
TOPICAL ISSUES OF FORMATION TRANSPORT AND LOGISTICS INFRASTRUCTURE OF UKRAINE IN THE CONDITIONS OF EUROPEAN INTEGRATION AND GLOBAL CHALLENGES OF TODAY**Nataliya Tyukhtenko^{1*}** 

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Abstract: The presented article is dedicated to the study of the transport and logistics infrastructure of Ukraine under the influence of globalization and integration challenges on the basis of finding ways of sustainable development to improve the quality of life of people (including taking into account the environmental component) and the efficiency of business processes. The issue of the essence of the transport and logistics infrastructure is mastered, its main components are systematized and characterized: technical, infrastructural, institutional, organizational and economic. The significance of the functioning of the transport-logistics system and transport-logistics centers, which were the first to be created in the developed market countries of the world, having shown their effectiveness, is proven. The importance, essence, main development goals and world experience of the operation of transport and logistics centers for their effective implementation in the logistics infrastructure of Ukraine are shown. Based on the analysis of the dynamics of the LPI logistics efficiency index, which is calculated by the World Bank once every two years, the state of the transport and logistics infrastructure of Ukraine in comparison with other countries of the world has been determined. An analytical assessment of the dynamics of Ukraine's LPI in the period from 2010 to 2023 was carried out to understand the main obstacles to effective transport logistics. The priority directions for its improvement are outlined on the basis of advanced foreign experience, taking into account the detailed characteristics of infrastructural losses suffered by Ukraine as a result of the military aggression of the rf. The main advantages that a modern integrated multi-level transport and logistics infrastructure, built in the best traditions of the developed countries of the European Union and the world, gives to the country, region, city, and every settlement are presented. It was determined that globalization challenges increase the need for the formation of high-quality transnational, national, regional transport and logistics systems, which determines the importance of making effective management decisions and systematic managerial support in the transport industry of Ukraine.

Keywords: transport and logistics infrastructure, sustainable development, transport and logistics system, Logistics Efficiency Index, European integration, environmental impact, administrative support.

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1. Introduction. Current global development is influenced by numerous complex processes related to the search for their solutions to ensure sustainable development, high quality of human life and business processes. Technological revolutions, environmental problems, total digitalisation and the introduction of the artificial intelligence in all areas of the economy, pandemic and post-pandemic challenges, military aggression, the creation of new professions related to the provision of innovative management technologies for relevant changes - this is just a short list of the issues that should be researched and addressed. The economy's capability to satisfy the aggregate demand of all its actors depends to a large extent on the quality of the existing transport and logistics infrastructure. This is what capable of satisfying the needs for the delivery of goods between producers in the B2B system and between producers and consumers in the B2C system. The issue of creating an effective transport and logistics infrastructure is of particular relevance in the era of globalisation and integration processes. For the Ukrainian economy, which, on the one hand, is at war and, on the other hand, is striving to become a fully-fledged member of the European Union, the issues of integrated logistics and the operation of a multi-level transport and logistics infrastructure (centres, systems, clusters, etc.) are becoming extremely important today.

Accordingly, the purpose of the article is to provide substantiation of current issues of formation of the transport and logistics infrastructure of Ukraine and practical recommendations for improving the efficiency of its functioning on the basis of sustainable development and environmental friendliness in the context of today's globalisation challenges and search for ways of post-war recovery of the national economy.

2. Literature Review.

The problematic chosen for this scientific publication is considered by researchers in the context of mastering a variety of definitions. Among them: 'transport and logistics infrastructure', 'logistics infrastructure', 'transport and logistics system', 'transport and logistics centres', 'transport and logistics complex', 'logistics industry', 'transport and logistics services', etc.

An attempt to systematise the problems and prospects of the transport and logistics infrastructure of Ukraine is presented in the works of scientists A. Pasichnyk, I. Lebid, V. Kutyrev (Pasichnyk et al., 2012). M. Kharchenko substantiates the position of transport and logistics infrastructure in the socio-economic system of Ukrainian enterprises (Kharchenko, 2020). The development of transport and logistics infrastructure in the context of deepening integration into the EU is the subject of the works of H. Prytula, A. Maksymenko, Y. Kalat, I. Kyryk (Prytula et al., 2023). O. Lukyanova and D. Krivtsun present their own vision of the implementation of international experience and prospects for the development of transport and logistics infrastructure in Ukraine (Lukyanova & Krivtsun, 2018). Also, the trends in the development of transport and logistics infrastructure in Ukraine and the world are presented in the views of O. Polyakova and O. Shramenko (Polyakova & Shramenko, 2017). The experience and patterns of formation of the global transport and logistics infrastructure are presented by A. Kuzmenko (Kuzmenko, 2015), and the place of Ukraine's logistics infrastructure in the world rankings is studied by O. Karyy and G. Podvalna (Karyy & Podvalna, 2017).

P. Yaremchuk and M. Bas-Yurchyshyn propose to consider the priorities for the development of logistics infrastructure through the realisation of the export potential of domestic regions (Yaremchuk & Bas-Yurchyshyn, 2023).

H. Ilchenko and A. Kulik examine the development of Ukraine's transport and logistics system (Ilchenko & Kulik, 2019). The works of L. Ivashova and K. Shatrova are focusing on the impact of indicators of foreign economic activity on the development of the transport and logistics system of Ukraine in the context of European integration (Ivashova & Shatrova, 2017).

I. Lutsenko studies the issue of the need for state support for transport and logistics systems in the geopolitical aspect (Lutsenko, 2021). An analysis of various aspects of the functioning of transport and logistics systems is presented by L. Hrytsyna and O. Kharun based on a comparative analysis of the world's leading countries in this area (Hrytsyna & Kharun, 2019).

The problems of the transport and logistics centres functioning are presented in the studies of T. Kovtun, T. Smokova, D. Kovtun in terms of history and international experience (Kovtun et al., 2021). The economic importance of the logistics industry in Ukraine was studied by S. Moroz and S. Levchenko (Moroz & Levchenko, 2023).

N. Trushkina (Trushkina, 2022) proposes a study of partnership in transport logistics in the context of war in Ukraine, and B. Kernychyi (Kernychyi, 2021) discusses key issues of transport and logistics management. Zoriana Vata in her work tries to master the EU transport and logistics complex in terms of modern trends in innovative development (Zoriana Vata, 2013), which is important in the current economic environment.

As we can see, the above analysis of research and publications of recent years shows a quite high level of scientists' interest in the issues of forming transport and logistics infrastructure in Ukraine, considering the positive experience of its global functioning.

At the same time, the issues of innovative development on the basis of sustainable development, considering the environmental component, effective management, state regulation and mechanisms of functioning of the transport and logistics infrastructure of Ukraine during the war and in the post-war recovery of the national economy, with due regard for the integrative and globalisation challenges of modern times, remain insufficiently researched.

3. Methodology and research methods.

To address the current problems of forming the transport and logistics infrastructure in Ukraine, we used a variety of methods. For instance, the method of dialectical cognition was used to clarify the essence, main elements and assess the impact of the transport and logistics infrastructure efficiency on the country's GDP level, considering the processes of internationalisation and globalisation. The historical and evolutionary analysis is used to systematise the world's positive experience of the transport and logistics infrastructure functioning at all stages of its formation. The method of induction and deduction was used to estimate the damage to the Ukrainian economy (its logistics infrastructure) from the military aggression of the Russian Federation. Economic-statistical and graph-analytical methods were used to analyse the level and dynamics of the Logistics Performance Index of Ukraine in comparison with other countries of the world, including the European Union. Scientific generalisation and systematisation methods allowed to identify the factors of insufficient performance of the modern domestic transport and logistics system of Ukraine. The necessity of building a multi-level integrated national transport and logistics infrastructure in the context of post-war reconstruction on the way to sustainable development and environmental friendliness is proved based on the use of an abstract and logical approach and the method of structural and logical modelling.

4. Results.

Analytics show that approximately 20-30 per cent of the GNP of the world's leading countries is linked to logistics systems, and a 1 per cent reduction in logistics costs causes a 10 per cent loss in business sales (Pasichnyk et al., 2012). It means that the country's economic power is almost one-third (emphasis added) dependent on logistics. In the period of current global challenges, the issues of improving the transport and logistics infrastructure are even more relevant. We should agree with the authors who stress that globalisation processes in the world economy 'have not only contributed to the growing internationalisation of many national economic systems, but have also caused a significant increase in the intensity of international economic relations and the geographical expansion of transport and logistics activities, which has led to a complication of the structure of transport and logistics infrastructure and an increase the volume and concentration of flows' (Yaremchuk & Bas-Yurchyshyn, 2023).

Ukraine, which is presently in a state of war, is trying to find ways to keep its production potential on the basis of integration communications with the international community, especially with the countries of the European Union, which we are striving to become a member in the future. Therefore, the formation of a modern transport and logistics infrastructure is certainly one of the most important strategic priorities for national development. This understanding was based on the National Transport Strategy of Ukraine for the period up to 2030, approved by the Cabinet of Ministers of 30 May 2018, No. 430-r (On the approval of the National Transport Strategy of Ukraine for the period up to 2030).

Considering the huge scale of losses in all sectors of Ukraine's economy caused by the full-scale war, it has to be taken into consideration that Ukraine's transport and logistics infrastructure is among those that have suffered the greatest destruction. According to the Report on direct damage to infrastructure caused by Russia's military aggression against Ukraine, as of the beginning of 2024, direct damage to transport infrastructure facilities amounted to \$36.8 billion, and 25.4 thousand km of roads, 344 bridges and bridge crossings of state, communal and local importance were destroyed. After the destruction of the Kakhovka hydroelectric power station, 290.3 km of roads were flooded, which corresponds to USD 0.3 billion in damages. The railway infrastructure across Ukraine suffered losses of USD 4.3 billion. Destroyed transport of public utilities and private carriers (trolleybuses, trams, buses) is estimated at \$0.83 billion; private passenger vehicles worth \$1.9 billion (212,000 cars) were destroyed. The amount of losses from the destruction of 1629 units of firefighting equipment was \$89 million (Kyiv School of Economics: website, 2024). It should be noted that these are only preliminary estimates.

In view of the importance of the transport and logistics structure for the functioning and post-war recovery of Ukraine in the context of globalisation, we should turn to the experience of different countries of the world, which will allow us to make effective management decisions in the logistics management system.

The global experience of transport and logistics development outlines a number of positive aspects, the main of which are

- reduction in the cost of goods and services,
- increase in the number of jobs;
- optimisation of trade turnover (retail and wholesale),
- improving the quality of customer service,
- improving the environmental situation by optimising transport and logistics infrastructure,
- increasing the investment attractiveness of regions with developed transport and logistics infrastructure,
- increase in income of the state, its regions, cities, towns and villages from the realisation of transit potential, etc.

The relevance of developing transport and logistics infrastructure in Ukraine is confirmed by the experience of developed countries that are actively creating and improving transnational, national and regional transport and logistics systems. They are an important and objectively necessary communicator between all economic actors: consumers, businesses, the state and foreign countries.

The main components and structural elements of the transport and logistics infrastructure are shown in Figure 1.

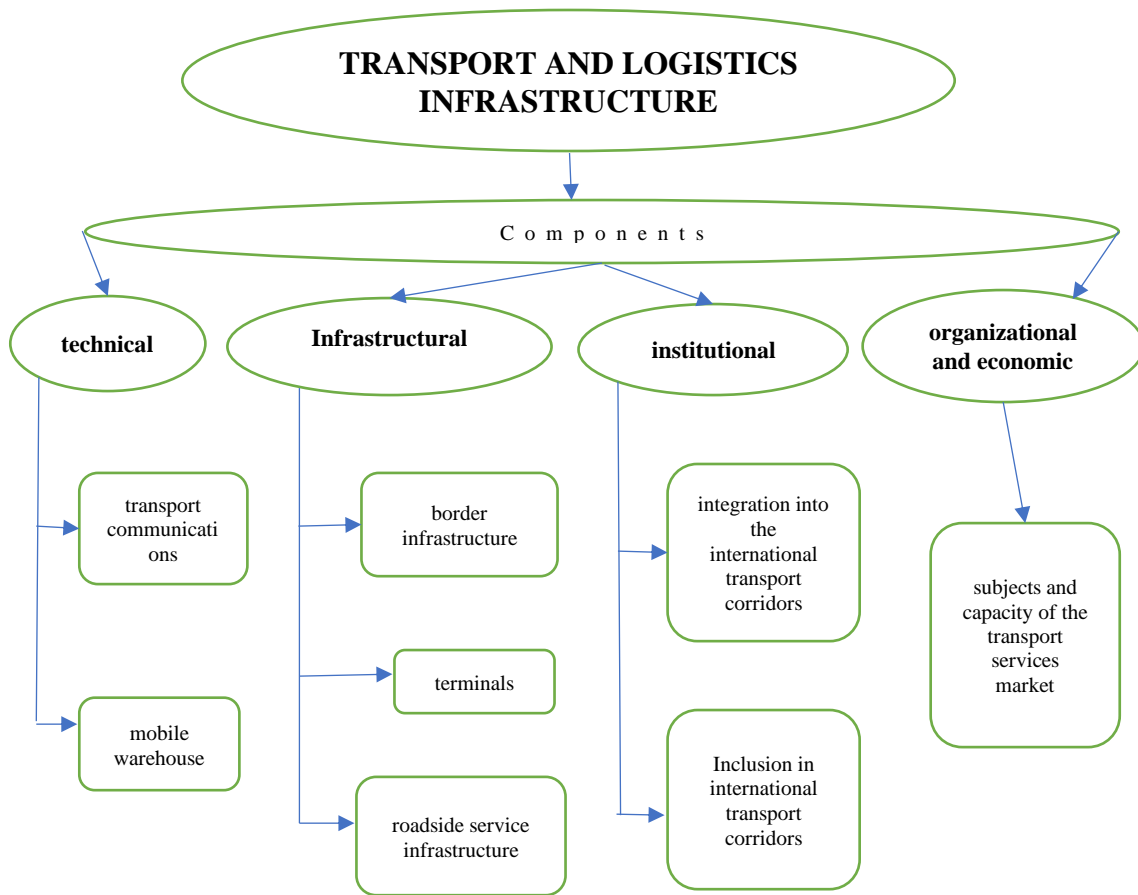


Figure 1. Characteristics of the main elements of the transport and logistics infrastructure

Sources: developed by the authors based on (Development of the logistics and transport infrastructure of the border regions of the Western region of Ukraine, 2023)

Since Ukraine has borders with the European Union and many other countries, the transport industry is attractive to domestic and foreign investors and can be efficient if the appropriate transport and logistics infrastructure is implemented. This can be achieved by implementing existing international advanced experience and understanding the priorities of its own development in the context of various areas of activity, industries, and the business environment as a whole.

One of the most important strategic priorities for the development of the national economy in its post-war reconstruction should be the creation of transport and logistics systems and relevant centres (clusters) based on integrated logistics. The analysis shows that they allow 'to reduce total logistics costs by about 12-35%, transport costs by 7-20%, and loading and unloading costs by 15-30%, as well as to accelerate the turnover of material resources by 20-40% and simplify their reserves by 50-200%' (Ivashova & Shatrova, 2017).

Evolutionarily, the 60s of the XX century are considered the beginning of the formation of transport and logistics infrastructure facilities (in the form of simple warehouses), and the 80s of the XX century are associated with the emergence of logistics centres providing a range of services with their further evolution based on the integration of all participants in the logistics process at each stage. The main objectives of transport and logistics centres are as follows:

- Coordination and interaction of transport modes and participants in the transport and logistics process;
- high quality of transport and logistics services;
- preservation of goods and cargo, safety of transportation, processing and storing;
- information and analytical support along the entire journey of goods and cargo;
- managing commodity and material flows;
- reducing transport and logistics costs on the basis of the introduction of modern integrated logistics technologies;
- obtaining the maximum possible synergistic effect on the basis of logistics coordination and coordination of the interests of all participants of the transport and logistics centre and business partners (Kovtun et al., 2021).

Among the many definitions of a transport and logistics centre, we consider that the European Association of Transport and Logistics Centres (Europlatform) should be given special attention. The definition presented by them takes into account the structure, functioning and management and considers a transport and logistics centre as a certain territory where all activities related to the transportation, logistics and distribution of goods for national and foreign transit are carried out by different operators (they may be owners, tenants of various facilities built on the territory of the centre). Current business conditions in the globalised world require access to the maximum possible number of types of transport (road, air, rail, sea, river, pipeline, etc.). It is important that an efficient transport and logistics structure should be managed from a single centre, with representation from the state and the private sector (FV-2000, 1999). It is clear that a modern transport and logistics centre should correlate with European quality standards, which will allow for maximum synergies and optimal cooperation of all participants based on effective management decisions of a commercial, logistical, organisational and transport nature, considering environmental issues and achieving a clean environment.

The international analysis of the development of transport and logistics infrastructure at the country level (139 countries were assessed and compared in 2023) is assessed using the Logistics Performance Index (LPI) (World Bank, 2024). The LPI helps countries identify current challenges and opportunities for improving transport logistics performance. Using an online questionnaire, logistics professionals from partner countries evaluate logistics companies (mainly international (transnational)) where they do not work. The Logistics Performance Index is calculated by the World Bank every two years (since 2010) based on expert assessment (on a 5-point scale) of six indicators of a country's logistics performance:

1. Customs - the effectiveness of customs clearance and border management procedures (weighting factor 0.40);
2. Infrastructure - the quality of trade and transport infrastructure (weighting factor 0.42);
3. International shipments - ease of organising affordable international transport (weighting factor 0.40);
4. Logistics quality and competence - competence and quality of logistics services (weighting factor 0.42);
5. Tracking and tracing - the ability to track and control the passage of goods (weighting coefficient 0.41);
6. Timeliness - the time spent on transporting goods to their destination is within the planned or expected delivery time (weighting factor 0.40) (Worldbank, 2024; Yudenko, 2018; Zharska, 2017).

Analysing the LPI of the world's countries for 2023, we can notice that it ranges from 1.9 (the worst condition) to 4.3 (the best condition). Among the 139 countries included in the 2023 ranking, the highest scores (3.6-4.3) and the lowest (1.9) are those presented in Table 1.

Table 1. Logistics performance index LPI in countries with the highest and lowest scores in 2023

LPI index	Countries and corresponding LPI rating
4,3	Singapore (1)
4,2	Finland (2)
4,1	Denmark (3), Netherlands (3), Germany (3), Switzerland (3)
4,0	Austria (7), Belgium (7), Hong Kong (7), Canada (7), UAE (7), Sweden (7)
3,9	Spain (13), Taiwan (13), France (13), Japan (13)
3,8	Korea (17), USA (17)
3,7	Australia, Great Britain (19), Greece (19), Italy (19), China, Norway (19), South Africa (19)
3,6	Israel (26), Ireland (26), Iceland (26), Luxembourg (26), Malaysia (26), New Zealand (26), Poland (26), Estonia (26)
3,5-2,8
2,7	Ukraine (79), Bahamas, Belarus, Djibouti, El Salvador, Georgia, Kazakhstan, Papua New Guinea, Paraguay
2,6-2
1,9	Afghanistan (138), Libya (138)

Sources: systematized by the authors based on (Worldbank, 2024)

As we can see, Ukraine, despite the state of war, is ranked 79th, holding an approximately middle position among the countries represented in the ranking. Analysing the dynamics of Ukraine's LPI over the years (Figure 2), we can see that since 2010, it has been growing steadily, with the highest value recorded in 2014 (LPI=2.98). In 2016, there was a decline of almost 0.24, after which, according to 2018 data, Ukraine's LPI increased to 2.83. In the period from 2019 to 2022, the World Bank has not recorded an estimate of this indicator. Most likely, this is due to the pandemic processes that have taken over the world and the beginning of Russia's military aggression against Ukraine. It should be noted that in 2023, despite the difficult military circumstances, Ukraine managed to ensure an LPI of 2.7, which is 0.1 higher than, for example, in rf.

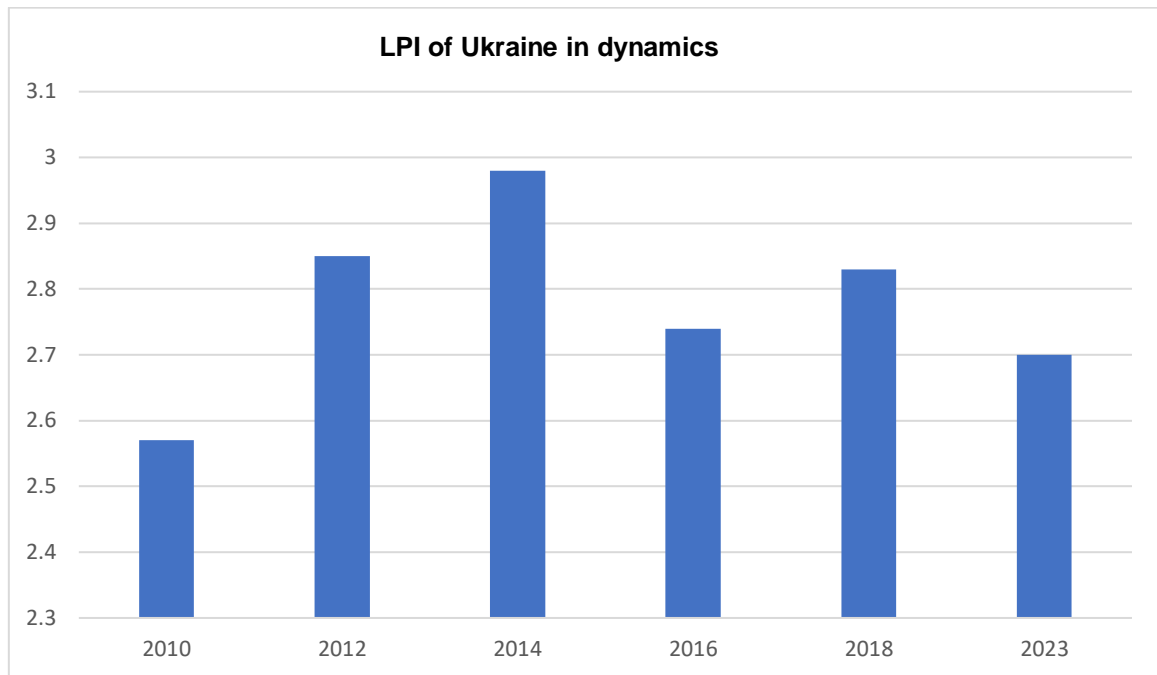


Figure 2. Dynamics of the LPI Logistics Performance Index of Ukraine (2010-2023)

Sources: Worldbank, 2024

As Ukraine's persistent aspirations to join the European community are evident, it should be noted that all EU countries have LPI scores in 2023 ranging from the lowest of 3.2 (Hungary, Bulgaria, Romania) to the highest of 4.2 (Finland). Germany (4.1), the Netherlands (4.1), Denmark (4.1), Belgium (4.0), Austria (4.0), Sweden (4.0), France (3.9), and Spain (3.9) also have high LPI scores in 2023.

We can see that even the lowest LPI score of 3.2 among the EU countries in 2023 is much higher than the score for Ukraine. What are the main reasons for this position? We should agree with the Ukrainian Logistics Alliance scientists, who identify the following factors for the insufficient level of functioning of the domestic transport and logistics system

- high cost of services of its operators;
- the possibility of delivery delays;
- often inappropriate competence characteristics of the staff;
- insufficiently high quality of services;
- an aspect of a certain distrust of domestic logistics;
- the legislative framework that needs to be aligned with international standards in this area of activity, etc (Avramenko, 2017).

This once again underlines the relevance of researching ways to improve the efficiency of the domestic transport and logistics infrastructure for the sustainable development of Ukraine in its post-war recovery and approximation to European and world standards. It should be noted that over the past decade, road transport has remained the leader of all transport in Ukraine (approximately 75%), a trend that is also observed in a significant number of EU countries (Chukurna et al., 2022). At the same time, river, sea and air transport account for only 0.4% of the total structure of domestic domestic logistics, while in EU countries this figure is much higher (2.6-18.7%) (Prytula et al., 2023). It is important to introduce an integrated multi-level transport and logistics infrastructure that can satisfy the maximum possible number of business needs and their quality.

The authors' proposal to create a five-level structure of logistics interaction in Ukraine is interesting, where

- at the first level, all objects (terminals, warehouses, enterprises, services, etc.) are interacting;
- the second level includes transport and logistics centres for local, regional and international purposes;
- the third level is dedicated to regional transport and logistics systems;
- the fourth level is transport and logistics clusters;
- the fifth level is an integrated multilevel transport and logistics system of Ukraine, including the international component of the transport infrastructure (Syrtychuk, 2010).

It seems that this approach really reflects the main elements of the functioning of the country's transport and logistics infrastructure, taking into account international aspects, which can form its optimal domestic version and increase efficiency in the context of globalisation and integration challenges and the search for adaptive management decisions in the post-war recovery of Ukraine.

5. Discussion.

In our opinion, further researches should be focused on the issues of creating an effective domestic transport and logistics infrastructure, in which the environmental component will have priority. At the same

time, the globalisation and integration processes today require the creation of optimal mechanisms for the functioning of the transport and logistics infrastructure on the basis of effective management support and appropriate management decisions at the level of business and in terms of state support. We believe this will allow Ukraine's LPI score in 2025 to reach at least the level of the most recently joined EU countries. This system may become the key to further success in the post-war recovery and sustainable development of Ukraine in the context of improving its ranking in the global community and, most importantly, the welfare and quality of life of each of its citizens.

6. Conclusions.

By considering in this article the essential current issues of creating an integrated multi-level transport and logistics infrastructure, we have substantiated its importance for the functioning of all economic actors and its impact on improving the country's macroeconomic indicators. The main elements of the country's transport and logistics infrastructure include relevant centres, systems, clusters, etc., whose performance requires further research and development on the basis of innovativeness, environmental friendliness and the use of best domestic and international experience in this area.

The issues of approximation, adaptation and integration of the transport and logistics structure to international legislation, standards and trends in relevant activities in different countries, especially countries with Ukraine's close international relations today and in the future, are of particular relevance in the context of European integration and global cooperation in the post-war national recovery.

Conflicts of Interest: Authors declare no conflict of interest.

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АКТУАЛЬНІ ПИТАННЯ ФОРМУВАННЯ ТРАНСПОРТНО-ЛОГІСТИЧНОЇ ІНФРАСТРУКТУРИ УКРАЇНИ В УМОВАХ ЄВРОІНТЕГРАЦІЇ Й ГЛОБАЛЬНИХ ВИКЛИКІВ СУЧАСНОСТІ

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Представлена стаття присвячена дослідженню транспортно-логістичної інфраструктури України під впливом глобалізаційно-інтеграційних викликів на засадах пошуку шляхів сталого розвитку для підвищення якості життя людей (в тому числі з урахуванням екологічної складової) та ефективності бізнес-процесів. Опановано питання сутності транспортно-логістичної інфраструктури, систематизовані й охарактеризовані її основні складові: технічну, інфраструктурну, інституційну, організаційно-економічну. Доведено значення функціонування транспортно-логістичної системи й транспортно-логістичних центрів, які еволюційно першими почали створюватися у розвинених ринкових країнах світу, показавши свою ефективність. Показана важливість, сутність, основні цілі розвитку й світовий досвід функціонування транспортно-логістичних центрів для їх ефективного впровадження у логістичній інфраструктурі України. На основі аналізу динаміки Індексу ефективності логістики LPI, що розраховується Світовим банком один раз на два роки, визначено стан транспортно-логістичної інфраструктури України у порівнянні з іншими країнами світу. Здійснено аналітичну оцінку динаміки LPI України у період з 2010 по 2023 роки для розуміння головних перешкод ефективної транспортної логістики. Окреслено пріоритетні напрями її удосконалення на основі передового зарубіжного досвіду з урахуванням детальної характеристики інфраструктурних втрат, що зазнала Україна внаслідок військової агресії рф. Представлено основні переваги, які дає країні, регіону, місту, кожному населеному пункту сучасна інтегрована багаторівнева транспортно-логістична інфраструктура, що побудована у кращих традиціях розвинених країн Європейського союзу й світу. Визначено, що глобалізаційні виклики посилюють необхідність формування якісних транснаціональних, національних, регіональних транспортно-логістичних систем, що обумовлює важливість прийняття ефективних управлінських рішень й системного менеджерського супроводу у транспортній галузі України.

Ключові слова: транспортно-логістична інфраструктура, сталий розвиток, транспортно-логістична система, Індекс ефективності логістики, євроінтеграція, екологічний вплив, управлінській супровід.