

**Tertiary Sector Economics**

Valentyna CHERVIAKOVA

**ORGANIZATIONAL AND METHODOLOGICAL
APPROACHES TO THE POST-WAR RESTORATION
OF UKRAINE'S TRANSPORT
AND LOGISTICS INFRASTRUCTURE****Abstract**

The article presents a comparative analysis of the transport infrastructure characteristics in Ukraine and neighbouring countries. It outlines the fundamental shortcomings and challenges in the development of domestic transport infrastructure before the war, highlighting their impact on the socioeconomic situation in Ukraine. The article further analyzes preliminary estimates regarding the damage inflicted on the transport infrastructure due to hostilities. In light of the these findings, the conclusion is drawn that the post-war reconstruction of Ukraine's transport infrastructure should adhere to key principles such as multimodality, flexibility, connectivity, sustainability, technology, inclusiveness, productivity, and value creation. The author recommends priority measures for restoring the road, rail, air, and water transport infrastructure, considering both current requirements and future trends. The article substantiates the possibility and necessity of involving international organizations and private businesses in the process of post-war reconstruction of Ukraine's transport infrastructure.

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Chervyakova, Valentyna, PhD, Associate Professor, Department of Economics, National Transport University, Kyiv, Ukraine. ORCID: 0000-0003-3568-3836 Email: ChervyakovaV@gmail.com

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Problem Statement and Literature Review

Transport infrastructure is the cornerstone of economic development, facilitating the efficient movement of people and goods. It plays a crucial role in reducing production costs, fostering domestic and foreign trade, supporting communications among regions and communities, and determining the development of tourism. An efficient transport network not only reduces transportation costs for businesses and consumers, but also makes goods more accessible for consumers, enhancing market competitiveness. A well-developed transport infrastructure connects regions of the country, bridging disparities in resources, services, and opportunities, thereby stimulating the development of less-developed areas. Improved transport connections increase exports and imports, fostering overall economic growth in the country. In addition, the availability and quality of a country's transport infrastructure are key considerations for companies planning to invest in new businesses. Consequently, modern transport infrastructure can significantly enhance a country's attractiveness to foreign investors.

The war in Ukraine has inflicted considerable damage on its transport infrastructure, resulting in the destruction or impairment of numerous roads, railways, airports, and seaports. This devastation poses a substantial impediment to Ukraine's economic growth. The post-war reconstruction of the country's transport infrastructure is an urgent task for the government. These reconstruction efforts can enable Ukraine to resume economic growth, create new jobs, increase competitiveness in the world market, attract investment, and improve the overall quality of life for its citizens.

The restoration of Ukraine's transport infrastructure is a complex, long-lasting, and resource-intensive process, which is nevertheless necessary for the survival and prosperity of the country. At present, Ukraine has every chance to rebuild its transport infrastructure, aligning with contemporary requirements and future trends.

The works authored by Ukrainian scientists, including Bondar (2014), Karpenko and Luchnikova (2019), Vlasova (2020), Luchnikova et al. (2023), Loza (2023), Gameliak et al. (2021), Pusieva (2023), and others, focus on various aspects of transport infrastructure development in Ukraine. An analysis of their studies allows us to draw a generalized conclusion that Ukraine's transport infrastructure has significant potential and that its overall development is oriented toward European integration. Most authors emphasize the importance of utilizing public-private partnerships to implement large infrastructure projects in the transport sector.

For example, Pusieva (2023) outlines the following key strategic directions for the development of transport infrastructure: improving the institutional environment, increasing the level of technological and environmental safety, enhancing the quality of transport services, investing in transport infrastructure using PPP mechanisms, integrating into European and global transport networks, ensuring compliance with international environmental and energy efficiency standards, ensuring the priority of national security and countering hybrid threats, and combating corruption in the transport sector. The author believes that in the coming years Ukraine will adopt a mixed model of transport infrastructure development. In this model, the state would assume the leading role, bearing high investment risks in some infrastructure projects, while the private sector would also be engaged to address issues where the state cannot or does not want to get involved.

Europe has not seen a full-scale military conflict of this magnitude since World War II. Consequently, the previous experience of post-war infrastructure reconstruction can only be applied to a limited extent in planning the post-war reconstruction in Ukraine. Some authors highlight the general insufficiency of data in the literature on post-conflict infrastructure reconstruction (Sakalasuriya et al., 2016). Nevertheless, certain conclusions based on relevant studies can be considered and summarized.

For example, Sakalasuriya et al. (2018) propose a conceptual model for analyzing post-conflict reconstruction. They emphasize the importance of careful planning before implementing reconstruction projects.

Hoeffler (1998) examines the state of infrastructure reconstruction in twelve African countries affected by military conflicts, concluding that, given the lack of public funding, it was necessary to bring in private investors to ensure the successful completion of the reconstruction work. However, she notes that investors'

perception of Sub-Saharan Africa posed a significant obstacle to attracting private capital.

Harvie and Saleh (2008) document the rebuilding of Lebanon's infrastructure after the civil war. They draw attention to the fact that the country was left with significant public debt after the reconstruction.

Earnest (2015) surveyed stakeholders involved in post-war infrastructure reconstruction projects in Kosovo. Respondents indicated that the implementation of these projects in practice turned out to be much more challenging than expected. The key reason was the low quality of planning and implementation of reconstruction projects in complex conditions and volatile, uncertain environments.

Therefore, the main «pitfalls» of post-war infrastructure reconstruction revolve around the financing and implementation of reconstruction projects. Some studies emphasize the importance of attracting private capital. Despite its obvious importance, the issue of reshaping the transport infrastructure is not given much attention in the mentioned publications.

The post-war development of Ukraine will present an opportunity to reconsider the planning of transport infrastructure to better meet the needs of the economy and citizens. ***This article aims to*** investigate the strategic directions of the restoration and development of the transport infrastructure of Ukraine in the post-war period.

Methodology

The research relies on open and independent information sources. In the course of the study, various methods were employed, including analysis, synthesis, generalization, systematization, and graphical visualization. Data from the WorldData.info website were visually represented to compare the density of roads, railways, waterways, sea and river ports, and airports per unit area in Ukraine and neighbouring countries, as well as in relation to the population. The comparison was also made relative to average rates in Europe. Data from the State Statistics Service of Ukraine were used to analyse changes in the operating length of public transport routes in Ukraine from 1980 to 2020. Data from the official websites of CEIC Data and the International Organization of Motor Vehicle Manufacturers were used to study the dynamics of registered vehicles in Ukraine and the comparison countries. The study utilized the latest available data from the World Bank for 2019 and data from the World Health Organization for 2016 to examine statistical indicators on road traffic accidents and their consequences. In comparing the qualitative characteristics of the transport and logistics infrastructure in Ukraine and neighbouring countries, their positions in the CMS Infrastructure Index, Global Competitiveness Report, and Logistics Performance Index

were analyzed, with advantages and disadvantages summarized and systematized. When assessing the damage caused to the transport infrastructure of Ukraine by the war, the study relied on the latest available calculations of the World Bank, the Government of Ukraine, the European Union, and the United Nations. The main principles guiding the post-war reconstruction of Ukraine's transport infrastructure have been generalized and systematized based on approaches outlined in the works of Ukrainian and foreign researchers, as well as analytical reports from international organizations and consulting firms. Recommendations for harmonising the legislative regulations between Ukraine and the European Union concerning specific types of transport were formulated by analysing their main provisions and obligations within the framework of inter-state agreements. Proposals addressing the organizational and financial aspects of Ukraine's post-war transport infrastructure reconstruction have been developed based on the analysis of the requirements of potential donors.

Research Results

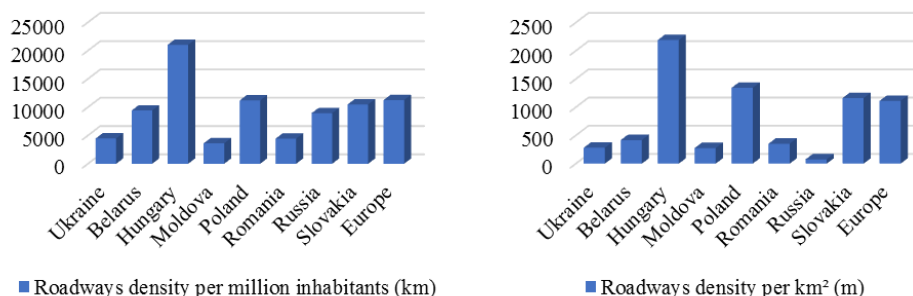
Ukraine has an extensive multimodal transportation system, encompassing roads, railways, airports, seaports, and pipelines, crucial for its export-oriented economy. In 2021, the transportation sector, including warehousing, postal, and courier services, contributed 6.5% to GDP.

Ukraine can boast a road network stretching over 200,000 kilometres. In 2021, road transportation accounted for 41% of the total transported cargo, measured in tonnes, and 20% of the total transported volume of goods, measured in tonne-kilometres. This primarily included the transportation of «last mile» cargo, such as heavy freight, agricultural products, and perishable goods, over relatively short distances. Trucks are commonly utilized to transport agricultural products to ports and import high-value goods from the EU. As we can see in Figure 1, Ukraine's road density is about one-third of that in Europe if measured by population and one-quarter if measured by area.

Ukraine's railway network, excluding temporarily occupied territories, spans 19,800 kilometres, with 47% of the tracks electrified. The density of railways in Ukraine surpasses that of Europe, with 496.27 kilometres per million inhabitants in contrast to 429.97 kilometres in Europe (see Figure 2). This railway system connects major urban centres, towns, and border crossings with neighbouring nations, facilitating the movement of both passengers and cargo. Before the war, the railway transportation system predominantly handled the movement of metal, coal, iron ore, and construction materials.

Figure 1

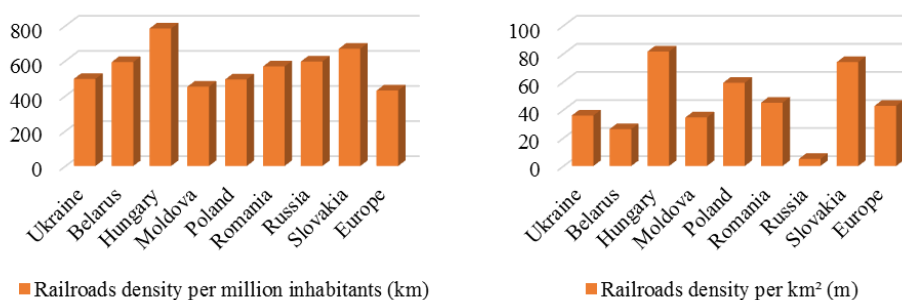
Roadways density in Ukraine compared to neighbouring countries and the EU



Source: compiled by the author based on data from WorldData.info (n.d.).

Figure 2

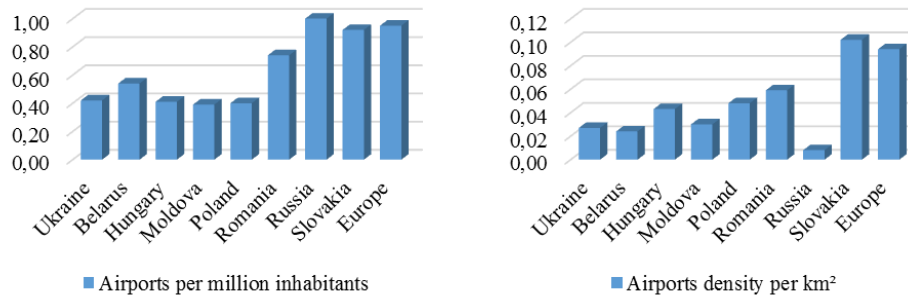
Railroads density in Ukraine compared to neighbouring countries and the EU



Source: compiled by the author based on data from WorldData.info (n.d.).

Ukraine has 19 airports, equivalent to 0.37 airports per million inhabitants. This is about one-third of the rate observed in the EU, which is 0.95 airports per million inhabitants (see Figure 3). Before the suspension of air traffic due to the war, the market hosted 21 passenger airlines and 19 airlines handling mail and cargo. In 2021, these airlines collectively served 16.2 million passengers.

Figure 3

Airports density in Ukraine compared to neighbouring countries and the EU

Source: compiled by the author based on data from WorldData.info (n.d.).

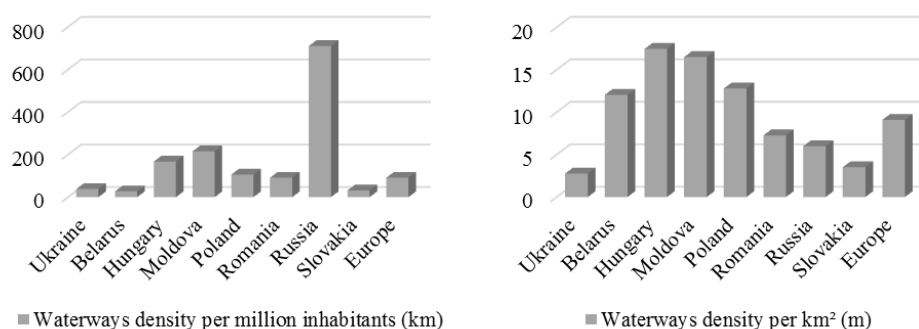
There are 18 seaports in Ukraine, 13 of which are located within its continental territory and 5 in the temporarily occupied region of the Autonomous Republic of Crimea. Seaports play a significant role in Ukraine's economy as over half of the nation's total exports are transported via maritime routes, in particular agricultural products (formerly 90% of grain exports), metals, chemicals, and fertilizers.

The nation's inland waterways extend for 6,200 kilometres, with the Dnieper, the Desna, the Pripyat, the Danube, and the Pivdennyi Buh rivers serving as the main navigable routes. Ukraine has 38.18 kilometres of waterways and 9.34 harbours per million inhabitants. This is much fewer than in Europe, which has 91.17 kilometres of waterways and 25.39 harbours per million inhabitants (Figure 4).

Thus, the density of Ukraine's transport infrastructure, excluding railways, is on the overall lower compared to neighbouring countries and the EU average. This discrepancy indicates an insufficient level to meet the current needs of the economy and the demand from the population. Consequently, there exists a considerable hidden and deferred demand for quality transport infrastructure to ensure fast and reliable domestic and international transportation of goods and passengers.

It is noteworthy that, despite a significant inflow of public investment, the operational length of public transport routes in Ukraine has remained nearly unchanged over the past 40 years. In the lead-up to the full-scale invasion, Ukraine invested heavily in road infrastructure improvements.

Figure 4

Waterways density in Ukraine compared to neighbouring countries and the EU

Source: compiled by the author based on data from WorldData.info (n.d.).

The «Big Construction» project, launched in 2019, allocated public expenditure of \$5.3 billion for road and highway construction. However, the funds were primarily spent on repairs rather than new constructions. Moreover, the project's implementation was marred by numerous corruption investigations (Cheriyakova V. & Cheriyakova T., 2020). As illustrated in Figure 5, the decline in the length of the transport network since 2014 can be attributed to changes in statistical data reporting, which excluded the temporarily occupied territories of the Autonomous Republic of Crimea, the city of Sevastopol, and parts of the Donetsk and the Luhansk regions from official statistics.

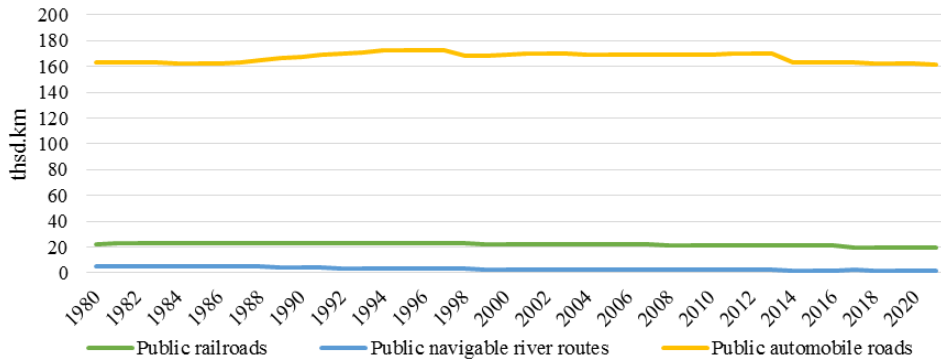
At the same time, Figure 6 illustrates that the number of motor vehicles in Ukraine experienced rapid growth until 2013 but has been decreasing since.

However, when measured by the number of cars per 1,000 inhabitants, Ukraine's indicators are significantly lower at 192 units than those of all neighbouring countries and the European average of 518 units (see Figure 7).

The lack of funding to upgrade and maintain transport infrastructure had negative consequences for the safety of travellers and cargo, reducing the overall efficiency of the transport system of Ukraine. The growing popularity of private cars and underdeveloped public transportation in cities have led to a heavy congestion on city roads, a shortage of parking spaces, increased air pollution, a higher frequency of road accidents, and a higher stress level for passengers (Merforth, 2014). The discrepancy between the level of transport infrastructure development and the growing number of road users and modern safety standards has resulted in Ukraine ranking among the worst performing regions for the number of road accident victims (Figure 8).

Figure 5

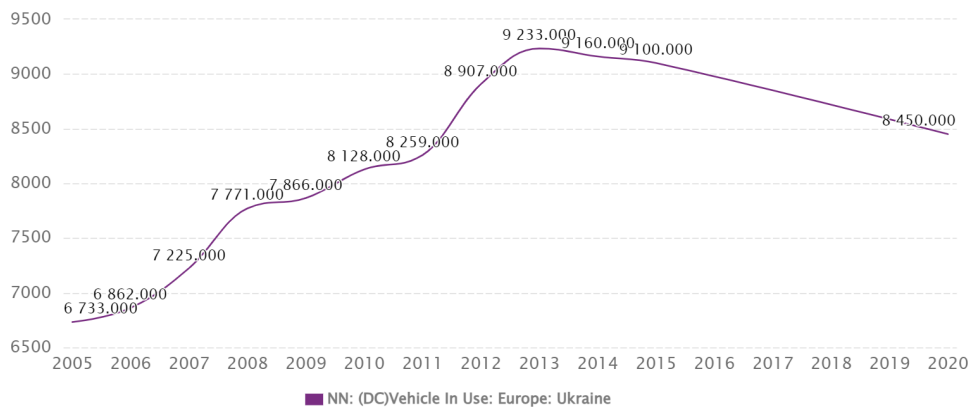
Length of the transport network in Ukraine, from 1980 to 2020



Source: compiled by the author based on State Statistics Service of Ukraine (n.d.) and State Statistics Service of Ukraine (2023).

Figure 6

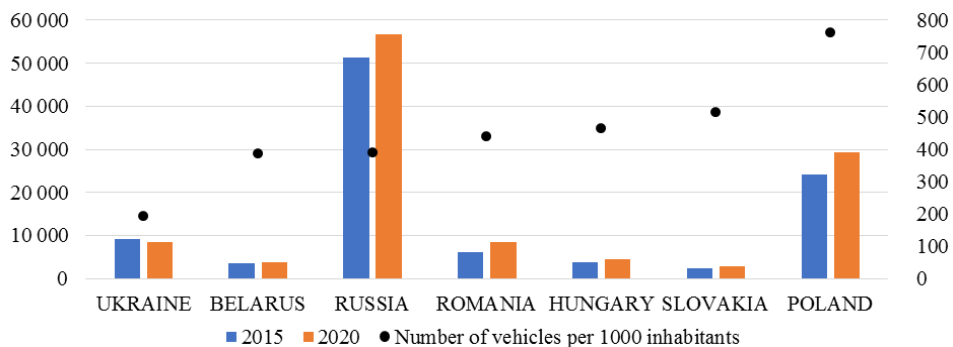
Registered motor vehicles in Ukraine from 2005 to 2020



Source: CEIC Data (n. d.).

Figure 7

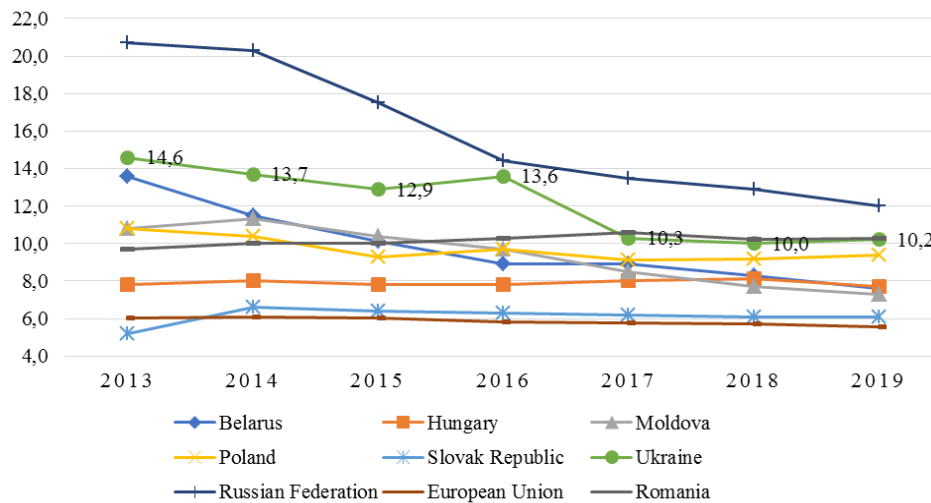
Number of vehicles in use (thousand units) and vehicles per 1000 inhabitants



Source: compiled by the author based on data from International Organization of Motor Vehicle Manufacturers (n. d.).

Figure 8

Mortality caused by road traffic injury (per 100,000 population) from 2013 to 2019

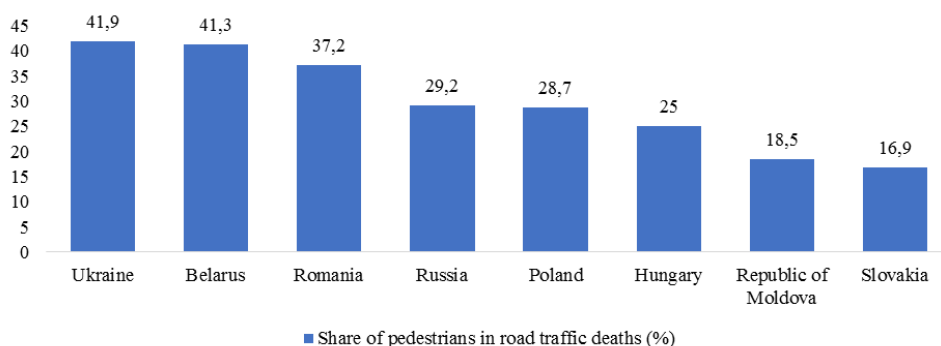


Source: compiled by the author based on data from World Bank Data (n. d.).

Furthermore, because of the imperfect transport infrastructure in Ukraine, pedestrians suffer the most. Ukraine has the highest mortality rate among pedestrians due to traffic accidents compared to other neighbouring countries (Figure 9). Taking into account that Ukraine is home for more than three million people with disabilities, their needs should also be taken into account when planning the construction and reconstruction of transport infrastructure facilities, such as pedestrian crossings and public transport stops.

Figure 9

Pedestrian mortality rate due to traffic accidents per 100,000 population in 2016



Source: compiled by the author based on data from World Health Organization (n. d.).

It should be noted that the development and modernization of Ukraine's transport infrastructure required significant investment well before the war. However, according to the 2021 CMS Infrastructure Index, Ukraine ranked 46th among 50 countries, holding the lowest position in Central and Eastern Europe in terms of attractiveness for infrastructure investment. Additionally, the country ranked 48th by economic status, 30th by sustainability and innovation, 12th by tax environment, 48th by political stability, 44th by ease of doing business, and 43rd by private participation. Therefore, the post-war reconstruction of the transport infrastructure must be accompanied by the solution of economic, political, and institutional issues, ensuring the protection of the rights of participants in reconstruction investment projects, intransigent fight against corruption, as well as the introduction of innovative solutions for the modernization of the transport complex of Ukraine in line with modern requirements (CMS, 2021).

Persistent underfunding, lack of effective competition, control and responsibility, and numerous cases of corruption in the field of transport construction have resulted in the unsatisfactory state of Ukraine's transport infrastructure even before the start of the full-scale war. According to the World Economic Forum's estimates presented in The Global Competitiveness Report 2019, Ukraine ranked 59th among other countries by the state of transport infrastructure. In particular, the country occupied the 59th position in terms of road connectivity, 114th position in terms of road infrastructure quality, 25th position by railroad density, 34th position by efficiency of train services, 53rd position by airport connectivity, 101st position by the efficiency of air transport services, 57th position by liner shipping connectivity, and 78th position by the efficiency of seaport services (Schwab, 2019).

The subpar condition of the transport infrastructure has led to the non-competitiveness of Ukraine's transport and logistics infrastructure and services. This has complicated the foreign economic activity of local enterprises and discouraged international carriers from choosing Ukraine for transit transportation. According to the World Bank's Logistics Performance Index (LPI), Ukraine ranked 79th globally in 2023, falling behind almost all European countries (except Russia and Moldova).

The Logistics Performance Index (LPI) is the weighted average value of the country's indicators on six key dimensions: (1) the efficiency of the transportation registration process or customs clearance by border and customs services (i.e., speed, simplicity and predictability of procedures); (2) the quality of commercial and transport infrastructure (in particular, highways, railways, ports, warehouse infrastructure, and mobile communications); (3) the ease of arranging competitively priced shipments; (4) the quality of accompanying logistics services (including the competence of transport operators, customs brokers and other intermediaries); (5) the ability to track and trace consignments; (6) timeliness of cargo delivery to the destination (i.e., its arrival at the planned or expected time). A comparison of Ukraine's positions in the LPI rankings by subcomponent is detailed in Table 1 and visually represented in the radar chart shown in Figure 10.

For Ukraine, the most challenging aspects of the transport and logistics system include tracking and tracing the movement of goods, the quality of logistics services provided by local businesses, the operations of border control and customs authorities, and the quality of transport infrastructure. The railway sector has the most outdated infrastructure, as its modernization is the most expensive. Some railway stations, routes, and even locomotives are in critical condition. Another problem lies in the poor condition and low capacity of border checkpoints.

Table 1

Logistics Performance Index (LPI) 2023 of Ukraine and neighbouring countries

Country	LPI Rank	LPI Score	Customs Rank	Customs Score	Infrastructure Rank	Infrastructure Score	International shipments Rank	International shipments Score	Logistics competence Rank	Logistics competence Score	Tracking & tracing Rank	Tracking & tracing Score	Timeliness Rank	Timeliness Score
Poland	26	3.6	24	3.4	39	3.5	38	3.3	33	3.6	23	3.8	21	3.9
Slovak Republic	43	3.3	37	3.2	44	3.3	57	3.0	42	3.4	49	3.3	46	3.5
Hungary	51	3.2	65	2.7	52	3.1	26	3.4	57	3.1	41	3.4	35	3.6
Romania	51	3.2	65	2.7	59	2.9	26	3.4	46	3.3	37	3.5	35	3.6
Belarus	79	2.7	74	2.6	68	2.7	91	2.6	92	2.6	94	2.6	76	3.1
Ukraine	79	2.7	90	2.4	89	2.4	75	2.8	92	2.6	94	2.6	76	3.1
Russian Federation	88	2.6	90	2.4	68	2.7	121	2.3	92	2.6	98	2.5	93	2.9
Moldova	97	2.5	133	1.9	132	1.9	85	2.7	76	2.8	80	2.8	87	3.0

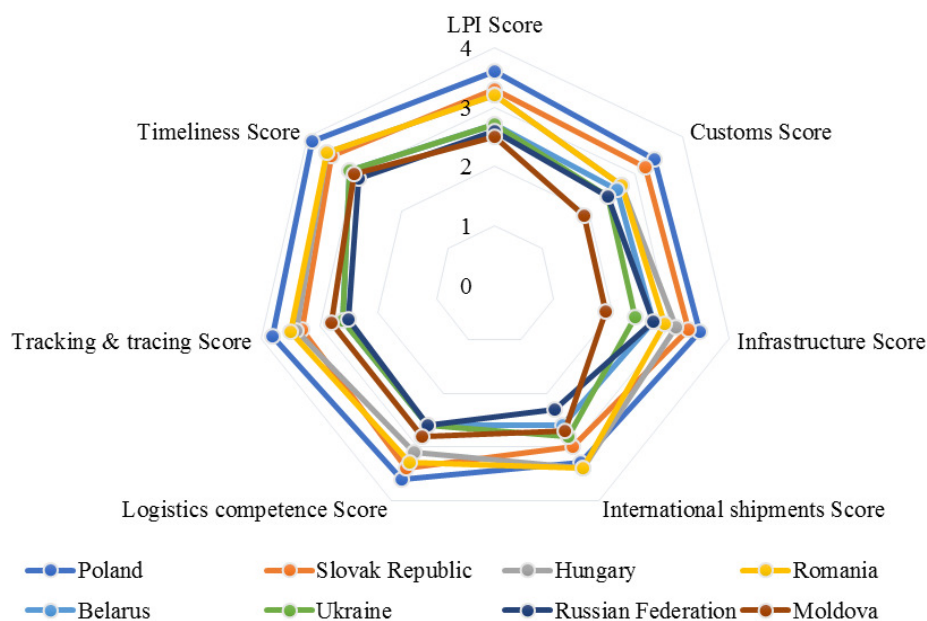
Source: compiled by the author based on data from World Bank (n.d.).

The ongoing armed aggression of the Russian Federation has significantly impacted the transport system of Ukraine. After the beginning of the full-scale war, transport infrastructure facilities have become the primary targets of the aggressor's shelling and missile attacks. As of February 2023, the total damage was estimated at \$35.7 billion, equivalent to 17.8% of 2021 GDP. The Russian aggression has resulted in the destruction of 25,000 km of roads and 344 bridges and overpasses. The largest share of losses occurred in Donetsk (26%), Kherson (15%), Luhansk (15%), and Zaporizhia (14%) regions. These regions were either under Russian occupation or witnessed prolonged positional battles. The railway system also suffered extensive damage: 507 km of tracks and 126 stations were affected. The regions of Donetsk (where damage to railway infrastructure accounts for 36% of the total damage) and Zaporizhia (23%) were the most severely affected. As of February 2023, 19 civilian airports were damaged, with runways

destroyed in 12 of them (World Bank; Government of Ukraine; European Union; United Nations, 2023). However, the war and the destruction of infrastructure in Ukraine persist, rendering all loss estimates preliminary at the present time.

Figure 10

Comparative LPI analysis: Ukraine’s trade and transport infrastructure vs. neighbouring countries



Note. Logistics Performance Index: the quality of trade and transport infrastructure is rated from «very low» (1) to «very high» (5).

Source: compiled by the author based on data from World Bank (n.d.).

A modern and efficient transportation system is a prerequisite for ensuring the competitiveness and development of the industrial and agricultural sectors of the economy. Given that these sectors are export-oriented, they should serve as the drivers of Ukraine’s post-war recovery. The key directions for the reconstruction of Ukraine’s transport and logistics system should include the improvement of the quality and capacity of roads and border checkpoints, the modernization of

the railway network and the fleet of locomotives, and the modernization of port infrastructure and development of inland waterways. To implement the «Build Back Better» approach, the infrastructure reconstruction program in the transport sector must adhere to the following principles (Kosse, 2023):

Multimodality: Ukraine should develop a multimodal transportation system that allows for the quick transfer of cargo between different modes transport, such as using containers. This requires the construction of multimodal terminals in the west and south of Ukraine, which will serve as transport and logistics hubs offering customs services. These terminals should also facilitate connections between rail and water transport to promote the use of inland waterways and divert some freight traffic from roads to water. Multimodal principles should also be implemented in passenger transportation, involving the construction of multimodal stations to ensure convenient transfers of passengers between different modes of transport.

Flexibility: To address the challenges posed by the war, Ukraine's transportation system must be highly adaptive and capable of withstanding potential damage. In addition to enhancing the capacity for rapid repairs of damaged infrastructure, it is essential to establish alternative ground routes to prevent bottlenecks. Developing new logistics centres and checkpoints on the border with the EU, as well as increasing the capacity of the existing ones, is crucial for expanding the transshipment capacity and meeting the operational interoperability requirements. With the closure of sea routes, road transportation has gained an increasingly significant role in Ukraine's international trade. As a result, the development of road infrastructure, including border crossing points, agricultural product control points, parking lots for trucks and places for drivers, and warehouse infrastructure has become a top priority.

Connection: The disparity between the railway track standard used in Ukraine and that used in most EU countries poses a huge obstacle to transportation cooperation. Prioritizing the gradual transition of the railway network to the European track width standard should become imperative for Ukraine. In the long-term perspective, Ukraine should explore the possibility of constructing European-width tracks between major Ukrainian cities and industrial centres and checkpoints on the western border. Additionally, it is crucial to focus on the further electrification of the railway network and the introduction of high-speed rail traffic.

Sustainable urban mobility: According to the EU's Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, the transition to sustainable mobility requires a strategic approach to ensure the interaction and development of different types of urban transport. The purpose of strategic planning for urban mobility is to ensure its accessibility and quality for all users, as well as adherence to the principles of sustainable development of urban transport, taking into account economic feasibility, social justice, preservation of public health and environmental quality (Rupprecht Consult, 2019).

Climate resistance: When reconstructing transport infrastructure, it is necessary to anticipate the increasing frequency of extreme weather events due to climate change. The McKinsey Global Institute predicts a global average temperature increase of 1.5°C to 5°C over the next three decades, with more than a 15 percent probability of heightened temperatures during summer months. Therefore, when designing new and modernizing existing transport infrastructure, it is necessary to foresee its location and construction technology in such a way as to minimize the harmful effects of natural phenomena resulting from climate change.

Inclusion: Transport infrastructure is a public good and, therefore, should contribute to social integration. As defined by the Global Infrastructure Hub, inclusive infrastructure is «any infrastructure development that enhances positive outcomes in social inclusivity and ensures no individual, community, or social group is left behind or prevented from benefiting from improved infrastructure» (Global Infrastructure Hub, 2023). To ensure the inclusiveness of transport infrastructure, it is necessary to take into account the interests of all interested parties, including the provision of mobility for all strata of the population and barrier-free space for people with disabilities, jobs creation for businesses, and tax revenues for local communities and the state.

Technologies: Digital technologies are crucial in ensuring the sustainability of transport infrastructure. In the railway sector, the implementation of advanced train control and signalling systems, such as the European Rail Traffic Management System (ERTMS), which uses wireless communication for controlling train movements, has the potential to enhance the sustainability of freight transport, simultaneously reducing capital expenditure and operating costs related to maintenance. Digital applications encompassing traffic flow optimization, smart metering, and energy solutions, can contribute to curbing carbon emissions from aircraft. Digitizing the supply chain (including cloud and IoT technologies, advanced analytics tools for freight routing, and the adoption of biofuels) can reduce harmful emissions worldwide. Installing a charging infrastructure for electric vehicles is one of the most effective intelligent solutions for highways to improve their environmental friendliness. Initiatives like «smart maintenance», involving the optimization of road maintenance through data analytics, not only reduce congestion, but also yield environmental, social, and economic benefits.

Productivity and value creation: Investing in transport infrastructure as an asset entails a long payback period. Thus, to appeal to private capital, transport infrastructure facilities must be sustainable and highly productive. Stakeholders could move to a closed-loop relationship model where the entire supply chain is committed to taking care of the asset throughout its life cycle. Instead of being a financial burden, sustainable transport infrastructure should generate value through innovative business models. Participants across the value chain can use digital platforms to increase transparency, streamline business processes and collaborate to improve efficiency. For example, infrastructure condition moni-

toring and predictive maintenance combined with road user data can optimize traffic to reduce congestion and emissions from idling vehicles.

Sustainable transport infrastructure must meet the four standard sustainability criteria: environmental, social, institutional, and economic (Milani et al., 2021).

From the environmental criterion perspective, transport infrastructure must be planned, designed, built and operated in such a way as to minimize pollution, protect flora and fauna, and ensure resilience to climate change. The concept of transport infrastructure sustainability assumes that all materials for its construction and maintenance will gradually transition to renewable ones, allowing for reuse, repair, recycling, and restoration.

The social criterion postulates that sustainable infrastructure should ensure respect for human rights, consider and mitigate possible negative impacts on vulnerable groups, meet the demands of all stakeholders, and enhance the inclusiveness and accessibility of transport services.

The institutional criterion stipulates for the consistency of projects for the reconstruction and modernization of transport infrastructure with the main provisions of the country's development strategy, including its integration into political and economic alliances and prioritization of economic sector development and ways of decarbonization.

The economic criterion demands that projects for the reconstruction and modernization of transport infrastructure should be economically justified in terms of payback, job creation, income generation, and economic growth.

Successful reconstruction efforts would enable Ukraine to further enhance its economic integration with the EU through trade and active participation in regional value chains. To achieve this, the Ukrainian government should harmonize its domestic infrastructure strategies with the strategic priorities outlined in EU infrastructure initiatives. The crucial initial step involves pinpointing areas of mutual interest and collaboration, such as transportation networks, energy infrastructure, digital connectivity, and social infrastructure. Subsequently, close coordination with the EU is necessary to amplify the impact of investments. This entails aligning project schedules, timelines, and funding mechanisms to ensure a cohesive and complementary approach between domestic and EU ventures.

The Ukrainian government can take advantage of the technical support and expertise extended by the EU, particularly in aspects such as project preparation, feasibility studies, regulatory frameworks, and capacity enhancement. This collaboration can enhance the quality and viability of infrastructure projects, expediting their execution. When combining domestic infrastructure strategies with EU initiatives, a focus on sustainability and resilience is of paramount importance. This ensures the establishment of enduring, efficient, and shock-resistant infrastructure that contributes to sustained regional economic growth and progress.

Ukraine should implement cross-border infrastructure projects in collaboration with neighbouring EU countries. This collaborative approach will contribute to strengthening of regional ties and deepening of economic integration. It involves joint investment in the development of the transport network and digital connectivity, which can generate mutual benefits for both Ukraine and its neighbouring EU countries. These joint projects have the potential to foster trust and cooperation between nations, leading to stronger economic ties and an improved business climate in Ukraine.

The unification of regulatory and legal acts should be carried out based on the European Union-Ukraine Association Agreement, ensuring the availability of transport services for people with disabilities and other groups with limited mobility, compliance with the rules of environmental and sanitary safety during construction and reconstruction, removal and disposal of waste, and transition to alternative renewable energy sources.

Regarding specific types of transport, Ukraine should cooperate with EU countries to undertake the following measures (Gameliak et al., 2021):

Road transport: Since Ukraine and the EU/EU member states are already signatories to numerous agreements in the field of road transport regulation, significant changes in the national legislation of Ukraine are not required. However, there are still some disagreements to address before achieving full liberalization of road transport between Ukraine and the EU. These include meeting Ukraine's obligations to comply with rules on transportation safety, driver training and confirmation of driving qualifications, and the installation of tachographs to record working hours. Furthermore, a promising task is aligning the quantitative and qualitative characteristics of Ukraine's road network with at least the European average level.

Rail transport: Ukraine needs to align its legislation with EU norms concerning access of private and foreign investors to the rail transport market and railway infrastructure, as well as technical conditions and safety. Ukraine is required to implement seven EU directives and four regulations that encompass rules on railway development, licensing of railway companies, railway infrastructure capacity requirements, railway safety, certification of employees and railway infrastructure, compatibility between Ukrainian and European railway infrastructures, regulations for combined freight transport, rules for combined freight transport, competition in freight transportation, financial statement standardization for railway companies, rules for passenger transportation, and passenger rights and obligations. Despite the ongoing state of war, these measures can and should be implemented since Ukraine's economy and defence rely heavily on railway transport, which stands unparalleled in carrying capacity.

Air transport: The process of bringing Ukraine's legislation in the field of civil aviation into compliance with the Common Aviation Area Agreement (CAA Agreement) is expected to be implemented in two stages: The first stage involves

limited access to the market, while the second stage ensures full access to the market, as well as the recognition of certificates issued in Ukraine. A joint committee of representatives from Ukraine and the EU will monitor the implementation of the agreement. During the first stage, Ukraine will participate as an observer in the work of the European Union Aviation Safety Agency (EASA) and the Single Sky Committee. It will be responsible for aircraft certification to EASA. In the second stage of CAA Agreement implementation, Ukraine must adopt EU regulations and standards on initial airworthiness, maintenance of aircraft and their components, and certification systems of Ukraine and the EU. In addition, Ukraine will have to implement EU rules on free access to the air transport market, requirements for air transport management, licensing of air traffic controllers, aviation safety, environmental safety, and regulations on certain social aspects. The successful completion of the transition period will lead to the overall application of the CAA Agreement provisions, providing significant benefits for air transport users. However, the airspace over Ukraine is currently closed, which necessitates these measures to commence promptly upon its reopening.

Water transport: To gain access to the EU's internal maritime transport market, Ukraine must bring its legislation in line with EU norms within five years. This alignment includes adhering to regulations on maritime transport safety, technical and operational rules, and obtaining and confirming the qualifications for seafarers, along with their social protection. Ukraine's legislation on inland water transport should also be reformed to comply with EU regulations on access to the transport market infrastructure, compliance with technical conditions, and safety. Therefore, as a priority, it is imperative to implement key EU directives, such as Directive 96/75/EC concerning the systems of chartering and pricing in national and international inland waterway transport, Directive 87/540/EEC on access to the occupation of carrier of goods by waterway in national and international transport and on the mutual recognition of diplomas, certificates and other evidence of formal qualifications for this occupation, and Directive 2006/87/EC on technical requirements for inland waterway vessels. This work should be carried out concurrently with the restoration of port infrastructure damaged by Russian shelling.

Over the next few years, the transport infrastructure sector of Ukraine will require significant funding, institutional reforms, as well as prioritization and coordination of actions between the Government of Ukraine and international actors, including bilateral partners, multilateral financial institutions, and private investors. Given the difficult situation in the Ukrainian economy, foreign direct investment, including targeted lending, public-private partnerships, and concessions, will be crucial to finance large-scale projects aimed at restoring and modernizing the transportation infrastructure (Bandura et al., 2022).

However, the Ukrainian government must take a leading role in the reconstruction and modernization of infrastructure. In the transport and logistics sector, the coordination and implementation of infrastructure projects should be delegated to the Ministry of Infrastructure of Ukraine, as it is responsible for the entire

investment and regulatory framework in this area. The Ministry of Finance, especially its Department for Public-Private Partnerships, will also play a significant role in ensuring that customs and tax-related reforms are synchronized with inflows of infrastructure investment. Given the severe damage caused by the war and the vulnerability of Ukraine's post-war economy, the international community, in particular the European Union, multilateral development banks, and bilateral development finance institutions, must be prepared to contribute significantly to post-war recovery.

However, there are specific focal points that international donors should consider when developing an action plan in the transport and logistics infrastructure sector. *Firstly*, donors need to assign roles, assess their capabilities, and delineate project implementation responsibilities to avoid conflicts and leverage their unique strengths. Thus, the European Bank for Reconstruction and Development (EBRD) and the International Finance Corporation (IFC) support the construction of new airports, while the European Investment Bank (EIB) does not. The Japan International Cooperation Agency (JICA) has a successful track record of financing the construction of roads and railways, while the U.S. Trade and Development Agency (USTDA) has achieved success in preparing feasibility studies for transport infrastructure projects.

Secondly, donors can help the Ukrainian government to formulate a powerful package of economically viable infrastructure projects. After all, not every project described in the National Recovery Plan of Ukraine can attract funding. These projects must be carefully planned, meet modern standards and future trends, be consistent with the state's development strategy, and demonstrate tangible economic, social, and environmental benefits.

Thirdly, donors can help the Ukrainian government in selecting contractors and vetting investors in an unbiased manner, i.e., providing protection against undue influence, reducing the scope for corruption offences, and ensuring that a new class of oligarchs does not emerge in the process of post-war infrastructure reconstruction.

Fourthly, the establishment of an external independent monitoring and evaluation system is crucial to ensure proper funding tracking and achievement of infrastructure project goals. Given the level of corruption in Ukraine, such a system should include a wide range of authoritative international supervisors with appropriate powers.

Fifthly, Ukraine needs to carry out reforms in public administration, specifically introduce changes to customs and tax legislation, ensure the proper functioning of the law enforcement and judicial system, and take measures to fight corruption to attract foreign and private investors. International donors can contribute to the transformation process.

Finally, investors need effective mechanisms to mitigate the risks of losses due to hostilities or illegal interference in their activities. Therefore, Ukraine should develop and offer investors the effective instruments of insurance and state guarantees, facilitating the attraction of capital to Ukraine from various sources.

Conclusions

The reconstruction of Ukraine's transport and logistics infrastructure, based on the aforementioned principles, and the implementation of the proposed measures will fulfil the needs of businesses and the population, contributing to Ukraine's economic revival and integration into the European Community. This endeavour will be a long-term and painstaking effort, requiring a comprehensive roadmap spanning several decades and significant investments to create a truly sustainable infrastructure that meets the demands and expectations of all stakeholders.

Despite the ongoing hostilities, efficient preparations for the large-scale reconstruction of the transport infrastructure must begin as soon as possible. Only relevant competencies and political will are needed to implement the necessary legislative changes, reform public institutions, and ensure the rule of law and the fight against corruption. Ukraine should create favourable conditions for investment, while international stakeholders should allocate spheres of responsibility, establish processes for infrastructure project selection, and develop the corresponding financing mechanisms.

Delays in implementing the necessary actions, driven by political ambitions and conflicts between branches of power, levels of government, institutions, or individual officials, can significantly tarnish Ukraine's international image, potentially leading to the reluctance of foreign and private investors to finance Ukraine's post-war reconstruction. In this scenario, Ukraine would be left to grapple with extremely outdated and destroyed infrastructure, relying solely on its own efforts and finances. Such self-funded reconstruction efforts may extend over a prolonged period of time and might not yield success. Consequently, Ukraine risks losing its competitiveness and falling economically behind all European countries, with little hope for improvement. Simultaneously, the nation could lose millions of citizens who have fled due to the war and may be unwilling to return to a country marked by ruins and backwardness. Therefore, the urgency of post-war infrastructure reconstruction is not only crucial for the survival of Ukraine but also paramount for ensuring the well-being of its citizens.

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