Study of the current state of the transport infrastructure of road and rail transport of the Russian Federation

Petr Kurenkov¹, Oksana Pokrovskaya², Mark Anastasov³, Mikhail Sokolov⁴, Alexander Bochkov⁵

¹Russian University of Transport. RUT – MIIT, Obraztsova, 9, 127994, Moscow, Russia
²Emperor Alexander I St. Petersburg State Transport University (PGUPS), Moskovsky pr., building 9, 190031, St. Petersburg, Russia
³Moscow Automobile and Road Construction State Technical University (MADI), Leningradsky prospect, 64, 125319, Moscow, Russia
⁴Bauman Moscow State Technical University, 2-ya Baumanskaya str., 5, str.1, 105005, Moscow, Russia
⁵Moscow State University of Civil Engineering, Yaroslavskoe shosse, 26, Moscow, 129337, Russia

E-mail: petrkurenkov@mail.ru

Abstract. The transport system plays an important role in the conditions of dynamic development of the national economy, reliability and regularity of transport provision. The unified transport system is a combination of means of communication of conveyances, all types of transport, industrial enterprises, transport organizations, providing transportation of goods and passengers. This article describes the main advantages, disadvantages and specifics of railway transport. Currently, the majority of transport and economic land connections between the countries of Europe and Central, East and Southeast Asia to the territory of the Russian Federation, to its transport system, due to the peculiarities of the geographical position of the Russian Federation. The characteristic of the main Russian shipping companies is given. The main objects of the infrastructure of the railway industry in Russia. The main problems of the functioning of the railway industry of the Russian Federation listed. A comparative assessment of the railway transport network of Russia, USA, China and India is present. A SWOT analysis conducted to assess the strengths and weaknesses of the Russian rail and road transport.

1. Introduction
The transport system of the Russian Federation is characterized by a developed transport network, which includes about 88 thousand km of railways, more than 750 thousand km of paved roads, over 600 thousand km of overhead lines, 70 thousand km of main oil pipelines, over 140 thousand km of gas pipelines, 115 thousand km of river navigation routes [1].

The structure of the transport system of Russia includes all types of main transport: rail, road, river, sea, air and pipeline, as well as some types of special transport (monorail, conveyor, rope-suspension, hydraulic and pneumatic lines, etc.).
The railway industry is the most important link in the transport system of the Russian Federation. The special role of the Russian railways is due to long transportation distances, the remote location of the main agricultural and industrial centers from sea routes, the lack of inland waterways in the East-West direction, etc. In this connection, the share of railway transport accounts for about 45% of the freight turnover (excluding pipelines - 85%) and more than 30% of passenger turnover from all types of transport in the country.

2. Study methodology
The purpose of the publication is to analyze the scientific literature, regulatory framework and the results of scientific research on the development of the transport infrastructure of road and rail transport in the Russian Federation. The study used the following methods: a systematic approach, an integrated approach, strategic analysis, comparative analysis, analysis of official statistics; document analysis method.

The research of the development of transport infrastructure in the Russian Federation is the subject of the work of the following authors: S.S. Goncharenko, P.V. Kurenkov, F.Yu. V.A. Persianov, D.R. Talybov V.F., Yukisha and others.

Recently, there has been an increasing interest in exploring the role of international transport routes. However, at the same time, in the current world of scientific research and analysis models, there is a shortage of a comprehensive, systemic and substantively defined vision of this problem.

3. Assessment and results
The main scope of railway transport is the carriage of passengers and goods in interdistrict (interregional), suburban and intercity communications.

The advantages and technical and economic features of railway transport are as follows:
• high carrying capacity of railways;
• universality of use for transportation of various goods;
• regularity of transportation regardless of the season, time of day or weather;
• low cost of transportation compared to other modes of transport (except pipeline) [2-5].

The disadvantages of rail transport are the following:
• the relatively high cost of construction of railways, as well as a large proportion of fixed costs in the cost of transportation (up to 70%), and this limits the possibilities of a flexible tariff policy [11, 24];
• an insufficiently high level of transport customer service quality;
• failure of the current model of the freight market;
• lack of financing mechanisms for the effective development of the railway infrastructure [6,7,9].

OJSC “Russian Railways” - a holding engaged in freight and passenger transportation, repair activities, maintenance of infrastructure, information support for transportation, etc.

Russian Railways is the main owner of the public infrastructure of the Russian Federation.

In terms of freight traffic, Russian Railways is currently the only carrier, but the Target Market Model envisages the creation of competition “on the route” or “for the route” between private carriers.

Currently, the market for the provision of freight cars for transportation is completely demonopolized. Freight One is the largest operator and is sold to an independent transport company that is part of the international holding Universal Cargo Logistics Holding. Tariff rates for services for the provision of cars for transportation are determine by the companies-operators based on the ratio of supply and demand and are currently withdrawn from the sphere of state regulation [10].

Federal Passenger Company OJSC is the main carrier in the field of long-distance passenger transportation in Russia. Some part of passenger transportation is carry out directly by Russian Railways (transported on the Sakhalin Railroad, as well as transported on Sapsan trains). Currently, there are private carriers on this market that transport passengers in their own train formations [8].

Suburban transportation is carry out by twenty-six suburban passenger companies, mainly belonging to the Russian Railways holding. A difficult process is the transfer of passenger
transportation subsidies from JSC Russian Railways to the regions in which these services are carry out [9].

The main objects and capacities of the Russian railway industry include the following main groups of assets:

- locomotives (about 14 thousand main and 6 thousand shunting);
- rolling stock used to maintain the work of the infrastructure (about 5 thousand units of repair-track and specialized equipment, 34 thousand cars);
- track facilities (access, station, sorting, trunk routes with a total length of main tracks of more than 123 thousand km.);
- station economy (~ 60 sorting, ~ 330 precinct, ~ 720 cargo, ~ 3530 intermediate stations);
- more than 1.2 million freight cars belonging to different owners in the Russian Federation;
- locomotive and car-repair facilities, etc.

It should be noted that over the past 25 years, the length of the railway network of the Russian Federation has almost not changed. Currently, the construction of a number of railway infrastructure facilities is not accompanied by the elimination of low-density lines. At the same time, the load on the railway transport infrastructure has significantly increased due to an increase in laden and empty car traffic flows. In this regard, we note the main problems of the functioning of the railway industry of the Russian Federation [12-14]:

- Physical and moral aging of technical equipment. The average depreciation of fixed assets of the main railway transport is 59%, and in diesel locomotives and freight cars, it is more than 80%.
- Increased filling capacity at a number of critical sites. The length of the bottlenecks in capacity is about 8 thousand km, which is equivalent to 30% of the main cargo-intensive areas of the railway network;
- Weak level of transport provision, as well as lack of transport accessibility of some regions of Russia. For example, in seven regions of the Russian Federation, there are no railways, while a quarter of the railways in the central regions operate in overload mode.
- The lagging of railway equipment and technologies from the level of developed countries of the world due to the low level of investment in the railway sector;
- There is no complexity in coordination and interaction with other modes of transport;
- The possibilities of interaction and coordination of railway transport with domestic engineering, instrument engineering and communication are not fully realized [15-17].

The total length of the world's railways is approximately 1.2 million km. Although the share of the main Russian railways in the length of the world's railways is 7%, however, they carry out 35% of the global passenger traffic. Traffic density on the railways of the Russian Federation is 15 million ton-km / km (average 5-6 million ton-km). Russia ranks second in the length of railways and first in the length of electrified roads (Table 1).

| Country  | Length, thousand km | % electrified lines |
|----------|---------------------|---------------------|
| Russia   | about 87            | about 51            |
| USA      | about 225           | 4                   |
| China    | more than 100       | about 54            |
| India    | about 65.5          | about 32            |

However, in terms of the density of the railway transport network (5 km per 1000 km2 of the country's area), Russia lags behind economically developed countries (99 km in Germany; 23.8 km in the USA; 10.8 km in China) (Figure 1). At the same time, Russian railways carry almost 85% of the country's cargo turnover (excluding pipeline transportation) and about 40% of domestic passenger traffic. In the USA, this ratio is 52/12, in the PRC - 65/35, in Germany - 19/6 (Figure 2).
The significant role of road transport in the market of freight and passenger traffic is due to its advantages, the main of which are:

- maneuverability and mobility, which allows you to quickly concentrate vehicles in the required quantity and in the right place;
- the ability to deliver goods and passengers from door to door;
- high speed delivery over short distances;
- the need for less capital investment compared to rail transport in the development of small passenger traffic at small and medium distances (in the development of large traffic volumes, these investments approach the cost of railway construction) [21-23].

The disadvantages of road transport include the following:

- high cost of transportation for medium and long distances;
- high level of environmental pollution;
- poor traffic safety [28-30].

The management of road transport in Russia is carried out by the Federal Budget Institution “The Agency of Automobile Transport” (Rosavtotrans), as well as the Federal Road Agency (Rosavtodor) located in the structure of the Ministry of Transport of the Russian Federation.
Rosavtotrans ensures the fulfillment of obligations arising from international treaties of the Russian Federation in the field of road transport, and Rosavtotor has the responsibility for the management of state property in the field of road facilities [25,27].

Over the past twenty years, road transport has significantly increased its participation in the transport market, especially in the freight market. However, the historically established sphere of application of road transport in Russia was the transportation of small consignments over short distances [24].

Due to the reconquers of the transportation market from the railway transport, the scope of application of automobile transport is gradually expanding.

The most intensively mentioned process took place in the early 1990s, as well as in 2012 - 2013. after the abolition of centralized transportation planning, when a large number of cargo owners began to leave the railway transport due to the difficulties of working in conditions of a mismatch between the size of the carriage fleet and the infrastructure possibilities [18-20, 26].

The reasons for the accelerated development of road transport are state support measures (in fact, the state provides full funding and development of road infrastructure), as well as a higher level of quality of services provided (cargo safety, transportation speed, door-to-door transport, etc.). Along with this, in recent years, road transport has successfully competed with rail transport and at the price of services provided.

Currently, road transport in the Russian Federation transports about 80% of the volume of transportation of all goods within the state and more than 50% of passenger traffic. For comparison, in many European countries about 90% of all passengers and cargoes are transport by road. For example, in the USA, automobile transport accounts for about 25% of the freight turnover of all types of transport, and in Russia - 5%.

The versatility of road transport is that only this type of transport can perform door-to-door transportation. If the railway transport performs transportation as a main type of transport, then the automobile transport acts as an adjacent mode of transport and participate in transportation as bringing it to or taking out the main transport.

The road sector of the Russian Federation is currently an integral part of the country's integrated transport system. At the end of 2017, the structure and length of the public road network in the Russian Federation is characterized by the following figures: the length of the federal road network is 55,000 km; regional roads - 472,000 km; local roads - 530 000 km. Total - 1 499 000 km [18].

The technical condition of the roads can be characterize by the level of permissible load on the axle of the estimated car, as well as the presence of a hard surface.

Thus, on federal roads, the current load of 11.5 tons per axle corresponds to only 9% of their length, the load of 10 tons / axis corresponds to only 54%, and on regional roads - 30% of the network, on local roads - 0.5%. Insufficient strength of the roadway is destruction on the carriageway, which reduces speed and increases the risk of traffic. Also, out of 2120 out-of-class and large bridges and overpasses on the network of public roads, 30% are in unsatisfactory technical condition.

The rate of change in the length of the network of public roads in Russia over the past 20 years is characterized by a small increase in the length of the network of federal roads, a decrease in the length of the network of regional roads and an attributed increase in the length of the network of local roads (with minimal construction of only access roads to individual rural settlements from 1 to 5 km ).

4. Conclusions

Thus, most of the roads in Russia are a collection of sections of completely different levels of technical development. Thus, any motorway of federal or regional significance is a gradual transition, as it moves away from the starting point, from a higher technical level road to a lower level road, as it approaches the final point, this level gradually increases. The range of such changes is very high - from world-class roads to highways 2 and even 3 "Russian" technical categories. For example, even on federal highways, there are sections with a dirt carriageway.
Table 2. Strengths and weaknesses of rail and road transport.

| Strengths | Weaknesses |
|-----------|------------|
| **Railway transport** | • high carrying capacity of railways; |
| | • universality of use for transportation of various goods; |
| | • regularity of transportation regardless of the season, time of day or weather; |
| | • low cost of transportation compared to other modes of transport (except pipeline). |
| | • the relatively high cost of construction of railways, as well as a large proportion of fixed costs in the cost of transportation (up to 70%), and this limits the possibilities of a flexible tariff policy; |
| | • an insufficiently high level of transport customer service quality; |
| | • failure of the current model of the freight market; |
| | • lack of financing mechanisms for the effective development of the railway infrastructure. |
| **Automobile transport** | • maneuverability and mobility, which allows you to quickly concentrate vehicles in the required quantity and in the right place; |
| | • the ability to deliver goods and passengers from door to door; |
| | • high speed delivery over short distances; |
| | • the need for less capital investment compared to rail transport in the development of small passenger traffic at small and medium distances (in the development of large traffic volumes, these investments approach the cost of railway construction). |
| | • high cost of transportation for medium and long distances; |
| | • high level of environmental pollution; |
| | • poor traffic safety. |

So, the automobile and railway types of transport have their own disadvantages and advantages of use (Table 2). In contrast to the developed countries of the world, the system of automobile transport and road infrastructure of the Russian Federation cannot “look ahead” in the interests of the economic development of the state in terms of the functioning of the logistics of transport bridges.

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