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Issues of Integration of Trans-Korean and Continental Railways

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ABSTRACT

Since the 1990s, the Government of the Republic of Korea has pursued a systematic policy of connecting the railways of the Korean Peninsula to organise a Trans-Korean railway with access to the mainland railway network but has not achieved the implementation of this project. Differences in economic systems and infrastructure of two countries are deterrents to organisation of the Trans-Korean railway.

The paper considers main historical periods, reflecting the stages of reunification of the Trans-Korean railway with the possibility of organising a transcontinental transportation. For the Republic of Korea, the emergence of a Trans-Korean and continental railway transportation will allow reorienting container flow from sea and road transport to the railway in the Asia-Europe direction, which will significantly speed up and make the delivery of goods more stable. The predicted volume of container flow between Korea and Eurasia can reach 300,000 containers per year by 2040. The objective of this study is to analyse the state, problems and trends in organisation of the Trans-Korean railway with an access in future to the transport network of the Asia-Pacific region. In this study, methods of analysis, synthesis and comparison are used.

Possible solutions for integration of Trans-Korean and continental railways are presented in five aspects. Long-term policies and plans drawn up based on consultations between the leadership of two Korean countries need support through revealing interests of international organisations and neighbouring countries. The strengthening and development of the railway infrastructure of the DPRK is possible with the help of joint projects with the Republic of Korea and neighbouring countries. The creation of a transcontinental railway and the development of technology for accelerated customs clearance of containers will allow the countries of the Korean Peninsula to reach a new level of political and economic cooperation.

Keywords: *Trans-Korean railway, continental railway, transport infrastructure of the DPRK and the Republic of Korea.*

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Текст статьи на русском языке публикуется в первой части данного выпуска.

INTRODUCTION

The Trans-Korean Railway on the Korean Peninsula has a long history of development, including the period of colonialism. The road was necessary for organisation of passenger transportation to Russia or China. Railway transportation was interrupted 75 years ago due to hostilities, the result of the war was the division of the country into the Republic of Korea and the DPRK. Since the 1990s, the Republic of Korea has held various strategic sessions for the connection to the mainland railway through the Trans-Korean railway. As of today, this project has not been implemented, in addition to various technical and infrastructural problems, the political situation is the most important part of resumption of the Trans-Korean railway transportation. In July 2021, President of the Republic of Korea Moon Jae-in and Chairman of the State Council of the DPRK Kim Jong-un agreed to resume the direct line of communication between Seoul and Pyongyang, and also agreed to help restore trust and strengthen bilateral relations. If the political situation on the Korean peninsula stabilizes and relations between two countries continue to improve, the unification of Korean railways can happen at any time, and integration with the mainland railway network is possible, so the preparation of infrastructure and the development of technology is a mandatory issue for the development of the Trans-Korean railway [1].

Thus, the *objective* of this study is to analyze the state, problems and development trends of the Trans-Korean railway with a promising entry into the transport network of the Asia-Pacific region.

RESULTS

Analysis of Political Decisions on the Issue of Reunification of the Trans-Korean Railway and Organization of Transcontinental Railway Transportation

The 1990s are considered the beginning of integration of the Trans-Korean and continental railways. Various discussions were held about connecting the Trans-Korean railway in the 1970s and 80s, but since the 1990s, with participation of Russia and the international community, discussions have begun on implementation of the continental railway project by connecting with the Trans-Korean railway.

The years 2000–2008 of the administration of Kim Dae-jung and Roh Moo-hyun are associated with progress in resolving the issue of unification of the Trans-Korean railway and integration with the continental railway. Due to the active cooperation between the governments of the Republic of Korea and the DPRK, cooperation between two countries was achieved in various transport areas, including road, sea, air and Trans-Korean railway transportation.

The Kim Dae-jung administration (1998–2003) interacted with the DPRK leadership on various issues of unification policy and tried not to interrupt the dialogue. On June 15, 2000, President of the Republic of Korea Kim Dae-jung and Chairman of the State Council of the DPRK Kim Jong-il presented a joint declaration at the first inter-Korean summit held in Pyongyang. There was no direct mention of development of the transport sector, but an agreement was reached on economic cooperation between two parties [4]. This allowed further negotiations to continue.

During the administrations of Kim Dae-jung and Roh Moo-hyun, there were 13 inter-Korean summits and subsequent meetings of the working groups of representatives of Republic of Korea and the DPRK, 10 negotiations in the military sector, 11 meetings on economic cooperation, 5 working meetings on development of railway and roads, 13 meetings were held on organisation of railway and road transportations.

2008–2017 years. This is the period of the administrations of Lee Myung-bak and Park Geun-hye, which can be characterized as a period of «stagnation» in the issue of connecting the Trans-Korean railways, the reasons were political differences and military conditions, so the discussion of inter-Korean relations was suspended.

In 2013, in a keynote speech at the Eurasia International Conference, Park Geun-hye's new administration officially launched the «Eurasian Initiative» aimed at bringing peace to the Korean Peninsula by uniting Eurasia as a single continent. Attention was focused on the need to create energy networks (Pic. 1), gas and oil pipelines, through the implementation of the Silk Road Express, which runs through Busan–DPRK–Russia–China–Central Asia–Europe.

2017–present. In 2017, the Moon Jae-in administration upon its formation proposed the «New Economic Map of the Korean Peninsula» and «New Northern Policy» projects based on cooperation between the countries of the Korean

Table 1

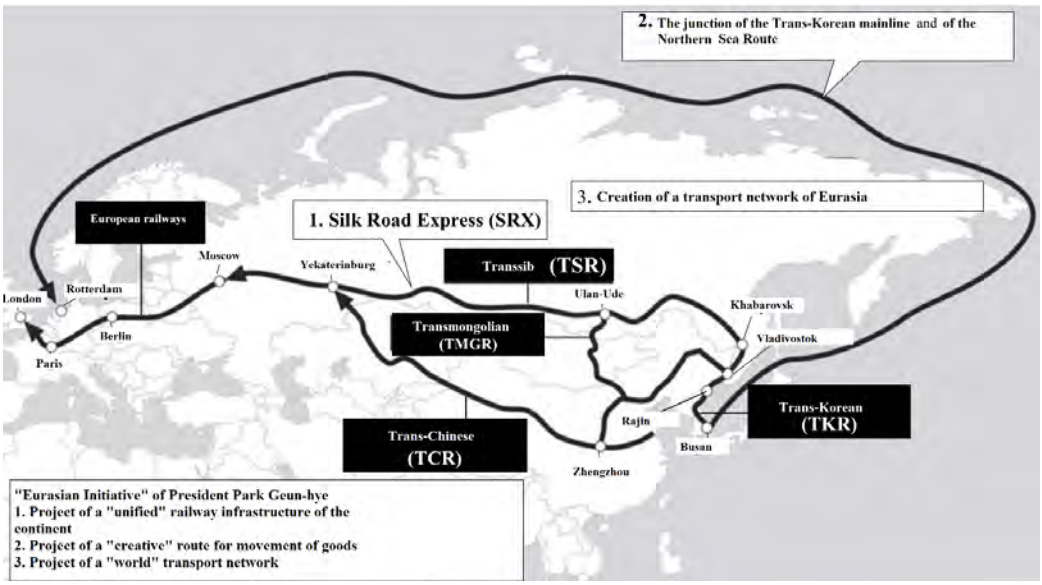
The main stages of organisation of Trans-Korean and continental railway transportation in the 1990s

Year	Participating countries	Main content
1991	Republic of Korea and Russia	A protocol on cooperation in the field of international multimodal sea and railway transportation between Republic of Korea and Russia was signed [2]
1992	Republic of Korea and DPRK	Adoption of agreements and understandings attached to them on reconciliation, immunity, exchange and cooperation. Junction of Gyeonggi Railway Line and Road between Munsan and Kaesong
1996	ESCAP Conference (Economic and Social Commission for Asia and the Pacific)	Efforts are aimed at rebuilding railways in Republic of Korea and DPRK to create a northern route for the Trans-Asian Railway [3]

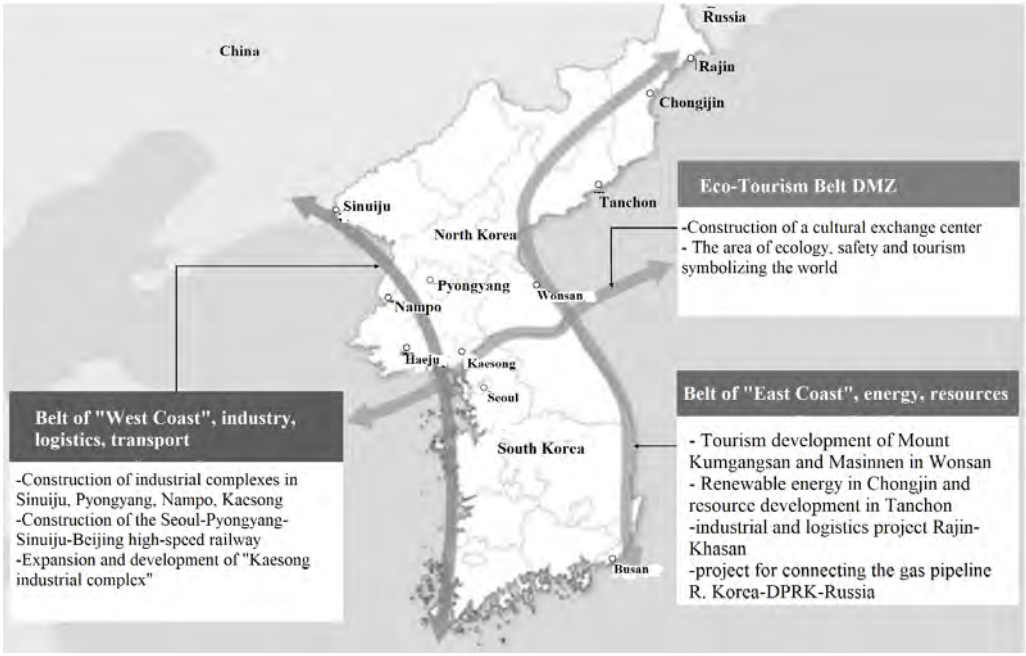
Table 2

The main stages of organisation of Trans-Korean and continental railway transportation in 2000–2008 [2]

Year	Participating countries	Main content
2000	Republic of Korea and DPRK	Within the framework of the Inter-Korean Summit and the Joint Declaration of the Republic of Korea and the DPRK, they agreed to intensify exchanges and cooperation in the economic sphere between two parties
		The result of the First and Second Inter-Korean Ministerial Meetings was the signing of the Agreement on Railway and Road Connection of the Gyeonggi Line
2001	Repbulic of Korea and Russia	Agreed on the Iron Silk Road project, which connects Europe and Asia through the Korean Peninsula
2002	Republic of Korea and DPRK	Formalization of the project implementation along the Donghae line
		Start of construction of the Donghae railway line
2003	Republic of Korea and Russia	Agreement on joint research between Republic of Korea, DPRK and Russia
2004	Republic of Korea, DPRK and Russia	A trilateral meeting of railway experts of Republic of Korea, DPRK and Russia
2005	Republic of Korea and DPRK	Restoration work completed on a single-track railway
2007		Test train operation between Chongjin and Kumgangsan and organisation of cargo traffic between Republic of Korea and the DPRK on the Gyeonggi railway line
		Joint declaration for cargo railway transportation between Munsan and Bongdong. Discussing reconstruction of the Kaesong-Sinuiju railway and the Kaesong-Pyongyang expressway for shared use



Pic. 1. Project «Eurasian Initiative» [5].



Pic. 2. Project «New Economic Map of the Korean Peninsula» [6].

Peninsula and the northern regions in the field of transport and logistics. The New Northern Policy aims to strengthen cooperation projects that take into account the industrial and economic capacity of 14 countries in Northeast Asia, including Russia, Mongolia, China (three northeastern provinces) and the CIS countries.

The «New Economic Map of the Korean Peninsula» (Pic. 2) represents economic integration with the northern regions of the peninsula, through formation of three belts – on the east coast, west coast and the demilitarized zone [7]. The «New Economic Initiative of the Korean Peninsula» aims to provide new growth drivers for the Korean Peninsula and joint economic development with the northern regions through creation of three major economic belts. The presence of a railway connection between Republic of Korea and the DPRK makes it possible to consider the development of Eurasian cooperation, which extends beyond the Korean Peninsula to Russia and Europe.

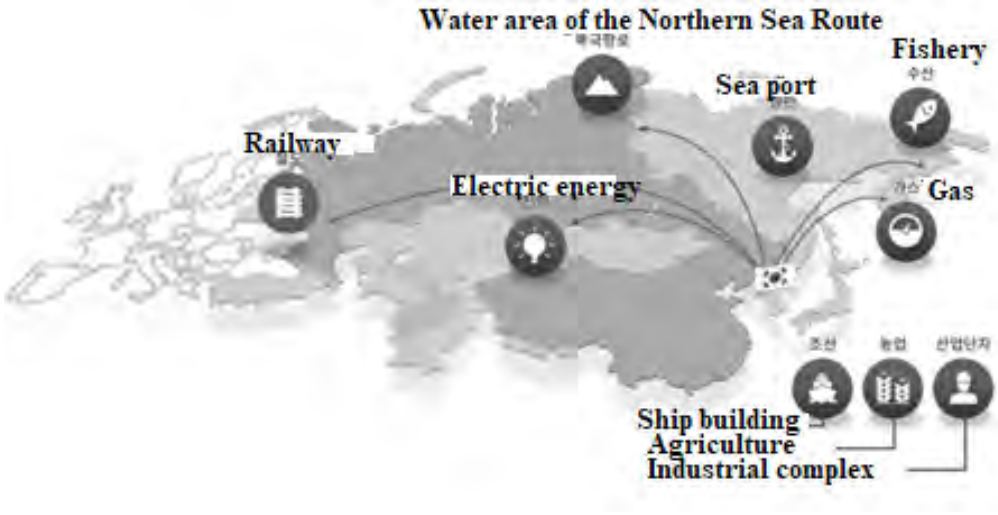
At the Eastern Economic Forum, held in Vladivostok in September 2017, President Moon Jae-in presented the 9 Bridges strategy, which includes nine areas (Pic. 3) of cooperation between Korea and Russia [9].

In January 2018, inter-Korean summit was held, which restored the mood of reconciliation on the Korean peninsula and made it possible to start a dialogue between two countries.

As inter-Korean relations improved, it became possible for Republic of Korea to join the OSJD. In addition, President of Republic of Korea Moon Jae-in proposed the creation of the «East Asian Railway Community» – an organisation of cooperation between countries, including the United States, with participation of six countries of Northeast Asia (Republic of Korea, DPRK, China, Russia, Mongolia and Japan). The East Asian Railway Community might be an international council that implements investment projects for development of infrastructure and economic cooperation in the railway transport of East Asia [7].

As a result of the inter-Korean summit held in September 2018, with the support of the United States, joint studies of the Trans-Korean railway in the DPRK section were carried out, and the foundation laying ceremony of the Gyeonggi line and the Donghae line was held. The Kaesong–Sinuiju section of the Gyeonggi Line (411,3 km) was surveyed in a day, and the Kumgangsan–Dumangan section of the Donghae Line (783,4 km) was surveyed for 10 days.

In December 2007, a field study was carried out on the Kaesong–Sinuiju section of the Gyeonggi line, and over the past 10 years there have been infrastructural changes that will require additional investment to upgrade the Gyeonggi line. The Kumgangsan–Dumangang section on the Donghae line is of great transport



Pic. 3. Strategy of «9 bridges» [8].

and logistics importance, and for the first time, after the division, railway transportation is carried out through it.

Analysis of the State of Transport Infrastructure

The DPRK geographically borders the Republic of Korea in the south, Russia and China in the north, so the connection of the Trans-Korean railway with a continental railway (Trans-Siberian Railway, Trans-China Railway and Manchurian Railway) depends on the state and capacity of the transport infrastructure of the DPRK. Unlike the Republic of Korea, where cargo transportation is concentrated on road transport, in the DPRK, cargo transportation is carried out by railway, and road transport is auxiliary. The development of the transport system of the DPRK was influenced, namely, by natural conditions with many mountainous areas [7].

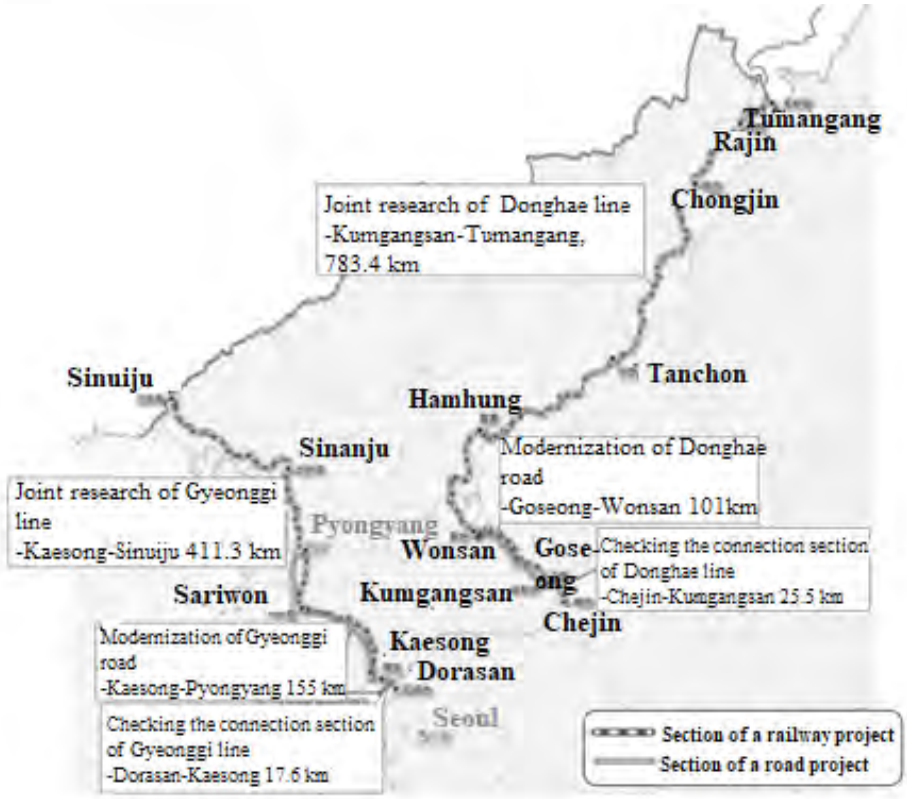
The length of roads in the DPRK is 26196 km [9]. The topography of the roads, due to the mountainous terrain, makes it difficult for vehicles to travel faster than 50 km/h, except on some highways. The road infrastructure of the DPRK is an additional tool for organising railway transportation, road transportation is mainly carried out over short distances (within 150−200 km) and is focused on interregional transportation. Road transport delivers goods between railway stations and regions where there is no railway, and also provides tourist and military transportation [9].

The total length of railways in the DPRK is 5295 km, which is about 1,3 times more than in the Republic of Korea [9]. Most of the DPRK railways use 1435 mm gauge, some

Table 3

Main stages of organization of Trans-Korean and continental railway transportation from 2017 to the present

Year	Participating countries	Main content
2017	Repbulic of Korea	New Northern Policy Initiative and New Economic Map of the Korean Peninsula [9]
		Repbulic of Korea announces «9 Bridges» strategy aimed at implementing joint projects with Russia [9]
2018	OSJD	Republic of Korea is OSJD member country
	Six countries of Northeast Asia and the USA	Proposal for organization of the «East Asian Railway Community»
	Repbulic of Korea and DPRK	Three meetings at the inter-Korean summit
		Joint study of railway and road infrastructure on the DPRK section of the Donghae and Gyeonggi lines
		Groundbreaking ceremony for the railway and road connection of the Donghae and Gyeonggi lines



Pic. 4. Inter-Korean transport cooperation projects agreed in 2018 [7].

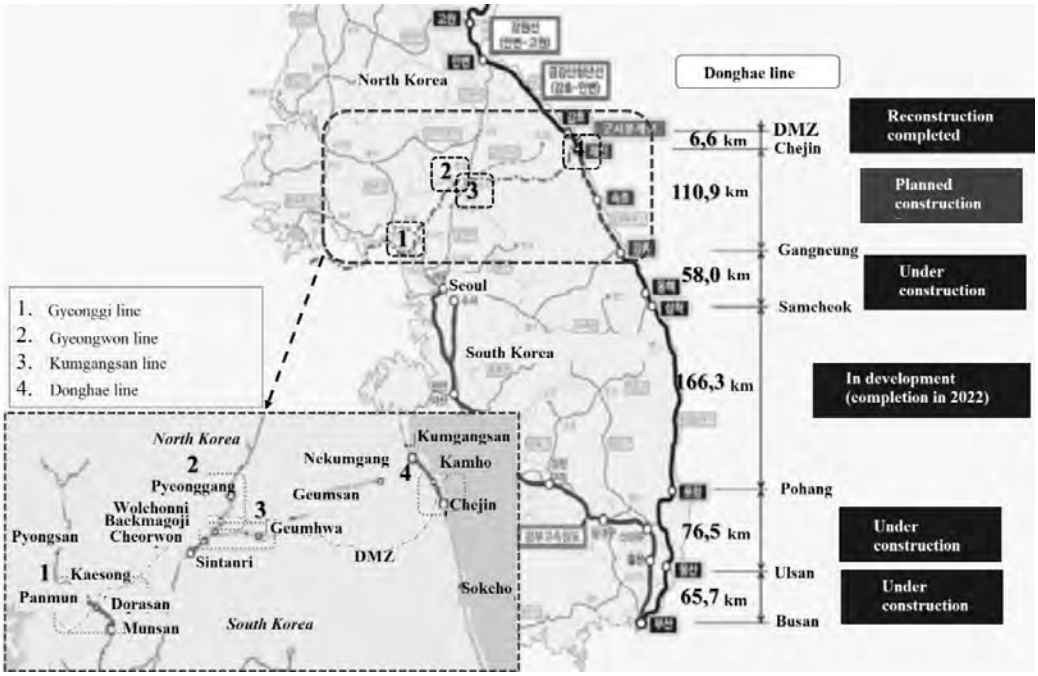
lines in mountainous areas use 762 mm gauge. In addition, on the Tumangan–Rajin section, where Russian trains operate, a gauge of 1520 mm and 1435 mm is installed [10]. According to some experts, DPRK has a mostly single-track railway system, and infrastructure capacity is insufficient. In some areas of the DPRK, wooden sleepers are used, and in the future, they could be a factor preventing the increase in the speed of trains. Many tunnels were built during the Japanese colonial period (1910−1940s) and were left without maintenance, which led to severe corrosion of concrete [7]. Communication and signalling systems are mostly semi-automatic and require modernization [11].

Pic. 5 shows the railways of Republic of Korea and DPRK, which form the Trans-Korean railway.

Table 4

Characteristics of the transport infrastructure of Republic of Korea and DPRK

Characteristics by type of transport		Republic of Korea	DPRK
Railway transport	Total length, km	4148,1	5295,0
	Share of electrified lines, %	73,2	81,2
	Share of double-track sections of the total length, %	63,5	3,0
	Gauge width, mm	1435 mm – 100,0 %	762 mm – 9,8 % 1435 mm – 87,7 % 1520 mm – 2,5 %
	Main voltage	AC 25 kV	DC 3 kV
	Transportation	automatic	semi-automatic
	Average speed, km/h	70~100	15~50
Road transport	Total length, km	111314,0	26196,0
	The length of motorways, km	4767,0	658,0
	Share of road surfaces (without motorways), %	93,2	Less than 10



Pic. 5. Map of the state of the railway infrastructure of the Republic of Korea and the DPRK as part of creation of the Trans-Korean railway [12].

Since December 2007, the Gyeonggi Line, which connects Munsan station in South Korea and Panmun station in North Korea, has been dedicated to cargo transportation of the Kaesong Industrial Complex, which was closed in November 2008. Currently, the line between Munsan and Dorasan is undergoing electrical installation work on a 9,7 km section, and only some sections are open to traffic. On the west coast of the peninsula, the Gyeonggi line is connected to Seoul and the metropolitan area, with the line's existing capacity linked to the Gyeongbu line, which no longer has capacity reserve. Therefore, government negotiations are underway to build a high-speed railway between Seoul and Sinuiju to meet the demand for passenger transportation.

Rehabilitation work on the Gyeongwon Line between Baekmagoji and Wolchonni stations is currently on hold, while construction work to restore the section to Pyeongchang Station remains a long-term plan. Today, the restoration of the Kumgangsan line continues, but the priority remains with the project to connect the Gyeonggi and Donghae railway lines.

The Donghae line includes the Busan–Pohang double-track electrified section and the Samcheok–Gangneung double-track electrified section, as well as the Pohang–Samcheok single-track electrified section, and the Gangneung–Chejin single-track section is under construction.

The Pyongi, Hambuk and Manpo railway lines have access to the Chinese railways, the Pyeongnae line is connected to the Russian railways.

In 2013, modernization of the Khasan−Rajin railway section (54 km) connecting the North Korean port of Rajin and the Russian border railway station Khasan was completed.

China is interested in development of transport infrastructure in the region of the northeastern border, this is reflected in the projects «Development of the Northeast of the PRC» and «One Belt, One Road» [14]. In February 2014, China formed an international consortium representing state-owned enterprises. As part of the activities of the consortium, a memorandum of understanding (MOU) was signed for implementation of high-speed rail transportation on the Kaesong–Pyongyang–Sinuiju direction [15].

SUGGESTION AND SOLUTIONS

1. Stabilization of inter-Korean relations. It is necessary to establish long-term relations between two countries of the Korean Peninsula, which will be the basis for planning the development of the peninsula's transport network. In Republic of Korea, when

Pic. 6. Map of railways of the DPRK [13].

administrations change, the policy of connecting railways with subsequent integration with continental railways also changes. There is no possibility now to conduct research and a detailed analysis of the state of the railway infrastructure, therefore, economic assessment of organisation of the Trans-Korean railway is not complete and in the future will have the effect on the increase in time and cost of connecting the Korean railways [16].

2. The need for international social cooperation. Republic of Korea needs economic and transport cooperation with neighbouring countries. Unlike the DPRK, which has rail links with Russia and China, Republic of Korea has no experience in international railway transportation. From the point of view of Republic of Korea, railway transportation is not only a path for economic development, it is a peaceful relationship between two countries and an opportunity for unification of the Korean Peninsula.

3. Modernization and development of the transport infrastructure. The priority development of the railway transport infrastructure is justified by the connection of the Trans-Korean railway with the Asian transport network for organisation of continental routes. An urgent issue is construction of a second track on the existing single-track road in the DPRK. A double-track railroad is an important competitive advantage in logistics and passenger transportation. The construction of the second tracks should be carried out in stages, considering the financial burden, the capacity of the line, as well as existing and forecast train flows.

4. Connectivity of railways of the Republic of Korea and of the DPRK. Currently, of four railway lines in South Korea, the Gyeonggi Line, located on the West Coast of the peninsula, and the East Sea Line, are considered priority projects. The Gyeonggi line connects South Korean Seoul and Pyongyang (DPRK), with organisation of railway transportation, the demand for cargo and passenger transportation will be high. Therefore, it is necessary to build a passenger high-speed railway, cargo transportation will be carried out by public railways with appropriate cargo handling points. Seoul is the capital of the Republic of Korea, a metropolis that has an extensive metropolitan subway network, many suburban lines and high-speed lines. Under such conditions, the

Table 5

Forecast of container railway transportation volumes between Korean Peninsula and Eurasia (thousand TEU, %) [15]

Direction	2020	2030	2040	Increase percentage	
				'20~'30	'30~'40
Korea → Eurasia	10,871	54,722	198,271	17,5	13,7
Eurasia → Korea	5,285	26,603	96,388	17,5	13,7
Total	16,156	81,325	294,659	17,5	13,7

organisation of cargo traffic is impossible, in the future development it is necessary to organise cargo terminals in the northern and southern parts of Seoul, which will function as points for import-export containers «Ui-wang ICD». The presence of container terminals in different parts of the metropolis will allow formation of container trains and feeder transportation, the terminal in the northern part of Seoul will be the operator for organising cargo railway transportation to the DPRK and China [17].

The Donghae line is located along the East coast of the peninsula and connects the South Korean port of Busan with the Russian Khasan station. Currently, a project is being implemented in Republic of Korea to strengthen the railway infrastructure from Busan station to the demilitarized zone. This route will allow organising transportation of containers from the seaport of Busan through the Trans-Siberian Railway with access to the European market. The task ahead is to replace in some sections of the single-track track structure with a double-track one, taking into account economic feasibility. Today, the price of sea freight and delivery time determine the competitiveness of a business, so construction of the Donghae double-track railway line is one of the main vectors for development of the country's economy.

5. Organisation of border traffic between countries. The competitiveness of railway transport in Asia depends on the speed of the customs clearance system. In the European Union, transport and goods freely cross borders; it is currently not possible to organise such a system for movement of goods between China, Russia, DPRK and Republic of Korea. At the same time, it is necessary to gradually reduce the time of customs clearance by improving the system and interaction between the border authorities of the participating countries. In the future, container transportation will be in demand, in which the customs inspection of the cargo is carried out in the port of Busan (RK) and this will allow the container to follow in transit through Rajin (DPRK) and Khasan (RF).

CONCLUSIONS

The Trans-Korean Railway (TKR), as a project to connect the railways of the Republic of Korea and the DPRK, will be completed through integration with the continental railway. Despite the efforts of the international community, the railway on the Korean Peninsula is only at the level of discussion of this project. In the Republic of Korea, when the government changes, the policy of unifying the railways of two countries also changes, so it is necessary to ensure constant cooperation between the working groups and approve a long-term development program for the Trans-Korean Railway.

According to preliminary forecasts, by 2040, the demand for cargo transportation from Korean Peninsula to Europe will be up to 300,000 containers per year (Table 5), in order to process 200,000 containers with export cargo, it is necessary to send 7–8 trains to Europe every day, consisting of 50 cars. Due to the disproportion of import and export containers, there is a need for empty containers, it is assumed that the return of empty containers will be carried out by sea transport with a low freight rate [18].

Republic of Korea has no experience in organising international railway transportation, so it requires the involvement of Russian and Chinese experts in railway transport, the organisation of training and exchange of specialists from Korean transport companies, and the cooperation and support of the UN and OSJD is also necessary.

The project of unification of railways on the Korean Peninsula with subsequent integration into the Asian transport network is impossible without the survey and modernization of the railway infrastructure of participating countries. The development of technology for accelerated customs clearance of transit container flow between the Republic of Korea and neighbouring countries will allow redirecting significant

volumes of traffic from sea and road transport to railway transport.

Further studies of development of the railway infrastructure and port facilities of the Republic of Korea, taking into account the increase in container traffic, may be aimed at creating a simulation model for loading the existing transport system as well as for various options of development of transport infrastructure. Simulation data will make it possible to develop solutions for phasing and efficiency of implementation of measures aimed at strengthening the throughput and processing capacity of transport hubs [19].

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