Republic of Korea "Seoul Subway Construction Project II"

Report Date: September 1998

Field Survey: May 1998

Project Summary

Borrower:	Government of Republic of Korea
Executing Agency:	Seoul Metropolitan Government (Office of Subway Construction)
Prior Notification:	March 30, 1990
Exchange of Notes (E/N):	September 11, 1990
Date of Loan Agreement (L/A) (Issued):	October 31, 1990 (January 9, 1991)
Final Disbursement Date:	January 9, 1998 (Extended two years from initial date of January 9, 1996)
Loan Amount:	¥ 72,000 million
Loan Disbursed Amount:	¥ 59,135 million
Loan Conditions:	Interest rate: 4.00% for annual rate Repayment period: 25 years (7 years for grace period)
Procurement Conditions:	General Untied

Reference

(1) Local currency: Won

(2) Changes of exchange rate and consumer price index

FY	1990	1991	1992	1993	1994	1995	1996	1997
Yen/US$	144.79	134.71	126.65	111.20	102.21	94.06	108.78	120.99
Won/US$	707.76	733.35	780.65	802.67	803.45	771.27	804.45	951.29
Won/Yen	4.888	5.444	6.164	7.218	7.861	8.200	7.395	7.863
Exchange fluctuation	100	111.37	126.10	147.67	160.82	167.76	151.29	160.86
CPI	100	109.3	116.1	121.7	129.2	135.0	141.7	148.0

Consumer price index(CPI): 1990=100.
Exchange rate is annual average value. Exchange fluctuation is fluctuation of Won/Yen rate, 1990=100。
Source: International Financial Statistics, International Monetary Fund

(3) Fiscal year: January 1 ~ December 31

Introduction

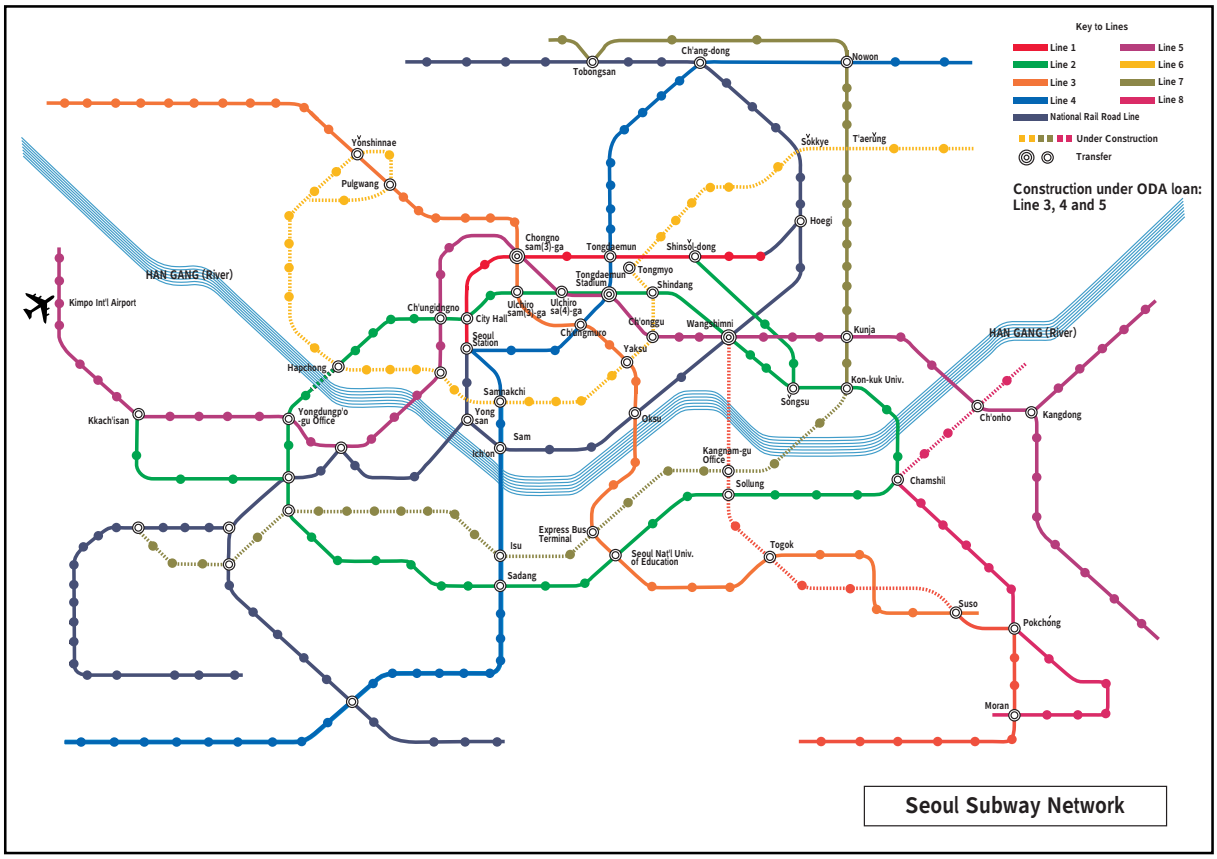
The Seoul Subway consists of 7 lines as of June 1998, carries approximately 4.5 million passengers every day, and represents about 40% of Seoul's daily transportation volume. The total rail distance in operation is 183.6 km, a network that is not limited to Seoul City proper but extends to suburban areas and fulfills an indispensable role for work and school commuters in the Seoul metropolitan area.

The OECF implemented a project called Seoul Subway Construction and National Railway Electrification Project covering the construction of 9.5 km of rails for Subway Line 1 and the electrification of 98.6 km of lines extending from Line 1 to suburban areas in the 1970s, the initial period of construction of the Seoul Subway.

Thereafter, Seoul's subway network went through Phase 1 involving the construction of Lines 2, 3, and 4, and from the beginning of the 1990s, entered Phase 2 using new technology. At this point, the JBIC received a new request for cooperation from Korea, and agreed to extend a loan to cover the extension of subway lines 3 and 4 and the new construction of line 5.

This post-evaluation covers only the part financed by this ODA loan (extension of Lines 3 and 4, and construction of Line 5). However, regarding the project effects and impact, we studied the effects and impact of the overall subway network because this project was the first step to expand the Seoul Subway Network. While the effects of the portion covered by the project are also measured, establishing the contribution of this project to expanding the subway network was thought to be more meaningful as the project's effects and impact.

Project Location



1. Project Summary and Comparison of Original Plan and Actual

1.1 Outline of Seoul Subway Construction Plan

The overall plan for the construction of the Seoul subway consists of three phases, as shown in Table 1 below.

Table 1 Overall Plan for Seoul Subway Construction

Step of Plan	Construction Line	Line Extension	Present Condition
Phase-1 (1971-1985)	Lines 1 to 4	118km	Completed, in operation.
Phase-2 (1989-1999)	Extension of Phase 1 New Lines 5 to 8	160km	Start of partial operation of Lines 5, 7, and 8, with remaining part in construction.
Phase-3 (1999-2010)	New Lines 9 to 12	120km	Under planning.

Since it entered operation in 1974, the Seoul Subway has been continuously expanded. Now (June 1998), Phase 1 has been completed, and Phase 2, which consists in line extensions from the city center (Lines 1 to 4), and line extensions and construction of new lines to suburbs (Lines 5 to 8), is in progress.

The construction will result in a network that will support approximately 70% of Seoul's passenger transportation traffic by the year 2010, with the aims of resolving traffic congestion, reducing traffic pollution (atmospheric pollution, noise pollution, dust, etc.), and securing access to all areas in the city. When Phase 3 is completed, the Seoul Subway will consist of a network of approximately 400 km of lines, and be among the major subway networks of the world.

Future subway construction plans have been tentatively set in April 1990 by the Office of Subway Construction, Seoul Metropolitan Government. But due to changes in transportation demand, and changes in city planning and financial conditions, and changes in the basic design, planning has been adapted in a flexible manner. In particular, the economic recession that began with the bankruptcy of various financial institutions between 1997 and 1998 and the financial austerity policy have made it necessary to again change or revise planning for future lines.

1.2 Implementation Portion Covered by ODA Loan

This project covers the extension of Lines 3 and 4, and the construction of new Line 5, as part of Phase 2, which is the core phase of the above-described total plan. Concretely, the lines in question are those indicated with shading in Table 2 below.

Initially, the construction period for Phase 2 was going to be from 1993 to 1997, but due to the urgent solution of the traffic problem at that time, the Seoul Metropolitan Government decided to move up the start of construction. This ODA loan covers part of the portion of construction thus brought forward (Step 1). As shown in Table 3, the ODA loan covered the entire foreign currency portion of the project costs, and procurement items (planned) are listed in Table 4.

Table 2　Seoul Subway Phase-2 and Portion Covered by this Project

Step of plan	Planned sections		Extension km	Total investment amount ($ 1 billion)
Phase-2	Line 2 (Extension line)	Mokdon - Shindorim	3.0	
Step-1	Line 3 (Extension line)	Yangjae - Suso	8.0	
(1990-92)	Line 4 (Extension line)	Sanggye - Tangkogae	1.0	
	Line 4 (Extension line)	Sadang - Namtaeryong	3.0	
	Line 5 (New line)	Panghwa - Youido	17.0	
	Line 5 (New line)	Kodok - Wangshimni	15.0	
	Line 5 (New line)	Youido - Wangshimni	13.0	
	Line 5 (New line)	Kildong - Koyo	7.0	
	Line 7 (New line)	Sanggye - Hwayang	16.0	
	Line 8 (New line)	Chamshil - Sungnam	15.5	
		Sub-total	98.5	6.41
Phase-2	Line 6 (New line)	Yokch'on - Shinnae	31.0	
Step-2	Line 7 (New line)	Hwayang - Onsu	26.0	
(1993-99)	Line 8 (New line)	Amsa - Chamshil	4.5	
		Sub-total	61.5	4.63
		Grand-total	160.0	11.04

Table 3 Breakdown of Project Cost and Portion Covered by ODA Loan

Item	Foreign currency (¥ million)	Local currency (Million Won)	Total (¥ million)
Civil engineering, construction (including rails)	1,080	629,100	135,707
Electric equipments (transformers, signal, communication equipment)	19,584	67,400	34,008
Inspection and repair facility at rolling stock yards	2,304	29,800	8,681
Cars	45,288	46,800	55,303
Design cost	0	33,700	7,212
Physical contingencies	3,744	0	3,744
Land acquisition	0	85,000	18,190
Total	72,000	891,000	262,845

Exchange rate (1990): ¥0.214/Won

Table 4 Procured Items Covered by ODA Loan

Procurement items	Lines to be covered
1. Electric equipments (transformers, signal, communications equipment etc.) 2. Station facilities (air filter, escalator, automatic ticket gate etc.)	(Main lines) Line 3 (Extension line) Yangjae - Suso 8.0 km Line 4 (Extension line) Sanggye - Tangkogae 1.0 km Line 5 (New line) Panghwa - Youido 17.0 km Line 5 (New line) Kodok - Wangshimni 15.0 km Total 41.0 km
3. Inspection and repair facilities for rolling stock yard	(Rolling stock yard and retracting line part) Line 3 (Extension line) Suso rolling stock yard Line 5 (New line) Panghwa rolling stock yard and 1.2 km retracting line Line 5 (New line) Kodok rolling stock yard and 1.2 km retracting line
4. Civil engineering, construction materials (rails)	Line 5 (New line) Panghwa - Youido 17.0 km Line 5 (New line) Kodok - Wangshimni 15.0 km Line 5 (New line) Panghwa rolling stock yard and 1.2 km retracting line Line 5 (New line) Kodok rolling stock yard and 1.2 km retracting line
5. Cars (train)	366 cars for Line 5

1.3 Background

(1) Korean Economic Growth and Population Increase in Seoul City

From the second half of the 1980s, Korea entered a period of fast economic growth exceeding 10% annually, and Seoul City played a central role both politically and economically. During this growth process, there was a constant increase in the population of the capital (Table 5), and in 1990 it had grown to a size in excess of 10.61 million (24.5% of the nation's total population).

Not only Seoul, but also surrounding areas became increasingly urbanized, the metropolitan area kept on growing, and various population-related problems have emerged, including congestion, environmental, employment, and housing problems.

Table 5 Economic Growth Rate etc. of Korea and Seoul City from 1980 to 1990

		1980	1985	1990	Growth rate (%)	
					1980-85	86-90
Economic growth rate (%)	Korea	6.7	6.9	9.5	(Annual rate) 8.4	(Annual rate) 10.0
Population (1000 people)	Korea	38,124	40,806	43,296	7.0	6.1
	Seoul (percentage in Korea %)	8,364 (21.9)	9,639 (23.6)	10,613 (24.5)	15.2	10.1
No. of automobiles (1000 cars)	Korea	528	1,113	3,395	114.9	168.3
	Seoul (percentage in Korea %)	207 (39.2)	445 (39.9)	1,194 (35.1)	110.7	205

Source: Korea Statistical Yearbook 1997, Seoul Statistical Yearbook 1997

(2) Traffic Problems Accompanying Seoul's Urbanization

Among Seoul's social problems, that of transportation is particularly severe, as the number of (family) cars has increased along with incomes increase in the 1980s, but the construction of roads has not kept apace, and congestion has become a chronic problem.

In 1989, when the ODA loan for subway construction was requested, the Seoul Subway (118 km) was already in operation, and the extension of existing lines and the construction of new ones was in progress, but transportation within Seoul and between Seoul and suburban areas depended mostly on buses using the road network. However, transportation demand was such that it could not have been met with road construction only, and the average speed of cars running inside the city had fallen to as low as 25 km/h (1990). Unless railway transportation such as subways was expanded, this speed was expected to drop to 10 km/h or less, further exacerbating the congestion problem.

On the other hand, the exhaust gas pollution became severe and the number of traffic accidents was increasing. Therefore, the necessity for continuing to build subways lines and expand the subway network kept on rising.

(3) Control of Road Traffic and Construction of Mass-Transit Organ

To solve the above-mentioned congestion problem, the Seoul Metropolitan Government pushed ahead with the construction of roads and at the same time road traffic controls (transport demand control) in a comprehensive program to handle congestion, and on the other hand, it also set the promotion of subway construction, to realize a means of mass transit, as an urgent and important policy goal.

Seoul city will have constructed 160 km of subway network in addition to the existing 118 km of subway lines, and the Korean government has linked the Korean National Railway in Metropolitan Area under the jurisdiction of the Railway Ministry to the Seoul subway, and its has extended new lines into Seoul's suburbs with the aim to increase its transportation allotment capability through railways in the entire metropolitan area, including subways.

Table 6 below shows forecast of transportation demand in the case that no new subway lines were constructed, made in 1988 based on a survey on transportation demand conducted by the Office of Subway Construction. According to these forecasts, if no new lines are constructed from 1988, traffic demand within the city allotted by buses and passenger cars would still be more than 80%, same as the 1988, level in the year 2000. In other words, the construction of additional subway lines was indispensable in order to avoid an aggravation of existing congestion.

Table 6 Forecast of Traffic Demand in Seoul City

Fiscal Year	Total traffic population per day (1 million)	Bus		Passenger car		Subway	
		Allotted ratio (%)	No. of passengers (1 million)	Allotted ratio (%)	No. of passengers (1 million)	Allotted ratio (%)	No. of passengers (1 million)
1988	21.6	50.6	10.66	32.6	6.86	16.8	3.53
2000 (without new construction of subways)	28.07	54.0	15.16	30.0	8.42	16.0	4.49
2000 (with new construction subways)		37.0	10.39	18.0	5.05	45.0	12.63

Source: Office of Subway Construction, Seoul Metropolitan Government

1.4 History of Project

1989	August:	Completion of Feasibility Study for Subway construction
	November 10:	Request of this project by Korean government (receipt of official request at Japanese Embassy in November 14) and $500 million were requested.
1990	January:	Visit to Korea by Japanese government mission and JBIC appraisal mission
	March 31:	Prior Notification
	September 11:	Exchange of Notes
	October 31:	Signing of Loan Agreement
1993	October:	Start of operation of Extension Line 3
1992	November:	Change subway project plan (Additional procurement of 242 cars etc.)
1994	April:	Start of operation Extension Line 4
	April:	Establishment of Rapid Transit Corporation (managing company of Subway Line 5)
1996	August:	Completion of cars procurement for Line 5
	December 30:	Start of operation of Line 5

1.5 Comparison of Original Plan and Actual

1.5.1 Comparison of Project Scope

Table 7 Difference between Original Plan and Actual Concerning Project Contents

Item	Original scope of plan	Actual	Difference
1. Plan of lines			
(1) Line 3 (Extension line) Yangjae – Suso and Suso rolling stock yard	8 km	8.2 km	+0.2 km
(2) Line 4 (Extension line) Snaggye - Tangogae	1 km	1.26 km	+0.26 km
(3) Line 5 (New line) Phanghwa - Youido	17 km	16.6 km	-0.4 km
(4) Line 5 Phanghwa rolling stock yard (retracting line)	1.2 km	1.2 km	±0
(5) Line 5 (New line) Kodok - Wangshimni	15 km	15.34 km	+0.34 km
(6) Line 5 Kodok rolling stock yard (retracting line)	1.2 km	1.2 km	±0
Total of lines	43.4 km	43.8 km	+0.4 km
2. Procurement of equipments			
(1) Rails	11,100 ton	13,447 ton	+2,337 ton
(2) Electric equipments			
a. High-speed circuit beaker	630 sets	403 sets	-227 sets
b. Central monitoring control equipment	1 set	1 set	±0
c. Insulator, glass etc.	35,965 sets	33,589 sets	-2,376 sets
d. Lighting equipment etc.	122,635 sets	112,289 sets	-10,346 sets
(3) Signal equipments			
a. Train dispatcher facility	4 sets	4 sets	±0
b. ATC/ATO device	20 sets	20 sets	±0
Signal power supply		25 sets	+25 sets
c. Signal interlocking device	20 sets	20 sets	+-0
d. Maintenance and testing device	4 sets	6 sets	+2 sets
(4) Communications equipment			
a. Train radio system	20 sets	18 sets	-2 sets
b. Leakage coaxial cable	50 km	50 km	+-0
c. DB facility	40 sets	34 sets	-6 sets
d. AFC device	37 sets	37 sets	+-0
(5) Cars	366 cars	608 cars	+242 cars
(6) Station facilities			
a. Air filter	232 sets	232 sets	+-0
b. Escalator	56 sets	69 sets	+13 sets

(7) Rolling stock yard facilities			
a. Wheel shave device	3 sets	3 sets	±0
b. Automatic car washer	3 sets	3 sets	±0
c. Automatic car inspection device	1 set	0 set	-1 sets
d. Car wheel lathe device	1 set	1 set	±0
e. Wheel set press device	1 set	1 set	±0
f. Carriage cleaning device	1 set	1 set	±0
g. Testing equipment			
① Operation simulation equipment	3 sets	1 set	-2 sets
② Recovery device of derailment accident	3 sets	2 sets	-1 set
③ Ultrasonic search equipment	3 sets	1 set	-2 sets
④ Bearing washer	3 sets	1 set	-2 sets

1.5.2 Comparison of Implementation Schedule and Delivery Date

Table 8 Original Plan, Actual and its Difference at Implementation Schedule and Delivery Date

Item	Original plan (months)	Actual (months)	Difference (months)		
Loan agreement	1990/08	1990/10	+2		
Lines 3 and 4			Start	Completion	Period
Detailed design	07/1987～06/1990 (36)	06/1989～09/1990 (16)	-23	+3	-20
Bidding	04/1990～01/1991 (10)	04/1990 (1)*	+-0	-9	-9
Procurement of materials	02/1991～12/1992 (23)	10/1993 (1)*	-32	+10	-22
Construction works	12/1989～12/1992 (37)	12/1989～04/1994 (53)	+-0	+16	+16
Start of operation	12/1992	04/1994	+16	+16	0
Line 5					
Detailed design	07/1989～01/1991 (19)	08/1989～12/1991 (29)	+1	+11	+10
Bidding	04/1990～01/1991 (10)	10/1993 (1)*	+42	+33	-9
Procurement of materials	02/1991～12/1992 (23)	12/1993 (1)*	+34	+12	-22
Construction works	11/1989～12/1992 (38)	12/1993～12/1996 (37)	+49	+48	-1
Start of operation	12/1992	12/1996 (1)	+48	+48	0
Cars for Line 5					
Detailed design	07/1989～06/1990 (12)	08/1989～08/1990 (13)	+1	+2	+1
Bidding (366 cars)	07/1990～04/1991 (10)	10/1990～06/1992 (21)	+3	+14	+11
(242 cars)		01/1993～12/1993 (12)	N.A	N.A	N.A
Delivery (366 cars)	05/1991～12/1992 (20)	12/1994～11/1995 (12)	+43	+35	-8
(242cars)		02/1996～08/1996 (7)	N.A	N.A	N.A
Land acquisition	1990/01～1991/12 (24)	1990/01～1994/12 (60)	+-0	+36	+36

* The following items related to the performance in procuring equipment for Lines 3, 4, and 5 were not covered by this evaluation: Data was not arranged using the same standard and counting methods as those employed during initial planning; Differing delivery dates although the bidding period was the same; Delays in project start were caused by delays in construction start and delays in the implementation schedule, etc.

1.5.3 Comparison of Project Cost

Table 9 Original Plan, Actual and its Difference at Project Cost

Item/Cost	Original plan (at the time of appraisal)			Actual			Difference		
	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total
Civil engineering, construction (Rail)	1,080	629,100	135,707	904	1,522,825	198,117 (+46%)	-176	+893,725	+62,410
Electric equipments (Transformer/ communication/ signal equipment)	19,584	67,400	34,008	11,411	90,468	23,127 (-32%)	-8,173	+23,068	-10,881
Rolling stock yard facility	2,304	29,800	8,681	2,304	81,557	12,866 (+48%)	+-0	+51,757	+4,185
Cars	45,288	46,800	55,303	44,516	1,745	44,742 (-19%)	-772	-45,055	-10,561
Design	0	33,700	7,212	0	46,222	5,986 (-17%)	+-0	+12,522	-1,226
Physical contingencies	3,744	0	3,744	0	0	0 (-100%)	-3,744	+-0	-3,744
Land acquisition	0	85,000	18,190	0	276,051	35,750 (+97%)	+-0	+191,051	+13,816
Others									
Total	72,000	891,800	262,845	59,135	2,018,868	320,588 (+22%)	-12,865	+1,127,068	+57,743

All foreign currencies correspond to ODA loan (unit: 1 million yen, all local currencies correspond to domestic budget (unit: 1 million won), total expressed in units of 1 million yen.

The exchange rates during planning was ¥144/US$ and ¥0.214/won.

The exchange rates during implementation was ¥0.1295/won (average exchange rate from 1989 to 1996, which was the project implementation period).

2. Analysis and Evaluation

2.1 Evaluation on Project Planning and Implementation

2.1.1 Project Scope

As the result of basic design and detailed design during the implementation stage, the subway line layout was changed, and the amount for equipment and material procured also increased. The changes in the basic design that were made during detailed design, and the changes in procurement quantities depend on the accuracy of the basic design, but changes in detailed design are always possible. No fundamental changes occurred for this project, and all increases and decreases described below are considered to be adjustments in detailed design.

(1) Increase in rail procurement amount

The rail procurement amount was increased by 2,337 tons. The reason for this increase was while the use of 50 kg/m rails had been planned initially, this was changed to 60 kg/m rails in order to prevent excessive vibration and noise[1]. Furthermore, although the total rail extension amounted merely to 0.4 km, the 1 km change in double tracks resulted in a four-fold increase in the rail purchase amount, and changes in the rolling stock yard and an increase in side tracks had an even greater impact on the total amount of rail procurement. All these changes occurred during the detailed design stage and do not represent a problem in particular.

(2) Changes in procurement quantities of transformers and signal transmitters

With regard to high-speed circuit breakers, procurement amount decreased resulting from detailed design and partial purchase using the domestic budget resulted in a decrease in the numbers covered by the ODA loan, from 630 sets planned originally to just 403 sets. With regard to signal equipment, different technology from the originally planned ATC/ATO equipment[2] was adopted in the end, so that signal power supplies were purchased within the cost of the initial plan.

Changes in the specifications of additional equipment such as transformers and signal/communications equipment and so on are thought to be within the tolerable range of the original project objectives to construct an overall subway system, but regarding these changes, the following points should be pointed out.

- The changes did not have a negative impact on the objectives of the original plan, and are obviously rational and appropriate.
- The detailed design that was done in order to raise the accuracy of the basic plan is rational and appropriate.
- The purchase value following these changes does not significantly exceed the amount that was

[1] Changing the rail weight per meter from 50 kg to 60 kg (shift to heavy rails) enables higher car travel speed and stability on one hand, while reducing vibration and noise on the other hand. The use of heavier rails is also advantageous from the point of view of maintenance in that it extended rail life.

[2] Acronyms standing for Automatic Train Control, Automatic Train Operation, referring to train signal equipment for automatic train control and automatic train operation.

initially planned.

None of the above-mentioned changes in the detailed design of this project did have a major impact on the overall subway system, but the executing agency did not consult the JBIC sufficiently in advance regarding changes arising from detailed design, nor did it relay or report these changes. Previous relay of these changes in order to ensure the smooth, obstruction free promotion of this project should have been done.

(3) Increase in number of procured cars

The initial plan was to purchase 366 cars for operation on Line 5, but during the execution stage, this plan was changed and instead this purchase number was increased to 608 cars.

As the result of intense competition among the companies from Korea, Japan, Germany, and England car makers participating in the bidding process for the initially planned subway cars, and also as the result of the appreciation of yen during the bidding period, so that non-yen bids wound up being lower in yen terms, the purchase value of the initially planned subway cars wound up being only ¥27.896 million, or considerably less than the ¥45.288 million initially forecasted during the initial survey (approximately 60% of the budget). As a result, the difference of ¥17.392 million in ODA loan was earmarked for the purchase of an additional 242 subway cars, whose procurement was originally to be covered by the domestic budget. Furthermore, the strength of the yen during the bidding stage resulted in an overestimation of the budget for car procurement.

The procurement of these cars was approved by the JBIC with the sanction of the Japanese government in consideration of the rising transportation demand toward subways, the worse-than-expected exacerbation of congestion, the report of the efficiency of the initial project, the urgent need for project implementation, the effective utilization of ODA loan in the past, and the wish to achieve the target of US$1.85 billion in financial aid to Korea formally announced by Japan to the international community[3].

The initial budget estimated during the appraisal for this project was appropriate in light of past subway car price statistics for Japan and Korea at that time. However, at that time, the world's rail car market was entering a period of intense competition, and the strategic prices of bidders turned out to be far less than the contract price. It is impossible to forecast the strategic price of bidders during the appraisal, and the final price was a result of international bidding under general untied conditions. (The rail car unit price at the time (Japan, etc.) was approximately ¥125 million, and the budget price for this project was set at ¥123.7 million).

(4) Increase in escalator procurement number

During the detailed design, emphasis was placed on consideration for the handicapped, and thus it was decided to increase the number of stations where escalators would be installed. Therefore the number of escalators to be purchased was increased.

[3] At the time of Prime Minister, Mr. Nakasone's visit to Korea on January 1983, he expressed that Japan's policy of economic cooperation toward Korea was to provide the utmost level of economic cooperation and thereafter, during the 7-year period from 1982, Japan aimed to extend a total of US$1.85 billion in ODA loan to Korea. The ODA loan of fiscal 1988, which included this particular loan, were the last loans to Korea. With these loans, the target figure of US$1.85 billion was almost to be achieved.

(5) Reduction in the procurement number of rolling stock yard equipment (automatic car detectors, inspection equipment)

The purchase of automatic car detectors was omitted in the end because it was decided to provide them on the car themselves. Regarding inspection equipment, the initial plan was to purchase such equipment for three different rolling stock yards (Suso, Panghwa, and Kodok), but then it was decided that inspections could be performed in common for all three yards in a location somewhere between these three yards, so that redundant purchases were eliminated. Both decisions are considered to be appropriate.

2.1.2 Implementation Schedule

Construction of extension sections for Lines 3 and 4 started as planned, but the start of operations was behind some 16 months due to delays in the implementation schedule. Moreover, except for the Line 5 within Seoul City, the start of construction was delayed 49 months, the implementation schedule was shortened by 1 month, so that operations started 48 months behind schedule. Although the procurement term of cars for Line 5 were available 8 months ahead of schedule, bidding was extended 11 months over the initially planned schedule, and as a result, the cars had to be delivered 35 months behind schedule in order to match the construction schedule of Line 5. This delay was due to a number of factors. The major factors and the measures taken by the executing agency (Office of Subway Construction) to handle them are as follows.

The procurement of individual items of equipment such as transformers, communications equipment, and signal equipment for Lines 3, 4, and 5 also suffered delays. However, since data based on the standard and counting methods that were used during planning are not available, the bidding for the equipment to be procured was done in batch, delays in the start of operations for each line was caused not by delays in the delivery of the equipment but by delays in construction start and the implementation period, the evaluation for the delays in the procurement of the above listed items was excluded.

(1) Necessity of land acquisition for building lines

Description: Securing of land for the lines in the detailed design took a lot of time to achieve a consensus among the local residents of the 6 residential districts adjacent to Line 5. This caused the delay in the start of construction of Line 5.

Measures: Through the holding of public hearings and coordinating conferences, maximum consideration was given to the opinions of local residents, and their understanding was obtained.

Cautions: In the case of projects that require the land acquisition, the land acquisition progress and acquisition method, the juridical system for forced land acquisition, environmental considerations, etc., are confirmed in advanced by the JIBC and executing agency.

(2) Existence of difficult construction areas

Description: Line 5 includes 2 tunnels under the Han Gang River (a major river flowing from east to

west of Seoul), and there were weak ground areas near the Han Gang River. These factors were responsible for the extension of the implementation schedule for Line 5.

Measures: Construction of the tunnels passing under the river had to be done using great care, and, therefore, the extension of the implementation schedule had to be approved. The weak ground areas were handled with ground and civil engineering improvements.

Cautions: In case all the details of the construction schedule are not known at the time of the appraisal, changes in the construction methods and extensions in the implementation schedule can be handled flexibly. Since changes in the construction methods and extension in the implementation schedule are frequently linked to increases in construction expenses, arrangements for additional funding need to be secured in case these costs increases cannot be covered by physical contingencies.

(3) Securing of additional funds in case of rise in construction costs

Description: In parallel with the subway construction, residential housing supply policy were going full steam ahead, and an excess number of orders caused sharp price increases in the domestic construction industry. For this reason, procedures for securing additional funding took time, and resulted in the delays in the implementation schedules for Lines 3 and 4.

Measures: Additional construction costs were secured by the injection of additional funds by the Seoul Metropolitan Government.

Cautions: With regard to additional budgets of the Seoul Metropolitan Government, allocation between the Korean Government and the Seoul city, future financial burden, and the democratic decision process need to be confirmed.

Besides of the above-mentioned factors, following the collapse of the bridge over the Han Gang River in 1994, strict emphasis on implementation safety and construction inspections also caused the delays in the implementation schedule.

The delays in the implementation schedule caused not only the delay in start of construction but also directly reflected in costs, through the increase in the construction costs (and accompanying interest cost), the loss of operating income, and so on. In the case of projects that involve large-scale civil engineering works, such as the construction of subways, the executing agency is to monitor progress and aim for the start of operation as planned, after setting an initial plan drafted giving consideration the appropriateness and safety of the construction plans.

(4) Delays in procurement of cars for Line 5

Although bidding started 3 months behind the date planned due to prospects that construction of Line 5 would be completed 5 months behind schedule, contracts and deliveries were delayed, and as a result, delivery of the cars was completed with a total delay of 35 months. Procurement of equipment in expectation of the completion of civil engineering was affected by the progress of construction, thus, this was considered to be unavoidable.

2.1.3 Project Cost

(1) Actual

The following changes in project costs occurred.

Foreign currency (covered by ODA loan):
Reduction of ¥12,865 million (18% reduction compared to initial plan)

Local currency (covered by local budget):
Increase of 1,127,068 million won (26% increase)

Various factors have been involved in relation to these changes in costs, such as international competitive bidding leading to reduction of foreign currency cost, inflation, cost increase and decrease due to changes in the project scope and implementation period, and furthermore the unrealistic level of cost estimates and technical problems. These various problems are analyzed as follows.

① Reduction in foreign currency expenses through international competitive bidding:
▲¥12,865 million

The total cost of items procured with foreign currency (ODA loan) was reduced by ¥12,865 million due to the influence of international competitive bidding and the appreciation of yen.

② Changes in number of cars procured with local currency: ▲45,055 million won

These changes are due to the fact that the number of cars to be procured as per the initial plan with local currency (local budget) was reduced. Initially, of the 608 cars to be procured for Line 5, 366 were to be purchased using ODA loan, and the remaining 242 cars were to be purchased using the budget of the Seoul Metropolitan Government. However, it was decided to also purchase those 242 cars with ODA loan, and accordingly local currency costs were reduced by this amount (45,055 million won).

With regard to the increase in local currency costs, the following 3 factors are involved. 1) The increase in design costs due to inflation (design administration costs), 12,522 million won. 2) The unexpected situations and unrealistic construction budget plans, causing various cost increases such as for land acquisition (supplementary costs, general management costs, temporary land usage fees, steel product usage fees, etc.), 191,051 million won. 3) These 2 factors were earmarked, but cost increase of 968,550 million won consisting of civil engineering, construction, electric equipment, rolling stock yard is thought to be due to a combination of factors, and determining the increase for each factor is difficult.

③ Inflation

From 1989, when the feasibility study for this project was completed, until 1996, when Line 5 entered operation, the inflation rate was approximately 40%. Civil engineering and construction costs in particular were directly affected by domestic prices, and this is considered to be the main reason for the rise in construction costs, which was greater than expected.

④ Changes in project scope

In the part of Line 3 and Line 5 contained portions, changes were unavoidable due to adjustments with local residents, and the resulting increases in construction costs could not be avoided.

⑤ Occurrence of unexpected situation and unrealistic project cost estimates

Changes in construction methods for difficult construction areas in Line 5, and the occurrence of unexpected situation such as changes in the line contributed to the rise in civil engineering and construction costs. Furthermore, the project costs for Phase 2 of the subway were estimated based on the projects costs for Phase 1, but thereafter civil engineering and construction costs rose, so that the Phase 2 cost calculations turned out to be unrealistic. The initial project cost estimations were too low, and consequently additional funds had to be secured in order to enable the completion of the project.

(2) Fund raising

① Foreign currency (JIBC) part:
Entirely covered by ODA loan (money borrowed by government and sublease to Seoul Metropolitan Government)

② Local currency (domestic budget) part:
The increase in the local currency part of this project, 11,271 won, was wholly provided by the fiscal spending of Seoul Metropolitan Government. The statistics of procurements paid for with local currency are shown in Table 10.

Table 10 Breakdown of Funds Procurement in the Local Currency (Domestic Budget)

(Unit: 100 million won)

Classification	Original plan	Actual	Difference
Total project costs of local currency	8,918	20,189	+11,271
(Breakdown)			
Fiscal spending by Seoul Metropolitan Government	5,778	18,547	+12,769
Issuance of subway bond by Seoul Metropolitan Government	0	1,642	+1,642
Introduction of traffic tax by Korean Government	1,140	0	-1,400
Fiscal special loan by Korean Government	2,000	0	-2,000

2.1.4 Project Implementation Scheme

(1) Organization

The executing agency that oversees the construction of all subways in Seoul is the Seoul Metropolitan Government (SMG), and this project was no exception. The executing agency at the city government

level was the Office of Subway Construction, a city office (see attached organization chart).

The organization of the Office of Subway Construction consists of a Division Chief, administration subchief, technical subchief, and under them are the Safety and Process Control Department, Design Control Department, Construction Department, Car Maintenance Department, etc., all in all 11 departments, 50 sections, and 464 employees. Thus subway construction was implemented based on management by a reliable organization. From the existing Line 1 to the Line 8 currently under planning, this organization implements all subway constructions, and its plan implementation capability, construction know-how, and execution capability have been clearly established.

Regarding the roles of each department, for instance regarding cars, the Car Maintenance Department creates specifications, and after bidding, it supervises technical aspects from contract transactions to final acceptance. In this process, the Electrical Equipment Department, the Signal and Communications Department, and the Safety Control Department are all involved. Clerical operations are overviewed by the General Affairs Department. Additionally, electric equipment, signal and communications equipment, and so on, were similarly the responsibility of the Electrical Equipment Department and the Signal and Communications Department.

In the material and equipment procurement stage of this project, there is a request from Office of Subway Construction to the equipment contractor that the responsibility for interface with other systems (civil engineering works, equipment work, cars and signal, transformers, signals, communications, and so on) should be on the equipment contractor (ultimately, no special problems occurred despite the fact that responsibilities remained unclearly defined). In case technical characteristics pertaining to railway project were considered, regarding interfaces between individual systems, insofar as no blanket contract was done to cover the whole systems, the Office of Subway Construction (ordering party, implementing party) side should take responsibility of it. Therefore, interface responsibility should have been taken on the side of the Office of Subway Construction. According to the project, interface responsibility is the area of consultants on the undertaker side, but in the case of this project, only in-house consultants were hired, and consultants responsible for the interface between the executing agency and the contractor were not employed.

(2) Procurement of materials and equipment

① Foreign currency (covered by ODA loan) part

Foreign currency denominated procurements (covered by ODA loan) in this project came to a total of 44 packages (contracts). Regarding these materials and equipment procurements, based on Korean law, the Office of Supply of the Republic of Korea (OSROK) is the main procurement agency. Therefore, in this project too, OSROK procured materials and equipment through international competitive bidding, and provided materials and equipment to the Seoul Metropolitan Government. For instance, taking rails as an example, the rails whose procurement was not covered by the ODA loan were also procured by the OSROK in one batch (including the portion for this project), and later apportioned to the rails covered by the ODA loan.

Such batch procurements of large quantities of material and equipment result in lower prices, and this streamlining of procurement activities was expected to yield administrative efficiencies.

What became a problem was that, during procurement of additional subway cars, on the day that bidding documents was opened, the minimum bidding amount exceeded the estimated price planned by OSROK, and OSROK has directly implemented rebidding without the consent of JBIC. (As a result, OSROK has given right of negotiation (award) to the lowest bidding firm in the first bidding. In this project, in view of the large scale of the bidding, JBIC has checked the bidding documents beforehand, a step that is usually omitted. The fact that, notwithstanding this action, OSROK went ahead with rebidding without the consent of JBIC is entirely due to a misunderstanding on the part of OSROK. In other words, based on bidding documents, there is a term, "OSROK has right to rebidding" and based on the ODA loan agreement, there is a term, "in the case of performing rebidding, the previous consent of the JBIC is required". Regardless of this fact, OSROK just went ahead into rebidding procedures without first obtaining the consent of JBIC. With regards to rebidding, the OSROK gave as reasons that, when the OSROK petitioned for contract negotiations (award) agreement, it followed the Korean Budget Accounting Implementation Ordinance, and furthermore, that it was urgently necessary to make a contract. Based on the explanation of OSROK, JBIC has agreed to the petition for giving right of negotiation (award) to the first lowest bidding firm, but after issuing severe cautions.

② Local currency (covered by domestic budget) part

Civil engineering works have been divided into sections of 1 to 2 km, and construction companies were selected by limited local bidding. Also with regards to materials and machinery, the contracts and procurement were conducted by limited local bidding.

(3) Contractors

The number of procurement contracts for this project was 44, as mentioned previously. The number of contracted companies was 32 (approximately 90% were Korean companies). According to a report by the Office of Subway Construction, there were no contractors who caused impediments to the implementation of the contract, nor were there contractors whose competence seemed insufficient.

(4) Separation of construction organization and operation organization

The Office of Subway Construction, Seoul Metropolitan Government is responsible solely for subway construction. In other words, this office was supplied materials and equipment by OSROK, and after completing a subway system, it transfers ownership rights and actual operation responsibilities to the public corporation established by the Seoul Metropolitan Government (described later). At this time, the completed system and at the same time the construction-related loans are also transferred.

This division of construction and management is due to the fact that there is know-how of construction in the Office of Subway Construction, Government authority can smoothly implement for land acquisitions and coordination with other government agencies rather than a public corporation, and especially regarding operations, management responsibilities based upon healthy labor relations are clearly seen.

The separation of construction and operations promotes independent accounting only of the operations

business without having construction loan repayment responsibilities. Taking a look at the Singapore Subway and other subways in the world, operations consignment methods for railway management are done. But in the case of the Seoul subway, all management responsibilities including the ownership rights and the repayment responsibility are transferred to the public corporation, and this is a point that marks a great difference.

(5) Procurement and repayment of construction costs

The Seoul Metropolitan Government, based on the strict financial base, is mainly in charge of subway construction costs using independent financing sources. The construction cost burden distribution per individual line is as shown in Table 11 below (JBIC covered part is shaded).

With regard to subways in the metropolitan area exceeding the administrative section of Seoul City, subway construction costs are borne by the Central Government, but in the case of this project (Lines 3 to 5), all costs are borne by Seoul Metropolitan Government.

Table 11 Breakdown of Share of Costs Borne for Each Railway Construction

Line	Phase-1 subway (118km)	Phase-2 subway (160km)		
		Step-1 (98.5km)		Step-2 (61.5km)
Line 1 (km)	7.8			
Line 2 (km)	54.2	3		
Line 3 (km)	27.7	8		
Line 4 (km)	28.3	4*(1)		
Line 5 (km)		17+15	20	
Line 6 (km)				31
Line 7 (km)			16	26
Line 8 (km)			5.5+10	4.5
Construction cost (100 million won)	23,926	23,820*(2)	27,490	Under construction
Share of costs borne (%)	Government subsidy 2.7 Government loan 13.1 Seoul City 84.2	Seoul City 100	Inside city 41.5km Government subsidy 12.8 Government loan 12.2 Seoul City 75 Outside city 10.0km Government subsidy 100	1994-97 budget Government support 25 Seoul City 75 Budget after 1998 Government support 40 Seoul City 60

Source: Seoul Metropolitan Government, Office of Subway Construciton

*(1) Of these 4 km, this project covers 1 km.

*(2) Consistency with the project cost statistics shown in Table 8 is not known, and figures from sources have been used as it is.

Moreover, accounting work for the subway construction project is done by the Special Project Accounting of Seoul Metropolitan Government, and in the 1997 budget, subway project accounting represented about 24% of the total Seoul City budget, making this an important project.

2.2 Evaluation of Operation

2.2.1 Operational Organization

As mentioned before, the Seoul subway is operated by the following two organizations that were established 100% with funding from the Seoul Metropolitan Government. The fact that several management organizations are used is thought to be due to the fact that the aim was to establish healthy labor relations, optimize the number of workers and the operation scale, and promote competition among the management organizations in order to improve service quality. Each line of these management organizations have different operating systems, and therefore they cannot be taken as a single integrated system.

① Seoul Metropolitan Subway Corporation (SMSC):
Established in 1981. Responsible for operation of subway Line 1 – 4.
(Organization Chart is as per attached)

② Seoul Metropolitan Rapid Transit Corporation (SMRTC):
Established in 1994. Responsible for operation of subway Line 5 – 8.
(Organization Chart is as per attached)

Both public corporations are formed based on the Subway Public Corporation Establishment Conditions and Seoul Municipal Government Subway Public Corporation Establishment Conditions, according to the regional corporation law. And generally, domestic laws apply. The top management of both public corporations is selected through public subscription, and assigned by the Mayor of Seoul City. Employees are hired according to employment regulations fixed by articles of association. With regard to organization and management (operations), neither Korean Government nor Seoul Metropolitan Government has shown excessive intervention.

2.2.2 Operational Status

(1) Operational Achievements

Currently the Seoul Subway operational performance is as shown in Table 12, with the total from Line 1 to Line 8 representing transportation of some 4.5 million passengers per day.

Table 12 Operational Performance of Seoul Subway (as of December 1997)

Classification of lines		Seoul Metropolitan Subway Corporation (SMSC)					Seoul Metropolitan Rapid Transit Corporation (SMRTC)			
		Total	Line 1	Line 2	Line 3	Line 4	Total	Line 5	Line 7	Line 8
Operational line extension (km)		134.9	7.8	60.2	35.2	31.7	84.2	52.1	19.0	13.1
Number of stations		115	9	49	31	26	83	51	19	13
Number of cars		1,944	160	834	480	470	834	608	136	90
Number of composite cars		199	16	88	48	47	108	76	17	15
Operation interval	At the time of commuting (minutes)	2.5-3.0	3	3	3	2.5	2.5-5.0	2.5 (Morning) 5.0 (Evening)	5.0 (Morning) 6.0 (Evening)	4.5 (Morning) 6.0 (Evening)
	At normal time (minutes)	4.0-6.0	4	6	6	5	4.5-6.0	4.5	6.0	6.0
Number of operations (number/day)		1,556	617	988	427	524	1,238	545	344	349
Number of passengers transferred (100 prns./day)		3,712	503	1,697	678	834	773	525	159	89
Degree of congestion (%)		201	156	242	178	227	166	168	213	117

Source: Seoul Metropolitan Government and Office of Subway Construction, Seoul Metropolitan Government

(2) Analysis of operational performance

The Seoul subway and other subways in the world were compared along the following parameters (annual base).

① Comparison of number of passengers (=subway transportation scale)
② Passengers per managed km (=effective use of managed lines)
③ Number of holding cars per managed km (=degree of passenger service)
④ Number of employees per managed km (=efficiency of allocated staff)
⑤ Passengers per employee (=transportation efficiency)

The features of each of these subways are determined by the relationships with the history, culture, and urban development of the relevant city, as well as a number of additional factors including existing social economic conditions. However, one of the aspects of the management of Seoul's subways was analyzed from the following data.

Table 13 Comparison of Subway Operation Between Seoul and Other Subways in the World

City	**Seoul**		Tokyo		Osaka	Nagoya	New York	London	Paris	Hong Kong	Singapore	Beijing
Operational organization	**SMSC**	**SMRTC**	TRTA	TBTM	OMTM	NMTB	NYMTA	LUL	RATP	MRTC	SMRTC	BMC
Number of passengers transferred (1 million passengers/km)	**1,354**	**292**	2090	564	977	381	1,093	784	1,352	813	278	530
Number of passengers transferred/Managed km (1 million passengers/km)	**10.188**	**3.47**	12.35	8.284	9.24	4.99	2.95	2.00	4.27	18.82	3.35	12.62
Number of holding cars/Managed km (car/km)	**14.63**	**9.90**	14.18	9.37	10.26	9.46	15.64	10.01	11.93	17.57	6.15	7.24
Number of employees/Managed km (person/km)	**95.10**	**57.60**	58.60	52.60	69.30	41.30	67.30	40.80	37.80	171.20	31.50	238.10
Number of passengers transferred/Number of cars (1 million passengers/car)	**0.70**	**0.35**	0.87	0.88	0.90	0.53	0.19	0.20	0.36	1.07	5.13	1.74
Number of passengers transferred/Number of employees (1 million passengers/employee)	**0.11**	**0.06**	0.21	0.16	0.13	0.12	0.04	0.05	0.11	0.11	0.11	0.05

Seoul ..... SMSC: Seoul Metropolitan Subway Corporation, SMRTC: Seoul Metropolitan Rapid Transit Corporation
Tokyo ..... TRTA: Teito Rapid Transit Authority, TBTM: Transportation Bureau of Tokyo Metropolitan
Osaka..... OMTB: Osaka Municipal Transportation Bureau
Nagoya ..... NMTB: Nagoya Municipal Transportation Bureau
New York ..... NYMTA: New York Metropolitan Transportation Authority
London ..... LUL: London Underground Limited
Paris ..... RATP: Regie Autonome des Transports Parisiens
Hong Kong..... MTRC: Mass Transit Railway Corporation
Singapore ..... SMRTC: Singapore Mass Rapid Transit Corporation
Beijing..... BMC: Beijing Metro Corporation

① Comparison of number of passengers (=subway transportation scale)

The 1,646 million (approximately 451 million passengers per day) transported by SMSC and SMRTC is among the top figures in the world. This, considering the scale of the Seoul Metropolitan Area (20 million residents), is believed to be the result of the high percentage of local residents' usage of subway. Considering that the Seoul subway has grown from zero into a huge network used by 4.51 million passengers on average daily in just 20 years, there seems to be rapid growth in number of transported passengers.

② Passengers per managed km (=effective use of managed lines)

This indicates the effective utilization of managed lines, while at the same time indicating the degree of congestion. In the case of Seoul, however, some of the lines of SMRTC are the extension lines of existing lines or new lines managed for the first time. Therefore, depending on the line segment, there are also some segments that have few passengers. However, in these regions, line development has started, and development is thought to be continuing and increasing. The figures for this category also bear in comparison with similar figures of other subways across the world.

③ Number of holding cars per managed km (=degree of passenger service)

Since SMSC has started operations since 1974, many of the cars it owns are old. On the other hand, Line 5 of SMRTC purchased cars of a new system of one-man operation by ATO system in batch procurement for this project (608 cars were purchased with the ODA loan), so that, for the current scale of managed lines, it owns a large number of cars. However, it is predicted that these purchased cars will be gradually placed on new lines that enter operation in the future.

The 608 cars that were purchased under this project represent approximately 73% of the total of 834 cars owned by SMRTC. Line 5, travels from Kimpo Airport (in the western suburb of Seoul), which is the door to the sky in Seoul, to the city center, and is a line that extends from the newly developed towns in the east part of Seoul. These cars allow 545 trains per day on Line 5, and are used by some 520,000 passengers daily. Furthermore, each train system differs, and cars cannot cross between SMSC lines and the SMRTC lines.

④ Number of employees per managed km (=efficiency of allocated staff)

The more there are passengers, more number of employees are needed for better service, but the introduction of automatic ticket gate and one-man operation through ATO system cars have made personnel reductions possible to some extent. Actually, regarding the lines under the management of SMRTC, the number of employees has been significantly reduced by one employee per train in all lines. While this numbers for SMSC are high, because there are numerous division (administrative and clerical) employees, it is still possible that special consideration may be given for hiring measures.

⑤ Passengers per employee (=transportation efficiency)

In the case of Japan's subways, facilities and car maintenance work is given to outside contractors.

Furthermore, subcontracting the cleaning the interior of cars, central management of station operations, centralized management of signal equipment within station precincts, using car designs that don't use paint, the mechanization of rail maintenance, and so on are among the many measures taken to achieve workforce reductions. Such efficiency improvements are being implemented in the Seoul subway, and while they are of lower level than similar measures implemented in Tokyo, they are as efficient as such measures implemented in other cities in Japan and cities in other countries.

2.2.3 Operations and Maintenance

Both public corporations perform car maintenance (inspections for running) every 72 hours as well as every 3 months, and heavy maintenance (overhauls) every 3 and every 6 years. Regarding maintenance, both public corporations subcontract maintenance work to outside companies. Actual maintenance is performed using the rolling stock yards of the managing corporations, and the cost of using equipment is borne by the public corporations. Maintenance is thus performed as described above, and, concerning with the above-mentioned operation status, no major problems are thought to exist in the maintenance status in the current system.

2.2.4 Financial Status (Handling of Deficit)

Both SMSC and the SMRTC's financial status is severe. They are shouldering the loan burden they took over from the Office of Subway Construction, Seoul Metropolitan Government, and they are not profitable due to low fares (described later). Their revenues and expenditures on fiscal 1997 are shown in Table 14, and their most recent profits and losses are shown in Table 15. Furthermore, the subway construction and management operations are characterized by the fact that, since they cannot be fully profitable by fares, which represent the largest source of revenues, government subsidies have to be relied on in order to pay for operations costs and the repayment of construction debt. Particularly during the initial operations phase, there was an unavoidable buildup of debt, similarly to the subways of Japan and other countries.

Table 14 Revenues and Expenditures for Fiscal 1997 in SMSC and SMRTC

(Unit: 1 million won)

Classification		SMSC		SMRTC	
Revenues	Total	1,243,000	100%	499,000	100%
	Operational income	650,459	52	160,519	32
	Seoul City's investment	184,900	15	172,400	34
	Loan	387,329	31	112,892	23
	Others	20,312	2	53,189	11
Expenditure	Total	1,243,000	100%	499,000	100%
	Operational expenses	499,149	40	208,304	42
	Capital expenditure	167,309	13	12,950	2
	Debt redemption	542,314	44	258,589	52
	Face amount	395,501	(32)	118,542	(24)
	Interest	146,813	(12)	140,047	(28)
	Reserve cost	34,228	3	19,157	4

Source: Seoul Metropolitan Government "Current Status of Municipal Government 1998".

Table 15 Final Profits and Losses at SMSC and SMRTC

(Unit: 1 million won)

Fiscal Year	Final profits and losses	
	SMSC	SMRTC
1988	-181,081	N.A.
1989	-154,126	N.A.
1990	-212,544	N.A.
1991	-186,096	N.A.
1992	-152,387	N.A.
1993	-169,866	N.A.
1994	-161,426	-61
1995	-224,490	-27,522
1996	-284,676	-148,061
1997	-358,436	-392,932
1998 (estimated)	-303,976	-442,111
1999 (estimated)	-265,700	-734,802

Source: Office of Subway Construction, Seoul Metropolitan Government

(1) Management deficit and measures

Both SMSC and SMRTC cannot manage to cover their operating costs with revenue from fares, therefore they receive subsidies from Seoul City. Both SMSC and SMRTC spend about half of their expenditures to repay construction debt, and this is putting pressure on management. Particularly in the case of SMRTC, there are many newly constructed lines, and furthermore not even operating costs can be covered by revenue from fares.

(2) Measures to improve profitability

Both SMSC and SMRTC should strive to improve their profitability, even if only by a little, and are indeed taking the following measures in order to secure more passengers.

① Accident prevention: They are publicizing to passengers the fact that they perform thorough operations training for their staff in order to ensure high safety, promoting the safety and reliability of the transport they offer.

② Improvement of services: The following activities are done. Transfer guidance signs, names of surface locations, building name guidance, identification of stations by numbering in addition to identification by name, volunteer activities by station employees in the neighborhood of stations (cleaning, crime control, etc.), the establishment of general guidance centers, concerts in subway corridors, art and other exhibits, the establishment of bicycle and car parkings on the surface, etc.

③ Ancillary businesses: Space rental to bookstores and restaurants in some subway stations, establishment of kiosks, etc.

(3) Fare revenues

One major reason that both SMSC and SMRTC are in a difficult financial situation is that fares are maintained at a low level. To maximize fare revenues, it is thought to be necessary to reconsider fare settings as well as securing more passengers. Currently, fares are set as follows.

SMSC and SMRTC:

In the section system, traveling one section costs 450 won, and traveling over two sections costs 500 won. The same charges apply all over within Seoul City.

National Railway Road within Metropolitan Area (Subway connecting lines):

Distance system with 10 km or less costing the same as one section, and fare incremented by 66 won for every additional 5 km.

Using the exchange rate as of May 1998 (¥0.098/won), the fare for one section cost approximately ¥45.

As public charges, subway fares are fixed after submission by the mayor of Seoul to the national Price Policy Review Committee after going through approval by the Minister of Construction & Transportation (equivalent to the Minister of Transport in Japan) and Minister of Finance & Economy (equivalent to the Minister of Finance in Japan). Both corporations are working toward reducing expenditures and raising management efficiency, and are asking the Mayor of Seoul to raise subway fares, but such a demand is a politically sensitive matter. In order to make operations more profitable, it seems to be necessary to raise fares. Unless fares are raised, keeping fares at an artificially low level will result to the city of Seoul having to fill the budget gap resulting from operating losses of both corporations.

2.3 Project Effects and Impacts

2.3.1 Expected Project Effects and Impacts

The project effects and impacts anticipated prior to the start of the project (anticipated at time of appraisal) were as follows. All these effects and impacts, rather than limited to the project only, are effects and impacts of the wider subway network including this project (we could even say the Subway Project's Phase 2).

(1) Promotion of alleviation of congestion in Seoul City and development of residential areas

(2) Activation of regional economic activity such as promotion of development of commercial and residential areas

(3) Prevention and control of environmental pollution through gas exhaust and reduction of traffic accidents

(4) Securing of transportation means for transportation disadvantaged persons (aged person, children, women) through construction of highly safe and reliable public transportation organs

2.3.2 Project Effects and Impacts Seen in Project

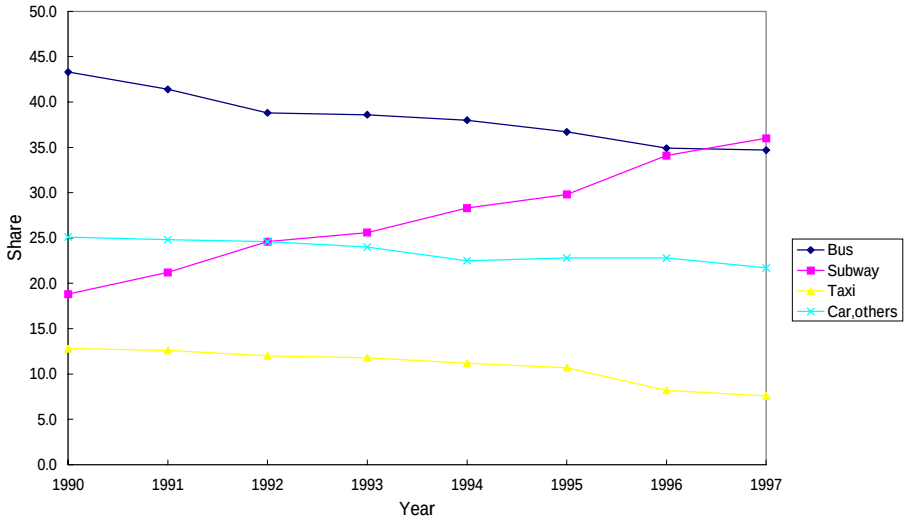
The project's effects and impacts obtained through the expansion of the subway network are listed below.

(1) Effects and impacts on road transportation

① Reduction in the number of bus and car users (increase in the number of subway users)

As indicated in Figure 3, the number of subway users has been increasing in recent years.

Figure 1　　Movements in Share of Each Seoul City Transportation Mode



Source: Seoul Metropolitan Government "Current Status of Seoul Municipal Government 1998"

As shown in Figure 1, the subway transportation ratio is rising every year, and in 1997 it exceeded the bus transportation ratio. This report does not include intraday transportation ratio statistics, but according to a survey among passengers performed by SMSC, morning and evening office commuters and school commuters are steadily increasing, which is contributing to the increase in the overall number of subway passengers.

This trend is due in part to the fact that people who used to ride buses or their own cars to go to work or to school have switched to the subway as the subway network has expanded. Moreover, the subway network is not only used for transportation inside Seoul City proper, but is also used by work and school commuters from surrounding areas to Seoul City. As a result, this network enables the expansion of the metropolitan area and is believed to promote the development of surrounding areas.

② Streamlining of bus routes

Following the start of operation of the subway, the number of bus lines in the city has diminished, whereas it has been increasing in the suburbs. This is due to the fact that in the city, the subway network, which has grown much more dense, has gradually replaced bus lines, with bus lines that are redundant with subway lines being eliminated, whereas in the suburbs, new bus lines have been established in order to get to and from subway stations. The number of buses in the city center and the bus line density accounted in part for the congestion, and the elimination of bus lines due to the construction of new subway lines has alleviated congestion in the city center.

Table 16 Movements in Number of Cars and Car Traffic Speed in Seoul City

Year/Item	1992	1993	1994	1995	1996	1997
Number of registered cars	1,563	1,750	1,945	2,043	2,168	2,249
Car traffic speed (km/h)	19.28	19.97	20.04	18.25	16.44	16.85

Source: Seoul Metropolitan Government "Current Status of Seoul Municipal Government 1998"

As a result of the above factors, the number of cars running on roads has declined in relative terms although the number of registered cars has increased, and bus lines have been eliminated. Therefore, the worst of traffic congestion is believed to have been avoided (Table 16). If no new subway lines had been constructed, road congestion would have been exacerbated due to a larger number of cars, and thus the construction of new subway lines and the expansion of existing ones is believed to definitely have contributed to relieving traffic congestion.

(2) Promotion of development of commercial and residential areas along subway lines

A look at the relationship between the expansion of urban centers and the expansion of the subway network and the national railway network shows the existence of a phenomenon as follows: as the city expands, transportation demand vis-a-vis railway is absorbed, the city expands because there are means of access via railway.

Access from suburbs to Seoul city, which used to be difficult for office and school commuters, has become possible via the subway and the national railway metropolitan network directly linked to the subway. Thus transportation to and from Seoul has grown by 10 times in 5 years, from 2,404 persons in 1990 to 26,400 persons in 1995, and this project's effects and impact can be also proved by the fact that nearly all the area designated as development areas by Seoul city are areas near subway stations or subway lines.

Furthermore, from the viewpoint of measuring the effects specific to this project, we have attempted to study the effects and impact of subway construction as seen through increases in tax revenues along the lines that were constructed by this project. While tax increase cannot be attributed solely to the construction of subways, the creation of additional stations provides more convenient access to people, it promotes development, it stimulates economic activity, and thus is believed to contribute to a greater or lesser extent to an increase in tax revenues. Table 17 shows a comparison of local tax revenues in the Seoul Metropolitan Area.

Table 17 Comparison of Tax Revenues Increase in Areas around Subway Stations

District name	Rough land area (km^2)	1990		1996	
		Local tax revenues	Number of stations	Local tax revenues	Number of stations
Songbuku-gu	25	39,314	1	111,455 (2.83 times)	3 (+2)
Yongdungp'o-gu	25	116,210	6	281,377 (2.42 times)	12 (+6)
Kangso-gu	40	42,139	0	169,275 (4.02 times)	9 (+9)
Kangnam-gu	40	199,142	6	679,548 (3.41 times)	14 (+8)

Source: Prepared from Seoul Statistical Yearbook 1991, 1997
The number of stations is the total number of subway stations and national railway stations connected to subway stations. Moreover, the increase in the number of stations (in parentheses in gray areas) corresponds to the lines that were built in this project.

From the above table, in districts with the same area, districts that have more subway stations bring in more tax revenues, which suggests that there is more economic activity in these areas. Moreover, all the districts which had new subway stations constructed between 1990 and 1996 have seen their tax revenues increase, and districts that had a greater number of subway stations built saw the largest increases in tax revenues.

(3) Air pollution, reduction of traffic accidents

As shown in Table 18 below, SO_2, CO, and NO_2, which are pollution indices, have been lower than the environmental measured value standard in Seoul since 1990. Considering the increase in the number of cars, the fact that these improved values is appreciable, and is thought to reflect the contribution of subway use in reducing the use of cars and air pollution. The same trend is observed for car accidents.

If no subway had been constructed, the current approximately 4.51 million subway users would be using buses and cars, which would result in a tremendous congestion problem as well as air pollution, and an increase in traffic accidents.

Table 18 Changes of Air Pollution Indices

Item	SO_2 (ppm/day)	CO (ppm/8 hour)	NO_2 (ppm/day)	Dust (μ g/m/day)
Environmental standard	0.03	9	0.05	150
1991	0.043	2.8	0.033	121
1992	0.035	1.9	0.031	97
1993	0.023	1.5	0.032	88
1994	0.019	1.5	0.032	78
1995	0.017	1.3	0.032	85
1996	0.013	1.2	0.033	85

Source: Seoul Statistical Yearbook, 1997

Table 19 Changes of Number of Traffic Accidents

Year	1991	1992	1993	1994	1995	1996
Number of traffic accidents	56,528	51,333	49,422	46,479	42,100	46,031

Source: Seoul Statistical Yearbook, 1997

(4) Securing means of transportation for transportation-impaired persons (aged persons, children, women, etc.)

Prior to the construction of the subway, transportation-impaired persons (aged persons, children, women, etc.) not having access to car transportation had no alternative but to use the bus. Bus riders who depend on buses that do not necessarily respect bus schedules to the vagaries of traffic, cannot ensure arrival to their destination on time, and also suffer the inconvenience due to difficulties in finding the desired bus and is time-consuming in the case of large bus stop stations where many buses stop. All these problems were solved with the completion of subway lines. Subways have provided an accurate, rapid means of locomotion for general users as well as for transportation-impaired users, the merit being particularly important for the latter group.

(5) Effects and impacts of technology transfers (Development of railroad-related industries)

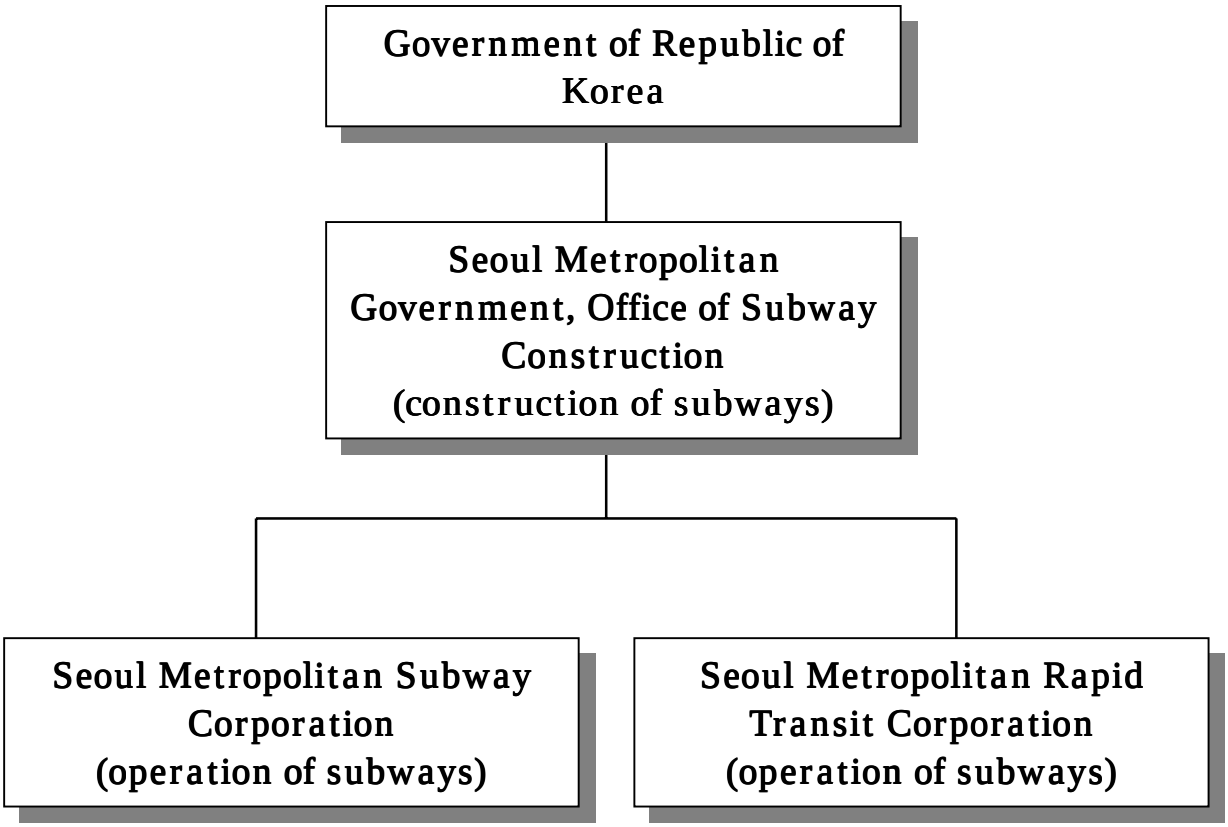
Subway construction and management operations differs from general civil engineering work and machine manufacturing, and consists of major integrated projects involving various technologies such as civil engineering works, materials, electricity, and signal and communications equipment manufacturing. In particular, 608 subway cars of the latest model were purchased as part of this project, with bodies made of stainless steel, and equipped with inverter control equipment and AC main motor. The total number of these cars were manufactured by a J/V of overseas and domestic makers, and domestic subway cars manufacturer raised the level of subway car manufacturing technology for this project. Based on delivery result to the Seoul Subway, acquiring manufacturing technology and know-how, they thereafter went into market in Indonesia, Malaysia, the Philippines, etc. This is a conspicuous example of the technology transfer results of this project.

3. Lessons Learned

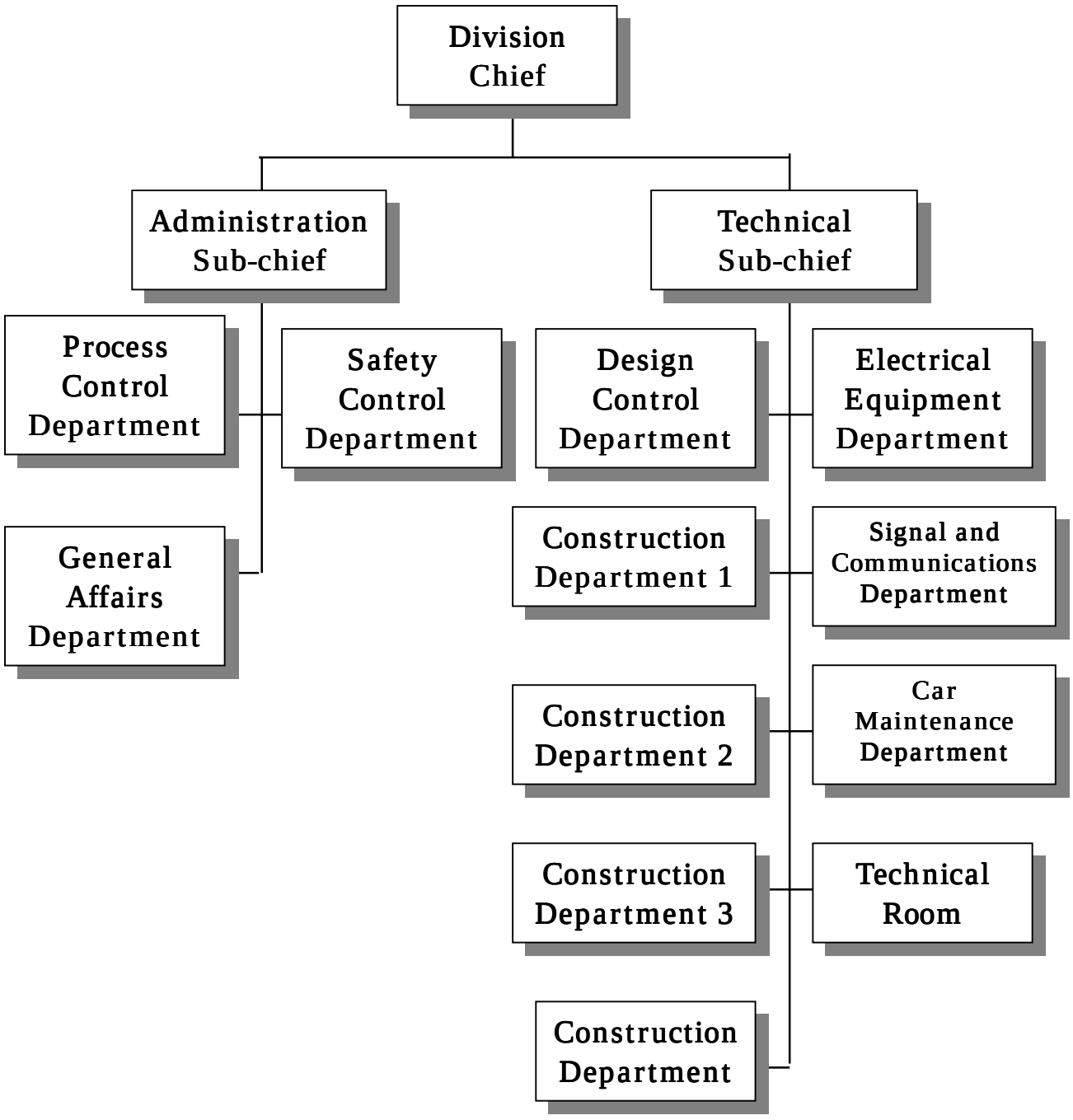
In order to avoid unnecessary project cost increase, the executing agency should strictly set and control the implementation schedule.

In projects that involve large-scale civil engineering works, delays in commencement of construction and extensions of the implementation schedule cause not only delays, but also increases in project costs. Based on this, the executing agency should avoid crash construction and careless construction and deliveries, and make the speed of project implementation its first priority, strictly enforcing the implementation schedule setting and management.

Organization Chart of Seoul Subway Related Organs



Office of Subway Construction, Organization Chart



① An exit of a Line Five station

② A gate of a Line Five station

③ A train of a Line Five passing a railroad bridge