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INNOVATIVE LOGISTICS AND SUPPLY CHAIN STRATEGIES UNDER GLOBAL MARKET CHALLENGES: EFFECTS, RISKS, AND COMPETITIVENESS OF THE MARITIME TRANSPORT SECTOR

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Abstract. *The subject of the study* is the conceptual, theoretical and applied principles of forming innovative strategies of logistics and supply chains in the maritime transport sector in the context of global market challenges. The article considers innovations as a key factor in ensuring the competitiveness of maritime transport, as well as a source of new risks that require systematic strategic management. It is proven that in the context of geopolitical instability, climate change, fragmentation of world trade and military operations in Ukraine, innovative logistics strategies are of critical importance not only for the efficiency of the maritime transport sector, but also for the stability of the national economy and its integration into global value chains. *Methodology*. The study used a set of general scientific and special methods: analysis and synthesis – to reveal the essence of innovative logistics and supply chain management strategies; induction and deduction – to identify patterns in the formation of competitiveness of the maritime transport sector; monographic method – to systematize modern scientific approaches and concepts. SWOT analysis was used to assess the opportunities and limitations of the development of maritime transport clusters, and its transformation into a matrix of strategic actions taking into account military risks in Ukraine was carried out. *The purpose of the article* is to substantiate theoretical and practical approaches to the formation of innovative logistics and supply chain strategies in the maritime transport sector in the face of global challenges and increased risks. *Results*. The article establishes that the competitiveness of the maritime transport sector in modern conditions is formed at the intersection of digital innovations, supply chain sustainability, environmental responsibility and institutional capacity. It is substantiated that the implementation of Logistics 4.0 technologies, smart ports, digital cargo flow management platforms and big data analytics is a necessary condition for the adaptation of maritime logistics to global uncertainty. It is proven that maritime transport clusters are an effective tool for increasing competitiveness and minimizing risks through coordination of participants, resource synergy and collective risk management. The proposed matrix of strategic actions demonstrates the possibility of transforming external threats, in particular military ones, into manageable parameters of strategic development. Particular attention is paid to the Ukrainian context, where military actions, shipping restrictions and infrastructure losses significantly reduce the country's logistics potential. It is proven that the development of maritime transport clusters, combined with route diversification, European integration and the use of "green" and digital financing, can become the basis for increasing the resilience and post-war recovery of the maritime transport sector of Ukraine.

Keywords: innovation strategies, logistics, supply chains, maritime transport, competitiveness, maritime transport clusters, risks.

JEL Classification: L91, R41, L23, F14, D81

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1. Introduction

The Maritime Transport Sector remains the backbone of global trade, carrying over 80% of the world's goods by volume and ensuring the uninterrupted flow of goods between continents (UNCTAD, 2025a).

However, in an era of unprecedented volatility, this critically important sector faces a storm of challenges that are fundamentally changing logistics and supply chain strategies.

Since late 2023, the ongoing Red Sea crisis has forced most container ships to reroute around the Cape of Good Hope, adding thousands of miles, weeks of transit time, and significant increases in fuel consumption, insurance premiums, and freight rates. Even with periods of relative calm following a ceasefire in 2025, uncertainty remains (UNCTAD, 2025b).

At the same time, climate-induced disruptions continue to limit key bottlenecks: persistently low water levels in the Panama Canal have led to ongoing restrictions on daily transits and vessel drafts, which are expected to be fully restored only in a few years, despite some easing by the end of 2025 (FreightAmigo, 2025).

The Ukrainian maritime transport sector has also faced serious challenges. Before the start of the full-scale war, 90% of Ukrainian grain exports were exported by sea, and only 10% by road to the nearest exporting countries (Luchnikova, 2022).

However, after the invasion of Russian troops into Ukraine, the opportunity to ensure the safety of shipping in the Black Sea-Azov region was lost, so the import and export of Ukrainian ports and cabotage of cargoes almost stopped. The ports of the Danube basin receive and ship insignificant volumes of cargo (UNIAN. UA, 2023).

Various geopolitical and environmental shocks have sharply increased the vulnerability of supply chains, raising costs, reducing the reliability of maritime transport and increasing inflationary pressures on consumer goods worldwide. But despite global challenges, maritime supply chain (MSC) effectively facilitates the transportation and exchange of goods between different stakeholders around the world, which increasingly plays a vital role in global trade transportation Wan, Yan, Zhang, Qu, & Yang, 2019).

Accordingly, the important goals of our research were:
– substantiation of approaches to the formation of innovative logistics and supply chain strategies in the maritime transport sector;
– identification of specific aspects of competitiveness and risks of the maritime transport sector in the face of global challenges.

2. Innovative Logistics and Supply Chain Strategies in a Globalized World

The current state of research on innovative strategies in logistics and supply chain management in maritime transport demonstrates a significant shift from traditional models to integrated, digitally-driven solutions.

Classical approaches emphasized operational efficiency and cost optimization as the central goals of supply chain management. However, with the spread of globalization, increased competition and frequent global shocks (crises, pandemics, geopolitical conflicts), the emphasis has shifted to flexibility, adaptability and resilience of supply chains as key factors for long-term competitiveness (Christopher, 2016). Seaborne trade volumes reached 12,720 million tons in 2024, exceeding the average for 2013–2023 (1.8%) (Clarksons Research, 2025). This indicates a positive trend, although the growth rate lagged behind the average for 2003–2023 (2.9%), indicating a long-term slowdown in global expansion. The slowdown is driven by structural, cyclical and political factors, weakening trade-GDP linkages, slower global value chain expansion, recurrent economic shocks, rising trade barriers and political instability, and geopolitical fragmentation (UNCTAD, 2025a).

Digital technologies, such as the Internet of Things (IoT), blockchain, big data and artificial intelligence (AI), are an important factor in developing innovation strategies. They have become catalysts for innovation in logistics and maritime transport. These technologies allow for increased transparency of processes, reduced transit times, forecast delays and optimize routes in real time. Digital technologies are increasingly being implemented to improve the efficiency, connectivity and environmental sustainability of port operations (Burmambet, 2025; Neumann, 2021).

Blockchain, in particular, is seen as a tool to ensure trust between participants in the chain, reduce paper documentation and combat fraud (Saberi et al., 2019). Smart port technologies, which enable real-time data exchange, predictive maintenance, and supply chain optimization, have become an important component of modern logistics (Rodrigue, 2020; Stroiko & Burkun, 2021).

A significant amount of research in modern maritime logistics focuses on the resilience of supply chains, i.e. the ability of the system to quickly recover from disruptions. The COVID-19 pandemic has demonstrated the vulnerability of global supply chains in the maritime sector: port blockages, delivery delays, uneven demand, and labor shortages (Ivanov & Dolgui, 2020). In essence, the COVID-19 pandemic and the war in Ukraine have tested the resilience of seaports around the world. Analytical and scientific research confirms that the integration of risk management strategies, safety stocks, supplier diversification and scenario planning are critical to reducing vulnerabilities (European Commission, 2023; UNCTAD, 2025a).

At the same time, operational efficiency and process innovation remain important, although they no longer

dominate strategic dimensions. New models, such as the concept of "logistics 4.0", combine automation, big data analytics and self-learning systems to support decision-making. Logistics 4.0 is a collective term for technologies and concepts for organizing the value chain. New technologies play a crucial role in Logistics 4.0:

– GPS monitor physical processes, create virtual copies of the physical world and make decentralized decisions within logistics processes;
– Data mining (DM) reveals the necessary knowledge to support decision-making processes;
– GPS communicate and collaborate with each other and with people in real time via the Internet of Things.

The collective use of barcodes, radio frequency identification (RFID) technology, sensors, global positioning systems (GPS) and other advanced network technologies for information processing and network communication constitute the concept of Logistics 4.0. These advanced technologies are widely used in logistics operations such as freight forwarding, warehousing, distribution, packaging, processing and related activities. Automated logistics operations and efficient transportation processes improve customer service and satisfaction, and reduce overall costs and consumption of natural resources (Wang 2021). Such approaches enhance the ability of companies to adapt to uncertainty and changes in demand (Bag et al., 2018). Another important aspect of shaping innovation strategies is environmental responsibility and green initiatives in maritime supply chains. In maritime transport, this is reflected in the introduction of energy-efficient vessels, route optimization to reduce emissions, and the use of environmental standards as part of a competitive strategy (Notteboom & Winkelmans, 2001; Wang et al., 2021).

Innovation strategies in maritime logistics and supply chains need to be comprehensive, technologically enabled, adaptable to change, and focused on risk management and sustainability. Competitiveness in such an environment increasingly depends not only on optimizing available resources, but also on the ability to anticipate, respond quickly to uncertain events, and use digital management tools as part of a long-term strategy.

3. Features of the Competitiveness of the Maritime Transport Sector in the Face of Global Challenges

The competitiveness of the maritime transport sector in modern conditions is increasingly determined by traditional factors such as fleet size, geographical location of ports or the level of freight rates. Under the influence of global market challenges, the adaptability of logistics systems, the ability to manage risks and the integration of innovations into strategic decisions are becoming key. According to UNCTAD expert opinions (UNCTAD, 2025a), countries and companies that do not invest in the sustainability and digital transformation of maritime logistics lose ground even in the presence of more favorable natural and geographical conditions. One of the basic features of the competitiveness of maritime transport is its high dependence on external systemic risks that are beyond the direct control of operators.

Geopolitical conflicts, sanction regimes, armed confrontations in key transport corridors and piracy directly affect the structure of routes, insurance costs and reliability of supplies. The Red Sea crisis and shipping restrictions in the Black Sea region have demonstrated that even global market leaders are forced to sacrifice efficiency for safety, which reduces the overall competitiveness of maritime transport compared to alternative modes of transportation (Notteboom et al., 2023).

At the same time, the competitive advantages of the maritime transport sector are increasingly formed through the quality of logistical integration into global value chains. Maritime transport no longer operates in isolation, but is a component of multimodal logistics systems, where the speed of data exchange, synchronization with port infrastructure and land transport determine the efficiency of the entire supply chain (Rodrigue, 2020). In this context, the digitalization of ports, the implementation of port communities (Port Community Systems) and data management platforms are becoming critical factors of competitiveness.

For countries with economies in transition and those located in the zone of military risks, in particular Ukraine, the competitiveness of the maritime transport sector is additionally limited by institutional and infrastructural factors. The loss of access to some ports, increased insurance premiums and restrictions on international shipping lines reduce integration into global supply chains. According to the Logistics Performance Index – 2023 (World Bank, 2023), Ukraine ranked only 79th with an overall index of 2.7 among 139 countries. While in 2014 it was in 69th position out of 160 countries in the world with an index of 2.98. Of course, military operations on the territory of Ukraine have a major impact on reducing the country's logistics potential.

At the same time, the development of alternative logistics routes, digital freight management services and cooperation with international logistics operators can partially compensate for these losses and form new competitive niches (European Commission, 2023; UNCTAD, 2025a).

Thus, the competitiveness of the maritime transport sector in the face of global challenges is becoming multidimensional. It is formed at the intersection of technological innovation, supply chain sustainability, environmental responsibility and institutional capacity.

In modern conditions, the winners are not those market participants who minimize costs in the short term, but those who are able to systematically adapt to uncertainty and integrate innovations into a long-term logistics strategy.

In today's conditions of fragmentation of global markets, increasing logistics risks and increased competition, the cluster approach is considered one of the most viable tools for increasing the competitiveness of the maritime transport sector. The maritime transport cluster unites ports, shipping companies, logistics operators, shipbuilding and ship repair enterprises, digital service companies, financial institutions, research centers, and government institutions into a single interconnected system.

A transport and logistics cluster should be understood as a group of interdependent enterprises, organizations and companies concentrated in a certain territory, specializing in the provision of transport and logistics services, as well as organizations related to their activities, which actively interact with consumers of logistics services and provide competitive advantages for the relevant territories. A cluster may include enterprises and organizations servicing transport and logistics infrastructure facilities. Transport and logistics clusters develop in regions with significant transit potential. In modern conditions, a cluster can be considered as a concentration of similar, adjacent or additional enterprises that are connected and interact with each other, have a common goal and common opportunities or threats.

Clusters allow for a transition from isolated competition to cooperative competitiveness, where economies of scale and knowledge synergies offset external shocks (Porter, 1998; De Langen, 2004). This is particularly relevant for maritime transport, as the industry is characterized by high capital intensity, dependence on infrastructure and the regulatory environment.

Based on a monographic analysis and expert assessments of international organizations, we conducted a SWOT analysis of the development of maritime transport clusters (Table 1).

Maritime transport clusters are not a universal solution, but in the context of global instability they remain one of the few structural instruments capable of simultaneously increasing the competitiveness, sustainability and innovation potential of the maritime transport sector. Their effectiveness directly depends on the quality of institutions, strategic vision and the ability to integrate digital and environmental innovations into a single development model.

4. Maritime Transport Clusters as a tool for Minimizing Risks in the Maritime Transport Sector in the Context of Modern Innovation Strategies

In the context of increasing uncertainty in global markets, risks in the maritime transport sector are becoming systemic and go beyond operational threats. Geopolitical instability, military actions, climate change, disruption of key transport corridors, cyber threats and increased environmental regulation form a multi-level configuration of risks that cannot be effectively neutralized by individual companies or isolated infrastructure projects. In this context, maritime transport clusters appear not only as a tool for increasing competitiveness, but also as a structural mechanism for reducing and redistributing risks

Table 1
SWOT analysis of the development of maritime transport clusters

Strengths	Weaknesses
High synergy effect from cooperation between ports, logistics operators, shipping companies and the IT sector Increasing innovation capacity through joint R&D and digital platforms Reducing operational and transaction costs in supply chains Forming a specialized labor market and concentration of human capital Increasing international attractiveness for investors and cargo owners	High dependence on the institutional quality of public administration Significant initial investment needs (infrastructure, digitalization, security) Uneven level of development of cluster participants Limited flexibility in case of dominance of large players Difficulty in coordinating interests between private and public sectors
Opportunities	**Threats**
Integration into European and global logistics networks Development of smart ports, green shipping and Logistics 4.0 Attracting financing through ESG, green bonds and international programs Diversification of routes and reduction of dependence on individual transport corridors Creation of new competitive niches (digital logistics services, analytics, risk insurance)	Geopolitical instability and military risks Regulatory fragmentation and inconsistent government policies Increasing competition from alternative logistics hubs Cyber risks and vulnerability of digital infrastructure Increasing environmental requirements without access to cheap investment

Source: formed by the author

in maritime logistics. The cluster approach allows transforming risk management from the individual level to the systemic level. Due to the concentration of ports, shipping companies, logistics operators, digital services, financial institutions and government agencies within a single organizational space, an environment is formed that is capable of collectively identifying, monitoring and responding to risks. As studies by De Langen (2004) and Notteboom et al. (2023) show, it is institutional density and coordination within clusters that significantly reduce the vulnerability of transport systems to external shocks.

In conditions of full-scale war, geopolitical instability and partial loss of maritime infrastructure, the formation of maritime transport clusters in Ukraine should be based on an adaptive, risk-oriented strategic model. Therefore, in order to take into account the risks of military actions in Ukraine, it is advisable to transform our SWOT analysis into a matrix of strategic actions that combines the internal capabilities of the maritime transport sector with external challenges.

For Ukraine, maritime transport clusters are not just growth tools, but mechanisms for recovery, adaptation and integration into the European logistics space. The strategic matrix we have formed demonstrates that even in conditions of military threats and structural constraints, the cluster model allows increasing the competitiveness of the maritime transport sector through coordination, innovation and risk management.

At the same time, one of the key risks of the maritime transport sector is the disruption of logistics supply chains, which manifests itself in delays, increased costs and loss of reliability of transportation. Maritime transport clusters minimize this risk through the integration of multimodal routes, synchronization of port and land operations and the use of digital cargo flow management platforms. The implementation of Port Community Systems, track & trace systems and big data analytics within clusters increases the transparency of processes and reduces information asymmetries, which are one of the main causes of logistics failures (Rodrigue, 2020).

Clusters also play a significant role in minimizing financial and insurance risks. Collective insurance mechanisms, joint investment funds, access to international financing and the use of ESG tools allow for the distribution of risks among cluster participants and reduce the cost of capital. For countries with increased military risks, in particular Ukraine, this is of fundamental importance, since individual market participants are often unable to independently attract

Table 2

Matrix of strategic actions for the development of the maritime transport sector of Ukraine in conditions of military risks

SO-strategies (Strengths / Opportunities)	ST- strategies (Strengths /Threats)
SO1. Formation of regional maritime logistics clusters based on Danube ports The use of the existing port infrastructure of the Danube basin and its integration with European transport corridors (TEN-T) allows Ukraine to strengthen its logistics role in the Black Sea-Danube region. The cluster model increases its attractiveness for European operators and compensates for limited access to deep-water ports. ***SO2. Use of digital potential to create smart clusters*** The combination of Ukrainian IT competencies with the logistics needs of the maritime sector allows the formation of digital services (PCS, track & trace, risk analytics) that increase the quality of logistics services and Ukraine's position in LPI. ***SO3. Attracting "green" financing for the modernization of cluster infrastructure*** A strong export orientation and integration with the EU create conditions for the use of ESG financing, which allows for the modernization of ports, fleet and logistics services without excessive fiscal burden.	***ST1. Diversification of logistics routes through cluster coordination*** The cluster approach allows for rapid redirection of cargo flows between sea, river and land routes, reducing dependence on a single transport corridor in the face of military threats. ***ST2. Collective risk management within clusters*** The creation of cluster risk management centers (insurance, cybersecurity, compliance) reduces individual costs of participants and increases the overall resilience of the system.
WO-strategies (Weaknesses/Opportunities)	WT- strategies (Weaknesses / Threats)
WO1. Institutional strengthening through European integration Implementation of EU norms in the field of customs, competition and state aid allows to reduce institutional weaknesses and increase the confidence of international investors in Ukrainian maritime clusters. ***WO2. Partnership with international logistics operators*** Involving global port and shipping operators within clusters compensates for the lack of capital, management experience and access to global networks. ***WO3. Development of human capital through cluster educational platforms*** Clusters can become the basis for joint educational and certification programs, which eliminates the personnel constraints of the maritime sector.	***WT1. Phased clustering instead of large-scale projects*** In conditions of limited resources, it is advisable to develop clusters modularly, starting with the most stable regions (Danube, rear logistics hubs), avoiding excessive risks. ***WT2. Regulatory "sandbox" for maritime clusters*** The introduction of special regulatory regimes for clusters reduces administrative barriers and allows testing innovative logistics solutions without systemic risks.

Source: formed by the author

long-term financing on acceptable terms (European Commission, 2023; UNCTAD, 2025a).

A separate group is made up of technological and cyber risks, which are amplified in the context of the digitalization of logistics. The cluster model creates the prerequisites for centralized cybersecurity management, standardization of digital solutions, and joint investments in the protection of critical infrastructure.

In the context of environmental risks, maritime transport clusters contribute to the collective implementation of "green" innovations, reducing individual costs of compliance with environmental standards. Joint investments in energy-efficient technologies, alternative fuels, and route optimization allow cluster participants to adapt to the stricter requirements of the IMO and European climate policy without losing competitiveness (Wang et al., 2021).

For Ukraine, the importance of maritime transport clusters as a tool for minimizing risks is enhanced by wartime conditions. Clusters can act as adaptive logistics hubs that provide route diversification, integration with European transport networks, and concentration of innovative services in relatively stable regions, particularly in the Danube basin. This not only reduces current risks, but also forms the basis for the post-war recovery of the maritime transport sector.

In general, maritime transport clusters do not provide a point-by-point reduction of individual risks, but form a systemic architecture of uncertainty management. The cluster approach allows transforming risks from exogenous threats into manageable parameters of strategic development, which is critically important for the maritime transport sector in the face of global instability and military challenges.

5. Conclusion

Summarizing the research, it can be noted that modern global market challenges are fundamentally transforming the logic of logistics and supply chains in the maritime transport sector. Geopolitical instability, military conflicts, climate restrictions, fragmentation of world trade and increased environmental regulation create an environment of high uncertainty in which traditional approaches to maritime logistics management lose their effectiveness. In such conditions, the competitiveness of the maritime transport sector increasingly depends not on scale or geographical advantages, but on the ability to systematically adapt to risks and integrate innovative solutions into strategic management.

For Ukraine, maritime transport clusters are not only a tool for economic growth, but also a mechanism for recovery, adaptation and integration into the European logistics space. Their effectiveness is determined by the quality of the institutional environment, the consistency of state policy and the ability to combine digital and environmental innovations with risk-oriented strategic management.

The results obtained can be used as a theoretical basis for further research into the problems of maritime logistics sustainability, as well as a practical tool for shaping state and corporate policies for the development of the maritime transport sector in conditions of prolonged global instability and military challenges.

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