

High Speed Rail Construction of Korea and Its Impact

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Cho Nam-Geon • Chung Jin-Kyu

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Summary

As regional traffic congestion intensified from the 1970s due to the clustered traffic demand on the Gyeongbu (Seoul~Busan) Corridor which had the most densely populated local areas in Korea and economic wealth intensely aggregated, a high speed rail was proposed to subdue this problem. Since its construction began in 1992, the high speed rail opened its first phase between Seoul and Daegu in 2004, which is presently operating. Operating at the highest speed of 300km/hr, the Korea Train Express (KTX) has transported approximately 150 million passengers since the four years after its opening. The high speed rail has proved railway technologies of Korea to the world.

Running along the Gyeongbu Line and Honam (Daejeon~Mokpo) Line, the KTX have drastically changed the regional passenger transportation structure in Korea. In particular, many travelers who used to fly have switched to the KTX. Especially, the KTX has substantially changed the passenger movement structure of long-distance travels such as between Seoul and Busan and between Seoul and Daegu. More passengers are using the high speed rail because they value time during their travel.

Currently, the second-phase project of the high speed rail is under way with its opening is slated for 2010. Once the second-phase project is complete, it is expected to improve passenger movement as well as freight movement. At present, the freight movement structure has been hardly enhanced, since the KTX is using the existing railway lines. Nevertheless, circumstances will change in 2010. Although freight movement mainly relies on trucks at the moment, the domestic transportation system will change and the national economy will take off if conditions of the railway freight movement improve.

Keywords: KTX (Korea Train Express), high speed rail, Gyeongbu (Seoul~Busan) Corridor

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1. Introduction

On 1 April 2004, Phase One section (Seoul~Dongdaegu) of the high speed rail (HSR) opened twelve years after construction began. For four years and four months since the opening, the total number of accumulated passengers reached nearly 150 million as of 31 July 2008. Operating at the maximum speed of 300km/hr, the Korea Train Express (KTX) traveled from Seoul to Busan (408.5km) within two hours and forty minutes. Compared with the travel time prior to opening of the HSR, the KTX cut down the travel time by approximately one hour and twenty minutes. After the HSR opened, the transportation system of the Seoul-Busan transportation line has demonstrated large changes. A considerable number of flight and express bus passengers between Seoul and Busan and between Seoul and Daegu have switched to the KTX. In particular, the number of flight passengers traveling the same routes has substantially declined. For relatively shorter distances, such as the line between Seoul and Cheonan-Asan (31 mins) and between Seoul and Daejeon (49 mins), the number of commuters traveling by the KTX has steadily increased.

The KTX is used more on the weekends than on the weekdays. This is attributable to the relatively high punctuality guaranteed by the KTX, whereas highways have a more unreliable punctuality on the weekends due to traffic congestion. People use the KTX mainly because they can quickly arrive at their destination. However, despite the opening of the HSR, the freight movement system has not been improved since railways of sections between Seoul and Siheung (near Seoul), and the railways between Dongdaegu (eastern Daegu) and Busan are currently shared by the KTX, general trains, and freight trains. In these sections, freight trains use the railways mostly during the nighttime owing to the saturated capacity of the lines. Nevertheless, when the Phase Two HSR open in 2010 and the KTX gets its exclusive lines, freight movement is expected to be smoothed out. Therefore, the domestic transportation system is forecast to become optimized after 2010 when the Phase Two HSR opens. This report covers the background of the Korean HSR, changes in the transportation system and socioeconomic characteristics since the opening.

2. Outline of High Speed Rail Plan

1) Background

The KTX is commonly called an aircraft on the rail, normally operating at a speed of 300km/hr. Korea's Act for Promoting Construction of HSR (31 December 1996 Legislation NO. 5,250) defines a railway that allows trains to operate on a certain section of the railway at speed of 200km/hr or faster as a HSR. This definition is identical to that of the Shinkansen in Japan (National Shinkansen Development Act of Japan; 13 May 1970). However, the speed limit is sometimes 250km/hr in Europe. Presently, in the countries with HSRs in operation, most trains have been operating at speed of 250km/hr or higher.

One of the major reasons to build the HSR in Korea was a necessity of dramatic measures to revive the outdated railway industry. At present, roads are highly essential to accommodate the popularization of passenger cars and increased transportation volume of freight vehicles, but railways had the upper hand in the Korean passenger and freight movement industry up to the 1960s compared with roads. In 1965, the number of registered vehicles nationwide posted merely 41,511 (Korea Automobile Manufacturers Association, 2002). At the time, most of the roads had one lane for each direction, and only a few were paved, resulting in discomfort for travelers.

The Korean railway industry had maintained the railways created during the period under the rule of Japan even after Korea regained independence, and used the railways as one of the major transportation facilities. After the Korean War, restoration of the transportation infrastructure was also conducted around the railways. Although the industrial lines were built around coal mining regions in the 1960s to meet the necessity to develop resources, the national traffic infrastructure remained quite poor. The railway industry enjoyed moderate improvements in the 1960s. Around 1967, freight trains operated exclusively for exports between Seoul and Busan, as did summer-vacation trains for an increase in tourism (Choi, 1995).

At the time of independence in 1945, the total length of railways was 2,642km nationwide of South Korea, which slightly increased to 3,020km (5,500km based on tracks) in 1970. In 1945, the total length of roads reached 16,241km, and the pavement rate posted a mere 4.2%. Thanks to the construction of highways in the late 1960s, the total length of roads in 1970 substantially escalated to 40,244km.

<Table 2-1> Development of Transportation Facilities in Korea

Facilities\Year	1945	1970	1980	1990
Total Length of Roads (km)	16,241	40,244	46,950	56,715
Pavement Rate (%)	4.2	9.6	71.5	74.0
Total Length of Railways (km)	2,642	3,020	3,199	3,121
Total Length of Tracks (km)	-	5,500	6,007	6,435

Data: Study on History of Korea's National Land Development (Kim, Eui Won) & Annual Report on Construction & Traffic Statistics (Ministry of Construction and Transportation, each year).

Source: Lee, Sang-Keon et al. (1999: 35, revised).

Up to the 1960s, passengers preferred railways to roads. However, as express-highways opened and the number of vehicles increased after 1970, passengers began to prefer roads. For freight movement, marine transportation shared the most, and the share of railways remained high throughout the 1970s, but the share of roads slowly started to rise from the 1980s. Investment in transportation facilities focused on railways up to the mid 1960s. Nonetheless, the investment in roads began surpassing that of railways in the late 1960s when construction of highways was initiated. This investment tendency has continued till quite recently.

From the late 1960s, the government embarked on building "highways" as a mode of the new transportation revolution, and opened the Seoul~Incheon Highway in 1969 and the Seoul~Busan Highway in 1970. At the time, trains were the primary mode of transportation, but their average speed was only 60~70km/hr. In 1962, trains traveled the Seoul~Busan Line in six hours and ten minutes. The travel time between Seoul and Busan shortened to five hours and forty-five minutes in 1967, and four hours and forty-five minutes in 1969. However, highways with the speed limit of 100km/hr required vehicles to travel the same distance for four hours to four hours and thirty minutes. Compared with the railways, highways guaranteed high speed, and provided excellent access to destinations, to

which the general public and shippers preferred highways. As the excellence of the highways became well-apparent, the significance of the railways began to slowly and relatively, weaken, and the government began to shift more investments in the transportation infrastructure to the highways.

<Table 2-2> Changes in Share of Transportation Modes

		(unit: %)			
Transportation Modes		1960	1970	1980	1990
Passenger	Road	46.0	66.0	75.2	71.5
	Railway	52.2	32.3	23.7	25.6
	Marine	1.6	0.8	0.5	0.3
	Air	0.2	0.9	0.6	2.5
Freight	Road	8.6	10.8	35.0	46.9
	Railway	87.5	57.6	37.5	19.6
	Marine	3.9	31.6	27.5	33.4
	Air	0.0	0.0	0.0	0.1

Data: Annual Report on Traffic Statistics & Annual Report on Construction Statistics (Ministry of Construction and Transportation, each year)

Source: Lee, Sang-Keon et al. (1999: 35, revised).

As highlighted in Table 2-3, the investment in railways expanded in 1992 when the 7th Economic Development Five-Year Plan commenced thanks to the initiated construction of HSR.

Through the 1990s, the investment in the railway industry had continued, but major projects included the construction of double lines, incorporation of electric railway lines, and improvement of lines, which did not easily enhance operating conditions of the railways. Given the traffic boom popularizing passenger vehicles in the late 1980s, use of roads gradually increased, whereas use of railways went straight downhill. Moreover, delivery efficiency (for instance, just-in-time processes and bulk transportation) was also emphasized in the logistics transportation, boosting transportation by freight vehicles. In particular, exports and imports increased in the 1970s, and so did container transportation, which freight vehicles mostly handled on the road. This was attributable to the large size of freight vehicles, escalated transportation capacity stemming from construction of highways, and better delivery efficiency of the roads than that of the railways.

<Table 2-3> Investment in Transportation Facilities during Five-year Economic Development Plan Periods

(unit: KRW billion (recurring prices), %)

Period	Transportation Facilities					
	Road*	Railway	Subway	Air	Harbor	Total
1st (1962~1966)	6.1 (17.2)	21.5 (60.6)	- (-)	2.6 (7.3)	5.3 (14.9)	35.5 (100)
2nd (1967~1971)	114.7 (52.0)	63.4 (28.7)	8.3 (3.8)	7.6 (3.4)	26.7 (12.1)	220.7 (100)
3rd (1972~1976)	467.4 (51.6)	266.9 (29.4)	24.8 (2.7)	18.9 (2.1)	128.4 (14.2)	906.4 (100)
4th (1977~1981)	1,630.2 (47.7)	743.4 (21.7)	553.2 (16.2)	146.9 (4.3)	345.1 (10.1)	3,418.8 (100)
5th (1982~1986)	3,719.1 (46.7)	964.7 (12.1)	2,437.9 (30.6)	222.3 (2.8)	618.6 (7.8)	7,962.6 (100)
6th (1987~1991)	11,522.5 (79.6)	1,462.0 (10.1)	78.9 (0.5)	253.8 (1.8)	1,153.8 (8.0)	14,471.0 (100)
7th (1992~1996)	34,404.6 (58.3)	7,535.3 (12.8)	9,814.6 (16.6)	2,581.2 (4.4)	4,646.7 (7.9)	58,982.4 (100)

* Road includes roads in rural areas.

Data 1) Budget Summary (Economic Planning Board) & Local Finance Yearbook (Ministry of Home Affairs).

2) Railway Statistics Yearbook (National Railroad Administration) & The 6th Five-year Economic and Social Development Plan (Ministry of Transportation).

Source: Korea Transportation Institute et al. (2000: 12, revised).

Container transportation by railway offered high punctuality between stations. However, a procedure (loading on vehicles) to move the containers to the station of a departing location from a harbor was required in order to transport the containers. In addition, another procedure (removal of container from the vehicles) was also necessary to move the containers to a warehouse or the final consumption point from the station of an arriving location. Due to such double freight transshipment, additional time and costs were needed, which economically burdened shippers. Furthermore, to cut down logistics expenses, it is essential for the shippers to reduce transportation time, but the railway transportation required more time than the road transportation. Such a long travel time and higher costs of the railways, forced the shippers to avoid using railways, and opted for road shipping.

2) Traffic Status of Seoul-Busan Corridor

Nonetheless, as passenger and freight movement using highways increased, highways began experiencing traffic congestion here and there from the late 1970s. At the time, more highways had been built continuously, but traffic congestion in busy traffic areas did not loosen easily. In the 1980s, the number of passenger cars sharply escalated corresponding to development of the national economy. The volume of leisure transit increased, and the amount of logistics transportation piercingly surged, leading to regular highways traffic congestion. Particularly, the Seoul-Busan traffic corridor suffered from the most severe traffic congestion.

The Gyeongbu traffic corridor is the growth axis and traffic pivot of Korea. In 1982, the Seoul-Busan Corridor was responsible for 65.8% of the total population and 73.7% of the gross national product. Additionally, handling 66% of passenger transportation and 70% of freight transportation out of the national traffic volume, the Seoul-Busan traffic corridor was a main artery of social and economic activities and the central axis of the Korean inland transportation as it interconnected the Incheon Harbor and Busan Harbor, Gimpo International Airport and Gimhae International Airport (Korea Rail Network Authority, 2000).

<Table 2-4> Passenger and Freight Movement Demand on Gyeongbu Corridor(1995)

	Nationwide	Gyeongbu Corridor	Share of Gyeongbu Corridor (%)
Passenger (1995)	7,300,000/day	4,800,000/day	66.0
Freight (1995)	1,230,000/day	860,000tons/day	70.0
Population (1995)	44,610,000	32,700,000	73.3

At the time, 38% of the Gyeongbu Highway was experiencing traffic bottlenecks. Furthermore, the number of traffic bottleneck areas was expected to enlarge despite new construction and expansion of highways nationwide due to a drastic increase in the number of vehicles. The number of registered vehicles in Korea reached 128,000 in 1970, but vastly increased to approximately 528,000 at the end of 1980, 1,110,000 in 1985, and 3,395,000 in 1990. In other words, the number of vehicles grew 4.12 times in 1980 from 1970, and approximately tripled in

1990 from 1980, becoming the direct factor to cause traffic congestion in the national roads and highways.

Meanwhile, railway facilities on the Gyeongbu Line also reached the limit of their capacity, making it impossible to inject additional trains. Even if the existing line could be used as an electric railway line to boost the line capacity, the Gyeongbu Line was expected to reach the limit again in 2000~2003. Nevertheless, highway traffic congestion worsened further because the supply of transportation facilities declined due to diminished investment in the transportation infrastructure in the late 1980s. Consequently, the government levied a new transportation tax on gasoline to expedite investment in roads from 1993, and enacted the Special Account Act for Road Projects funded by this new tax. Thanks to such financial support, the investment in highways increased, and the social overhead capital (SOC) investment grew 24% on the annual average over five years in the late 1990s. The SOC investment contributed 9.1% to the government budget in 1980, which rose to 10.4% in 1990 and 14.2% in 1998.

<Table 2-5> Social Overhead Capital Investment Expenses(1980~1998)

Year	Funding Size* (KRW 1000bn)	SOC Investment (KRW trn)	SOC/ Funding Size (%)
1980	6.72	0.61	9.1
1990	31.12	3.23	10.4
1995	54.82	6.63	12.1
1996	62.96	8.15	12.9
1997	71.40	10.13	14.2
1998	80.76	11.50	14.2

* Funding Size is based on the general accounting plus finance special net tax revenues.
Data: Finance of Korea 1999 (Meil Business Daily).

However, the stock volume of the SOC facilities posted quite a small increase. This was attributable to escalated construction costs and enlarged land compensation payments despite the increased SOC investment. Looking at the stock size of each category in the SOC facilities, the gross national product grew 10.8 times from 1980 to 1998, whereas road extension increased 1.85 times, airport facility capacity 1.47 times, and railways 1.11s, during the same period. In particular, the increase in the stock size of the railways was lower than that of other

facilities. In due course, insufficiency in the overall traffic facilities led to traffic congestion on the roads nationwide, interfering with timely deliveries and lowering delivery efficiency. The railways also experienced difficulties in maintaining high speeds, resulted in delayed departures and arrivals, and lost much of their reliability due to many restrictions on boosting the capacity.

The traffic jams which started in the late 1980s brought about an increase in logistics expenses, and became a large obstacle in the economic development. Accordingly, demand for new high-speed transportation grew day by day. Thus, the government set out to supply a new high-speed transportation mode in order to smooth out passenger and freight movement along the Seoul-Busan Corridor, and finally promoted construction of the HSR.

<Table 2-6> Stock Size by Transportation Facility

Year	Gross National Products (current price)		Road Length		Rail Length		Airport Capacity (No. of flights)		Port Load and Unload Capacity	
	(bn)	index	(km)	index	(km)	index	(1000)	index	(m-ton)	index
1980	36,857	1.00	46,951	1.00	6,007	1.00	1,407	1.00	87.2	1.00
1990	178,262	4.84	56,715	1.21	6,435	1.07	1,563	1.11	224.3	2.57
1995	348,979	9.47	74,237	1.58	6,554	1.09	1,680	1.19	285.2	3.27
1996	386,640	10.49	82,342	1.75	6,559	1.09	1,711	1.22	295.2	3.38
1997	416,018	11.27	84,968	1.81	6,580	1.10	2,022	1.44	357.3	4.10
1998	398,148	10.80	86,990	1.85	6,683	1.11	2,062	1.47	416.2	4.77

Data: Annual Report on Construction & Traffic Statistics (Ministry of Construction and Transportation, 1998) & Annual Report on Social Overhead Capital Statistics (KRIHS, 1997).

Source: Korea Transport Institute et al. (2000).

3) Promotion Process

It has been known that the construction plan of Korea's HSR began in the 1970s (Korea Rail Network Authority, 2000). Upon request from the International Bank for Reconstruction and Development in 1972 to 1974, the Societe Nationale des Chemins de Fer Francais of France and Overseas Technical Cooperation in Railway Sector of Japan investigated the transportation status between Seoul and Busan

and solutions to an impasse, and suggested an opinion that it was desirable to build a new railway on the Gyeongbu Corridor to boost the transportation capacity as a long-term countermeasure. The full-scaled discussion for construction of the HSR was initiated when Korea Advanced Institute of Science and Technology (KAIST) conducted a project titled "the Study to Improve Large-sized Freight Transportation System and Optimize Traffic Investment" for three years, from 1978 to 1981. KAIST had predicted that the Gyeongbu Line would have traffic bottlenecks, and proposed to build a new multiple-line Gyeongbu electric railway between Seoul and Busan in order to enhance the transportation capacity, and to incorporate high speed electric railways into a new passenger-only Gyeongbu Line.

Established in 1981 based on such research, the 5th Economic & Social Development Five-year Plan(1982~1986) reflected the high speed electrical railway construction plan for the Seoul-Daejeon section for the first time as part of the government policy, and delivered the respective suggestion to the government. Nonetheless, the government made a judgment that it was unreasonable to take on the project without any experience or knowledge about building high speed electric railways, and demanded that a feasibility study should take place beforehand in 1983.

The feasibility study (Korea Research Institute for Human Settlements et al., 1983; The Ministry of Transportation, 1984) on the Gyeongbu high speed electrical railway was conducted by agencies such as the Korea Research Institute for Human Settlements (KRIHS), Louis Berger, Campsax, Hyundai Engineering. This report examined nearly 90 possible lines, and concluded that it was feasible to build a new HSR traveling via seven to eleven stations.

The construction plan of the Gyeongbu HSR was proposed as one of the former President Roh Tae-woo's electoral commitments in 1987. In 1989, the construction promotion plan of this project was determined, and the Gyeongbu High Speed Electrical Railway & New International Airport Project Committee was established in July 1989. In December 1989, the High Speed Electrical Railway Planning Department was established to fully promote the project. In June 1990, the Gyeongbu HSR Project Plan was announced. When the High Speed Electrical Railway Planning Department was expanded and restructured as the HSR Project Planning Board in March 1991,

the project plan to connect Seoul and Busan in 90 minutes finally took concrete shape.

Meanwhile, the Korea High Speed Rail Construction Authority was founded in March 1992, and the construction of the Gyeongbu HSR started on 30 June 1992. At this time "Gyeongu High Speed Electrical Railway" was renamed to "Gyeongbu High Speed Railway". The largest purpose at the time of commencing construction was to resolve the traffic bottlenecks on the Gyeongbu Highway caused by the population and industries clustered along the Gyeongbu Corridor, and to improve the transportation capacity of the Gyeongbu Corridor (Korea Rail Network Authority, 2000).

However, after the relief financing from the IMF in November 1997, the government modified the construction strategies of the HSR to encourage efficiency of the investment. First of all, the government decided to concentrate on building a new Seoul-Daegu line and transforming the existing Daegu-Busan line into the electric railway line as Phase One Construction Project.

In December 1999, a trial operation began on a 34.4km section of the trial line. On 1 April 2004, the 408.5km section finally opened twelve years after construction began, while the new high speed line section was 238.6km between Siheung (near Seoul) and Sindong (near Daegu). This marks a memorable event in 105 years since the first railway opened in Korea.

3. Current Status

1) Lines and Stations

Currently, the KTX is operating on the Gyeongbu (Seoul-Busan) Line and Honam Line, simultaneously using newly built HSRs and existing railways. This is attributable to the identical tracks (standard track of 1,435mm) of the new and existing railways. The HSRs presently operating the KTX have been newly constructed to reach 238.6km (223.6km of the Gyeongbu Line, and 15.0km of connecting railways), and 450.8km of the existing railways (169.9km of the Gyeongbu Line, 252.5km of the Honam Line, 13.7km of the Gwangju, and 14.7km of the Gyeongui Line) have been operating the KTX.

The KTX stops at a total of 20 stations (eight on the Gyeongbu Line, and twelve on the Honam Line). In 2010 when Phase Two of the Gyeongbu Line opens, the number of stopping stations will increase.

<Table 3-1> Stations on KTX Lines

(unit: km)					
Line	Stopping Station	Distance*	Line	Stopping Station	Distance
Gyeongbu (Seoul-Busan) Line	Seoul	-	Honam (Seodaejeon- Mokpo) Line	Yongsan	-
	Gwangmyeong	22.0		Seodaejeon	160.8
	CheonanAsan	96.0		Dugyae	180.5
	Daejeon	159.8		Nonsan	205.9
	Dongdaegu	293.1		Iksan	243.0
	Miryang	348.4		Gimje	260.7
	Gupo	392.0		Jeongeub	286.5
	Busan	408.5		Jangseong	318.9
				Songjeongni	340.8
				Gwangju	352.8
				Naju	356.6
				Mokpo	407.6

* From the Seoul (or Yongsan) Station to the stopping station

Station buildings at which the KTX stops affect the operating speed of the KTX. Usually, trains slow down to a stop, and it takes 2 minutes and 30 seconds to 3 minutes for the trains to depart and begin accelerating after stopping for 1 minute and 30 seconds to 2 minutes, which makes the total stopping time close to

6 minutes and a half to 7 minutes. Therefore, the number of stopping stations must be restricted to a minimum in order for the trains to maintain high speeds between the starting point and the final destination. Specifically, the distance between stations must be at least 50km when a train travels at 300km/h, and the appropriate number of in-between stations seemed to be two, considering economic efficiency. Nonetheless, given the delivery efficiency and user benefits, four stations (Cheonan-Asan, Daejeon, Dongdaegu and Gyeongju) were selected for the Gyeongbu HSR Line (Korea Rail Network Authority, 2000). However, during construction of the HSR, the Gwangmyeong Station was added. After the opening of the HSR, more stations such as the Ulsan, Gimcheon-Gumi and Osong have been added upon civil applications from the residents, etc. Since the KTX is longer than other trains, it was necessary to newly rebuild station buildings on the existing railway lines. Thus, platforms and waiting rooms at all of the KTX stopping stations have been built as new facilities.

Presently, the KTX is operating through Busan by using the existing lines with Phase One HSR now opened. The newly built KTX sections include Seoul Station, Gwangmyeong, Cheonan-Asan, Daejeon, Dongdaegu stations, and the existing line between Dongdaegu and Busan have Miryang, Gupo and Busan stations. In the meantime, the Honam Line also uses the existing lines to operate the KTX. The departing station of the KTX Honam Line is Yongsan Station, and the KTX diverges from the Seodaejeon Station, and stop at the Iksan, Gimje, Jeongeub, Naju, Songjeongni and Mokpo stations. However, the Honam HSR line to be newly built, will branch off from the Osong, and have station buildings at the Namgongju, Iksan, Jeongeub, Songjeongni (Gwangju) and Mokpo stations.

2) Operating Frequency and Number of Seats

At the time of opening in 2004, the KTX operated 128 times per day (94 times on the Gyeongbu Line, and 34 times on the Honam Line), and their operating frequency has increased to 163 times per day (125 times on the Gyeongbu Line, and 38 times on the Honam Line) at present. Currently, the daily average number of KTX seats available reaches 116,266 whose contribution to the total number of

seats available in the entire trains including general trains climbed 48% from one year prior to the opening of HSR. Owing to the opening of the HSR, the number of seats available in Mugunghwa trains and Saemaeul trains diminished, but that in the commuter trains nearly tripled. For the Seoul-Busan section, the first train leaves at 5:30am, and the last train at 10pm.

<Table 3-2> Trends in KTX Operation

(unit: times)

Line	At time of Opening	Mar. 2006			
		Total	Mon.	Fri., Sat., Sun.	Sat., Sun.
Total	128	163	3	7	17
Gyeongbu Line	94	125	3	7	15
Honam Line	34	38	-	-	2

Source: Internal data (KORAIL).

<Table 3-3> Number of Seats

(unit: seats)

Train	Prior to Opening (Apr. 2003~Mar. 2004)		One Year after Opening (Apr. 2004~Mar. 2005)		Two Years after Opening (Apr. 2005~Mar. 2006)	
	No. of Seats	Share(%)	No. of Seats	Share(%)	No. of Seats	Share(%)
Mugunghwa	242,956	79	232,588	51	227,820	49
Saemaeul	39,046	13	33,759	7	32,081	7
Commuting Train	25,358	8	71,943	16	75,032	16
KTX	-	0	116,266	26	128,510	28
Total	307,360	100	454,556	100	463,443	100

Source: Internal data (KORAIL).

3) Fare Level

KTX fares were fixed through studies by specialized agencies and public hearings so that the majority of the people could use the KTX without feeling pressured. The KTX fares stood at 125% of the existing Saemaeul train fares, and 62% of the air fares. In addition, various discounts became available to attract as many passengers as possible, taking 60% off the regular passes and 20% off the reserved tickets.

One year after the HSR Lines opened, KTX ticket fares for short-distance sections, such as the Seoul-Daejeon section stand at 105% of the Saemaeul ticket fares, and those for mid/long-distance sections, such as the Seoul-Busan section at 120%~128%. For the long-distance sections, KTX ticket fares were fixed at approximately 53%~59% of the air fares to encourage flight passengers to switch to the KTX.

<Table 3-4> KTX Fares

Section	Fare (KRW)	Ratio to Air Fares (%)	Ratio to Saemaeul Fares (%)	Ratio to Premium Express Bus Fares (%)
Seoul-Dongdaegu	34,900	64.2	128.3	173.6
Seoul-Busan	44,800	71.8	121.7	163.5
Seoul-Gwangju	33,300	60.7	112.1	159.3
Seoul-Mokpo	38,000	63.9	111.1	155.7

Source: Internal data (KORAIL).

4) Speed

At present, the KTX has been operating at the maximum speed of 300km/h in certain parts of the new sections. The maximum speed measured within the test section was 354km/h. The trains have been running at a reduced speed of approximately 250km/h in other sections, such as curvy sections.

5) Number of Passengers

(1) Number of Total Users

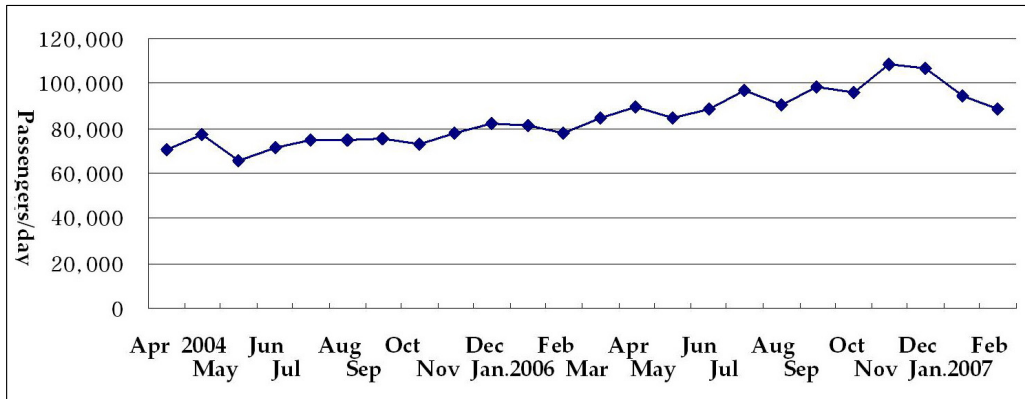
The number of passengers who used the KTX has continuously increased since the opening despite a few changing factors such as holidays and vacation seasons. The daily average number of users climbed 37.1% to 96,556 in the first quarter of 2006 two years after the opening in the second quarter of 2004 (70,429 passengers). Specifically, the number of passengers on the Gyeongbu Line increased 34.4% to 79,933 in the first quarter of 2006 (vs. 59,473 in the second quarter of 2004), and that on the Honam Line 51.7% to 16,622 in the first quarter of 2006 (vs. 10,956 in the second quarter of 2004).

<Table 3-5> Quarterly KTX Transport Results (Apr. 2004~Mar. 2006)

(unit: persons/ day)			
Period	Gyeongbu Line	Honam Line	Total
Apr. 2004 ~ Jun. 2004	59,473	10,956	70,429
Jul. 2004 ~ Sep. 2004	60,467	11,859	72,326
Oct. 2004 ~ Dec. 2004	62,217	11,902	74,120
Jan. 2005 ~ Mar. 2005	67,133	13,244	80,378
Apr. 2005 ~ Jun. 2005	71,407	13,978	85,385
Jul. 2005 ~ Sep. 2005	74,674	15,272	89,946
Oct. 2005 ~ Dec. 2005	80,891	17,902	98,793
Jan. 2006 ~ Mar. 2006	79,933	16,622	96,556
Change	34.4%	51.7%	37.1%

Source: Internal data (Korea Rail Network Authority).

<Figure 3-1> Monthly KTX Transport Results (Apr. 2004~Mar. 2006)



(2) Usage Rate

Looking at the day-to-day usage of the KTX, Fridays have posted the highest usage rate (20.8%), and Wednesdays the lowest (11.1%). Based on the daily average number of passengers, more passengers used the KTX on the two-day weekends (16.4%) than on the five-day weekdays (13.5%).

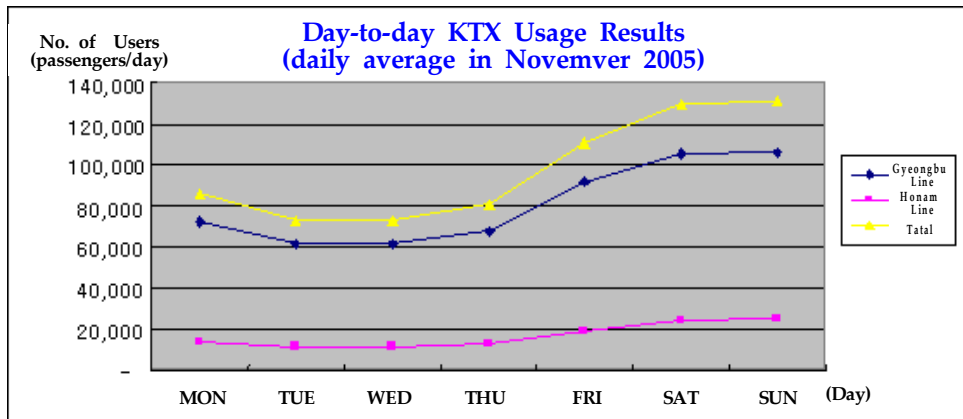
<Table 3-6> Day-to-day KTX Usage (Apr. 2004~Mar. 2006)

									(unit: %)
Day	Mon	Tue	Wed	Thir	Fri	Sat	Sun	Weekdays	Weekends
%	12.6	11.3	11.1	11.6	20.8	16.5	16.2	67.3	32.7

Source: Internal data (Korea Rail Network Authority).

KTX use tends to grow more on Fridays, Saturdays and Sundays than the other weekdays. This characteristic stems from the boosted leisure travels on the weekends and high punctuality of the KTX. In particular, passengers seem to use the KTX more on the weekends to avoid traffic congestion on the express-highways.

<Figure 3-2> Day-to-day KTX Usage Results



Data: KORAIL

By using the train operation status and number of users, the seat utilization was calculated to 68.1% on average (77.3% on the Gyeongbu Line, 42.8% on Honam Line), which is lower than expected.

<Table 3-7> Average Seat Occupancy Rates by KTX Line (Apr. 2004~Mar. 2006)

(unit: %)			
Line	Gyeongbu Line	Honam Line	Average
Occupancy Rates	77.3	42.8	68.1

Data: Internal data (Korea Rail Network Authority).

6) Comparison: Before and After KTX Opening

Table 3-8 outlines some changes in the Seoul-Busan section since the opening of HSR on 1 April 2004. First of all, the total length of the Gyeongbu Line got shorter by nearly 33.2km to 408.5km from 441.7km thanks to construction of the new railways (the total length of the Gyeongbu KTX Line will change to 412km when Phase Two construction is completed in 2010). As the maximum speed improved from 120km/h to 300km/h, the total travel time has been reduced by 1 hour and 30 minutes to 2 hours and 40 minutes from 4 hours and 10 minutes. Owing to the enlarged capacity of the lines, the number of seats available has increased approx-

imately 48%. In accordance with the high speed of the trains, the travel time has been cut down, and the general passenger fares have been raised nearly 22%.

<Table 3-8> Changes in Seoul-Busan Section

Category	Unit	Before Opening	After Opening	Difference	Remark
Length	km	441.7	408.5	▽33.2	
Travel Time	min	250	160	▽90	
Fare	KRW	36,800	45,000	+22.3%	General Passenger
No of Seats	seat	307,360	454,556	+48%	All Trains
Remark	-	2004 March	2004 April	-	

4. Impact of KTX Opening

1) Competitive Edge of High Speed Rail

According to internal data of the Ministry of Construction and Transportation (2006), construction expenses of the HSRs doubled those of the highways (four lanes) or conventional multiple-lane railways, but the unit construction expenses and delivery efficiency of the HSRs were approximately two to three times better than the other transportation facilities.

<Table 4-1> Investment and Efficiency of Transportation Facilities

Category	High Speed Rail (A)	Highway (B)	Multiple-line Railway (C)	A/B	A/C
Construction Costs*	KRW38.2bn/km	26.2	25.0	1.46	1.53
Delivery Capacity	520,000 passengers/day	250,000	275,000	2.08	1.89
Travel Time	1 hour 56 minutes	5 hours 20 minutes	3 hours 50 minutes	▽2.7	▽1.98
Delivery Efficiency**	3.93	1	1.60	-	-

* Construction Costs of the high speed rail exclude train carriage expenses.

** Delivery Efficiency = Delivery Capacity / (Travel Time × Construction Expenses)

Data: Internal data, High Speed Rail Team of Ministry of Construction and Transportation(2006).

Particularly, the HSR brings a large energy saving effect. According to reports, the energy consumption rate per passenger per km of TGV and Shinkansen contributed 19% ~ 24% to that of automobiles and airplanes. In addition, the KTX contributes to protecting the environment thanks to their much-lower discharge of air-polluting substances, such as CO₂, than that of the other ground transportation mode, such as passenger cars. For instance, Shinkansen is known to discharge 16% ~ 18% of the air-polluting substances per transportation unit discharged by automobiles and airplanes. Furthermore, the HSR requires merely 29% of the land used per delivery capacity unit of highways (four lanes), displaying high efficiency in the land utilization. Therefore, the HSR is an excellent alternative to counteract the climate change in the time of high oil prices and to build a sustainable transportation system.

2) Accomplishments of KTX Opening

The opening of the KTX has delivered several achievements. First, the national space has been shrunk to a half-day living zone. The KTX is a high-speed transport means. By substantiating the maximum speed of 300km/h, the KTX has put the areas that have the HSR service into the half-day living zone. Namely, it has reduced the interregional time and space to resolve spatial differences among the regions. In terms of the spatial system, the KTX helped the Seoul metropolitan area and suburban areas to realize balanced development.

Second, the KTX is a high-end mode that meets the national and people's economic level of Korea, and provides the people with pride. Currently, the most high-end mode is airplanes, but the KTX have wider service areas and cheaper ticket fares than airplanes, producing a wide user base. Moreover, the people are proud of the fact that the HSRs were built, and the KTX have been operating with domestic technology.

Third, the KTX has changed the people's way of life. The number of long-distance commuters who travel on the KTX has steadily increased, and the number of one-day business trips has escalated. The human resource exchange between the Seoul metropolitan area and the other areas has increased. Particularly, many people working in local areas would return to the Seoul metropolitan areas on Friday, and go back to work on Monday. The KTX have contributed to speedily joining families that used to be geographically broken.

Fourth, the HSR is a combination of the advanced new technologies with a high possibility of technical development. The HSR technology is the result of the longtime research. Korea's HSR technology has competitiveness in the global HSR market, which should lead to development of relevant industries through technology exports.

Lastly, the opening of the HSR has enhanced the domestic railway technology level to the international level. The HSR technology achieving the speed of 300km/h is one of the few advanced technologies in the world, proving Korea's technology power.

In 1964, Japan alarmed the world by reaching the maximum speed of 210km/h for the first time in the world, and operating Shinkansen between Tokyo

and Osaka. Shinkansen has become a milestone that changed the image of Japan into a technology nation. Since then, Shinkansen with Mt. Fuji for a background has become a symbol of Japan. Likewise, Korea's KTX has also become a milestone contributing to boosting the national image.

3) Reduction in Travel Time

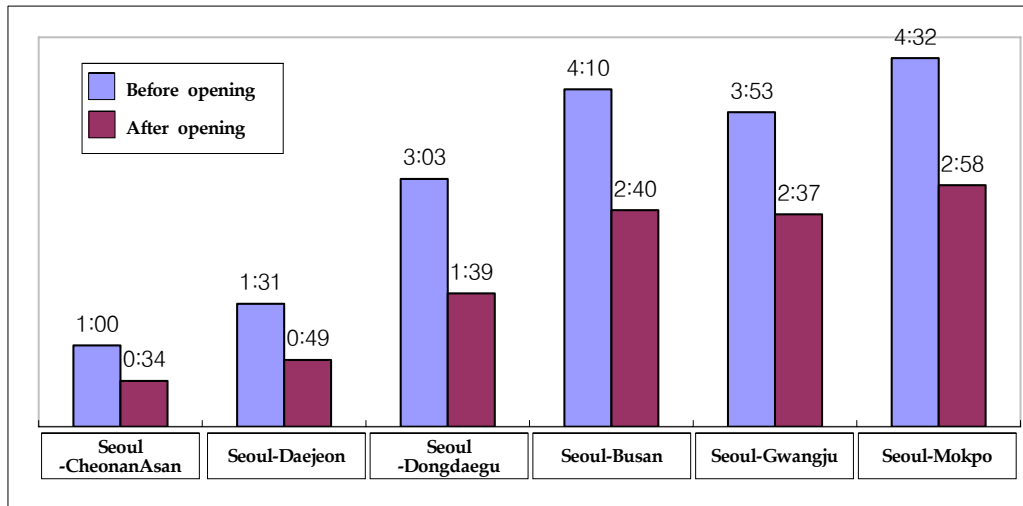
The largest change that the opening of the HSR has brought was a reduction in the travel time. The Seoul-Busan section previously required travel time of 4 hours and 10 minutes, which the KTX reduced by 1 hour and 30 minutes to 2 hours and 40 minutes after the opening of the HSR. Similarly, the KTX cut down the travel time in the Seoul-Dongdaegu section by 1 hour and 24 minutes, and 42 minutes in the Seoul-Daejeon section.

In line with the opening of the Gyeongbu HSR, the Honam Line has been remodeled as the electric railway line to accommodate the KTX. The total travel time was substantially decreased by the KTX due to the reduced travel time in the Seoul-Daejeon section and no stopping in the in-between stations. Namely, the KTX lowered the travel time in the Seoul-Gwangju section by 1 hour and 15 minutes, and 1 hour and 44 minutes in the Seoul-Mokpo section.

<Table 4-2> Travel Time and Reduction in Time by Section

Section	Apr. 2003 (A)	Apr. 2004 (B)	Reduction (B-A)
Seoul~CheonanAsan	1:00	0:34	0:26
Seoul~Daejeon	1:31	0:49	0:42
Seoul~Dongdaegu	3:03	1:39	1:24
Seoul~Busan	4:10	2:40	1:30
Seoul~Gwangju	3:53	2:38	1:15
Seoul~Mokpo	4:32	2:58	1:44

<Figure 4-1> Reduction in Travel Time after KTX Operation



4) Change in Traffic System

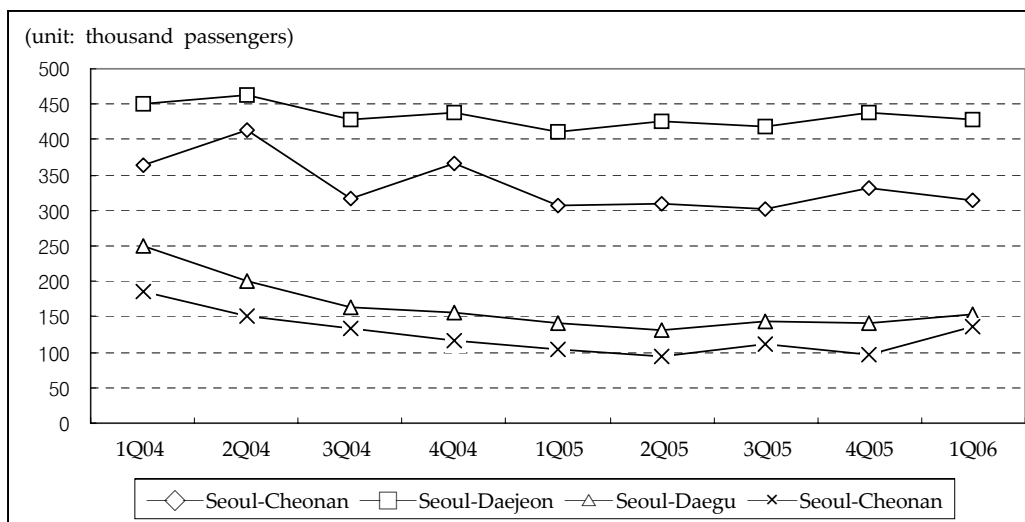
(1) Change in Transport Volume of Express Bus Lines

The number of passengers using express buses operating in the cities with KTX stations have diminished after the opening of the HSR. From the first quarter of 2004 through the first quarter of 2006, it declined 38.7% in the Seoul~Daegu section, 27.3% in the Seoul~Busan section, 13.3% in the Seoul~Cheonan section, and 5.0% in the Seoul~Daejeon section. Since the number of users traveling a long distance such as the Seoul~Daegu and Seoul~Busan sections more significantly decreased, the KTX has proved its competitiveness in long-distance transportation.

However, the number of express bus users drastically dropped in the Seoul~Cheonan~Asan section, which seems to arise from the impact of the Metropolitan region electric railway that opened in January 2005 rather than the opening of HSR. This is because: 1) the Cheonan~Asan station is in the outskirts of the Cheonan city, nearly 5km from the downtown; 2) it takes about 30 minutes for passengers on the city bus to get to the station due to detours and traffic congestion in the city areas; and 3) the KTX stops at the station only 12 times per day

on average. On the other hand, the Metropolitan region electric railway operates between the Cheonan Station and Euijeongbu (northern Seoul) for an affordable fare. Moreover, the railway allows the elderly (65 or older) to travel for free, and operates special commuting trains during the rush hours between Cheonan Station and Seoul Station (travel time of one hour 40 minutes), delivering favorable accessibility and punctuality compared with the existing express bus operation.

<Figure 4-2> Transport Volume by Express Bus Line



Note: Q stands for quarter of the year.

Source: Internal data, Korea Research Institute of Transportation Industries (each year).

(2) Changes in Flight Service

When the HSR opened, the Seoul~Busan traffic corridor had two flight routes between Seoul and Daegu, and Seoul and Busan. Two years after the HSR opened (the first quarter of 2006), the number of flight passengers and flight frequency largely decreased from before the opening of HSR (the first quarter of 2004). In the Seoul~Daegu section, the number of quarterly transported passengers declined by 1/12 to 27,854 in the first quarter of 2006 compared to 338,559 in the first quarter of 2004. The flight frequency diminished 1/8 to 375 flights in the first quarter of 2006 compared to 2,903 flights in the first quarter of 2004. In the Seoul~Busan

section, the number of quarterly transported passengers dropped 1/1.7 to 744,434 in the first quarter of 2006 compared to 1,284,795 in the first quarter of 2004. The flight frequency decreased 1/1.5 to 5,246 flights in the first quarter of 2006 compared to 7,821 flights in the first quarter of 2004. Judging from such flight results, the opening of the HSR has absolutely affected the Seoul~Daegu section.

Meanwhile, in case of the Seoul~Busan section, the HSR has vastly impacted a reduction in the number of flight passengers, but airplanes and the KTX are in considerable competition. The reason for this outcome is that the total travel time (airport access time + waiting time at the airport + flight time on the airplane + egress time at the airport) required for flight travel in the Seoul~Daegu section is not less than that for the KTX, and the airfare is more expensive than the KTX ticket fare. On the other hand, flight travel in the Seoul~Busan section does not provide definitely unfavorable travel conditions with respect to the total travel time and total travel costs compared with KTX travel.

<Table 4-3> Changes in Flight Service after KTX Operation

Section	Jan.~Mar. 2004 (before opening)		Jan.~Mar. 2005		Jan.~Mar. 2006	
	No. of Passengers Transported	Flight Frequency	No. of Passengers Transported (change)	Flight Frequency (change)	No. of Passengers Transported (change)	Flight Frequency (change)
Seoul~Daegu	338,559	2,903	52,856 (-84%)	686 (-76%)	27,854 (-92%)	375 (-87%)
Seoul~Busan	1,284,795	7,821	744,434 (-42%)	5,580 (-29%)	672,539 (-48%)	5,246 (-33%)

Source: Statistics by Domestic Flight Route, Flight Statistics (Korea Airports Corporation).

(3) Changes in Mode Shares in Interregional Travel

For one year after the HSR opened, changes in the mode shares in major stopping cities on the Gyeongbu traffic corridor demonstrate that the railway share has increased. The railway share increased 3.1% in the Seoul~Cheonan-Asan section and 6.4% in the Seoul~Daejeon section, which are the short-distance sections. In

the long-distance sections between Seoul and Daegu and between Seoul and Busan, the KTX share posted 52.2% and 50.5%, respectively, and the railway share also surpassed 60%.

Nonetheless, the Honam traffic corridor has not displayed as a high increase in the railway share on the Seoul-Busan traffic corridor. The railway share in the Seoul-Iksan section increased 3.1%, but declined 0.3% in the Seoul-Jeongeub section. The KTX share on the overall Honam Line reached around 20%, which is not as high as on the Seoul-Busan traffic corridor.

<Table 4-4> Changes in Mode Shares between KTX Stopping Cities (Gyeongbu Corridor)

(unit: %)

Category		Passenger Car*	Express Bus	Flight	Railway				Total
					Total	KTX	Saemaeul	Mugunghwa	
Seoul ~ Cheonan	Apr. 2003 ~ Mar. 2004	70.3	8.6	0.0	21.1	0.0	1.2	19.9	100.0
	Apr. 2004 ~ Mar. 2005	67.7	8.2	0.0	24.2	5.0	2.8	16.3	100.0
Seoul ~ Daejeon	Apr. 2003 ~ Mar. 2004	49.6	22.9	0.0	27.5	0.0	8.1	19.4	100.0
	Apr. 2004 ~ Mar. 2005	45.1	21.0	0.0	33.9	19.9	3.8	10.2	100.0
Seoul ~ Daegu	Apr. 2003 ~ Mar. 2004	30.2	14.7	14.7	40.5	0.0	19.5	21.0	100.0
	Apr. 2004 ~ Mar. 2005	24.6	9.0	2.8	63.6	52.2	4.6	6.8	100.0
Seoul ~ Busan	Apr. 2003 ~ Mar. 2004	12.1	7.8	42.2	38.0	0.0	22.0	15.9	100.0
	Apr. 2004 ~ Mar. 2005	9.4	4.7	25.0	60.9	50.5	5.1	5.4	100.0

* Passenger Car represents Type 1 (small car) and lightweight vehicles using highways, assuming that 2.2 persons are occupying each vehicle.

Note: The terminal location for each mode is different. For the Honam HSR, Seoul means Yongsan Station. For the Express Bus, Seoul means the Gangnam Express Bus Terminal. For flight, Seoul means Gimpo Airport.

Source: Lee, Jang Ho et al. (2005).

The reason for the aforementioned outcome is unclear. However, given that the number of express bus users in Gwangju has remained the same even after the HSR opened, travel fares considerably influence the region rather than the travel time. For example, the KTX offers a travel time of 2 hours and 50 minutes at a fare of KRW36,000 for the Yongsan~Gwangju section, whereas the express bus travels the same section for 3 hours and 30 minutes at a fare of KRW21,000, which is the average of the general, premium and late-night express bus fares (Lee et al., 2004). In particular, since it takes 4.6 hours (including access and moving time) for the express bus to get to the final destination from the departing location in the Seoul~Gwangju section, and 4.1 hours for the KTX, the HSR does not help passengers to save a significant amount of time (Lee et al., 2004). Hence, KTX's fare value over the travel time seems lower than that of the express bus, for which the express bus has maintained the number of users in the Seoul~Gwangju section.

<Table 4-5> Changes in Mode Shares between KTX Stopping Cities (Honam Corridor)

(unit: %)

Category		Passenger Car*	Express Bus	Flight	Railway				Total
					Total	KTX	Saemaeul	Mugunghwa	
Seoul ~ Iksan	Apr. 2003 ~ Mar. 2004	40.9	19.5	0.0	39.7	0.0	7.0	32.6	100.0
	Apr. 2004 ~ Mar. 2005	38.4	18.8	0.0	42.8	23.6	3.6	15.6	100.0
Seoul ~ Jeongeub	Apr. 2003 ~ Mar. 2004	34.5	30.5	0.0	35.0	0.0	6.9	28.1	100.0
	Apr. 2004 ~ Mar. 2005	35.8	29.5	0.0	34.7	13.9	4.8	16.1	100.0
Seoul ~ Gwangju	Apr. 2003 ~ Mar. 2004	31.0	39.2	14.6	15.2	0.0	4.6	10.6	100.0
	Apr. 2004 ~ Mar. 2005	30.3	39.1	10.5	20.0	14.8	1.5	3.7	100.0
Seoul ~ Mokpo	Apr. 2003 ~ Mar. 2004	59.1	14.3	3.1	23.5	0.0	5.1	18.4	100.0
	Apr. 2004 ~ Mar. 2005	53.8	14.9	1.1	30.1	21.1	1.8	7.2	100.0

* Passenger cars represent Type 1 (small car) and lightweight vehicles using highways, assuming that 2.2 persons are occupying each vehicle.

Note: The terminal location for each mode is different. For the Honam HSR, Seoul means Yongsan Station. For the Express Bus, Seoul means the Gangnam Express Bus Terminal. For flight, Seoul means Gimpo Airport.

Source: Lee, Jang Ho et al. (2005).

Furthermore, the usage pattern of the existing Gwangju~Gangnam Terminal Line is more convenient than that of the section between Gwangju Station and Yongsan Station, which may be another reason. People may feel more comfortable using the existing line than going to the new Yongsan Station, owing to familiarity with Gangnam Station that they have been using for a long time, accessibility between Gwangju Terminal and the final destination, and convenience of using the transport mode that they have previously used.

5) Change in Business Productivity

The KTX has also contributed to boosting the business productivity by reducing the travel time and extending the time for business. If traveling by the KTX from Seoul to Busan, people can now have extra 90 minutes for business, which they did not have when they traveled by a general train in the past. Moreover, the KTX has pushed back the time to return to Seoul. When the KTX did not exist, the last general train left Busan at 8pm. Now, the KTX offers the last train at 10pm. Ultimately, the KTX has increased the time for people to stay in Busan by 3 hours and 30 minutes.

When there was no KTX, people had to take the check-in time into account if they were to fly, which was the fastest mode at the time, and do business in Busan. The Gimhae (near Busan) Airport closed at 8pm. Thus, they had to check in at least 30 minutes prior to the departure time in order to come back to Seoul. To make it by the airport closing time, they had to finish their business in Busan by 6:30pm at the latest. Nevertheless, they can now take the last train at 10pm if they travel by the KTX. Thus, they can work in Busan until 9:30pm at present. This mode that they have at least extra 3 hours for business activities in Busan when they use the KTX instead of flying back to Seoul.

Hence, compared with general trains or airplanes in the past, businessmen going to Busan from Seoul now have at least extra 3 hours ~ 3 hours and 30 minutes for business activities, boosting the business productivity. Additionally, as they can do their business without staying overnight in Busan, the KTX has also lowered business trip expenses.

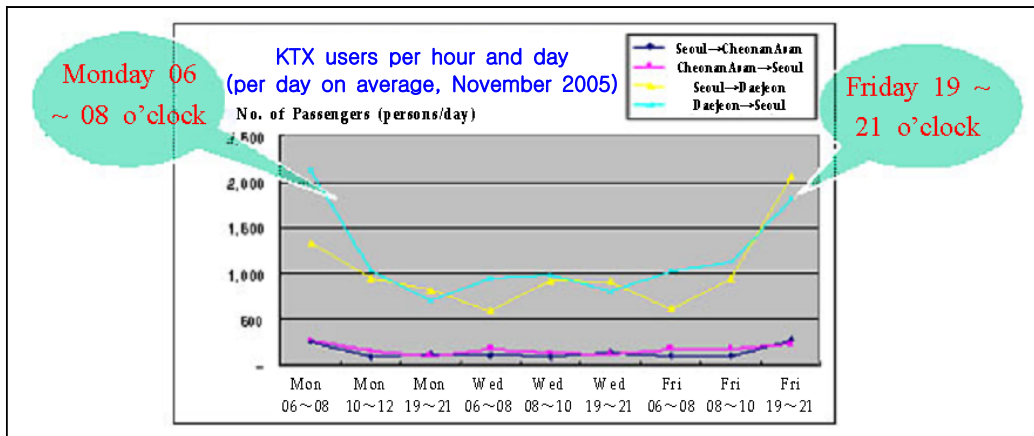
6) Change in Living Patterns

(1) Going Home on Friday, Returning to Work on Monday

The "going home on Friday and returning to work on Monday" phenomenon, which is one of the usage characteristics of Japan's Shinkansen, has been also shown in Korea. The "going home on Friday and returning to work on Monday" phenomenon corresponds to the travel characteristic that people work in Tokyo or a local city alone on the weekdays, return home on Friday at night, and go back to work on the Monday morning after the opening of Shinkansen.

The KTX passengers of Korea have been analyzed by their daily and hourly usage results. In the Seoul-Daejeon section, the number of KTX passengers nearly doubled at 19 to 21 o'clock on Friday and six to eight o'clock on Monday compared with that at the same time slots on other weekdays. Such a KTX usage characteristic proves that the "going home on Friday and returning to work on Monday" phenomenon is also happening in Korea, which is a new aspect that the operation of the HSR has brought to our society.

<Figure 4-3> Daily, Hourly and Sectional KTX Passenger Distributions



Data: Cho, Nam-Geon et al. (2006).

(2) Increase in Long-distance Commuters

Since the opening of HSR, the number of regular pass users has steadily increased. It takes only 34 minutes for the KTX to get to Cheonan-Asan Station from Seoul Station. It also takes merely 50 minutes for the KTX to reach Daejeon from Seoul. Looking at just the moving time, the travel times are close to the travel time within the Seoul Metropolitan regions. Plus, the KTX regular passes are discounted up to 50%.

The number of regular pass users nearly doubled to around 1,500 at the end of 2004 from approximately 700 in the first month after the opening of the KTX. In 2005, the number of regular pass users outnumbered 2,000 on daily average. As of 2006, the regular pass users contribute 2.6% (545,000) to the total users (18,768,000) of the Gyeongbu KTX, and 1.3% (50,000) to the total users (3,572,000) of the Honam KTX. On average, they occupy nearly 2.4% of the total KTX users.

For two years after the HSR opened, regular pass sales are quite sluggish compared with the number of passengers in each line. In particular, the regular pass users contribute a staggering 37.4% to the total KTX users of the Seoul~Cheonan-Asan section while they account for 4.7% of the total users in the Seoul~Daejeon section. Given these numbers, Cheonan city and Asan city where Cheonan-Asan Station is located are so close to Seoul in terms of the travel time that they can be even considered as administrative districts of Seoul.

<Table 4-6> Number of KTX Regular Pass Users (2005)

Category (Apr. 2004~Jan. 2005)	No. of Users	No. of Regular Pass Users	%
Gyeongbu KTX	18,768,000	545,000	2.6
Honam KTX	3,572,000	5,000	1.3
Total	22,340,000	595,000	2.4
Seoul-CheonanAsan	644,000	263,000	37.4
Seoul-Daejeon	2,184,000	117,000	4.7

Data: Internal data (Korea Rail Network Authority).

7) Characteristics of KTX Use

(1) KTX Impact Zone

According to the KTX user distribution, 90% of KTX users live within a 20km radius of KTX stations. People living within a 20km radius of Seoul Station and Busan station prefer using the KTX. Many users of Daejeon station and Dongdaegu station live within a 40km radius or further because Daejeon station and Dongdaegu station are the central location of the railway stations, and attract many passengers from the wide areas. Particularly, passengers from Pohang, Ulsan and Masan frequently use Dongdaegu station.

<Table 4-7> Spatial Distribution of KTX Users

Area	Within 20km Radius	20~40km	40km and above	No of Response
Seoul Station	93.4%	5.7%	0.9%	844
Daejeon Station	83.5%	6.0%	10.4%	182
Dongdaegu Station	84.5%	1.7%	13.8%	349
Busan Station	94.5%	4.0%	1.4%	693
Total	1,890	93	85	2,068

Data: Cho et al. (2005).

(2) Comparison with Early Stage of KTX Opening

The following table summarizes changes in the travel characteristics in the second year of the opening of the HSR. According to this table, significant increases have been shown in the number of KTX users, operating frequency, on-time ratio, and number of regular pass users.

<Table 4-8> Changes in KTX Use

Category		Early Stage of KTX Opening (Apr., May & Jun., 2004)	Second Year of KTX Opening (Dec. 2005–Feb. 2006)	Remark
No. of Daily Average Users		70,000	103,000	Increased by 33,000
Daily Average Income		KRW2,110m	KRW2,760m	Increased by KRW650m
Issue of Regular Passes		1,848 passes (3 months)	5,811 passes (3 months)	Regular passes tripled
Usage Rate	Gyeongbu (Seoul-Busan) Line	70.5%	85.0%	Increased by 14.5%p
	Honam Line	35.6%	57.1%	Increased by 21.5%p
On-time Ratio (5minutes)		86.4%	95.5%	Increased by 9.1%p
No. of Average Passengers per Train (Total number of seats: 935)		Approximately 550	Approximately 640	Increased by 90
Average Income per Train (Expected to reach app. KRW25m)		KRW16,400,000	KRW19,150,000	Increased by KRW2,750,000

Data: Internal data (KORAIL).

5. Future of Korea's High Speed Rail

1) Construction of Gyeongbu High Speed Rail: Phase Two

Since Phase One HSR section opened on 1 April 2004, the construction of Phase Two has been under way. Phase Two construction section covers Dongdaegu~Gyeongju~Ulsan~Busan with the total length of 167.2km and expected project costs of KRW7,190bn, and its completion is slated for 2010. The project costs have enlarged by KRW1491.9bn due to construction of new station buildings and new lines in the downtown areas of Daejeon and Daegu.

When Phase Two section opens, the travel time in the new Seoul-Busan section of 418.7km should decrease to 2 hours and 10 minutes from the present travel time of 2 hours and 40 minutes, which has increased by 14 minutes from the initially planned travel time of 1 hour and 56 minutes. This is attributable to the decision to build new aboveground lines through the downtown areas in Daejeon and Daegu instead of underground lines.

In the meantime, new station buildings have been added in step with the opening of Phase Two HSR. To accept civil applications from the KTX passing areas, the new station buildings will be established. Aside from Osong Station branching off from the Honam HSR, Gimcheon-Gumi Station and Ulsan Station among others will begin operating upon opening of the Phase Two KTX in 2010.

2) Construction of Honam High Speed Rail

Presently, the KTX leave Yongsan station in Seoul, and branch off from Seodaejeon station to take the existing Honam Line. However, the newly built Honam HSR will open in 2017.

The Korea Transportation Institute conducted research on construction of the Honam HSR in 2003. According to the research results at the time, the sections between Seoul (Suseo) and Hyangnam and between CheonanAsan ~ Osong ~ Daejeon and Iksan were to be newly built in 2015 as Phase One construction, the section between Hyangnam and CheonanAsan ~ Osong ~ Daejeon would share the Gyeongbu HSR, and the sections beyond Iksan would utilize the existing Honam Line. Nonetheless, the government decided to promote construction of the Multifunctional Administrative City, and has left the station diverging from the Honam Line undecided.

<Table 5-1> Revisions in Notified Gyeongbu HSR Project Phase Two

		Present	Revision (Bill)
Project Outline	Line	• Seoul ~ Daejeon ~ Gyeongju ~ Busan	Same
	Daejeon, Daegu & Downtown	• Construction of new underground lines	• Construction of new above-ground lines
	In-between Stations	• Cheonan, Daejeon, Daegu, Gyeongju	• Construction of additional new in-between stations in Ulsan, GimcheonGumi and Osong
	Heavy Maintenance Facilities, etc.	-	• New construction of heavy maintenance facilities and lockup facilities
	Project Costs	KRW5,698.1bn	KRW7,190.0bn (increased by KRW1,491.9bn)
	Period	2004~2010	Same
Operation Plan	Distance	412km	418.7km (increased by 6.7km)
	Time	116 minutes	130 minutes (increased by 14 minutes)
	Speed	300km/h	Same
Funding	National Treasury	• National Treasury: - Financing: 35% - Loans: 10% • Korea Rail Network Authority: 55%	• National Treasury: 50% financing • Korea Rail Network Authority: 50%

Data: Notification No. 2006-336 (28 August, 2006), publicized in the official gazette (Ministry of Construction and Transportation).

Based on KRIHS research in 2006, Osong was determined as the station diverging from the Honam HSR. Moreover, Namgongju Station would be built in the location of the Multifunctional Administrative City. However, the feasibility report on construction of the Honam HSR found that B/C (Benefit Cost Ratio) of the optimal plan to operate the railway for thirty years from 2018 stood at below 1.0, indicating a low economic value of the railway project (KRIHS et al., 2006). Nevertheless, the government notified the public of the basic Honam HSR plan on 28 August 2006, and commenced the design process in order to facilitate the local economy of the Honam regions and promote balanced national development. The construction of the Honam HSR is expected to finish in 2017 if the project is progressive as planned.

The Honam HSR is the total of 230.9km connecting Osong to Iksan to Gwangju to Mokpo (the Seoul-Osong section uses the current Gyeongbu HSR Line) with 6 station buildings, railway subgrade and tracks to be built. Its total construction costs are estimated to reach KRW10,541.7bn (50% funding by the national treasury). Once the new lines of the Honam HSR are completed, the Seoul~Gwangju section will cut down its time travel by 60 minutes to 1 hour and 33 minutes and the Seoul~Mokpo (352.7km) section by 79 minutes to 1 hour and 46 minutes.

3) Future Tasks

Given the opening of the Gyeongbu HSR, Korea's railway policy has faced large changes. Running at the maximum speed of 300km/h, the KTX have boosted passenger demand, and their high punctuality has satisfied users. In the time of emphasizing time values, the KTX have emerged as a long-distance mode equivalent to airplanes, as well as a environment-friendly mode to replace passenger vehicles.

However, the road transportation by passenger car is still in the central position of the national transportation system. The advantage of the road transportation is good accessibility on the back of door-to-door delivery. For freight movement, it is also easy to deliver goods to a location desired by a client on the road. On the other hand, the railway transportation has the largest restrictive fac-

tor that it is inconvenient to move around the stations despite many strong points such as high speed, environmentally friendliness and low energy consumption. Nonetheless, the entire world is now searching for an energy-saving mode due to high oil prices. In addition, people are encouraged to use a low-pollution mode given the common interests of the earth, including climate changes. Such common interests will also clearly influence the traffic policy.

Thus, the HSR and the KTX may be a suitable solution to the transportation policy. Although Korea's transportation investment has focused on roads, it is imperative to actively seek investment in the HSR in the future, considering the global trends. The existing railway lines urgently require high speed remodeling, and must expand their capacity through transformation into electric railways and incorporation of multiple lines. Additionally, the demand is likely to significantly grow, and it is necessary to build the HSR preferentially in areas with poor railway services. From such a perspective, it is essential to reexamine the construction of the HSR on the east-west corridor, which was planned quite some time ago. Considering the concentration of tourists on the eastern coast, the construction of the HSR will subdue traffic congestion on the road, and cut down the travel time of train users.

In the meantime, given the restrictions on financial sources of traffic investment, choices and concentration are necessary to make railway investment. Remodeling, electric railway transformation or multiple-line accommodation of the entire railways nationwide will likely lower investment efficiency. It is imperative to make preferential investments in urgent areas based on demand. The railway passenger demand can be secured when trains provide less travel time than passenger cars and the high speed of the trains is guaranteed. When the number of the KTX users sharply rises, opportunities of the railway investment can grow. At least from now on, it is necessary to set up principles of the railway investment and search for ways to boost investment efficiency.

Appendix

<Table> Major Revisions of Basic Gyeongbu HSR Project Plan

Classification	Basic Plan Established (14 June, 1990)	First Revision (14 June, 1993)	Second Revision (Phase 1) (31 July, 1998)
Line	• Seoul ~ Cheonan ~ Daejeon ~ Daegu ~ Gyeongju ~ Busan	• Seoul ~ Cheonan ~ Daejeon ~ Daegu ~ Gyeongju ~ Busan	• Seoul ~ Cheonan ~ Daejeon ~ Daegu ~ Busan
Distance	409km	430.7km	412km (409.8km)
Project Period	• August 1991 ~ August 1998	• June 1992 ~ May 2002	• June 1992 ~ 2010 (June 1992 ~ April 2004)
Project Cost	KRW5,846.2bn	KRW10,740.0bn	KRW18,435.8bn (KRW12,737.7bn)
Station Building	• Seoul, Cheonan, Daejeon, Daegu, Gyeongju, Busan	• Seoul, Southern Seoul, Cheonan, Daejeon, Daegu, Gyeongju	• Southern Seoul, Cheonan, Daejeon, Daegu, Busan • Seoul Station is expanded to use the existing Seoul Station and Yongsan Station.
Operating Time (2-station Stop)	101 minutes	124 minutes	116 minutes (160 minutes)
Speed	• 350km/h (designed maximum speed)	• 300km/h (maximum operation speed)	• 300km/h (maximum operation speed)
Train	• 46 trains organized	• 46 trains organized	• 46 trains organized (12 foreign trains; 34 domestic trains)
Funding Plan		• 45% financed & 55% from the own funding	• 45% financed & 55% from own funding
Major Changes		• Seoul, Daejeon and Daegu Stations are to use remodeled existing ground stations. • The section between Seoul Station and Anyang Station is to use the existing Gyeongbu line. • Southern Seoul Station (Gwangmyeong) is installed.	• The sections passing through downtown Busan, Daejeon and Daegu are to have the existing lines utilized as electrical railway lines. • The section between Seoul Station and Southern Seoul Station(Gwangmyeong) is to use the existing railways.

Note: Phase Two Project Plan was revised again in August 2006.
Data: Internal data (Ministry of Construction and Transportation, 2006).

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