FOUR: EVALUATION OF PERFORMANCE AND IDENTIFICATION OF BOTTLENECKS IN SELECTED CORRIDORS

4.1 CORRIDOR 1
TANGGU-TIANJIN-BEIJING-ERANHOT-ZAMIN UUD-ULAANBAATAR-ULAN UDE

4.1.1 Significance

Corridor 1 passes through three countries: China, Mongolia and the Russian Federation. This corridor is especially important to Mongolia. There are two reasons for this. On the one hand, the corridor is meaningful to Mongolia as a land transport route in itself. Mongolia's two neighbouring countries hold a significant position in its economy. In 2005, China and the Russian Federation, the most important trade partners of Mongolia, accounted for 38.5 per cent and 20.4 per cent of Mongolia's total foreign trade volume respectively (Table 4-1).

Table 4-1 Major trade partners of Mongolia

Export	2003		2004		2005	
	million US$	%	million US$	%	million US$	%
World	615.9	100	851.9	100	888.6	100
China	284.2	46.1	407.1	47.8	483.6	54.4
United States	142.9	23.2	152.9	17.9	126.8	14.3
United Kingdom	26.1	4.2	134.0	15.7	41.9	4.7
Russian Federation	41.2	6.7	18.1	2.1	26.1	2.9
Italy	9.1	1.5	17.3	2.0	16.7	1.9
Germany	4.6	0.7	11.5	1.3	15.8	1.8
Republic of Korea	7.5	1.2	7.8	0.9	12.1	1.4
Japan	8.5	1.4	33.5	3.9	5.6	0.6
Australia	34.5	5.6	0.1	0.0	0.3	0.0
Singapore	35.0	5.7	19.9	2.3	0.1	0.0
Imports	**2003**		**2004**		**2005**	
	million US$	%	million US$	%	million US$	%
World	801.4	100	1,011.3	100	1,197.4	100
Russian Federation	265.4	33.1	336.6	33.3	400.4	33.4
China	172.4	21.5	238.2	23.6	318.8	26.6
Japan	63.4	7.9	74.5	7.4	78.5	6.6
Republic of Korea	67.7	8.4	60.9	6.0	70.3	5.9
Germany	38.0	4.7	33.5	3.3	51.3	4.3
United States	23.5	2.9	46.9	4.6	31.7	2.6
Kazakhstan	4.9	0.6	26.6	2.6	29.5	2.5
Singapore	10.4	1.3	14.9	1.5	17.6	1.5
Australia	19.6	2.4	15.5	1.5	10.9	0.9
Hong Kong, China	23.9	3.0	15.4	1.5	7.5	0.6

Source: ADB, Key Indicators 2006: Measuring Policy Effectiveness in Health and Education, 2006

Corridor 1, which extends from Tianjin, one of China's major trade ports, via Beijing and Ulaanbaatar, the capital cities of China and Mongolia, to Ulan Ude, a connecting point to the Trans Siberian Railway (TSR), makes the greatest contribution to Mongolia's economic exchanges with its most important economic partners. Furthermore, most Mongolian cargos being moved to Central Asia or Europe are transported via the combination of Corridor 1 and the TSR.

On the other hand, Corridor 1 has even greater importance as a gateway to the sea for Mongolia, a landlocked country. The transport of cargos to regions other than China, the Russian Federation and Europe has mainly depended on the combination of Corridor 1 and sea transport. As shown in Table 4-1, the economic exchange of Mongolia with countries besides China and the Russian Federation, which account for 45.9 per cent of Mongolia's total foreign trade, also holds a crucial position in its economy. Especially, access to the United States of America, holding 16.2 per cent of the total, and to Japan and the Republic of Korea, together accounting totally for 13.0 per cent, seem especially important. Tianjin Port plays a decisive role as the only main exit for Mongolia to the Yellow Sea and the Pacific.

4.1.2 Current situation and prospects

Port. Tianjin Port, which is situated in north-east China, 137 kilometres from Beijing on the coast of the Bohai Sea, is a key gateway to northern China. As the closest land starting point to the Asia-Europe land bridge, it is on course to become an important link between Europe and North-East Asia. Transshipment volumes with Mongolia, Kazakhstan and other inland countries continue rising. According to ERINA, 4,000 to 5,000 TEU of Mongolia's container freight is handled at Tianjin Port annually.[1] (Table 4-2).

Table 4-2 Regional distribution of container traffic at Tianjin Port (Unit: thousands of TEU)

Regions	1999		2000		2001	
	Amount	%	Amount	%	Amount	%
Japan	391	30.0	379	22.2	356	17.7
Republic of Korea	365	28.0	463	27.1	453	22.5
North America	117	9.0	113	6.6	134	6.7
Europe	130	10.0	211	12.4	260	12.9
Others	299	23.0	542	31.7	808	40.2
Total	**1,302**	**100.0**	**1,708**	**100.0**	**2,011**	**100.0**

Tianjin Port is divided into four areas; (1) Inner River Port Area; (2) North Harbour Area; (3) South Harbour Area; and (4) Bulk Cargo Logistics Center. North Harbour Area is mainly developed for containers and general cargoes while South Harbour Area is a modern port area for coal, coke, oil and petrochemicals. The Inner River Port Area is located at the lower reaches of Heihe River, handling general cargo. Tianjin port is now the third largest port in China after Shanghai and Ningbo. It handled 163 million tons of cargo including 3 million TEU of containers in 2003.

At present Tianjin has eight specialized container berths totaling 2,373 metres, of which four berths of a total length of 1,150 m are operated by CSX Orient Container Terminal.

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[1] ERINA,Vision for the Northeast Asia Transportation Corridors, ERINA, Vol. 1, June 2002.

Table 4-3 Tianjin Port container terminals

Operating Company	Length (m)	Depth (m)	Number of berths × capacity (dwt)	Number of gantry cranes
Tianjin Port Container Terminal Co., Ltd. (TCT)	398 825	12 15.2	1×50,000 3×100,000	4 8
CSX Orient (Tianjin) Container Terminals Co., Ltd. (CSXOT)	1,150	14	4×25,000	8
Total	2,373	12-15.2	8	20

Source: http://www.tctcn.com; http://www.csxot.com

According to the General Development Plan of Tianjin Port, which was jointly reviewed and approved by the Ministry of Communications and Tianjin Municipality, Tianjin Port will be developed into a modern port with multiple functions, including transport arrangements, loading, unloading, warehousing, transshipment to coastal industry, logistics, bonded storage and information services. The plan includes an investment of CNY7 billion to construct a total of ten new container berths during the period from 2004 to 2009. Another CNY1.1 billion will be spent on building a container logistics centre covering 5.4 square kilometres. It is expected that by 2010, the throughput will reach 300 million tons, including 10 million TEU of container cargo.[2]

Railway. From Tianjin Port a multi-track line of around 137km goes to Beijing, and then an additional 501km of double track line goes to Jining via Datong, an additional 501km. It continues to Erenhot via a single-track line of 338km. At the border between China and Mongolia, transshipment is needed because of a gauge difference. Railroad tracks in Mongolia are broad gauge, i.e. 1520mm, while Chinese rail lines use the standard gauge of 1435mm. However, both standard and broad gauge rails are available at the border area between Erenhot and Zamyn Uud. The rest of the Mongolian and Russian sections are composed of broad gauge and single-track railway with a length of nearly 1,400km (Figure 4-1). Table 4-4 lists major segment distances along this rail route.

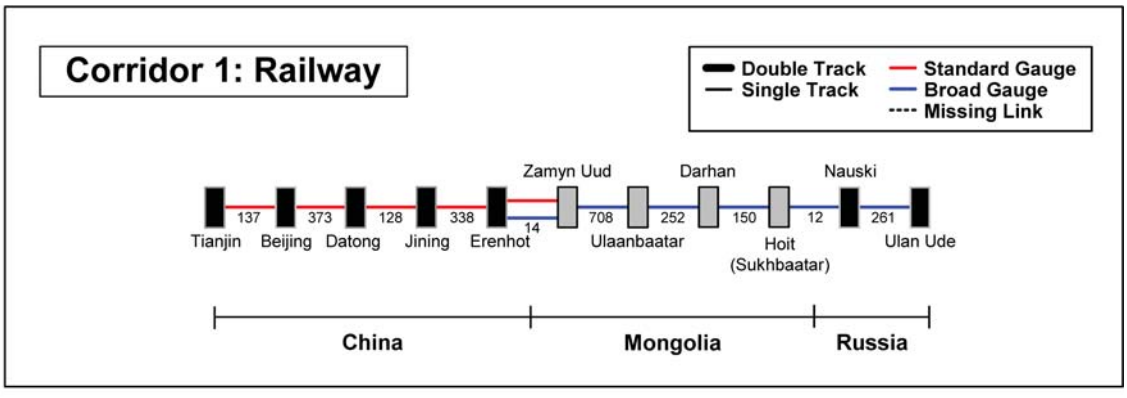

Figure 4-1 Present conditions of railway, Corridor 1

Source: Based on Country reports, ERINA, and Maps produced by UNDP.

[2] http://www.schednet.com/home/index.asp?area=news, 3 November 2004.

Table 4-4 Rail distance between Tanggu to Ulan Ude

Country	From	To	Distance (km)
China	Tianjin	Eranhot	976
Border	Eranhot	Zamin Uud	14
Mongolia	Zamin Uud	Ulaanbaatar	708
	Ulaanbaatar	Hoit(Sukhbaatar)	402
Border	Hoit	Naushki	12*
Russian Federation	Naushki	Ulan Ude	261
Total	(Tianjin-Ulan Ude)		2,373

Note: * estimate

Mongolia, meantime, has an overly high dependency on railway for cargo transportation. Based on tonnage, railway accounted for 86.0 per cent of the total cargo traffic volume in 2002, while road accounted only for 14.0 per cent (Table 4-5). With ton-km based calculation, the dependence on railway reaches to no less than 97.8 per cent. This difference suggests that the railway in Mongolia is used heavily in long-distance cargo transport. Considering Mongolia's vast area and sparse population density, railway seems an adequate mode for long-distance cargo transportation. The present condition of its railway system, however, demands more investment to improve transport time and services. ERINA also mentions the need to introduce reefer containers for dairy products and meat, the main export items for Mongolia.[3]

Table 4-5 Freight traffic volume in Mongolia by mode

Modes	2001				2002			
	1000 tons		million ton-km		1000 tons		million ton-km	
	volume	%	Volume	%	volume	%	volume	%
Railway	10147.7	69.0	5287.9	97.4	11637	86.0	6461.3	97.8
Road	1658.2	11.3	129.5	2.4	1888.7	14.0	133.6	2.0
Inland Waterway	1.7	0.0	0.4	0.0	1.8	0.0	0.5	0.0
Air	2.9	0.0	9.5	0.2	2.4	0.0	9.0	0.1
Total	11810.5	100	5427.3	100	13529.9	100	6604.4	100

Source: National Statistical Office of Mongolia, Mongolian Statistical Yearbook, 2002

Road. Corridor 1 is designated as a North-East Asian section of the Asian Highway by UNESCAP, and provides connections to the Trans Siberian Trunk Highway. The total length of this road route is about 2,163km (Figure 4-2 and Table 4-6).

Paved roads including the Tianjin-Beijing Expressway are available between Tianjin and Jining. The Chinese government plans to upgrade the Beijing-Erenhot section to expressway standards. Roads on the Mongolian side (1,026km) are in poor condition. With the exception of the Ulaanbataar-Altanbulag section (345km) where a motorway is available, most of the Mongolian sections are unpaved.

[3] ERINA,Vision for the Northeast Asia Transportation Corridors, ERINA Booklet, Vol. 1, June 2002.

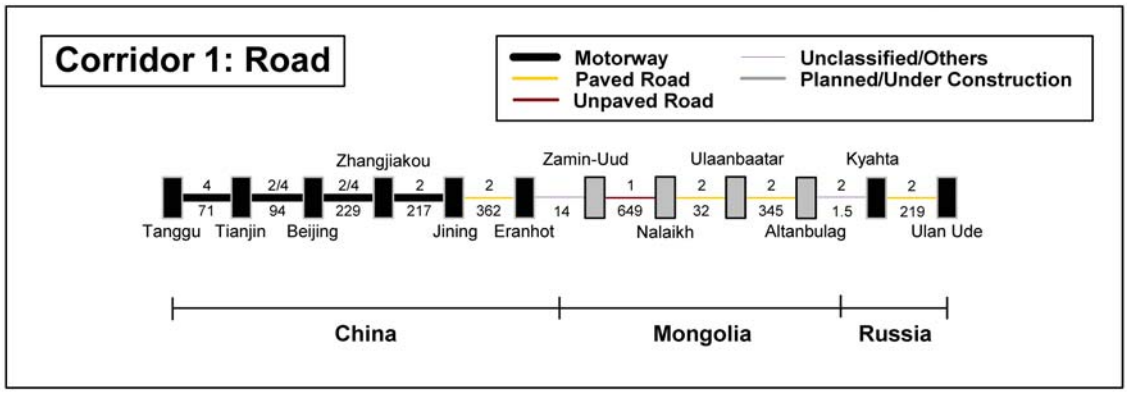

Figure 4-2 Present conditions of road, Corridor 1

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-6 Road distance between Tanggu and Ulan Ude

Country	From	To	Distance (km)
China	Tianjin	Eranhot	902
Border	Eranhot	Zamin Uud	14
Mongolia	Zamin Uud	Ulaanbaatar	681
	Ulaanbaatar	Altanbulag	345
Border	Altanbulag	Kyahta	1.5
Russian Federation	Kyahta	Ulan Ude	219*
Total (Tianjin-Ulan Ude)			**2,162.5**

Note: *Data from UNESCAP, Asian Highway – The road networks connecting China, Kazakhstan, Mongolia, the Russian Federation and the Korean Peninsula, 2001

Although the railway has a higher priority than road as a freight transport mode, road seems to play a crucial role in passenger transport in Mongolia. Based on the number of passengers, road accounts for 95.9 per cent of the total passenger travels, although this share decreases to 18.1 per cent if passenger-kms are considered rather than the number of passengers (Table 4-7). This huge difference suggests that road takes mainly short distance travels. As Mongolia's top priority route, the road development in this corridor is progressing based on the Medium Term Road Master Plan (MRMP), which was formulated in collaboration with the Asian Development Bank and accepted by the cabinet.

Table 4-7 Passenger traffic volume in Mongolia by mode

Modes	2001				2002			
	million passengers		million passenger-km		million passengers		million passenger-km	
	volume	%	volume	%	volume	%	volume	%
Railway	4.1	4.2	1062.2	53.9	4	3.8	1066.5	50.6
Road	94.1	95.5	371.1	18.8	101.4	95.9	380.6	18.1
Air	0.3	0.3	538.9	27.3	0.3	0.3	661.2	31.4
Total	98.5	100.0	1972.2	100.0	105.7	100.0	2108.3	100.0

Source: National Statistical Office of Mongolia, Mongolian Statistical Yearbook, 2002

4.1.3 Transport cost and time analysis

Based on a survey completed by national experts in each country, the cost and time to transport goods from Tianjin Port to Ulan Ude is reflected in Table 4-8[4]. Using this set of data, travel time and distance relationships of the road and rail transport along the Corridor 1 between Tianjin Port and Ulan Ude are presented in a graphical form in Figures 4-3 and 4-4.

Table 4-8 Transportation cost and time from Tianjin Port to Ulan Ude

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Tianjin Port	77.8	10	20	77.8	10	20	77.8
Tianjin-Eranhot	690	14	29	168.6[1]	23	40	168.6
Eranhot-Zamin Uud (Border)	250	24	120	120	12	24	120
Zamin Uud-Ulaanbaatar	95.2	14.8	15.5	150	48	72	95.2
Ulaanbaatar -Altanbulag/Hoit	48.2	4.4	5	85[2]	48[2]	72[2]	48.2
Altanbulag/Hoit-Kyahta/Naushki (Border)	250[3]	5min	10min	120[3]	12	24	120
Kyahta/Naushki -Ulan Ude	160[4]	3.7[5]	7.3[5]	26.1[6]	4.4[5]	8.7[5]	26.1
Total (Tianjin-Ulan Ude)	**1,571.2**	**71**	**197**	**747.5**	**157.4**	**260.7**	**655.9**
$/km	**0.66**			**0.35**			**0.29**

Notes:
1. The cost reported by expert from China is significantly different from ESCAP data ($500).
2. Estimate based on the cost and transit time of Zamin Uud-Ulaanbaatar
3. Estimates based on the cost of Eranhot-Zamin Uud
4. Average trucking charge (15ton) between Moscow-Vladimir (228km) and Moscow-Tver (209km)
5. Estimates based on maximum speed (60km/h) and minimum speed (30km/h)
6. The cost assumed at $0.1 per km

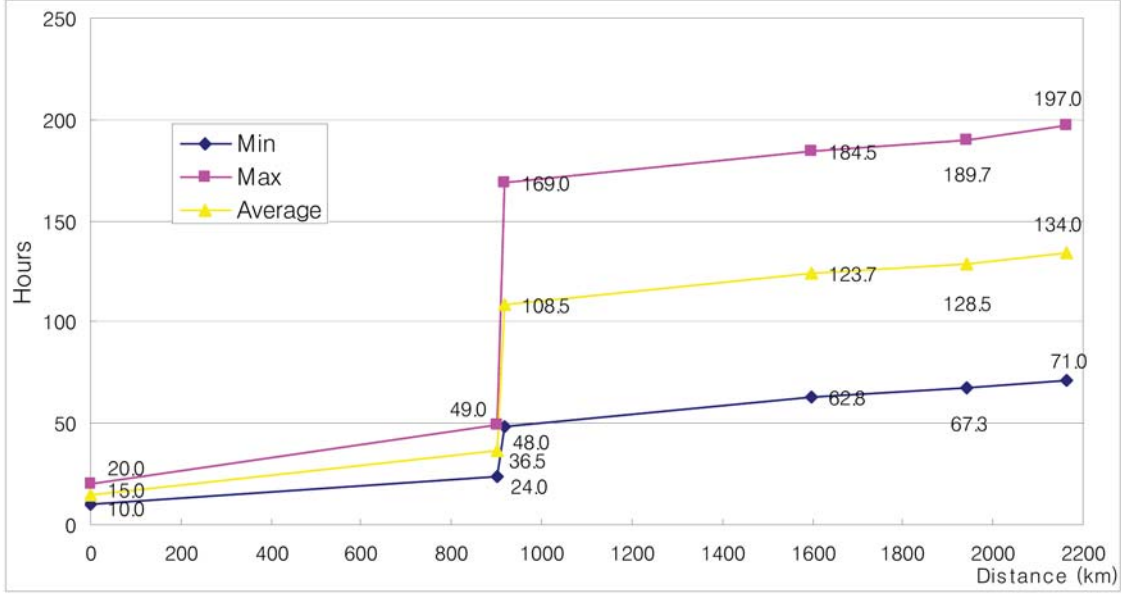

Figure 4-3 Tianjin-Ulan Ude transit time (road)

[4] The cost and time analysis in this chapter are based on the data provided by national experts unless otherwise stated.

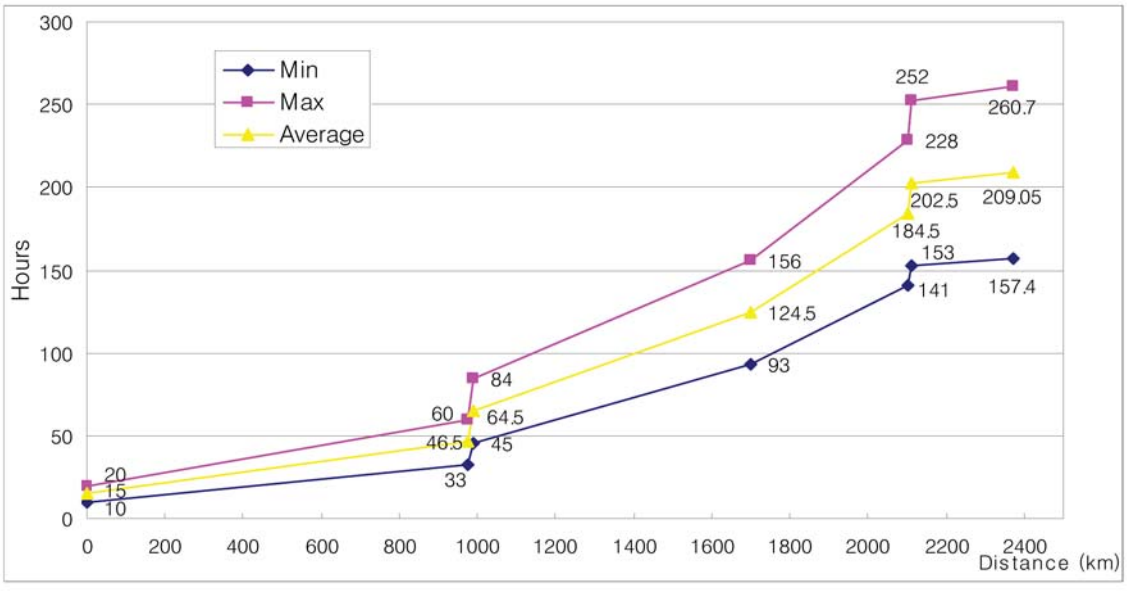

Figure 4-4 Tianjin-Ulan Ude transit time (rail)

Figure 4-5 shows the cost-distance relationship in Corridor 1 by transport mode. The total cost to transport between Tianjin and Ulan Ude by road is about $1,571 (for 2,162.5km) and $747 (for 2,373km) with rail. Theoretically, without considering additional cost for transshipment, the total cost can be reduced to $656 if the road and the rail transport can be combined, i.e., rail transport in China, road transport in Mongolia between Zamin Uud and Altanbulag/Hoit and rail transport between Altanbulag/Hoit and Ulan Ude. Figure 4-6 represents the transport cost breakdown of the this road and rail combined option. Border crossing charges represent about 24 per cent of the total cost, while road and rail transport represent 28 per cent and 33 per cent respectively.

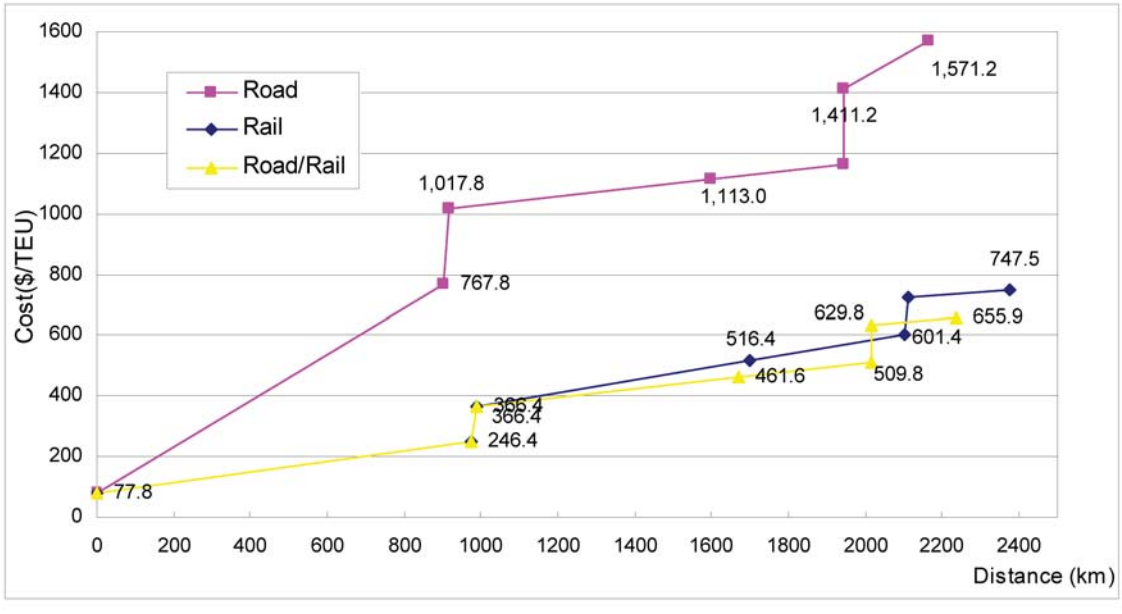

Figure 4-5 Cost-distance (Tianjin-Ulan Ude)

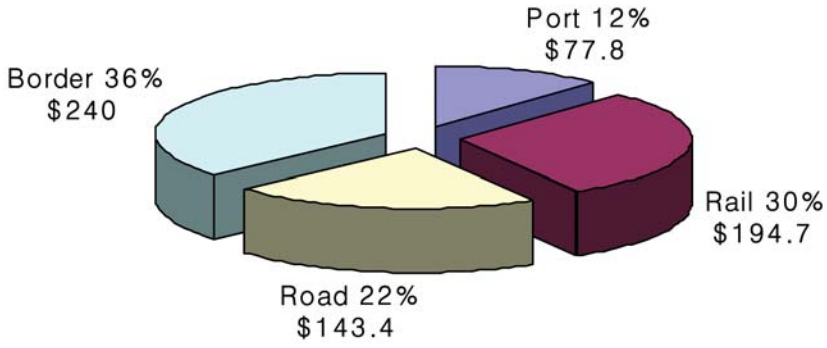

Figure 4-6 Cost breakdowns (road & rail combined)

Routes to consider

Rail route: China-Mongolia-Russian Federation

Intermodal route: China(road)-Mongolia(rail)-Russian Federation(rail)

This combination, however, can be operational only after road infrastructure in Mongolia is upgraded. Possible routes that can be considered presently include (1) unimodal transport entirely by rail and (2) intermodal route with transport in China by road and Mongolia and the Russian Federation by rail. Tables 4-8A, 4-8B and 4-8C, which are all derived from Table 4-8, show tabular information for transport cost and time for these routes, as well as additional cost and time for providing a sea transport connection to Japan with Corridor 1.

Table 4-8A Rail route (U-1.1) from Tianjin Port to Ulan Ude

	Rail		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Tianjin Port	77.8	10	20
Tianjin-Eranhot	168.6	23	40
Eranhot-Zamin Uud (Border)	120	12	24
Zamin Uud-Ulaanbaatar	150	48	72
Ulaanbaatar -Altanbulag/Hoit	85	48	72
Altanbulag/Hoit-Kyahta/Naushki (Border)	120	12	24
Kyahta/Naushki -Ulan Ude	26.1	4.4	8.7
Total (Tianjin-Ulan Ude)	**747.5**	**157.4**	**260.7**
$/km	**0.35**		

Table 4-8B Intermodal route (I-1.2) from Tianjin Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time(hours)		
	($/TEU)	Min	Max	
Tianjin Port	77.8	10	20	-
Tianjin-Eranhot	690	14	29	Road
Eranhot-Zamin Uud (Border)	250	24	120	Road
Zamin Uud-Ulaanbaatar	150	48	72	Rail
Ulaanbaatar -Altanbulag/Hoit	85	48	72	Rail
Altanbulag/Hoit-Kyahta/Naushki (Border)	120	12	24	Rail
Kyahta/Naushki -Ulan Ude	26.1	4.4	8.7	Rail
Total (Tianjin-Ulan Ude)	**1,398.9**	**160.4**	**345.7**	
$/km	**0.61**			

Table 4-8C Transportation cost and time from Kobe Port to Ulan Ude

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Kobe Port	182	NA	NA	182	NA	NA	182
Kobe-Tianjin	929	50[1]	50[1]	929	50[1]	50[1]	929
Tianjin Port	77.8	10	20	77.8	10	20	77.8
Tianjin-Eranhot	690	14	29	168.6	23	40	168.6
Eranhot-Zamin Uud (Border)	250	24	120	120	12	24	120
Zamin Uud-Ulaanbaatar	95.2	14.8	15.5	150	48	72	95.2
Ulaanbaatar -Altanbulag/Hoit	48.2	4.4	5	85	48	72	48.2
Altanbulag/Hoit-Kyahta/Naushki (Border)	250	5min	10min	120	12	24	120
Kyahta/Naushki -Ulan Ude	160	3.7	7.3	26.1	4.4	8.7	26.1
Total (Kobe-Ulan Ude)	**2,682.2**	**-**	**-**	**1,858.5**	**-**	**-**	**1,766.9**
$/km	**-**			**-**			**-**

Note: 1. Average transit time

4.2 CORRIDOR 2 BUSAN-SEOUL-PYEONGYANG-SHENYANG-BEIJING-ZENGZHOU

4.2.1 Significance

Corridor 2 connects the Republic of Korea with China via the Democratic People's Republic of Korea and can be connected to Japan through sea links. This corridor connects Beijing, Seoul and Tokyo (BESETO) metropolitan areas, which is perhaps the most important economic growth axis in North-East Asia (Figure 4-7). Those regions have played the most crucial role in their national economies as well as in socio-political fields. Each metropolitan area holds 7.9 per cent, 46.3 per cent and 26.3 per cent of each country's total population, and accounts for 12.7 per cent, 47.1 per cent, and 30.5 per cent of each country's GDP respectively (Table 4-9).

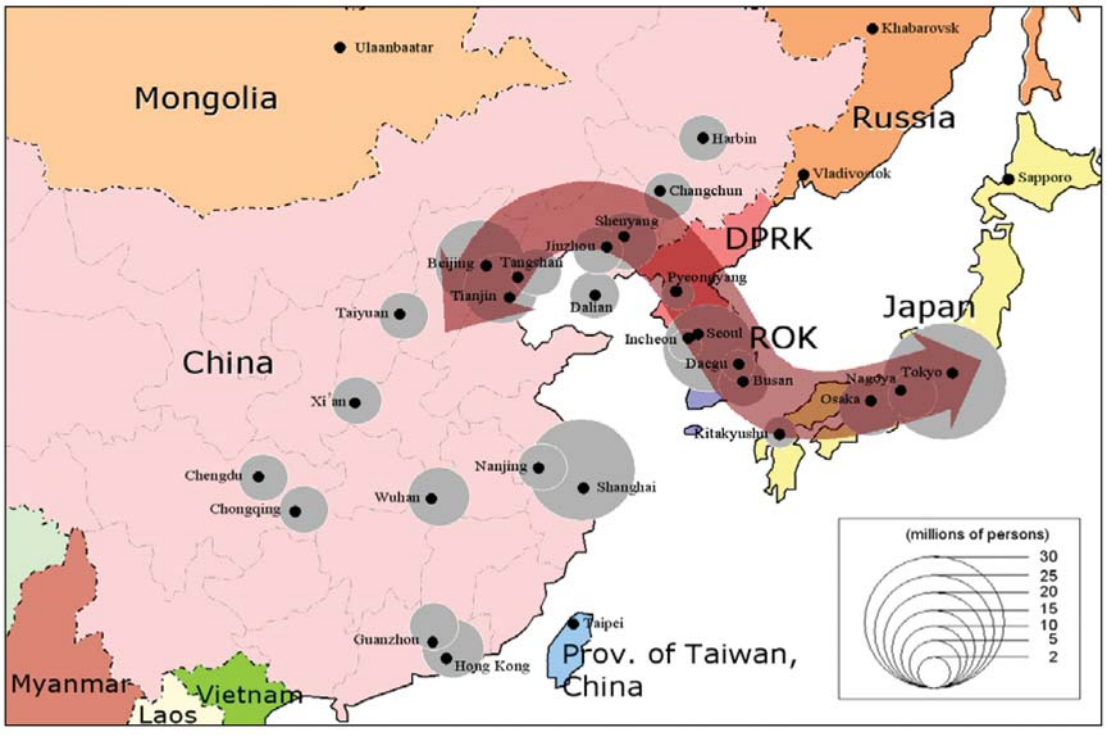

Figure 4-7 BESETO corridor

Source: Adopted from Kim, Won Bae et al, Building Infrastructure for the Facilitation of Economic Cooperation in Northeast Asia in the 21st Century: Focusing on Land Transport Linkages between Korea and China, KRIHS Special Reports No. 3, Korea Research Institute for Human Settlements, 2003.

Table 4-9 Major indicators of three metropolitan areas in the BESETO corridor

Indicators	Population		Gross Regional Domestic Product	
	(thousands)	% Share*	(million US$)	% Share*
Greater Beijing	99,125	7.9	125,226	12.7
Beijing	12,245	1.0	26,263	2.7
Tianjin	9,405	0.7	17,514	1.8
Hebei Province	64,580	5.1	55,186	5.6
Seoul Metropolitan Area	21,354	46.3	191,538	47.1
Seoul	9,895	21.4	87,065	21.4
Incheon	2,475	5.4	19,450	4.8
Gyeonggi Province	8,984	19.5	85,023	20.9
Greater Tokyo	33,418	26.3	1,446,408	30.5
Tokyo	12,064	9.5	603,498	12.7
Chiba Prefecture	5,926	4.7	231,503	4.9
Kanagawa Prefecture	8,490	6.7	335,303	7.1
Saitama Prefecture	6,938	5.5	276,014	5.8

Sources: Korea National Statistical Office (http://www.nso.go.kr); Statistics Bureau of Japan (http://www.stat.go.jp); National Bureau of Statistics of China (http://www.stats.gov.cn)

Note: * % share to each country

In total, the BESETO corridor forms a huge intraregional market composed of population of over 150 million and with a GDP of over US$1.7 trillion, even if other metropolitan areas within the corridor – e.g., Shenyang, Busan and Osaka – are counted out. Needless to say, these areas have been growth poles for national development, and have produced most of North-East Asia's transport and logistics demands. This trend is expected to continue or even strengthen.

Corridor 2 can support transport and logistics demands created along the BESETO corridor. In particular, Corridor 2 may be able to provide China and the Republic of Korea with a highly competitive trade corridor via inland transport connections, although this route is also expected to share part of the logistics demands of Japan's southern regions for trade with northern China. According to Kim, land transport via railway is judged to have enough economic efficiency, particularly in terms of time, to compete with sea transport between Seoul and Shenyang/Beijing (Table 4-10).[5] Corridor 2 via railway, especially, seems to have a high comparative advantage in the section between Seoul and Shenyang. More than 55 per cent of the total transport time by sea can be saved by using railway, while the transport cost gap between the two modes is relatively trivial. It is estimated that Corridor 2 will take charge of about 15 per cent of the cargo volume between Seoul and Beijing, and 40 to 50 per cent of that between Seoul and Shenyang.

Table 4-10 Estimation of transport cost between Seoul and Shenyang/Beijing by mode

Route	*Sea*	*Railway*	*Road*
Seoul – Shenyang			
Distance (km)	957 (533+424*)	769	822
Time (hours)	23 (17.5+5.5*)	9.5	8.5
Cost (Korean Won/ton)	14,000 ($13.5)	19,000 ($18.3)	61,000 ($58.6)
Seoul – Beijing			
Distance (km)	1,013 (852+161*)	1,608	1,361
Time (hours)	30.5 (28.5+2.0*)	20.5	14.0
Cost (Korean Won/ton)	10,000 ($9.6)	39,000 ($37.5)	101,000 ($97.1)

Sources: Kim, Gyeong-Seok. (1998). 'A study on measures for direct land transport within Republic of Korea and the Democratic People's Republic of Korea and Korean reunification'. Seoul, the Republic of Korea: The Ministry of Unification.

Notes: * Railway is assumed as a supportive mode for short distance movement.
1. Basic units for transport time: Road 100km/h, Railway 80km/h, Sea 30km/h.
2. Basic unites for transport cost: Road 74.07 Won ($0.0712)/km(ton, Railway 24.2 Won ($0.0233)/km(ton, Sea 7.48 Won($0.0072)/km(ton. (US$ 1=1,040 Won)

4.2.2 Current situation and prospects

Ports. This corridor starts from two major seaports of the Republic of Korea, Busan and Gwangyang. As of 2003, Busan, the largest seaport of the Republic of Korea, handled 10.4 million TEU, 78.9 per cent of total container cargo volumes for the Republic of Korea, being ranked the fifth in the world container port league. Although its share remains high, dependency on Busan Port has gradually decreased from 88.2 per cent in 1998 since the opening of Gwangyang Port. Most of the cargos handled at Busan Port are from

[3] Kim, Gyeong-Seok (1998), A study on measures for direct land transport within Republic of Korea and the Democratic People's Republic of Korea and Korean reunification, Seoul, the Republic of Korea: The Ministry of Unification.

or toward foreign countries. In 2003, the share of international cargos reached 98.8 per cent, which shows that Busan is essentially an international seaport (Table 4-11). The share of transshipment cargo in Busan Port has rapidly increased from 20.6 per cent in 1998 to 40.9 per cent in 2003, which is an important factor influencing container handling volumes at Busan Port. This also shows the potential of Busan as a regional hub port.

Table 4-11 Structure of container freight handled at Busan Port

Region	1999		2000		2001		2002		2003	
	TEU	%	TEU	%	TEU	%	TEU	%	TEU	%
Total	6,439,589	100	7,540,387	100	8,072,814	100	9,453,356	100	10,407,809	100
Import	2,271,997	35.3	2,483,753	32.9	2,496,764	30.9	2,729,332	28.9	3,029,020	29.1
Export	2,406,194	37.4	2,551,162	33.8	2,513,877	31.1	2,792,399	29.5	3,005,983	28.9
Trans-shipment	1,632,473	25.4	2,389,956	31.7	2,942,983	36.5	3,887,457	41.1	4,251,076	40.9
Domestic	128,925	2.0	115,516	1.5	119,190	1.5	44,168	0.5	121,730	1.2

Source: Korea Container Terminal Authority

The most popular partner region of Busan Port has been North-East Asia. In 2003, container cargos from/toward North-East Asia accounted for 45.6 per cent of the total foreign trade container cargos handled at Busan Port (Table 4-12). Busan New Port is under construction in Gadok Island, around 60km west of Busan. When completed with investment of $7.7 billion, Busan New Port will be equipped with 30 container berths (25 main line berths and 5 feeder berths) of a total length 9,950m with an annual capacity of 8.04 million TEU. The first three berths are scheduled to start operation in 2006.

Table 4-12 Regional distribution of container freight handled at Busan Port

Region	1999		2000		2001		2002		2003	
	TEU	%	TEU	%	TEU	%	TEU	%	TEU	%
World	6,310,664	100	7,424,871	100	7,953,624	100	9,409,188	100	10,286,079	100
North-East Asia	2,534,143	40.2	3,071,837	41.4	3,544,006	44.6	4,302,066	45.7	4,688,720	45.6
North America	1,455,069	23.1	1,651,386	22.2	1,711,706	21.5	1,998,273	21.2	2,209,392	21.5
Southeast Asia	599,533	9.5	654,665	8.8	825,525	10.4	896,101	9.5	921,287	9.0
Europe	690,481	10.9	710,689	9.6	734,927	9.2	873,594	9.3	922,384	9.0
Others	1,031,438	16.3	1,336,294	18.0	1,137,460	14.3	1,339,154	14.2	1,544,296	14.9

Source: Korea Container Terminal Authority
Note: Domestic container cargos are excluded.

Gwangyang Port, the second largest container seaport of the Republic of Korea, started its container operation in July 1998. The container throughput at Gwangyang Port reached 1 million TEU in 2002, after four years of operation, and 1.18 million TEU in 2003. Nearly 30 per cent of total container throughput at the Gwangyang Port is transshipment containers mainly to and from China. Since 1999, the most frequent origin or destination of containers handled in Gwangyang Port has been North-East Asia, whose share of total international cargos has doubled from 28.8 per cent in 1999 to 59.0 per cent in 2003 (Table 4-13). This trend is expected to be continued or deepened with the rapid expansion of the Republic of Korea's economic exchange with China.

Table 4-13 Structure of container freight handled at Gwangyang Port

Region	1999		2000		2001		2002		2003	
	TEU	%	TEU	%	TEU	%	TEU	%	TEU	%
Total	417,344	100	642,230	100	855,310	100	1,080,333	100	1,184,842	100
Import	206,304	49.4	282,886	44.0	319,450	37.3	346,024	32.0	387,180	32.7
Export	181,015	43.4	268,312	41.8	326,001	38.1	372,047	34.4	415,492	35.1
Transshipment	28,080	6.7	64,129	10.0	165,727	19.4	314,355	29.1	343,888	29.0
Domestic	1,945	0.5	26,903	4.2	44,132	5.2	47,907	4.4	38,282	3.2

Source: Korea Container Terminal Authority

Table 4-14 Regional distribution of container freight handled at Gwangyang Port

Region	1999		2000		2001		2002		2003	
	TEU	%	TEU	%	TEU	%	TEU	%	TEU	%
World	415,394	100.0	615,324	100.0	811,174	100.0	1,032,426	100.0	1,146,560	100.0
North-East Asia	119,765	28.8	217,217	35.3	386,315	47.6	615,149	59.6	676,327	59.0
North America	112,272	27.0	178,266	29.0	213,927	26.4	222,287	21.5	256,096	22.3
Southeast Asia	68,954	16.6	153,008	24.9	136,706	16.9	89,844	8.7	123,178	10.7
Europe	90,260	21.7	35,431	5.8	26,590	3.3	33,808	3.3	17,521	1.5
Others	24,143	5.8	31,402	5.1	47,636	5.9	71,338	6.9	73,438	6.5

Source: Korea Container Terminal Authority
Note: Domestic container cargos are excluded

Gwangyang container terminal is currently equipped with four 20,000 dwt-class and eight 50,000 dwt-class container berths (length 3,700m, depth 12-15m), which were constructed during the first and second phases of the port development plan. The third and fourth phases are under way to build 21 container berths with a total length of 7,350m until 2011. When completed, the Gwangyang Port will have 33 container berths with a handling capacity of 9.33 million TEU every year. To keep up with a global trend of increase in container ship sizes, four berths scheduled for 2006 (phase 3-1) will be able to accommodate vessels up to 12,000 TEU and three berths scheduled for 2008 (phase 3-2) are to be constructed as automated container terminals (ACT).

Railway. Corridor 2 spreads over three countries – the Republic of Korea, the Democratic People's Republic of Korea and China. At present, this route is not in operation because of missing links between the Republic of Korea and the Democratic People's Republic of Korea. However, as the Republic of Korea and the Democratic People's Republic of Korea agreed to the reconnection of railways and roads after the two Koreas' summit meeting of 2000, this route has attracted public attention as a major subregional corridor. The reconnection of railway seems crucial, because railway is advantageous for long-distance transport, environmentally sound, and preferred by the Government of the Democratic People's Republic of Korea.

As of July, 2003, Republic of Korea's sections of Corridor 2's missing links had already been restored, but sections of the Democratic People's Republic of Korea still remained at a standstill. For Corridor 2 to work, the 13.8km section between the Demilitarized Zone (DMZ) and Gaeseong should be recovered (Figure 4-8).

However, even if the missing links are restored, bottlenecks need to be dealt with in order to increase the total efficiency of the corridor. The railway is the most important transport mode in the Democratic People's Republic of Korea and accounts for 60 per cent of the total passenger transport and 90 per cent of the total cargo transport. Most of the railway sections consist of single tracks, and inadequate facilities and a shortage of electricity supply affect normal operations. Railways in the Democratic People's Republic of Korea's section along the Corridor 2 also has similar constraints. Although electrification has been completed, much work has to be done to ensure the its operation as a major international transport corridor.

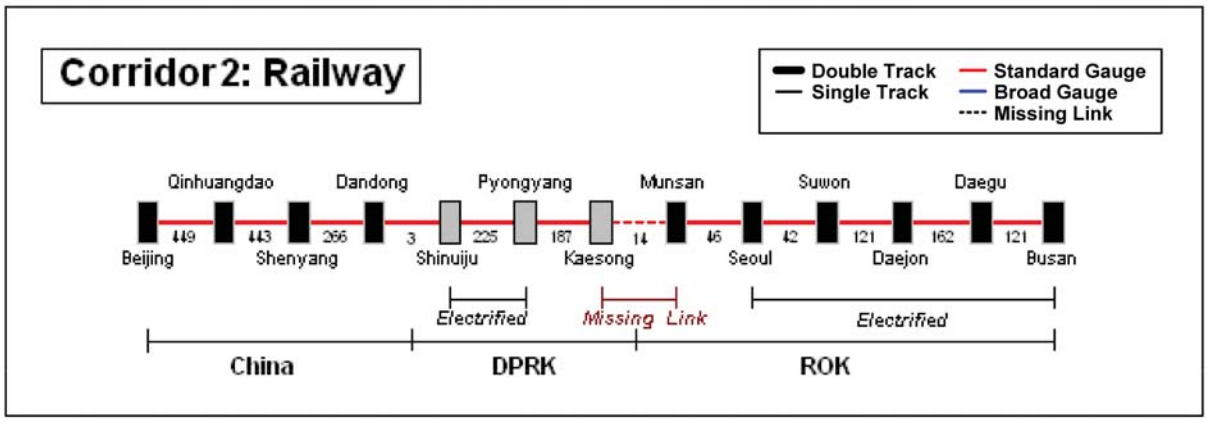

Figure 4-8 Present conditions of railway, Corridor 2

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Until the mid-1990s, the Republic of Korea had not made significant investment in improving its railway infrastructure. As a result, railway facilities became decrepit and unable to provide a high level of service. As of 1999, the ratio of double-tracked sections was no higher than 28 per cent; and just 18 per cent of the total railway network were electrified, which became a main reason for the low average train speed of between 50km/h and 100km/h, and the railway's low cargo transport share of 15.8 per cent[6]. However, the government of the Republic of Korea is striving to relieve this problem with national railway projects. Those projects include the upgrade of existing railways and the construction of new high-speed railway lines. The first high-speed railway line was opened between Seoul and Busan in 2004.

Much of China's section of the Corridor 2 also experiences traffic demands surpassing its traffic capacity. In particular, the section between Shenyang and Dandong, just 31.3 per cent of which is double-tracked[7], needs to be electrified and entirely double-tracked.

Distance and characteristics data were collected from national experts in each country (except the Democratic People's Republic of Korea). Based on their report, the total railway length of this route is about 2,077km[8] with the standard track gauge of 1,435mm. The rail between Busan and Munsan stretches about 490km with double and multi-track, although the line between Munsan and Seoul has only single track. A single-track electrified line runs from Pyongyang to Shinuiju for the distance of 225km. At Shinuiju, the railway is linked to Dandong in China by a bridge over the Yalu River. The total railway length from

[6] Korea Railroad Corporation (http://www.korail.go.kr/100th/year/c.html).

[7] Total length of Dandong-Shenyang railway is 283km, of which 88.6km is double-tracked.

[8] Democratic People's Republic of Korea's railway distance is gathered from other sources.

Dandong to Beijing is 1,158km with single track from Dandong to Shenyang and double track from Shenyang to Beijing (Table 4-15).

Table 4-15 Rail distance between Busan and Beijing

Country	From	To	Distance (km)
Republic of Korea	Busan Seoul	Seoul Munsan	444.5 46.0
Border	Munsan	Gaesung	13.8
Democratic People's Republic of Korea	Gaesung	Pyongyang	187
	Pyongyang	Shinuiju	225
Border	Shinuiju	Dandong	3.1
China	Dandong Shenyang	Shenyang Beijing	266 892
Total (Busan-Beijing)			**2,077.4**

Road. As with the railway, a missing link between the Democratic People's Republic of Korea and the Republic of Korea hinders the road of Corridor 2 from activation. At present, the section between Panmunjeom and Gaeseong is also disconnected. The two countries have agreed to the reconnection of the missing link, though no work has been done towards its realization yet (Figure 4-9).

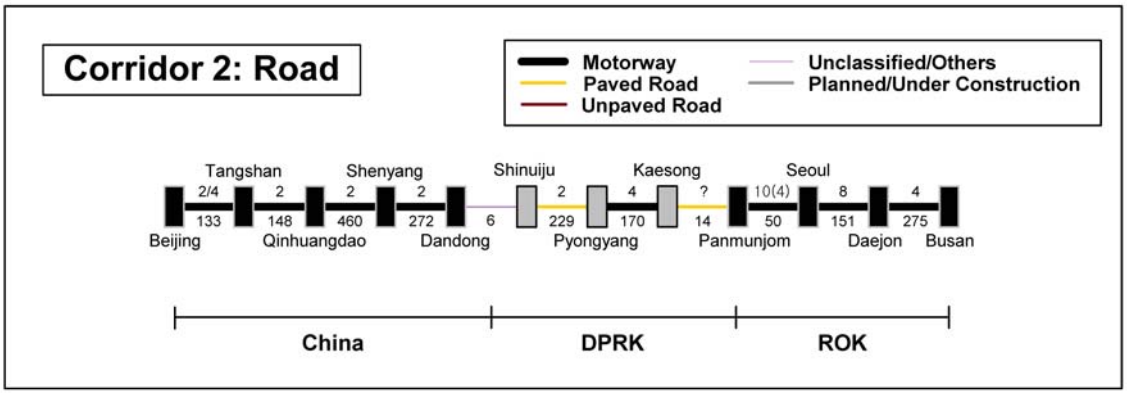

Figure 4-9 Present conditions of road, Corridor 2

Sources: Based on Country reports, ERINA and Maps produced by UNDP.

The road condition in the Republic of Korea is relatively good with the total length of 86,989km, 2,659km of which are at expressway standards, as of 2002 and 74.5 per cent of which are paved, as of 1999. Corridor 2 covers Gyeongbu and Honam Expressways. Gyeongbu Expressway, which connects Seoul with Busan, has been playing the most crucial role as the first expressway and amain artery in Republic of Korea's transportation. All sections of the expressway are composed of four, six, or eight lanes, and its total length is 417km. Some of the sections are reported as chronically congested. Honam Expressway, on the other hand, is an important transport axis which connects Gwangyang with Daejeon. All sections consist of four lanes and its total length is 249km.

The Democratic People's Republic of Korea considers road as a complementary transport mode to railway. The total length of the road network is about 34,000km, and the pavement rate is 8.1 per cent and some 30 per cent of all roads are narrow paths with a width of 2.4m or less, through which cars cannot move. Some expressways of 661km have six lanes or more. In the Democratic People's Republic of Korea's section of Corridor 2, both a four lane expressway (7m wide) and a Grade A road line (4.9 to 7.3m wide), paved with asphalt and concrete, pass between Gaeseong and Anju, to which Shineuiju is connected through a concrete-paved Grade A road. Despite the road conditions, the Gaeseong-Shineuiju section, one of the most important transport corridors for the Democratic People's Republic of Korea, does not seem to have serious difficulties in vehicle movement. The total length is about 400km and the road is capable of carrying most types of vehicles.

In China's section of Corridor 2, expressways exist from Shenyang through Beijing to Zhengzhou. This expressway line forms a backbone of China's 5(7 national trunk highway system. The section between Dandong and Shenyang, which is used as one of the Democratic People's Republic of Korea's main trade windows to China, is connected through a Grade A highway. This line has two to four lanes designed for travel speeds of 50km/hour, except for the section between Qinhuangdao and Beijing (where the design speed is 80km/hour). The average annual daily traffic (AADT) of China's section of Corridor 2 is about 35,000 vehicles and the segment has average degree of congestion (Table 4-16.)

Table 4-16 Road distance between Busan and Beijing

Country	From	To	Distance (km)
Republic of Korea	Busan Seoul	Seoul Panmunjum	425.5 49.8
Border	Panmunjum	Gaesung	13.8
Democratic People's Republic of Korea	Gaesung	Pyongyang	170.0
	Pyongyang	Shinuiju	228.8
Border	Shinuiju	Dandong	6
China	Dandong Shenyang	Shenyang Beijing	272 741
Total (Busan-Beijing)			**1,906.9**

4.2.3 Transport cost and time

Table 4-17 shows the cost and time to transport a container from Busan Port in the Republic of Korea to Beijing in China. The data were provided by national experts of each country; however, for the Democratic People's Republic of Korea, which has not yet reported its information, estimates based on other sources were used. Using this set of data, travel time and distance relationships of the road and rail transport along the Corridor 2 between Busan Port and Beijing are presented in a graphical form in Figures 4-10 and 4-11.

Table 4-17 Cost and time for transport from Busan Port to Beijing

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Busan Port	75	10	20	75	10	20	75
Busan-Panmunjum/Munsan	480	5.1	8	135	7	10	135
Panmunjum/Munsan-Gaesung (Border)	420[1]	4.3[1]	28.3[1]	420[1]	4.3[1]	28.3[1]	420
Gaesung-Shinuiju	199.4[2]	11.5[3]	22.9[3]	82.4[4]	10.3[3]	20.6[3]	82.4
Shinuiju-Dandong (Border)	40	1	12	40	7	12	40
Dandong-Beijing	810	15	30	205	17	26	205
Total (Busan-Beijing)	**2,024.4**	**46.9**	**121.2**	**957.4**	**55.6**	**116.9**	**957.4**
$/km	**1.06**			**0.46**			**0.46**

Notes:
1. Data based on the cost and transit time of road distance between Paju and Gaesung from Hyundai-Asan Co. Ltd.
2. The cost assumed by $0.5 per km
3. Estimate based on maximum speed (40km/h) and minimum speed (20km/h) in Democratic People's Republic of Korea
4. The cost assumed at $0.2 per km

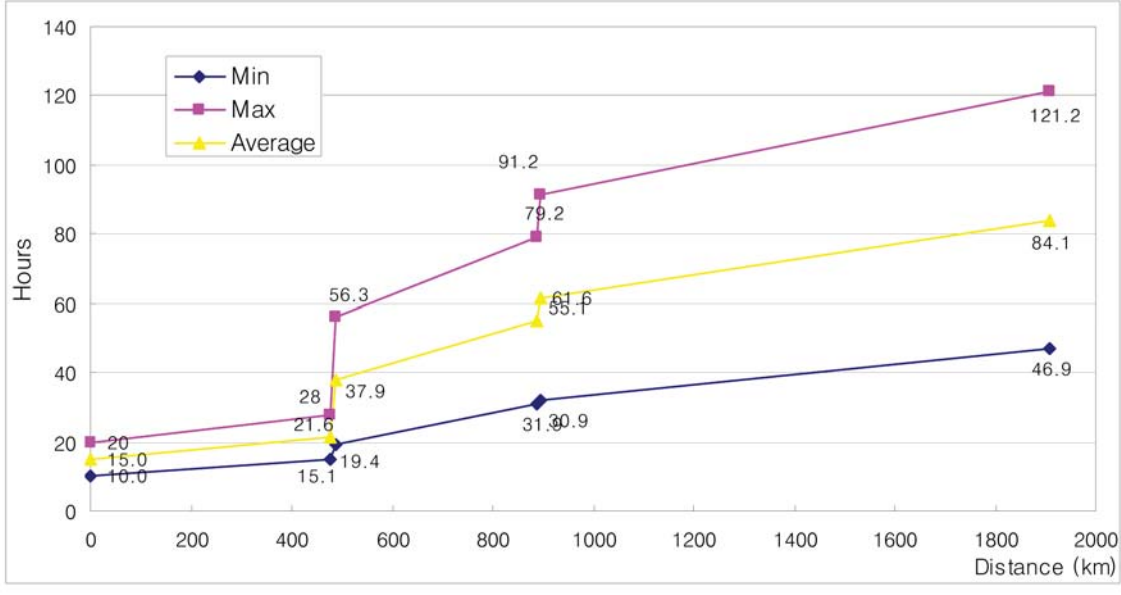

Figure 4-10 Busan-Beijing transit time (road)

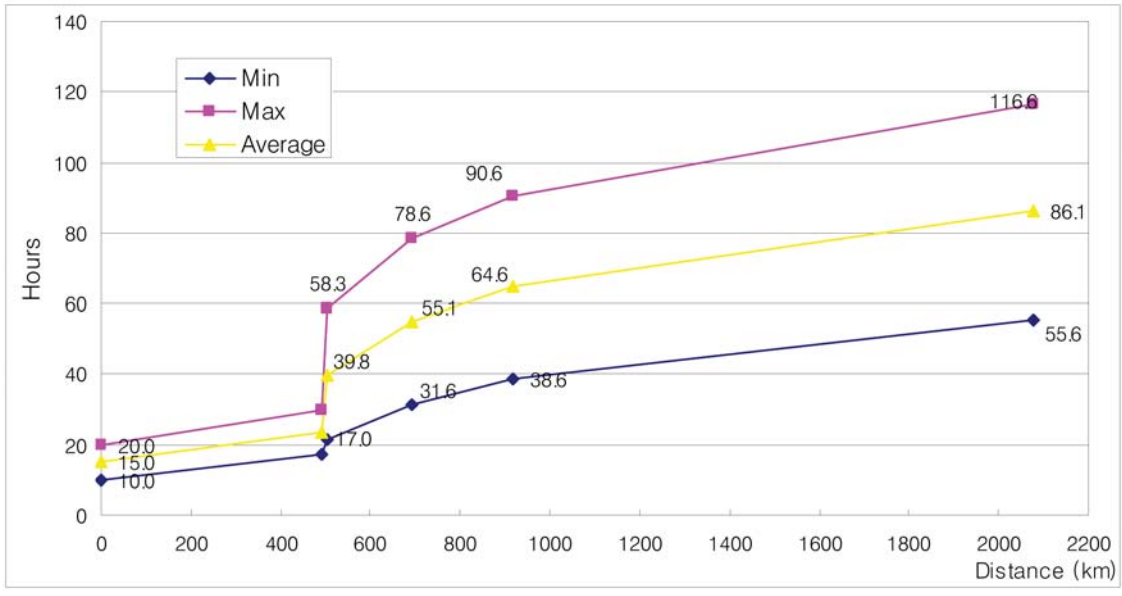

Figure 4-11 Busan-Beijing transit time (rail)

Figure 4-12 shows the cost-distance relationship in Corridor 2 by transport mode. The total cost to transport from Busan to Beijing by road is estimated $2,024 per TEU (for 1,907km) and $957 per TEU (for 2,077km) with rail. Unimodal option by rail transport for the whole journey provides the lowest transport costs.

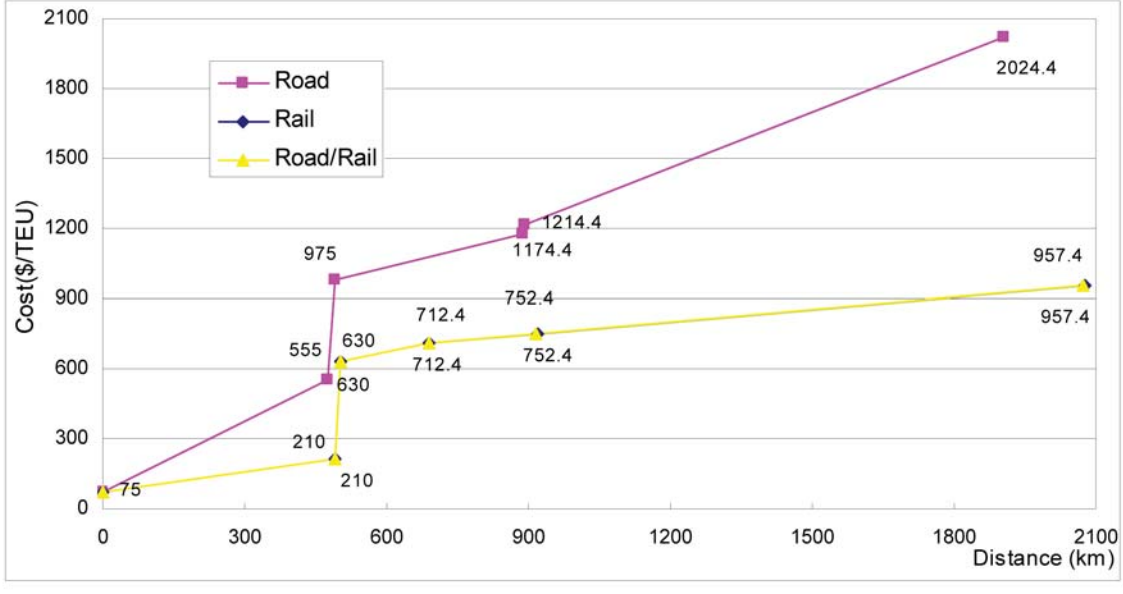

Figure 4-12 Cost-distance (Busan-Beijing)

Routes to consider

- Rail route: China-Democratic People's Republic of Korea-Republic of Korea
- Intermodal route 1: China (road)-Democratic People's Republic of Korea (rail)-Republic of Korea (rail)
- Intermodal route 2: China (rail)-Democratic People's Republic of Korea (rail)-Republic of Korea (road)
- Intermodal route 3: China (road)-Democratic People's Republic of Korea (rail)-Republic of Korea (road)

In addition to this all-rail alternative, three intermodal routes can be considered in view of existing situation of the Corridor 2. Tables 4-17A to 4-17E, which are all derived from Table 4-17, show tabular information for transport cost and time for these routes, as well as additional cost and time for providing sea transport connection to Japan with Corridor 2.

Table 4-17A Rail route (U-2.1) from Busan Port to Beijing

	Rail		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Busan Port	75	10	20
Busan-Panmunjum/Munsan	135	7	10
Panmunjum/Munsan-Gaesung (Border)	420	4.3	28.3
Gaesung-Shinuiju	82.4	10.3	20.6
Shinuiju-Dandong(Border)	40	7	12
Dandong-Beijing	205	17	26
Total (Busan-Beijing)	**957.4**	**55.6**	**116.9**
$/km	**0.46**		

Table 4-17B Intermodal route (I-2.2) from Busan Port to Beijing

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Busan Port	75	10	20	-
Busan-Panmunjum/Munsan	480	5.1	8	Road
Panmunjum/Munsan-Gaesung (Border)	420	4.3	28.3	Road
Gaesung-Shinuiju	82.4	10.3	20.6	Rail
Shinuiju-Dandong (Border)	40	7	12	Rail
Dandong-Beijing	205	17	26	Rail
Total (Busan-Beijing)	**1,302.4**	**53.7**	**114.9**	
$/km	**0.63**			

Table 4-17C Intermodal route (I-2.3) from Busan Port to Beijing

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Busan Port	75	10	20	-
Busan-Panmunjum/Munsan	135	7	10	Rail
Panmunjum/Munsan-Gaesung (Border)	420	4.3	28.3	Rail
Gaesung-Shinuiju	82.4	10.3	20.6	Rail
Shinuiju-Dandong (Border)	40	1	12	Road
Dandong-Beijing	810	15	30	Road
Total (Busan-Beijing)	**1,562.4**	**47.6**	**120.9**	
$/km	**0.81**			

Table 4-17D Intermodal route (I-2.4) from Busan Port to Beijing

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Busan Port	75	10	20	-
Busan-Panmunjum/Munsan	480	5.1	8	Road
Panmunjum/Munsan-Gaesung (Border)	420	4.3	28.3	Road
Gaesung-Shinuiju	82.4	10.3	20.6	Rail
Shinuiju-Dandong (Border)	40	1	12	Road
Dandong-Beijing	810	15	30	Road
Total (Busan-Beijing)	**1,907.4**	**45.7**	**118.9**	
$/km	**0.99**			

Table 4-17E Cost and time for transport from Tokyo to Beijing

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Tokyo-Hakata Port	439	18[1]	18[1]	2,273	72[1]	72[1]	439
Hakata Port	242	NA	NA	242	NA	NA	242
Hakata Port-Busan Port	470	13.5[1]	13.5[1]	470	13.5[1]	13.5[1]	470
Busan Port	75	10	20	75	10	20	75
Busan-Panmunjum/Munsan	480	5.1	8	135	7	10	135
Panmunjum/Munsan-Gaesung (Border)	420	4.3	28.3	420	4.3	28.3	420
Gaesung-Shinuiju	199.4	11.5	22.9	82.4	10.3	20.6	82.4
Shinuiju-Dandong(Border)	40	1	12	40	7	12	40
Dandong-Beijing	810	15	30	205	17	26	205
Total (Tokyo-Beijing)	**3,175.4**	**-**	**-**	**3,942.4**	**-**	**-**	**2,108.4**
$/km	**-**			**-**			**-**

Note: 1. Average transit time

4.3 CORRIDOR 3 BUSAN-POHANG-KOSONG-WONSAN-KIMCHAEK-SONBONG-RAZDOLNOYE-USSURIYSK-KHABAROVSK-BELOGORSK-CHITA-ULAN UDE

4.3.1 Significance

Corridor 3 runs up the eastern side of the Korean Peninsula from Busan, as far as the Rajin-Sonbong Economic and Trade Zone in the Democratic People's Republic of Korea, and then crosses the Russian border into the Khasan area to join with the Siberian Land Bridge (SLB) transportation corridor. As with Corridor 2, this corridor is not yet functioning because of missing link between the Democratic People's Republic of Korea and the Republic of Korea. In addition to promoting cargo transportation between the Democratic People's Republic of Korea and the Republic of Korea, the development of this corridor would secure an overland transportation route from the Republic of Korea and the Russian Far East. Furthermore, by connecting up with the SLB corridor, the corridor would diversify transportation routes from East Asia to Europe.

4.3.2 Current situation and prospects

Railway. It is hoped that this corridor will provide an overland link between the Republic of Korea and the Russian Federation through the Democratic People's Republic of Korea. All of the railway sections in the Korean Peninsula along this corridor are single track with a standard track gauge of 1,435mm, while the Russian Federation has broad gauge (1,520mm) double track, except for the track between Hasan and Baranovsky. Both standard and broad gauge rails are available for 50km between Rajin/Sonbong in the Democratic People's Republic of Korea and Hasan in the Russian Federation. The total length of this rail route is about 5,242km. Table 4-18 lists major segment distances along this rail route.

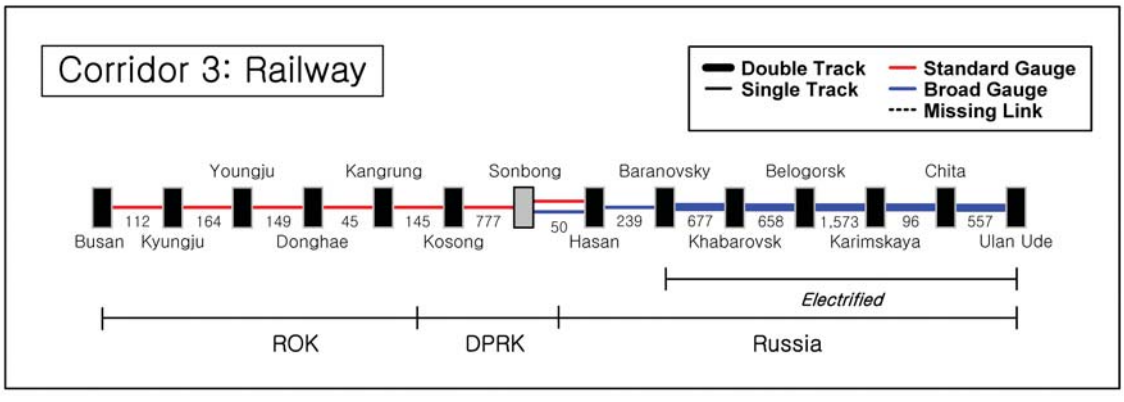

Figure 4-13 Present conditions of rail, Corridor 3

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-18 Rail distance between Busan and Ulan Ude

Country	From	To	Distance (km)
Republic of Korea	Busan Kyongju	Kyongju Kangnung	112.3 357.3
Border	Kangnung	Kosong	145
Democratic People's Republic of Korea	Kosong	Wonsan	117[1]
	Wonsan	Rajin/Sonbong	660[1,2]
Border	Rajin/Sonbong	Hasan	50[3]
Russian Federation	Hasan Ussuriysk Khabarovsk Belogorsk Chita	Ussuriysk Khabarovsk Belogorsk Chita Ulan Ude	262 654 658 1,669 557
Total (Busan-Ulan Ude)			**5,241.6**

Notes: 1. Data from KOTI ' Plan for an Comprehensive Transport System of Korean Peninsula in Preparation for Unification(1998)'
2. Distance between Wonsan and Rajin
3. Distance between Rajin and Hasan

Road. The physical road conditions in the Korean Peninsula being the same as described above for Corridor 2, the main issue in this corridor is the lack of connectivity between the Democratic People's Republic of Korea and the Republic of Korea. Priority therefore needs to be given to pursuing the established transportation agreement by the two Koreas to enable this corridor to function. On the Republic of Korea side, a well paved ordinary road exists from Busan to Gangnung along the eastern coastline of the Korean Peninsula. In the Democratic People's Republic of Korea, however, while the road from Kumgangsan to Wonsan is a highway, the road from Wonsan to Rajin/Sonbong is understood to be unpaved. The total length of the Democratic People's Republic of Korea's road section of Corridor 3 from Kosong to Rajin/Sonbong is about 650km. Of this 650km, 198km are paved and in fair condition, while the remaining section needs to be upgraded (Table 4-19).

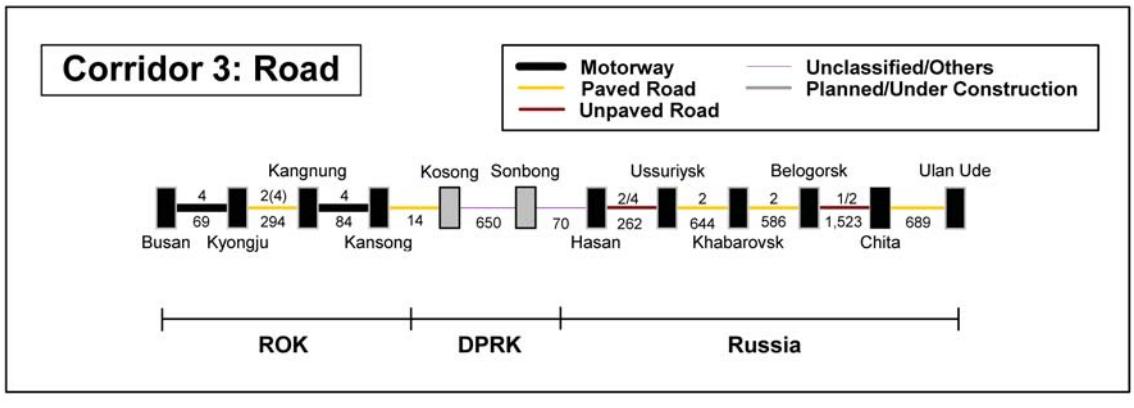

Figure 4-14 Present conditions of road, Corridor 3

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-19 Road distance between Busan and Ulan Ude

Country	From	To	Distance (km)
Republic of Korea	Busan Kyongju Kangnung	Kyongju Kangnung Kansong	68.7 293.9 83.9
Border	Kansong	Kosong	14.2
Democratic People's Republic of Korea	Kosong Wonsan Kimchaek	Wonsan Kimchaek Sonbong	650[1]
Border	Sonbong	Hasan	50[2]
Russian Federation	Hasan Ussuriysk Khabarovsk Belogorsk Chita	Ussuriysk Khabarovsk Belogorsk Chita Ulan Ude	262 644 586 1,523 689[3]
Total (Busan-Ulan Ude)			**4,864.7**

Notes: 1. Data from UNESCAP, Priority Road Network in North-East Asia, 2002
2. Rail Distance between Rajin and Hasan
3. Estimate based on difference between Moscow-Chita and Moscow-Ulan Ude distance

4.3.3 Transport cost and time

Table 4-20 shows the cost and time required to transport a container from Busan Port in the Republic of Korea to Ulan Ude in the Russian Federation along the Corridor 3.

Table 4-20 Cost and time for transport from Busan Port to Ulan Ude

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Busan Port	75	10	20	75	10	20	75
Busan-Kansung/Kangnung	358	4	7	150	4.8	6.8	150
Kansung/Kangnung-Kosong (Border)	600[1]	5[1]	29[1]	NA	NA	NA	600
Kosong-Sonbong	325[2]	16.3[3]	32.5[3]	196	8.3	11.5	196
Sonbong-Hasan (Border)	218[4]	1[4]	3[4]	218[4]	1[4]	3[4]	218
Hasan-Ulan Ude	2,003[5]	61.7[6]	123.5[6]	636	47.5	94	636
Total (Busan-Kansung) (Busan-Ulanude)	**433.0 3,579.0**	**14 144.0**	**27 215.0**	**225**	**14.8**	**26.8**	**225.0 1,875.0**
$/km	**0.74**			**-**			**0.36**

Notes: 1. Data based on the cost and transit time of road distance between Sokcho and Gumgangsan from Hyundai-Asan Co. Ltd.
2. The cost assumed at $0.5 per km
3. Estimates based on maximum speed (40km/h) and minimum speed (20km/h) in Democratic People's Republic of Korea
4. Estimate based on the cost and transit time of Wonjong-Quanhe
5. Average trucking charge (15ton) between Moscow-Ust-Kamenogorsk (3,775km) and Moscow-Novosibirsk (3,785km)
6. Estimates based on them in and max transit time using maximum speed (60km/h) and minimum speed (30km/h)

The data for Table 4-20 were provided by national experts of each country; however, for the Democratic People's Republic of Korea, which has not yet reported its information, the study team made estimates based on other sources available. Using this set of data, travel time and distance relationships of the road and rail transport between Busan Port and Ulan Ude are presented in a graphical form in Figures 4-15 and 4-16.

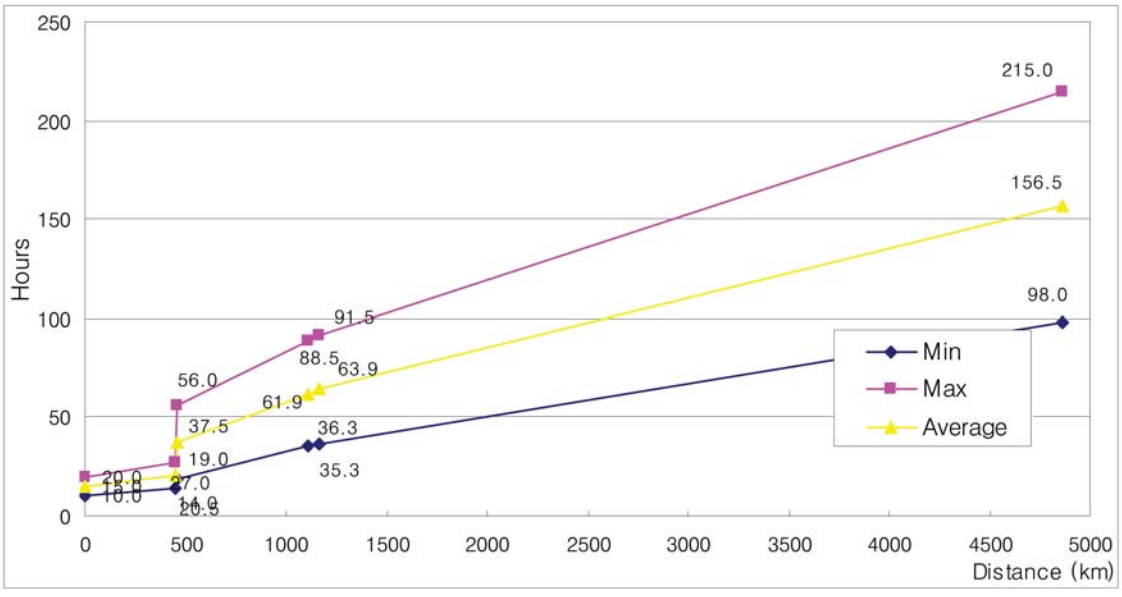

Figure 4-15 Busan-Ulan Ude transit time (road)

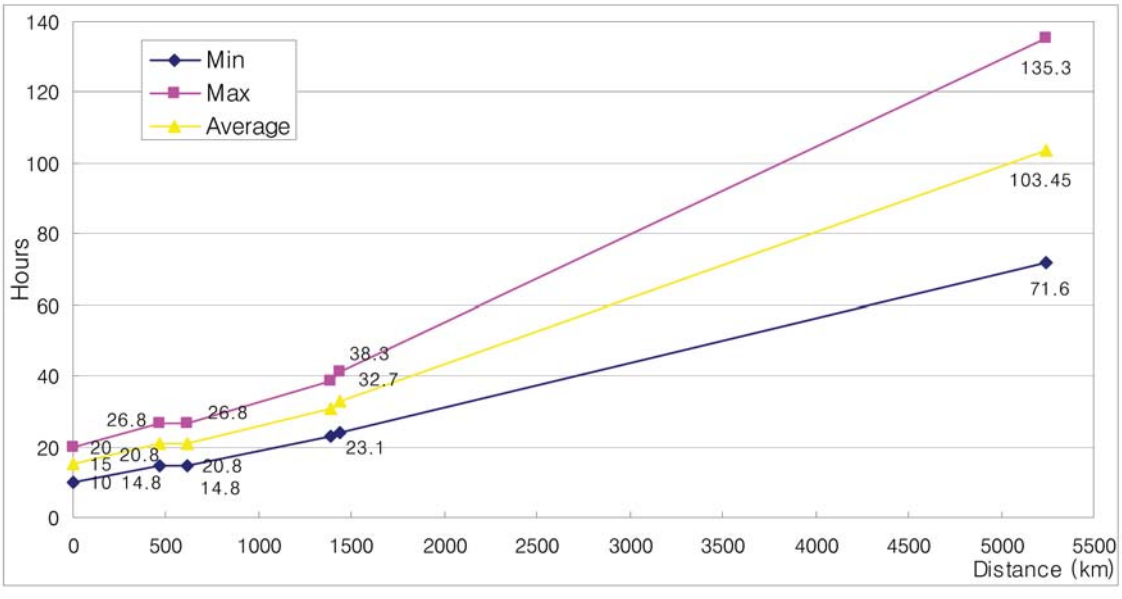

Figure 4-16 Busan-Ulan Ude transit time (rail)

Figure 4-17 shows the cost-distance relationship in Corridor 3 by transport mode. For the section in the Republic of Korea, the cost of road transport is about $433 per TEU and the rail cost is about $225 per TEU. In Russian Federation, for transporting containers from Hasan to Ulan Ude (3,800km), it is estimated that rail transport costs about $636 per TEU, compared to $2,003 per TEU by road. Estimates for the Democratic People's Republic of Korea's section are based on the values of the Republic of Korea. Using rail transportation for the entire route seems to provide the lowest transport cost. However, due to the missing link of 145km between Gangnung and Kosong crossing the border between the two Koreas, an all-rail option along the Corridor 2 is currently not feasible.

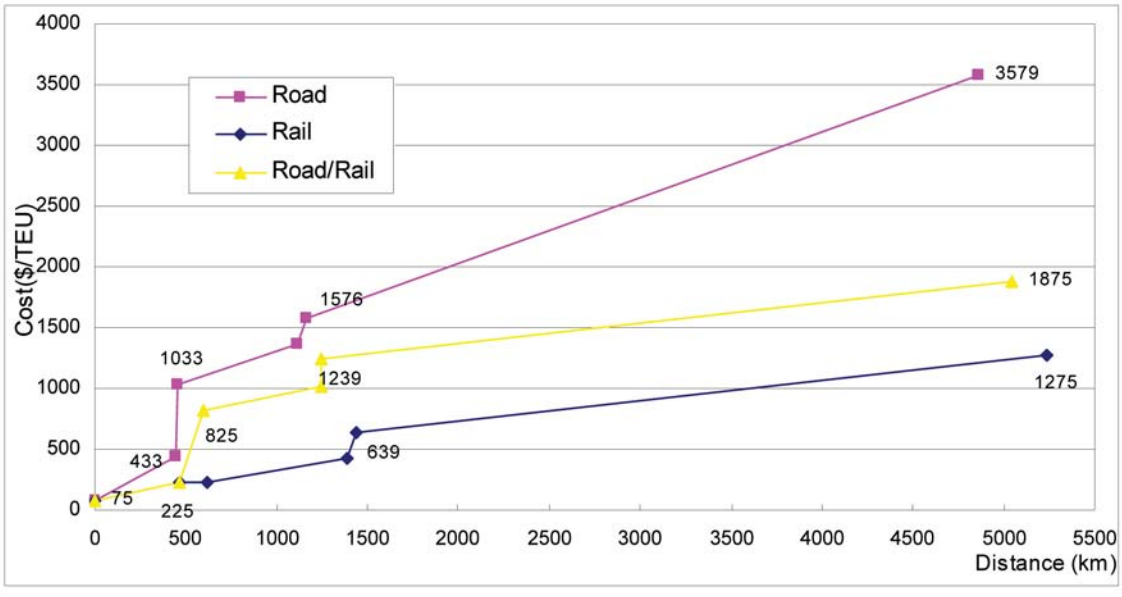

Figure 4-17 Cost-distance (Busan-Ulan Ude)

Routes to consider

- Rail route: Republic of Korea-Democratic People's Republic of Korea-Russian Federation
- Intermodal route: Republic of Korea(road)-Democratic People's Republic of Korea(rail)-Russian Federation(rail)

In view of the fact that railway is the priority mode of transport in the Democratic People's Republic of Korea and that railway is a preferred transport mode for such a long distance as Corridor 3, an all-rail transport alternative is considered a suitable option. In addition, since the major part of the missing link of rail tracks between Gangnung and Kosong is on the side of the Republic of Korea, intermodal options that could be considered as part of the current situation in Corridor 2 are limited to the combination of road transport in the Republic of Korea and rail transport for the other segments. Tables 4-20A and 4-20B, which are derived from Table 4-20, show tabular information for transport cost and time for these two optional routes, and 4-20C presents the additional costs and time for providing a sea transport connection to Japan with Corridor 3.

Table 4-20A Rail route (I-3.1) from Busan Port to Ulan Ude

	Rail		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Busan Port	75	10	20
Busan-Kansung/Kangnung	150	4.8	6.8
Kansung/Kangnung-Kosong (Border)	NA[1]	NA[1]	NA[1]
Kosong-Sonbong	196	8.3	11.5
Sonbong-Hasan (Border)	218	1	3
Hasan-Ulan Ude	636	47.5	94
Total **(Busan-Kansung)** **(Busan-Ulanude)**	**225** **-**	**14.8** **-**	**26.8** **-**
$/km			

Notes: 1. Missing link

Table 4-20B Intermodal route (I-3.2) from Busan Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Busan Port	75	10	20	-
Busan-Kansung/Kangnung	358	4	7	Road
Kansung/Kangnung-Kosong (Border)	600	5	29	Road
Kosong-Sonbong	196	8.3	11.5	Rail
Sonbong-Hasan (Border)	218	1	3	Rail
Hasan-Ulan Ude	636	47.5	94	Rail
Total **(Busan-Kansung)** **(Busan-Ulanude)**	**433** **2,083.0**	**14** **75.8**	**27** **164.5**	
$/km	**0.41**			

Table 4-20C Cost and time for transport from Yokohama Port to Ulan Ude

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Yokohama Port	168	NA	NA	168	NA	NA	168
Yokohama Port-Busan Port	430	72	98	430	72	98	430
Busan Port	75	10	20	75	10	20	75
Busan-Kansung/Kangnung	358	4	7	150	4.8	6.8	150
Kansung/Kangnung-Kosong (Border)	600	5	29	NA	NA	NA	600
Kosong-Sonbong	325	16.3	32.5	196	8.3	11.5	196
Sonbong-Hasan (Border)	218	1	3	218	1	3	218
Hasan-Ulan Ude	2,003	61.7	123.5	636	47.5	94	636
Total **(Yokohama-Ulan Ude)**	**4,177.0**	**-**	**-**	**-**	**-**	**-**	**2,473.0**
$/km	**-**			**-**			**-**

4.4 CORRIDOR 4
RAJIN/SONBONG - JILIN - CHANGCHUN - ULANHOT - SUMBER -ULAANBAATAR

4.4.1 Significance

Corridor 4 provides Mongolia and China with a main exit to the East Sea (Japan Sea) and the Pacific. Although this corridor is defined in this study to start from Rajin/Sonbong in the Democratic People's Republic of Korea, it also has a branch starting from Zarubino/Posiet in the Russian Federation as an alternative exit to the sea. As this corridor spreads over four countries, it can be activated and made efficient only with cooperation among countries. Although some progress has been achieved through the Tumen River Area Development Programme since the early 1990s, much remain to be done to facilitate trade and transport along bordering areas of China, the Democratic People's Republic of Korea and the Russian Federation.

Corridor 4 provides a cheaper and less time consuming transport option than available at present for the trade of the Chinese north-eastern three provinces (CNETP), i.e., Liaoning, Jilin and Heilongjiang, with the Republic of Korea and Japan. For example, most of the freight between Hunchun and Busan is currently transported via Dalian, which involves a long distance (2,300km) and travel time (6 to 11 days) as well as high transport cost of $1,400 to $1,900 per TEU (Table 4-21). However, if Corridor 4 becomes operational, the total distance would be significantly reduced to 927km, transport time to 2.5 days, and cost to about $1,200 to $1,300 per TEU.

Table 4-21 Comparison of routes in Corridors 4 and 2: Hunchun-Busan

Items	*Corridor 2*		*Corridor 4*
Land	Hunchun-Dalian (Road)	Hunchun-Dalian (Rail)	Hunchun-Rajin (Road)
Distance (km)	about 1,300	1,296	93
Time (days)	4-5	10	0.5
Cost (US$/TEU)	1,300	800	600-700
Sea	Dalian-Busan	Dalian-Busan	Rajin-Busan
Distance (km)	about 1,000	about 1,000	834
Time (days)	2	2	2
Cost (US$/TEU)	600	600	600
Total	(Road-Sea)	(Railway-Sea)	(Road-Sea)
Distance (km)	2,300	2,300	927
Time (days)	6-7	8-11	2.5
Cost (US$/TEU)	1,900	1,400	1,200-1,300

Notes: 1. In the case of Land, customs clearance procedures and transshipment happened by the difference of railway gauges, etc. are considered for the estimation of transport time and cost.
2. In the case of Sea, time and cost for shipment at each stopover port are considered.

Corridor 4 also greatly curtails the transport cost and time between the CNETP and Japan. At present, most of the traffic between the CNETP and Japan relies mainly on Corridor 2, using railway transport to Dalian Port and then sea transport to Japan. For example, container transport between Changchun and Niigata using this Dalian route combination of rail and sea transport requires 17-20 days (for 1,940km) and $1,270 per TEU (Table 4-22). Corridor 4, on the other hand, is expected to serve as a more economical corridor for trade between CNETP and Japan. If the Rajin route is used, transport distance from Changchun to Niigata will be reduced to 1,624km, and time and cost also come down to 8 to 11 days and $1,000 per TEU. If the traffic goes through Zarubino Port instead of Rajin Port, Corridor 4 is expected to provide even more cost reduction with a similar level of transport time. In consequence, with the operationalization of Corridor 4, it is expected that trade between CNETP and Japan could enjoy savings of around 50 per cent and 25 per cent of present total transport time and cost, respectively.

Table 4-22 Comparison of routes in Corridors 4 and 2: Changchun-Niigata

Items	*Corridor 2*	*Corridor 4*	
Land: Railway	Changchun-Dalian	Changchun-Zarubino	Changchun-Rajin
Distance (km)	702	673	694
Time (days)	6-9	5-8	5-8
Cost (US$/TEU)	320	420	500
Sea	Dalian-Niigata	Zarubino-Niigata	Rajin-Niigata
Distance (km)	1,940	880	930
Time (days)	11	3	3
Cost (US$/TEU)	950	500	500
Total			
Distance (km)	**2,642**	**1,553**	**1,624**
Time (days)	**17-20**	**8-11**	**8-11**
Cost (US$/TEU)	**1,270**	**920**	**1,000**

Notes:
1. In the case of land, customs clearance procedures and transshipment happened by the difference of railway gauges, etc. are considered for the estimation of transport time and cost.
2. In the case of sea, time and cost for shipment at each stopover port are considered.
3. It is assumed that one day is spent for shipment at each stopover port.
4. 18 tons are calculated into one TEU.

4.4.2 Current situation and prospects

Ports. Rajin Port, a free trade seaport of the Democratic People's Republic of Korea located at the centre of the Rajin-Sonbong Free Economic and Trade Zone, has 13 berths totalling 2,520m with the depth of 8-10.6m. Rajin Port is capable of accommodating ships of the 5,000 to 30,000 ton class. Containers are handled using ordinary wharf cranes[9]. It is generally known that two Russian ports, Zarubino and Posiet, are not in a good condition for container transport. Wharves are not well maintained and loading/unloading and storage facilities also require improvements.

[9] ERINA, Vision for the Northeast Asia Transportation Corridors, ERINA Booklet, Vol. 1, June 2002.

Railway. All railway sections in China and the Democratic People's Republic of Korea of Corridor 4 consist of non-electrified, standard gauge, single-track railway. The Zarubino/Posiet branch route of this corridor involves broad gauge rail tracks in the section of the Russian Federation. However, both standard and broad gauge tracks are available between Kraskino and Hunchun, where dual gauge rail tracks were constructed in 1999 (ERINA 2002). Currently no rail tracks exist in Mongolia's section of Corridor 4. The total railway length from Rajin to Sumber at the Mongolian border with China is 1,213km (Table 4-23).

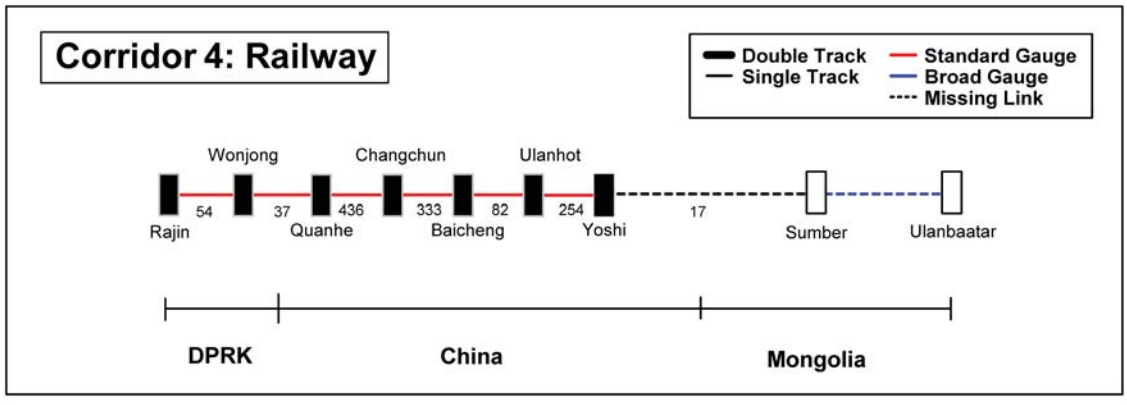

Figure 4-18 Present conditions of railway, Corridor 4

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-23 Rail distance between Rajin/Sonbong and Ulaanbaatar

Country	From	To	Distance (km)
Democratic People's Republic of Korea	Rajin	Wonjong	54[1]
Border	Wonjong	Quanhe	37
China	Quanhe Changchun	Changchun Yorshi	436 669
Border	Yorshi	Sumber	17
Mongolia	Sumber	Ulaanbaatar	NA[2]
Total (Rajin-Ulaanbaatar)			

Notes: 1. Data from UNDP ' Democratic People's Republic of Korea: Rajin-Wonjong Road Project, Prefeasibility Study Report (2001)'
2. Missing link

Road. The Chinese sections of roads in Corridor 4 are in relatively good condition. At present, paved road is available between Ulanhot and Hunchun (Class III or higher), and the Chinese government has a plan to construct an expressway for the Hunchun-Changchun section. The Hunchun-Kraskino section is concrete-paved and 9-12m wide (Class III). The section from Zarubino and Posiet to Kraskino is partly paved, and a new road was completed for the Quanhe-Hunchun section in 2000 (ERINA 2002). In the Rajin route, the 46km section between Sonbong and Wonjeong is frequently mentioned as a bottleneck area with the most urgent need for improvement (Kim et al. 2003; Lee et al. 2001; ERINA 2002; PADECO 1999). It is understood that this section is not paved, and container trucks have difficulties in transporting through this road, especially in a bad weather. The Democratic People's Republic of Korea plans to construct an expressway for the section and further progress of the plan requires funding.

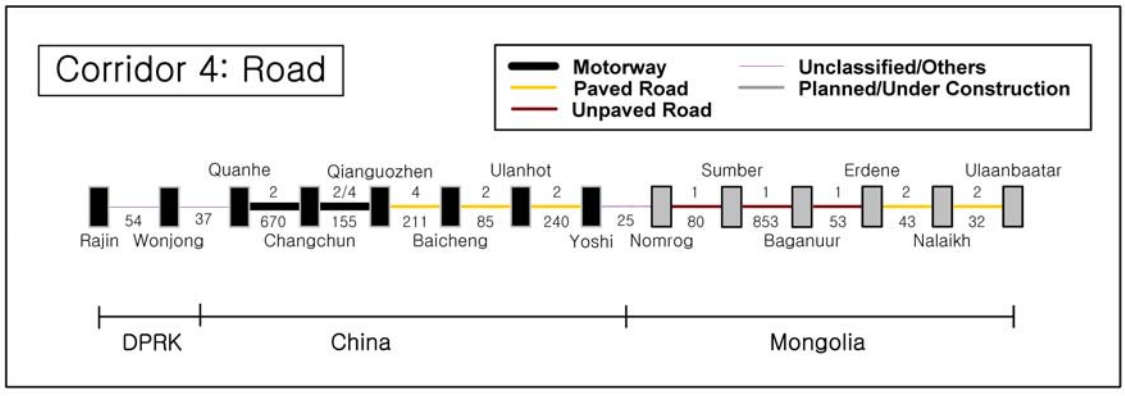

Figure 4-19 Present conditions of road, Corridor 4

Sources: Based on Country reports, ERINA and Maps produced by UNDP

At present, only 11.9 per cent (1,317.6km) of the total Mongolian road network (11,063km) is paved (Road Department of Mongolia 2001). Despite this low pavement ratio in general, the Mongolian government has a strong will to improve the Sumber-Ulaanbaishint section in particular as a major horizontal transport axis of Mongolia, as a long-term plan to develop the so called 'Millennium Road'. ESCAP has also classified this section as a part of the Asian Highway's North-East Asian section. If this road is completed, Corridor 4, with a road network of 2,500km, is also expected to perform as a transcontinental corridor which extends from Far Eastern Asia via Central Asia to Europe (Table 4-24).

Table 4-24 Road distance between Rajin/Sonbong and Ulaanbaatar

Country	From	To	Distance (km)
Democratic People's Republic of Korea	Rajin	Wonjong	54[1]
Border	Wonjong	Quanhe	37
China	Quanhe Chanchun	Chanchun Yorshi	670 691
Border	Yorshi	Nomrog	25
Mongolia	Nomrog	Sumber	80
	Sumber	Ulaanbaatar	981
Total (Rajin-Ulaanbaatar)			**2,538**

Note: 1. Data from UNDP, Democratic People's Republic of Korea: Rajin-Wonjong Road Project, Prefeasibility Study Report , 2001

4.4.3 Transport cost and time

Table 4-25 shows the estimated cost and time to transport a container from Rajin Port in the Democratic People's Republic of Korea to Ulaanbaatar in Mongolia along Corridor 4. It should be noted that only limited data and information were available for this corridor; therefore, analysis was based on rough estimates.

Table 4-25 Cost and time for transport from Rajin/Sonbong Port to Ulaanbaatar

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Rajin Port	180	48	96	180	48	96	180
Rajin-Wonjong	27[1]	1.4[2]	2.7[2]	10.8[3]	1.4[2]	2.7[2]	10.8
Wonjong-Quanhe (Border)	218	1	3	218	1	3	218
Quanhe-Changchun	490	9.5	19	78	12	23	78
Changchun-Yorshi	500	12	24	120	14	26	120
Yorshi-Sumber (Border)	16.1	1.9	4.2	5	1	2	5
Sumber-Ulaanbaatar	135.4	19	25	NA[4]	NA[4]	NA[4]	135.4
Total (Rajin-Ulaanbaatar) (Rajin-Yorshi)	**1,566.5 1,415.0**	**92.8 71.9**	**173.9 144.7**	**- 606.8**	**- 76.4**	**- 150.7**	**747.2 606.8**
$/km	**0.62**			**-**			**0.34**

Notes:
1. The cost assumed at $0.5 per km
2. Estimates based on maximum speed (40km/h) and minimum speed (20km/h) in Democratic People's Republic of Korea
3. The cost assumed at $0.2 per km
4. Missing link

Figures 4-20 and 4-21 present the relationships between travel time and distance of the road transport from Rajin Port to Ulaanbaatar and rail transport from Rajin Port to Sumber, respectively.

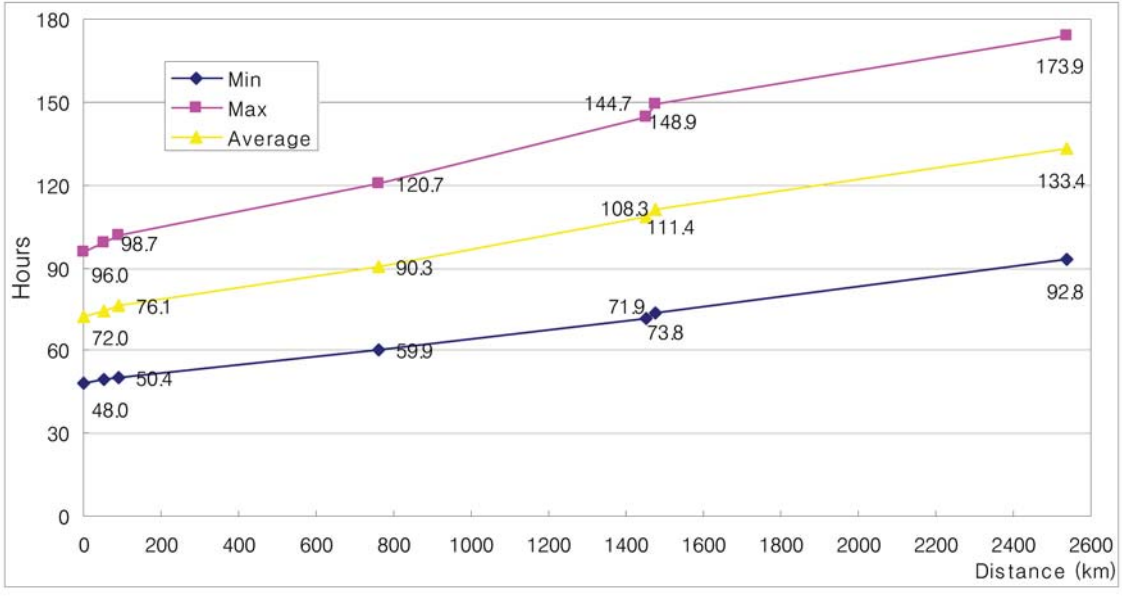

Figure 4-20 Rajin-Ulaanbaatar transit time (road)

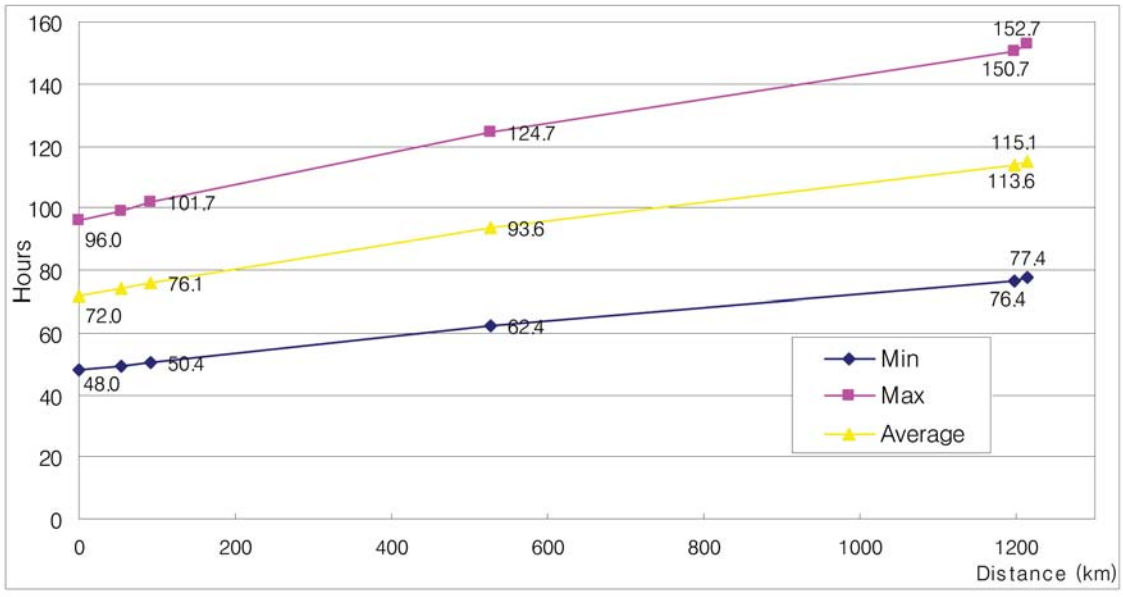

Figure 4-21 Rajin-Ulaanbaatar transit time (rail)

Figure 4-22 shows the cost-distance relationship in Corridor 4 by transport mode. In view of the extended length of this corridor, railway apparently provides the cheaper transport. In China's section, for example, the estimated cost of transporting containers from Quanhe to Yorshi by rail (1,105km) is about $198 per TEU, compared to $990 per TEU by road.

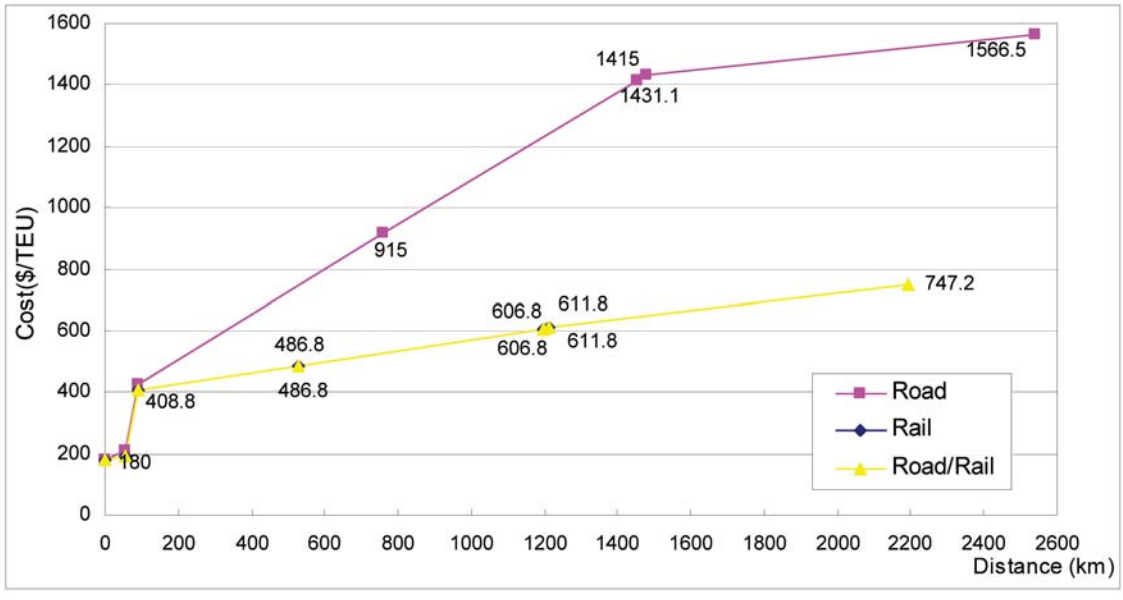

Figure 4-22 Cost-distance (Rajin-Ulaanbaatar)

Routes to consider

- Road route: Democratic People's Republic of Korea-China-Mongolia
- Intermodal route 1: Democratic People's Republic of Korea (rail)-China (road)-Mongolia (road)
- Intermodal route 2: Democratic People's Republic of Korea (rail)-China (rail)-Mongolia (road)
- Intermodal route 3: Democratic People's Republic of Korea (road)-China (rail)-Mongolia (road)

Intermodal routes that can be considered currently in terms of Corridor 4 are limited to the combination of road and rail transport only in China and the Democratic People's Republic of Korea. Tables 4-25A through 4-25D are derived from Table 4-25 to show tabular information for transport cost and time for these two optional routes, and 4-25E presents additional cost and time for providing a sea transport connection to Japan with Corridor 4.

Table 4-25A Road route (U-4.1) from Rajin/Sonbong Port to Ulaanbaatar

	Road		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Rajin Port	180	48	96
Rajin-Wonjong	27	1.4	2.7
Wonjong-Quanhe (Border)	218	1	3
Quanhe- Changchun	490	9.5	19
Changchun-Yorshi	500	12	24
Yorshi-Sumber (Border)	16.1	1.9	4.2
Sumber- Ulaanbaatar	135.4	19	25
Total (Rajin-Ulaanbaatar)	**1,566.5**	**92.8**	**173.9**
$/km	**0.62**		

Table 4-25B Intermodal route (I-4.2) from Rajin/Sonbong Port to Ulaanbaatar

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Rajin Port	180	48	96	-
Rajin-Wonjong	10.8	1.4	2.7	Rail
Wonjong-Quanhe(Border)	218	1	3	Rail
Quanhe- Changchun	490	9.5	19	Road
Changchun-Yorshi	500	12	24	Road
Yorshi-Sumber (Border)	16.1	1.9	4.2	Road
Sumber- Ulaanbaatar	135.4	19	25	Road
Total (Rajin-Ulaanbaatar)	**1,550.3**	**92.8**	**173.9**	
$/km	**0.61**			

Table 4-25C Intermodal route (I-4.3) from Rajin/Sonbong Port to Ulaanbaatar

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Rajin Port	180	48	96	-
Rajin-Wonjong	10.8	1.4	2.7	Rail
Wonjong-Quanhe (Border)	218	1	3	Rail
Quanhe- Changchun	78	12	23	Rail
Changchun-Yorshi	120	14	26	Rail
Yorshi-Sumber (Border)	5	1	2	Rail
Sumber- Ulaanbaatar	135.4	19	25	Road
Total (Rajin-Ulaanbaatar)	**747.2**	**96.4**	**177.7**	
$/km	**0.34**			

Table 4-25D Intermodal route (I-4.4) from Rajin/Sonbong Port to Ulaanbaatar

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Rajin Port	180	48	96	-
Rajin-Wonjong	27	1.4	2.7	Road
Wonjong-Quanhe(Border)	218	1	3	Road
Quanhe- Changchun	78	12	23	Rail
Changchun-Yorshi	120	14	26	Rail
Yorshi-Sumber (Border)	5	1	2	Rail
Sumber- Ulaanbaatar	135.4	19	25	Road
Total (Rajin-Ulaanbaatar)	**763.4**	**96.4**	**177.7**	
$/km	**0.35**			

Table 4-25E Cost and time for transport from Tokyo to Ulaanbaatar

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Tokyo-Niigata Port	1,114	5[1]	5[1]	714	48[1]	48[1]	714
Niigata Port	136	NA	NA	136	NA	NA	136
Niigata Port-Rajin Port	850	48[1]	48[1]	850	48[1]	48[1]	850
Rajin Port	180	48	96	180	48	96	180
Rajin-Wonjong	27	1.4	2.7	10.8	1.4	2.7	10.8
Wonjong-Quanhe (Border)	218	1	3	218	1	3	218
Quanhe- Changchun	490	9.5	19	78	12	23	78
Changchun-Yorshi	500	12	24	120	14	26	120
Yorshi-Sumber (Border)	16.1	1.9	4.2	5	1	2	5
Sumber- Ulaanbaatar	135.4	19	25	NA	NA	NA	135.4
Total (Tokyo-Ulaanbaatar)	**3,666.5**	-	-	-	-	-	**2,447.2**
$/km	-			-			-

Note: 1. Average transit time

4.5 CORRIDOR 5 NAKHODKA/VLADIVOSTOK-USSURISK-POGRANICHNY-HARBIN-MANZHOULI-CHITA-ULAN UDE

4.5.1 Significance

Corridor 5 is another major corridor through which the Chinese north-eastern provinces can connect to the East Sea (Japan Sea) and the Pacific. This corridor extends from Nakhodka, Vostochny and Vladivostok, via Harbin, the largest city of the Heilongjiang Province, and finally links up with the TSR in Karymskaya and Chita.

Corridor 5, together with Corridor 4 mentioned earlier, seems reasonable as an alternative to Corridor 6 (Figure 4-23). These two corridors cannot only disperse traffic demands loaded on Corridor 6 but also serve as more economically efficient transport corridors enabling a great degree of transport time and cost reduction. Take, for example, the transport between Harbin and Niigata, and between Suifenhe and Niigata. At present, containers are mainly transported through a combination of Corridor 6 and sea transport. It takes 18 to 21 days for transporting 2,884km from Harbin to Niigata and costs $1,340 per TEU, and 21 to 25 days and $1,510 per TEU for 3,432km from Suifenhe to Niigata (Table 4-26). However, a combination of Corridor 5 and sea transport needs no more than 13 days and $1,190 per TEU from Harbin to Niigata (1,812km), and at most seven days and $1,020 per TEU from Suifenhe to Niigata (1,264km), saving 40 to 60 per cent of transport time and 10 to 30 per cent of transport costs.

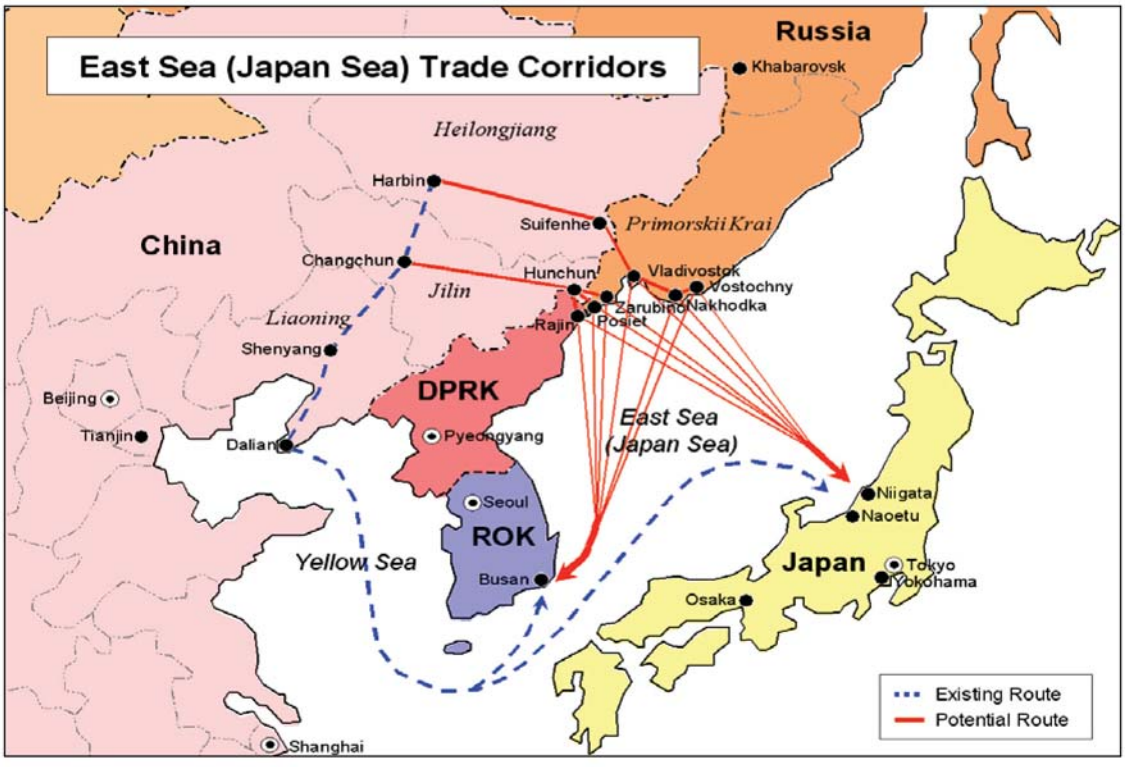

Figure 4-23 Potential East Trade Corridor utilizing Corridor 4 and Corridor 5

Source: Adopted from MOT of Japan (recited from Kim, Won Bae et al, Building Infrastructure for the Facilitation of Economic Cooperation in Northeast Asia in the 21st Century: Focusing on Land Transport Linkages between Korea and China, KRIHS Special Reports No. 3, Korea Research Institute for Human Settlements, 2003)

Table 4-26 Comparison of routes in Corridors 5 and 6: Harbin/Suifenhe-Niigata

Items	*Corridor 6*	*Corridor 5*	*Corridor 6*	*Corridor 5*
Land: Railway	Harbin-Dalian	Harbin-Vostochny	Suifenhe-Dalian	Suifenhe-Vostochny
Distance (km)	944	1,032	1,492	484
Time (days)	7-10	6-10	10-14	2-4
Cost (US$/TEU)	390	690	560	520
Sea	Dalian-Niigata	Vostochny-Niigata	Dalian-Niigata	Vostochny-Niigata
Distance (km)	1,940	780	1,940	780
Time (days)	11	3	11	3
Cost (US$/TEU)	950	500	950	500
Total				
Distance (km)	2,884	1,812	3,432	1,264
Time (days)	18-21	9-13	21-25	5-7
Cost (US$/TEU)	1,340	1,190	1,510	1,020

Notes:
1. In the case of Land, customs clearance procedures and transshipment happened by the difference of railway gauges, etc. are considered for the estimation of transport time and cost.
2. In the case of sea, time and cost for shipment at each stopover port are considered.
3. It is assumed that one day is spent for shipment at each stopover port.
4. 18 tons are calculated into one TEU.

4.5.2 Current situation and prospects

Ports. Corridor 5 includes three Russian ports: Nakhodka, Vladivostok and Vostochny. These ports have been mainly used as starting points for the TSR. In particular, Vostochny Port, the principal container port in the Far Eastern region of the Russian Federation, handles most of container cargos for the TSR. JSC Vostochny Port operates two general cargo/container berths (length 675m, depth 13.5m). Vostochny Port International Container Terminal is operated by Vostochny International Container Services (VICS), which is a Joint Venture of Vostochny Port, P&O Ports and CSX World Terminals. VICS operates two general cargo/container berths (length 672m, depth 12.5m) with a total capacity of approximately 400,000 containers per annum.[10] Container throughput of VICS was 134 thousand TEU in 2002, which was well below capacity. Vladivostok Port, with two container berths (lengths 320m, depth 11.6m), handled 85,800 TEU of containers in 2002. Some containers are also handled at the port of Nakhodka, although detailed statistics are not available.

Railway. Broad gauge rails are in use on the Russian side of the corridor. Electrified, double-track railways are available between the three ports and Ussuriysk, and non-electrified, single-track railway for the sections from Ussuriysk to Grodekovo and from Manzhouli to Karymskaya. Contrary to the Russian Federation, China uses standard gauge track, and therefore break-of-gauge operation is needed at the borders between the two countries. Dual gauge tracks are installed at the border area between Grodekovo in the Russian Federation and Suifenhe in China. Non-electrified, double-track rails are in operation for the section from Mudanjiang to Hailar, while the remaining sections in China are composed of non-electrified, single track rails.

The total length of the railway network along Corridor 5 is 2,968km from Nakhodka and Ulan Ude and the distance from Vladivostok to Ulan Ude is 2,809km (Table 4-27).

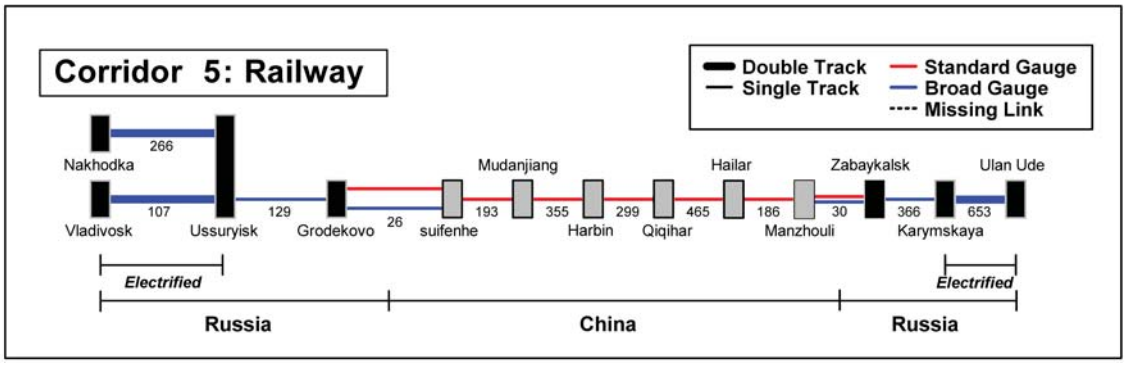

Figure 4-24 Present conditions of railway, Corridor 5

Sources: Based on Country reports, ERINA and Maps produced by UNDP

[10] http://www.vics.ru/scripts/issue.dll?lang=eng&idm=1

Table 4-27 Rail distance between Nakhodka and Ulan Ude

Country	From	To	Distance (km)
Russian Federation	Vladivostok Nakhodka	Grodekovo Grodekovo	236 395
Border	Grodekovo	Suifenhe	26
China	Suifenhe	Manzhouli	1,498
Border	Manzhouli	Zabaykalsk	30[1]
Russian Federation	Zabaykalsk	Ulan Ude	1,019
Total (Vladivostok-Ulan Ude) (Nakhodka-Ulan Ude)			**2,809 2,968**

Note: 1. Data from road distance between Manzhouli-Zabaykalsk

Road. Available information suggests that the road condition of Corridor 5 is relatively favorable even for cargo traffic, in general. However, the utilization of road transport in Corridor 5 is considered very low. No more than 9 per cent of the total freight moving through Corridor 5 chooses road, which corresponds to just 10 per cent of the total capacity of the road transport.

The entire Russian section consists of paved two lane roads, through which container cargo can pass without any difficulties. Although the Grodekovo-Suifenhe section partially includes unpaved roads, they do not produce any serious problems for cargo transport. An expressway is available from Suifenhe via Harbin to Arun Qi. The Chinese government plans to extend this expressway line to Manzhouli. At present, National Highway 301 passes from Arun Qi to Manzhouli (ERINA 2002). ESCAP designated the section between Nakhodka and Harbin as a subregional Asian Highway route, and the section between Harbin and Chita as an international Asian Highway route.

By road the distance between Nakhodka and Ulan Ude is 3,218km and the distance between Vladivostok and Ulan Ude is 3,049km, about 240km longer than the distance by rail (Table 4-28).

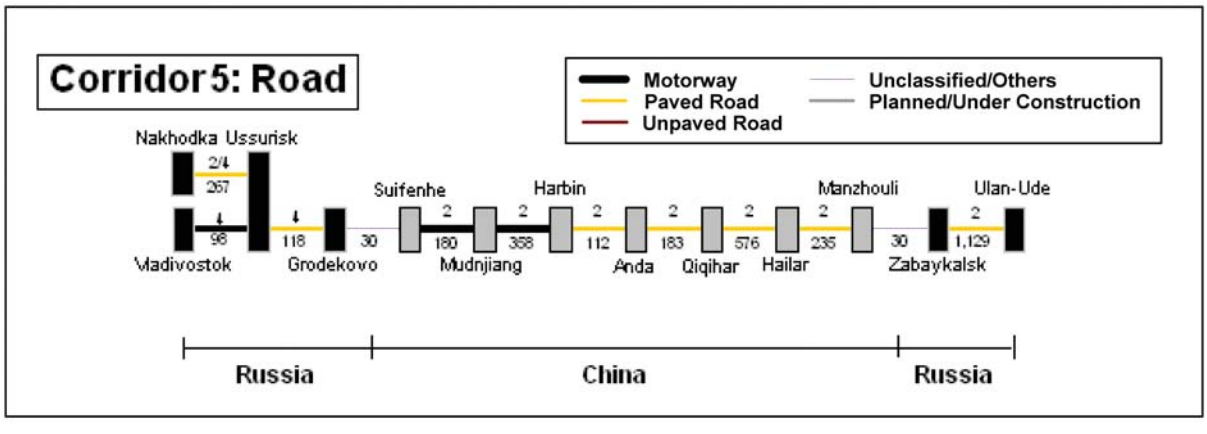

Figure 4-25 Present conditions of road, Corridor 5

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-28 Road distance between Nakhodka and Ulan Ude

Country	From	To	Distance (km)
Russian Federation	Nakhodka	Grodekovo	385
	Vladivostok	Grodekovo	216
Border	Grodekovo	Suifenhe	30
China	Suifenhe	Manzhouli	1,644
Border	Manzhouli	Zabaykalsk	30
Russian Federation	Zabaykalsk	Ulan Ude	1,129
Total (Nakhodka-Ulan Ude) **(Vladivostok-Ulan Ude)**			**3,218** **3,049**

4.5.3 Transport cost and time

Table 4-29 shows the cost and time to transport a container from Vladivostok port to Ulan Ude in the Russian Federation via the Suifenhe-Manzhouli section in China along Corridor 5. Figures 4-26 and 4-27 present the relationships between travel time and the distance of road transport from Nakhodka and Valdivostok Port to Ulan Ude, respectively.

Table 4-29 Cost and time for transport from Nakhodka/Vladivostok Port to Ulan Ude

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Nakhodka Port	100[1]	1[2]	2[2]	100[1]	1[2]	2[2]	100
Vladivostok Port	80	1	2	80	1	2	80
Nakhodka-Grodekovo	279.5[3]	6.4[4]	12.8[4]	154	5.3	8.5	154
Vladivostok-Grodekovo	160[5]	3.6[4]	7.2[4]	100	3.5	5.5	100
Grodekovo-Suifenhe (Border)	100	1	24	100	12	24	100
Suifenhe-Manzhouli	1100	24	48	227.2	24	35	227.2
Manzhouli-Zabaykalsk (Border)	100[6]	1[6]	24[6]	100[6]	12[6]	24[6]	100
Zabaykalsk-Ulan Ude	633.5[7]	18.8[4]	37.6[4]	353	12.6	27.5	353
Total **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	**2,313.0** **2,173.5**	**52.2** **49.4**	**148.4** **142.8**	**1,034.2** **960.2**	**66.9** **65.1**	**121.0** **118.0**	**1,034.2** **960.2**
$/km **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	**0.72** **0.71**			**0.35** **0.34**			**0.35** **0.34**

Notes:
1. Data from Nakhodka port
2. Data from Vladivostok port
3. Average trucking charge (15ton) between Moscow-Gorokhovech (382km) and Moscow-Kostroma (381km)
4. Estimates based on maximum speed (60km/h) and minimum speed (30km/h)
5. Average trucking charge (15ton) between Moscow-Vladimir (228km) and Moscow-Tver (209km)
6. Estimate based on the cost and transit time of Grodekovo-Suifenhe
7. Average trucking charge (15ton) between Moscow-Novocherkask (1,108km) and Moscow-Samara (1,131km)

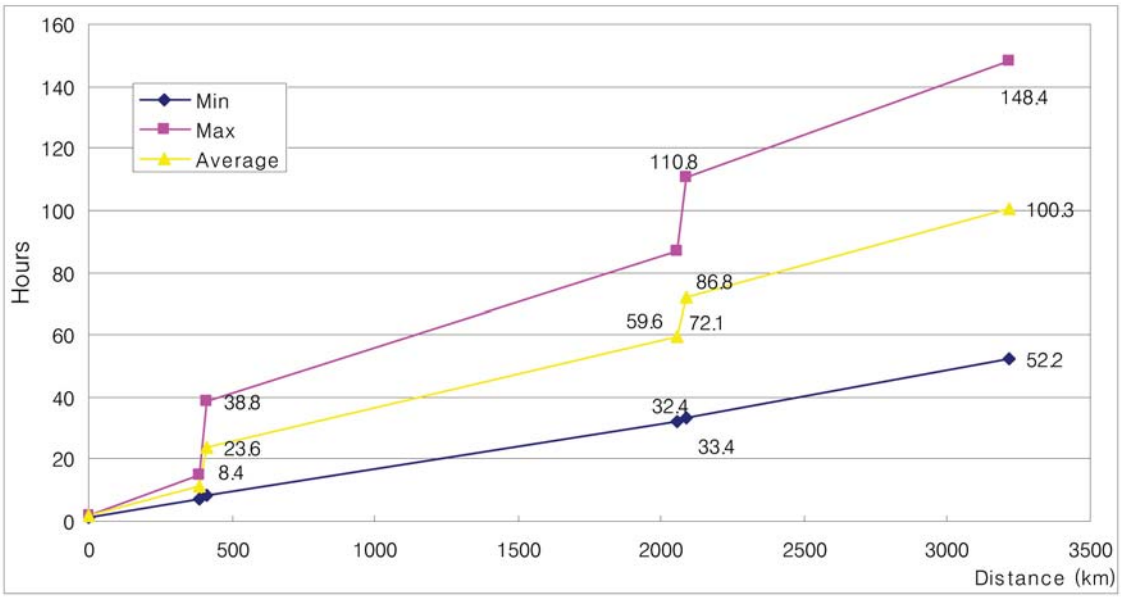

Figure 4-26 Nakhodka-Ulan Ude transit time (road)

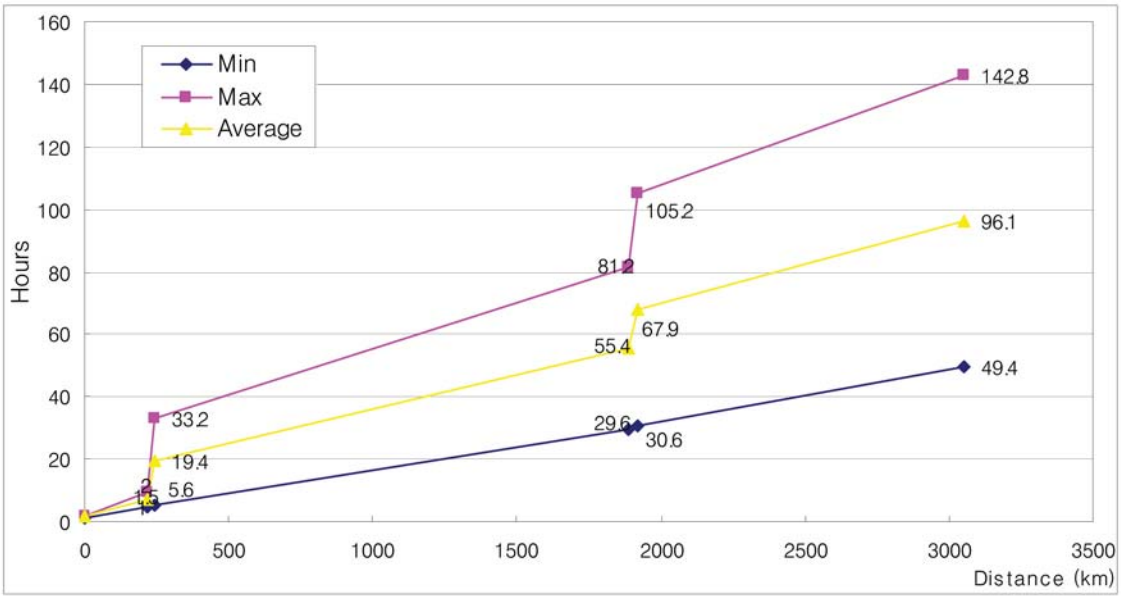

Figure 4-27 Vladivostok-Ulan Ude transit time (road)

Figures 4-28 and 4-29 present the time-distance relationships of the rail transport of the same routes.

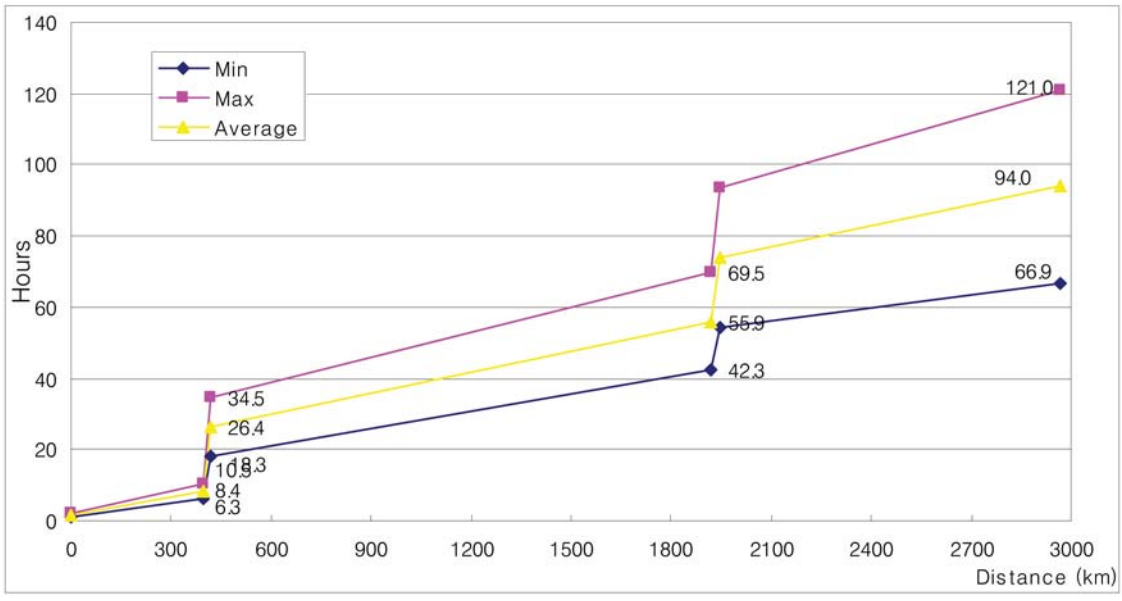

Figure 4-28 Nakhodka-Ulan Ude transit time (rail)

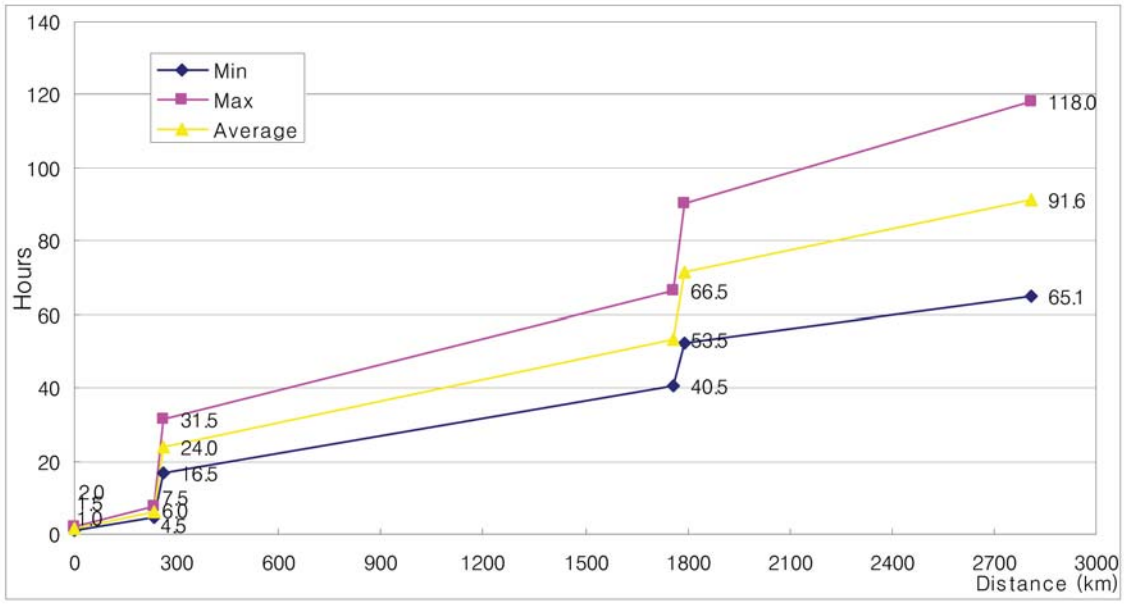

Figure 4-29 Vladivostok-Ulan Ude transit time (rail)

Figures 4-30 and 4-31 show the cost-distance relationships in Corridor 5 by transport mode. In view of the extended length of this corridor, using rail transportation for the entire route results in the lowest transport cost of $1,034 from Nakhodka and $960 from Vladvostok. The road transport cost in China's section is about $1,100 per TEU and takes between 24 hours to 48 hours. Rail transport is significantly cheaper, costing only $227 for the entire section of 1,498km. In the Russian Federation, the rail cost between Nakhodka and Godekovo is about $154 per TEU and $353 per TEU between Zabaykalsk and Ulan Ude.

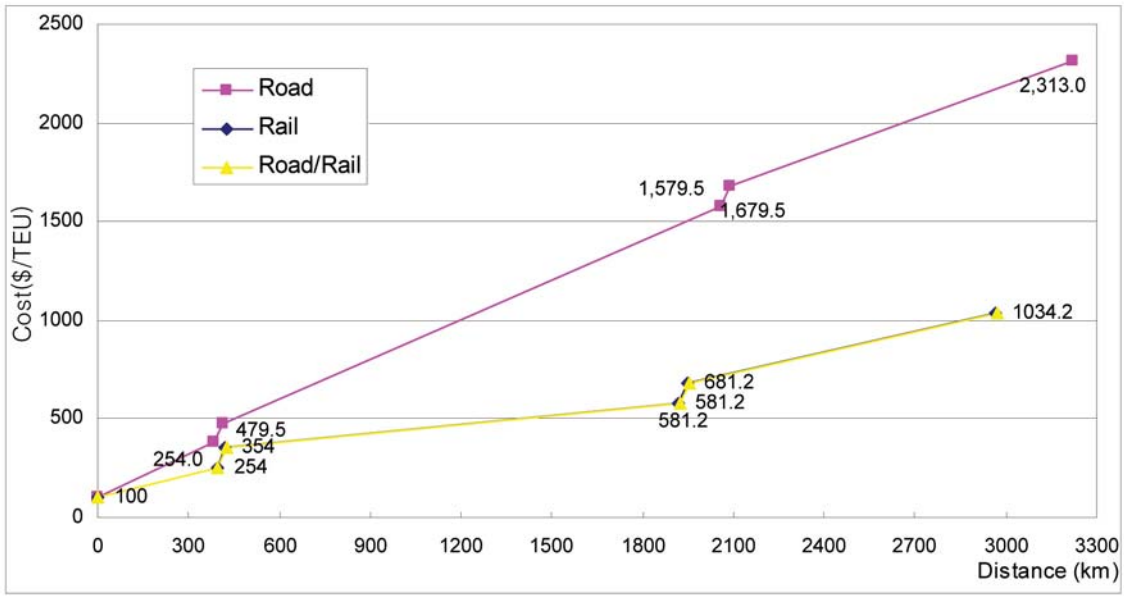

Figure 4-30 Cost-distance (Nakhodka-Ulan Ude)

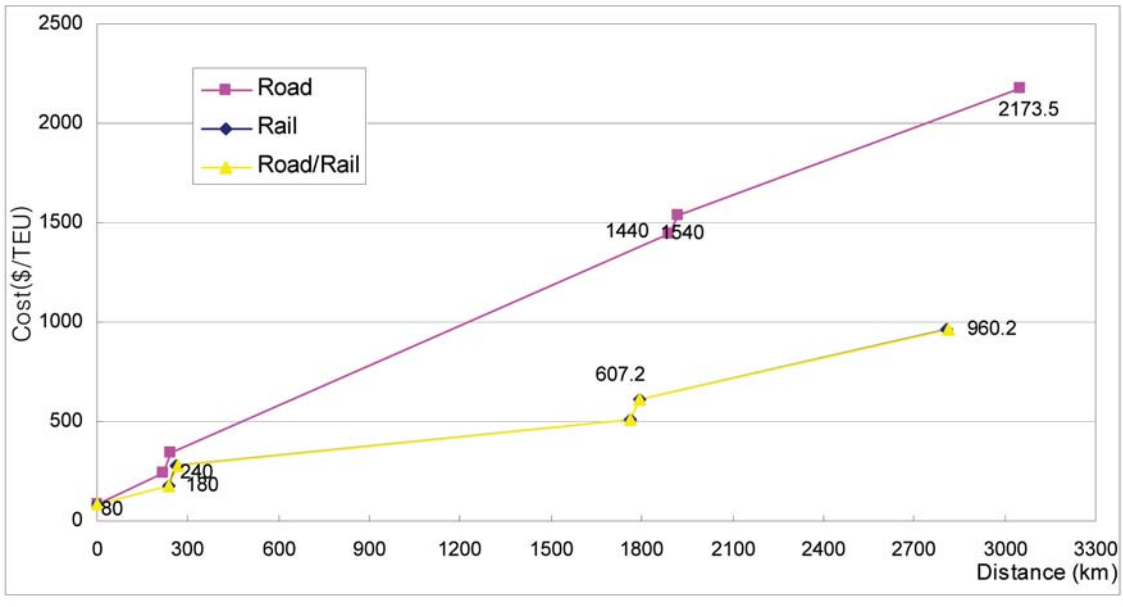

Figure 4-31 Cost-distance (Vladivostok-Ulan Ude)

Routes to consider

- Rail route: Russian Federation-China-Russian Federation
- Road route: Russian Federation-China-Russian Federation
- Intermodal route 1: Russian Federation(rail)-China(rail)-Russian Federation(road)
- Intermodal route 2: Russian Federation(rail)-China(road)-Russian Federation(road)
- Intermodal route 3: Russian Federation(rail)-China(road)-Russian Federation(rail)
- Intermodal route 4: Russian Federation(road)-China(rail)-Russian Federation(rail)
- Intermodal route 5: Russian Federation(road)-China(road)-Russian Federation(rail)
- Intermodal route 6: Russian Federation(road)-China(rail)-Russian Federation(road)

In view of relatively good condition of the rail as well as the road along Corridor 5, all possible combination of rail and road for different sections can be considered for intermodal route analysis. Tables 4-29A through 4-29H are derived from Table 4-29 to show tabular information for transport cost and time for these alternative routes. Table 4-29I presents additional cost and time for providing a sea transport connection to Japan with Corridor 5.

Table 4-29A Rail route (U-5.1) from Nakhodka/Vladivostok Port to Ulan Ude

	Rail		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Nakhodka Port	100	1	2
Vladivostok Port	80	1	2
Nakhodka-Grodekovo	154	5.3	8.5
Vladivostok-Grodekovo	100	3.5	5.5
Grodekovo-Suifenhe (Border)	100	12	24
Suifenhe-Manzhouli	227.2	24	35
Manzhouli-Zabaykalsk (Border)	100	12	24
Zabaykalsk-Ulan Ude	353	12.6	27.5
Total **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **1,034.2** **960.2**	 **66.9** **65.1**	 **121.0** **118.0**
$/km **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **0.35** **0.34**		

Table 4-29B Road route (U-5.2) from Nakhodka/Vladivostok Port to Ulan Ude

	Road		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Nakhodka Port	100	1	2
Vladivostok Port	80	1	2
Nakhodka-Grodekovo	279.5	6.4	12.8
Vladivostok-Grodekovo	160	3.6	7.2
Grodekovo-Suifenhe (Border)	100	1	24
Suifenhe-Manzhouli	1100	24	48
Manzhouli-Zabaykalsk (Border)	100	1	24
Zabaykalsk-Ulan Ude	633.5	18.8	37.6
Total **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **2,313.0** **2,173.5**	 **52.2** **49.4**	 **148.4** **142.8**
$/km **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **0.72** **0.71**		

Table 4-29C Intermodal route (I-5.3) from Nakhodka/Vladivostok Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Nakhodka Port	100	1	2	-
Vladivostok Port	80	1	2	-
Nakhodka-Grodekovo	154	5.3	8.5	Rail
Vladivostok-Grodekovo	100	3.5	5.5	Rail
Grodekovo-Suifenhe (Border)	100	12	24	Rail
Suifenhe-Manzhouli	227.2	24	35	Rail
Manzhouli-Zabaykalsk (Border)	100	1	24	Road
Zabaykalsk-Ulan Ude	633.5	18.8	37.6	Road
Total **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **1,314.7** **1,240.7**	 **62.1** **60.3**	 **131.1** **128.1**	
$/km **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **0.43** **0.43**			

Table 4-29D Intermodal route (I-5.4) from Nakhodka/Vladivostok Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Nakhodka Port	100	1	2	-
Vladivostok Port	80	1	2	-
Nakhodka-Grodekovo	154	5.3	8.5	Rail
Vladivostok-Grodekovo	100	3.5	5.5	Rail
Grodekovo-Suifenhe (Border)	100	1	24	Road
Suifenhe-Manzhouli	1100	24	48	Road
Manzhouli-Zabaykalsk (Border)	100	1	24	Road
Zabaykalsk-Ulan Ude	633.5	18.8	37.6	Road
Total **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **2,187.5** **2,113.5**	 **51.1** **49.3**	 **144.1** **141.1**	
$/km **(Nakhodka-Ulan Ude)** **(Vladivostok-Ulan Ude)**	 **0.68** **0.69**			

Table 4-29E Intermodal route (I-5.5) from Nakhodka/Vladivostok Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Nakhodka Port	100	1	2	-
Vladivostok Port	80	1	2	-
Nakhodka-Grodekovo	154	5.3	8.5	Rail
Vladivostok-Grodekovo	100	3.5	5.5	Rail
Grodekovo-Suifenhe (Border)	100	12	24	Rail
Suifenhe-Manzhouli	1100	24	48	Road
Manzhouli-Zabaykalsk (Border)	100	1	24	Road
Zabaykalsk-Ulan Ude	353	12.6	27.5	Rail
Total (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**1,907.0 1,833.0**	**55.9 54.1**	**134.0 131.0**	
$/km (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**0.61 0.62**			

Table 4-29F Intermodal route (I-5.6) from Nakhodka/Vladivostok Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Nakhodka Port	100	1	2	-
Vladivostok Port	80	1	2	-
Nakhodka-Grodekovo	279.5	6.4	12.8	Road
Vladivostok-Grodekovo	160	3.6	7.2	Road
Grodekovo-Suifenhe (Border)	100	1	24	Road
Suifenhe-Manzhouli	227.2	24	35	Rail
Manzhouli-Zabaykalsk (Border)	100	12	24	Rail
Zabaykalsk-Ulan Ude	353	12.6	27.5	Rail
Total (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**1,159.7 1,020.2**	**57.0 54.2**	**125.3 119.7**	
$/km (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**0.39 0.37**			

Table 4-29G Intermodal route (I-5.7) from Nakhodka/Vladivostok Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Nakhodka Port	100	1	2	-
Vladivostok Port	80	1	2	-
Nakhodka-Grodekovo	279.5	6.4	12.8	Road
Vladivostok-Grodekovo	160	3.6	7.2	Road
Grodekovo-Suifenhe (Border)	100	1	24	Road
Suifenhe-Manzhouli	1100	24	48	Road
Manzhouli-Zabaykalsk (Border)	100	1	24	Road
Zabaykalsk-Ulan Ude	353	12.6	27.5	Rail
Total (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**2,032.5 1,893.0**	**46.0 43.2**	**138.3 132.7**	
$/km (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**0.65 0.64**			

Table 4-29H Intermodal route (I-5.8) from Nakhodka/Vladivostok Port to Ulan Ude

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Nakhodka Port	100	1	2	-
Vladivostok Port	80	1	2	-
Nakhodka-Grodekovo	279.5	6.4	12.8	Road
Vladivostok-Grodekovo	160	3.6	7.2	Road
Grodekovo-Suifenhe (Border)	100	1	24	Road
Suifenhe-Manzhouli	227.2	24	35	Rail
Manzhouli-Zabaykalsk (Border)	100	1	24	Road
Zabaykalsk-Ulan Ude	633.5	18.8	37.6	Road
Total (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**1,440.2 1,300.7**	**52.2 49.4**	**135.4 139.8**	
$/km (Nakhodka-Ulan Ude) (Vladivostok-Ulan Ude)	**0.47 0.45**			

Table 4-29l Cost and time for transport from Tokyo to Ulan Ude

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Tokyo-Fushiki-Toyama Port	1,291	6[1]	6[1]	NA	NA	NA	1,291
Fushiki-Toyama Port	279	NA	NA	279	NA	NA	279
Fushiki-Toyama Port-Nakhodaka/Vladivostok Port[2]	872	240[1]	240[1]	872	240[1]	240[1]	872
Nakhodka Port	100	1	2	100	1	2	100
Vladivostok Port	80	1	2	80	1	2	80
Nakhodka-Grodekovo	279.5	6.4	12.8	154	5.3	8.5	154
Vladivostok-Grodekovo	160	3.6	7.2	100	3.5	5.5	100
Grodekovo-Suifenhe (Border)	100	1	24	100	12	24	100
Suifenhe-Manzhouli	1100	24	48	227.2	24	35	227.2
Manzhouli-Zabaykalsk (Border)	100	1	24	100	12	24	100
Zabaykalsk-Ulan Ude	633.5	18.8	37.6	353	12.6	27.5	353
Total **(Tokyo-Nakhodka-Ulan Ude)** **(Tokyo-Vladivostok-Ulan Ude)**	 **4,775.0** **4,615.0**	 - -	 - -	 - -	 - -	 - -	 **3,476.2** **3,402.2**
$/km	-			-			-

Notes: 1. Average transit time
2. Data from Fushiki-Toyama port-Vostochny port

4.6 CORRIDOR 6 DALIAN-SHENYANG-CHANGCHUN-HARBIN-HEIHE-BLAGOVESHCHENSK-BELOGORSK

4.6.1 Significance

Corridor 6 crosses the Chinese North-Eastern Three Provinces (CNETP) and further connects by sea transport through Dalian Port with Japan and the Republic of Korea. Japan and the Republic of Korea play a crucial role in CNETP's economy. Those two countries have already become not only major investors but also the most important trade partners for the CNETP. A number of Japanese and Korean companies have established factories in the CNETP, which are producing various manufactured goods. In most cases, these factories specialize in the assembly process and parts and components for finished products are imported from Japan and the Republic of Korea. This is one factor which has led to the increase of logistics and transport demands in those regions. In addition, CNETPs' abundant human resources, who can speak Japanese and Korean, are expected to play a crucial role in attracting more and more companies from those two countries. Economic exchange and cooperation between CNETP and Japan and the Republic of Korea is expected to strengthen further in the future.

As of 2002, the CNETP held 8.3 per cent of China's total population, and 11.1 per cent of GDP. In other words, CNETP has a huge market backed up by a population of more than 100 million and great growth potential driven by a gross regional domestic product (GRDP) of more than $100 billion. This has resulted in the region being attractive to foreign investors (Table 4-30).

In addition, the CNETP composes the Bohai economic circle with the Greater Beijing region (Beijing, Tianjin and Hebei Provinces). The Bohai region is one of the three major economic areas in China with the Zhu River Delta (Shenzhen, Guangzhou and Hongkong) and the Chiang River Delta (Shanghai) (Figure 4-32).

In this sense, it does not seem unreasonable to expect that the CNETP will become another important growth axis of North-East Asia. Herein lies the significance of Corridor 6, which can support transport demands for this region.

Table 4-30 Major indicators of Chinese North-East three provinces, 2002

Regions	Population		Gross Regional Domestic Product	
	(10 thousands)	% Share	(100 million Yuan)	% Share
North-East Three Provinces	10,715	8.3	11,586.5	11.1
Liaoning	4,203	3.3	5,458.2	5.2
Jilin	2,699	2.1	2,246.1	2.1
Heilongjiang	3,813	3.0	3,882.2	3.7
China Total	1,28,453	100.0	104,790.6	100.0

Source: Statistical Yearbook of China, www.ststs.gov.cn

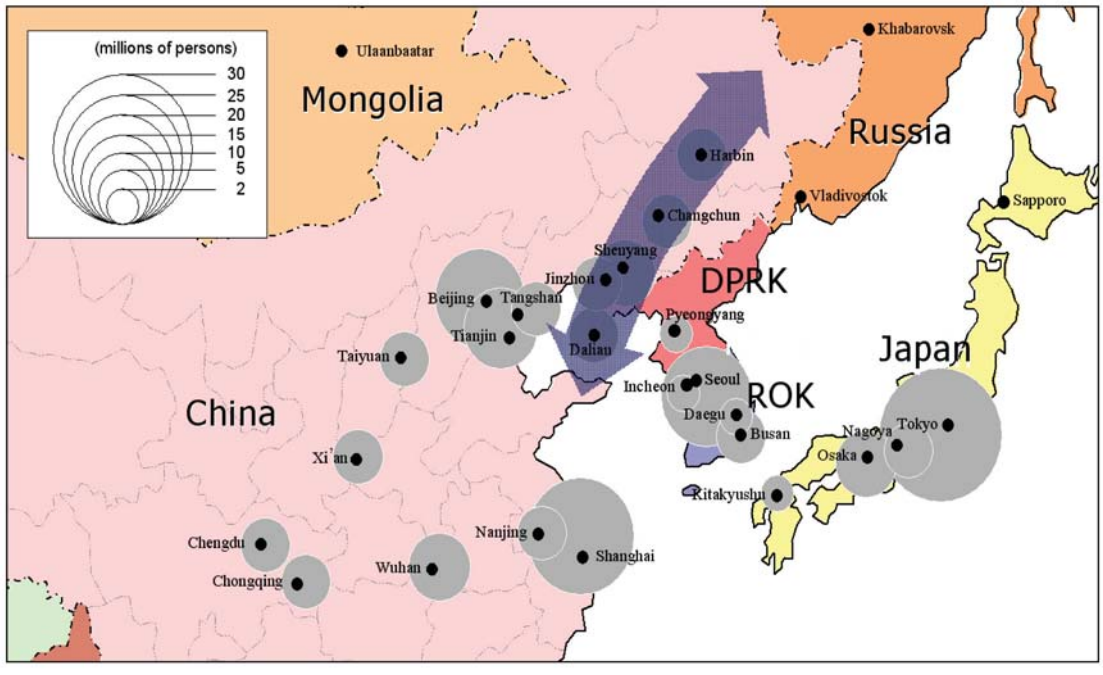

Figure 4-32 Dalian-Harbin axis

4.6.2 Current situation and prospects

Ports. The Port of Dalian, which is located at the southern tip of the Liaodong Peninsula, serves as the gateway to north-eastern provinces of China. The port is linked to an inland container transport network with dedicated train services to the inner cities of Changchun, Harbin, Shenuang and Yanji with more than 40 departures every week. Dalian Port handles 85 per cent of the total export cargos produced in CNETP. Around 80 per cent of the container freight handled at the port is from the Dalian area, 10 per cent from the Shenyang area, and the other 10 per cent from the Changchun and Harbin area.

Container operation at the Dalian Port involves two terminals, both operated by PSA Corporation in a joint venture with the port authority. Dalian Dagang Container Terminal (DDCT) handles mainly domestic and coastal cargoes and has an annual handling capacity of 400,000 TEU. Dalian Container Terminal (DCT), located in Dalian Jinzhou Economic Development Zone, has five container berths totaling 1,500m with the capacity to handle 1.8 million TEU of international container cargoes annually. Container throughput at Dalian Port was recorded as 1.67 million TEU in 2003.

The Port of Dalian is stepping up its development in a bid to become the international shipping centre for North-East Asia. Dalian Port plans to invest CNY$27 billion on new and improved port facilities by 2010. By 2010, total throughput will increase to 200 million tons and container throughput to 6 million TEU.

Railway. Electrification of rail on the Dalian-Harbin line was completed in November 2001, where container trains are in operation (ERINA 2002). Double tracks are available from Dalian to Suihua, and single tracks from Suihua to Heihe in China. Russian Federation's rail in this corridor is run by diesel on a single track. There is a missing link of 85km at the border area between Heihe in China and Blagoveschensk in the Russian Federation. Since the track gauge is different between China and the Russian Federation, connecting the missing link needs to consider dual gauges at the border. By rail, the total length of this corridor is 1,795km (Figure 4-33 and Table 4-31).

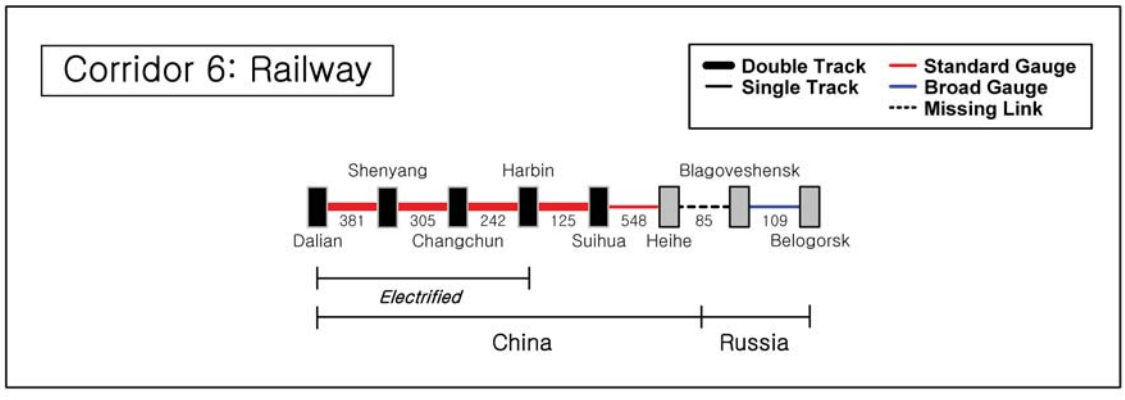

Figure 4-33 Present conditions of railway, Corridor 6

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-31 Rail distance between Dalian and Belogorsk

Country	From	To	Distance (km)
China	Dalian Changchun	Changchun Heihe	686 915
Border	Heihe	Blagoveschensk	85
Russian Federation	Blagoveschensk	Belogorsk	109
Total (Dalian-Belogorsk)			**1,795**

Road. Road development in China's north-eastern provinces is progressing at a tremendous rate. For example, by 2002 a new expressway had been constructed between Dalian and Harbin. The Dalian to Shenyang section was completed in 1990; the Shenyang to Siping section in 1994; the Siping to Changchun section in 1998; and Changchun to Harbin section in 2002 (ERINA 2002). The average travel time has also

been reduced significantly with the new highway systems. It takes about 11.5 hours, on average, to travel from Dalian to Harbin, a distance of 914km. The road beyond Harbin is paved up to the Bei'an region with a design speed of 60km/hour. However the section from Bei'an to Heihe is not paved. The average travel time from Harbin to the border of the Russian Federation, a distance of 604km, is about 11 hours[11]. The total road distance of Corridor 6 is 1,712km, slightly shorter than the rail distance (Figure 4-34 and Table 4-32).

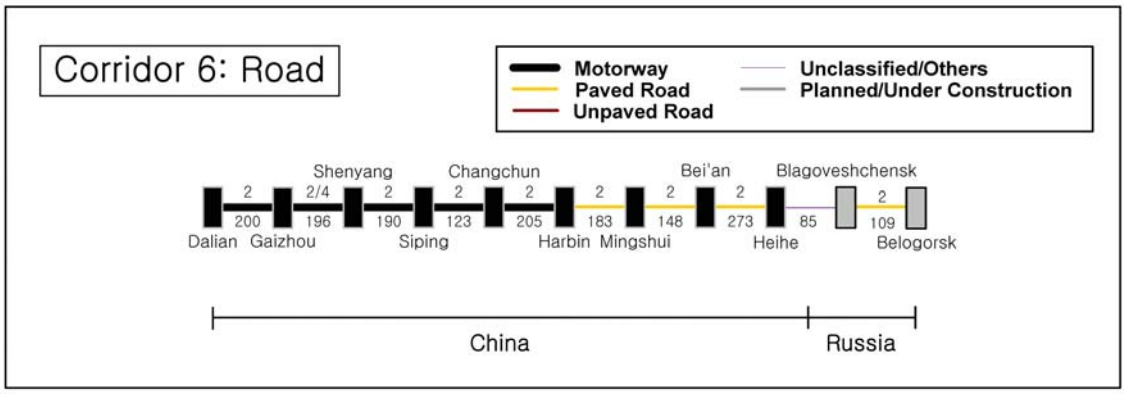

Figure 4-34 Present conditions of road, Corridor 6

Sources: Based on Country reports, ERINA and Maps produced by UNDP

Table 4-32 Road distance between Dalian and Belogorsk

Country	From	To	Distance (km)
China	Dalian Changchun	Changchun Heihe	709 809
Border	Heihe	Blagoveschensk	85[1]
Russian Federation	Blagoveschensk	Belogorsk	109
Total (Dalian-Belogorsk)			1,712

Note: 1. Data from rail distance between Heihe and Blagoveschensk

4.6.3 Transport cost and time

The cost and time to transport goods from Dalian port to Belogorsk is outlined in Table 4-33.

[11] This travel time is significantly lower than 26 to 51 hours for the section from Dalian to Heihe in Table 4-34, based on the data provided by the national expert in China.

Table 4-33 Cost and time for transport from Dalian to Belogorsk

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Dalian Port	80	15	30	80	15	30	80
Dalian-Changchun	500	12	24	104[1]	10	14	104
Changchun-Heihe	620	14	27	139[1]	17	24	139
Heihe-Blagoveschensk (Border)	85[2]	4.3[3]	8.5[3]	85[2]	4.3[3]	8.5[3]	85
Blagoveschensk-Belogorsk	110[4]	1.8[5]	3.6[5]	10.9[6]	1.8[5]	3.6[5]	10.9
Total **(Dalian-Belogorsk)**	1,395	47.1	93.1	418.9	48.1	80.1	418.9
$/km	0.81			0.23			

Notes:
1. The costs reported by Chinese expert are updated with ESCAP data using cost per kilometre conversion
2. The cost assumed by $1.0 per km at border crossing
3. Estimates based on maximum speed (20km/h) and minimum speed (10km/h) at border crossing
4. Average trucking charge (15ton) of distance (120km) between Moscow and Dmitrov
5. Estimates based on the maximum speed (60km/h) and minimum speed (30km/h)
6. The cost assumed at $0.1 per km in the Russian Federation

Figures 4-35 and 4-36 present the time-distance relationships of road and rail transport in Corridor 6, from Dalian to Belogorsk.

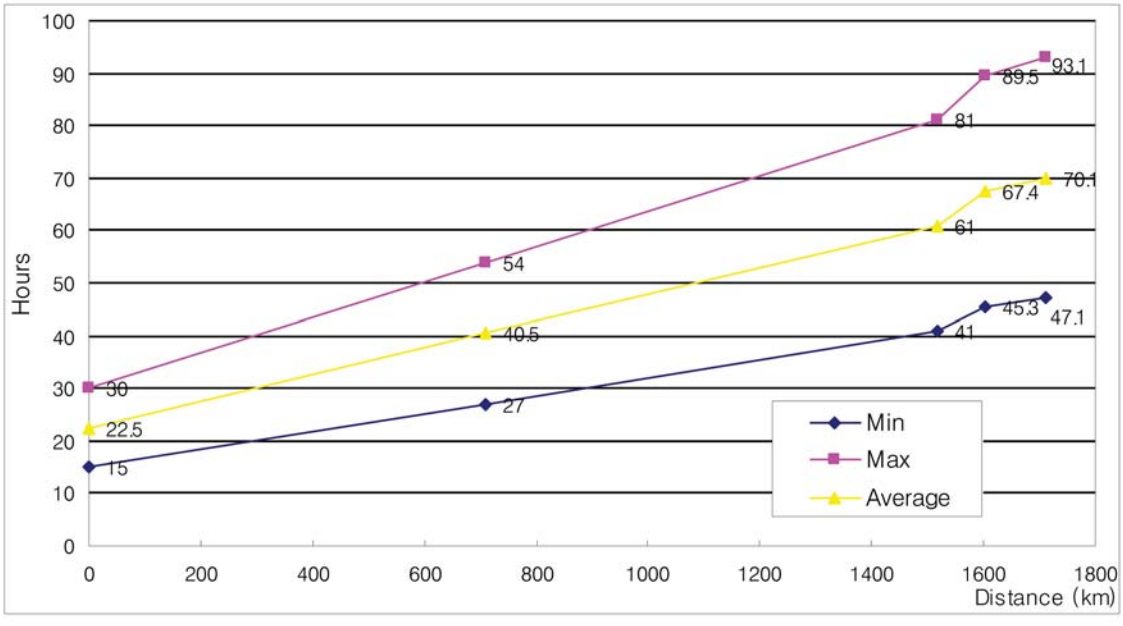

Figure 4-35 Dalian-Belogorsk transit time (road)

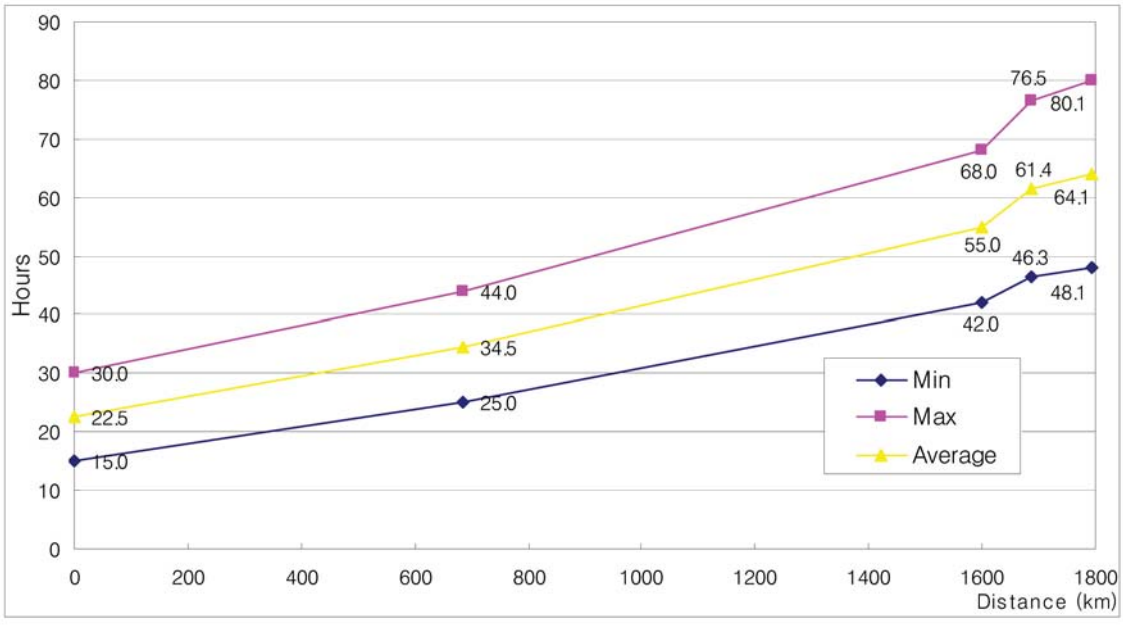

Figure 4-36 Dalian-Belogorsk transit time (rail)

Figure 4-37 shows the cost-distance relationships for different transport modes in the corridor. The total cost to transport containers between Dalian and Heihe by road is about $1,200 per TEU (for 1,518km) and $323 per TEU (for 1,601km) with rail.

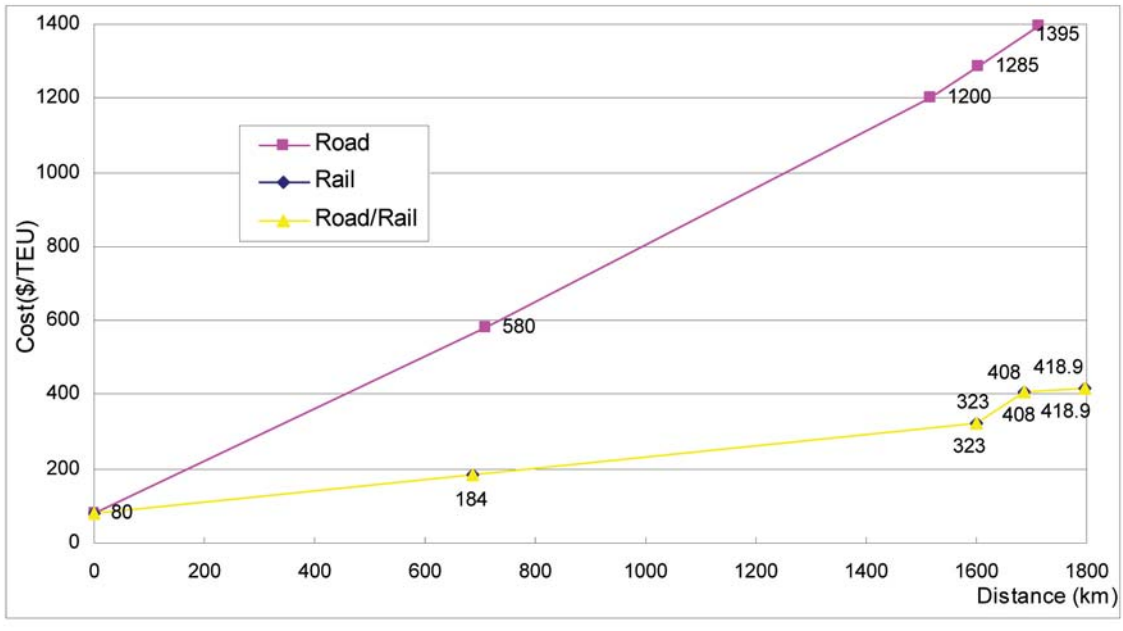

Figure 4-37 Cost-distance (Dalian-Belogorsk)

Routes to consider

1) Rail route: China-Russian Federation
2) Road route: China-Russian Federation
3) Intermodal route 1: China(rail)-Russian Federation(road)
4) Intermodal route 2: China(road)-Russian Federation(rail)

Using rail transport for the entire route seems to provide the lowest transport cost. However, due to the missing link of 85km between Heihe and Blagoveschensk crossing the border between China and the Russian Federation, an all-rail option along Corridor 6 is currently not feasible. Other alternative intermodal routes as well as an all-road route can be considered for analysis. Tables 4-33A through 4-33D, which are derived from Table 4-33, show tabular information for transport cost and time for these alternative routes. Table 4-33E presents additional cost and time for providing a sea transport connection to Japan with Corridor 6.

Table 4-33A Rail route (U-6.1) from Dalian Port to Belogorsk

	Rail		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Dalian Port	80	15	30
Dalian-Changchun	104	10	14
Changchun-Heihe	139	17	24
Heihe-Blagoveschensk (Border)	85	4.3	8.5
Blagoveschensk-Belogorsk	10.9	1.8	3.6
Total (Dalian-Belogorsk)	**418.9**	**48.1**	**80.1**
$/km	**0.23**		

Table 4-33B Road route (U-6.2) from Dalian Port to Belogorsk

	Road		
	Cost	Transit Time (hours)	
	($/TEU)	Min	Max
Dalian Port	80	15	30
Dalian-Changchun	500	12	24
Changchun-Heihe	620	14	27
Heihe-Blagoveschensk (Border)	85	4.3	8.5
Blagoveschensk-Belogorsk	110	1.8	3.6
Total (Dalian-Belogorsk)	**1,395**	**47.1**	**93.1**
$/km	**0.81**		

Table 4-33C Intermodal route (I-6.3) from Dalian Port to Belogorsk

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Dalian Port	80	15	30	-
Dalian-Changchun	104	10	14	Rail
Changchun-Heihe	139	17	24	Rail
Heihe-Blagoveschensk (Border)	85	4.3	4.3	Road
Blagoveschensk-Belogorsk	110	1.8	3.6	Road
Total (Dalian-Belogorsk)	**518**	**48.1**	**75.9**	
$/km	**0.29**			

Table 4-33D Intermodal route (I-6.4) from Dalian Port to Belogorsk

	Road + Rail			Road/Rail
	Cost	Transit Time (hours)		
	($/TEU)	Min	Max	
Dalian Port	80	15	30	-
Dalian-Changchun	500	12	24	Road
Changchun-Heihe	620	14	27	Road
Heihe-Blagoveschensk (Border)	85	4.3	8.5	Rail
Blagoveschensk-Belogorsk	10.9	1.8	3.6	Rail
Total (Dalian-Belogorsk)	**1,295.9**	**47.1**	**93.1**	
$/km	**0.76**			

Table 4-33E Cost and time for transport from Nagoya Port to Belogorsk

	Road			Rail			Road/Rail
	Cost	Transit Time (hours)		Cost	Transit Time (hours)		Cost
	($/TEU)	Min	Max	($/TEU)	Min	Max	($/TEU)
Nagoya Port	234	NA	NA	234	NA	NA	234
Nagoya Port-Dalian Port	182	72	168	182	72	168	182
Dalian Port	80	15	30	80	15	30	80
Dalian-Changchun	500	12	24	104	10	14	104
Changchun-Heihe	620	14	27	139	17	24	139
Heihe-Blagoveschensk (Border)	85	4.3	8.5	85	4.3	8.5	85
Blagoveschensk-Belogorsk	110	1.8	3.6	10.9	1.8	3.6	10.9
Total (Nagoya-Belogorsk)	**1,811**	**-**	**-**	**834.9**	**-**	**-**	**834.9**
$/km	-			-			-