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The “Engineer” publishes the most significant results of scientific and applied research carried out in universities of transport profile, as well as other higher educational institutions, research institutes, and centers of the Republic of Uzbekistan and foreign countries.

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Analysis of the transport sector and ensuring transport safety in the context of globalization

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Abstract: In this work, explores contemporary trends in the development of the transport sector within the framework of globalization, emphasizing its critical role in economic growth and international trade. The study analyzes the current state of railway, road, air, and maritime transport, identifying key challenges associated with transportation safety and the integration of innovative technologies. Particular attention is given to the digitalization and automation of transport processes, including the application of artificial intelligence and intelligent control systems. The research presents data on freight transport dynamics, transport infrastructure development, and the influence of environmental factors on transport policy. The findings underscore the necessity of a comprehensive approach to transport system modernization, incorporating principles of sustainability and technological advancement to enhance safety and operational efficiency.

Keywords: transport sector, globalization, transportation safety, digitalization, innovative technologies, transport infrastructure

1. Introduction

The modern transport sector is an integral part of the global economy, ensuring the efficient movement of goods and passengers. Amid growing volumes of international trade and urbanization, the key challenges include developing transport infrastructure, enhancing its safety and environmental sustainability, and implementing innovative technologies.

The acceleration of interactions across all economic sectors necessitates the continuous development and improvement of the transport sector. Issues related to optimizing operations and effectively coordinating transport systems, including the formalization of automated interaction models among transport process participants, have been examined in the works of authors such as Uwe Clausen, Maike Rotmann [1], G.R. Ibragimova, S.K. Xudayberganov, A.M. Bashirova, Sh.Sh. Kayumov, [2], Muxamedova Z.G. [3], Расулова М.Х. [4], Xuefei Li, Maoxiang Lang [5], Jin Guo, Pei-yan Yun [6], Joon-Young Ko, Jae-Young Park [7], Рахмангулов А.Н. [8], Анохов И.В. [9], Гарлицкий Е.А. [10], Мищенко Н.Г. [11] и других.

The growth of industrial production and international trade necessitates changes in the global transport sector, which itself has become one of the key drivers of globalization [**Ошибка! Источник ссылки не найден.**2].

2. Materials and method

The global railway network was largely established in the early 20th century. Although railway transport accounts for only 9% of the world's freight volume, making it less significant than road transport in this regard, it remains an essential mode of land transportation. A comparison of track lengths and freight volumes by transport type is presented in Figure 1.

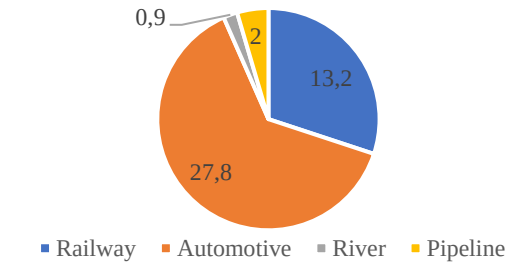

Figure 1. Length of the Global Railway Network, million km, and Share of Freight Transport in the Global Volume

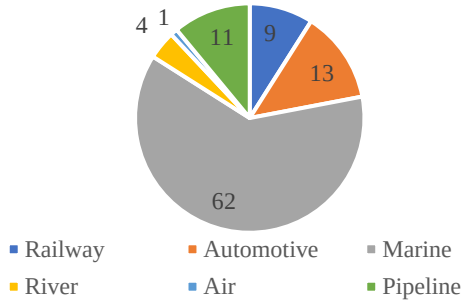

Figure 2. Density of the Railway Network, million km, in "leading" countries

As shown in Figure 1, the total length of the global railway network currently stands at 13.2 million km, with significant disparities in its distribution. Although railways exist in 140 countries worldwide, more than half of the total length is concentrated in the "top ten countries": the United States, Russia, Canada, India, China, Australia, Argentina, France, Germany, and Brazil. In terms of network density, European countries stand out the most (see Figure 2) [13].

Structural processes in the transport sector during the transition to a market economy have a significant impact on

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both the economy and society. Understanding and predicting these changes is essential for making informed decisions in transport policy and infrastructure development.

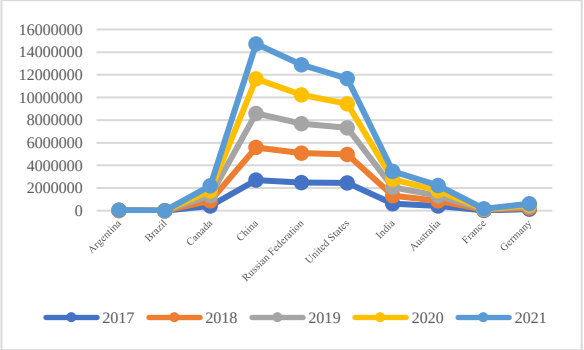

Figure 3. Share of the Global Market Volume in Freight Turnover

To maintain sustainable economic growth, transport systems must undergo continuous modernization. In particular, the introduction of digital technologies such as artificial intelligence and automation enhances transport management efficiency. The development of railway transport, as a key element of freight and passenger transportation, requires substantial investments in rolling stock renewal, track electrification, and the implementation of modern safety systems.

In road transport, the focus is on creating sustainable logistics routes, developing intelligent transport systems, and adopting environmentally friendly fuels. The development of aviation and maritime transport remains a priority, particularly in improving flight and shipping safety.

Mainline railway transport in the country will better meet the national economy's transportation needs if industrial transport operates more efficiently.

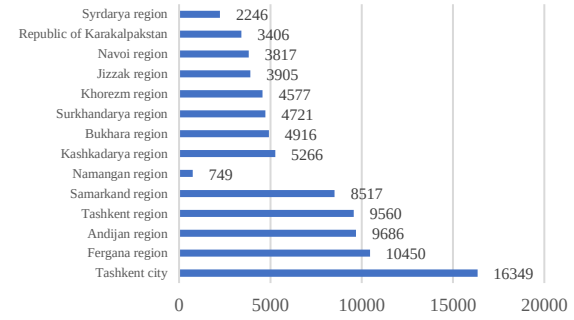

Figure 4. Number of Active Industrial Enterprises by Region of the Republic of Uzbekistan

Recently, industrial transport has been gaining increasing importance in the economic development of the Republic of Uzbekistan, considering the growth of industrial production in the regions. The number of industrial enterprises by region is presented in Figure 4 [14]

As shown in Figure 4, a high concentration of industrial enterprises is observed mainly in Tashkent, the Fergana region, the Andijan region, and the Tashkent region.

The volume of national economic cargo transported by industrial transport is three times greater than that of mainline railway transport, while the volume of loading and unloading operations is six times higher than that of all public transport modes combined. More than 90% of railway freight flow originates at and over 80% is completed at the sidings of industrial and supply-distribution enterprises, organizations, and construction sites.

The initial stage of freight transport is reflected in the indicator “dispatched (shipment) cargo,” while the final stage is indicated by “arrived (arrival) cargo.” In this regard, it is particularly interesting to analyze freight transport and turnover figures for all transport modes in the Republic of Uzbekistan for 2019-2023, as shown in Figure 5.

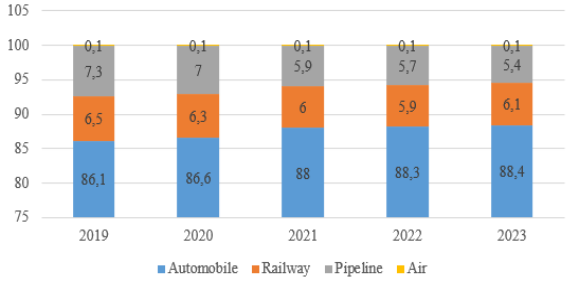

Figure 5. Structure of Freight Transport by Mode of Transport for January-March (in %) for 2019-2023

As seen in Figure 5, from January to March 2023, road transport accounted for a significant portion of total freight transport—88.5%, while other transport modes accounted for 11.5%. For the same period, the total freight turnover share of pipeline transport was 43.6%, railway transport—35.5%, road transport—20.5%, and air transport—0.4%.

The structure of freight turnover by transport mode is illustrated in Figure 6.

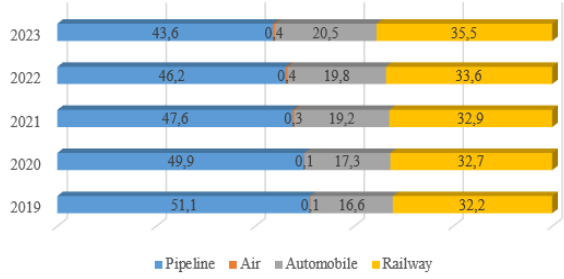

Figure 6. Structure of Freight Turnover by Mode of Transport for January-March (in %) for 2019-2023

As observed in Figure 7, compared to the same period in 2022, changes occurred in the share of certain transport modes within the overall freight transport volume. The share of pipeline transport decreased by 2.6%, while railway transport increased by 1.9%, road transport by 0.7%, and the share of air transport remained unchanged at 0.4%.

Railway transport, as a form of public transport, is part of a unified production-technological complex that includes enterprises, institutions, and organizations of both industrial and social significance. This mode of transport is closely linked to the railway networks of Russia and other countries.

As of January 1, 2022, the total length of railway sidings was 383.6 km, while the operational railway network length of JSC "Uzbekistan Railways" amounted to 7,019.3 km. The locomotive fleet of JSC "Uzbekistan Railways" includes 154 electric locomotives, 111 diesel locomotives, and 199 shunting locomotives, 21 of which are privately leased. These material resources are allocated along the railway sidings of industrial and supply-distribution enterprises, organizations, and construction sites adjacent to railway stations, with 1,350 service contracts in place. Therefore, improving the efficiency and quality of industrial railway transport is of significant economic importance.

The successful operation of industrial railway transport plays a crucial role in the performance of mainline railways. More than 80% of all freight loading and unloading on Uzbekistan Railways takes place at enterprises and organizations.

Despite the steady increase in freight transportation across various transport modes, mainline railway transport remains the dominant mode in the country's freight turnover. Figure 7 illustrates the growth dynamics of freight transported by all transport modes, highlighting railway transport.

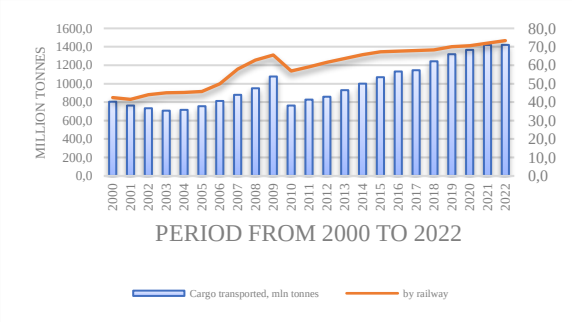

Figure 7. Growth Dynamics of Transported Goods for the Period 2000-2022

Figure 7 demonstrates a significant increase in freight transport across all transport modes, particularly railway transport.

In the first quarter of 2023, the volume of freight transported by railway amounted to 17.9 million tons, reflecting a growth rate of 100.7% compared to the same period in 2022. Freight volumes also increased in 2022 (17.8 million tons, growth rate—101.8%), 2021 (17.5 million tons, growth rate—102.3%), 2020 (17.1 million tons), and January-March 2019 (16.9 million tons, growth rate—101.6%).

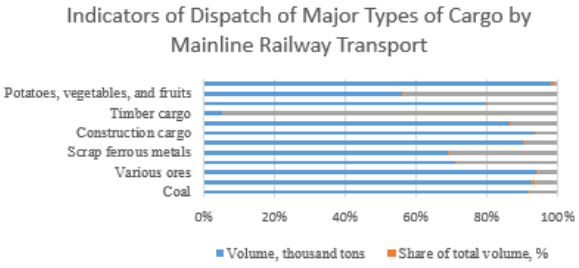

Figure 8. Indicators of Dispatch of Major Types of Cargo by Mainline Railway Transport

The average distance per ton of cargo transported was 329.9 km, exceeding the previous year's level by 1.6%.

In the first quarter of 2023, significant increases were recorded in the volume of railway freight shipments compared to the same period in 2022. The highest growth rates were observed in categories such as various ores (135.4%), forest products (125.9%), and petroleum cargo (113.3%). Conversely, declines were noted in cement (60.4%), potatoes, vegetables, and fruits (68.0%), construction materials (75.9%), chemical fertilizers (77.9%), and ferrous scrap metal (83.1%). The largest shares of total freight shipments by railway were occupied by various ores (12.7%), petroleum cargo (9.0%), construction materials (6.9%), coal (6.6%), chemical and mineral fertilizers (4.3%), and other cargo (52.9%).

3. Conclusion

Based on the analysis of industrial production and transport indicators in the Republic of Uzbekistan, it can be concluded that the railway sector plays a crucial role in the country's economy, highlighting the need for further research into transport infrastructure development, safety enhancement, environmental sustainability, and the integration of innovative technologies.

Transport system security is one of the key factors in its development. To minimize risks in railway transport, automated train control systems and infrastructure monitoring technologies using unmanned aerial vehicles are actively being implemented. Road transport is being improved through the development of intelligent driver assistance systems such as adaptive cruise control, collision avoidance systems, and automatic emergency braking.

In freight transport, safety is ensured through cargo condition monitoring, real-time tracking technologies, and enhanced cybersecurity measures. This is particularly important amid growing international trade volumes, where efficient logistics management helps minimize losses and prevent accidents.

Transport sector development trends indicate increased integration of various transport modes, the creation of multimodal logistics chains, and the expansion of automated and autonomous transport systems. In the long term, the development of high-speed rail and unmanned freight transport systems is expected, significantly reducing transportation time and costs.

Thus, the transport system of the future must ensure not only high-speed and efficient transportation but also maximum safety and environmental sustainability. The development of transport infrastructure, the adoption of advanced technologies, and the strengthening of safety measures will help create a stable and reliable transport network that meets the demands of the modern economy and society.

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