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Rail Transport Corridors of the Organisation for Co-operation of Railways

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Summary
International transport corridors are part of the global transport system and are an important part of the activities of the Organisation for Co-operation of Railways[2]. The development activities in the Eurasian space are aimed at modernising and developing rail transport by upgrading the technical and operational parameters of the corridors in order to improve the competitiveness of railways in freight transport in Asia and Europe. These corridors are widely used to plan and organise the routing of container trains in international traffic between the OSJD member states. Today, nearly 300 container trains are in continuous operation. The aim of the article is to present the activities to date in the development of corridors, their role and importance in rail transport in the area of the member states of the Organisation for Co-operation of Railways. The article presents issues related to the development and freight transport on 13 international rail transport corridors from the Eurasian railway area. New corridor solutions were highlighted, as well as the New Silk Road[3] which is part of China's broader so-called One Belt, One Road Initiative concept. It is a global infrastructure plan developed in China and implemented in more than 100 countries, mainly in countries referred to as emerging markets.

Keywords: international transport corridor, rail transport corridor, indicators for transport corridors, New Silk Road

1. Introduction

Transport corridors are today a permanent feature of transport policy and are an important part of the global transport network. A transport corridor is a transport infrastructure of international importance, along which different transport routes (e.g. motorways and railway lines with appropriate operational parameters) run. It also features transport hubs (e.g. logistics centres, intermodal terminals and seaports) [4]. From the point of view of the activities of the Organisation for Co-operation of Railways (OSJD), international corridors are of importance. An international corridor should be understood as a part of the national or international transport system which ensures the transfer of significant traffic flows of people and goods between geographical regions and covers infrastructure facilities and means of transport of all transport branches occurring in a given corridor, as well as all technological, organisational and legal conditions of the implementation of these services [11][4]. This is confirmed by the development of transport corridors between Asia and Europe and the interest in using the corridors by many international organisations and countries, e.g. China and Poland [6, 7]. The Chinese plans, highlighting the importance of the OSJD in corridor development and freight using corridors [3] are shown in Figure 1.

2. Premises for establishment of the OSJD rail transport corridors

Rail traffic between the OSJD member states is characterised by long routes (from 5,000 to 10,000 km and more) with double track gauge changes in one-way traffic (1435 mm – 1520 mm – 1435 mm) and

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[2] OSJD – the Organisation for Co-operation of Railways, headquartered in Warsaw, founded in 1956 in Bulgaria, associates 27 member states from Europe and Asia. The organisation's strategic objective is to develop international rail transport.
[3] The concept of the New Silk Road – a land and sea route, was presented by PRC President Xi Jinping in autumn 2013. It envisaged the creation of a network of infrastructure links, mainly transport corridors, between the PRC and Europe – China's key economic partner.
[4] Multimodal transport is freight transport by at least two different modes of transport.

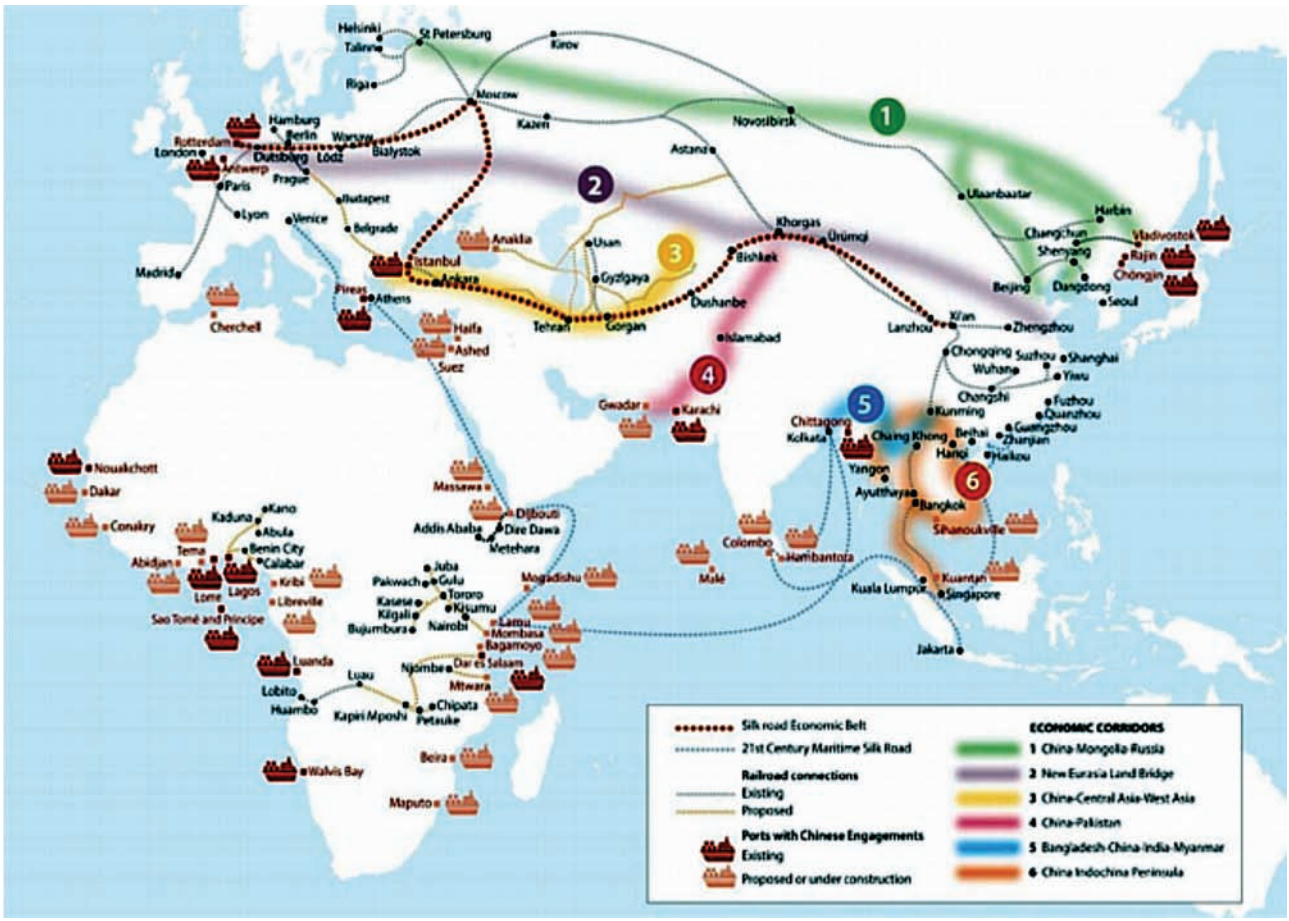

Fig. 1. The Chinese initiative [13]

many border crossings along the way. In addition, the organisation of transport on routes between Europe and Asia is governed by rules and regulations that differ to a certain extent from those in force in Western Europe[5]. The main focus of the organisation's activity is the development and improvement of international rail transport, primarily in transport between Europe and Asia, including combined transport [8].

Within the framework of the OSJD activity, a number of measures have been implemented to develop a document titled "The OSJD transport corridors and their parameters", which is an element integrating the railway system from the Eurasian space with the system of the pan-European corridors. Experts from all OSJD member states participated in the work. The pan-European transport corridor materials adopted in Crete, Helsinki and St. Petersburg, materials on the TRACECA[6] corridor and the Asian-Asian railway network developed by UNESCAP[7] were used during the development of the diagram of the main railway lines (corridors).

When developing seven rail transport corridors, the concept of a rail transport corridor was used as a group of land railways and rail-water crossings with modern technical facilities, aimed at concentrating international transit traffic with the shortest delivery times for goods and passengers as well as high operational and economic indicators [8]. The corridors were divided into three categories:

- corridors of latitudinal direction (east-west),
- corridors of meridional direction (north-south),
- corridors occupying an intermediate position between those of latitudinal and meridional direction.

[5] The Agreement on International Goods Transport by Rail (SMGS).

[6] TRACECA is an international transport programme involving the European Union and 12 member states of Eastern Europe, Caucasus and Central Asia. The programme aims to strengthen economic relations, trade and transport in the Black Sea Basin, South Caucasus and Central Asia.

[7] United Nations Economic and Social Commission for Asia and Pacific. It is one of the five regional commissions under United Nations Economic and Social Commission.

The basic requirements for corridors include [1]:

- the corridor should follow the main route of the railway line along which there is or will be a large volume of international freight and passenger traffic,
- the corridors must meet international technical parameters or be upgraded in accordance with the requirements of the European Agreement on Main International Railway Lines (AGC),
- the corridor should cross the territory of several countries,
- the corridor route should be as short as possible between the freight pipeline centres and their final collection centres.

Currently, there are 13 transport corridors in the Eurasian space within the OSJD. Geographically, they cover almost all member states of the OSJD from west to east and from north to south (Figure 2). Between 1996 and 2001, during the course of the work, the Organisation for Co-operation of Railways analysed the geographical, technical and operational parameters of 13 corridors and collected and analysed data on infrastructure and border crossings, as well as examining improvements in freight transport technology. The result of this work was the development of comprehensive measures to improve the organisation of international rail transport along transport corridors between Europe and Asia.

The countries concerned signed a Memorandum[8] on cooperation and corridor development. It has become the basis for coordinated action by countries to reorganise and to upgrade their relevant railway lines. The main objectives of the activities under the Memorandum included:

- cooperation in monitoring the freight pipeline and in implementing comprehensive measures to improve the traffic flow and the development of the corridor;
- exchanging information on the condition of the infrastructure in the rail corridor and seeking coordinated action to develop it;
- the application of mutually advantageous and economically competitive tariff conditions to support the implementation of combined and multimodal freight transport along the corridor.

3. Core analytical indicators for transport corridors in 2019

The organisation and development of rail transport along the OSJD corridors significantly facilitate border crossings both from a technical, legal and administrative point of view, thereby significantly reducing train stopping times at borders and, as a result, overall journey times. Attention should also be paid to

Fig. 2. The OSJD transport corridors [7]

[8] The Memorandum on cooperation in the development of 13 Eurasian railway corridors was signed in June 2013 by OSJD member states.

the continuous investment projects aimed at upgrading the technical condition of the corridors, including the restoration of the original operating parameters, general improvement of the technical condition of the railway structure and upgrading the connections to adapt the corridor sections to the required speed.

Documentation was prepared for each corridor detailing its operational parameters, border crossings, capacity, needs and plans for further development. To this end, a "Memorandum of Cooperation on Technical, Operational and Commercial Development of the OSJD Railway Corridor" has been signed for each corridor, which obliges its participants to provide appropriate conditions for the maintenance and development of the specific corridor. Corridors are characterised by different parameters and the operational work performed on them. The basic parameters characterising the individual corridors are presented in the analytical data. Particularly important are those OSJD corridors that run through the territory of Poland.

Basic parameters characterising the 13 OSJD corridors

- Corridor 1 (TRANSSIB) is the longest transport corridor in the world, running through the territory of Poland, Latvia, Lithuania, Estonia, Belarus, Russia, Kazakhstan, Uzbekistan, China, Mongolia and North Korea. Its total length with branching is 25,210 km (Table 1).

Table 1

Parameters characterising Corridor 1 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Belarus	856	17,448,255	20,383
Kazakhstan	1,753	26,472,511	15,101
China	3,717	182,001,022	48,964
Latvia	1,017	12,856,093	12,641
Lithuania	316	986,773	3,123
Mongolia	1,532	619,875	405
Poland	682	7,549,093	11,069
Russia	15,181	1,107,877,244	72,978
Uzbekistan	23	302,934	13,171
Estonia	133	422,074	3,173
Total	25,210	1,356,535,874	53,809

[Author's work].

- Corridor 2 runs through the territory of Russia, Kazakhstan, China and Vietnam. The corridor length with branching is 13,869 km (Table 2).

Table 2

Parameters characterising Corridor 2 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Vietnam	156	53,890	345
Kazakhstan	3,625	79,469,765	21,923
China	7,438	391,865,565	52,684
Russia	2,650	162,837,786	61,448
Total	13,869	634,227,006	45,730

[Author's work].

- Corridor 3 crosses the territory of Poland, Ukraine and Russia. The length of this corridor is 2,227 km (Table 3).

Table 3

Parameters characterising Corridor 3 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Poland	679	6,669,554	9,823
Russia	482	9,203,904	19,095
Ukraine	1,066	18,668,756	17,513
Total	2,227	34,542,214	15,511

[Author's work].

- Corridor 4 crosses the territory of the Czech Republic, Slovakia, Poland, Hungary and Ukraine. The total length of the corridor including branching is 2,693 km (Table 4).

Table 4

Parameters characterising Corridor 4 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Hungary	65	867,177	13,341
Poland	490	2,165,908	4,420
Slovakia	847	21,704,060	25,625
Ukraine	6	36,418	6,070
Czech Republic	1,285	8,594,320	6,688
Total	2,693	33367883	12,391

[Author's work].

- Corridor 5 is located in the territory of Hungary, Slovakia, Ukraine, Russia, Kazakhstan, Georgia, Azerbaijan, Moldova, China and Kyrgyzstan. The total corridor length with branching is 22,528 km (Table 5).

Table 5

Parameters characterising Corridor 5 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Azerbaijan	680	4,866,953	7,157
Hungary	1,695	15,546,110	9,172
Georgia	447	2,628,129	5,879
Kazakhstan	5,759	101,243,255	17,580
China	4,442	279,670,730	67,293
Kyrgyzstan	324	867,882	2,679
Moldova	209	174,922	837
Russia	5,299	306,757,609	57,890
Slovakia	549	13,987,456	25,478
Ukraine	3,124	69,307,771	22,950
Total	22,528	795,050,817	35,913

[Author's work].

- Corridor 6 passes through the Czech Republic, Slovakia, Hungary, Romania, Serbia, Bulgaria, Greece, Turkey, Iran and Turkmenistan. The corridor length with branching is 10,054 km (Table 6).

Table 6

Parameters characterising Corridor 6 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Bulgaria	1,402	712,926	509
Hungary	1,722	10,477,108	14,511
Romania	1,349	7,159,871	5,308
Slovakia	220	6,714,716	30,521
Czech Republic	452	4,436,483	9,815
Total	5,145	29,501,104	5,734

[Author's work].

- Corridor 7 crosses the territory of Poland and Ukraine. The length of the corridor is 1,551 km (Table 7).

Table 7

Parameters characterising Corridor 7 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Poland	612	4,509,820	7,369
Ukraine	939	22,317,660	23,767
Total	1,551	26,827,480	17,297

[Author's work].

- Corridor 8 links Ukraine, Russia, Kazakhstan, Uzbekistan and Turkmenistan. Including the branching, the total length of the corridor is 5,444 km (Table 8).

Table 8

Parameters characterising Corridor 8 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Kazakhstan	1,395	18,683,744	13,393
Russia	1,199	25,563,445	21,320
Uzbekistan	1,290	3,080,086	2,388
Ukraine	964	28,856,418	37,721
Total	4,848	76,183,693	15,714

[Author's work].

- Corridor 9 is located in the territory of Belarus, Lithuania and Russia. The length of this corridor with branching is 863 km (Table 9).

Table 9

Parameters characterising Corridor 9 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Belarus	164	3,977,172	24,251
Lithuania	548	13,361,951	24,383
Russia	151	1,427,183	10,194
Total	863	18,766,306	22,026

[Author's work].

- Corridor 10 crosses the territory of Georgia, Azerbaijan, Turkmenistan, Uzbekistan, Kyrgyzstan, Tajikistan, Kazakhstan (land part), using ferry crossings from Bulgaria, Romania and Ukraine to the Georgian seaports (Poti, Batumi), and from Baku (Azerbaijan) to Turkmenistan and Aktau (Kazakhstan). The total length of the corridor including the ferry routes is 11,512 km (Table 10).
- Corridor 11 crosses the territory of Russia, Azerbaijan and Iran. The total corridor length with branching is 7,690 km (Table 11).
- Corridor 12 crosses the territory of Moldova, Romania and Bulgaria. The total length of the corridor is 1,416 km (Table 12).
- Corridor 13 crosses the territory of Poland, Lithuania, Latvia, Estonia and Russia. The length of the corridor is 1,360 km (Table 13).

Table 10

Parameters characterising Corridor 10 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Azerbaijan	501	3,528,675	7,043
Bulgaria	2	11,165	5,583
Georgia	447	2,628,129	5,879
Kazakhstan	6,599	102,843,606	15,585
Kyrgyzstan	324	867,882	2,679
Tajikistan	630	231,745	368
Uzbekistan	2,195	14,658,397	6,678
Ukraine	9	22,896	2,544
Total	10,707	124,792,495	11,655

[Author's work].

Table 11

Parameters characterising Corridor 11 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Azerbaijan	504	2,084,496	4,136
Russia	5,722	141,987,779	24,814
Total	6,226	144,072,275	23,140

[Author's work].

Table 12

Parameters characterising Corridor 12 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Bulgaria	548	313,840	573
Moldova	216	204,181	945
Romania	537	3,043,664	3,806
Ukraine	115	110	962
Total	1,416	2,672,267	1,887

[Author's work].

Table 13

Parameters characterising Corridor 13 [8]

Country	Section length [km]	Freight transport [thou.-net tonne-kilometres]	Traffic volume [thou. tkm per 1 km]
Latvia	242	767,182	3,170
Lithuania	165	282,251	1,711
Poland	355	1,945,729	5,481
Russia	174	7,098,695	40,797
Estonia	424	1,650,147	3,892
Total	1,360	11,744,004	8,635

[Author's work].

The analysis presented confirms the great importance of all corridors for the development of freight transport. It should be emphasized that the Asia-Europe transport corridor (Corridor 1 and Corridor 10) is characterised by large freight transports of Russia, China and Kazakhstan. This is important due to the fact that these transports are made through Poland on the main branch of the New Silk Road Railway together with the development of corridors within the TMTM[9] concept and the transports of India and Iran [5]. The transport corridors are shown in Figures 3 and 4.

Trade between the East and the West is one of the main factors determining the development of freight transport, also with the use of rail transport [10]. According to Eurostat data, the value of bilateral trade in 2019 was €644.4 billion. Chinese exports to the Union in 2019 were worth €419.2 billion, 6.1% higher than in 2018, while the value of imports from EU countries to China amounted to €225.5 billion, an increase of 6.6% YoY. Of the EU members, only three countries: Finland, Ireland and Germany recorded a trade surplus with China, while Poland's trade of goods with China in 2019 reached the value of USD 35,585 million. In 2019, the value of Chinese imports to Poland increased by more than USD 2.1 billion, or 4.3%, while the value of Polish exports to China increased by less than USD 500 million, or 18.9%. The bilateral trade deficit increased to a record-breaking level of USD 29,646 million. China is Poland's second largest import partner, but only the twentieth market in terms of the value of Polish exports [13].

[9] The TMTM corridor was established in 2014 to provide a transport link between China and Europe via Kazakhstan, Azerbaijan, Georgia, and Turkey/Ukraine. The emerging TMTM Trans-Caspian International Route Association will include the railways of Ukraine, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Turkmenistan, Turkey, China and Poland.

Fig. 3. The TMTM corridor [9]

Fig. 4. The corridor from Iran [9]

Despite the complex conditions associated with the coronavirus pandemic, the booming container traffic on the New Silk Road is not surprising, as shown in Figure 5.

In conclusion, the idea of the Silk Road is, both now and in the future, extremely important because of, among other things, the expansion of infrastructure and trade [12]

4. Work on updating and developing the OSJD corridors

Since, due to many factors, the geography of transport routes is constantly changing, the OSJD is adapting and refining its development strategy concerning intercontinental transport along the main rail routes.

Fig. 5. Silk Road Railway [2]

An example is the Roadmap, which provides for the creation, implementation and monitoring of Comprehensive Transportation Improvement and Corridor Development Plans under the OSJD's Transportation Policy and Development Strategy Commission.

Comprehensive roadmaps for the further development of rail infrastructure with technical and operational indicators and passports for all 13 corridors have already been approved. They describe the rail infrastructure development measures for each corridor section and show the progress of their implementation and present the comparative dynamics of the changes in freight volumes achieved as a result of these measures. The technical and operational indicators with passports show the technical equipment and bottlenecks of the corridor for each section, the characteristics of the terminals, border crossings and the system of transport law and tariffs are also given.

In accordance with the decision[10], the Comprehensive Plans for the OSJD's Transport Improvement and Development of Rail Transport Corridors Nos. 2, 5, 8, and 10 until 2020 were revised with the addition of new lines. The preparation of new Comprehensive Plans for Transport Improvement and Development of the OSJD Transport Corridors Nos. 1-13 until 2030, taking into account the national railway transport development programmes, was also addressed. Considering this issue, it was decided that these works should start after the preparation of a document that would regulate the issues of preparation and completing new Comprehensive Plans. To this end, the experts from the OSJD member states have started and are continuing work on the development of the "Rules for creating and filling in the OSJD technical and operational passport" project.

It should be noted that the main measures envisaged in the Comprehensive Plan are being implemented by the OSJD member states on their own and by EU member states with the support of the European Union. From 2010 to date, monitoring has been organised for Comprehensive Transport Corridor Plans.

5. Conclusions

Active use of the OSJD rail transport corridors in international transport enables better planning of transport, significantly facilitates crossing borders between railway systems of different legal and technical standards, shortens transport times and improves interoperability between different transport modes in multimodal traffic, which ultimately contributes to increasing the efficiency, competitiveness and attractiveness of rail transport. As a result, despite the difficult conditions, freight transport in the OSJD countries in 2020 maintained a level of transport above 5 billion tonnes (Fig. 6). The main competitiveness factor is the speed and timeliness of freight delivery. Container trains can now cover more than 1,000 km

[10] Decision of the XLVII session of the OSJD Ministers' Meeting (4–7 June 2019, Tashkent, Republic of Uzbekistan).

Fig. 6. Freight volumes in the OSJD countries [8]

per day. This encourages the development of transit services. The main routes and directions are Asia – Europe – Asia.

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