

DIGITALIZATION OF THE TRANSPORT SECTOR AS AN IMPORTANT FACTOR IN IMPROVING FREIGHT TRANSPORT MANAGEMENT AND DEVELOPING LOGISTICS IN THE REPUBLIC OF TAJIKISTAN

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The article examines the digitalization of the transport sector as one of the key factors for improving freight transport management and developing the logistics system in the Republic of Tajikistan. The relevance of the study is determined by the growing volume of freight transportation, increasing demand for modern logistics services, and the need to establish an efficient system for managing transport processes. In the context of the digital economy, the implementation of information and communication technologies, automated management systems, GPS monitoring, Transportation Management Systems (TMS), Warehouse Management Systems (WMS), electronic document management, and digital logistics platforms is becoming increasingly important. The study considers the impact of digitalization on improving the transparency, speed, and efficiency of freight transportation processes, reducing logistics costs, strengthening control over vehicle movements, and ensuring more rational use of available resources. Particular attention is paid to the potential of digital technologies to improve information exchange among participants in transport and logistics processes, integrate individual elements of the supply chain, and create a unified information and logistics environment. Based on the analysis, the main directions for the digital transformation of the transport sector in the Republic of Tajikistan are identified. The study substantiates that the systematic implementation of digital solutions can contribute to improving the quality of transport services, reducing cargo processing time, optimizing transportation routes, increasing the competitiveness of the national transport system, and making more effective use of the country's transit potential. The results may be useful for developing strategic measures aimed at accelerating digital transformation and improving logistics management.

Keywords: digitalization, transport sector, freight transportation, transport management, logistics, digital technologies, TMS, WMS, supply chain, logistics services, transport efficiency, transit potential.

РАҚАМИКУНОНИИ СОҲАИ НАҚЛИЁТ ОМИЛИ МУҲИМИ ТАКМИЛИ ИДОРАКУНИИ ҲАМЛУ НАҚЛ ВА РУШДИ ЛОГИСТИКА ДАР ҶУМҲУРИИ ТОҶИКИСТОН

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Дар мақола масъалаҳои рақамикунонии соҳаи нақлиёт ҳамчун яке аз омилҳои муҳими такмили идоракунии ҳамлу нақли бор ва рушди низоми логистикӣ дар Ҷумҳурии Тоҷикистон мавриди таҳлил қарор дода мешаванд. Муҳимияти тадқиқот ба афзоиши ҳаҷми ҳамлу нақли бор, баланд гардидани талабот ба хизматрасониҳои логистикӣ ва зарурати ташаққули низоми муносири идоракунии нақлиётӣ вобаста мебошад. Дар шароити рушди иқтисоди рақамӣ истифодаи технологияҳои иттилоотӣ коммуникатсионӣ, системаҳои автоматикунонидашудаи идоракунии мониторинги GPS, системаҳои идоракунии нақлиёт (TMS), системаҳои идоракунии анбор (WMS), ҳуҷҷатгузори электронӣ нақлиётӣ ва платформаҳои рақамии логистикӣ аҳамияти махсус пайдо менамояд. Муаллиф таъсири рақамикунониро ба баланд бардоштани шаффофият, суръат ва самаранокии равандҳои ҳамлу нақл, коҳиш додани хароҷоти логистикӣ, беҳтар намудани назорати ҳаракати воситаҳои нақлиёт ва истифодаи самаранокии захираҳои баррасӣ менамояд. Инчунин, имкониятҳои рақамикунонӣ барои ҳамгироии иштирокчиёни занҷири таъминот ва ташаққули занҷири ягонаи иттилоотӣ логистикӣ таҳлил карда мешаванд. Дар асоси натиҷаҳои таҳлил самтҳои асосии рушди рақамикунонии соҳаи нақлиёт ва нақши он дар баланд бардоштани иқтисоди транзитӣ ва рақобатпазирии низоми нақлиёти Ҷумҳурии Тоҷикистон пешниҳод мегарданд.

Калидвожаҳо: рақамикунонӣ, соҳаи нақлиёт, ҳамлу нақли бор, идоракунии нақлиёт, логистика, технологияҳои рақамӣ, TMS, WMS, занҷири таъминот, хизматрасониҳои логистикӣ, самаранокии нақлиёт, иқтисоди транзитӣ.

ЦИФРОВИЗАЦИЯ ТРАНСПОРТНОЙ ОТРАСЛИ, КАК ВАЖНЫЙ ФАКТОР СОВЕРШЕНСТВОВАНИЯ УПРАВЛЕНИЯ ГРУЗОВЫМИ ПЕРЕВОЗКАМИ И РАЗВИТИЯ ЛОГИСТИКИ В РЕСПУБЛИКЕ ТАДЖИКИСТАН

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В статье рассматриваются вопросы цифровизации транспортной отрасли, как одного из важнейших факторов совершенствования управления грузовыми перевозками и развития логистической системы в Республике Таджикистан. Актуальность исследования обусловлена ростом объемов грузовых перевозок, увеличением спроса на современные логистические услуги и необходимостью формирования эффективной системы управления транспортными процессами. В условиях развития цифровой экономики особое значение приобретает внедрение информационно-коммуникационных технологий, автоматизированных систем управления, GPS-мониторинга, транспортных систем управления (TMS), систем управления складскими операциями (WMS), электронного документооборота и цифровых логистических платформ. Автором рассматривается влияние цифровизации на повышение прозрачности, оперативности и эффективности процессов грузовых перевозок, снижение логистических издержек, совершенствование контроля за движением транспортных средств и рациональное использование имеющихся ресурсов. Особое внимание уделяется возможностям цифровых технологий в обеспечении информационного взаимодействия между участниками транспортно-логистического процесса, интеграции отдельных элементов цепи поставок и формировании единого информационно-логистического пространства. На основе проведенного анализа определяются основные направления цифровой трансформации транспортной отрасли Республики Таджикистан. Обосновывается, что последовательное внедрение цифровых решений способствует повышению качества транспортных услуг, сокращению времени обработки грузов, оптимизации маршрутов, повышению конкурентоспособности транспортной системы и более эффективному использованию транзитного потенциала страны.

Ключевые слова: цифровизация, транспортная отрасль, грузовые перевозки, управление перевозками, логистика, цифровые технологии, TMS, WMS, цепь поставок, логистические услуги, эффективность транспорта, транзитный потенциал.

Introduction

The transportation industry is one of the country's key sectors, satisfying consumer demand. Today, it is impossible to imagine the development of any sector without the use of transportation services. Technological progress, economic growth, and consumer demand are among the factors influencing service quality. Digitalization is closely linked to the aforementioned factors and influences the formation and development of transportation services. Therefore, the impact of digitalization on the sector is paramount for improving service quality, ensuring the timely delivery of goods and products, and reducing transportation and logistics costs. Digitalization is a key factor in the sector's progress and has a positive impact on its development. «In the context of globalization and the integration of transport systems, the demand for an increasing number of industrial, construction, and other types of enterprises is growing, thereby contributing to the progressive development of the country's economic and social sectors» [1]. Therefore, in this article, we have included the issue of digitalization as an important discussion point for the formation and development of the sector, improving the quality of transportation services, and developing the country's logistics sector.

In the context of globalization of the transport system, economic development, and technological progress, digitalization is an important way to improve the efficiency of the transport and logistics sector. For the Republic of Tajikistan, a mountainous region where consumer demand is limited by road transport and access to other modes of transport is limited, digitalization of the sector is a key factor in the development of the transport and logistics industry. Requesting and accepting orders, linking production and consumption, and establishing connections between manufacturing enterprises and producers can only be achieved through digitalization, which has a significant impact on the development of the country's logistics sector. Based on statistical indicators and the volume of transport services, freight traffic in the country has been growing in recent years. Specifically, in 2024, it will reach 134.4 million tons by mode of transport, with the majority of freight traffic (over 95%) being carried by road. This indicates that the development of transport infrastructure in the country is at its peak, including the construction of highways, the development of sea routes, consumer demand, and other factors related to the development of freight flows. «Intermodal transportation has become an important instrument for stimulating trade between these continents, as it meets the economic interests of customers through the integration and optimal utilization of the resources and assets offered by each mode of transport» [2].

The digitalization of the country's transport sector is not only the introduction and implementation of information technologies in the country, but also a systemic change in the transport management mechanism. The essence of this issue is expressed in the transition from separate process management to the formation of a single information environment in which information about the vehicle, cargo, route, road conditions, transport documents, terminals and border processes is collected and exchanged in digital form.

The great importance of digitalization is manifested in the fact that more information is entering enterprises and their timely processing must be implemented. For example, there are route selection, cargo and vehicle selection, transport costs and other indicators, the timely implementation of which requires the digitization of sectors. Therefore, the use of digitalization is at the forefront for timely data management. The development of the logistics sector should be carried out in conjunction with digitalization activities. Transport infrastructure, such as terminals, customs points, warehouses, and consumers, which are considered important links in the implementation of logistics services, are closely linked to the field of digitalization.

In this article, the transport and logistics system of the Republic of Tajikistan is considered as the object of research, and the subject of research is the relations, methods and mechanisms of digitalization of transport management and logistics processes.

To achieve this goal, we set the following tasks:

- To study and analyze the current state of the dynamics of freight transportation volumes in the Republic of Tajikistan and identify factors influencing the improvement of freight transportation development.
- to evaluate and determine the role of road transport in freight transportation, as well as the need to implement information technology and digitalization;
- analyze the impact of economic indicators, including production volume, domestic trade, export and import, as well as the number of vehicles, on the formation and growth of freight transportation;
- To determine the impact of digitalization on improving efficiency and cargo transportation management.

Materials and Methods

The study applies a combination of statistical, comparative, trend, correlation and system-analysis methods. Statistical data for 2018–2024 were used to examine changes in freight transportation by mode, the structure of international freight transportation, and the growth of the vehicle fleet. Comparative analysis was applied to identify changes in the shares of road, rail and other modes of transport. Trend analysis was used to assess the dynamics of freight volumes and international cargo flows. Correlation analysis was applied to determine the degree of statistical association between export and import freight indicators; the resulting coefficients are interpreted as measures of association rather than evidence of causality. System analysis was used to examine digitalization as an integrated process involving transport management, logistics, documentation, monitoring and border-crossing procedures. The analysis also considers the institutional development of transport-sector digitalization in Tajikistan and the reported implementation of 30 digitalization modules.

In particular, in 2022, by a decision of the Government of the Republic of Tajikistan, the State Unitary Enterprise “Center for Digitalization of the Transport Sector” was established. According to the Ministry of Transport, 30 digitalization modules have been developed in the sector, some of which have already been put into operation. In this study, these modules are considered as an institutional and technological basis for the digital transformation of transport management and logistics processes.

The above-mentioned areas can affect the development of the transport sector, improving the economy, improving the quality of services, and the development of the logistics sector.

Discussion

The analysis identified several constraints affecting the development of the transport and logistics sector, including limited use of digital technologies, insufficient integration of information systems, relatively high transport and logistics costs, increasing complexity of freight operations, and incomplete digitalization of freight management. These issues indicate areas in which digital tools can improve coordination, information exchange, monitoring and document processing [2-4].

Results

As noted above, one of the main factors and important indicators that affect the implementation of the digitalization of the sector is the construction of highways, the formation of freight and passenger routes, and connections to production centers. In order to overcome the communication deadlock and turn the country into a transit country, the Republic of Tajikistan has been actively implementing the construction of highways to date. According to statistical data, more than 14,307 km of highways have been built and put into operation to date, which indicates that there is a close relationship between producers and consumers in the country, and the volume of transport services is growing. This indicator is a good basis for implementing the digitalization of the sector and contributes to the development of the country's logistics sector [3].

As follows from statistical data, the volume of transportation by modes of transport, including road and rail, has been growing in recent years. The following figure shows the volume of freight transported by mode of transport (Figure 1).

As shown in Figure 1, road transport accounts for the largest share of freight transportation in the Republic of Tajikistan. During the analyzed period, its share remained above 90% of the total freight volume. This dominant position is associated with the country's mountainous terrain, the limited availability of alternative modes of transport in many regions, and the flexibility of road transport for short- and medium-distance deliveries. Figure 2 presents the share of road transport in the total freight volume.

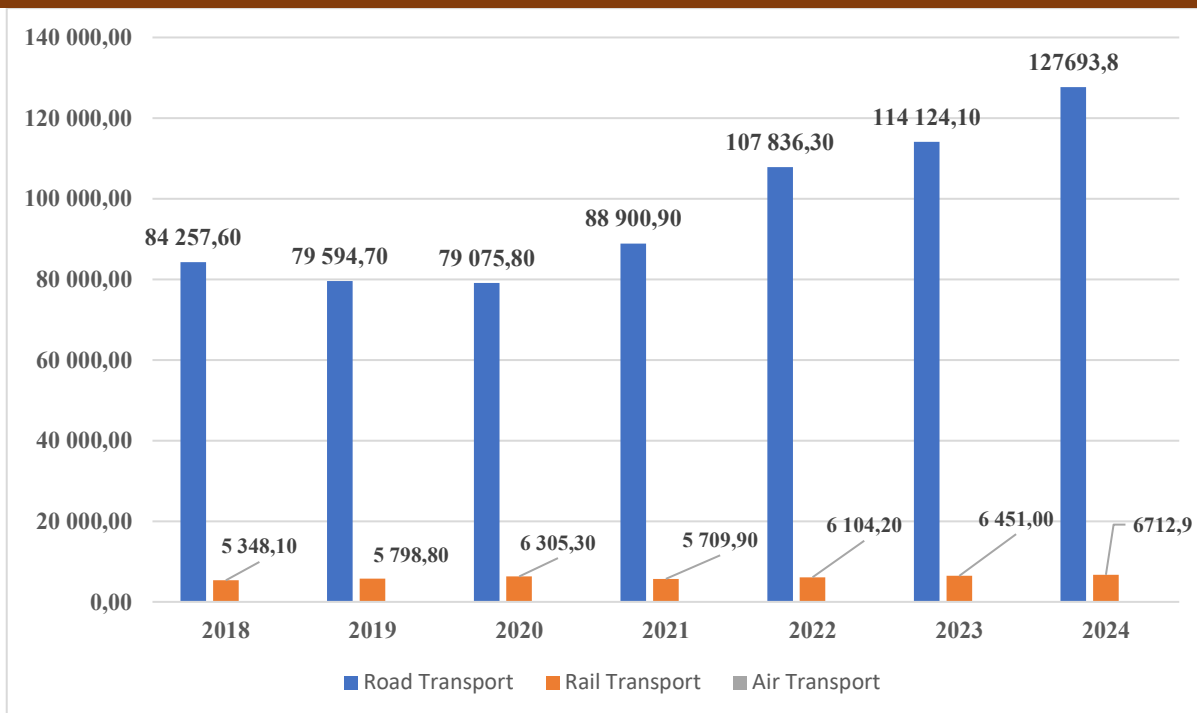


Figure 1 – Freight transportation by all modes of transport 2018-2024

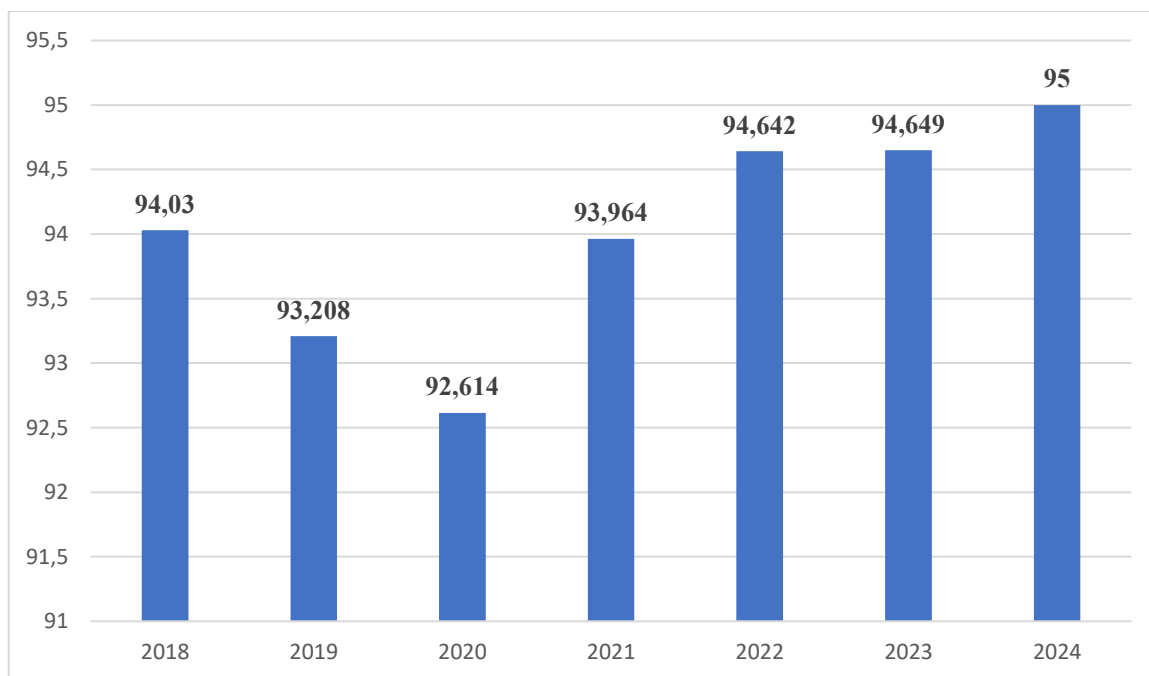


Figure 2 – The share of road transport in the total volume of freight transportation, %

Figure 2 confirms the dominant role of road transport, whose share exceeds 90% of total freight transportation. This structure increases the importance of digital tools for route planning, fleet monitoring, freight documentation and coordination of logistics operations. Road transport also plays a major role in the movement of imported and exported cargo through the country's border-crossing points[8].

Table 1 – Volume of export, import and transit cargo in the Republic of Tajikistan, 2019–2024

Year	Export cargo, thousand tons	Import cargo, thousand tons	Total volume of international freight transportation, thousand tons
2019	3 583,0	18 705,3	22 288,3
2020	3 844,0	21 810,3	25 654,3
2021	4 168,4	23 600,7	27 769,1
2022	4 653,6	26 980,4	31 634,0
2023	5 185,7	31 213,0	36 398,7
2024	5 704,8	34 119,9	39 824,7

The data in Table 1 show that the volume of imported cargo consistently exceeds the volume of exported cargo during 2019–2024. The total volume of international freight transportation increased over the period, although the dynamics varied from year to year. Correlation analysis of the annual export and import series indicates a very strong positive statistical association ($r \approx 0.99995$ for the analyzed export series and $r \approx 0.99752$ for the import-related comparison). These coefficients characterize the synchronization of the observed time series and should not be interpreted as proof that digitalization directly caused the changes in freight volumes. The results instead demonstrate the need for integrated digital management of international freight flows, particularly for information exchange, documentation and monitoring.

Along with freight transportation, passenger transport activity is also expanding in the country and abroad. Electronic requests, documentation, bills of lading and other document operations are important prerequisites for the transition to digital processes. Passenger transport is particularly significant in the regions of the Republic of Tajikistan, including Dushanbe as the country's administrative and economic center. The growing number of freight and passenger vehicles also increases the need for effective fleet management, road-safety monitoring and information technologies. The following table presents statistics on the vehicle fleet in the country.

Table 2– Statistics on the vehicle fleet in the country

Year	Total number of cars	Passenger cars (conventional/electric)	Trucks (conventional/electric)	Buses (regular/electric)	Motorcycles (regular/electric)	Trailers	Semi-trailers
2019	504785	442533 / 0	40853 / 0	15731/113	3249 / 0	2086	333
2020	507361	444905 / 0	40869 / 0	15811/113	3343 / 0	2106	327
2021	527332	463939 / 0	42145 / 0	15515/159	3411 / 145	2002	320
2022	601136	524045 / 0	51781 / 0	16491/138	3726 / 587	4246	847
2023	666074	587074 / 2 417	52362 / 0	16554/210	4071 / 584	5167	846
2024	701231	606296/29 116	53967 / 0	16520/160	19 441 / 5 081	5164	843

As shown in the table, the number of passenger vehicles increased during the analyzed period, reaching 701,231 vehicles in 2024. This figure is expressed in units, not thousands of units. The growth of the vehicle fleet increases the requirements for timely fleet management, road safety and service quality. A modern transport-management system incorporating digital technologies can support these functions through data exchange, monitoring and operational control.

The institutional and technological development of transport-sector digitalization creates opportunities for further improvement of the logistics system. Key areas include digital logistics platforms connecting warehouses, terminals and production sites; intelligent transport monitoring; digitalization of international transport corridors; improved transparency of customs procedures; and electronic transport and travel documents. These directions can strengthen coordination and information exchange across the logistics chain, while their actual effects should be evaluated using operational and economic performance indicators.

Conclusion

The analysis of transport, technical and operational indicators demonstrates the continuing importance of the transport services sector for the economy of the Republic of Tajikistan. Road transport remains the dominant mode of freight transportation, accounting for more than 90% of the total volume

during the analyzed period. The study shows that this structure increases the importance of digital solutions for freight planning, fleet monitoring, electronic documentation, logistics coordination and border-crossing procedures. The analysis of international freight data also indicates a strong statistical association between the dynamics of the analyzed cargo flows; however, correlation alone does not establish causality. The development and implementation of the reported 30 digitalization modules, together with integrated transport-management and logistics information systems, provide an institutional and technological basis for improving the efficiency, transparency and coordination of freight transportation. Further research should assess the economic and operational effects of individual digitalization measures using measurable performance indicators.

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