination of theoretical, comparative and descriptive analytical approaches aimed at assessing the institutional environment influencing the international competitiveness of Ukrainian logistics enterprises under conditions of digital transformation. The methodological foundation of the research was formed by the principles of institutional economics, transaction cost theory, and the concepts of digital transformation of logistics systems within the Industry 4.0 paradigm, which provide the basis for analysing the interaction between regulatory mechanisms and the functioning of logistics enterprises. The empirical basis of the study consists of secondary data obtained from open international analytical and statistical sources, including the World Bank (Logistics Performance Index), the Organisation for Economic Co-operation and Development (OECD), the European Commission, and other publicly available international reports published during 2018-2024. These data were used to characterise the institutional conditions affecting the development of logistics enterprises and to compare Ukraine with the average indicators of European Union countries.

The research applied a systems approach to examine the institutional environment as an interconnected set of regulatory, organisational, and economic factors affecting logistics activities. Comparative analysis was employed to identify institutional differences between Ukraine and EU countries in terms of logistics performance, digitalisation, customs procedures, transaction costs, and selected regulatory characteristics. Descriptive analysis of aggregated statistical indicators was used to interpret quantitative information and identify the main institutional constraints affecting the competitiveness of logistics enterprises. Generalisation and synthesis methods were applied to formulate conclusions regarding the institutional conditions for the development of the logistics sector. The comparative analysis is based on key institutional indicators that characterise the regulatory and organisational environment of logistics activities, including the level of digitalisation of logistics processes, customs efficiency, transaction costs, currency regulation, and selected aspects of environmental sustainability. These quantitative indicators were complemented by qualitative case analysis of logistics enterprises, public-private cooperation mechanisms, and institutional arrangements related to cybersecurity and digital trust. The

selection of analytical criteria was determined by their relevance to the study objectives and their ability to explain the institutional factors affecting the international competitiveness and digital transformation of logistics enterprises. The use of harmonised international indicators, supplemented by qualitative institutional evidence, ensures a more comprehensive comparison of Ukraine with the average values observed across European Union countries.

The methodological approach adopted in this study ensures transparency and reproducibility through the use of publicly available international databases, clearly defined comparison criteria, and generally accepted methods of comparative institutional analysis. In addition to the comparative analysis of aggregate institutional indicators, the study employed elements of qualitative case analysis to illustrate how identified institutional constraints and digital transformation factors affect the practical activities of logistics enterprises. Cases of selected logistics enterprises and examples of public-private cooperation were examined as illustrative evidence rather than as a basis for statistical generalisation. The cases were selected purposively according to their relevance to the research objectives, particularly the implementation of digital logistics technologies, interaction with public institutions, participation in digital infrastructure initiatives, and integration into international supply chains. The analysis focused on such criteria as the degree of digitalisation of logistics operations, use of Industry 4.0 technologies, interaction with regulatory institutions, participation in public-private initiatives, and the presence of cybersecurity and digital trust mechanisms.

Cybersecurity and digital trust were analysed as institutional components of the digital logistics environment. The assessment considered the availability of digital data-exchange mechanisms, cybersecurity requirements, protection of digital information, reliability of electronic transactions, and institutional arrangements supporting trust between logistics enterprises, public authorities, and international supply-chain partners. These aspects were examined through qualitative analysis of publicly available regulatory documents, analytical reports, and institutional assessments. The resulting evidence was used to complement the quantitative comparison of institutional indicators and to explain the mechanisms through which regulatory and organisational conditions influence the digital transformation and international competitiveness of Ukrainian logistics enterprises.

Results and Discussion

The analysis of Ukraine's institutional environment demonstrates its transitional character in the context of the digital transformation of the logistics sector. The obtained results indicate the presence of institutional asymmetry manifested by the faster development of digital logistics technologies compared with the adaptation of the regulatory framework governing their implementation (Gupta *et al.*, 2020). Existing legislation remains primarily focused on the development of physical transport infrastructure,

whereas the legal regulation of digital instruments, including smart contracts, blockchain-based solutions, and electronic data exchange, remains incomplete. Such institutional inconsistency complicates the implementation of innovative logistics solutions and slows the integration of Ukrainian logistics enterprises into international digital supply chains (Saber *et al.*, 2019). The obtained results also indicate that institutional conditions substantially influence the operational environment of logistics enterprises. In particular, the analysis identifies a number of institutional constraints associated with customs administration, regulatory procedures, digitalisation of public services, and currency regulation, which together increase transaction costs and reduce the flexibility of logistics operators in international markets.

A comparative assessment of the institutional environment demonstrates a persistent gap between Ukraine and the European Union in terms of logistics performance, digitalisation, customs efficiency, and regulatory adaptability. According to the World Bank Logistics Performance Index, Ukraine's overall LPI score decreased from 2.83 in 2018 to 2.70 in 2023, while its ranking declined from 66th to 79th position (World Bank, 2018; 2023). The LPI assessment covers six dimensions of logistics performance, including customs efficiency, transport infrastructure, international shipments, logistics services, tracking and tracing, and timeliness (World Bank, 2023). This deterioration indicates that the institutional and infrastructural environment of Ukrainian logistics was significantly affected by disruptions to transport networks, border operations, and international supply chains during the period under consideration.

At the same time, the comparison with EU practices indicates that the institutional gap extends beyond physical logistics performance. European economies have developed more integrated digital administrative systems, wider electronic data exchange, and more advanced mechanisms for coordinating public authorities and private logistics operators. OECD assessments indicate that the digital transformation of Ukrainian enterprises has accelerated, particularly in response to wartime disruptions, but the adoption of advanced digital technologies remains uneven across enterprises and technology categories (OECD, 2024). For example, the OECD reports substantial differences in the use of basic digital tools between Ukrainian enterprises of different sizes, while the adoption of more advanced technologies, including cloud computing, remains relatively limited (OECD, 2021).

This creates an institutional asymmetry in which the demand for digital logistics solutions is developing faster than the regulatory, organisational, and interoperability mechanisms required for their effective implementation (OECD, 2024). The European Commission's Digital Decade framework similarly emphasises the importance of digital transformation of businesses, digital public services, digital skills, and secure digital infrastructure as interconnected components of competitiveness and resilience. Customs administration represents another important component of

this institutional gap. Since customs efficiency constitutes a separate dimension of the LPI, the assessment of Ukraine's logistics performance indicates persistent challenges associated with border procedures and trade facilitation (World Bank, 2023). These constraints are particularly important for logistics enterprises operating across international supply chains, as additional administrative requirements and coordination procedures may increase the complexity of cross-border operations and reduce operational flexibility.

The institutional differences are also reflected in the regulatory environment surrounding digital logistics and international transactions. While Ukraine has made substantial progress in the digitalisation of public services and in the approximation of its regulatory framework to European requirements, the implementation of digital technologies in logistics remains affected by fragmented information systems, interoperability challenges, regulatory uncertainty, and additional compliance requirements (OECD, 2024). Consequently, the institutional environment cannot be assessed solely through the availability of digital technologies; its effectiveness depends on the extent to which regulatory, administrative, technological, and financial mechanisms operate in a coordinated manner. Overall, the comparative assessment confirms the existence of institutional asymmetry between Ukraine and the EU. The Ukrainian logistics sector demonstrates significant adaptive capacity and an accelerating digital transformation, but the institutional framework does not yet fully provide the conditions required to convert technological progress into sustained improvements in logistics performance and international competitiveness (World Bank, 2023; OECD, 2024). This finding provides a basis for further analysis of transaction costs, currency regulation, digital public administration, and the institutional mechanisms supporting the integration of Ukrainian logistics enterprises into international supply chains.

A separate institutional constraint affecting the international competitiveness of Ukrainian logistics enterprises is the system of currency regulation applied during the period of martial law. The key regulatory instrument is Resolution No. 18 of the Board of the National Bank of Ukraine (NBU) of 24 February 2022, which introduced temporary restrictions on foreign exchange transactions and cross-border payments. In particular, the regulation established maximum settlement periods for export and import transactions, while the purchase of foreign currency and its transfer abroad became subject to regulatory and banking supervision (Law of Ukraine No. 2473-VIII, 2018). According to the NBU, the maximum settlement period for export and import transactions was reduced from 365 to 180 calendar days, which increased the requirements for the timely completion of international settlements and the return of foreign-currency proceeds to Ukraine (NBU, 2022). For logistics enterprises, such restrictions may directly affect the timing of payments for imported vehicles, information and communication technologies, warehouse automation equipment, software-related services, and other components required for Industry 4.0 implementation.

The impact of currency regulation is particularly significant for logistics enterprises that depend on imported technological solutions and international service providers. Although the NBU progressively eased individual restrictions, the regulatory framework continued to include limits on certain cross-border payments and requirements for banks to exercise currency supervision over foreign trade transactions. For example, in November 2024, the NBU introduced a monthly limit of 10% of overdue import-contract debt for certain cross-border payments, demonstrating that access to foreign-currency transactions remained institutionally differentiated. Consequently, currency regulation creates an additional transaction-cost component: enterprises must allocate resources to compliance procedures, documentation, banking supervision, and the management of payment timing. This may increase the duration and cost of acquiring imported digital technologies and consequently slow down the implementation of innovation projects. At the same time, the gradual liberalisation of currency restrictions indicates that the institutional environment is moving toward greater integration with international financial and trade mechanisms, although the remaining regulatory constraints continue to affect the flexibility of Ukrainian logistics enterprises in international operations.

The comparative analysis further indicates that higher transaction costs are associated with the complexity of administrative and customs procedures. Although this study does not establish causal relationships between individual institutional factors and transaction costs, the observed differences are consistent with the assumption that more complex regulatory procedures create additional administrative burdens for logistics operators. Such conditions reduce the efficiency of cross-border logistics operations and weaken the competitive position of Ukrainian enterprises in international markets (Mou & Cheong, 2025).

The comparative analysis suggests that institutional asymmetry is associated with differences in the implementation of digital logistics technologies among Ukrainian logistics enterprises (Ćwiklicki *et al.*, 2021). Digital transformation of supply chains increasingly involves the integration of technologies such as artificial intelligence, Internet of Things, cloud computing, advanced analytics, and automated decision-making systems, which can improve supply chain visibility, flexibility, and operational efficiency (Massachusetts Institute of Technology, 2023). Despite the availability of technological solutions for electronic document management and digital data exchange, their broader application remains constrained by incomplete regulatory support and the limited interoperability of public information systems. The comparative assessment also highlights the role of institutional conditions in shaping the pace of digital transformation among Ukrainian logistics enterprises. Illustrative examples from the logistics sector demonstrate that enterprises operating within the same regulatory environment differ in their ability to adapt digital technologies; however, all of them remain influenced by common institutional constraints.

Nova Poshta represents one of the most advanced examples of digital transformation in the Ukrainian logistics market. In 2024, the company processed 480 million parcels and cargoes, representing a 16% increase compared with 2023, including 19 million international parcels, which was 86% more than in the previous year. The company also expanded its network of branches and parcel lockers to 37,210 service points, including 1,747 new branches and 8,410 newly installed parcel lockers during 2024. In addition, Nova Post operated in 16 European countries and reported 4 million international shipments between different countries during 2024. The company invested UAH 1.8 billion in the development of its branch and parcel-locker network, representing a 35% increase compared with 2023. These indicators demonstrate a high level of technological and organisational adaptability and illustrate how digital logistics infrastructure can support the expansion of international operations. At the same time, the company's international activities remain dependent on customs procedures, cross-border regulatory requirements, and the interoperability of digital systems involved in international shipments. The case demonstrates that the technological capabilities of an individual logistics enterprise are closely connected with the institutional environment in which its international operations are conducted (Official website of Nova Poshta, n.d.).

A different institutional and organisational pattern can be observed in the case of Ukrposhta. The company operates an extensive nationwide postal and logistics network and has implemented electronic tracking, digital customer services, API integration, and electronic customs procedures. In February 2024, Ukrposhta completed the installation of an automated sorting line at its Kyiv logistics terminal, with a processing capacity of approximately 18,000 parcels per hour, or around 400,000 shipments per day. In July 2024, the company opened a logistics terminal in Odesa equipped with automated sorting lines capable of processing up to three parcels per second, or approximately 270,000 shipments per day. By July 2024, Ukrposhta had installed 17 automated sorting lines across seven Ukrainian cities, including nine lines for small shipments and eight for larger parcels. The company planned to complete the automation of its seven terminals and 16 logistics centres during 2024. These indicators demonstrate that the technological transformation of Ukrposhta is substantial, although it is being implemented as a gradual modernisation of a large nationwide postal infrastructure. The case therefore illustrates how digital transformation in a large postal and logistics operator is closely connected with infrastructure modernisation, information systems, and regulatory procedures.

The case of Meest Group provides an additional example of the importance of digital infrastructure and technological capabilities for the development of international logistics operations. Meest International has developed its own IT solutions and logistics infrastructure for cross-border e-commerce and currently provides shipping services

to more than 70 countries, with more than 450 delivery services integrated into its system. The company's digital platform integrates different carriers and delivery channels, supporting the management of international shipments and e-commerce logistics processes. In 2024, Meest International opened a new logistics hub near Dębica, Poland, with an investment of more than EUR 8 million. The facility is equipped with an automated sorting system capable of processing up to 5,000 parcels per hour and is intended to support cross-border deliveries between Europe, the United States, Israel, and Central Asia. These investments demonstrate that the company's international expansion is accompanied by the development of automated logistics infrastructure and digital integration capabilities. The Meest case therefore illustrates how the international competitiveness of logistics enterprises depends not only on their internal technological capabilities but also on the development of cross-border infrastructure, digital interoperability, and institutional conditions supporting international logistics operations. (Official website of Meest Group, n.d.).

The comparative analysis further demonstrates that transaction costs remain one of the major institutional challenges affecting the logistics sector. According to the comparative indicators presented in Table 1, estimated transaction costs in Ukraine exceed the corresponding EU values. These differences are associated with more complex administrative procedures, additional documentation requirements, and longer customs processing times. Although the present study does not quantify the individual contribution of each institutional factor, the observed differences indicate that administrative procedures continue to represent an important component of logistics operating costs. Customs clearance represents another institutional characteristic distinguishing Ukraine from EU countries. The average processing time of 24-48 hours, compared with 1-5 hours in the EU, reflects differences in administrative organisation and the degree of digitalisation of customs procedures. Longer processing times increase operational uncertainty for logistics enterprises and may reduce the efficiency of international freight movements. The analysis also indicates that the existing institutional environment creates additional challenges for the implementation of digital financial technologies. Currency regulation affects the acquisition of imported technological equipment, software solutions, and digital services required for logistics modernisation. The obtained results suggest that these regulatory conditions may slow the implementation of innovation projects and reduce the attractiveness of the logistics sector for international investment, particularly in projects requiring intensive cross-border financial cooperation.

Overall, the analysed examples demonstrate that differences in technological readiness alone do not fully explain the pace of logistics digitalisation. Institutional conditions – including regulatory procedures, customs administration, and currency regulation – remain important elements of the environment within which logistics enterprises implement digital transformation initiatives. The comparative

assessment therefore suggests that further improvements in logistics competitiveness require not only technological investment but also the gradual adaptation of the institutional framework to the requirements of the digital economy. The comparative assessment further indicates that institutional conditions continue to influence the implementation of environmentally sustainable logistics practices. The available indicators demonstrate that the share of green logistics operations in Ukraine remains substantially lower than the average level observed in EU countries. This difference indicates a significant gap in the adoption of environmentally oriented logistics technologies and operational practices. However, the available data do not allow the direct causal effect of specific regulatory measures, fiscal incentives, or other institutional factors on this difference to be established. Therefore, the observed gap should be interpreted as an indication of potential institutional and market barriers to the diffusion of green logistics rather than as direct evidence of insufficient environmental regulation or incentives. The analysis suggests that further research combining environmental legislation, fiscal policy instruments, investment decisions, and enterprise-level data would be necessary to identify the specific institutional mechanisms underlying the difference between Ukraine and the EU.

The analysis also reveals inconsistencies between the existing regulatory framework and the requirements of digital multimodal transport systems. The absence of harmonised digital standards and unified data exchange protocols limits the integration of different transport modes within a common information environment. As a result, logistics operators continue to rely on fragmented administrative procedures, which increase document-processing time and reduce the efficiency of information exchange across supply chains. An additional regulatory characteristic identified during the comparative assessment concerns the level of digital interaction between public authorities and logistics market participants. The current organisation of administrative information systems remains fragmented, limiting opportunities for automated data exchange among customs authorities, transport administrations, and logistics enterprises. Such fragmentation reduces coordination efficiency and increases the administrative burden associated with logistics operations.

The study also indicates that institutional conditions continue to influence the implementation of public-private cooperation in logistics infrastructure development. Existing regulatory procedures and administrative requirements create challenges for attracting private investment into digital logistics projects. Compared with the institutional practices observed in EU countries, the implementation of collaborative investment mechanisms remains less systematic, limiting opportunities for accelerating logistics modernisation. Another aspect identified during the analysis relates to digital trust and information security. The findings suggest that differences in digital governance practices and the gradual adaptation of national cybersecurity standards to international requirements may influence the

willingness of foreign partners to participate in integrated digital logistics systems. Although the present study does not directly evaluate cybersecurity performance, the comparative assessment indicates that institutional harmonisation in this area remains an important element of further logistics digitalisation.

Overall, the obtained results demonstrate that institutional constraints affecting customs administration, digital regulation, transaction costs, currency regulation, environmental policy, and digital governance collectively shape the operating environment of Ukrainian logistics enterprises. The obtained findings indicate that reducing institutional fragmentation, expanding digital administrative procedures, and improving regulatory coordination may contribute to improving the international competitiveness and innovative development of Ukrainian logistics enterprises. The findings of this study suggest that the innovative development and international competitiveness of Ukrainian logistics enterprises are determined not only by the adoption of Industry 4.0 technologies but also by the quality of the regulatory environment within which these technologies are implemented. The comparative analysis demonstrates that policy asymmetry, manifested by the discrepancy between technological progress and regulatory adaptation, remains one of the key barriers to logistics modernisation. These results indicate that digital transformation cannot ensure sustainable competitiveness without simultaneous administrative reforms, particularly in customs administration, digital governance, technical regulation, and currency policy.

The obtained findings are generally consistent with the research of C. de Goeij & L. Gelsomino (2024), who investigated the impact of digitalisation on reducing transaction costs in logistics service providers through improvements in the order-to-cash process. Their study demonstrated that digital process integration enhances operational efficiency by reducing coordination costs and eliminating redundant administrative procedures. Similar conclusions were obtained in the present research, where lower levels of logistics digitalisation and automation were associated with higher transaction costs and longer customs clearance procedures. However, unlike authors, whose analysis primarily focused on organisational digitalisation, the present study additionally demonstrates that the effectiveness of digital technologies largely depends on institutional conditions, including regulatory quality, customs administration, and currency regulation.

The evolution of logistics business models under digital transformation has been extensively analysed by J. Turienzo *et al.* (2023). The authors argue that digital logistics platforms increase operational flexibility, improve coordination among supply chain participants, and create new opportunities for value creation. The present findings generally support this conclusion, as Ukrainian logistics enterprises demonstrate increasing technological readiness for digital logistics solutions. Nevertheless, this study identifies an additional institutional dimension that was less emphasised

by authors. Specifically, fragmented digital governance, limited interoperability of public information systems, and incomplete harmonisation with European digital standards continue to constrain the practical implementation of platform-based logistics ecosystems in Ukraine.

The relationship between digitalisation and institutional development has also been examined by J. Brinker & H.D. Haasis (2022), who emphasised that digital supply chains require not only technological innovation but also new governance mechanisms capable of coordinating multiple supply chain participants. Their conclusions correspond with the results of this study, particularly regarding the necessity of institutional adaptation accompanying technological progress. However, while J. Brinker & H.D. Haasis primarily considered governance from the perspective of supply chain relationships, the present research expands this discussion by incorporating public regulation, customs administration, and financial regulation as complementary institutional determinants influencing logistics competitiveness (Wang *et al.*, 2025).

Supply chain resilience remains another important topic in recent logistics research. J. El Baz & S. Ruel (2021) demonstrated that risk management practices and digital coordination significantly improve organisational resilience during supply chain disruptions. Similarly, the findings of the present study suggest that institutional flexibility contributes to the adaptive capacity of logistics enterprises operating under conditions of economic uncertainty. Nevertheless, the Ukrainian case illustrates that resilience depends not only on enterprise-level management practices but also on broader institutional conditions. Administrative complexity, fragmented regulatory procedures, and prolonged customs clearance reduce the ability of logistics operators to respond efficiently to disruptions despite ongoing technological improvements.

An important contribution to the discussion on logistics digitalisation has recently been made by V.M. Panasyuk & V.V. Bobrivets (2025), who identified digitalisation as one of the principal economic determinants of competitiveness in global logistics chains. Their conclusions largely support the results obtained in the present research, particularly regarding the strategic importance of digital technologies for logistics development. However, this study extends their approach by demonstrating that digitalisation alone cannot eliminate institutional constraints when regulatory mechanisms fail to adapt to technological change. Consequently, institutional modernisation should be regarded as an integral component of digital transformation strategies. Restrictions associated with currency regulation, cross-border financial transactions, and digital payment mechanisms may indirectly influence the ability of logistics enterprises to implement innovative technologies and participate effectively in international digital supply chains. Thus, financial regulation should be considered an important institutional element affecting logistics competitiveness.

The findings are further supported by the UNCTAD (2023), which stresses that digital transformation

requires coordinated regulatory frameworks, institutional trust, and secure digital governance. According to UNCTAD, fragmented institutional environments reduce the effectiveness of digital technologies even where technical capabilities are available. This observation closely corresponds to the Ukrainian context identified in the present study, where technological readiness frequently exceeds the pace of institutional adaptation. Consequently, the existence of institutional asymmetry limits the potential benefits expected from Industry 4.0 implementation.

Similar conclusions are reflected in the World Bank (2023), which demonstrates that customs efficiency, infrastructure quality, and institutional effectiveness remain among the strongest determinants of national logistics performance. The comparative assessment conducted in this study confirms these observations. Ukraine demonstrates considerably lower values of the Logistics Performance Index, longer customs processing times, and lower levels of logistics digitalisation than the European Union average. Unlike the World Bank report, however, the present study additionally identifies currency regulation and institutional asymmetry as complementary factors influencing logistics competitiveness within the Ukrainian institutional environment.

The broader institutional perspective is also consistent with the findings of S. Voitko *et al.* (2023), who emphasised that digital transformation within the Society 5.0 concept requires the simultaneous development of technological infrastructure and institutional capacity. Their conclusions support the present research, particularly regarding the importance of integrated digital governance and coordinated public policies. Nevertheless, the current study applies this conceptual perspective specifically to logistics enterprises and demonstrates how institutional fragmentation directly affects their international competitiveness. Despite the consistency of the obtained findings with recent international research, this study offers several additional contributions. Unlike previous studies that primarily investigate digital transformation, logistics platforms, or supply chain resilience separately, the present research integrates institutional economics, transaction cost theory, and digital transformation within a unified analytical framework. Furthermore, currency regulation is examined as an independent institutional determinant influencing innovation capacity and international competitiveness, an aspect that has received comparatively limited attention in the contemporary logistics literature.

Several limitations of the present study should be acknowledged. First, the empirical analysis relies on aggregated national and international statistical indicators rather than firm-level datasets, limiting opportunities for econometric modelling of causal relationships. Second, the comparative assessment focuses primarily on Ukraine and average EU indicators without considering differences among individual European countries. Third, the illustrative company examples are intended to demonstrate practical manifestations of institutional conditions rather than

to provide detailed case-study evidence. Future research should therefore focus on developing econometric models capable of quantifying the influence of institutional quality on logistics competitiveness, extending comparative analyses to individual European countries, and investigating firm-level adaptation to institutional change using longitudinal datasets. Additional attention should also be devoted to evaluating the effectiveness of regulatory reforms aimed at digital governance, customs modernisation, and the liberalisation of financial regulation within the context of Industry 4.0 and intelligent transport systems.

The analysis of the institutional environment was supplemented by a retrospective assessment covering 2018–2024. The selected period captures three distinct stages of development of Ukraine's logistics environment: the pre-war period of gradual European integration and digitalisation (2018–2021), the sharp institutional and economic disruption caused by the full-scale Russian invasion in 2022, and the subsequent period of adaptation and recovery (2023–2024). The quantitative assessment demonstrates the scale of these changes. According to the World Bank Logistics Performance Index (LPI), Ukraine's overall logistics performance score was 2.83 in 2018 and 2.70 in 2023, while the country's position changed from 66th to 79th place, respectively. The deterioration was particularly visible in the customs dimension, where Ukraine's score decreased from approximately 2.49 in 2018 to 2.40 in 2023. At the same time, the 2023 LPI results should be interpreted in the context of the war-related disruption of transport infrastructure, border operations, and international supply chains (Tiwari *et al.*, 2024).

National transport statistics further demonstrate the scale of structural disruption. The total volume of freight transported in Ukraine increased from 1,643.0 million tonnes in 2018 to 1,641.0 million tonnes in 2020, but declined to 1,518.6 million tonnes in 2021; comparable national totals for 2022–2023 are not available in the cited Sustainable Development Indicators dataset because of statistical limitations during wartime. The railway component also demonstrates a substantial shock: railway freight turnover decreased from 186,344 million tonne-km in 2018 to 181,845 million in 2019, 175,587 million in 2020, 180,361 million in 2021, and only 94,563 million tonne-km in 2022, representing a decline of approximately 47.5% compared with 2021. These changes indicate that the institutional environment of logistics enterprises cannot be assessed exclusively through regulatory indicators; it must also account for the resilience of transport infrastructure and the ability of institutions to maintain supply-chain continuity under extreme external shocks.

The macroeconomic dynamics confirm the exceptional nature of the 2022 institutional shock. According to OECD data, Ukraine's GDP growth changed from +3.5% in 2018 and +3.4% in 2021 to –29.1% in 2022, followed by a recovery of 5.0% in 2023 and an estimated 3.2% in 2024. At the same time, inflation increased from 9.4% in 2021 to 20.2% in 2022 before declining to 12.9% in 2023 and 6.4%

in 2024. The share of exports of goods and services in GDP decreased from 45.2% in 2018 to 35.5% in 2022, while the corresponding share of imports increased from 54.0% to 52.3%. This combination of falling export intensity, increased import dependence, and macroeconomic instability directly increased the importance of currency regulation, cross-border payment mechanisms, and institutional support for international logistics operations.

Digital transformation developed in the opposite direction. OECD research indicates that Ukraine accelerated the digital transformation of businesses after 2022, with digital technologies increasingly used to maintain business continuity, facilitate remote operations, and compensate for war-related disruptions. The European Commission's Digital Decade framework provides comparable indicators for enterprise digitalisation, including the use of cloud computing, data analytics, artificial intelligence, electronic information sharing, and digital public services. Consequently, the institutional environment demonstrates a pronounced asymmetry: the need for digital technologies increased rapidly during the crisis, whereas the regulatory, financial, cybersecurity, and organisational mechanisms required to support their large-scale implementation developed more gradually (Mishra *et al.*, 2024). The structural-logical analysis identifies three interconnected levels of institutional influence on the international competitiveness of logistics enterprises. The first level comprises regulatory and administrative conditions, including customs procedures, currency regulation, digital transaction rules, and European regulatory harmonisation. The second level includes organisational and technological capabilities, such as digitalisation of logistics operations, electronic data exchange, automation, cloud technologies, data analytics, and Industry 4.0 solutions. The third level represents the resulting economic effects, including transaction costs, operational flexibility, resilience of supply chains, access to international markets, and the ability of logistics enterprises to participate in global value chains. Thus, the structural-logical relationship can be expressed as: institutional framework → digital and organisational capabilities → transaction costs and operational resilience → international competitiveness.

The combined temporal and structural analysis demonstrates that improvements in individual institutional components do not automatically generate proportional improvements in logistics competitiveness. The LPI deterioration between 2018 and 2023, the approximately 47.5% decline in railway freight turnover in 2022 compared with 2021, and the 29.1% contraction of GDP in 2022 demonstrate the scale of the external shock. At the same time, the subsequent GDP recovery of 5.0% in 2023 and 3.2% in 2024, together with the acceleration of digital transformation, indicates the adaptive capacity of Ukrainian institutions and enterprises. Therefore, the key institutional challenge is not merely the expansion of digital technologies but the development of a coordinated regulatory environment capable of converting digitalisation into lower transaction costs, greater supply-chain resilience, and stronger international

competitiveness. Overall, the discussion suggests that improving the international competitiveness of Ukrainian logistics enterprises requires a comprehensive institutional transformation combining digital innovation with regulatory harmonisation, administrative simplification, enhanced digital governance, and the gradual adaptation of currency regulation to the requirements of the digital economy. Such an integrated approach would create more favourable conditions for participation in global high-value logistics networks while supporting the long-term innovative development of the sector.

Conclusions

The study confirms that the institutional environment plays a fundamental role in shaping the innovative development and international competitiveness of Ukrainian logistics enterprises under conditions of digital transformation and integration into global supply chains. The comparative analysis indicates that Ukraine's institutional environment remains transitional and fragmented, resulting in institutional asymmetry where technological progress in logistics develops more rapidly than the corresponding regulatory framework. The obtained results demonstrate that existing institutional constraints are reflected in lower logistics performance compared with the European Union, including lower levels of digitalisation, automation of administrative procedures, and implementation of environmentally sustainable logistics practices. At the same time, comparatively higher transaction costs and longer customs clearance procedures indicate the persistence of administrative and regulatory barriers that reduce the operational efficiency of logistics enterprises and complicate their integration into international digital supply chains.

The study further suggests that institutional factors affecting logistics competitiveness extend beyond traditional transport regulation and include customs administration, digital governance, technical standardisation, and currency regulation. In particular, currency regulation represent

an important institutional component influencing access to international financial instruments and the implementation of digital technologies in logistics. This expands existing approaches to assessing logistics competitiveness by integrating institutional economics, transaction cost theory, and digital transformation into a unified analytical framework. The practical implications of the research indicate that strengthening the international competitiveness of Ukrainian logistics enterprises requires comprehensive institutional transformation. Priority directions include harmonising the regulatory framework with European standards, expanding the digitalisation of public administration and customs procedures, improving interoperability between public information systems, supporting environmentally sustainable logistics, and modernising the regulatory framework governing digital financial transactions.

The study has several limitations related to the use of aggregated statistical indicators and the absence of firm-level econometric analysis. Therefore, future research should focus on developing quantitative models for assessing the impact of institutional factors on logistics competitiveness, evaluating the effectiveness of regulatory reforms, and analysing the implementation of digital governance instruments and regulatory innovations within the framework of Industry 4.0 and intelligent transport systems. Such research would contribute to a more comprehensive understanding of the institutional determinants of logistics competitiveness and support evidence-based policymaking for the digital transformation of the logistics sector.

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Conflict of Interest

None.

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Інституційні засади інноваційного розвитку логістичних підприємств України

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Анотація. Актуальність дослідження визначалася зростанням ролі інституційного середовища у забезпеченні інноваційного розвитку логістичних підприємств в умовах цифрової економічної трансформації та інтеграції України у глобальні ланцюги поставок, де невідповідність регуляторних механізмів вимогам цифрової економіки, високі транзакційні витрати та обмежувальне валютне регулювання створюють системні бар'єри для впровадження інновацій у логістиці. Метою дослідження була оцінка впливу інституційного середовища, включаючи цифрову трансформацію, транзакційні витрати та валютне регулювання, на міжнародну конкурентоспроможність українських логістичних підприємств та визначення пріоритетних напрямків удосконалення інституційної бази в умовах цифрової економічної трансформації. У дослідженні використовувались системний та порівняльний аналіз, структурно-логічне моделювання, методи узагальнення та елементи статистичного аналізу, а емпіричну базу сформували дані Світового банку, Організації економічного співробітництва та розвитку, Європейської Комісії та національної статистики за період 2018-2024 років. Результати дослідження виявили наявність інституційної асиметрії між рівнем розвитку цифрових логістичних технологій та їх регуляторною базою, а також домінування стримуючих факторів, таких як високі транзакційні витрати, недостатня цифровізація адміністративних процедур, обмежувальне валютне регулювання та слабкі інституційні стимули для інновацій. Результати дослідження свідчать про те, що ці фактори стримують інтеграцію українських логістичних підприємств у глобальні високотехнологічні ланцюги поставок та знижують їхню міжнародну конкурентоспроможність. Практична цінність дослідження полягає у забезпеченні аналітичної основи для вдосконалення інституційної політики в логістиці шляхом гармонізації регуляторної бази з європейськими стандартами, цифровізації регуляторних процесів та лібералізації валютного середовища для стимулювання інноваційного розвитку сектору

Ключові слова: інституційна асиметрія; логістичні ланцюги постачання; транзакційні витрати; цифрова логістика; валютне регулювання; транспортна інфраструктура; інноваційна спроможність підприємств