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A Study of Efficiency and Prioritize of Eurasian Logistics Network

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Abstract**—**Recently, Northeast Asia has become one of the three largest trade areas, covering approximately 30% of the total trade volume of the world. However, the distribution facilities are saturated due to the increase in the transportation volume within the area and with the European countries. In order to accommodate the increase of the transportation volume, the transportation networking with the major countries in Northeast Asia and Europe is absolutely necessary. The Eurasian Logistics Network will develop into an international passenger transportation network covering the Northeast Asian region and an international freight transportation network connecting across Eurasia Continent. This paper surveys the changes and trend of the distribution network in the Eurasian Region according to the political, economic and environmental changes of the region, analyses the distribution network according to the changes in the transportation policies of the related countries, and provides the direction of the development of composite transportation on the basis of the present conditions of transportation means. The transportation means optimal for the efficiency of transportation system are suggested to be train ferries, sea & rail or sea & rail & sea. It is suggested to develop diversified composite transportation means and routes within the boundary of international cooperation system.

Keywords**—**Eurasian Logistics, Integrated Distribution Transport, Northeast Asia, Transportation Networking

I. Introduction

MAJOR discussions over the formation of the Northeast Asian and Eurasian integrated transportation and distribution system will deal with the 89,000 km Trans-Asian Highway (32,500 km in Northeast Asia) and the Asian Highway, plans for which are being carried forward by the United Nations Economic and Social Commission for Asia and the Pacific. The outlook on growth has declined because of the worldwide economic crisis and the economic crisis has affected even the emerging markets, which were the major source of potential, and slowed things down. Primary risk factors include the question of whether an exit strategy can be implemented, the possibly of instability in terms of obtaining resources and a slow employment market. Eurasian countries are quickly recovering from the shock of the financial crisis. How quickly Eurasian countries change outside factors into demand and maintain stable macroeconomics, and how they reshuffle their exports towards areas quickly growing worldwide will play a decisive role in escaping the recession.

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TABLE I
INTERNATIONAL TRADE STATISTICS OF KOREA, JAPAN AND CHINA

Year		2003	2004	2005	2006	2007	2008
Korea	Export	23,279	30,047	33,397	38,044	38,926	38,918
	Import	15,925	17,495	19,845	22,420	24,385	25,257
	Total	39,204	47,542	53,242	60,464	63,311	64,175
Japan	Export	66,353	73,569	73,344	75,646	76,996	74,229
	Import	39,399	42,429	42,833	43,776	42,585	40,842
	Total	105,75	115,99	116,17	119,42	119,58	115,07
China	Export	95.619	126,37	157,88	191,16	229,56	246,35
	Import	39,808	47,532	51,072	62,578	70,742	76,898
	Total	135,42	173,90	208,95	253,73	300,30	323,24

Source : Korea International Trade Association
Unit: million €

In this report, Eurasia refers to those countries lying in Europe and Asia, including the core economic region comprising Korea, Japan, China, central Eurasian Russia and the central Asian countries.

Trade between Korea, Japan, China and the EU is maintaining a consistent growth rate with that of Korea at 10.4%, Japan at 1.7% and China at 19%. China's rate of increase is particularly high.

China, is continuously improving its transportation infrastructure and this development has brought great investment opportunity to China, providing a driving force for this nation which is one of the fastest growing in the world.

II. The State of the Eurasian Logistics Network

A. The Integration of Railways and Road Networks in Eurasia

The route between Northeast Asia and Europe by continental train includes 4 main lines: the TSR, the China Transcontinental Railroad, the Manchuria Transcontinental Railroad, and the Mongolian Transcontinental Railroad.

UNESCAP forecasts that the TSR-TKR line will be the most competitive in the future This is due to the fact that it has the fewest countries to pass through, reducing time, and basic facilities and infrastructure, and so is in a comparatively advantageous situation.

The connection points between the Korean peninsula and China and Russia are Sinuiju, Manpo, Namyang and Namjin. Presently, between North Korea and Russia, the Najin and Hasan rail line, and the Najin port are being renovated. It seems that this project is under way because North Korea desires economic support and the strengthening of political ties. Russia also wants to broaden its political influence regarding the Korean peninsula in the long term. The agreement between

North Korea and Russia for the the Najin and Hasan rail line and the Najin port renovation was signed on April, 24 2008 but construction has presently been suspended.

The Far Eastern intercontinental railroad network comprises two arterial rail lines—The Trans Siberia Railroad, which connects Russia from East to West, and the Baikal Amur Railroad (BAM) and other branch lines.

The importance of connection with the intercontinental railroad through China expected to increase in the long term. The Chinese government is actively pursuing development in the three Northeastern provinces and the Hwanbal Sea region. From this standpoint, it is expected that connection of the Korean Peninsula Cross Country Railroad and the Trans China Railroad (TCR) will emerge as an important assignment to consider.

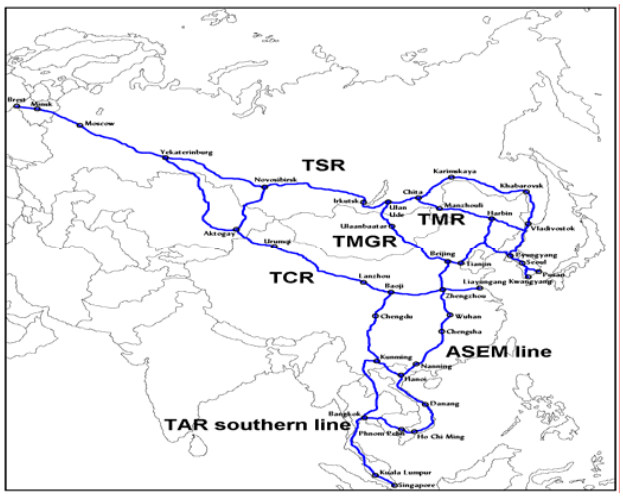

Fig. 1 Intercontinental Railroad Network
Source: Korea Transportation Research Center

Fig. 2 Asian highway route map
Source: U.N. Economic and Social Commission for Asia and the Pacific (ESCAP)

The Asian Highway construction project connects Asia by car. It is being pursued along with the railroad project by the U.N. Economic and Social Commission for Asia and the Pacific (ESCAP) under the structure of the Asian Land Transport Infrastructure Development (ALTID) project drawn up in 1992. 27 countries signed the agreement for the Asian Highway construction plan in Shanghai, China on April 26, 2004, and the agreement came into effect on July 4, 2005.

If this plan becomes a reality, neighboring countries will be closely connected by car as in Europe. Of course, this is possible if a institutional foundation, such as no visa passage between neighboring countries, is offered as in the European Union.

B. Present Eurasian Marine and Air Distribution Conditions

In the airline industry, there is no international cooperative enterprise akin to the intercontinental railroad or the Asia Highway. At the individual country level however, an expansion of port facilities to attract rapidly growing shipping of goods is being pursued. What must be particularly noted are China's actions. This is because large scale port facility development projects are being carried forward in the Changjangsamgakju, Jujangsamgakju and Jingjinji regions based on fast growth in this area. In the Jingjinji Region, recently of note in the 11th Chinese five year plan , the three core Balhae Gul ports, , Qingdao, Tianjin and Dalian, are growing as International Trade Ports.

In South Korea, a railroad service will be installed at 16 of its 29 trade ports and 35 international industrial complexes. As for railroads connected to airports, railroad service will be completed at appropriate times in Western Gwangyang Airport (2010) and the new Pusan Airport (2011), and will increase transport capability and speed. While expanding transportation volume, there are also plans to increase express freight train speeds (90km/h→120km/h).

There are plans to expand roads at appropriate times including Incheon Bridge and a highway connecting to the airport (completed in 2009), and new Pusan Airport and Gwangyang Airport Access Roads.

Apart from this, there are plans to build and standardize an information system to raise distribution service quality, and plans to build a radio frequency identification (RFID) infrastructure distribution based information system by 2012 (begun in October, 2008) connecting airports and interior distribution stations. Likewise, based on a distribution standardization plan (April, 2007), transport package storage and distribution standardization in each field is being supported.

In the shipping sector, through overseas base securement and global company (Mega-Carriers) promotion, maritime transport agreements will be signed with India (2008), Turkey (2008) and Egypt (2009). The number of countries with whom a maritime transport agreement has been signed is expected to increase from 18 to 21 countries.

Freedom of air travel, agreed upon with Japan, is being pursued with China (2010), and using this as a foundation, a combined airline network is being built in Northeast Asia.

In the railroad sector, over an extended period of time, there are plans to push ahead with applying for membership in the international railroad organization (OSID), forming a comprehensive Northeast Asian integrated transportation distribution market and expanding comprehensive diplomatic

cooperation with major economic blocks such as ASEAN, NAFTA and the EU.

III. Efficiency of Eurasian Logistics network

The distribution network can be described as the connection of links, including roads, railroads, shipping lanes and airways, and nodes, including ports, airports and railroad terminals. This type of distribution network forms an important understructure for distribution activity. It can be an important factor for a shipper in determining distribution cost or time consumed in distribution.

A. Eurasian Transport Efficiency

Regarding transport linking Northeast Asia and Europe, the incompleteness and economic effects imposed directly and indirectly on the nations involved must be considered. Such considerations include the possibility of distribution cost and transportation time reductions, the possibility of resource procurement including natural gas and oil, trade expansion with neighboring countries, the possibility of economic union in the Northeast and the possibility of an increase in two sided or multilateral economic cooperation. For distribution to Europe, a railroad can reduce transport time by up to 10 days over shipping. Another task to overcome for an intercontinental railroad is infrastructure and service development allowing ease of transport by simplifying customs clearances taking into account each country's clearance profits. In using an intercontinental railroad, natural gas, oil, and natural resources can be expected to be procured, and trade between neighboring countries can be expanded.

TABLE II
Data for Vostochniy and Vladivostok Port freight processing through TSR usage

Classification	2001	2002	2003	2004	2005	2006	2007
quantity of TSR goods (TEU)	120,15	157,94	245,50	400,92	406,80	420,53	620,83
Amount of Vostochiny Port Freight (TEU)	89,92	133,80	204,65	272,53	272,01	291,42	370,99
Amount of Vladivostok Port Freight (TEU)	-	-	-	102,58	124,72	146,84	223,50

Source : CCTT

The increasingly busy Vostochniy Port, which connects to the TSR rail line handling export freight between Russia and Central Asia and Korea, , together with the TSR is the departure point for the international transport route which handles the highest export goods traffic from Korea.

The quantity of import goods at the Vostochniy Port accounts for a majority of Russia's own import goods. Although it is not large, research has shown that the quantity of goods heading to Tajikistan and Poland is consistently increasing.

It has however, been shown that because of the convoy charge imposed in 2005, the Vostochniy Port to Finland has greatly reduced. Research has shown that the quantity of exchange with the Central Asian countries has reduced and the TCR railroad use along with Chinese ports is the main reason for this.

The far eastern Russian ports which handle the TSR transport are the Vostochniy and Vladivostok ports. They handle 80% of the TSR container freight. The Vostochniy Port is very well connected with the TSR and is located towards the northeast of the Far Eastern region. It is the second largest container port in all of Russia after St. Petersburg Port on the Baltic Sea.[1] With four berths (extended over 1,347 m), it handles the highest quantity of containers in the Far Eastern region.

Vladivostok Port is another entry connecting to the TSR, and is located at the southern edge of Muravyov-Amur Bay. Research has shown that it handles mainly bulk or regular cargo including crude oil, processed oil, coal, and timber with approximately 50% of the cargo handled using the TSR.[2]

Due to the shortage of port facilities and freight cars in Far Eastern Russia and the limitations of TSR transport capacity (demand is greater than supply) the freight rates increased in 2006.

Previous research on the TSR was limited to Deep Sea area fare and transport time analysis with Hamburg as the base. Studies have shown however, that the areas where distribution companies provide service to the TSR is expanding in Russia (Taganrog, Moscow, Irkutsk and Novosibirsk) and European regions. This in turn reveals the limitations of the current research.

The Asian Highway Network is an expressway crossing 32 Asian nations, running 140 kilometers in length. The United Nations Economic and Social Commission for Asia and the Pacific is carrying this project forward. One of the three the Asian Land Transport Infrastructure Development (ALTID) projects, —it was approved by ESCAP in 1992. A modern Silk Road plan is being developed using primarily existing road networks.

Asian Highway 1 is planned to depart from Tokyo and cross through Southeastern and Central Asia, connecting to the Bulgarian border. There is an anticipation of connectivity enhancement between Southeast Asian countries, India and Russia. In order to complete the highway, existing roads will be improved with $250 billion invested in 2007.[3]

There 55 highways total, with 8 main highways (AH-AH8) and the rest, branch highways. The section connecting Korea and Japan as well as Malaysia and Indonesia is divided by water and will be linked by car ferry. There is also discussion being made over a Korea and Japan undersea tunnel which will connect Korea and Japan.

B. A Comparison of Eurasian Logistics Transport Methods Efficiency

On examining a variety of shipping networks, reasonable distribution cost is found in integrated transport, which is more

efficient and effective than single transport, with its use steadily increasing.

When selecting among integrated transport services, a comparison and evaluation of transport services efficiency must be made multilaterally, including transport quantity, distance, safety, speed, climate, unit load system, weight restrictions, loading and unloading, packaging, and storage.[2]

Integrated Railroad Transport using the TSR has the great advantage of shortening transport distance and time by approximately 10 days. As well the ability to directly deliver freight to Russia and Central Asia and the advantage of an approximately 78% lower transport cost than shipping when transporting to interior regions like Moscow, makes freight charge reduction and prompt transport possible.

Efficiency maximization is also possible from the supplier standpoint, by offering a door-to-door connection service. The problem of declines in price competitiveness following the 2006 increase in freight charges, in service level due to lack of facilities investment, process complexity, freight car shortages, worn out facilities, and capacity limitations all weaken competitiveness. Problems associated with differences in standards are also being considered.

Except for cases of transport to interior areas, shipping is approximately 60% less expensive to the western coast of Europe than the combined TSR transport cost. Similarly, because various international transport networks exist that provide service for long distance and mass transport, shipping continues to carry large scale freight between continents. Infrastructure and information systems standardization plays a large role as well in the increase in maritime transport. [4]

TABLE IV
COMPARISON OF TRANSPORT DAYS AND COSTS BETWEEN SHIPPING, RAILROAD, AND SHIPPING TRANSPORT COMBINED

Classification	Section	Transport Days	Cost (20“)
Shipping	Seoul-Busan-Suez Canal-Rotterdam-Brest	28-30 days	$2,280
Railroad and Shipping[a]	Seoul-Busan Port-Vostochniy -Brest	28-30 days	$2,980
	Seoul-Busan Port-Lianyungang-Brest	33-36 days	$3,080

Based on data from the Korean Maritime Institute
([a]Freight charge increase when transport to interior regions is included)

Nevertheless, when taking into account susceptibility to the weather and the disadvantage of transport time, it is possible to recognize that because navigation plans must unavoidably be changed because of the weather, and because it takes approximately 10 more shipping days, there is the problem of schedule. As well, building shipping infrastructure requires a large amount of investment. Thus, at present, when comparing the two transport methods, it is difficult to definitively select one over the other.

According to Korean Maritime Institute research in 2007, the transport time for combined railroad transport compared to shipping is reduced by approximately 10 days. The freight charge from Busan to Moscow through combined railroad transport is 23% cheaper than shipping. From Busan to Rotterdam or Hamburg, maritime transport is 44% less expensive than by combined railroad transport.[5]

TABLE III
MAIN INTERCONTINENTAL RAILROAD SPECIFICATIONS

Classification	Section	Distance	Double track	Railroad Electrification	Track gauge	Remarks
Trans-Siberian Railway (TSR)	Vladivostok ~ Khabarovsk ~ Chita ~ Ulan - Ude ~ Irkutsk ~ Omsk ~ Novosibirsk ~ Yekadelinburg ~ Moscow	9,880	9,880	9,880	Russia broad gauge (1,520㎜)	• Transport capacity: 140,000TEU/ year • Freight system: MTT
Trans-China Railway (TCR)	Lianyun port ~ Jeongju ~ LanZhou ~ Urumqi ~ Arasanku (Cn) ~ Druzhba (Ka) ~ Presgonorkovka (Ka) ~ Zaulalie St. (Ru) connecting to TSR	8,613	7,127	5,001	China standard gauge (1,435㎜)/ Kazakhstan broad gauge (1,520㎜)	• Freight system: ETT
Trans-Manchuria Railway (TMR)	Domun ~ Manchuri (Cn) ~ Zabaykalsk (Ru) ~ Kalimskaya St. (Ru) connecting to TSR	7,721	7,367	6,067	China standard gauge (1,435㎜)	
Trans-Mongolian Railway (TMGR)	Tienjin (Cn) ~ Beijing ~ *Eren Hot (Cn) - Zamiin Uud (Mo) - Ulaanbaatar ~ Suhbator (Mo) - Nauski (Ru) ~ Ulan Ude St. (Ru) connecting to TSR	7,753	6,296	5,777	Mongolia broad gauge (1,520㎜)	Single track railway for the whole section of Mongolia

Based on data from the Korean Railroad Research Institute

C. Methods Eurasian Logistics Transport Efficiency enhancement and Integrated Distribution Transport Improvement

The ideal transport method is one that maintains a level of service suitable for a certain purpose and reduces distribution cost.

The most important factors in method selection are reliability of total scheduled transport time and door to door costs. Clients generally select transport methods based on freight, cost and consumer demand. To secure transport time confidence, the lead time for each transport mode, stopover locations, transport schedule, economic feasibility and safety must be analyzed.

For transport efficiency enhancement, each transport method's strengths are united and integrated transport, with its streamlined process for various transport networks, is increasing.

Among the recent integrated transport growth factors are an increase in valuable small quantity-high frequency freight, of global distribution company transport services unification long distance transport promptness. [6]

Models representing combined transport services include Sea and Air service and Land Bridge service.

Sea and Air transport combines the cost advantage of shipping, with the speed advantage of flight. This method optimizes the long lead time of maritime transport and the high cost of air transport.

This method can efficiently overcome problems of high costs which occur when transporting by flight the entire distance, and lengthens lead time when shipping.

Sea and Air transport is not consistent like Land Bridge transport, and speed, precision, economic feasibility and safety procurement, which are the core of efficient transshipment, are basic requirements that must be met.[5]

Because Sea and Air transport has great potential over long distances, it is used in routes from Asia to Europe, South America and the United States. Development is particularly centered around long distance routes to Europe.

TABLE V
A COMPARISON OF TRANSPORT TIME USING A JOINT SOUTH AND NORTH KOREAN RAILROAD VERSUS THE TRAIN FERRY[B]

Section	Distance	Transport Time	Comparison
Seoul-Sinuiju (Dandong)-Zhengzhou	2,274km	43.37hours	Crosses borders twice
Seoul-Incheon-Yantai - Zhengzhou	1,728km	33.97hours	Crosses border once

Yoo, Jae-gyun and others (2003), Research on the technological development of the North Korean distribution system connecting with Northeast Asia, Ministry of Land and Maritime Transport
([B]Train operating speed: Korea and China 60km/h, North Korea 30km/h: excluding time lost through location checks including borders)

Land Bridge transport is based on land, sea and air consistent transport system growth, by which freight is not transferred and is transported consistently under the responsibility of the transport company to its final destination via two or more different transport methods-, ship, truck or train.

In order to achieve a consistent transport system based on Land Bridge transport, an understanding of joint transport facility use, transport facility expansion and maintenance, a change in freight charges, and research on transport methods must be put in place.

A train ferry integrated transport route may be used as one measure for building a new Land Bridge system. A train ferry transport system is an consistent integrated transport method combining the savings of maritime transport with the capability of railroad transport to move bulk quantities at cheap costs. It can maximize the freight charge savings from ships and trains.

Currently proving its efficiency through the new Land Bridge System between Korea and China (see table), the basic train ferry possibility is in serving as a response measure to future freight and transport demand increases between Korea and China. Operation of a train ferry must be pursued on the basis of each port, harbor, and nation and freight type.

IV. CONCLUSION

The United States APC has stated that when choosing a transport service, importance is ranked as follows: on time delivery, transport company system of accountability, freight charge, cargo collection as scheduled, and transport time. A majority of research ranked the order as time, cost, convenience, consumer impressions of the Transport Company, and productivity.

As mutual economic reliance and the movement for economic integration increases between neighboring countries, the importance of China, Japan, Korea and Russia is increasing. Thanks to this, integrated transportation network development is being pursued in Northeastern Asia. The Asian Highway and intercontinental railroad construction, which are major development projects being pursued to connect severed land transportation routes are examples of this and currently being prepared for economic development.

Because the major countries in the Northeastern region, South Korea, China and Japan—cannot use the transportation facilities of North Korea, they do not possess a land transport system. This background causes a reliance on shipping and the dependence of travelers on flight. To solve this problem, a Land and Sea transport system with lessened reliance on maritime transport, has improved its efficiency. The ideal method to procure transport system efficiency is the sea and rail, or rail and sea methods. A variety of Land Bridge transport routes and shipping rights must be developed within the system of international collaboration.

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