DEVELOPMENT OF RAIL FREIGHT CARRIAGE: GLOBAL TRENDS

Karapetyants, Irina V., *Russian University of Transport, Moscow, Russia.*

ABSTRACT

European experts believe that development of high-speed rail requires upgrading of existing technologies and transport infrastructure, changing organization of traffic, and control and management system. In addition, new standards of safety, environmental friendliness, sustainability, better means of signaling and control are needed. It is believed that the US rail cargo traffic service has made progress through specially allocated tracks and reduced downtime. In Europe, introduction of such projects is still impossible, which leads to long delays in rail cargo delivery. Downtime is due to the fact that priority is given to passenger trains, as well as to violations in operation of signaling systems, inefficiency of loading and unloading of goods. At the same time, organization of services in the sphere of express delivery of goods in Europe is considered as the most important task that will result in reduction of technical and bureaucratic barriers at the national borders, and will help to attract new markets, clients, customers to the railway sector.

Keywords: high-speed cargo traffic, railway transportation, communication control systems, traffic delay, regularity of transportation, speed of delivery of goods, high-speed traffic mode.

Background. *A regular, well-established international rail freight traffic has become one of the main conditions for functioning of the world economy, which will continue to determine the dynamics of development of global transport services. This is due primarily to the general condition, rightly called by some analysts as the Renaissance of railway transport.*

Objective. *The objective of the author is to consider different aspects of freight transportation in Europe, China and the US.*

Methods. *The author uses general scientific methods, comparative analysis, evaluation approach.*

Results.

Top-technologies and megaprojects

On the wave of renaissance the basic concepts of top technologies for railways of 21st century have been formed. Among them there are:

– vacuum superconducting trains;

– string transport systems;

– tubular railway transport;

– monorail system on suspended tracks;

– high-speed traffic using alternative energy sources;

– electric trains equipped wireless charging;

– electric trains of SARTRE system etc. [1].

The basic guidelines of modern research in the field of railway transport have been defined:

– development of intelligent transport systems;

– increase in carrying capacity of rolling stock, modernization of fleet of freight cars;

– creation of compatible digital control systems, navigation and monitoring tools;

– optimization and standardization of requirements for high-speed parameters, increase in reliability, traffic safety;

– development of intermodal network logistics infrastructure;

– improvement of environmental safety and energy efficiency.

Nowadays, the role of international railway freight transport has grown more than ever and as a confirmation of this we can enlist a number of facts:

1. Rapid development of the railway freight transportation market in the world. In the PRC, for example, in 2016 the volume of such shipments reached 2,38 trillion ton-kilometers. At the same time, freight transportation by high-speed railways in 2017 increased by 70 % compared to the previous year [2].

The total freight traffic on the US railways in 2016 amounted to 26,59 million units of cars, containers and trailers [3].

The guidelines for increasing the scale and role of freight rail transportation in comparison with other modes of transport are included in almost all modern national transport strategies. There are countries, for example Switzerland, which at the governmental level require restricting the movement of road freight transport in favor of rail.

2. Active introduction of new technologies.

3. Significant volume of both public and private investments in construction of transport and logistics infrastructure. In the US in 2016, private investors invested 27 billion dollars to support the growth of freight rail transport [4]. China, which is the world's second economy, set the task to connect by 2020 all cities with a population of at least 200000 people to the railway networks [5].

4. A major focus on development of railway networks, routes and corridors on the part of emerging economies, in which up to 70 % of production capacity will be located by 2030, main trade markets and labor resources will be concentrated.

5. Ecological advantages in comparison with other modes of transport, allowing, with intensive urbanization of territories and their modern interregional integration, to define electric rail transport as the most acceptable mode of transportation, allowing to avoid serious damage to the environment. The EU, for example, by moving to a gradual reduction

of the share of road freight and air transportation in its countries, planned to reduce by 2020 greenhouse gas emissions by 20 % [6].

6. Expansion of construction of railways as the basis for ensuring functioning of modern trade routes and corridors, identifying them as the main component of implementation of transport mega-projects (including the «New Silk Road»).

7. Intensive development of research in the direction of unification and standardization of requirements for safety, energy efficiency and reliability of railway transport, improving its speed characteristics and comfort.

8. Improving sustainability of development of a common market for transit freight transportation.

9. Broad diversification of services offered by railway operators.

10. Maintaining a high share of rail transport in the labor market – in ensuring employment and obtaining jobs. In the US, in the railway industry in 2016, more than 125200 workers and employees were employed [7].

11. Annual growth of tax revenues received from transportation of goods by rail to national budgets. In 2014, rail revenue amounted to 3 % of total EU GDP [8].

12. Enhancing the role of rail freight transportation in organization and maintenance of online trade.

Europe is concerned about delays

In Europe rail freight traffic, as everywhere else, becomes the central sphere of economic and political cooperation. Until 2030, it is planned to create nine railway freight corridors [9].

Countries such as Austria and Switzerland are investing heavily in construction of new tunnels and roads Koralm tunnel in Austria, Brenner basistunnel between Austria and Italy, the 57-kilometer Gotthard-Basistunnel / Galleria di base del San Gottardo in Switzerland, etc.) in order to increase the volume of cargo transportation, improve capacity of cargo trans-European corridors, increase their competitiveness, use the possibility of transport intermodality in the transport system, primarily for building links with ports and sea transport.

In Europe, so many cargo goods have never before been transported by rail, despite the fact that it is still behind road transportation. From 1995 to 2013, road freight transportation showed an increase by 33,4 %, and railway transportation of only 4,7 %. Of course, this is the average. In Switzerland, that figure is 33 %, and in Belgium – 15 %. Nevertheless, with a slowdown in economic growth, the overall productivity of freight traffic in the EU countries in 2014 was 411 billion ton-kilometers, about 1,1 % less than in 2013 [10].

That is why the specialists pay special attention to development of high-speed freight trains, the problem of increasing the volumes of rail freight transportation, improvement of organization of international cargo communications, development of optimal logistics schemes, adoption of harmonized information solutions, creation of common communication control systems, installation of more sophisticated signaling facilities and control devices. Central to this are the issues of organization of freight traffic. According to scientists at the Technical University of Denmark, freight trains have to move twice as fast nowadays [11].

Of course, when planning freight traffic routes, one should also take into account the fact that railway stations of many cities and districts need to be expanded and modernized, as they are subject to more intensive exploitation, including for international transportation. Sometimes the share of such transportation reaches 49 %. The quantity and volumes of goods transported should also increase. For example, rail freight transport in the US carries 10 times more cargo than in Europe [12].

One of the reasons for this superiority is availability of tracks owned by railroad freight companies, which provides American trains with an average transportation speed five times faster than European trains can achieve. In addition, the EU countries are increasingly opting for road transportation for shipment of goods, because they consider rail transport as too slow. Container trains in Europe are also much shorter than in the US, and are subject to restrictive regulation of their routes [13]. It should also be pointed out that in the US a third of all goods are transported by rail, and its amount is estimated to increase by 88 percent until 2030 [8].

A serious reason for insufficiently effective operation of an international cargo traffic is the lack of regularity in its circulation, delays en route. According to Markus Hecht, dean of the Faculty of Railway Vehicles of Berlin Technical University, every third freight train in Germany and on European routes faces a delay in transit. On average, it reaches 23 hours [8].

While this is happening, it is unlikely to expect reduction of costs of freight rail transportation. Idle time for freight trains in Germany and some other European countries is due to the fact that priority is given to passenger trains, as well as to problems caused by frequent disturbances in signaling systems, insufficient effectiveness of loading / unloading operations. Therefore, in a number of countries, international maritime transport is preferred, which delivers goods to the nearest port, and then goods are delivered by road vehicles.

The solution of the above problems can be achieved, in particular, by creation of intelligent freight trains with a digital control system that allows to track their movement in real time. In the next 20 years, Deutsche Bahn, for example,

plans to invest EUR 8 billion in upgrading its traffic control, control and signaling systems to strengthen the network's ability to provide fast and reliable movement of goods to markets, the ability to deliver goods on time.

More recently, the increase in efficiency of rail freight transport was associated with creation of a convenient logistics infrastructure along the route. It required huge investments in construction of logistics terminals, large warehouses, influencing thus the level of transportation prices. Today, in order to calculate the optimal time for arranging railway carriage, it is necessary not only to reduce the time of unloading and unloading of goods, to have possibility to process and distribute goods at intermediate warehouses, but to provide regularity and speed of transportation, accuracy of determining the delivery time.

The necessity to perform carriage in accordance with timetable is now considered to be a determining factor for competitiveness and stability of rail transport, which would overcome the problems of fragmentation in its use. According to Henrik Sylvan, the head of the centre of railway technology of Technical University of Denmark, in order to make freight traffic uninterrupted and maximally effective, it is necessary to at least double the number of regular freight voyages.

On the threshold of change?

In fact, we need a revolution that could make routes and timetables for trains, a schedule of deliveries more adaptive, accurate and reliable, and avoid unforeseen expenses and find an optimal length of a freight train. Of course, this requires closer international coordination of infrastructure maintenance, a certain flexibility in organization (cancellation of routes) of train traffic, reduction (improvement) in transit time, standardization of requirements for operation of terminal and intermediate hubs, a more detailed calculation of intermodal capabilities and loads.

With further liberalization of the transport (railway) sector, operators of an open type will increasingly become operators that will be able to service regular freight trains. At the same time, it is necessary to consolidate the efforts of many actors, to provide a different level of interregional interaction, so that this scheme really does work. It is necessary to facilitate access to the terminals, primarily to the port terminals, and to the crossing loops. Often it is difficult for a freight train to get to a terminal or an intermediate hub in time, because due to competition of operators and monopoly ambitions of terminal owners, unforeseeable downtime of trains and unplanned financial expenses in the form of additional fees arise.

Within the framework of the EU, where we can see growing integration of national markets harmonization of legislative norms governing development of a freight rail transport sector, transfer into electronic form of accompanying documentation, a project of transition to implementation of freight traffic control of freight scheduled can be implemented. Moreover, there is already a lot of practical knowledge about potential problems and costs that arise in the process of organization of freight transportation, and there is a conviction that introduction of a scheduled freight trains will lead to an increase in density and regularity of the flows of low-cost, well-loaded trains operating on a reliable scheme, will save a significant amount of energy resources, increase the overall environmental parameters, will contribute to development of industry and trade.

The established regime of regular rapid cargo traffic will undoubtedly have a beneficial effect on reducing the cost of the goods delivered. Of course, another type of logistics will be needed, since its role is to optimize the entire delivery process, and its costs now range from 20 % to 50 % of the total cost of shipping the goods [14]. Another approach should be focused on scheduling and reaching an agreement with all participants in the supply chain, on economic and time calculations, on determining the best mode of transportation, speed of movement, processing of goods at terminals.

The terminals themselves, first of all port facilities, will have to be distinguished by new features. E.g. port terminals should be supported by a number of internal terminals connected by a high-capacity corridor, because they have to adapt to changing load in terms of accepting trains, cargo handling, etc. Logistics takes full responsibility for information, reflecting the management features of real physical cargo flows and development of a unified network of interaction between manufacturers, distributors, carriers and end-users. This involves synchronizing threads, nodes, and networks.

Such proposals or ideas of reforming of international freight traffic are among possible ways to solve the problem of the still insufficient inclusion of rail transportation in meeting the requirements of the world commodity market. In any case, all modern documents reflecting in one way or another the EU transport strategy contain provisions on importance of development of freight rail transportation, acceleration of train traffic, reduction of time for processing cargo, and the risks associated with downtime.

The representative of the French SNCF operator Pierre Blayau said in an interview that they conducted experiments with launching of freight trains at fixed time on certain sections, and innovation promises a certain economic effect [15]. At the same time, in order to introduce this system, according to P. Blayau in Europe it is necessary to create a special freight network for railway trains. In particular, trains might consist of different wagons, convenient for quick

unloading and loading with carrying capacity up to 68 tons. Primarily container-type gondola cars, platform cars, open cars (with a tightly closed bottom and a hatch) will be needed.

And this is only a part of discussed steps towards expected reforms. The volume of changes is deemed to be undoubtedly more considerable.

Conclusions.

1. Development of rail transport is an essential factor in globalization of the world economy and in functioning of the international market of goods and services. Its advantages include environmental friendliness, sustainability, energy efficiency, ability to increase the volume of transportation of goods, expansion of intraregional and international intermodal transportation, a long-established, largely consolidated legislative framework that regulates and harmonizes the requirements for operation of railways.

2. The railway transport sector has become an important segment of investments and innovative developments, the main of which provide:

– increase in productivity, energy efficiency, safety, environmental sustainability;

– designing and creating impact-resistant road structures using composite materials;

– modeling and analysis of transport flows using intelligent control systems, modern means of navigation and signaling;

– creation of smart, «green» railway transport, infrastructure and logistics facilities, etc.

3. Development of rail transportation helps to identify systemic problems, related to inability to fully meet global challenges that characterize the modern freight transportation market; imperfection of organization and logistics of freight traffic (idle time, inflexible transportation schedule, absence of allocated tracks, etc.); weak interaction of manufacturers, distributors, carriers and end-users in synchronization of flows, nodes and networks.

4. Possible solutions of existing problems and innovative approaches to organization of rail freight services include:

– development of rapid freight railway traffic;

– launch of regular freight railway traffic;

– introduction of new logistics approaches, consistent with modern technologies and methods of traffic organization.

REFERENCES

1. Radical railways: Top 10 transportation systems of the future [Electronic resource]: http://newatlas.com/future-transport/22959/. Last accessed 09.11.2017.

2. China sees continued growth in rail freight [Electronic resource]: https://www.railfreight.com/business/2017/08/18/china-sees-continued-growth-in-rail-freight/. Last accessed 09.11.2017.

3. The total freight traffic on the US railways in 2016 was reduced by 5% to 26,6 million units of cars [*Sovokupniy gruzovoi trafik na zheleznyh dorogah SShA v 2016 godu sokratilsya na 5% do 26,6 mln edinits vagonov*]. [Electronic resource]: http://www.gudok.ru/news/? ID=1361808. Last accessed 09.11.2017.

4. US Railways [*Zheleznie dorogi SShaA*]. [Electronic resource]: http://www.webeconomy.ru/index.php?newsid=1773&page=cat&type=news. Last accessed 09.11.2017.

5. The length of high-speed railways in China will double by 2025 [*Protyazhennost skorostnyh zheleznyh dorog v Kitae udvoitsya k 2025 godu*]. [Electronic resource]: http://www.interfax.ru/business/519640. Last accessed 09.11.2017.

6. Greenhouse gas emission statistics – emission inventories – Statistics Explained [Electronic resource]: http://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics. Last accessed 09.11.2017.

7. May 2017 National Occupational Employment and Wage Estimates [Electronic resource]: https://www.bls.gov/oes/current/oes_nat.htm#53–0000. Last accessed 09.11.2017.

8. Returning to the rails. Technologist No. 9, 2016 [Electronic resource]: http://www.technologist.eu/returning-to-the-rails/. Last accessed 09.11.2017.

9. Core Network Corridors Progress Report of the European Coordinators [Electronic resource]: https://ec.europa.eu/transport/sites/transport/files/infrastructure/tentec/tentec-portal/site/brochures_images/CorridorsProgrReport_version1_2014.pdf. Last accessed 09.11.2017.

10. Railway freight transport statistics [Electronic resource]: http://ec.europa.eu/eurostat/statistics-explained/index.php/Railway_freight_transport_statistics. Last accessed 09.11.2017.

11. Landex, A. Methods to estimate railway capacity and passenger delays. Ph.D. thesis. November 2008 [Electronic resource]: http://www.transport.dtu.dk/~/media/Institutter/Transport/forskning/publikationer/2008/rap5_2008_phd_thesis_al_hjemmeside.ashx. Last accessed 09.11.2017.

12. High-speed railroading. The Economist [Electronic resource]: https://www.economist.com/node/16636101. Last accessed 09.11.2017.

13. European rail operators losing containerized freight to road transport [Electronic resource]: https://www.joc.com/rail-intermodal/international-rail/europe/european-rail-operators-losing-containerized-freight-road-transport_20160701.html. Last accessed 09.11.2017.

14. Logistics and Freight Distribution [Electronic resource]: https://transportgeography.org/?page_id=3928. Last accessed 09.11.2017.

15. Blayau, P. La «La SNCF doit sortir des normes du passé [Electronic resource]: http://www.lefigaro.fr/societes/2009/06/25/04015–20090625ARTFIG00338-pierre-blayau-la-sncf-doit-sortir-des-normes-du-passe-.php. Last accessed 09.11.2017.

Information about the author:
Karapetyants, Irina V. – D.Sc. (History), professor, director of the Institute of International Transport Communications, vice-rector for international educational programs of Russian University of Transport, Moscow, Russia, karapetyants.imo.miit@gmail.com.

Article received 09.11.2017, revised 25.02.2018, accepted 11.04.2018.