

Sustainable development trends in the Ukrainian logistics market

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Abstract. The article explores the impact of current challenges on Ukraine's logistics sector, emphasizing its crucial role in supply chain management and integration into the global economy. Political instability and military conflicts have severely disrupted logistics, particularly due to port closures and transport route blockages, necessitating immediate strategic adjustments by companies. The study examines the evolution of the logistics market and how global and local factors influence process optimization. The need for new strategies to rebuild the damaged logistics infrastructure during post-crisis recovery is substantiated. Using quantitative and qualitative methods, including trend analysis, comparative analysis, expert interviews, and case studies, the article offers a comprehensive understanding of the Ukrainian logistics market's dynamics and challenges. It identifies key industry transformations, such as digitalization, shifts in international trade, and adaptations to domestic market conditions, underscoring the importance of integrating advanced technologies into supply chain management. The article also emphasizes the critical role of flexible and efficient logistics strategies in supporting the national economy's sustainability amid global challenges and internal shifts. It highlights the role of adaptive logistics in maintaining economic stability and international competitiveness while addressing the opportunities and challenges these strategies present.

1 Introduction

Modern logistics in Ukraine is critical in ensuring efficient supply chain management, optimizing production processes, and expanding international trade, which is critical in the country's integration into the global economic space [1]. Increasing domestic and foreign trade requires improving logistics processes and adapting to rapidly changing market conditions [2].

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At the same time, political instability, military operations in the east of the country, and related logistical challenges necessitate a detailed analysis of current trends and the development of new logistics strategies.

Before Ukraine's military events in 2014, international logistics companies and carriers actively sought ways to make their supply chains more flexible. This trend was significantly influenced by the COVID-19 pandemic, which caused significant disruptions to traditional logistics schemes: the long-term suspension of air travel and severe delays in land transport forced reforms in existing logistics practices [1, 3, 4].

With the onset of martial law, previously stable and efficient supply chains were suddenly disrupted, making it impossible for them to operate effectively. The closure of key ports halted maritime transport, while the suspension of air traffic further compounded the challenges faced by logistics companies [1, 5]. The numerous risks associated with road transport, including safety concerns and damaged infrastructure, made traditional logistics routes unreliable. As a result, companies with well-established logistics networks were forced to rapidly reassess and modify their strategies to adapt to these unprecedented conditions [3, 6]. This abrupt shift required them to explore alternative routes, invest in new technologies, and develop contingency plans to ensure the continued flow of goods [7]. The situation highlighted the need for agility and resilience in supply chain management during times of crisis.

This issue of optimizing logistics processes in supply chains has been explored by several scholars, including Ye. Krykavskyy, V. Marchuk, I. Zharska, H. Prokudin, L. Fadile, T. Skrypko, E. Chukurna, G. Pruntseva, O. N. Popadynets, I. Kolomiyets O. Demchenko, T. Glushenko, I. Zakharchenko, K. Pavlov, O. Pavlova, V. Kupchak, among others. However, their research did not anticipate the consequences of disrupting logistics chains due to the military conflict.

As previously mentioned, the Ukrainian logistics market is undergoing a notable transformation towards green logistics, driven by a growing emphasis on eco-friendly practices [8]. Companies are increasingly prioritizing the optimization of transport routes to minimize fuel consumption and reduce their environmental impact [5, 9]. This shift includes significant investments in fuel-efficient vehicles, which are becoming a core part of logistics fleets [10]. The incorporation of electric and hybrid trucks is gaining momentum as businesses seek to modernize their operations with cleaner technologies [8, 11]. The trend toward using electric vehicles (EVs) for urban deliveries is particularly noteworthy, reflecting a broader commitment to lowering carbon emissions [12]. These efforts demonstrate the industry's dedication to contributing to a more sustainable and environmentally responsible future.

Digitalization is increasingly pivotal in advancing sustainability within the logistics sector, driving significant improvements in efficiency and environmental impact [8, 13]. Ukrainian companies are actively adopting smart logistics systems that leverage cutting-edge technologies like AI, IoT, and Big Data to optimize every aspect of their supply chains [14]. These technologies enable more precise planning and decision-making, helping to reduce waste, streamline operations, and improve fuel efficiency across the board [15]. Furthermore, the integration of blockchain technology is being explored to enhance transparency and traceability within the supply chain [16]. This innovation ensures that sourcing practices are more sustainable and helps to minimize the risk of fraud by providing a secure and immutable record of transactions [17]. Collectively, these digital advancements are reshaping the logistics industry, making it more resilient, efficient, and environmentally responsible.

Sustainable warehousing is another area of focus, with many companies adopting green building standards like LEED to minimize environmental impact [8, 18]. This involves using energy-efficient lighting, better insulation, and water-saving systems in warehouses. The adoption of automation and robotics in warehousing is also increasing, leading to greater efficiency and reduced energy consumption, further supporting sustainable operations.

Government initiatives are supporting the shift towards sustainability, with policies offering incentives for companies that adopt eco-friendly practices and stricter emission standards

pushing logistics companies to adopt cleaner technologies [19]. Collaborations within the industry and cross-border partnerships are driving the development and implementation of sustainable logistics practices [20]. As consumer awareness and demand for sustainability grow, Ukrainian logistics companies are under increasing pressure to align their practices with global sustainability goals, despite challenges such as infrastructure limitations and the need for significant investment in new technologies [21].

Thus, studying the evolution and trends of the Ukrainian logistics market allows us to identify the main directions of its development, assess the impact of global and local factors on logistics systems, and, as a result, contribute to the formation of an efficient logistics infrastructure in the country according to the principles of the sustainable development. This is important for increasing the competitiveness of the national economy and ensuring its sustainable development.

The purpose of the article is to study the processes of reforming the logistics market during the Ukraine crisis to identify opportunities for rehabilitation of the destroyed logistics infrastructure in the context of further reconstruction of the country.

2 Methods and methodology

Sustainable development trends in the Ukrainian logistics market are increasingly shaping the industry's future, driven by a growing commitment to environmental responsibility and efficiency. Companies are leveraging advanced technologies to create more eco-friendly logistics operations, incorporating smart logistics systems powered by AI, IoT, and Big Data [5, 14, 22]. These technologies facilitate route optimization, waste reduction, and improved fuel efficiency, contributing significantly to lower carbon footprints [8, 23]. The rising trend towards integrating electric and hybrid vehicles into fleets, particularly for urban deliveries, reflects a shift towards cleaner transportation solutions. Blockchain technology is also being explored to ensure greater transparency and traceability in supply chains, supporting sustainable sourcing and helping to prevent fraud [24]. Overall, these trends illustrate a broader movement towards a more sustainable and resilient logistics sector in Ukraine, aligning with global environmental goals and enhancing operational effectiveness [25].

To better understand these developments and the dynamics facing the Ukrainian logistics market, the article employs a range of analytical methods. Trend analysis based on existing data from domestic and international cargo turnover provides insights into the evolving logistics landscape [8, 24, 26]. This includes studying statistics from various governmental and international organizations to identify key trends [19, 27]. Comparative analysis further assesses the impact of crisis events, such as military operations and pandemics, on the logistics system by comparing indicators before and after these disruptions.

To quantitative methods, qualitative approaches such as interviews with experts and case studies of logistics companies are used to gain deeper insights. These methods reveal the real challenges and strategic decisions made at the enterprise level, highlighting numerical changes and qualitative shifts in supply chain management [26, 28]. By combining these approaches, the article provides a comprehensive and objective picture of the logistics industry's prospects and its responses to external threats.

The article also highlights several advanced methods used to drive sustainable development in the logistics market. Advanced data analytics, including AI and machine learning, play a crucial role in optimizing logistics processes by analyzing large volumes of data to predict demand, streamline routes, and improve inventory management [22, 24, 29]. Big Data analytics supports this by offering insights into supply chain trends, further reducing waste and enhancing operational efficiency.

The Internet of Things (IoT) is another key component, enabling real-time tracking of goods and offering valuable data on location, temperature, and condition. This improves supply chain

visibility and helps prevent spoilage while optimizing routes [14, 17, 24]. Additionally, IoT devices in fleet management monitor fuel consumption, vehicle maintenance, and driving behavior, leading to better fuel efficiency and reduced emissions. Blockchain technology enhances supply chain transparency by creating immutable records of transactions, ensuring compliance with environmental standards. Concurrently, green logistics practices, such as route optimization and the adoption of energy-efficient vehicles, and sustainable warehousing practices, including green building standards and automation, further support sustainability and reduce environmental impact.

3 Results and discussion

The logistics industry is undergoing continuous change, and companies that closely monitor these transformations and integrate them into their operations will gain significant competitive advantages in the market. Setting priorities is becoming increasingly challenging with the continuous evolution of transport and logistics systems. In this context, five main factors have a decisive impact on the development of the transport and logistics sector:

- Digitalization is bringing fundamental changes to the management of logistics processes.
- Changes in international trade that require logistics systems to be more flexible and adaptable.
- Software innovations that transform traditional supply chain management methods.
- Changes in the dynamics of domestic markets stimulate a rethinking of internal logistics strategies.
- The introduction of new technology requires a review of the industry's core operational processes.

Ukraine's logistics network has undergone significant changes since the first phase of the military conflict 2014. Military operations in the east of the country and the annexation of Crimea by Russia led to a reorientation of transport routes, including increased dependence on inland routes that bypassed the conflict zone [30]. Significant changes also affected seaports: the loss of Crimea resulted in the loss of control over several vital maritime hubs, forcing Ukraine to increase the operational capacity of other ports on the mainland.

With the further development of the conflict and the full-scale invasion in 2022, logistics in Ukraine have undergone additional and radical transformations. The blockade of ports in the Black Sea, the temporary occupation of part of the Sea of Azov, the suspension of air traffic, and the destruction of critical logistics centers prompted the relocation of businesses and production facilities to safer regions of the country.

In 2022, there was a 38.4% decline in physical exports. However, given martial law conditions, these results can be assessed as relatively positive [31]. Let us analyze the main trends in logistics markets.

Maritime transport. Before the war, Ukraine's maritime transport and port infrastructure played a critical role in agricultural exports, generating revenues worth \$27.9 billion in 2021. The sea routes were also vital for the metallurgical (\$16 billion), chemical (\$2.7 billion), and other industries, including mineral fertilizers (\$8.42 billion). Russia's seizure of Ukrainian ports has led to a significant loss of control over sea lanes, with severe consequences for the country's economy. Before the invasion, more than 70% of Ukraine's exports, or approximately \$47 billion, and almost 90% of agricultural products were transported by sea [32].

With the onset of the full-scale invasion, Ukraine's logistics underwent radical changes. The blocking of seaports and the occupation of critical waterways have complicated transportation, and the damage to logistics centers has forced businesses to reorient to safer regions. In response to the challenges, Ukraine has stepped up operations at three small ports at the mouth of the Danube – Izmail, Reni, and Ust-Dunai – which accounted for less than 5% of exports during the peace. These ports are trying to compensate for the loss of seaport capacity.

However, they have limited capacity, as they can only handle up to 10 million tonnes of cargo per year, compared to the 250 million tonnes typical for seaports. However, Ukraine plans to increase the efficiency of the Danube ports by expanding their infrastructure.

Railways. In 2022, rail freight traffic in Ukraine experienced a significant decline, falling by 65.3%. The situation was complicated by the termination of international transit traffic along the Asia-Europe corridor [33]. In addition, significant difficulties in the export of products arose due to congestion of railway connections and bottlenecks caused by various restrictions: reduced throughput at checkpoints, restrictions on control procedures by border guards, customs officers, and phytosanitary inspectors, as well as technological limitations related to the change of carriage bogies to meet European gauge standards [34].

Amid the full-scale war that hit Ukrzaliznytsia, the Ministry of Infrastructure of Ukraine was forced to increase tariffs for rail transportation and related services by 70%, which was later reduced to 30% [32]. However, this decision continues to be economically disadvantageous for agricultural enterprises, which, due to declining profits and a deep working capital deficit, are forced to save on production needs, including the abandonment of fertilizers and other agricultural technologies. This could lead to a decline in the grain harvest in 2023, further aggravating the situation in the agricultural sector.

Air transport. In 2021, the volume of mail and cargo traffic through Ukrainian airports showed a significant increase of 21.1% year-on-year, reaching 63.2 thousand tonnes. However, the situation changed dramatically with the outbreak of a full-scale military conflict, which closed the airspace over Ukraine to civilian flights, paralyzing the operations of not only domestic but also foreign airlines. This led to significant complications in the logistics chain, particularly in cargo transportation. In addition, out of 19 civilian airports in Ukraine, 12 suffered the destruction of airfield complexes, including runways, buildings, and other structures, with estimated losses from damage to airports and air navigation equipment amounting to about UAH 200 billion [35].

Road transport. Given the sea and rail transport restrictions, the Ukrainian transport market has focused on road transport. Companies involved in the shipment of goods were forced to adapt the logistics of their export operations and reorient the movement of goods to the western border crossings. However, organizing road transport has proved challenging due to the low capacity of border crossings and the significant increase in logistics costs due to longer routes to EU ports. This led to significant logistical difficulties and increased delivery costs.

In addition, the business faced several problems at European ports, including difficulties in interacting with customs and other regulatory authorities, terminal restrictions, and poor service quality. The situation at border crossings, especially at points such as Yahodyn, was catastrophic, with frequent long queues of trucks resulting in damage to goods and financial losses for exporters and carriers [36]. In response to these challenges, steps have been taken to stabilize the situation, including increasing the number of controlling authorities and optimizing processes at all border crossing points, reducing logistical obstacles, and facilitating more efficient border crossing.

A brief analysis of the logistics market (Fig. 1) shows that in 2023 there was a significant increase in the share of water transport, which is closely related to the functioning of the grain corridor. This growth is primarily due to technical factors and temporary logistical conditions.

The company's research, which allows us to analyze the critical components of cargo turnover, is worth mentioning.

Based on the official data presented in the following three charts, it is possible to track the dynamics of industrial production, exports, and imports indices, which are fundamental to supporting domestic logistics and the country's overall economic activity. It is worth noting that since 2022, air logistics has disappeared due to the threats posed by missile attacks on Ukrainian cities.

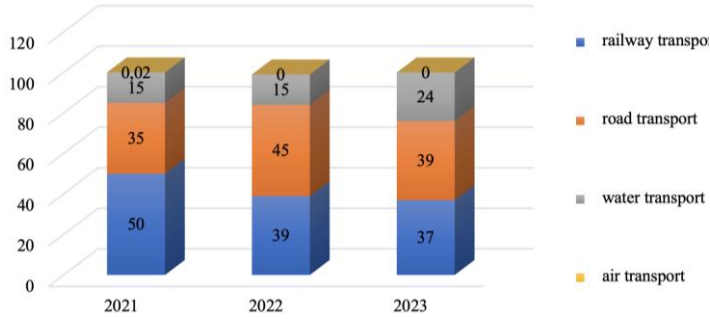


Fig. 1. Logistics market of Ukraine [37].

In response to the changed environment caused by the war and other global challenges, Ukrainian businesses have adapted by reorganizing logistics routes and focusing on developing new export routes through Europe’s land corridors. Businesses are particularly active in the western (to Poland, Germany, and the Baltic states) and southern (mainly to Romania) transport corridors. However, each of them has its unique challenges and problems. Accordingly, international freight forwarders’ associations from Turkey, Romania, Bulgaria, Poland, and other countries have played a key role in supporting Ukrainian businesses by helping resolve numerous logistical and customs clearance issues. The immense logistics potential that was mobilized allowed Ukraine to adapt to the brutal military conditions and ensure the stability of transport and logistics processes, which are vital for the country’s economy in a globalized and constantly changing environment.

However, we should pay attention to the negative impact that the COVID-19 pandemic had on the transport and logistics industry and, subsequently, the war. Such conditions have led to new trends that will shape the development of the logistics market in times of crisis (Fig. 2).

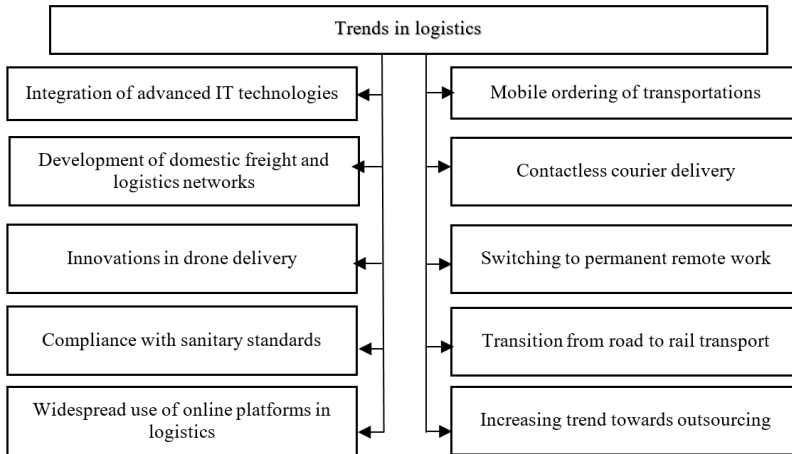


Fig. 2. Trends in logistics in a crisis.

Logistics providers must quickly adapt to new circumstances, including a prompt response to changes in volatile conditions. It is worth noting that in the post-crisis period, several emerging trends will continue, and these trends will significantly impact the logistics sector both in Ukraine and globally.

Trend 1: Integration of advanced IT technologies. Discussions of optimization and digitalization are not new, but honest and meaningful changes in approach were rare before the

pandemic. During this period, many companies took a decisive step towards digitally transforming their processes, thus launching an IT revolution in logistics. Among the key innovations was the introduction of IT platforms that allow logistics companies to exchange tariffs and rates in real-time.

Trend 2: Mobile freight ordering. The mobile transport industry is developing rapidly, creating a new industry called “mobile carriers” Highly automated logistics chains are becoming increasingly crucial as cargo owners demand access to various logistics services via mobile devices. Customers can order transport directly on digital logistics platforms with a few clicks in a mobile application, which increases the demand for such innovative solutions.

Trend 3: Development of domestic freight and logistics networks. The logistics industry has traditionally focused on international exchange, while the domestic market has often remained in the background. First, the COVID-19 pandemic and military actions have intensified the need to strengthen domestic production capacity, as the risk of border closures and reduced import flows encourages countries to build their production lines. The significant reduction in imports from Asia has led to increased domestic production, which has led to the active development of domestic logistics networks and improved quality to a new level.

Trend 4: Contactless courier delivery. The need to ensure the safety and health of senders and recipients during a crisis contributed to the rapid development of contactless delivery methods. Companies that provide delivery services without the need for physical contact are gaining an essential competitive advantage, as consumers are willing to pay extra for the opportunity to receive goods without the risk of infection. Such services ensure health and meet consumers’ needs for fast delivery directly to their door, reducing the need to visit stores or other public places.

Trend 5: Innovations in drone delivery. Recently, drone delivery has significantly developed, which is part of a broader trend of automating logistics processes. This trend originated in Asia and has become an essential alternative in the context of the pandemic, allowing for delivery without the need for human contact. This is especially true in China, where drones have become the primary means of delivering goods to homes during the pandemic.

Trend 6: Transition to permanent remote work. In the crisis, many companies were forced to transfer their employees to remote work, which required logistics operators to optimize and automate all business processes. This change implies the active involvement of employees in the company’s development, including through the creation of platforms for the exchange of ideas, which will help create transparent and efficient business processes.

Trend 7: Compliance with sanitary standards. The pandemic has imposed new requirements on logistics companies, forcing them to comply with strict sanitary standards, including disinfection of equipment and vehicles. These measures, which have become the norm, are an essential requirement from recipients to ensure product safety.

Trend 8: Shift from road to rail transport. In response to the high volatility of air and sea freight rates, there is a tendency to redistribute freight flows in favor of land transport routes, especially between Asia and Europe. Canceling passenger trains has opened new opportunities for rail freight, which is in line with changes in consumer demand.

Trend 9: The pandemic and war accelerated the shift to online platforms for logistics events like meetings, webinars, and conferences. This shift has proven effective and is likely to continue, as online events attract more participants than their offline counterparts.

Trend 10: Outsourcing non-core processes in logistics is increasingly popular. Since the early 2000s, it has helped companies save money, save time, and improve efficiency by allowing them to focus on key operations.

Manufacturing and trading organizations increasingly outsource logistics services in today’s competitive global economic environment. Logistics outsourcing, in which an external contractor performs part or all logistics operations under a contract, has demonstrated steady growth. Today, there are several main outsourcing models [38 – 40]:

- Capital outsourcing, where an external organization takes over the management of property, personnel, and technical facilities;
- Full outsourcing, which involves the transfer of not only personnel, but also critical assets related to the organization's core business, such as IT structures or financial resources, for the duration of the contract;
- Partnership outsourcing, when both parties to the contract act as partners;
- Intermediate outsourcing, where the management of platforms and systems is transferred to external specialists for the development of new systems;
- Transformational outsourcing, where the service provider completely rebuilds the business unit, developing new systems and skills, with the client regaining control after the project is completed;
- Outsourcing through joint ventures, which involves the creation of a new company to develop business opportunities, where the client's staff and assets are transferred;
- Multisourcing or selective outsourcing involves dividing business functions into components, some of which are performed by internal employees and others by external contractors.

It should be emphasized that in today's market economy, various forms of outsourcing have contributed to significant transformations in business models and led to the emergence of new outsourcing models and the use of network approaches as a methodology for creating innovative mechanisms for interaction between organizations. In globalization, numerous forms of business interactions have emerged, and a deep understanding of the company's internal business processes and external environment factors is critical when choosing a logistics service provider.

4 Conclusions

Considering current global challenges and Ukraine's internal political and economic dynamics, the role of logistics in ensuring the stability and development of the national economy is becoming increasingly important. Adapting logistics systems to changing market conditions, including during military conflicts and global pandemics, points to developing more flexible and efficient supply chain management strategies. Domestic and international logistics requirements are forcing a rethink of approaches to managing production processes, expanding international trade, and optimizing logistics operations.

Based on the analysis of current trends and challenges, Ukraine's integration into the global economic space requires the country to improve its logistics infrastructure and strengthen logistics ties with international partners. This, in turn, will ensure better adaptation to the changing conditions of the global economy and help maintain the stability of the domestic market in the face of political instability and external threats.

To sum up, today's forecasts for the development of the logistics market can be based on three scenarios: optimistic, pessimistic, and essential, which are mainly determined by the further course of hostilities. Given the current situation, we can expect continued stagnation in the Ukrainian economy and logistics due to a decline in industrial production and consumer demand.

At the same time, there is potential for development through business adaptation to wartime conditions, the introduction of innovative products, and increased efficiency of enterprises that go beyond traditional capabilities. The development of international cooperation and multimodal transport, as well as an increase in the range of quality logistics services, could be the key to the success of Ukrainian companies in the international arena. Ultimately, despite the potential difficulties, an optimistic view of the future can act as a catalyst for developing domestic logistics and overcoming the industry's challenges.

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