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Features of development and efficiency of transport logistics infrastructure

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Orientation: This research explores the vital role of transport logistics in the economic development of nations, with a specific focus on the Republic of Kazakhstan. It addresses the urgency of resolving transport logistics issues for the efficient functioning of the transport system, a key indicator of economic development in the modern market context.

Research purpose: The research aims to analyse the unique aspects of transport logistics infrastructure development in Kazakhstan's current system, seeking theoretical insights into optimising efficiency of transportation modes amid the dynamic global economic landscape and ongoing changes in the nation's transport system.

Motivation for the study: Motivated by the essential role a well-functioning transport system plays in economic development, this research seeks innovative solutions to elevate the quality of Kazakhstan's transport system, contributing to its economic growth.

Research design, approach and method: Research analyses global transport logistics development and unique features in Kazakhstan, using systematic analysis to identify optimal improvement opportunities.

Main findings: The study underscores the substantial importance of transport logistics infrastructure to Kazakhstan's economic well-being, emphasising the need for strategic measures to enhance the effective functioning of the transport logistics system.

Practical/managerial implications: The results offer actionable insights for professionals within the transport system of Kazakhstan, guiding them in finding optimal solutions to improve the functionality of the logical transport infrastructure and contributing to the economic advancement of the nation.

Contribution and value-add: This research emphasises the critical role of transport logistics in economic development, providing valuable insights and recommendations for optimising the transport system in Kazakhstan.

Keywords: transport system of the state; transport logistics; transport logical infrastructure; transport of the Republic of Kazakhstan; international transportation.

Introduction

The rapid development of state relations in the late 20th and early 21st centuries have significantly altered international trade principles. As a result, many leading positions in world trade have shifted, particularly to Asian countries, notably China. These economic policies changes have caused unprecedented activity in the transport systems of the states involved in the process of world trade and emergence of trade relations between most of the countries of Central and Soviet Central Asia, which was not previously observed throughout the history of their relations (Shibasaki, Kato & Ducruet 2020). To date, close foreign trade relations have already been established and are successfully functioning between the bulk of the countries of this region. The European Union (EU) and former Soviet republics have prioritised the development of transport logistics infrastructure, which is crucial in the context of this study.

Since 1991, the European Commission has initiated the Technical Assistance to the Commonwealth of Independent States (TACIS) programme aimed at supporting state-building, economic reforms, and attracting foreign investment in the countries of the Commonwealth of Independent States (CIS). This programme also encompassed all five Central Asian republics. Subsequently, a separate regional programme was established for this region for the period 2002–2006, focussing on cooperation in various areas including environmental protection, energy, transport, and others. In 2007, the TACIS programme was replaced by a new programme, the Development Cooperation

Instrument (DCI), which resulted in certain changes in the European-Kazakhstani political interactions. This, generally, boosted the EU's political influence on Kazakhstan.

Organisations that have become platforms for political dialogue between the countries of Central Asia and the EU include the United Nations (UN), OSCE (Organization for Security and Co-operation in Europe (OSCE), Council of Europe (Kazakhstan is an observer in the Council of Europe, while other republics participate in various partnership programmes of this organisation), North Atlantic Treaty Organization (NATO), World Trade Organization (WTO) (Kazakhstan, Kyrgyzstan, and Tajikistan are members of the WTO, while Uzbekistan holds observer status), among others.

The EU's first strategy towards Central Asia was adopted in 2007 as a conceptual document. In June 2019, the EU adopted a new strategy towards the Central Asia region. It focusses on a variety of security issues in the region, such as border control, combating extremist and terrorist activities, as well as tackling drug trafficking. Special attention is given to concluding bilateral agreements on enhanced partnerships and cooperation, aimed at harmonising norms with fewer obligations compared to the European Neighbourhood Policy and the Eastern Partnership. These agreements serve as benchmarks for the region's countries in their cooperation with the EU and are assessed as indicators of the effectiveness of the EU strategy in Central Asia. By signing such agreements, the Central Asian republics express their willingness to adopt and implement EU norms and values, such as democracy, human rights, and sustainable development, recognising the normative power of the EU.

Central Asian countries account for a negligible share of the overall exports and imports of goods and services of the EU, which collectively do not exceed 1%. Kazakhstan is the EU's main trading partner among these countries, accounting for nearly 40% of the total trade in goods and over half of the republic's export market. The EU is also a key investment partner for Kazakhstan. According to the Ministry of Foreign Affairs of Kazakhstan, the total trade turnover between Kazakhstan and the EU amounted to $41.9 billion in 2022. Uzbekistan and Kyrgyzstan rank second and third with a significant gap, while Tajikistan and Turkmenistan have very small trade volumes.

The established relations in the field of transport infrastructure are based on the use of all transport systems of the Asian region, and the most active participation is taken by those states that are most concerned about the implementation of projects for building high-quality transport systems involving the establishment of highly efficient and reliable transport communication channels between the continents. The Republic of Kazakhstan is among such states because it has every opportunity to take a direct part in the processes of information and cargo exchange, which are of paramount importance from the point of view of organising a full-fledged trade exchange between the states of the Asian region and to spread to other territories of Europe and Asia (Sarder 2020). Currently, the European Bank for Reconstruction and Development (EBRD) is implementing 131 projects in Kazakhstan. Over the entire period of cooperation between the EBRD and the Republic of Kazakhstan, 273 projects have been implemented, totalling approximately 2.8bn euros, primarily in the energy, transport, banking, and infrastructure sectors, including at the municipal level. The total volume of investments directed to the Republic amounts to over 8.6bn euros, with the private sector being the recipient of more than half of the financial resources and investments (Project Summary Documents, EBRD projects in Kazakhstan).

During the period between 2022 and 2026, the Eurasian Development Bank (EDB) plans to allocate financing for projects totalling at least $3.8bn. Taking into account the investment multiplier effect from other participants at a ratio of 3:1, the total volume of investments in the development of the Republic of Kazakhstan during this period will exceed $10bn. Eurasian Development Bank investments are projected to grow more than twice as fast (at 10.8% per year) as the gross domestic product (GDP) of the Republic of Kazakhstan (4–4.2% per year) (Country Strategy Eurasian Development Bank for the Republic of Kazakhstan for 2022–2026).

Recent trends in commodity exchange between developed and developing countries have highlighted the need for improved transportation technologies and logistics services. The economic growth of Kazakhstan for the first half of 2022 amounted to 3.4% year-on-year. Significant growth in the first half of 2022 was achieved in the construction, transportation, and communication sectors. An increase in export volumes also made a positive contribution to the GDP dynamics. Since late February 2023, business activity across various sectors of the economy has significantly accelerated, surpassing the expectations of the National Bank. In January-April 2023, goods production went up by 4.8% year on year, while services increased by 4.9%. This trend reflects the sustained implementation of consumer demand and the expansion of investment demand supported by state programmes aimed at economic development. Foreign trade turnover climbed by 40.7% year on year from January-May 2022. Exports increased by 59.1% year on year, while imports increased by 14.3% in nominal terms. The main growth in the export nomenclature came from mineral products, metals, and chemical industry products because of favourable price trends in global commodity markets. The increase in imports was mainly driven by products of the chemical industry, machinery and equipment, as well as foodstuffs. Trade turnover with Eurasian Economic Union (EAEU) member states grew by 4.8% year-on-year. Manufacturers of industrial and other goods rely on carriers for uninterrupted delivery to end consumers. This requires high-quality organisation of the entire cargo transportation process, from cargo formation to delivery route and consumer delivery (Villa, Boile & Theofanis 2020). Building such a chain requires high-quality organisation of the entire cargo transportation process; from the formation of cargo and planning of delivery routes to the final delivery to the consumer at the destination (Luzhanska 2020).

An integrated approach in building the principles of providing services of various kinds, from warehousing, transport and forwarding, to financial, informational and organisational, assumes the presence of a number of competitive advantages for specific carriers over other representatives of the market segment under consideration, which are able to provide a decisive advantage in the formation of transport logistics (Pan et al. 2020). Conceptual framework for the features of the development of a well-built transport logistics infrastructure in modern economic conditions imply the mandatory presence of specific advantages of companies dealing with transportation issues over their competitors, which in general can have a positive impact on the development of the entire sphere of transport and passenger transportation within one state and the entire geographical region (Bolodurina & Mishurova 2019).

The characteristics of a well-developed transportation logistics infrastructure in modern economic conditions provide a clear conceptual basis for the obligatory presence of specific advantages for companies engaged in transportation issues over competitors, which can positively impact the development of the entire sphere of freight and passenger transportation within a single state and the entire geographic region (Izteleuova 2022).

An important feature of the previously cited studies in this direction is the lack of disclosure of the relationship between the peculiarities of the development of transport logical infrastructure within the transport companies of one state and the construction of foreign economic and transport links with other states within the same geographical region and taking into account the prospects for their expansion (Dagdougui et al. 2018). This scientific study assumes a more in-depth study of the concept of building a logical transport infrastructure and its development both within a single country and in the context of interstate interaction in the foreseeable and remote time perspective.

Materials and methods

The methodological approach in this scientific study combines system analysis methods to examine the overall development features of a state's transport logistics infrastructure with analytical research specially focussed on transport logistics development within Kazakhstan's transport system. It aims to identify optimal opportunities to enhance the country's transport system and improve its logistics infrastructure to meet current economic demands nationally and globally. It aims to identify optimal strategies for enhancing Kazakhstan's transport system and aligning its infrastructure with current economic demands, both domestically and internationally. This methodological approach involves analysing various aspects of the transportation system using the principles of system analysis. It is aimed at studying and evaluating the relationships and interactions of different elements of the transport infrastructure, such as roads, railways, ports, airports, transportation hubs, among others, considering their impact on the overall efficiency of the transportation system.

An example of applying this method in Kazakhstan may be associated with the analysis of the development of highways and railways in the country. By applying methods of system analysis, researchers can examine various aspects such as capacity, safety, economic efficiency, and environmental consequences of different development options for transport infrastructure. Based on this analysis, recommendations can be developed for optimising investments in transportation infrastructure to make it more efficient and competitive.

This combination of scientific research methods suggests the potential for a quality study of the declared topics. It considers the features of transport logistics in Kazakhstan and its relationship with transport systems of other Asian countries. This interaction is crucial for coordinating Kazakhstan's logistics services with those of other states.

The research is based on studying publications by both domestic and foreign researchers. It focusses on understanding the development of transport logistics infrastructure, especially in Kazakhstan. This provides insight into the role of transport logistics in the country's transport system amid its current economic situation. In order to facilitate the perception of the information provided and to create the most objective and qualitative picture of scientific research, all the achievements of foreign authors, cited and presented in this scientific work, have been translated into Russian.

This study was carried out in three stages. At the first stage of this research work, a theoretical study of the features of the formation of transport logistics infrastructure was carried out, based on the available publications of foreign researchers of the issues raised in the subject of this work. Furthermore, a systematic study of the general features of the development of the transport logical infrastructure of a single state was carried out at this stage, which makes it possible to form a holistic view of the features of the development of the transport logical infrastructure of the Republic of Kazakhstan, in the context of the interrelation of the main elements of the country's transport logistics.

At the second stage, an analytical study of the features of the development of transport logistics in the transport system of Kazakhstan was conducted in the context of finding optimal opportunities to improve the country's transport system and improve the transport logical infrastructure in order to bring it in line with the requirements of the current economic situation in the country and in the world. In addition, at this stage of the research work, an analytical comparison of the preliminary results obtained during it with the results and conclusions of other researchers of the issues submitted for consideration was carried out, which contributes to the creation of highly objective and qualitative picture of scientific research, taking into account all points of view.

At the final stage of this research work, on the basis of the results obtained during it, final conclusions were formulated, summarising the results of the entire complex of scientific research and acting as a logical reflection of the results obtained in this scientific study.

Ethical considerations

An application for full ethical approval was made to the Research Ethics Review Commission and ethics consent was received on 10 November 2023.

Results and discussion

The standardisation and the logistics principle are fundamental principles in logistics management. The standardisation principle involves using standardised solutions and standards to optimise processes, while the logistics principle aims to ensure the flow of materials and information with minimal costs and maximum efficiency. Examples of applying the standardisation principle in Kazakhstan may include using standardised procedures for handling cargo in ports or organising warehouse operations. This can improve efficiency and reduce the time taken to complete logistical tasks. On the other hand, the logistics principle may manifest in optimising transportation routes or utilising modern information technologies to manage logistical processes. For instance, implementing a cargo tracking system can reduce delivery time and enhance the overall quality of transportation services in Kazakhstan.

Improving local infrastructure is also crucial for enhancing transportation services in Kazakhstan. This may involve constructing and upgrading roads, railways, airports, and ports. Developing local infrastructure will increase the efficiency and attractiveness of transit shipments through Kazakhstan. However, there may be obstacles in implementing these plans, such as financial constraints, difficulties in acquiring land for infrastructure construction, and environmental and social issues. Therefore, to successfully improve transport services, develop infrastructure, and increase transit cargo in Kazakhstan, stakeholders must identify potential obstacles and find ways to compromise on various and different interests.

The study of the specifics of transport logistics infrastructure development in the Republic of Kazakhstan has yielded the following results: the transport logical infrastructure in Kazakhstan is developing in accordance with the realities of the current economic situation in the country and the real needs of the freight and passenger transportation market, which has been formed in the country over the years of independence. At the same time, it should be noticed that the transport system of Kazakhstan includes several main modes of transport that can effectively solve the problems of passenger and cargo transportation and perform important functions in the overall economic system of the whole country (Ali et al. 2021).

To date, the following main types of transport can be distinguished in the Republic of Kazakhstan: railway, automobile, air, water, pipeline. The last of the listed modes of transport is intended exclusively for the transportation of oil and gas, and does not play any role in passenger transportation in the country, as well as in the transportation of other types of cargo. Figure 1 shows a schematic distribution of cargo transportation volumes in the Republic of Kazakhstan by various modes of transport

As can be seen in Figure 1, railway transport in Kazakhstan occupies a leading place in terms of freight traffic because the country's railways provide 68% of the total cargo turnover and about 57% of passenger turnover. Accordingly, the share of road transport in the country accounts for 20% and 17%, respectively, the share of air transport accounts for 8% and 23%, respectively; and the share of water transport accounts for 4% and 3% of the total volume of cargo and passenger traffic in the country, respectively.

The specified percentage ratio largely determines the tasks of the transport logistics system in the country, which are formulated taking into account the specifics of the distribution of passenger and cargo flows on the scale of the transport system of the entire state, taking into account all types of transport used. Figure 2 illustrates the main tasks of building a transport logistics system in the Republic of Kazakhstan (Romanko & Musabekova 2014).

To date, there are two basic principles of organising the process of cargo transportation in the transport system of any state, namely typical and logistic. When using the typical principle of the organisation of transportation, the use of a unified transportation management system is not practised. For this reason, coordination of all issues of information and financial support of the transport process is at a low level (Izteleuova et al. 2021). The logistics way of organising the transportation of goods presupposes

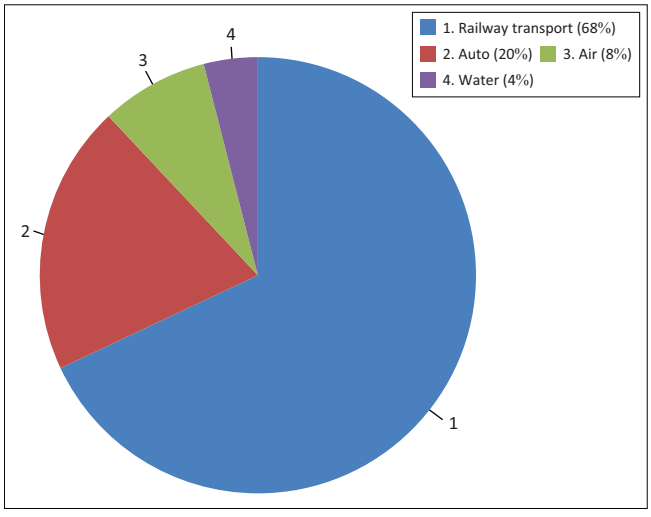


FIGURE 1: The ratio of cargo transportation volumes using various modes of transport in the Republic of Kazakhstan (Average statistical data on all modes of transportation in Kazakhstan for the period 2021–2023.).

the presence of a multimodal transportation operator, the presence of which allows for high-quality planning of the flow of material values with obtaining specific parameters at the output that are of fundamental importance from the point of view of describing the quality of transportation (Ivanova 2015).

Figure 3 shows a scheme for organising transportation using a logistics approach.

When organising mixed-type transportation, there are certain differences between the results of the application of these principles. Such differences are presented in Table 1.

In recent years, Kazakhstan has taken various steps to enhance transportation attractiveness and modernise its transportation system. Examples include, infrastructure development programmes, such as road construction and modernisation; railway upgrades; airport improvements; and port enhancements. One significant project is the construction of the China–Kazakhstan–Europe Corridor, which reduces delivery times between China and Europe and increases Kazakhstan's attractiveness as a transit country. Kazakhstan is also actively implementing modern logistics technologies, such as logistics management and cargo tracking systems. For example, the creation of electronic transport corridors and digital platforms for managing logistics processes helps optimise delivery routes and improve overall system efficiency. Furthermore, Kazakhstan's strategic transportation development plans focus on developing multimodal transportation, improving services for cargo owners and carriers, and creating a favourable investment climate to attract private investments in the transportation sector. All these efforts aim to improve transportation infrastructure, enhance service quality, and increase Kazakhstan's transportation attractiveness for transit freight flows.

With regard to the realities of the transport system of the Republic of Kazakhstan, it is necessary to highlight the main directions of development of the country's transport and logistics infrastructure.

- The formation of high-quality transport services that can fully meet the transport needs in various sectors of the country's economy
- Development of transport and logistics infrastructure of local type in all regions of the Republic of Kazakhstan
- The steady improvement of the quality of freight and passenger transportation within the country and abroad, with the creation of all necessary conditions to maintain the safety of such transportation
- Creation of transport corridors directly on the territory of the country, with their connection to the unified system of international transport
- Gradual increase in the volume of transit traffic through the territory of the country
- Creation of a system for monitoring the targeted use of public funds allocated for the development of the country's transport and logistics infrastructure
- Training of qualified personnel capable of effectively solving the tasks of developing the transport logistics system in the Republic of Kazakhstan.

The consistent implementation of these tasks will contribute to the creation of appropriate conditions for the qualitative development of the transport logistics infrastructure in Kazakhstan and the country's transport system reaching a high level that allows to effectively solve any problems related to the organisation of transportation.

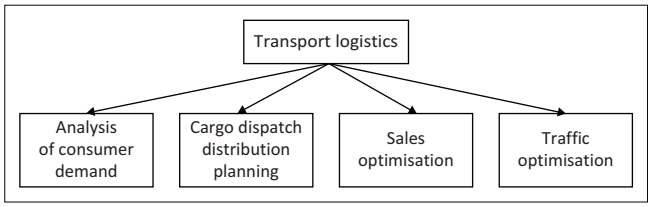
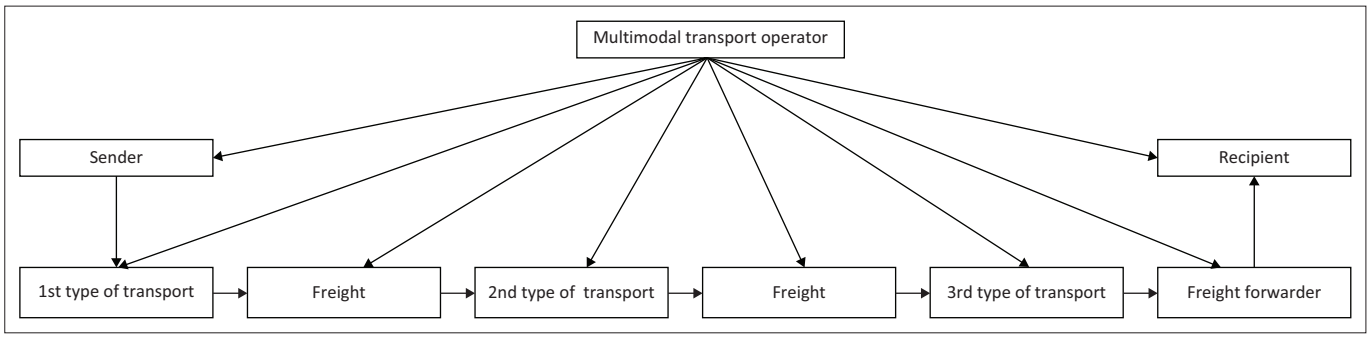


FIGURE 2: The main tasks of the transport logistics system in the Republic of Kazakhstan in the current economic situation in the country.

TABLE 1: Comparative characteristics of the principles of transportation organisation.

Typical principle	Logistics principle
Multiple modes of transport	Multiple modes of transport
Absence of an operator managing the transportation process	Presence of an operator managing the transportation process
No single tariff for transportation	An adopted single tariff for transportation services
No centralised interaction scheme	An adopted unified scheme of centralised interaction



Source: Izteleuova M.S., Arimbekova P.M. & Gritsuk I.O. & Tarandushka L.A., 2021, *Organization and logistics of transportation*, p. 264, OLDIPLUS, Kherson

FIGURE 3: Logistics approach in the organisation of cargo transportation.

To ensure the quality development of transport logistics infrastructure in Kazakhstan, it's essential to create a logistics map of the country. This map enables industrial enterprises to plan their marketing strategies for timely delivery of products to consumers. It also helps to establish a systematic dispatch system considering the needs of all participants in the supply chain, including intermediaries (Raimbekov, Syzdykbayeva & Sharipbekova 2012).

Today, taking into account all the realities of the current economic situation in Kazakhstan and the states bordering it, the transit potential of the country should be regarded as the most important starting point of its economic growth. In this context, it is necessary to steadily increase the transport attractiveness of the Republic of Kazakhstan and consistently form the most modern efficient transport and logistics system among the countries of the former USSR. Improving transport logistics operations across all modes of transport is crucial for the development of the country's logistics infrastructure. This involves offering diverse services with competitive tariffs, enhancing transit corridors for smooth cargo flow, adhering to schedules and cost efficiency. Additionally, optimising conditions and infrastructure for incoming and outgoing cargo flows, including local distribution, are essential for overall development (Giusti et al. 2019). This is far from the final list of tasks that should be solved to maximise the use of the transit potential of the Republic of Kazakhstan. Consistent and effective solution of all the stated tasks means an undeniable advantage of the transport logistics system of Kazakhstan in terms of the emerging development prospects and the possibility of increasing the contribution of the country's transport logistics to the economic development of the state as a whole.

Thus, the prospects for the development of transport logistics infrastructure of any state in general and Kazakhstan in particular have close links with the economic development of the state, the peculiarities of the functioning of its industrial sector, and the financing of industry and transport by the state. Consistent development of transport logistics infrastructure in Kazakhstan will create optimal conditions for industrial and economic growth, as well as have a positive impact on strengthening the country's economy and strengthening its international authority. Ensuring the coordinated work of the transport system with all branches of industry and economy can create all the necessary conditions for economic recovery and increasing the pace of industrial production, which, in turn, is a prerequisite for confident conduct of foreign policy and obtaining the proper level of recognition in the world community.

Today, there is a long overdue real need to create an effective system for ensuring the establishment of economic ties through the formation of high-quality transport links, taking into account the peculiarities of building transport logistics within a single state system. Ensuring sustainable transport links between the states of the Eurasian region is currently the defining task of the transport system of the Republic of Kazakhstan and other Central Asian states that are part of the unified economic system of the Central Asian region. In present market conditions, the product promotion system assumes the mandatory use of transport as an effective means of delivering goods to the final consumer, taking into account all the features of building transport logistics within the transport system of the state. To date, the procedure for the delivery of goods from the manufacturer to the final consumer involves the use of a unified transport logistics system, implying the use of a logistics chain that includes a whole range of operations for the delivery of goods and their storage during transportation (Kuznetsov 2011).

The foreign experience accumulated to date clearly indicates that the most promising direction for the development of the transport system of any state should be considered the satisfaction of the need for the delivery of any product to the end consumer, taking into account all their wishes and in the shortest possible time. The development of transport projects with the expansion of the powers of companies providing transport logistics services should be considered a prerequisite for the formation of the economy of any state, through the formation of a high-quality transport logistics infrastructure and ensuring timely delivery of goods of any type to the final addressees (Gornova & Konysheva 2016).

The real experience accumulated by the enterprises of the United States of America (US) transportation system clearly demonstrates the existence of significant competition between companies that have vertical integration in the field of freight transportation infrastructure and companies whose main field of activity is passenger transportation (Ferrari et al. 2018). Consistent implementation of the latest scientific and technical developments in the field of transport logistics infrastructure contributes to the quality organisation of the transportation process with maximum consideration for the needs of both passengers and cargo owners, as well as their end users concerned about the speedy delivery of goods and passengers to their destination. In recent years, the increase in multimodal transportation volume, along with the coordination of various transport modes, ensures efficient goods movement. This interaction guarantees high-quality functioning of the transport logistics system, facilitating timely delivery to destinations regardless of distance or time constraints (Faulin et al. 2018). In the US, the lowest concentration of service personnel per square kilometre of railway tracks for goods transportation was achieved. This, along with the highest labour productivity in the sections studied, indicates the high efficiency of the transport logistics service. Its primary responsibilities include quality control and ensuring transportation continuity (Faulin et al. 2018).

Multimodal logistics terminal centres play a very important role in the transport logistics system of any state, essentially ensuring the sequence of the stages of development of the transport and logical infrastructure of the country. Such

organisations are responsible for the centralisation of cargo transportation and all work that is directly related to the expansion of cargo turnover and the creation of optimal conditions for the development of the transport logistics system of the state (Zgaya & Hammadi 2016). At the same time, the organisation of a proper process of distribution of cargo turnover within the transport network requires load distribution across the entire transport network, which, in turn, leads to the creation of optimal conditions for the development of the entire transport logical infrastructure system. Such logistics terminal centres should be built in all transport hubs that are significant in terms of traffic volumes, regardless of the types of transport: rail, air, road, river or sea. The removal of such terminal centres directly from the main strategic transportation routes and ensuring their connection with each other and in the general system of freight and passenger transportation is of special importance when choosing the construction site of these centres because their impact on the logistics transport infrastructure largely depends on the geographical location (Teodorovic & Janic 2016). The functioning of such centres is necessary to ensure a qualitative relationship between multiple cargo and passenger flows because in this way large corridors of transport interchanges are formed, which involve the sequential movement of significant volumes of cargo (Wagener 2017). The practical application of terminal logistics centres in the system of international transport logistics ensures the creation of a high-quality communication system for multiple cargo flows and their distribution to the transport infrastructure for various types of transport systems. The use of modern high information technologies in the field of cargo handling and distribution, telecommunications and management, full transparency and multimodality of terminal logistics centres makes it possible to timely determine the most rational and effective options for the interaction of participants in the logistics process in the system of transportation of goods using the basic principles of transport logistics (Chen et al. 2021).

The gradual development of the tendency to complicate the principles of functioning of various branches of the transport services market leads to the gradual integration of transport logistics segments and cargo and passenger transportation processes (Huber, Klauenberg & Thaller 2015). In the current situation, a consistent analysis of the main trends in the development of transport logistics on a global scale reveals the end of the protection period in relation to transport systems and carriers currently in operation (Huber et al. 2015). In addition, there has been a consistent transformation of the concepts of transport carriers, which implies a consistent transformation of the previously existing system of transport routes into a system of centres and hubs for transport management. The modern market of goods and transport services shapes a new infrastructure: transport and logistics. This involves creating multifunctional terminal and logistics centres. These centres establish a centralised system, optimising profitability by shifting from physical transportation to service provision (Huber et al. 2015).

Current market trends influence the development of transport and logistics infrastructure worldwide. This necessitates the creation and growth of specialised transport logistics centres. These centres enhance transport interaction and improve overall efficiency in various countries. Historically, conditions have been formed such that the development of transport logistics is one of the main directions of state policy, a priority in terms of the formation of high-quality conditions for cargo transportation on the scale of a single country. The government performs the tasks of finding investment funds for the qualitative implementation of the tasks of developing the country's transport infrastructure, while every year there is a tendency to increase the planned investment indicators and the actual volume of investment funds invested in the development of the state's transport system (Sagynbayeva 2024). The investment funds allocated at the state level are directed to the development of new schemes for the provision of logistics services, as well as to the creation of coordination centres of transport and logistics infrastructure, the functions of which include direct management of the processes taking place in the country's transport logistics system. At the same time, the control of funds allocated for the development of transport logistics infrastructure should be carried out at the national level because without clear control of funds allocated annually by the state for measures designed to improve the current state of affairs in the transport logistics system, it is difficult to make tangible progress towards creating an effective transport logistics infrastructure (Wang et al. 2020).

Particular importance in the context of creating an effective transport logistics system should be given to the formation of an international logistics infrastructure that could contribute to the creation of international transport corridors passing through the territory of several states at the same time and connecting various modes of transport, whose direct functions include the organisation of cargo transportation in containers (Wagener 2017). Thus, at one time there was a service for the transportation of goods using container ships, with the creation of special terminals in which the direct shipment of the transported products was carried out. The infrastructure of this kind is a system of elements of transport, communication, warehousing. It is also related to the service of the end user, additional processing of transported goods, as well as the provision of a whole range of services, both administrative and commercial, and household. Directly in the transport logistics infrastructure system, its varieties should be distinguished, such as transport, production, warehouse, information, financial and sales (Yavas & Qzkan-Ozen 2020).

Transport logistics terminals are specific components of the described infrastructure, as they are hubs located at the intersection of major traffic flows of international importance. It should also be taken into account that there is a separation of transport infrastructure facilities into three main groups of international, local and regional importance. The first group includes a concentration of complex structures belonging to

the transportation infrastructure, and whose direct functions include servicing exclusively of an international nature. The division of labour organisation principles, combined with the specifics of the state's allocation of investment funds aimed at the development of the entire transport system as a whole, determines the specific functioning of all transport infrastructure groups, manifested over a given time period (Camur et al. 2021).

In general, the transport logistics infrastructure of a particular state is a complex set of interrelated actions and decisions aimed at organising the process of transportation with the least possible losses for the manufacturer of products, as well as for the carrier of goods, while meeting the needs of the end-user in terms of product quality and delivery time to the maximum extent possible. Moreover, the achievement of this compliance becomes possible provided that the actions of all transport services are coordinated, which implies the need to develop and implement a set of measures of the transport logistics system aimed at obtaining optimal results in the context of organising the transportation and improving its efficiency (Kamyabniya et al. 2021).

Special attention in the organisation of transport logistics infrastructure should be paid to setting tariffs for specific transportation services, which in general will contribute to the maximum satisfaction of customer requests and improve the quality of cargo transportation services provided (Naumov et al. 2022). In particular, a similar situation concerns the railway industry of the Republic of Kazakhstan, in which many consumers, dissatisfied with the quality of cargo transportation services provided, were forced to switch to using alternative modes of transport, including automobile and aviation (Naumov et al. 2022). In this context, the gradual increase in the competitiveness of Kazakhstan's railway transport in terms of the ability to withstand competition with other modes of transport intended for the transportation of goods and cargo is one of the priorities of the transport logistics system in the country (Orji et al. 2020; Yermekov & Begaliyev 2018).

Thus, the issues of the development of transport logistics infrastructure on the scale of a single state and geographical region as a whole require systematic resolution in the context of modern economic realities and the requirements put forward today for the quality of cargo transportation using any possible modes of transport. The timeliness of measures to improve the transport logistics system is crucial. In a rapidly changing economy, the quality of transportation depends on timely implementation of improvements. These developments can enhance individual modes of transport and the entire country's transport system (Orji et al. 2020; Yermekov & Begaliyev 2018).

Kazakhstan plays a crucial role in the land transportation corridors linking East (China) and West (Europe). Significant progress has been made in the development of the Central Asian Transport Corridor 'North-South', connecting South Asia (Afghanistan, Pakistan, India) with regions of Europe, Central Asia, the Urals, Siberia, the Far East, and the *Trans-Caspian* International Transport Route (TITR). Amid geopolitical shifts, EAEU countries are reevaluating their external trade and creating new logistics routes. The disruption of traditional logistics chains becomes a key factor in strengthening economic ties, where the role of the 'North-South' and TITR corridors significantly increases. The cargo volume along the 'North-South' corridor exceeded 13 million tonnes in 2021, primarily because of Russian exports through the seaports of Russia and Iran. The demand for transportation is forecasted to reach 30 million tonnes annually. The transportation of Russian goods, including through the Caspian Sea ports and the Astara-Rasht railway section, is expected to continue growing along this route. It is necessary to develop trading hubs near the State border of Kazakhstan with neighbouring countries to redirect exports through Russia and the Black Sea to the Persian Gulf countries.

To increase capacity and delivery speed along the TITR corridor, additional terminal facilities are planned at the Baku seaport and the Alyat terminal (Azerbaijan). They are expected to operate on a 'access to infrastructure in exchange for cargo' basis and provide joint operation with dry cargo berths. Implementing this initiative should increase the port's capacity to 25 million tonnes of cargo per year, including the construction of a universal dry cargo terminal with a capacity of 10 million tonnes per year, container platforms and a grain terminal.

Kazakhstani enterprises are actively integrating into the regional transport and logistics system, investing their resources in developing advanced infrastructure and rolling stock to meet the growing demand for transportation services from neighbouring countries. Kazakhstani companies also plan to establish a modern multimodal transport and logistics centre with a container terminal in Uzbekistan to meet the growing demand for rolling stock and containers in the region. Establishing large modern regional transport and logistics centres in Astana, Shymkent, and Karaganda allows providing comprehensive logistics services using single-window customs service centres. It is projected that the demand for modern international-class warehouse space will reach about 2 million square metres over the next 5 years, with cargo processing and distribution volume reaching 20 million tonnes per year. These measures will strengthen logistics chains and ensure efficient delivery of goods across neighbouring regions. Introducing new technologies in transportation solutions, such as Rail-Air and Less-than-Container Load (LCL) multimodal transport, as well as containerised transport, will optimise the delivery of goods of various values. Kazakhstani companies are already testing the Rail-Air logistics scheme for delivering goods from China to Europe, reducing delivery time and cost. Kazakhstan has the potential to become a key player in the cargo aviation market in the region and in international communications.

Conclusions

This scientific study of the main features of the development of transport logical infrastructure has led to the following conclusions.

The formation of transport logistics infrastructure should take place in strict accordance with real economic trends and is designed to meet the needs of modern society in the field of transportation. Methods of quality control of the functioning of the transport logistics system should be selected in strict accordance with the principles of the development of transport and logical infrastructure, the improvement of which is essential from the point of view of strengthening the economic potential of the country and strengthening its foreign policy.

The specifics of the development of transport logistics infrastructure imply the consistent solution of a number of tasks related to the organisation of transportation both within the country and abroad, as well as the creation of a network of transit corridors within the Republic of Kazakhstan in order to ensure high efficiency of transportation of strategically important goods through the territory of the country. Moreover, the development of the transport infrastructure of a single state presupposes a high-quality organisation of centralised control over the state of the country's transport system, as well as the timely dispatch of goods and their delivery to the final consumer. In addition, the high level of transport and logistics services implies constant improvement of the quality of transportation and its safety, as well as training of personnel capable of solving on a high professional level the issues of timely delivery of goods and passengers to their respective destinations and to ensure uninterrupted and regular transportation both within the country and abroad.

In general, the transport logistics infrastructure of Kazakhstan has significant prospects for effective development, because of the high quality of transport services, as well as the variety of modes of transport used for the transportation of goods and passengers at a given time. In addition, the steady improvement in the efficiency of the functioning of the country's transport logistics system is ensured through the creation of a network of terminal logistics centres designed to ensure high-quality control over the organisation of transport and passenger transportation, in full compliance with the needs of the country's industry and individual sectors of its economy.

Logistics face several key tasks: ensuring the availability and competitiveness of services, eliminating disparities, comprehensive infrastructure development, increasing throughput capacity, creating an integrated network of logistics centres, and providing information support.

The dynamics of economic progress require an evolution of the transportation system capable of efficiently meeting logistical needs. Currently, the industry faces challenges such as infrastructure and technology development, information support, creating a unified information space, improving corridors for transit cargo flows, and establishing optimal conditions and infrastructure for inbound and outbound cargo flows with subsequent distribution to final destinations.

Logistics actively adapts to constantly changing conditions and problems, requiring prompt response and resolution. However, the existing infrastructure of the transportation sector continues to face several issues, including weak integration and synchronisation of key stakeholders, insufficient development of aviation and maritime logistics, and a severe shortage of qualified professionals.

Kazakhstan, without access to the sea, aims for direct access to global markets through the development of efficient transportation and logistics infrastructure. This is crucial for accessing global markets, supporting trade, and stimulating economic growth. Kazakhstan, located in Central Asia and bordered by Russia, China, Uzbekistan, Kyrgyzstan, and Turkmenistan, can greatly benefit from a reliable transport and logistics network. This will facilitate regional integration, streamline cross-border trade, and attract foreign investment.

The difficulties associated with customs procedures lead to delays at the border, increased transportation costs, and reduced competitiveness of Kazakhstani goods. The regulatory framework also proves to be contradictory and requires clarification, creating obstacles for businesses in the country.

Kazakhstan is a participant in several international conventions on the transportation of goods by land, sea, and air, but their implementation and integration into national legislation are not yet complete.

Security remains a problem. Kazakhstan's transportation and logistics industry is vulnerable to security threats such as smuggling, theft, and piracy, which can increase business costs and complicate the attraction of foreign investments.

Attention must also be paid to the shortage of qualified personnel. Educational programmes in universities should be reviewed, platforms for exchanging expertise with Kazakhstani and foreign experts should be established, and the presence of necessary human resources to support the development of the warehouse sector and logistics as a whole should be ensured.

Addressing these issues requires serious reforms, including improving transportation infrastructure, simplifying customs procedures, clarifying the regulatory framework, and developing qualified personnel. A sustainable transportation and logistics system capable of meeting logistical needs at competitive costs is needed today. Logistics must become a key driver of economic development, fostering its growth. Improving the situation requires considering the following recommendations.

It is important to start with conducting comprehensive market research and developing a holistic master plan for the development of the transportation and logistics industry in Kazakhstan. This will require the involvement of all stakeholders and the establishment of a public-private advisory council for open dialogue.

It is also necessary to engage the private sector and attract investments into the logistics market to create a competitive environment. This can be achieved by reducing state monopolies or eliminating competition with the private sector. To attract foreign investors, incentives should be offered for their participation in the development of the transportation and logistics industry.

Providing accessible financing and incentives is a priority. For example, financial institutions can be engaged to provide loans with low interest rates for enterprises in the transportation and logistics sector. Additionally, a public–private partnership can be developed with the involvement of financial instruments and guarantees from both sides, as well as providing targeted grants or subsidies for infrastructure development and the implementation of new technologies in the logistics sector.

It is also important to digitise transportation logistics by implementing advanced IT solutions for data management and optimising communications between stakeholders. A single-window system should also be developed to streamline interactions with tax, law enforcement, and customs authorities.

The preparation of qualified personnel is also a necessary step. Education in the field of international transportation and logistics should be developed, collaboration with international educational institutions and industry experts should be pursued to update educational programmes and requirements. Skills upgrading for existing personnel can be achieved through offline and online training.

It is also necessary to develop and implement an effective regulatory framework and policy. This includes the development of a comprehensive logistics policy, ensuring transparent rules for fair competition, and facilitating public–private partnerships.

Finally, it is important to collaborate with regional and international partners for the exchange of expertise and resources in logistics development. Leveraging its strategic position, Kazakhstan can strengthen relations with neighbouring countries and participate in regional initiatives.

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Authors' contributions

M.I. conceptualised the study and wrote the original draft. P.A. developed the methodology, and was involved in the writing, review and editing. K.M. contributed to formal analysis, data curation, and resources. A.A. was involved in visualisation, validation, and supervision.

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Data availability

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