

Policies

[Metro] Introduction of the Rapid Urban Railway System - Construction of Subway Line 9

Date 2017-01-23 **Category** Transportation **Updater** 이해인

Writer

Seung-Jun Kim & Joon-Ho Ko

Affiliation

Seoul Institute

Date

2017-01-23

Last Update

2017-04-27

Background

From the 1950s onwards, the population of Seoul underwent such explosive growth that it had risen by 630% by 1990. Even in the early 1990s, the population continued to increase. Although the 2nd phase of construction of subway lines was in progress at that time, the need to carry on with the 3rd phase of construction was raised for the first time in 1991, because of this explosive growth. In November 1993, a basic plan for five subway lines, including the construction of new subway lines (lines 9~12) and the extension of subway line 3, was announced. At that time, the transport share of the subway lines was 32%, but the goal of the basic plan was to raise their transport share to 75% upon completion of the 3rd phase of construction of subway lines.

The accident involving an explosion that occurred on the Daegu subway in 1995 caused all the subway lines then under construction or on the planning list to undergo a reevaluation of their plans or an adjustment of their construction periods before construction could be started or resumed according to the government policy, which resulted in a delay in completing the 2nd phase of construction. The start of the 3rd phase of construction was scheduled for 1996, but was postponed until at least 1998 because the policy on the financing method could not be established in time. Even though the construction work had been delayed, the locations of the stations on subway line 9 were determined in 1996. Then, in March 1997, the Seoul Metropolitan Government (SMG) announced a new plan to start the 3rd phase of construction, came up with a project plan for the 3rd phase of construction, and held consultations with the central government on the financing measures for the 3rd phase project, giving priority to subway line 9 and the extension of subway line 3, and then started the construction work immediately after reaching an agreement on the financing measures. Yet again, however, the commencement of construction was delayed because of budget cuts due to the IMF monetary crisis in 1997. In June 1998, the Mayor of Seoul, newly inaugurated at the time, ordered a reappraisal of all the subway line routes in the 3rd phase of construction, which meant postponing the start of construction work for an indefinite time period. Finally, in September 1998, the existing plan for the 3rd phase of construction was modified so that only the extension of line 3 and the construction of line 9 would be executed as drafted, while the length of line 11 would be shortened to that of the current Bundang line, and the other plans would be replaced by the construction of a light rail transit and a small monorail, and the addition of branch lines to the 1st- and 2nd-phase subway lines. The feasibility investigation for line 9, for which the execution designs had by then been completed, was passed and the start of construction was confirmed in 2001 as a project of private sector investment for profit (BTO).

The profitability of line 9 was forecast to be somewhat bleak in the initial stage because the line was operated on a similar route to the Olympic Expressway, one of the city's urban expressways, and the overall metro transports demand showed stagnant results. In order to cope with such conditions, the Seoul Metropolitan Government planned to introduce a mixed service of normal (all stop) trains and express trains for the first time in Korea. The operational plan for subway line 9 was expected to enhance accessibility from the surrounding areas to central Seoul and to improve passenger services by providing various patterns of train operations.

Progress

Construction History of Subway Line 9

- Jun. 1994: Set the route for the 3rd phase of construction.
- 1997: Establishment of the implementation plan for the 3rd phase of construction.
- 1998: Decision made to start constructing a part of the 3rd phase subway lines because of the IMF crisis (Line 9 included).
- Oct. 2001: Approval of the basic construction plan for the 1st stage sections of line 9.
- Dec. 2002: Start of underground construction work for the 1st stage sections of line 9.
- May 2005: Signing of execution agreement between the Seoul Metropolitan Government and the project implementer (private sector

investment project for the above ground part of the subway lines).

- Jun. 2007: Start of aboveground construction work for the 1st stage sections of line 9.
- O&M (Operations and Maintenance) contract between the project implementer and the subway operator
- Jul. 2009: Opening of the 1st stage sections of line 9.
- Oct. 2011: Number of operating trains increased (24 trains → 36 trains).

Project Process by Stage

The construction of subway line 9 progressed in 3 stages. Train operations at each section commenced with the completion of each stage. As shown in <Figure 1>, the construction of subway line 9 started from the Gangseo section, which was lacking in subway services, and was expected to have relatively higher demand for such services. In July 2009, the stage 1 section (Gaehwa~Sinnonhyeon) was opened and is currently in operation. According to the operation performance of the stage 1 section over the past five years, the actual daily traffic reached 97% of the 2010 forecast, and 103.8% in 2012, showing a high utilization rate. Therefore, passenger traffic was anticipated to increase further still after stages 2 and 3 were constructed and opened for operations. In the stage 2 sections, which was scheduled for completion in March 2015, transfers to the Bundang line (at Seonjeongneung Station) and to line 8 (at Jamsil Sports Complex Station) would be made possible, thereby improving access for passengers using the Bundang line and line 8 to the central part of the city. With the construction of the stage 3 sections slated for completion in April 2016, line 9 would be fully constructed and opened.

<Figure 1> Construction Sections of Subway Line 9



Operating Characteristics of Subway Line 9

Introduction of the Express Train Service

Construction of Nation's First Express Urban Railway

The principal feature of subway line 9 is the introduction of an express route on which the train speed is faster and the express trains stop at fewer stations. Of the Seoul Metropolitan Rapid Transit routes, subway line 9 was the first one to be constructed after taking express trains into account from the construction planning phase. Express trains on subway line 9 stop at the main stations, including the transfer stations, and pass through the other stations without stopping. Of the 25 stations on subway line 9, the express trains stop at only nine stations. Subway line 9 was designed to operate all-stop trains and express trains on one track. The express routes are operated at a speed about 40% faster than normal all-stop trains.

Operation between Normal/Express Trains

As the normal trains and express trains use one track on subway line 9, it is important to strictly adhere to the operating schedule. The operation ratio of normal to express trains is 3:1 during rush hour, offering greater convenience to passengers, and 2:1 during regular times. The platforms and boarding locations of the express trains are the same as those of normal trains for the convenience of passengers in most cases. (At some stations, they use same platforms, but the boarding locations of the normal and express trains are arranged in opposite directions.)

Operation of Express Train Using Double Track + Sidetrack Method

A typical method used in operating subway express trains is to construct a four-track line for a separate express line. Another method consists in operating the double track plus a sidetrack (or evacuation track) by which the express trains can pass the normal trains at some stations. With regard to transport and efficiency, the four-track line method is sufficient, but it requires a huge amount of additional

investment. Thus, the dual-track plus sidetrack method was adopted for subway line 9. In the case of the stage 1 section of line 9 currently under operation, six stations have been installed with sidetracks, and the express trains stop at nine stations including the transfer stations. The total travel time of the normal trains is around 47 minutes from Gimpo International Airport Station to Sinnonhyeon Station, but it only takes about 30 minutes by express train. If one were to travel along the same route by passenger car it would take around 40 minutes, while by bus it would take 64 minutes. Therefore, the express trains are much more advantageous compared to passenger cars and buses.

<Figure 2> Normal/Express Trains Operation Method in the Subway Line 9



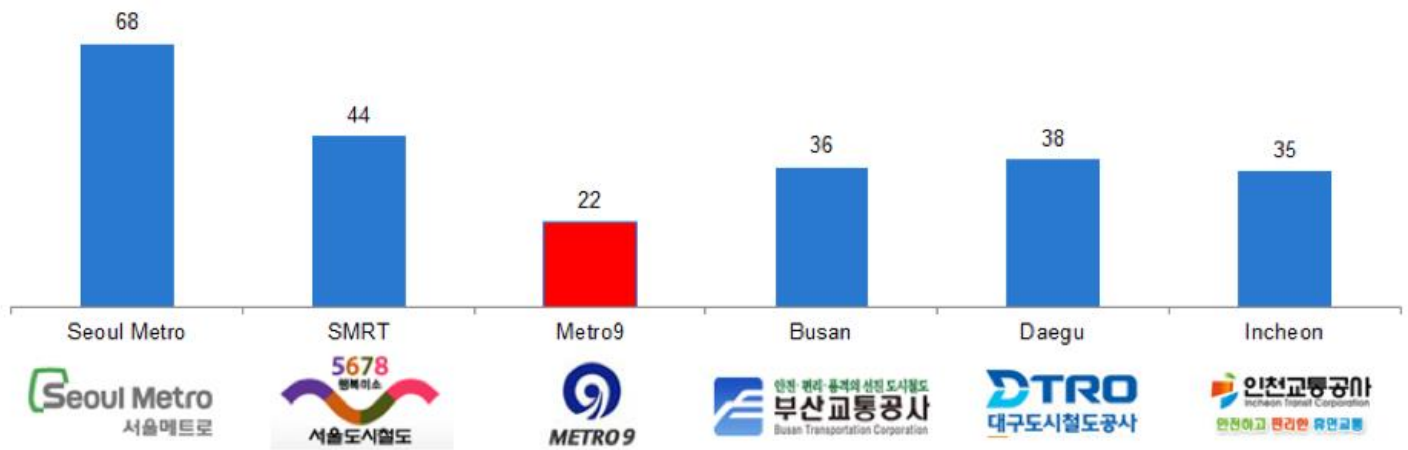
<Table 1> Travel Time of Normal/Express Trains

Classification	Normal (N)	Express (E)	(N-E)/E×100%
Gimpo Int'l Airport ~ Yeouido	26min. 25sec.	15min. 50 sec.	41%
Gimpo Int'l Airport ~ Sinnonhyeon	47min. 30sec.	30min. 00 sec.	37%

Slim Organization (Execution of 5-Free Policy)

The subway line 9 route represents the most modern construction method of all the Seoul subway lines, having adopted the 5-free policy for the first time. The 5-free policy means that the stations on line 9 do not have the five things that are present in the operating procedures of existing subway lines – namely, a stationmaster, a station office, a ticket office, a general office, and facilities for night duty. According to this policy, personnel are not assigned to ticket offices, and there is no station office. Instead, a convenience store sells transportation cards and provides card charging services, while a couple of station employees and ticketing supporters remain on-site at the station to provide safety instructions and guidance to passengers. In addition, the on-site office - which used to be operated for facility maintenance and management by the existing subway operating institutes – has been eliminated to give the organization a slimmer, leaner structure. Also, in order to maximize operational efficiency, the maintenance and management tasks for trains, elevator facilities and other facilities are outsourced, with the result that the number of operating personnel per kilometer on subway line 9 is lower than on any other subway line in Korea, as shown in <Figure 3>.

<Figure 3> No. of Operating Personnel per Kilometer of Subway Line in Korea



Measures to Reduce Overcrowded Trains on Line 9

Following its opening in July 2009, subway line 9 introduced a dual operating system composed of normal and express trains. The line was spotlighted by Seoul citizens as a new and convenient means of transportation between Gangseo and Gangnam. The number of passengers using line 9 rose continuously, with the daily average number of passengers in the first year of opening reaching 214,000, and increased consistently to 294,000 in 2011 (January to July), showing a growth rate of around 37%. In the case of express trains with a high user preference, however, the degree of congestion exceeded 250% during rush hour because many passengers gathered at specific time periods, causing inconvenience in using the subway. The Seoul Metropolitan Government increased the number of express train runs during the most crowded rush hour (07:30 ~ 08:20) without increasing the number of trains, but even this measure failed to make a fundamental improvement to the congestion problem.

The Seoul Metropolitan Government completed the operating plan related to the car increase scheduled for 2014 more than two years in advance. In October 2011, the Seoul Metropolitan Government added 48 cars for 12 trains in total, and five trains (with 20 cars) that had passed their performance tests were added during the rush hour to increase the transport capacity. In addition, the interval between express trains was shortened from 20 minutes to 10 minutes, while the normal train interval was reduced from 6.7 minutes to 5 minutes during rush hour from October 2011, when the early investment was committed. Outside of rush hour, the interval between express trains was shortened from 20 minutes to 13 minutes, and that between normal trains from 10 minutes to 6.5 minutes, in a bid to reduce passengers' waiting times on the platforms. In spite of such efforts on the part of the Seoul Metropolitan Government, the congestion problem on line 9 remained, to be taken care of in the future. When the stage 2 and 3 sections of subway line 9 were completed, many commuters were expected to flow to the line, thus intensifying the congestion problems. In order to cope with such a situation, the Seoul Metropolitan Government discussed the issue of crowded trains with the operating company responsible for subway line 9.

<Table 2> Status of Congestion of Trains on Subway Line 9

Classification	Max. Degree of Congestion	Max. Congestion Section	Remarks
Express Train	251% (Noryangjin Station)	Gayang Station~Express Bus Terminal Station (exceeding 210%)	Exceeding 30% that of the opening period
Normal Train	206% (Yeouido Station)	Dangsan Station~Noryangjin Station (exceeding 206%)	

Restructuring of Subway Line 9 as an Innovative Model of the Private Sector Investment Project of Seoul

Construction and Operation of Subway Line 9 by Applying the MRG System

The Seoul Metropolitan Government attracted private capital to cover the lack of public funding due to the IMF crisis and to complete the infrastructure of subway line 9 earlier. The Seoul Metropolitan Government also tried to reduce the burden of public funding for subway line 9, introduce the creativity and efficiency of private enterprises, and diversify the sources of investment by attracting private investment. The BTO (Build Transfer Operate) scheme was adopted, and it was agreed for the first time that the private sector would operate the line for 30 years. Thus, 33.3% of the total project cost was supported by the central government, 51.0% by the Seoul Metropolitan Government, and 15.7% by private sector investment. According to the initial execution agreement, the minimum revenue guarantee (MRG) should be set at 90% for 5 years from the operation starting date, 80% for 6 to 10 years, and 70% for 11 to 15 years in the event of a shortfall in the expected fare revenues specified in the agreement, regardless of the actual operating revenue. As the financial burden grew due to the long time compensation for revenue and as the negative perception of MRG spread, the Seoul Metropolitan Government started seeking new ways to complement the MRG system.

Restructuring of the Subway Line 9 Project

The existing business agreement contained too many advantageous terms for the private operator. According to the agreement, the right to decide the fare was granted to the private operator, and an earning rate higher than market interest rates was guaranteed. That was the main reason why the need to improve the overall conditions of the project was raised continuously. Seoul Metro 9, the company which

operates subway line 9 as a private implementer, posted the fare increase statement unilaterally in April 2012 during the period of fare negotiations with the Seoul Metropolitan Government, causing confusion among Seoul’s citizens. The Seoul Metropolitan Government started reviewing the restructuring of the subway line 9 project in July 2012; formed a task force for subway line 9 in January 2013; organized a negotiation group consisting of lawyers, accountants, transportation experts, etc.; and proceeded with negotiations for alternation of the execution agreement with new potential investors. The negotiations mainly concerned three items; ① dealing in stocks between the existing shareholders and new investors, ② modification of the execution agreement between the Seoul Metropolitan Government and the new investors; and ③ conclusion of a management and operation agreement between the new investors and the operating company. The Seoul Metropolitan Government entered into a modified execution agreement with Seoul Metro 9 in October 2013 through such negotiation process, finalizing the one-year process of restructuring subway line 9. The main contents of the modified agreement are as follows.

Overall Replacement of Existing Private Sector Shareholders

The Seoul Metropolitan Government compelled the existing construction investors and financial capitalists - including Macquarie, who had caused a preferential controversy – to dispose of their shares, and thereafter attracted new asset management firms and financial capitalists. According to the measures taken by the Seoul Metropolitan Government, seven construction investors including Hyundai-Rotem, which completed the construction of the 1st stage section of subway line 9, sold all of their shares in order to withdraw from the running of line 9. Of the existing financial capitalists, Macquarie and the Industrial Bank of Korea disposed of their shares and completely handed over the rights to operate line 9.

<Figure 4> Changes of Investors according to the Restructuring of Subway Line 9

Before Restructuring		After Restructuring
<ul style="list-style-type: none"> ◦ Construction Investors (7) Hyundai-Rotem, POSCO ICT, Hyundai Engineering & Construction, POSCO Engineering, Sampyo E&C, Ultra Construction & Engineering, Ssangyong Engineering & Construction, ◦ Financial Capitalists (6) Macquarie, Shinhan Bank, LG Fire & Marine Insurance, Shinhan Life Insurance, Industrial Bank of Korea, Dongbu Insurance 	↕	<ul style="list-style-type: none"> ◦ Asset Management Firms (2) Hanwha Asset Management, Shinhan BNP PARIBAS Asset Management ◦ Financial Capitalists (11) Kyobo Life Insurance, Hanwha Insurance, Shinhan Bank, Heungkuk Life Insurance, Samsung Life Insurance, Dongbu Insurance, Hanwha, Hanwha General Insurance, Shinhan Life Insurance, LIG Insurance, Nonghyup Life Insurance, Heungkuk Fire & Marine Insurance

How the Seoul Metropolitan Government Came to Hold the Rights to Decide the Fares on Subway Line 9

The right to decide the fares on subway line 9 belonged to the private operator. In 2012, the private operator confused the public by announcing an arbitrary increase in fares without any prior consultation with the Seoul Metropolitan Government. In order to avoid such confusion, the Seoul Metropolitan Government decided to obtain the actual rights to set the fare rate and to correct the deformed fare increase structure. According to the initial agreement, the private operator was allowed to decide the fare rates autonomously within the range prescribed in the execution agreement, and then report such changes to the Seoul Metropolitan Government before implementing them. After the Seoul Metropolitan Government’s decision, the private operator had to acquire the approval of the Seoul Metropolitan Government on fare-related matters (i.e. charging, collecting, and increasing fares). In addition, the Seoul Metropolitan Government solved the problems related to the mandatory steep annual increase of subway fares built into the initial contract to guarantee the yield that had been promised to the private operator.

<Table 3> Table of Subway Line 9 Fare Rates before the Right to Set Fares Belonged to the Seoul Metropolitan Government

Year	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22
Unchangeable Basic Fare (KRW)	1,264	1,307	1,352	1,398	1,446	1,495	1,546	1,599	1,653	1,710	1,735	1,761	1,787	1,814
Fare Increase Rate (%)	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	1.49	1.49	1.49	1.49

Abolition of the MRG System

In 1998, when Korea was embroiled in the foreign exchange crisis, the MRG system was introduced to Korea to attract private capital for SOC projects including the construction of railways, roads, tunnels, and so forth. As the financial burden on the long-term revenue guarantee for the private operators had increased, negative perceptions about the MRG system became widespread. The central government first abolished the MRG system for projects suggested by the private sector in 2006, and then abolished the MRG system for projects officially announced by the government in 2009. The Seoul Metropolitan Government also stopped payments according to the existing MRG system in order to solve the problems caused by revenue compensation for subway line 9. Instead, the MRG system

was converted to the Minimum Cost Compensation (MCC) system according to which the private operator had to cover its operating costs with the actual business income, while the Seoul Metropolitan Government had to compensate any cost shortages. More concretely, compensation based on the newly applied MCC is determined based on the difference calculated every quarter by subtracting the sum of fare income, affiliated business income, etc. generated by operating subway line 9 from the sum of the depreciation amounts of the managing and operating rights, the interest (interest rate: 4.86%), and the operating costs. In this case, the value of the managing and operating rights would be amortized equally every quarter, reaching zero in 2039. The interest amount would also be decreased every year so as to sharply reduce the financial burden on the Seoul Metropolitan Government. Under the new system, the private project operator cannot receive compensation for the excess amount even when its management, operation, and maintenance costs exceed the amount for management and operation costs stipulated in the agreement.

South Korea's Introduction of the KRW 100 Billion "Citizens Fund"

The Seoul Metropolitan Government decided to introduce the KRW 100 billion 'Citizens Fund' in the form of bonds for the first time in Korea during the process of restructuring the project in order to cope with the problems surrounding subway line 9 together with the public. When an increase of the fares on line 9 became an issue in 2012, the then Seoul Mayor suggested the citizens fund as an alternative, and it was evaluated as a revolutionary win-win attempt for both the Seoul Metropolitan Government and its citizens. Members of the public could now invest in the 'subway line 9 fund' with guaranteed higher returns than the interest rates offered by commercial banks. The Seoul Metropolitan Government made the best use of the fund by concentrating on the stable operation of subway line 9 and on a drastic reduction of its financial burden. The Seoul Metropolitan Government issued long-term confirmed bonds with 4, 5, 6 and 7-year maturity, worth KRW 25 billion each, with different earning rates according to the period (but around 4.3% on average). A citizen could invest up to KRW 20 million. The Seoul Metropolitan Government also decided to work under the supervision of the Financial Supervisory Service to protect citizens who invested in the fund and to allow the fund to be repurchased even before maturity for public convenience.

<Table 4> Earning Rate of the Subway Line 9 Citizens Fund

Classification	4 Year Maturity	5 Year Maturity	6 Year Maturity	7 Year Maturity	Average
Earning Rate (Excluding Commission)	4.15%	4.25%	4.35%	4.45%	4.30%

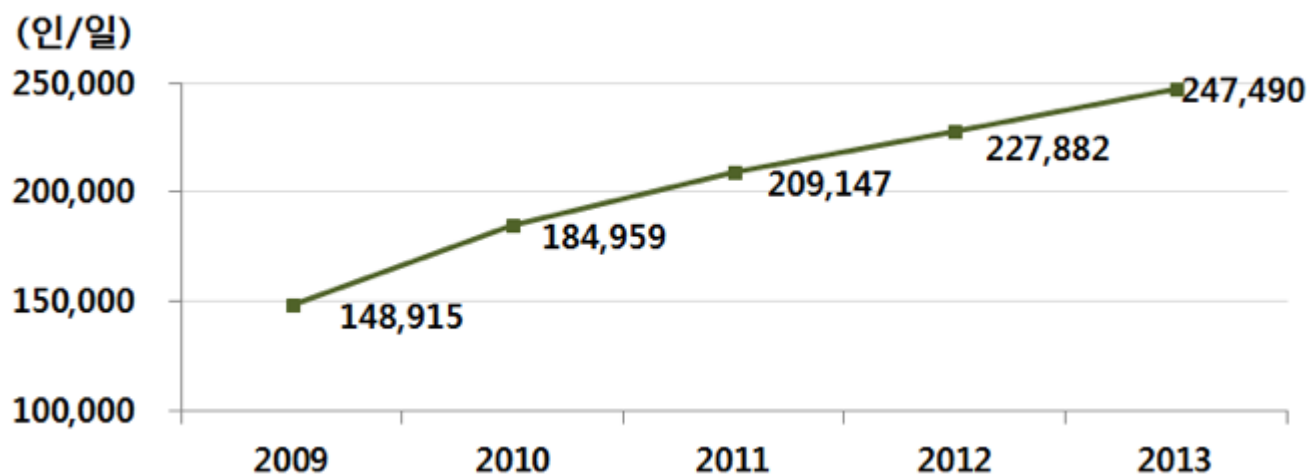
Main Achievements

Increase of Passenger Transport Rights after the opening of subway line 9 in July 2009. The line seemed to have absorbed the demand for passenger transport in the Gangseo section, which had relatively poor access to subway lines.

Increase of Passenger Transport

Immediately after the opening of subway line 9 in July 2009, many people began to use it. The line seemed to have absorbed the high demand for passenger transport in the Gangseo section, which had relatively poor access to subway lines and public transportation. In the beginning stage of the line, the average daily passenger volume on subway line 9 stood at 184,959 passengers, thus reaching 97% of the 2010 forecast. The volume of passenger traffic increased continuously and the number of line users per day reached 227,882 on average in 2012, showing 103.8% of the forecast daily passenger volume.

<Figure 5> No. of Passengers Using Subway Line 9 by Year



Passenger/Day

Transportation Expenses of around 40 Million Passengers Reduced by over KRW 4.1 Billion (Reduction of KRW 100~200 per Pass)

The construction of subway line 9 connected the Gangseo region, an area lacking in public transportation, to the Gangnam region of Seoul, significantly shortening the travel time and reducing the transportation expenses of citizens using that section of the line. According to the Seoul Metropolitan Government's analysis, most of the passengers who were using subway line 9 could save around KRW 100~200 per pass, thus reducing the transportation costs of around 41 million passengers by over KRW 4.1 billion every year.

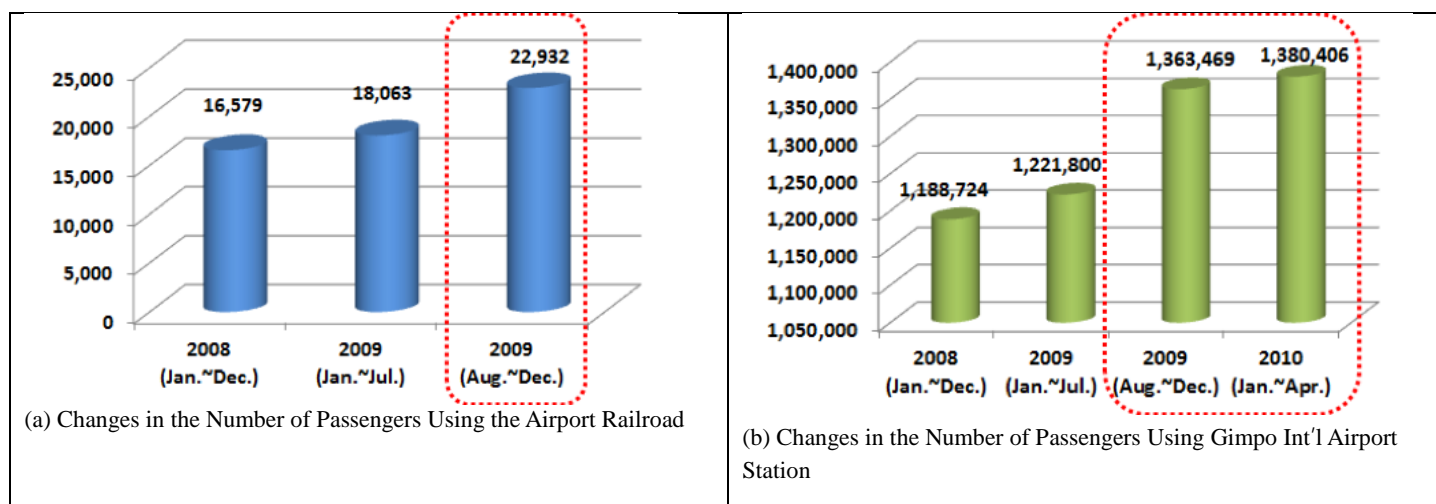
<Table 5> Annual Effect of Transportation Expense Reduction according to the Opening of Subway Line 9

Cut by KRW 100			Cut by KRW 200			Total		
Passengers (Persons)	Reduced (KRW)	Expense	Passengers (Persons)	Reduced (KRW)	Expense	Passengers (Persons)	Reduced (KRW)	Expense
39,936,110	3,993,611,000		807,015	161,403,000		40,743,125	4,155,014,000	

Stronger Connection to Other Modes of Public Transport including the Airport Railroad

The opening and stable operation of subway line 9 and the increase in passengers have had a positive effect on the increase of passenger volume on other linked public transports. In particular, passengers on line 9 can transfer to the Airport Line on the same floor at the Gimpo Int'l Airport Station, resulting in more convenient transfers. According to a recent survey, the number of passengers using Gimpo Int'l Airport Station increased by 14.2%, showing the beneficial synergy effect of subway line 9 on other linked public transportations. Also, the number of passengers using the Airport Railroad increased by 33.8% - mainly as a result of the improved access to the central areas of Seoul following the opening of subway line 9.

<Figure 6> Increase/Decrease of Passengers Using the Airport Railroad before and after the Opening of Subway Line 9 (Persons/Day)



2nd Golden Route Following Subway Line No. 2

The most crowded of all the subway lines in South Korea is subway line 2, which was built in the 1st phase of the subway line project as the only circular line in Seoul. Subway influential areas were largely formed around the stations on line 2, and land prices in those areas are rated as the highest in Seoul. That is the reason why line 2 is known as the "golden route." Subway line 9 was nicknamed the "second golden route" due to the rapid increase in the number of passengers and the development of subway influential areas after its opening. Upon completion of the stage 3 construction work, subway line 9 would give better access to the Gangnam region and increase the potential for further development. As the surrounding areas of Magongnaru Station located in Dunchon-dong, Gangdong-gu would also offer better access to the Gangnam area via subway line 9, many plans for station area development were recently in progress.

Since the opening of subway line 9, the apartment trading volume - including lease and sales - in the Gangseo region has increased by 64%, enjoying the special demand generated by line 9. This suggests that the route of subway line 9 was confirmed in consideration of the balanced regional development of Seoul, and has contributed to the economic recovery of the southwestern area of Seoul from the initial state of opening. Such an increase in apartment trading could lead to an influx of population into the southwestern region of Seoul. The Seoul Metropolitan Government is evaluated as paving a different way to the balanced development and improvement of Seoul, i.e. through the construction of subway line 9.

Limit and Required Improvement in the Future

Continuous Demand for a Higher Number of Trains

The express trains on subway line 9 connecting the Gangseo region and the Gangnam region of Seoul showed a degree of complexity approaching almost 240% of capacity during rush hour, gaining notoriety as a train to hell. This is mainly because the difference in the average travel speed between normal trains and express trains is around 16.6km/h, so passengers continued to concentrate on the express

trains. The Seoul Metropolitan Government expanded the express train services by increasing the operating rate of the express trains, but the degree of complexity was still serious as the number of passengers using line 9 was increasing continuously. With the completion of construction stages 2 and 3, it was anticipated that the number of passengers would increase exponentially and that the degree of complexity would also worsen. The Seoul Metropolitan Government reviewed the plan to operate an equal ratio of normal trains and express trains all day long, but the passengers using the 16 stations, where only normal trains stopped, would suffer disadvantages as a result. Therefore, the efficient deployment of both normal and express trains is required to alleviate congestion and to reduce passengers' inconvenience on subway line 9.

Requirements for the Introduction of Express Trains at Gaehwa Station with the Regional Transfer Center

Gaehwa Station, the first and the last train station on line 9, contains garages for line 9 trains, Gangseo public garages, a regional transfer center, and transfer parking lots. The transfer system in Gaehwa Station was prepared to provide essential services for passengers living in the western part of the Seoul Metropolitan area to transfer to subway line 9 for Seoul. The main intention behind the installation of a regional transfer center at Gaehwa Station was to improve access to the metropolitan area of Seoul. But the station was designed for only normal trains to stop, without the operation of express trains. Thus, passengers using line 9 at Gaehwa Station were inconvenienced because they had to take a normal train bound for Gimpo Int'l Airport Station to get on an express train there. Some of the passengers who used line 9 at Gaehwa Station filed a steady stream of civil complaints and organized various signature petitions. However, Seoul Metro 9 has stuck to its position that it is difficult to comply with the citizens' requests because the signal systems and the rail configuration were designed for express trains to depart from Gimpo Int'l Airport Station. In order for subway line 9 to become a convenient form of transport connecting the western part of the metropolitan area and Seoul, it will be necessary to introduce the express trains at Gaehwa Station.

<Figure 7> Regional Transfer Center of Gaehwa Station



References

Press Release of the Seoul Metropolitan Government, 2010, "Subway Line 9 Going together with the Citizens of Seoul!"

Press Release of the Seoul Metropolitan Government, 2013, "Subway Line 9 Born Again as an Innovative Model of Private Sector Investment Project of Seoul, Reducing KRW, 3.2 Trillion"

관련 자료

[Metro] A Driving Force for Sustainable Development and Remarkable Change, Seoul Metropolitan Subway

[Metro] Construction of the Seoul Metro – the Driver behind Sustainable Urban Growth & Change

첨부파일

PDF icon 3권_Metro_Introduction of Rapid Urban Railway System - Construction of Subway Line 9.pdf