Prospects of cargo transportation within the borders of the countries of the 1520 Railway Gauge Space

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Abstract. Objective: to assess the importance of cargo transportation for the economy of the 1520 countries. This study confirms the need to expand the capabilities of the railway infrastructure despite the consequences of sanctions restrictions, the uncertainty of the international political situation and the imbalance of trans-Eurasian container transportation in order to achieve economic growth of the national economies of the 1520 countries. Methods: methods of data analysis and diagnostics (observation, analysis, synthesis) of regulatory legal provisions regulating relations within the framework of freight transportation on the railway network, as well as reports of leading railway companies of the 1520 countries - JSC "Russian Railways", JSC "Kazakhstan Temir Zholy", Belarusian Railway are used etc., Russian and foreign forwarding companies, carrier operators, data from the Federal Customs Service of the Russian Federation and foreign customs authorities, statistical and analytical information databases. Results: The characteristic of the main railway systems of the leading countries of the 1520 Space is given, specifying the number of international and domestic container and container-trailer routes. The factors influencing the development of cargo transportation on the territory of Russia along the 1520 gauge are identified, the prospects for cargo transportation are assessed taking into account the current state of the transport and logistics market in Russia. Practical significance: the results obtained are of an applied nature, since they propose and justify a number of measures to ensure the effective development of cargo transportation, taking into account existing infrastructure constraints.

1 Introduction

The unification of states within the 1520 Space (Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Moldova, Mongolia, Russia, Tajikistan, Turkmenistan, Uzbekistan, etc.) creates conditions for synchronizing activities aimed at developing international transport corridors and increasing the share of revenue from railway transportation in GDP of national economies [1]. It should be noted that these states collectively occupy more than 16% of the world's territory, and the length of railway tracks

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conforming to 1520 mm gauge standards is about 18% of the length of the world railway network (about 240 thousand km).

In recent years, there has been a slight negative trend in the main indicators of cargo transportation on the railway network, which is undoubtedly due to the lockdown due to the pandemic crisis, restrictive measures and sanctions against Russia by the world community. Nevertheless, for the countries of the 1520 Space, the decrease in cargo transportation volumes was not so critical (Fig. 1) in comparison with the reduction in passenger transportation volumes (35%) to the level of 2019.

![Graph showing dynamics of cargo transportation indicators on the railway network in the 1520 Space](image)

**Fig. 1.** Dynamics of cargo transportation indicators on the railway network in the 1520 Space

Russian railways occupy leading positions in transportation in the 1520 Space, which is confirmed by data on the volume of cargo transportation – about 60% and cargo turnover - 85% by the beginning of 2022 (Fig. 2-3).

![Pie chart showing leading countries in terms of cargo transportation in the 1520 Space in 2021](image)

**Fig. 2.** The leading countries in terms of cargo transportation in the 1520 Space in 2021.
For most countries, the railway industry is a system-forming economic component, since it provides transportation of products from production sites to points of its processing and sale, as well as expands the possibilities of the transit potential of national transport systems.

2 Materials and methods

The purpose of this study is to assess the importance of cargo transportation for the economy of the 1520 countries. The regulatory and legal provisions regulating relations within the framework of cargo transportation on the railway network are taken as a basis:

- Agreements on international freight traffic, which fixes the form of a unified waybill confirming the conclusion of contracts for international cargo transportation via the railway network [3].

The lack of regulatory and legal consolidation of the definition of multimodal transportation gives us reason to take into account the volume of cargo transportation by containers as the main market indicator.

The research materials were reports of the leading railway companies of the 1520 countries – JSC "Russian Railways", JSC "NC "Kazakhstan Temir Zholy", the Belarusian Railway, etc., Russian and foreign operating companies, carrier operators, data from the Federal Customs Service of Russia and foreign customs authorities, statistical and analytical information bases data.

In the aspect of systems theory, the national transport system belongs to the category of complex systems with all the characteristic features, which determines the application of system analysis methods. In particular, a comparative analysis of the functioning of national freight transportation systems and cargo flows made it possible to form a reference on the main indicators characterizing the state of the main railway systems of the countries of the 1520 region for 2021 in the segment of cargo transportation (Table 1.).

<table>
<thead>
<tr>
<th>Main Features</th>
<th>Russia</th>
<th>Kazakhstan</th>
<th>Belarus</th>
</tr>
</thead>
<tbody>
<tr>
<td>The share of railway transport in the structure of the total cargo turnover of the Russian Federation, %</td>
<td>46</td>
<td>41</td>
<td>36.8</td>
</tr>
<tr>
<td>The length of the public railway infrastructure, thousand km</td>
<td>85.5</td>
<td>16.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Load capacity of the railway infrastructure, million ton-km for 1 km</td>
<td>304</td>
<td>13.9</td>
<td>8.8</td>
</tr>
<tr>
<td>Tariff cargo turnover, billion ton-km</td>
<td>25992.0</td>
<td>223.8</td>
<td>48.4</td>
</tr>
<tr>
<td></td>
<td>2018</td>
<td>2021</td>
<td>2022</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Number of freight cars, thousand cars</td>
<td>1,179.5</td>
<td>132</td>
<td>44.8</td>
</tr>
<tr>
<td>The size of the traction rolling stock fleet, thousand units</td>
<td>19.7</td>
<td>1.8</td>
<td>0.761</td>
</tr>
<tr>
<td>Cargo transportation volumes, million tons</td>
<td>1405</td>
<td>283.9</td>
<td>145.5</td>
</tr>
<tr>
<td>The cost of cargo transportation, rubles per ton</td>
<td>800.5</td>
<td>569.5</td>
<td>569</td>
</tr>
<tr>
<td>Share in cargo turnover of the countries of the Space 1520, %</td>
<td>84</td>
<td>8</td>
<td>1.5</td>
</tr>
<tr>
<td>Share of income from railway transport in GDP, %</td>
<td>1.3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>The size of the average salary of railway transport employees, thousand rubles</td>
<td>58.5</td>
<td>35.5</td>
<td></td>
</tr>
<tr>
<td>The ratio of the average salary of railway transport employees to the national average, %</td>
<td>122</td>
<td>112.5</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 4.** The number of international and domestic container and container-piggyback routes of the countries of the Space is 1520

During the period from 2018 to 2021, there was a positive dynamics of railway container traffic within the borders of the 1520 countries with a pre-property growth of 178% on the route "China-Europe-China". This is explained by the imbalance in the segment of sea cargo transportation due to the pandemic crisis, the shortage of containers in China and the increase in the cost of freight by 2-4 times. The first half of 2022 records a decrease in indicators for the volume of cargo transportation by containers by a total of 9%, which is the result of sanctions restrictions and an uncertain international political situation.

### 3 Results

Result 1. The factors influencing the development of cargo transportation within the territorial borders of Russia along the 1520 gauge have been established

The results of 2016-2021 showed a stable growth of container cargo transportation on the railway network – more than 80% for the entire period. The spring lockdown of 2020, caused by the pandemic crisis [4], was followed by a gradual restoration of container turnover, renovation of logistics chains, an increase in freight rates with an increase in container cargo transportation in domestic traffic of 112%, export - 114%, import 116%, transit - 140%. A special role in this situation is assigned to the transport potential of the Far Eastern region and the Arctic, which is confirmed by the designation of strategic goals for rail freight transit of the North-South and East-West international transport corridor and the launch of the modified logistics service RZD-Logistics and FESCO.

JSC "Russian Railways" is actively increasing the volume of container cargo turnover, compensating for the lost share of revenues that arose in 2020 as a result of the application of preferential tariffs for transit through the territory of the Russian Federation during the
pandemic crisis [5]. Taking into account the challenges of 2022 regarding the escalation of sanctions, we note the change in tariff decisions from the 2nd half of 2022 [6] and the record indexation of railway tariffs for cargo transportation by 11% to the level of 01.01 - 31.05.2022 [7]. Currently, the total increase in the tariff burden in comparison with 2021 is more than 118%. In addition to the above, for the summer period of 2022, privileges for the export of coal were excluded, which led to an increase in the additional tariff burden on shippers by +/- 150%, depending on the distance of the distance and a reduction in the volume of cargo.

Result 2. Measures are proposed to ensure the effective development of cargo transportation via the railway network, taking into account existing infrastructure restrictions.

An additional factor hindering the systemic development and full realization of the potential of multimodal transportation is the limited capacity of the railway infrastructure and logical capacities. At the same time, the transport and logistics market of the 1520 states is characterized by a limited and narrowly focused nature of the use of digital services and intelligent technologies, as well as the presence of customs and legal restrictions, despite interstate unions and agreements. In the current conditions, many countries use bypass routes of Central Asia, which reduces the interest of investors in the development of national transport infrastructure.

For reference, in Russia by the beginning of 2022, the volume of cargo transportation, taking into account all modes of transport, amounted to more than 9 billion tons, while the largest share (98%) in transportation is accounted for by road, rail and pipeline modes of transport. Taking into account the distance in the structure of cargo turnover, the share of automobile transportation is about 6% (up to 500 km), rail and pipeline 48% and 44%, respectively, for transportation over distances of 500 km. At the same time, the insufficient development of inland water transport of the Russian Federation, which accounts for more than 1% of the volume of cargo transportation, hinders the efficiency of mixed container cargo transportation. The reason for this was the lack of the necessary infrastructure and a specialized container fleet - transportation is carried out exclusively by dry cargo vessels with an average number in operation from 35 to 45 years (the useful life according to technical documentation is up to 10 years). As a result, the transportation of goods by containers is mainly represented by the transshipment of products in ports to rail transport, the export of products from the places of extraction/ processing to the main highways of the Northern Sea Route with a specific gravity of less than 1% along the inland waterways of the Russian Federation.

Thus, the problem of limited and uneven infrastructure development, in particular, the lack of access roads to industrial facilities, lack of rolling stock, remains relevant with regard to water and rail transport modes [8]. For example, the facilities of the marine infrastructure of the Arctic basin and the Far Eastern region significantly exceed the capacity of road and rail modes of transport. In particular, the key trunk networks of the Russian Federation – BAM and Transsib – require modernization with an increase in throughput capacity, since the presence of bottlenecks leads to a slowdown in cargo flows in the direction of the Far Eastern Federal District and the Arctic and back. In addition, there is a high need for the creation and modernization of access infrastructure to mining and industrial enterprises, since the volume of port capacities is increasing annually in parallel with the increase in the cargo load of land approaches to them. In Fig. 5 the solutions aimed at the development of multimodal transportation of goods across the territory of the Russian Federation are proposed, which allow combining several types of vehicles within one transportation with a more flexible choice between the cost and speed of cargo delivery in the context of Russia’s territorial capabilities.
The proposed solutions are aimed not only at increasing the volume of transported goods, but also expanding the digital capabilities of the transport industry in terms of creating a logistics platform for a joint integrated transportation process, creating ecosystems of digital transport corridors in the 1520 space [9]. It should be noted that the logistics eco-platform refers to those tools that will make it possible to use the full potential of logistics, such as post-production chain management and network interaction technologies. Within the boundaries of the eco-space, it is proposed to unite individual disparate segments of transportation information systems together, based on the principle of national sovereignty of data, making the transportation process as transparent, efficient and understandable as possible for users of various levels: from cargo owners and cargo carriers to control and supervisory authorities. This will optimize the process of transportation and cargo declaration, minimize barriers and increase competitiveness for bona fide participants in the transportation process, including by determining the most optimal routes and conditions of transportation, using legally significant electronic documents, optimizing the functions of state regulatory authorities and the formation of a unified information environment, including on at the supranational level, which will ensure a significant reduction in administrative and time costs of carriers, an increase in cargo turnover.

Result 3. The prospects of cargo transportation are assessed taking into account the current state of the transport and logistics market of Russia

One of the factors for optimizing cargo flows is the creation of a supporting network of transport and logistics centers (hereinafter referred to as TLCs) operating in the dry ports mode, with the solution of a set of tasks - to reduce the threshold of logistics costs, create conditions for the effective development of the transport and logistics services market, ensure the growth of entrepreneurial activity with the following indexation of positions Russia in the logistics efficiency rating.

The need for the development of transport infrastructure facilities is confirmed by the results of the forecast data of the general scheme for the development of the TLC network [10] to assess the cargo processing potential of the reference network of transport and logistics centers (Fig. 6) and the inclusion of the departmental project "Formation of a network of transport and logistics centers" in the state program "Development of the transport system" in 2021.
The study of the experience of foreign countries has shown that the formation of transport and logistics centers is a significant factor that significantly affects the development of the national transport complex. Thus, by the beginning of 2021, the revenues of the transport industry in the Netherlands are 40% secured by the results of the activities of transport and logistics centers, other European countries - more than 30%. A promising format for the work of transport and logistics centers is a cargo village located between several cities within the borders of the countries of the 1520 space with the integration of in-thermodal infrastructure: airport, railway tracks, port, business parks and social facilities (e.g., "Plaza", Madrid, Spain), which contributes to savings on transport transportation costs, increased mobility due to improved coordination and sorting of goods, and, as a social factor, provides employment by creating additional jobs.

In addition, attention should be paid to the need to increase the volume of piggyback transportation (Fig. 7).

According to JSC "Russian Railways" by September 2022, the fleet of universal and fitting platforms of the Russian Federation has more than 65,000 units, the fleet of piggyback platforms of JSC "FGC" — 102 special piggyback platforms with plans for additional purchase of 100 units of the "well" type. In comparison, more than 100 special terminals have been formed as part of the US transport complex in the presence of 310 thousand piggyback platforms. Despite the instability of global logistics, in 2021 pilot routes between the countries of the 1520 Space were tested, the characteristics of which are shown in Fig. 8.
The positive effects of the development of piggyback transportation for the countries of the 1520 Space can be attributed to the growth of the qualitative component of the transport service: safety (cargo safety), environmental friendliness, mobility of transportation [11, 12]. The multiplicative effect of transportation by trailers depends on the growth of freight volumes and the efficiency of the use of electric traction. However, as of the beginning of 2022, the status of the contrailer has not been determined, since the trailer is a vehicle and a parallel cargo transported on the railway platform. Accordingly, it is necessary to take measures regarding amendments to existing regulatory legal acts to improve customs procedures and determine the status of the transported cargo by a contrailer.

In 2020-22, the Russian freight transportation market has undergone significant changes. The restructuring of sales markets, sanctions, and the departure of global container giants from the Russian Federation led to a decrease in rates and volumes of ocean transportation - from the maximum values of 10-15 thousand dollars per freight of a 40-foot container on the Sino-European route (the level of autumn 2021), the cost decreased to 2.7 thousand dollars [13]. Rail container transportation is less volatile to external conditions, and therefore can act as a duplicate instrument. The main trend remains the transportation of goods from West to East, which is confirmed by data on an increase in the volume of container traffic on the Trans–Caspian International Transport Route up to 14 thousand TEU by the end of 6 months 2022 (an increase of 1.5 times with the same period in 2021), from China in transit through Russia - up to 500 thousand TEU, and so-the same export of goods from Iran to Russia for 2022 by more than 70% [14]. Unfortunately, the current global situation does not make it possible to predict, including for a short-term period, which definitely leads to the use of adaptive mechanisms by container operators and work in an operational mode.

4 Conclusion

The conducted research and the results of 2022 confirm the need to expand the capabilities of the railway infrastructure [15]. In 2023, taking into account the current global situation, the toxic atmosphere around Russia and Belarus, there is a recovery in the dynamics of transit from China to Europe and an increase in volumes by almost 58%, despite the reduction in Chinese subsidies for the export of goods by rail (reduction – up to 10%). In the opposite direction, a policy of containment is still being pursued, which predetermines the imbalance of trans-Eurasian container traffic along the 1520 gauge. All of the above points to the "stress resistance" of most of the routes and justifies the need to provide favorable conditions for increasing the volume of cargo transportation [16] in order to achieve economic growth of the national economies of the 1520 countries.
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