

International Passenger Train Service in the Corridor between Seoul and Beijing (서울↔베이징간 국제 여객열차 운영의 수익성에 관한 연구)

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ABSTRACT

올해(2004년) 연말로 예정된 남북철도 연결이 동북아 지역의 물적교류에 미칠 영향에 관한 연구는 TSR, TCR, TMGR, TMR에 관한 연구와 함께 국내에 이미 상당한 수준 축적 되었지만 물적 교류와 함께 동북아 교류협력에 또 한 축을 이루고 있는 인적교류 즉 여객수송에 관한 연구는 거의 없는 실정이다.

본 연구에서는 인구가 조밀하고 경제성장 속도가 빠른 서울↔북경 축에 국제 여객열차를 운행할 경우를 가정하여 기존의 항공·해운에서 철도로의 수요 전환량을 실제 설문조사를 통하여 구하고 이를 수송할 열차 운행계획을 세운다.

나아가 국제 여객열차 운영자의 입장에서 예상수입 및 비용을 현실성 있게 계산하고 수익성 여부도 검토한다.

1. Introduction

The inter-Korean railway is expected to be reconnected by the end of 2004, 60 years after its severance on September 11 in 1945. Once completed, it would facilitate human and goods exchanges among the North East Asian countries. There have been many studies on the reconnection of the two Korean railways and further on the Trans-China Railway (TCR), the Trans-Siberia Railway (TSR), the Trans-Manchurian Railway (TMR) and the Trans-Mongolian Railway (TMGR). While most of those studies mainly focused on goods transportation, studies on human exchange have been rare.

This study aims to estimate the demand shift from air to train when passenger train services are available in the corridor between Seoul and Beijing. Another purpose of the study is to establish a train operation plan based on the estimation. In addition, the study evaluates the profitability of offering passenger train services between Korea and China (Beijing and the

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major cities in the three Northeast states) from the standpoint of the train service providers.

2. Passenger Transportation Demand

2.1 Total Passenger Demand for the Routes between Korea and China

Inquiries are conducted on the number of passengers on the flights going between Korea and China during the six-year period from 1997 to 2002. For the purpose of the study, it is assumed that passengers increase until 2008 at the same rate as that of the six years surveyed and at half the rate from 2009 to 2013.

The demand estimate is shown in the table below.

Table 1. Estimated Passenger Demand

Unit: Persons

Route	Seoul - Beijing	Seoul - Shenyang	Seoul - Changchun	Seoul - Harbin	Seoul - Daeryun	Busan - Beijing
2008	3,523,508	967,997	379,274	215,443	351,771	492,324
2009	3,902,285	1,014,945	428,580	241,403	365,842	555,834
2010	4,321,721	1,064,170	484,295	270,492	380,476	627,537
2011	4,786,373	1,115,782	547,253	303,087	395,696	708,489
2012	5,300,908	1,169,898	618,396	339,609	411,523	799,884
2013	5,870,755	1,226,638	698,788	380,532	427,984	903,069

2.2 Demand Shift to Railway Travel

To predict modal shift triggered by the international train service, the study derived utility functions for air, sea and railway transportation from survey results and used a logit model. Surveys were conducted twice adopting a stated preference approach and the utility functions were derived through LIMDEP 7.0 with NLOGIT. 454 persons responded to the survey at the Incheon International Airport.

The survey data were processed with LIMDEP 7.0 with NLOGIT and the resulting modal shares are shown in the following table.

Table 2. Modal Share of Passenger Transportation Demand

Unit: %

Route	Seoul - Beijing	Seoul - Shenyang	Seoul - Changchun	Seoul - Harbin	Seoul - Daeryun
Railway	36	82	67	69	22
Air	64	18	33	31	78

The Table 3 shows the demand shift to railway calculated from the values on the Table 1 and Table 2.

Table 3. Train Passenger Transportation Demand (in both directions)

Unit: Persons

	Seoul - Beijing	Seoul - Shenyang	Seoul - Changchun	Seoul - Harbin	Seoul - Daeryun	Total
2008	1,268,463	793,758	254,114	148,656	77,390	2,542,381
2009	1,404,823	832,255	287,149	166,568	80,485	2,771,280
2010	1,555,841	872,619	324,478	186,639	83,705	3,023,282
2011	1,723,094	914,941	366,660	209,130	87,053	3,300,878
2012	1,908,327	959,316	414,325	234,330	90,535	3,606,833
2013	2,113,472	1,005,843	468,188	262,567	94,156	3,944,226

3. Train Operation Plan

In establishing a train operation plan, a trainset set is assumed to be composed of an locomotive and 17 passenger coaches. Among the 17 passenger cars, one is used as a crew service compartment and for luggage storage and another one is for dining car. When twenty beds are offered per couch, a trainset can accommodate three hundred passengers. If we assume the occupancy rate to be eighty five percent, the annual passenger numbers amount to 93,000. In other words, one trainset is needed to meet the round-trip demand from 93,000 passengers (186,000 passengers for one-way trip).

The number of trainsets required are shown in the Table 4.

Table 4. Number of Trainsets Required

Section	Seoul - Beijing	Seoul - Shenyang	Seoul - Changchun	Seoul - Harbin	Total (one-way)
2008	6	5	1		12(24)
2009	7	5	1		13(26)
2010	8	5	1	1	15(30)
2011	9	5	2	1	17(34)
2012	10	5	2	1	18(36)
2013	11	5	2	1	19(38)

The year 2014 is excluded from the analysis, because the tracks on the North Korean part are considered to be already at its full capacity before or in the year without the possibility of additional services.

4. Estimated Sales of International Train Service Providers

In calculating train service providers' sales, applied fares vary from section to section to be the levels which give the service providers maximum sales : 190,000 won between Seoul and Beijing; 170,000 won between Seoul and Harbin; 150,000 won between Seoul and Changchun; 130,000 won between Seoul and Shenyang. A one-way train carries 93,075 passengers annually, so the sales from a train service between Seoul and Beijing amount to 17,684,250,000 (93,075 x 190,000) won. The sales for the year 2008 can be calculated by multiplying the per-train sales with the number of train offered (17,684,250,000 x 12). The same logic is applied to the other service sections as well.

Table 5. Annual Sales from International Passenger Train Operations

Unit: Billion Won

	Train Operation Frequencies (one-way)				Estimated Total Sales
	Seoul - Beijing	Seoul - Shenyang	Seoul - Changchun	Seoul - Harbin	
2008	12	10	2	0	361.13
2009	14	10	2	0	396.50
2010	16	10	2	2	463.31
2011	18	10	4	2	526.80
2012	20	10	4	2	562.17
2013	22	10	4	2	597.54

5. Operational Costs

5.1 Assumptions for Cost Analysis

The cost analysis is based on some assumptions : the train service providers collect fares from customers for their services and to meet the expenses; the train service operators pay track use fees to the infrastructure owners.

Firstly, the study estimates the costs for trainset purchasing and maintenance and crew salaries.

The trainset costs consist of the depreciation cost and the opportunity cost of purchasing trains.

When adding the expenses for maintenance parts and cleaning, the annual maintenance costs amount to 50 million won per locomotive and 30 million won per passenger car. In other words, a train set needs 560 million won for its maintenance on a yearly basis.

Train crew refers to drivers, assistant drivers, train masters, conductors, and on-board maintenance personnel.

The labor cost rates of the Korean National Railroad (KNR) are used because they are the highest among those of the three countries involved.

Then, electricity costs for train operation are calculated.

In estimating the energy expenditure, adopting the Chinese electricity charge rates is considered to be reasonable due to the fact that most of the international train services are offered on the Chinese territory. Also, the electricity rates are similar to those of South Korea. As mentioned above, track use fees are paid to the infrastructure owners, the governments concerned. Using KNR data is regarded as the most accurate method for costs estimate.

Using the KNR's applicable performance data is considered to be reasonable here again. Taking all the expenses into account, track use costs per kilometer are 5,162 won.

Lastly, the study covers the costs for offering various services including food and beverage service on the train. By adding the costs for other supplies on the trains, the costs per passenger can be assumed at the level of 30,000 won.

Table 6. Annual Track Use Costs

Unit: Hundred Million Won

Country	2008	2009	2010	2011	2012	2013
China	328.3	370.6	443.8	508.0	550.4	592.7
N. Korea	194.4	210.6	243.1	275.5	291.7	307.9
S. Korea	26.2	28.4	32.8	37.2	39.2	41.5

5.2 Total Operation Costs for the Passenger Train Service

To calculate the annual operation costs, all the aforementioned items are combined: trainset purchasing costs, car maintenance and cleaning costs, crew labor costs, energy costs, track use costs, and costs for meals services and supplies. The Table 12 identifies the detailed costs which should be undertaken by train service providers if they offer international train services.

Table 7. Annual Operational Costs for the International Train Service

Unit: Hundred Million Won

Items	2008	2009	2010	2011	2012	2013
Rolling Stocks	510.0	571.2	673.2	775.2	836.4	877.2
Maintenance & Cleaning	413.0	462.6	545.2	627.8	677.3	710.4
Labor Costs	542.0	593.0	644.0	797.0	848.0	899.0
Energy	319.3	354.6	418.5	477.3	512.6	547.9
Track Use	548.9	609.6	719.7	820.7	881.3	942.1
Meals & Supplies	670.1	726.0	837.7	949.4	1005.2	1116.9
Total	3,003.3	3,317.0	3,838.3	4,447.4	4,760.8	5,093.5

6. Profitability Analysis

In this section of the study, the profitability of the international passenger train service is analyzed by comparing sales with net income without considering the time value of money. Then, the profitability is determined through the net present value (NPV) and the financial internal rate of return (FIRR).

6.1 Annual Operating Profit

The ratio of net income to sales is calculated based on the estimated total income and the costs corresponding to the operation of the passenger train service. The ratios ranging from 14 to 17 percent indicate that operating passenger trains between Korea and China would be highly profitable.

Table 8. Annual Net Profit and the Ratio of Net Income to Sales

Unit: Hundred Million Won

Category	Estimated Total Income	Train Operational Costs	Net Profit	Net Profit/ Total Sales
2008	3,611	3,003	608	16.8%
2009	3,965	3,317	648	16.3%
2010	4,633	3,838	795	17.2%
2011	5,268	4,447	821	15.6%
2012	5,622	4,761	861	15.3%
2013	5,975	5,094	881	14.7%

6.2 Net Present Value (NPV)

A. Annual Cash Inflow and Cash Outflow

Cash outflow and cash inflow for each year could be derived by replacing the trainset item in the annual operation costs, with the annual costs for train acquisition (the cash outflow above) and the residual value of the trains at the end of 2013. In calculating the cash flows illustrated in the Table 9, it is assumed that cash outflow for trainset purchasing occurs early in the year and that cash flows out to pay for train operation costs late in the year. Regarding cash inflow, the assumption was made that cash inflow comes late in every year.

Table 9. Cash Outflow and Cash Inflow

Unit: Hundred Million Won

	Cash Outflow			Cash Inflow	(Cash Inflow)- (Cash Outflow)
	Trainset Purchasing	Train Operational Costs (Trainset Costs Not Included)	Total		
Early 2008	3,990.0		3,990.0		-3,990.0
Late 2008	420.0	2,493.3	2,913.3	3,611.0	697.7
Late 2009	840.0	2,745.8	3,585.8	3,965.0	379.2
Late 2010	840.0	3,165.1	4,005.1	4,663.0	657.9
Late 2011	420.0	3,672.2	4,092.2	5,268.0	1,175.8
Late 2012	420.0	3,924.4	4,344.4	5,622.0	1,277.6
Late 2013		4,216.3	4,216.3	5,975.0 5,697.6 (Trainset Residual Value)	7,456.3

B. Net Present Value (NPV)

In order to obtain the net present value of operating the international passenger train service as of January 1 in 2005, a discount rate of six percent is applied to the following equation.

$$NPV = \sum_{i=1}^n \frac{R_i - C_i}{(1 + 0.06)^i} = 394.66 \text{ Billion Won}$$

The resulting NPV shown above indicates that the passenger train service between Korea and China is profitable enough to operate.

6.3 Financial Internal Rate of Return (FIRR)

Financial internal rate of return (FIRR) is the discount rate that equates the present value of future net revenue streams to the present value of the costs. Therefore, FIRR (r) could be derived from the following equation:

$$\sum_{i=1}^n \frac{R_i - C_i}{(1+r)^i} = 0$$

where, R_i = Yearly Cash Inflow
 C_i = Yearly Cash Outflow

The FIRR for the passenger train service is 25.0 percent when the based date is January 1, 2005. The figure is well above the present market interest rate and the social discount rate of 11.0 percent.

7. Conclusion

As explained before, the international train service is profitable enough for the all train service providers involved and would help South Korea's development in every aspect. Needless to say, North Korea would be one of the beneficiaries. There is no need for the Pyongyang Government to worry since train operations can be easily controlled with no harm to its system unlike the case of allowing vehicle passages from the South. The study did not address transportation demand from the part of the North due to the difficulties associated with data acquisition and the inter-Korean relations.

To be more specific, the North can receive approximately 19.4 billion won and 30.8 billion won in 2008 and in 2013 respectively for its track lease. Not only that, there is more cash to flow in from the employment of the locals, electricity use and so on. That amounts to twice that from charging foreign service providers track use fees. From the long-term perspective, involving with the train operation will offer the North an opportunity to significantly advance its economy as a whole.

China has more to gain from the service operation than the North. First of all, China can participate in manufacturing the rolling stocks needed. Since the large part of the service areas is on the Chinese territory, the Beijing government will be able to charge train service providers track use fees. The amount of salaries received by those involved would reach twice the income from track lease. In addition, Chinese goods can be used for car maintenance. Human and goods exchanges with the two Koreas would boost the economies of the regions served by the international passenger train. By further enhancing cooperation with South Korea, China could play a major role in the development of the North East Asian region. The paper intended to encourage such studies by showing that the project is beneficial for the three nations involved in both a direct and an indirect way, not to mentioning its business profitability for train service providers. The writer hopes that the purpose has been served.