Rahmanov, Farhad; Neymatova, Lala; Aliyeva, Ramilya et al.

Article

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Reference: Rahmanov, Farhad/Neymatova, Lala et. al. (2022). Management of the transport infrastructure of global logistics : cross-country analysis. In: Marketing i menedžment innovacij 13 (4), S. 65 - 75.
https://armgpublishing.com/wp-content/uploads/2023/01/A652-2022-07_Rahmanov.pdf.
doi:10.21272/mmi.2022.4-07.

ARMG PUBLISHING "Thinking ahead"

sciendo

Marketing and Management of Innovations, 4, 2022
ISSN 2218-4511 (print) ISSN 2227-6718 (online)

MANAGEMENT OF THE TRANSPORT INFRASTRUCTURE OF GLOBAL LOGISTICS: CROSS-COUNTRY ANALYSIS

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Type of manuscript: research paper.

Abstract: *In modern society, there is a constant development and improvement of the transport industry, due to which the role and distribution of this logistics industry, which is a service, is growing for the high-quality and fast delivery of goods. To maximize the export of finished products and more effective penetration into international markets around the world are organized by global logistics systems. This article summarizes the arguments and counterarguments within the scientific discussion on the place and prospects of management of the transport infrastructure of global logistics. The study's main purpose is to confirm the hypothesis about the existence of global logistics clusters united by a common transport infrastructure in accordance with the geopolitical and economic features of the regions. In this regard, the array of input data is presented in the form of ten transport infrastructure indicators from databases of the World Bank and Organisation for Economic Co-operation and Development. The study of the transport infrastructure of global logistics in the article is carried out in the following logical sequence: the formation of an array of input data; input data normalization; determination of the integral index of the level of transport infrastructure's development (principal component method); clustering (the k-means method) and interpretation of the obtained results. Forty-five European and Asian countries were selected as the object of the study from 2006 to 2020. The study empirically confirms the above hypothesis, evidenced by the identified integral index of the level of transport infrastructure's development and qualitative composition of the obtained clusters. The road passenger transport indicator exerts the most significant influence on the integral index of transport infrastructure, air transport, passengers carried, container port traffic and railways, passengers carried. In general, during the studied period, countries were grouped into three and two clusters. The consolidation of clusters in 2020 indicates that the transport infrastructure of countries with an average level of economic development began to develop actively. In particular, this concerns the increased demand for road transport. The study results can be useful for public authorities and international organizations that provide services for managing the transport infrastructure of global logistics.*
Keywords: transport infrastructure, global logistics, management of the transport infrastructure, transport industry, international logistics, integral index.
JEL Classification: L91, R40

Received: 20 June 2022 **Accepted:** 2 November 2022 **Published:** 30 December 2022

Funding: There is no funding for this research.
Publisher: Sumy State University

Cite as: Rahmanov, F., Neymatova, L., Aliyeva, R., & Hashimova, A. (2022). Management of the Transport Infrastructure of Global Logistics: Cross-Country Analysis. *Marketing and Management of Innovations*, 4, 65-75. https://doi.org/10.21272/mmi.2022.4-07

Introduction. An open economy of any country cannot function without a well-established international logistics system, among which transport infrastructure occupies a leading place. It ensures the supply chains are being established and made operative, enabling the country to participate in the global trade and international division of labour. The above creates prerequisites for a decent living standard for the population, the country's socio-economic development, and national security. Under the influence of globalization and digitalization processes, the transport infrastructure in the international logistics system is developing rapidly. According to the international platform Statista, the volume of the global logistics industry in 2021 accounted for 8.43 trillion Euros (Statista, n.d.), which is 2.7 trillion Euros more than in 2020. This post-COVID growth is also due to specific changes in supply chains, increased e-commerce, etc. However, Asia Pacific is the most powerful region in terms of market size due to rapid and severe measures to contain the spread of the virus.

Despite this, the COVID-19 pandemic and other geopolitical factors are significantly influencing the logistics and trade industry, which is anticipated to experience significant changes in supply chains in the medium and long term. Under these conditions, the issue of managing the transport infrastructure of global logistics becomes particularly relevant, as it makes it possible for the markets to be interconnected physically.

Literature Review. To make literature analysis more comprehensive, it is proposed to apply the bibliometric analysis tools. First, the study analyses the quantitative outcomes, measured as the frequency of keywords occurring on the selected research topic in the most common scientometric databases (Table 1).

Table 1. Quantitative results of the bibliometric analysis as of 01.11.2022

Keywords	Scopus database			WoS database		
	results	citations	h-index	results	citations	h-index
international logistics	455	3630	29	295	1915	22
transport infrastructure	7 637	78 827	100	4 769	41 416	90
transport infrastructure AND logistics	418	3 020	27	318	2 073	24

Sources: developed by the authors on the basis of data from Scopus, WoS, and Google Scholar databases.

H-index characterizes the productivity and impact of the published works and is used as one of the indicators of bibliometric analysis. Among the analysed research areas, the h-index has the most significant value in transport infrastructure in Scopus and the WoS database (the value is 100). A more specific clarification of the research area using the keywords transport infrastructure AND logistics made it possible to obtain an h-index at 27 in Scopus and 24 in the WoS database. These results suggest little attention to the issue of transport infrastructure formation in the international logistics system, which requires a more thorough study. This study focuses on the last search query because it allows for narrowing the scope of the research and analysing these results in more detail. With the total number of research papers on the keywords «transport infrastructure AND logistics» 418 in the Scopus database, the search query starts from 1989, in the WoS database – from 1998. Figure 1 shows the dynamics of their occurrence in these databases from 1995.

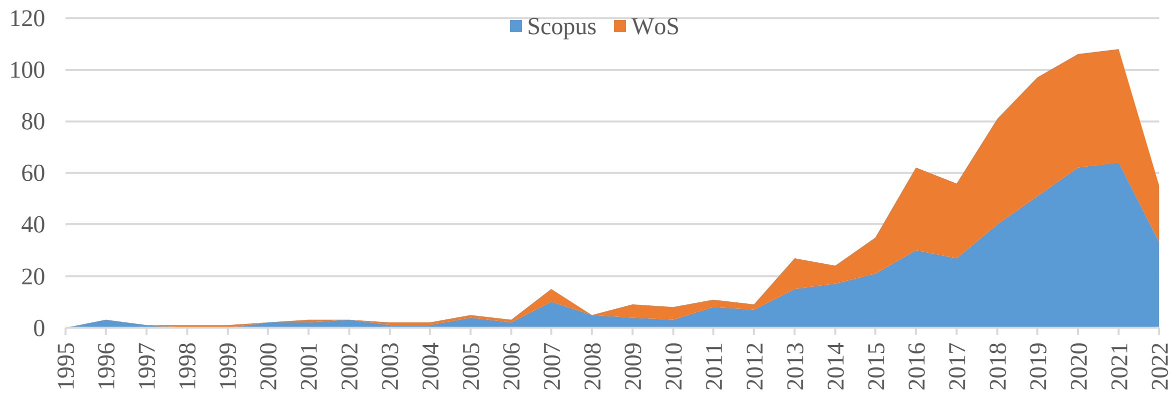

Figure 1. Dynamics of the use of the keywords «transport infrastructure AND logistics» in Scopus and WoS database

Sources: developed by the authors on the basis of data from Scopus and WoS databases.

The first mention in the Scopus database is found in the work of Sundberg & Carlén (1989), which is devoted to the mechanism of state budget fund spending for interregional transport and communication infrastructure in the example of Sweden. After that, the number of papers gradually increased, mainly since 2012. There has been a steady increase in the analysed indicator. In 2021, they reached peak values – 64 papers in Scopus and 44 papers in the WoS database. Given that 2022 is not over yet, the available data are not complete. By subject area, the distribution of results in the WoS database is as follows (Figure 2).

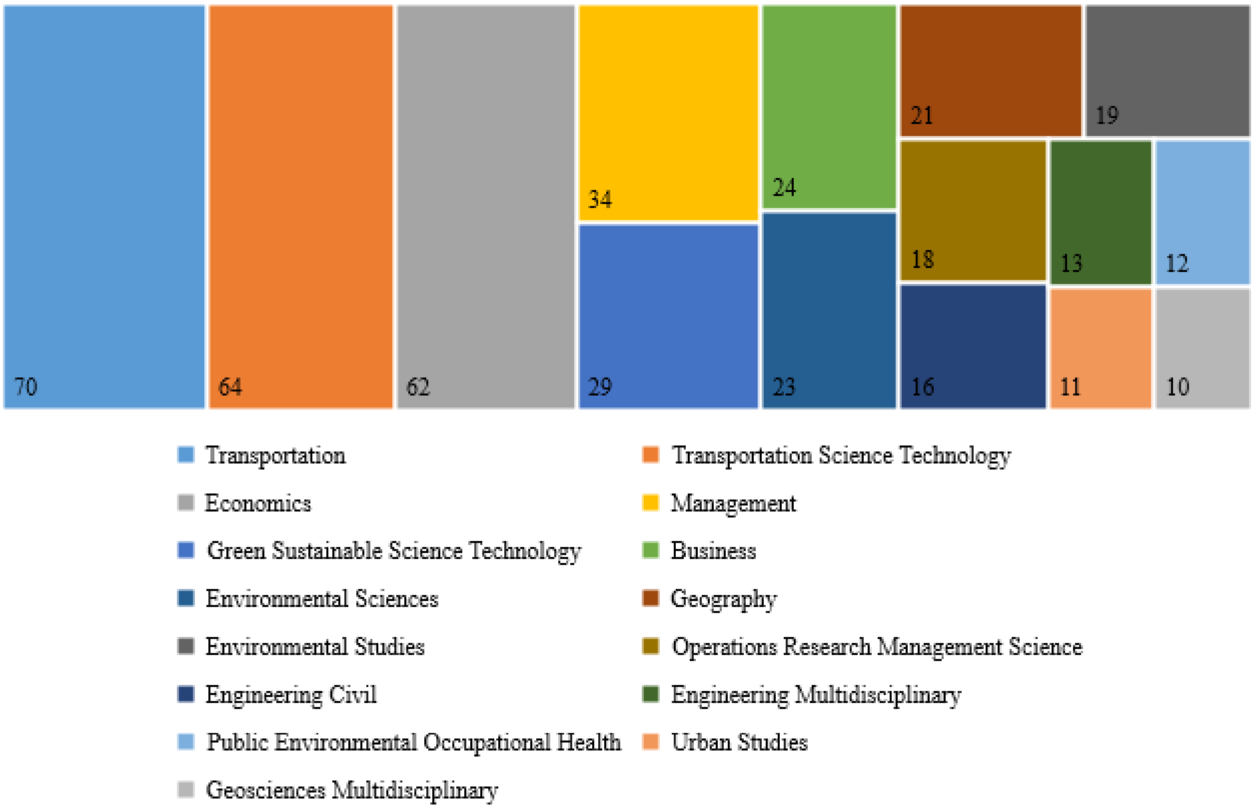

Figure 2. Distribution of the subject area by the keywords «transport infrastructure AND logistics» in the WoS database

Sources: developed by the authors on the basis of data from WoS databases.

Figure 2 shows that most works are focused on the subject area of transport (over 42%), economics (over 19.5%), and management (over 10%), a separate group of areas focused on the environment (e.g., Green Sustainable Science Technology, Environmental Sciences, Environmental Studies) or even geography (Geography, Geosciences). Based on this, the study focuses more specifically on the individual research papers of scientists who have studied various aspects of transport infrastructure formation in the international logistics system. Thus, the research paper of Lom et al. (2016) investigates the peculiarities of transport system formation and infrastructure in Smart City and Industry 4.0, which will ensure more efficient use of resources and sustainable development. Matyushenko et al. (2019) also developed this idea and considered the peculiarities of forming the Logistics 4.0 paradigm, which is based, in particular, on advanced technologies and the digitalization of business processes. Paprocki (2017) considered the peculiarities of the spread of the Internet of things (IoT) in the context of transport and logistics operators and provided recommendations to strengthen interaction with other market players and government agencies for more effective implementation.

The importance of transport infrastructure from the perspective of increasing a country's international competitiveness was examined by Bensassi et al. (2015) using 19 Spanish regions as a case study, which confirms the positive impact of logistics on export flows using a gravity model. Similar studies by Kiel et al. (2014), Purwanto et al. (2017), Liu et al. (2022) showed a positive impact of transport infrastructure development on competitiveness. Raimbekov et al. (2016) studied the impact of logistics infrastructure on regional economic development, taking Kazakhstan as an example. And Lean et al. (2014) tested the relationship between logistics development and economic growth in both the short and long term, taking China as an example, applying the Granger test. A study by Meersman and Nazemzadeh (2017) proves that economic growth in Belgium is positively influenced not only by economic openness, investment rates, and technological change but also by the length of highways, rail networks, and investment in port infrastructure.

Rodrigue et al. (2013) outlined the main direct and indirect effects of transport infrastructure development on regional development. In particular, the study refers to the direct effects of increased employment rates and surplus value due to time savings and accessibility. Indirect ones are multiplicative economic effects through lower prices for goods or services, etc. Similar benefits may be found in Lakshmanan (2011), Michniak (2015), etc. Studies on changes in transport infrastructure within the international logistics system because of the COVID-19 pandemic and quarantine restrictions deserve particular attention. Their impact is unprecedented in most economic sectors by exacerbating economic and social crises, with the transport industry no exception. Thus, Xu et al. (2021) assessed the impact of COVID-19 on China's transport and logistics sector based on structural equation modelling. The results show a significant adverse effect on air and ground freight transport within the country. On the contrary, Medyakova et al. (2020) highlighted that the pandemic accelerated the accumulated digitalization potential of the transport sector. In this context, the Sun et al. (2020) study addresses resilience metrics and measurement for transport infrastructure.

Another equally important issue is the measurement of transport infrastructure as a unified indicator. Commonly known international metrics such as the Global Competitiveness Index (GCI) or Logistics Performance Index (LPI), which are provided by the World Economic Forum and the World Bank, respectively, are used in academic circles (Skorobogatova and Kuzmina-Merlino, 2017). Lesik (2020) proposed his own version of an integral measurement of transport infrastructure development on the example of Ukrainian regions based on the best possible estimate of the comparable points. The following variables were selected: gas stations, length of public roads, road haulage, cargo transportation, carriage of passengers by road transport, etc., to form an integral indicator. Saba et al. (2021) investigated the convergence of transport infrastructure among countries with different income levels by calculating an integral transport index using principal component analysis (PCA). Depending on the level of transport infrastructure development, different types of logistics centers or clusters may be created (Higgins et al., 2012, Sheffi, 2012). Lyfar (2014) proposed the structure of a transport cluster whose specialization depends on the available and developed modes of transport in the region and on interregional cooperation between science, business, and government.

Despite numerous studies, the effective management of transport infrastructure in the global logistics system in modern conditions has not been given enough attention, and the existing ones form a rather partial perspective. Predetermines the following objective of this research – to confirm the hypothesis about the existence of global logistics clusters united by a common transport infrastructure under the geopolitical and economic features of the regions.

Methodology and research methods. To test these hypotheses, a two-step model will be constructed. In the first step, this study constructed an integral transport infrastructure indicator (TII). Usually, the integral indicator is based on several explicit indicators. First, it is necessary to normalize the input data set, as this will allow for levelling out differences in the units of measurement between the input indicators. Given the essence of the research, the min-max normalization method should be applied. That will produce dimensionless data ranging from 0 to 1, and will consider the nature of the influence of the factors on the integral indicator. Determining the nature of the influence will depend on how a change in a particular transport infrastructure indicator will affect the change in TII. If this influence is positive, the indicator is defined as a stimulant and will be calculated according to formula 1. If it is negative, it will be defined as a disincentive and will be calculated according to formula 2.

$$\bar{x}_{ic}^{t} = \frac{x_{ic}^{t} - min(x_{i}^{t})}{max(x_{i}^{t}) - min(x_{i}^{t})}, \quad (1)$$

$$\bar{x}_{ic}^{t} = \frac{max(x_{i}^{t}) - x_{ic}^{t}}{max(x_{i}^{t}) - min(x_{i}^{t})}, \quad (2)$$

where $\bar{x}_{ic}^{t}$ is the normalized value of the indicator of the c-the country in the t-the year; x_{ic}^{t} is the value of the indicator of the c-the country in the t-the year; min (x_{ic}^{t}) is the minimum value averaged over all years and countries; max(x_{ic}^{t}) is the maximum value averaged over all years and countries.

The next step requires determining the weighting factors for each indicator included in the TII. To do this, factor analysis was used to determine the optimal number of factors (through the Kaiser criterion and the Scree

Plot), mark the statistically significant factor loadings of the indicators, and highlight the proportion of variance that each factor explains. As a result, the weighting factors will be determined by formula 3.

$$w_i = \frac{|fl_i|p_k}{\sum_i |fl_i|p_k}, \quad (3)$$

where w_i is the weighting factor for variable i; $fl_i$is the significant factor loading of the i-the variable; p_k is the proportion of the total variance of the k-th factor.

The next step is to calculate an integral indicator for the transport infrastructure, obtained as the sum of the product of the normalized data and the weighting factors for each year. The integral indicator will be determined using the following formula (4).

$$I = \sum \overline{y_{ij}} \cdot w_i, \quad (4)$$

In the second stage of modelling, the countries are clustered based on the indicators of transport infrastructure, which, according to the results of factor analysis, had the highest value of factor loading within the selected factors. Clustering is carried out by two methods: the hierarchical clustering method (Ward's method) and the k-means method. In this case, the hierarchical clustering method makes it possible to construct a dendrogram that describes the proximity of individual points and clusters concerning each other and represents the sequence of cluster merging in a graphical representation. Figure 3 shows the schematic representation of the dendrogram.

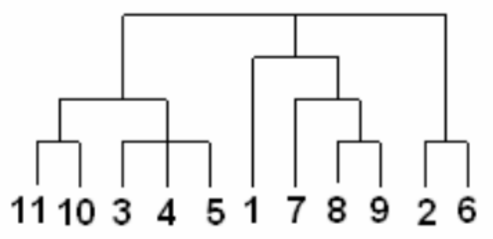

Figure 3. Schematic representation of a vertical dendrogram built as a result of hierarchical clustering

Sources: developed by the authors on the basis of (Pindyck and Rubinfeld, 1991).

The number of clusters identified by hierarchical clustering will be the basis for k-means clustering. Unlike the previous method, this method requires a preliminary determination of the number of clusters. Therefore, this study uses hierarchical clustering. Clustering by the k-means method also makes it possible for us to analyse each cluster's exact composition, obtain the analysis results of variance (to check the statistical significance of the indicators underlying the clustering), and graphically represent the mean values of the indicators within each selected cluster.

Results. This integral indicator of transport infrastructure is based on eight indicators, which are indicators of the development rate of transport infrastructure in the studied countries (45 countries in Europe and Asia) for the period 2006-2020 (Table 2).

Table 2. The array of input data

Indicator symbol	Indicator name	Indicator content
TI1	Air transport, freight	Air freight is the volume of freight, express, and diplomatic bags carried on each flight stage (operation of an aircraft from take-off to its next landing), million ton-km.
TI2	Air transport, passengers carried	Air passengers include domestic and international aircraft passengers of air carriers registered in the country (persons).
TI3	Container port traffic	Port container traffic measures the flow of containers from land to sea transport modes, and vice versa, in twenty-foot equivalent units (TEUs), a standard-size container (20 foot equivalent units).
TI4	Liner shipping connectivity index	The Index captures how well countries are connected to global shipping networks (units).

Continued Table 2

Indicator symbol	Indicator name	Indicator content
TI5	Railways, goods transported	Goods transported by railway are the volume of goods transported by railway, measured (million ton-km).
TI6	Railways passengers carried	Passengers carried by railway are the number of passengers transported by rail times kilometres travelled ((million passenger-km).
TI7	Road freight transport	Road freight transport: any movement of goods using a road vehicle on a given road network (tonnes-kilometres, millions).
TI8	Road passenger transport	Road passenger transport: any movement of passengers using a road vehicle on a given road network (passenger kilometres, millions).

Sources: developed by the authors on the basis of (OECD; World Bank).

Given that all the indicators presented positively impact the integral transport infrastructure index (i.e., stimulators), formula 1 allows normalizing the input data. The normalized values should be conducted as a factor analysis. Before determining the factor loadings of the indicators and the variance of the selected factors, it is necessary to determine the optimal number of factors. For this purpose, the Scree Plot is used (Figure 4), and the table of the factors' eigenvalues and the allocated cumulative variance (Table 3).

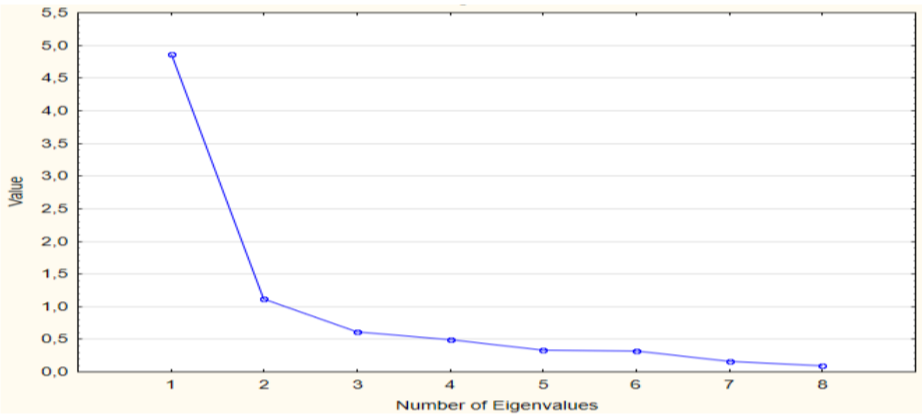

Figure 4. «Stony scree» graph

Sources: developed by the authors.

The place on the graph where the line begins to change more smoothly corresponds to the second factor (the Kaiser criterion is greater than one). In addition, the cumulative variance for the first two identified factors is greater than 74 %, which also confirms the sufficiency of the first two factors for further analysis.

Table 3. Eigenvalues

Factors	Eigenvalue	Total variance	Cumulative eigenvalue	Cumulative total variance
Factor 1	4,87	60,87	4,87	60,87
Factor 2	1,12	14,02	5,99	74,88

Sources: developed by the authors.

The next step is to examine the factor loadings in the context of these factors. To do this, a table with factor loadings for the studied indicators is used (Table 4).

Table 4. Factor loadings

Variable	Eigenvalue	Total variance
TI1 (Var1)	-0,80	-0,13
TI2 (Var2)	-0,82	-0,15
TI3 (Var3)	-0,86	-0,27
TI4 (Var4)	-0,75	-0,33
TI5 (Var5)	-0,31	0,88
TI6 (Var6)	-0,84	0,33
TI7 (Var7)	-0,79	0,12
TI8 (Var8)	-0,90	0,07

Sources: developed by the authors.

Substitute the obtained factor loadings and the selected variances into formula 3 and obtain the values of the weighting factors for each transport infrastructure indicator (Table 5).

Table 5. Weighting factors

TI1	TI2	TI3	TI4	TI5	TI6	TI7	TI8
0,13	0,14	0,14	0,13	0,03	0,14	0,13	0,15

Sources: developed by the authors.

The greatest influence on the integral index of transport infrastructure is exerted by road passenger transport (TI8) (weight coefficient 0.15), the influence of air transport, passengers carried (TI2); container port traffic (Tl3) and connectors, longitudinal workers (Tl6) (weighting factor 0.14) is no less significant. Railways and goods transported (TI5) have the least impact on the integral index among the studied indicators. The obtained values of weight factors should be substituted into formula 4 to determine the transport infrastructure index (TII). There is the integral index for the studied countries as of 2006, 2013, and 2020 (Figure 5).

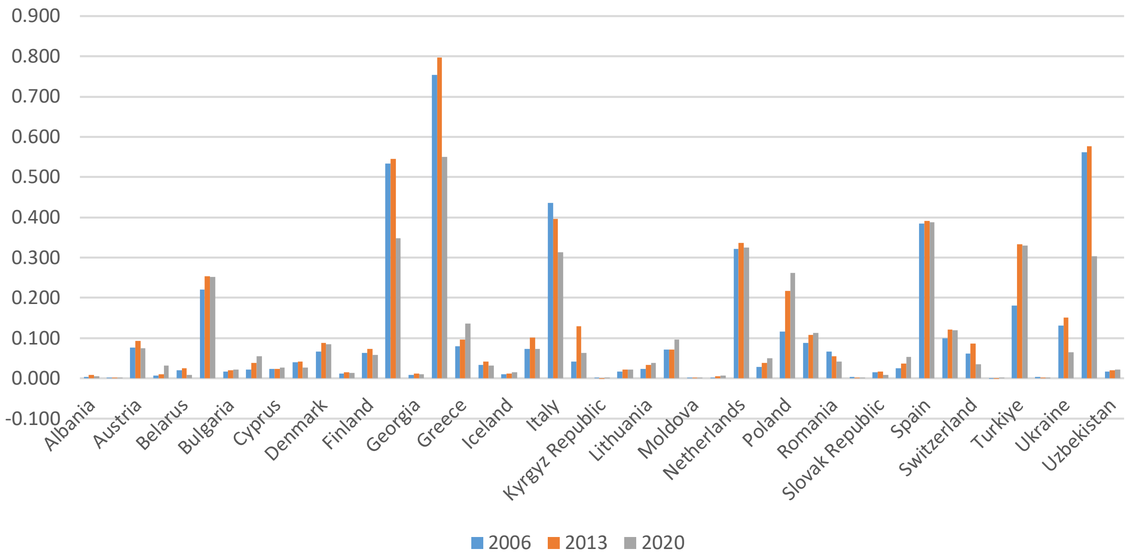

Figure 5. Integral index of transport infrastructure for 45 countries in Europe and Asia as of 2003, 2013 and 2020

Sources: developed by the authors.

The leading countries in terms of transport infrastructure index (TII) values are seven Western European countries (Germany, UK, France, Italy, Spain, Netherlands, Belgium, Poland) and one South-Eastern European country (Turkey). The values of the integral index for these countries have not fallen below 0.2 during the period 2006-2020, except for Poland and Turkey. These countries showed a positive trend in 2013 compared to 2006. Germany is the absolute leader in terms of transport infrastructure development. Its integral index did not fall below 0.5 in 2020. It was above 0.8 in 2013. However, the integral index for Azerbaijan increased from 0.007 to 0.031 from 2006 to 2020. It indicates a modest but positive transformation of its transport infrastructure.

In the second stage of modelling, the countries should be clustered under study. Ward's method will make it possible to estimate the optimal number of clusters to be formed from the 45 countries involved in the study. The clustering process is based on four transport infrastructure indicators, representing each transport mode and having a more important influence in this study, given the value of their factor loadings in Table 4: air transport, passengers carried (TI2), container port traffic (TI3), railways, good transport facilities (TI5) and tourist services (TI8).

Thus, based on hierarchical clustering, three clusters were formed in 2006 and 2013 and two clusters in 2020. The results of k-means clustering allow a more in-depth study of the structure of the selected clusters and conclusions on their homogeneity. Table 6 presents the k-means clustering results.

Table 6. Results of country clustering by the k-means method

Year	Clusters		
2006	**Cluster 1** France, Germany, Italy, Spain, United Kingdom	**Cluster 2** Kazakhstan, Ukraine	**Cluster 3** Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, Georgia, Greece, Hungary, Iceland, Ireland, Kyrgyz Republic, Latvia, Lithuania, Luxembourg, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovak, Republic, Slovenia, Sweden, Switzerland, Tajikistan, Turkmenistan, Turkey, Uzbekistan
2013	**Cluster 1** France, Germany, Italy, Spain, Turkey, United Kingdom	**Cluster 2** Kazakhstan, Ukraine	**Cluster 3** Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, Georgia, Greece, Hungary, Iceland, Ireland, Kyrgyz Republic, Latvia, Lithuania, Luxembourg, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovak, Republic, Slovenia, Sweden, Switzerland, Tajikistan, Turkmenistan, Uzbekistan
2020	**Cluster 1** Belgium, France, Germany, Italy, Netherlands, Spain, United Kingdom	**Cluster 2** Albania, Armenia, Austria, Azerbaijan, Belarus, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, Georgia, Greece, Hungary, Iceland, Ireland, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Luxembourg, Moldova, Montenegro, Norway, Poland, Portugal, Romania, Serbia, Slovak, Republic, Slovenia, Sweden, Switzerland, Tajikistan, Turkmenistan, Turkey, Ukraine, Uzbekistan	

Sources: developed by the authors.

Given the k-means clustering results, countries were grouped into three clusters in 2006 and 2013. In 2020, it was reasonable to regroup the countries into two clusters. This redistribution of countries indicates that in 2020 the differences in transport infrastructure development between middle-income countries in Europe and Asia are becoming less noticeable. In contrast, the leading countries (predominantly European countries with high economic growth) are permanently in the first cluster. It should be noted that only two countries belonged to the second cluster in 2006 and 2013 (Kazakhstan and Ukraine). Azerbaijan, however, was always in the third cluster. Thus, it is appropriate to analyse the average values of the transport infrastructure indicators underlying the clustering (Figure 6).

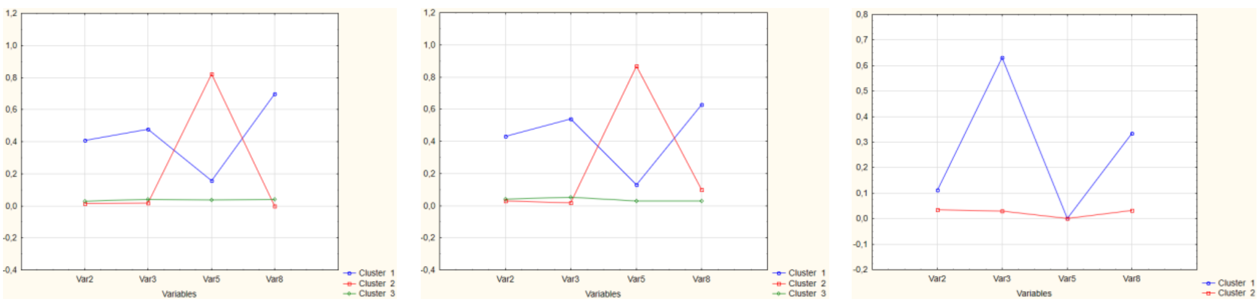

Figure 6. Average values of transport infrastructure indicators that underlie the selected clusters
Sources: developed by the authors.

Figure 6 shows the presence of homogeneity between the selected clusters in 2006 and 2013. The average values of transport infrastructure indicators for the countries in the third cluster are the lowest compared to the first two clusters. However, in 2006, the average value of air transport, passengers carried container port traffic and air transport, passengers carried for the countries of the third cluster was higher than for the countries of the second cluster. At the same time, the average value of the indicator railways and goods transported for the countries belonging to the second cluster is the highest among all the selected clusters. In 2020, the second and third clusters from previous years merged into the second cluster. The average value of transport infrastructure indicators in this cluster is clearly inferior to the corresponding average value in the first cluster.

Conclusions. Following the purpose of the article, which was to confirm the hypothesis about the existence of global logistics clusters united by a common transport infrastructure under the geopolitical and economic features of the regions, a two-stage model was built for forty-five countries in Europe and Asia for the period 2006-2020. In the first stage, an integral transport infrastructure indicator was built using factor analysis. It was found that the list of leading countries by the value of the integral index of transport infrastructure includes seven countries of Western Europe (Germany, Great Britain, France, Italy, Spain, the Netherlands, Belgium, and Poland) and one country of South-Eastern Europe (Turkey). The values of the integral index for these countries during 2006-2020 did not decrease below 0.2, except for Poland and Turkey. It showed positive dynamics of this indicator in 2013 compared to 2006. Germany is the absolute leader in terms of transport infrastructure development. Its integral index during the study period did not fall below 0.5 in 2020 and reached more than 0.8 in 2013. At the same time, the value of the integral index for Azerbaijan increased from 0.007 to 0.031 from 2006 to 2020. It indicates a slight but positive transformation of its transport infrastructure. In the second stage of the study, the clustering of the studied countries was carried out using two clustering methods: the hierarchical clustering method (Ward's method) and the k-means method. The findings showed that the countries changed their position in the selected clusters during the study period because of their transport infrastructure development. Thus, the hypothesis regarding forming global logistics clusters of countries united by common transport infrastructure can be confirmed.

Author Contributions: conceptualization, F. R. and L. N.; methodology, R. A.; software, A. H.; validation, F. R., R. A. and L. N.; formal analysis, A. H.; investigation, F. R.; resources, L. N.; data curation, R. A.; writing-original draft preparation, A. H.; writing-review and editing, F. R.; visualization, L. N.; supervision, F. R.; project administration, R. A.; funding acquisition, A. H.

Conflicts of Interest: Authors declare no conflict of interest.

Data Availability Statement: Not applicable.

Informed Consent Statement: Not applicable.

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Управління індустрією транспорту глобальної логістики: порівняльний аналіз за країнами

Для сучасного суспільства характерний постійний розвиток та вдосконалення транспортної галузі, яка забезпечує якісну та швидку доставку вантажів. Для максимального збільшення експорту готової продукції та більш ефективного проникнення на міжнародні ринки організовуються глобальні логістичні системи. У статті узагальнено аргументи та контраргументи в рамках наукової дискусії щодо місця та перспектив управління транспортною інфраструктурою глобальної логістики. Основною метою дослідження є підтвердження гіпотези про існування глобальних логістичних кластерів, об'єднаних спільною транспортною інфраструктурою відповідно до геополітичних та економічних особливостей регіонів. Вхідні дані дослідження представлено у вигляді десяти індикаторів транспортної інфраструктури. Джерелами даних є Світовий банк та Організація економічного співробітництва та розвитку. Дослідження транспортної інфраструктури глобальної логістики здійснено у наступній логічній послідовності: формування масиву вхідних даних; нормалізація вхідних даних; визначення інтегрального показника рівня розвитку транспортної інфраструктури (метод головних компонент); кластеризація (метод k-середніх) та інтерпретація отриманих результатів. Об'єктом дослідження є 45 країн Європи та Азії за період з 2006 по 2020 роки. Проведене дослідження емпірично підтверджує вищезазначену гіпотезу, про що свідчить визначений інтегральний індекс рівня розвитку транспортної інфраструктури та якісний склад отриманих кластерів. Найбільш вагомий вплив на інтегральний індекс транспортної інфраструктури здійснює показник пасажирських перевезень автомобільним транспортом, на інтегральний індекс авіаційного транспорту – показник перевезень пасажирів, контейнерних портових перевезень, тоді як на інтегральний індекс залізничного транспорту – показник перевезень пасажирів. Загалом, протягом досліджуваного періоду країни групувалися в три та два кластери. Укрупнення кластерів у 2020 році свідчить про те, що транспортна інфраструктура країн із середнім рівнем економічного розвитку почала активно розвиватися. Зокрема, це стосується збільшення попиту на автомобільні перевезення. Результати дослідження можуть бути корисними органам державної влади та міжнародних організацій, які надають послуги з управління транспортною інфраструктурою глобальної логістики.

Ключові слова: транспортна інфраструктура, глобальна логістика, управління транспортною інфраструктурою, транспортна індустрія, міжнародна логістика, інтегральний індекс.