

2016/17 KSP Policy Consultation III : Support for the Development of Sustainable Operation and Maintenance of Urban Railway in Ho Chi Minh City, VietNam : Phase II



2016/17 KSP Policy Consultation III

Project Title	Support for the Development of Sustainable Operation and Maintenance of Urban Railway in Ho Chi Minh City, VietNam : Phase II
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Summary

I . Project Overview	1
1. Project Objective & Scope	1
2. Scope of the Project	3
3. Direction of the Project and Major Contents	4
4. Expected Results	6
II . Political, Economic and Social Trends in Vietnam	7
1. General Status	7
2. Political & Social Trends	8
3. Economic Trends	11
4. International Credit Ratings and the Relationship with Korea	14
5. Major Features	15
III. Transportation and Urban railway Status of HCMC	18
1. General Status of HCMC	18
2. Transportation Status of HCMC	21
3. HCMC Metro O&M Status	31
IV. Preliminary Study on HCMC Metro Operation Management and Preparation	33
1. Special Assistance for Project Implementation (SAPI) for HCMC Urban Mass Rapid Transit (UMRT) Line 1, Eastern Section (2009)	33
2. Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban railway in HCMC(2013)	37
3. SAPI for Ho Chi Minh City Urban railway Construction Project (2016)	43
V. Analysis of urban railway system O&M in Korea [focused on needs] ...	48
1. Analysis of the Vietnamese needs	48
2. Urban Railway-Related Laws in Korea	49
3. Urban railway Driver's License System in Korea	53
4. Railroad Safety Approval System in Korea	62
5. Organization and Job Description of Seoul Metro	67
6. Preparations to start operation in Korea and examples	77

VI. Review of Other Case Studies in Korea	96
1. O&M-related Regulations	96
2. Integrated Fare System in Seoul	100
3. Urban railway Disaster Prevention System	106
4. Process of Working Adjacent to Metro Area	112
VII. Policy Recommendation	116
1. Proposal of Urban railway O&M-related regulations	117
2. Proposal of modifying the railroad safety laws and RAMS	120
3. Need for defining the roles of HCMC Metro-related agencies	123
4. Driver's license test system and strengthening driver's capacity	126
5. Proposal of introducing Shadow Operator	128
6. Recommendation to Urban Railway Transit's Integrated Test-Run	132
7. Proposal of additional considerations	133
VIII. Conclusion	135

List of Tables

Table 1. Project Objective	2
Table 2. Detailed contents necessary for HCMC Metro O&M	6
Table 3. General Status of Vietnam	7
Table 4. The Main Economic Indicators of Vietnam	11
Table 5. Trade of Korea to Vietnam	15
Table 6. Foreign Direct Investment Inflows	16
Table 7. Commute Scenery in HCMC	22
Table 8. Transportation Planning in Vietnam	23
Table 9. Current Status of Personnel and Vehicle Holdings	26
Table 10. Annual Operating Status	27
Table 11. Long-term Development Plan for Vietnam Railway	28
Table 12. Vietnam Railway Development Plan for 2001 ~ 2010	29
Table 13. Vietnam Railway Development Plan for 2010 ~ 2020	29
Table 14. Development plan for Vietnam railroad 2010~2020	30
Table 15. MAUR status	31
Table 16. Details of support for establishing an implementation organization for operation and maintenance	35
Table 17. Summary of Work Roadmap	36
Table 18. Summary of detailed work plan by organization	36
Table 19. Summary of seminars and consultation	37
Table 20. Summary of task results in the area of administrative management and safety management	39
Table 21. Summary of task results in the area of human resources	40
Table 22. Summary of task results in the area of finance	41
Table 23. Summary of task results in the area of sales	42
Table 24. Progress of operator establishment and registration (as of March 2016)	43
Table 25. Summary of the results of support for urban railway operator establishment and management	45
Table 26. Summary of the results of support for survey on operator regulatory agencies and research	45
Table 27. Summary of the results of support for strengthening capacity of an operator's employees	46
Table 28. Summary of the results of support for TC2 preparation	47
Table 29. Requirements for HCMC Metro O&M	48
Table 30. Railroad-related laws	50

Table 31. Type of license and the vehicles	53
Table 32. Process to obtain the driver's license of railway vehicle	54
Table 33. Selection of trainees by institution	56
Table 34. Training curriculum and course for class 2 electric locomotive license	57
Table 35. Training curriculum and course for class 2 electric locomotive license	57
Table 36. Test subjects for class 2 electric car license	58
Table 37. Procedure to Obtain Rolling Stock Driver's License in Japan	59
Table 38. Subject and Schedule for Rolling Stock Driver's License (JR, Japan)	60
Table 39. Rolling Stock Driver's License System in the U.S.	61
Table 40. Rolling Stock driver's license system in the U.K.	62
Table 41. Railroad SMS program	65
Table 42. Train operation program	65
Table 43. Maintenance program	66
Table 44. Tokyo Metro Organization	73
Table 45. Organization of Bureau of Transportation, Tokyo Metropolitan Government	73
Table 46. Organization of Transportation Bureau, City of Yokohama	74
Table 47. Transportation Bureau, City of Nagoya	74
Table 48. Organization of Osaka Municipal Transportation Bureau	75
Table 49. Organization of Transportation Bureau, City of Yokohama	75
Table 50. Job Description of O&M Organization	76
Table 51. Applicable laws and regulations	77
Table 52. Guideline for Integrated T&C	79
Table 53. Method by stage	82
Table 54. Responsibilities for T&C and take-over procedure by stage	84
Table 55. Project summary	85
Table 56. Manpower mobilization plan	88
Table 57. Recruitment (subsidiary)-Open competition	89
Table 58. Curriculum	90
Table 59. Stage of preparation for incidental business	91
Table 60. Project approval procedure	91
Table 61. Major legal approval requirements	91
Table 62. Approval of railroad safety management system	92
Table 63. Task force/support organization (for stable approval process)	92
Table 64. Facility inspection, performance inspection, integrated test run	93

Table 65. Major tasks	93
Table 66. Major Task Performed by Each procedure	94
Table 67. Rolling stock and inspection facility handover procedure	95
Table 68. Rolling stock and inspection facility handover inspection	95
Table 69. Components of Company Regulation	98
Table 70. Composition & Contents of O&M-related Regulations	98
Table 71. Cause of Declined Competitiveness of Bus	102
Table 72. Station Safety System	107
Table 73. Tunnel Safety System	109
Table 74. Onboard Safety System	110
Table 75. Establishment of VOF system	111
Table 76. Improvement of Emergency Response Manual	112
Table 77. Classification and Consultation & Management	113
Table 78. Summary of National Technical Standard for Urban Railway O&M in Vietnam	117
Table 79. Comparison of railway enforcement decree of Korea and Vietnam	118
Table 80. Korea's Railroad related Laws and Regulations	119
Table 81. Supplement of Railroad Safety Act	120
Table 82. RAMS summary	121
Table 83. Cases of RAMS (domestic/foreign)	123
Table 84. Pre-Operation Procedure by Urban Railway Operator in Korea	124
Table 85. Pre-operation Procedure of Central & Local Government in Korea	125
Table 86. Procedure for Obtaining Rolling Stock Driver's License	126
Table 87. Training Program for the Drivers in Foreign Countries	127
Table 88. Shadow Operator's work scope by stage	129
Table 89. Cases of Shadow Operator worldwide	130
Table 90. Comparison between Jakarta project and HCMC	130
Table 91. Area Requiring Additional Study (Maintenance)	133
Table 92. Area Requiring Additional Study (Integrated Fare)	134
Table 93. Area Requiring Additional Study (Office IT system)	134

List of Figures

Figure 1. Trend of Economic Growth	13
Figure 2. HCMC Whole Map	18
Figure 3. The Organization Chart of Vietnam Railway Corporation	26
Figure 4. Organization Chart of MAUR	32
Figure 5. MAUR Project Operation System (HCMC Line 1) and Decision Making Structure	32
Figure 6. Legal system in Korea	49
Figure 7. Structure of Urban Railroad Act	51
Figure 8. Structure of Railroad Safety Act	52
Figure 9. Configuration of Railroad Safety Management System	63
Figure 10. Railroad Safety Management System-Related Regulations	64
Figure 11. Railroad Safety Management System-Approval & Change Procedure	66
Figure 12. Organization of Seoul Metro	67
Figure 13. Urban railway Operation Procedure	79
Figure 14. Metro Line 7 Extension	80
Figure 15. Test Run and Facility Handover Procedure	81
Figure 16. Process by Each Stage	83
Figure 17. Project Structure	86
Figure 18. Push Forward Strategy for Gimpo LRT	87
Figure 19. Project structure	87
Figure 20. Operation Preparation Roadmap	88
Figure 21. Handover Procedure and Schedule	94
Figure 22. Position of O&M-related Regulations	96
Figure 23. Establishment/Revision Procedure of Company Regulation	97
Figure 24. General Information of the Metropolitan Area	101
Figure 25. Transportation Means	101
Figure 26. Integrated Fare System Application Procedure	103
Figure 27. Fare System Reconfiguration History	105
Figure 28. Transfer Passenger and Satisfaction with Public Transportation	106
Figure 29. Work Process of Neighboring Excavation	114
Figure 30. Policy issues roadmap	116
Figure 31. O&M-related Regulations	119
Figure 32. RAMS Standards	122
Figure 33. Shadow Operator stage	129
Figure 34. Seoul Metro Line 9 CAPEX OPEX cost comparison	131
Figure 35. 5-stage integrated test-run	132

List of Abbreviations

ADB	Asian Development Bank
ATC	Automatic Train Control
ATS	Automatic Train Stop
EC	European Commission
EDCF	Economic Development Cooperation Fund
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GII	Global Innovation Index
HSE	The Health and Safety Executive
HSR	High Speed Rail
HURC1	Ho Chi Minh City Urban Railways No.1 Company Limited
IoT	Internet of Things
JICA	Japan International Cooperation Agency
KSCC	Korea Smart Card Company
KSP	Knowledge Sharing Program
MAUR	Management Authority of Urban Railways
MIS	Management Information System
MOLIT	Ministry of Land, Infrastructure, and Transport
MOT	Ministry of Transport
ODA	Official Development Assistance
O&M	Operation & Maintenance
PHA	Preliminary Hazard Analysis
PPP	Public Private Partnership
PU	Preparation Unit
PUC	Preparation Unit for Setting up the O&M Company
RAMS	Reliability, Availability, Maintainability and Safety
SAPI	Special Assistance for Project Implementation
SBV	State Bank of Vietnam
SMS	Safety Management System
SOC	Social Overhead Capital
TA	Technical Assistance
UMRT	Urban Mass Rapid Transit
UN	United Nations
USN	Ubiquitous Sensor Network
WB	World Bank

Summary

o Ho Chi Minh City (hereinafter referred to as “HCMC”) is the largest city as an economic and commercial hub of Vietnam with about 9 million inhabitants. Recently, there have been serious social problems such as traffic congestion, stagnation and environmental pollution due to the rapid increase of ground transportation and continuous population increase because of urbanization, increasing social and economic losses. The Government of Vietnam and HCMC announced a 2020 public transportation master plan in April 2013 in response to the rapidly growing demand for transportation infrastructure facilities and to reduce such social and economic losses. According to this plan, HCMC plans to build six urban railways, one tramway, and two monorail routes. Of the total nine routes, Line 1 is under construction by Japanese financial resources, and the other lines are currently in the feasibility survey, investor recruitment, and planning stage.

o To support efficient operation and maintenance of the HCMC Metro through the Knowledge Sharing Program (“KSP”) consulting project, Seoul Metro Consortium has analyzed the current state of the HCMC Metro and its operation preparation, and studied the operation and management experience and know-how of Korea, and presented cases applicable to HCMC. In addition, working-level staff members of Vietnam were invited to Korea to provide them the opportunity to participate in theoretical lectures and field training sessions to strengthen their ability. On-the-job training and seminars were also held in Vietnam by dispatching metro expert. The final dissemination seminar was held on site to present the final output of HCMC Metro operation and maintenance.

o This report presents five major issues including the legal and regulatory affairs, safety management, roles of organizations involved in the urban railway operation and maintenance, engineer training, and preparation for opening. This report also shows six case studies on urban railway O&M related laws, the engine driver license system and the railway safety approval system, as well as the integrated fare system, the status of the urban railway disaster prevention system, and procedures of adjacent excavation work.

o Considering the major issues of the project, the five policy recommendations are are: First, legal and regulatory arrangement; second, improvement of safety-related laws and introduction of RAMS; third, clarification of the roles of HCMC Metro organizations; fourth, the need to have high-quality engineers; fifth, introduction of a shadow operator which could help the HCMC Metro for opening and operation preparation.

o In addition, suggestions on maintenance, an integrated fare system and an office IT system are introduced for efficient O&M of the HCMC Metro.

o It is not easy for Vietnam Government to implement an effective and a successful Metro operation management at once without any previous Metro operation experience. Since, the scope of Metro operation management is very extensive, and it is not only limited to theories, but there is also a part achieved through actual practice. However, based on the conclusion and recommendation of this report, if the active will of an actual support by the Vietnamese government and related organizations are accompanied, an effective operation and management policy for Line 1 and subsequent lines shall be settled. Moreover, this will also link to follow-up projects such as Metro operation consulting and HCMC Metro operation projects. Based on HCMC's safe and effective Metro operation, it will contribute to the strengthening HCMC's competitiveness. Furthermore, it will contribute to economic development of HCMC.

I . Project Overview

1. Project Objective & Scope

A. Background

- o Korea was a beneficiary country in the past but it serves as a donor country with a rapid economic growth. The Ministry of Strategy and Finance (“MOSF”) is taking the lead in providing the developing countries with policy advice and consulting service through the KSP.
- o HCMC, the largest city in Vietnam, is an economic center and business hub with a population of about 9 million citizens. Recently, the city has faced serious social issues such as population migration from a rural area, traffic congestion, and environmental pollution caused by the rapid increase of ground transportation. Such issues have emerged as serious obstacles to sustainable development.
- o Confronting these issues, HCMC and the Vietnamese government announced the Master Plan 2020 in April 2013 to improve public transportation and expand transportation infrastructure. According to the plan, the city will build six metro lines, one tram line, and two monorail lines.
- o Metro Line 1, which began construction on February 21, 2008, is 19.7 km with 14 stations in total. The underground section is 17.1 km with 11 stations and the above ground section is 2.6 km long with 3 stations. The ground section on the east side of the Saigon River began construction in August 2012. It was scheduled to commence operations by 2018 in the original 2007 plan but it is now expected to operate in 2020 due to delay.
- o Management Authority of Urban Railways (“MAUR”) of HCMC was established on September 13, 2007 as a public agency by the Decision No. 119 under the People’s

Committee of the city to supervise and control the metro construction plan. The People's Committee has also established the Ho Chi Minh City Urban Railways No.1 Company Limited ("HURC1") on December 2, 2015, by Decision No. 6339. HURC1 will oversee operation and maintenance ("O&M") of the Metro Line 1.

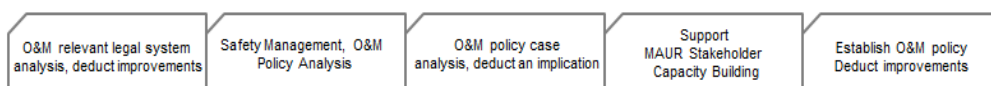
- o The Korean government will support the HCMC through the KSP consulting program for the city to operate and manage the metro system efficiently and to minimize trial and error. The project aims to share Korea's forty years of successful experience in metro O&M and to ultimately contribute to the economic and social development of Vietnam.

B. Objectives of the Project

- o The objective of the project is to support HCMC to develop a sustainable HCMC Metro O&M system through analyzing the current HCMC Metro management and to share Korea's successful experiences. HCMC will be able to secure more efficient and safe Metro O&M system and achieve sustainable urban development with the implementation of this Project.

Table 1 | Project Objective

Project Name	o Support for the Development of Sustainable Operation and Maintenance (O&M) of Urban railway in Ho Chi Minh City, Vietnam: Phase II
Implementing Agency	o Republic of Korea Ministry of Strategy and Finance
Project Characteristic	o Knowledge Sharing Program (KSP)
Project Objective	Through sharing Korea's successful Metro operation management experience and know-how, support establishment of sustainable Metro operation management system in Ho Chi Minh City. This way, Ho Chi Minh City can possess more efficient and safe Metro Operation management system and support Ho Chi Minh City to become sustainable city development.



Support O&M policy establishment & capacity building of MAUR in order to strengthen Ho Chi Min City's competitiveness by safe operation of Metro.

- o The purpose of this project includes legal and regulatory analysis of metro O&M, improvement plans, analysis of safety management and O&M policies, case study of O&M policy, support for capacity building for Management Authority of Urban Railways (MAUR) staffs, derivation of O&M policy improvement plans, and support for establishing an O&M policy of HCMC Metro to upgrade the competitiveness of HCMC through safe operation of urban railway.

2. Scope of the Project

- o The project was carried out from March 8 until July 31, 2017, for about 5 months and the work scope was categorized into 5 areas described as below.

1) Current Status Analysis

- o This task covers the status analysis of the HCMC Metro and it is aimed to analyze laws and planning for HCMC Metro O&M.
 - Analysis of regulations on Vietnamese Metro O&M and scope of responsibility among government agencies
 - Analysis of laws and regulations on the establishment of HURC1 & current status
 - Precedent study on HCMC metro operation and maintenance and review of preparation status
 - Review of the HCMC Metro O&M plan

2) Korean Case Studies

- o This task deals with introducing the best Korean Metro O&M Cases
 - Laws and regulations & government support system pertaining to Korea's Metro
 - Review of an operator structure and management system
 - Preparation for the opening by stage and manpower planning, Metro O&M planning at their fields
 - Analysis of metro driver's license system and driver's training system
 - Analysis of safety management codes & countermeasures for disaster management
 - Review of other Korean cases (Seoul's integrated fare system, life safety system, adjacent excavation, etc.)

3) Capacity Building Training

- o It aims to strengthen the capacity of the working-level staffs at MAUR by providing

theoretical education and on-site training sessions.

- Lectures on the process of excavation work adjacent to the metro area
- Lectures on public transportation pricing systems in Seoul
- Lectures on comprehensive test operation procedures
- Lectures on the status of disaster prevention system of Seoul Metro
- Lectures on comparison of Korea-Vietnam railroad driver's license system
- Visit stations for job experience
- Visit training in response to station submersion
- Experience in driving simulator
- Visit WOOJIN's vehicle manufacturing plant and wireless tram

4) Policy Recommendations

- o Seoul Metro Consortium will propose effective alternatives for Metro O&M and safety management and recommend policies for establishing efficient management plan of the Metro O&M Company under the HCMC.
 - Preparation guidelines at each stage for the Metro opening
 - Improvement of HCMC metro-related laws
 - Establishment of roles between metro-related agencies
 - Metro O&M organization and personnel deployment and training plan including driver
 - Proposal for the areas requiring additional study including integrated fare system and Office IT system

5) Final Dissemination Seminar

- o Seoul Metro Consortium will hold the final dissemination seminar with relevant stakeholders of Vietnam and discuss the implementation of follow-up projects.

3. Direction of the Project and Major Contents

A. Strategic direction of the project

1) In-depth Diagnosis of Current Status

- o Since Seoul Metro has successfully implemented the KSP project for the HCMC Metro in 2016, Seoul Metro possesses latest updates of Vietnam. Seoul Metro will find specific

needs on the project by establishing a network with the relevant institutions and HURC1.

- o By analysing the JICA report and diagnosing the current situation of HCMC Metro, the Seoul Metro Consortium will try to find ways to maximize the effect of the project.

2) Conduct an interactive work with beneficiaries

- o Seoul Metro Consortium will cooperate with MAUR and other relevant agencies to organize seminars and OJTs to strengthen the capacity of all parties

3) Strategic input of experts to develop follow-up KSP projects

- o The Seoul Metro Consortium will establish an O&M plan applicable to HCMC by mobilizing O&M experts and other infrastructure maintenance experts with experience in 4 urban railway projects in Korea including Seoul Metro Line 9 and UI TRANS LRT.

B. Major Scope of the Project

- o The Seoul Metro Consortium made efforts to establish the HCMC metro O&M support plan and held expert seminars from the beginning of the project for MAUR was keen with sharing their specific needs. Improvements for an efficient urban railway O&M that fits HCMC are summarized in the table below.
- o The Seoul Metro Consortium has derived necessary prerequisites to be performed prior to opening the HCMC Line by incorporating the comments from MAUR, which was not dealt in the Technical Assistance from Japan. Based on this, the Seoul Metro Consortium could carry out the tasks by experts with relevant policy making experience and expert knowledge. As a result, the Seoul Metro Consortium could propose efficient HCMC metro O&M policies.
- o To that end, the Consortium carried out project preparation, site investigation, training for working-level staffs and policy consultation on a step-by-step basis, ensuring the project consistency and reliability through a perfect project management including schedule management, personnel management, and quality management.

Table 2 | Detailed contents necessary for HCMC Metro O&M

Classification	Description
Establishment of legal system related to Metro O&M	• Status and legal system of urban railway-related laws & regulations of Korea - O&M regulations based on applicable laws - Legal system, urban railway laws, and railroad safety law
Locomotive engine driver's license system and driver training	• Case study of foreign railway vehicle driver's license system and process analysis - Figure out cases of driver's license system applicable to HCMC Metro
Railway safety approval system	• Railroad operation and facility safety approval system - Railroad SMS, train operation, O&M program, and RAMS
O&M organization structure and job description	• Examples of O&M organizations and job description of Seoul Metro and Japanese operators - Organization of railroad operators and responsibilities
Opening service preparation and T&C	• Laws related to opening service and operation process - Case study of Seoul Metro Line 7 extension and Gimpo LRT - T&C process

Source: Agreement between Seoul Metro consortium-MAUR

4. Expected Results

- o Based on the status analysis of HCMC Metro and capacity building training for O&M agencies and officials, Seoul Metro Consortium will systematically deliver advanced Metro O&M experiences and know-how of Korea.
- o The Seoul Metro Consortium will present a basic plan required for a systematic opening preparation of the HCMC Metro by applying Korean examples. Capacity building workshop was held to minimize trial and error, to transfer successful operation technology to Vietnam, and to accomplish MAUR's internal capacity building.
- o From a long-term perspective, the Seoul Metro Consortium will contribute to Vietnam's economic development by sharing Korea's metro O&M experience and knowledge and to ultimately prepare the ground for Korean ventures' entry into the O&M sector in Vietnam.

II. Political, Economic and Social Trends in Vietnam

1. General Status

A. General Status of Vietnam

Table 3 | General Status of Vietnam

Classification	Contents
Country Name	• The Socialist Republic of Vietnam
Location	• East Indochina Peninsula
Population	• 92.7 million (end of 2016, Statistical Bureau of Vietnam)
Capital	• Hanoi
Area	• 330,958km ² (about 1.5 times of Korean Peninsula)
Political Regime	• Socialist Republic
Ethnic Groups	• Viet (Kinh, 85.7%), Thai, Overseas Chinese (about 820,000), etc.
Language	• Vietnamese
National Foundation Day	• September 2, 1945
Administrative Districts	• consist of 5 direct-centrally governed municipalities and 58 provinces
Diplomatic Relations	• diplomatic relations with 176 countries (trade in 200 countries, about 80 countries invested in Vietnam)
Diplomatic Relations with Korea	• December 22, 1992

Source: Vietnam, Country Info., Overseas Business Information Portal, KOTRA, 2017,

- o Vietnam is in the eastern part of the Indochina Peninsula and adjoins China, Laos, and Cambodia. In the north-south direction, the maximum length is 1,700 km and the maximum width between east and west is 550 km in the north and 340 km in the south. It is bordered by China to the north, Laos, and Cambodia to the west. Its capital city is Hanoi, and it has 63 administrative districts (58 provinces and 5 special municipalities: Ho Chi Minh, Hanoi, Haiphong, Danang and Can Tho).
- o Hanoi, the capital city of Vietnam, is in the northern part of Vietnam and Ho Chi Minh (formerly Saigon), the largest city in Vietnam, is situated in the south. Vietnam was divided due to the Vietnam War (1954~1975, a long war in the mid-20th century). Vietnam was divided into two parts, North Vietnam (known as the Democratic Republic of Vietnam) and South Vietnam (known as the Republic of Vietnam). The division was initially attributed to military reasons but political reasons later. Vietnam has unified again in April 1975 and the Socialist Republic of Vietnam was established in July 1976.
- o Vietnam consists of 3 major axes: party, parliament, and government. The Communist Party is the only power that leads the nation and society and the Politburo of the Communist Party decides the main policies. The National Assembly is the highest constitutional authority and the government is a central administrative body. The members of the National Assembly are elected as the five-year tenure of office. The central government is composed of the chairman (the prime minister), the vice chairman and the ministers. They are elected by the National Assembly and their term will follow the term of the National Assembly. The president, the leader of Vietnam, is also elected by the National Assembly. He represents Vietnam internally and externally for a term of five years and serves as the chairman of the National Defence and Safety Council.
- o Vietnam has a centralized economic system based largely on agriculture. After Vietnam declared openness to the outside world according to the Doi Moi policy in 1986, its economic system has been shifting to a market economy to promote an economic reform. The export shares of agriculture products (rice and coffee, etc.), textiles and apparel products are high.

2. Political & Social Trends

A. Political Trends

1) The Stable Operation Regime by Vietnamese Communist Party

- o Vietnam has a collective leadership system that seeks appropriate mutual control and

balance among the General Secretary of the Communist Party of Vietnam (1st ranking), President of the Socialist Republic of Vietnam (2nd ranking), Chairman of National Assembly (3rd ranking) and Prime Minister (4th ranking).

- o On January 20 to 28, 2016, the 12th National Congress of the Communist Party of Vietnam attracted attention as an event to elect political leaders who will lead Vietnam's next government (2016~2020). Nguyễn Phú Trọng, a moderate, was remained as General Secretary of the Communist Party of Vietnam and the reformist Trần Đại Quang was elected as President of the Socialist Republic of Vietnam. Nguyễn Xuân Phúc was elected as Prime Minister. Also, Nguyễn Thị Kim Ngân was elected as Chairman of National Assembly.
- o Some conflicts can arise between reformers and conservatives in the party, but there is no problem with maintaining the regime. It is expected that political stability will continue for a considerable period because the opposition against the system of the Communist Party is socially weak.

2) Utilitarian Policy Basis

- o Vietnam won the long war with France and the United States and defended its independence. Vietnam was supported by socialist countries such as China and the Soviet Union during the war, but later it has strengthened the practical policy while experiencing the war with China and the collapse of the Soviet Union.
- o After the reunification, Vietnam focused on stabilizing the system through the recovery of the national economy and forming a close relationship with various countries. To achieve this, Vietnam has strived for economic development rather than socialist ideology and has established diplomatic policies that continue to expand economic cooperation by forming friendly relations with other countries which have different ideologies.
- o By the end of the 1970s, Vietnam had been actively seeking to improve the relations with United Nations (UN), major Western nations and international aid organizations including Asian Development Bank (ADB) and the World Bank (WB).
- o On the other hand, the relation with the United States is improving better as a whole except the human rights issue. Vietnam is on the line of socialist pragmatism with the possibility of deteriorating relations with China due to the territorial disputes in the South China Sea (East Sea of Vietnam).

B. Social Trends

1) Abundant Workforce and Active Female Activity

- o The total population of Vietnam was about 86.93 million in 2010, with a population density of 260 people per square kilometer. The sex ratio of male to female is 98.1 to 100 women, and the phenomenon of a high female to male ratio is gradually reduced, compared to the male-female ratio of 96.7 to 100, 10 years ago. The birth ratio is 18.6 percent and the mortality rate is 5.3 percent. The number of childbirth per childbearing woman is 2.3. The average life expectancy is 71 years for men and 73 years for women. Around 43 percent of the population is concentrated in the Hồng River and the Mekong Delta areas.
- o The population structure of Vietnam is a perfect pyramid with about 43 million young people under the age of 24. It is estimated that abundant and high-quality labor force will supply for economic development in 20 to 30 years. Since 70.4 percent of the whole population lives in rural areas, rural population are expected to rapidly inflow to an urban area in the future.
- o Women are participating very actively in social activities and are taking lots of key positions in Communist Party, the government, and other organizations. As of 2011, women are taking the share of 24.4 percent in the lawmakers of the 13th National Parliament (122 out of 500).

2) Expanding gap among classes and regions as the benefit of economic growth concentrates.

- o In the process of reform and opening, foreign investment is concentrated in the large cities such as Ho Chi Minh, Hanoi, and Haiphong. The benefit of the economic development has been mainly concentrated on the upper class of the large cities. As a result, Vietnam has come to face several social issues including large gap among classes and regions, corruption in party members and bureaucrats, and increasing crimes, etc.
- o Accordingly, the government is making efforts to support rural and minority residential areas that are alienated from the economic development. The government policies include rural development, poverty eradication, ethnic minority care, and crime prevention.

3. Economic Trends

A. Economic Environments

Table 4 | The Main Economic Indicators of Vietnam



Sources: KOTRA (2017). Foreign market news, Economic indicators for each country, KOTRA

- o According to the Global Competitiveness Index of World Economic Forum, the infrastructure of Vietnam only ranks 76th out of 140 countries. Especially, roads (93rd), ports (76th), and aviation (75th) are generally vulnerable. Transportation burden is heavy because of the poor logistics infrastructure.
- o In addition, Vietnam ranked 113th among the 176 countries surveyed in the International Corruption Perceptions Index in 2016. It was higher than India's (79th), China (79th), Indonesia (90th) and Philippines (101st). The prevalent corruption has become a stumbling block to economic growth.

B. Growth Potential

1) Expansion of export by attracting foreign investment

- o The inflow of foreign direct investment was 10.1 billion dollars on yearly average and 1,148 billion dollars in total from 2012 to 2016. According to the Global Innovation Index (GII), Vietnam ranked 29th out of 128 countries in the net foreign capital inflow to GDP. As a result, foreign-invested companies have been increasing the share in the Vietnam's total exports and the share has recorded 71.5 percent in 2016.
- o The foreign investments have mostly concentrated in manufacturing sectors such as mobile phones, electricity, electronics, textiles, etc. Manufacturer products account 75 percent of exports.
- o Foreign investment will also continue in the areas of power generation, roads, railways, water development, etc. These infrastructure investments are expected to reach 170 billion dollars from 2013 to 2020.

2) Secure growth power with abundant and high-quality labor

- o The share of working-age (15–64 years old) population of Vietnam is around 70 percent in 2015 and ranks high among the Asian countries. The number of economically active population is estimated to be around 55 million by the end of 2016. In addition, most people have well received basic education under the socialist system. Capitalist experience in the past South Vietnam is also contributing to the transition of the economic system.
- o Vietnam has a high-quality but low-wage workforce due to its high expenditure on education to GDP. Vietnam is increasing its investment in human development to address low labor productivity and the lack of managerial expertise.

3) Growing domestic market led by younger generation

- o With a population of about 94 million, Vietnam has the 15th largest population in the world and is expected to reach about 100 million by 2025. Currently, about 50 percent of the total population is under 30 years old. About 30 million are the 20s and 30s who are regarded having high consumption propensity. The 40s with high consumption level are also expected to continue to increase.

- o Purchasing power is concentrated among emerging high-income earners and youths in large cities such as Ho Chi Minh and Hanoi. They are the main consumers of high-end products. The favorable condition is forming for consumer market development as the middle class is expected to expand thanks to the high economic growth.

C. Sustainable Economic Growth

1) Economic development will continue with expansion of consumption and investment

- o The Vietnamese economy is an export-oriented economy centered on manufacturing, which is sensitive to the global economic condition. In 2012, Vietnam recorded the lowest in GDP growth since 2000 owing to the aftermath of the global financial crisis and some domestic negative factors. In 2013–14, manufacturing sectors such as electronics and textile industries began to recover as their exports increased and consumer sentiment improved. The foreign direct investment also saw expansion. In 2015, the GDP growth rate recorded 6.68 percent that was the highest growth rate in the past 8 years and exceeded the target rate of 6.2 percent.
- o In 2016, the Vietnamese economy is facing some adverse economic factors including the drought-related slump in the agricultural sector and the drop in international oil prices. However, the economic growth is expected to record 6 percent due to the expansion of private consumption and continuing inflows of foreign direct investment. The average increase of 12.4% in the minimum wage will have effects of boosting the private consumption.

Figure 1 | Trend of Economic Growth



Sources: General Statistics Office of Vietnam, EIU (as of December 2016)

2) Stable consumer price inflation

- o Since raw materials and intermediate goods are mainly imported, the inflation rate is heavily influenced by the international commodity prices and Dong exchange rates. Due to contraction monetary policy and stabilization of international commodity prices since 2012, the inflation rate has continued to decline to around 4 percent in 2014.
- o In 2015, consumer price inflation in Vietnam was 0.63 percent, the lowest level in the last decade thanks to the lower oil prices and raw material prices, and the government's efforts to stabilize the economy. The inflation rate is expected to remain low due to low oil prices in 2016.

4. International Credit Ratings & the Relationship with Korea

A. International Credit Ratings

- o The foreign debt structure of Vietnam is mostly secure. The medium-long term loans comprise around 82 percent of the total debt. Since borrowing from international organizations and foreign government agencies is as high as 25 percent of the total debt, the burden of repayment of principal and interest is not significant.
- o The OECD has maintained its 5th-grade rating since 2009. Moody's upgraded from B2 to B1 in July 2014 and Fitch also raised its rating from B + to BB- in November 2014.

B. Relationship with Korea

- o Korea and Vietnam established formal diplomatic relations and founded the embassies in the capital cities on December 22, 1992. Korea also founded a Consulate General in Ho Chi Minh on November 19, 1993.
- o The trade with Vietnam increased from 37.6 billion dollars in 2015 to 45.2 billion dollars in 2016. The trade balance has been continuing surplus. The trade is expected to increase further as the Korea-Vietnam FTA came into effect in December 2015.

Table 5 | Trade of Korea to Vietnam

Unit: Million Dollars

Classification	2014	2015	2016	Items
Exports	22,333	27,771	32,651	Communication equipment, semiconductor, display and sensors, Cloths, footwear
Imports	7,989	9,805	12,495	
Total	30,322	37,576	45,146	–

Source: Korea International Trade Association (2017), Vietnam's national information, KITA

5. Major Features

A. Major Economic Policies

1) Socio-Economic Development Plan for 2016-2020

- o The Vietnamese government announced the Socio-Economic Development Plan for 2016–2020 in 2016. The plan aims economic growth, economic restructuring, productivity enhancement, safety, welfare and improvement of the quality of life, etc. The targets of 2020 include per capita GDP of 3,200 to 3,500 dollars, the urbanization rate of 38 to 40 percent, the ratio of a worker with vocational training of 65 to 70 percent, and medical insurance participation ratio of 80 percent.

2) Flexible monetary and exchange rate policy

- o The State Bank of Vietnam (SBV) assessed that it has achieved economic growth and inflation stabilization through flexible monetary policies by adjusting its policy rates. To strengthen export competitiveness, the Bank devalued its currency by 1 percent in 2013 and 2014 respectively. During 2015, the Bank also raised exchange rates three times by 3 percent in total. The Bank is actively taking measures including 0.03 percent depreciation in 2016.

B. Trends in Foreign Direct Investment

1) Recent trends of foreign direct investment

- o After 2009, the foreign direct investment to Vietnam had shown stagnant due to the global

economic downturn and domestic economic instability. However, there has been a steady flow of capital inflows since 2011.

Table 6 | Foreign Direct Investment Inflows

Classification	2010	2011	2012	2013	2014	2015	2016 Jan.~Nov.
Number of case	1,237	1,191	1,287	1,530	1,588	2,013	2,240
Amount	19,887	15,619	16,348	22,352	20,231	22,760	18,103

Source: KOTRA (2017), National Information, Vietnam, Investment, Foreign Investment Trend, KOTRA

2) Investment trend by countries, sectors, and regions

- o Korea is the largest investor country in the areas of both total amount of investment and the number of investment from 1988 to November 2016. Korea recorded 51.6 billion dollars of investment, ahead of Japan (\$ 42 billion), Singapore (\$ 38 billion) and Taiwan (\$ 31.3 billion). The total number of investments is 5,656 during the period. As of November 2016, the cumulative shares of investment of Korea, Japan, Singapore, Taiwan, British Virgin Islands, and Hong Kong are respectively 17.6, 14.4, 13, 10.7, 7.3, and 5.7 percent.
- o By sectors, the manufacturing and processing sectors account for the highest portion of the investment. As of June 2016, manufacturing and processing account for 58.3 percent of the total investment amount. Real estate (18.0%), electricity, gas, and water supply (4.3%), construction (3.8%), and hotel service (3.8%) are the following sectors. (Source: Vietnam Foreign Investment Agency)
- o By regions, the southern Vietnam has received 59.2 percent of the total investment as of accumulation by November 2016. In the southern Vietnam, Ho Chi Minh City is the largest recipient region, amounting to 6,655 in the number of case and 44.8 billion dollars in amounts. Investment in the northern region has recently shown a gradual increase due to the strategy of the government to develop the capital city Hanoi, its geographical advantage connected to China, and expansion of Korean investment.

C. Graduation from ODA Recipients

- o The World Bank and the Asian Development Bank announced a plan to suspend ODA to Vietnam in July 2017 and January 2019 respectively. The World Bank upgraded Vietnam

as a middle-low income country and announced a plan to suspend ODA to Vietnam from July 2017. The Asian Development Bank also announced a plan to suspend ODA to Vietnam from January 2019. The ODA has been continuing to decline since the announcements.

- o The amount of ODA that Vietnam had contracted with the WB and the ADB from 2011 to 2015 was about \$ 27.7 billion. However, the actual amount was only 14 billion dollars and so accounted about 50 percent of the contracts. In consequence, the infrastructure construction plan is expected to change.
- o Since most of foreign loans are used for the development of social overhead capital (SOC), the suspension of ODA will activate public-private partnership (PPP) to expand the various infrastructure investment such as transportation, logistics, urban development, and energy, etc.

III. Transportation & Urban Railway Status of HCMC

1. General Status of HCMC

A. General Information

Figure 2 | HCMC Whole Map



Source: World City Research Center, 2014, Ho Chi Minh City, Vietnam, City Profiling

- o HCMC is in the southern part of Vietnam and is about 1,700 km away from the capital, Hanoi. It is about 55 km away from the sea and faces the Saigon River, the tributary of the Dong Nai River.
- o In the latter half of the 17th century, the Vietnamese descending from the border area of China began to pioneer. They had set up the prefectures (huyện) called Gia Định by the Nguyen Dynasty, but natives call it Saigon.
- o The city was occupied by the French in 1859 and rapidly developed into the central city of Cochinchina. In 1950, the Bao Dai regime was established under the auspices of France,

and it has become the capital of South Vietnam since Vietnam was split into North and South in 1954.

- o The PAVN (often referred to as the Việt Minh) led by Ho Chi Minh, who declared independence of the Democratic Republic of Vietnam in Hanoi, led the victory in the battle with France in 1954 and France withdrew from Indochina.
- o In 1975, Vietnam (Socialist Republic of Vietnam) was found with the unification of North Vietnam. Saigon was renamed HCMC by merging the satellite cities, Saigon, Cho Lon, and Gia Dinh in 1976.
- o This was to honor Ho Chi Minh, who is the founder of the Communist Party of Vietnam, a revolutionary who greatly contributed to the national liberation from the French colonial rule and the best national leader of modern Vietnam.

B. Census of HCMC

- o It is the most populated city in Vietnam and has the highest population density. 8.6% of Vietnam's total population resides in HCMC. As of 2016, the urbanization rate in Vietnam is about 34.7 percent, and about 25.2% of the total urban population (33,121,400) lives in Ho Chi Minh City.
- o HCMC's annual population growth rate is about 2.5% for the last three years. This is more than twice the overall population growth rate in Vietnam, which is about 1%. Since 1995, while the population growth rate in Vietnam has decreased from 2% to 1%, the population of HCMC has increased by up to 5% and its population growth rate remains to be over 2.5%.

C. Economic Status of HCMC

- o Vietnam's economic growth rate was 6.21% in the 1st half of 7 . Meanwhile, HCMC's economic growth rate was 7.76%, which is higher than other cities.
- o HCMC is playing a leading role in Vietnam's economic growth with its favorable location, relatively good infrastructure and concentration of foreign investment. In addition, to create jobs, the government is aggressively implementing policies such as attracting foreign investment in free trade zones, being focused on fostering IT and electronics industry and abolishing unnecessary corporate regulations & audits. Looking at the

industrial structure of HCMC through the number of industries registered in HCMC in 2017, the service sector accounts for the largest portion.

- HCMC's total industrial output (471,647.7 billion VND) accounts for 23% of Vietnam's total industrial output (2,046,681.82 billion VND) (as of 6 , General Statistics Office of Vietnam)
- Trade: Export \$30 billion, import \$23.3 billion (total exports of Vietnam \$175.9 billion, total imports of Vietnam \$173.2 billion). HCMC accounts for 18% of Vietnam's total exports.
- Total registered foreign direct investment (FDI) registered by 6 : \$37 billion
- Unemployment rate 2.96% (as of 2016, Vietnam 2.23%, Ministry of Foreign Affairs and Trade, 2016)

D. Foreign Investment Environment in HCMC

- o HCMC is the hub of Vietnam's economy, commerce, finance, services, and education, attracting foreign investment in a wide range of sectors including commercial services, logistics, finance, insurance, telecommunications, education, medical and legal consulting.
- o The Tan Son Nhat International Airport, which is the largest airport in Vietnam, is in HCMC signifying that traffic infrastructures and communication facilities are relatively modernized compared to other areas in Vietnam. It has a large market and rich human resources due to its large urban population, making it an attractive investment destination for foreign investors.
- o However, high wages, rents, and living expenses are considered disadvantageous when investing in HCMC. In 2015, land lease rates in HCMC ranked 32nd in the highest in Asia. In addition, the strict bureaucratic tendency of HCMC, in terms of legal regulations, foreign investment conditions and taxes, is also a demerit to foreign investment in HCMC.
- o Since 1988 to December 2015, the number of projects relying on foreign capital was 19,929 projects in total and its investment size reached about \$279 billion.
- o As of the end of , there has been 2,381 representative offices of foreign firms in HCMC, including Korea 215, Hong Kong 237, Singapore 208 and Japan 161. (Based on the approval of the Ministry of Industry and Trade, Vietnam)

2. Transportation Status of HCMC

A. Transportation status

1) Road

- o The most common traffic facility in Vietnam is roads. They are subdivided into national roads managed by the central government, provincial roads managed by the provincial government, local roads managed by local administrative units and routes managed by cities and villages. The total length of the roads in Vietnam is about 222,179 km with 19.0% paved. Paved roads are mainly national roads and provincial roads. The national road system length is 17,295 km with 83.5% of its length paved. The provincial road system is 27,762 km with 53.6% paved.

2) Motorcycle

- o It is the most common transportation system in Vietnam, suitable for the traffic situation and the most popular mode of transportation (90% of total population).
- o Currently, there are 45 million motorcycles in Vietnam, and approximately one in two person owns motorcycles. The number of registered motorcycles in large cities such as Hanoi and HCMC was 8.5 million (18% nationwide) in 2016.
- o Most Japanese and Taiwanese motorcycles are produced in Vietnam and the average price is US\$ 2,000~5,000 per vehicle. The less expensive products are imported from China.
 - Advantages: It is more convenient than taking the bus or taxi which is limited and unstructured. It is suitable for traffic situation (narrow streets) in Vietnam. Therefore, if you are to live in Vietnam for over 90 days, it is very inconvenient to move without a motorcycle.
 - Disadvantages: Motorcycles cause urban pollution and health hazards due to dust and smoke. Motorcycles are often small and prone to cutting in line, and users often do not keep up with traffic laws. Therefore, motorcycles cause a lot of traffic accidents.

Table 7 | Commute Scenery in HCMC

Using the same route for motorcycles and vehicles	Motorcycle Overload
	

Source: Vietnamese Ministry of Transport Web site(<http://mt.gov.vn/>)

3) Taxi

- o It is the safest public transportation system with the highest utilization rate of foreigners. It is equipped with wireless communication. The basic fare based on the meter is generally 11,000 ~ 12,000 VND.

4) Bus and Car Rental

- o The bus utilization rate is still low, but the utilization rate is gradually increasing due to the replacement of old buses and the bus route change. Bus fare is 3000 ~ 5000 VND. Most Vietnam-based companies use private car rental services (including chauffeurs) for commuting.

B. Transportation Planning and Status of Vietnam

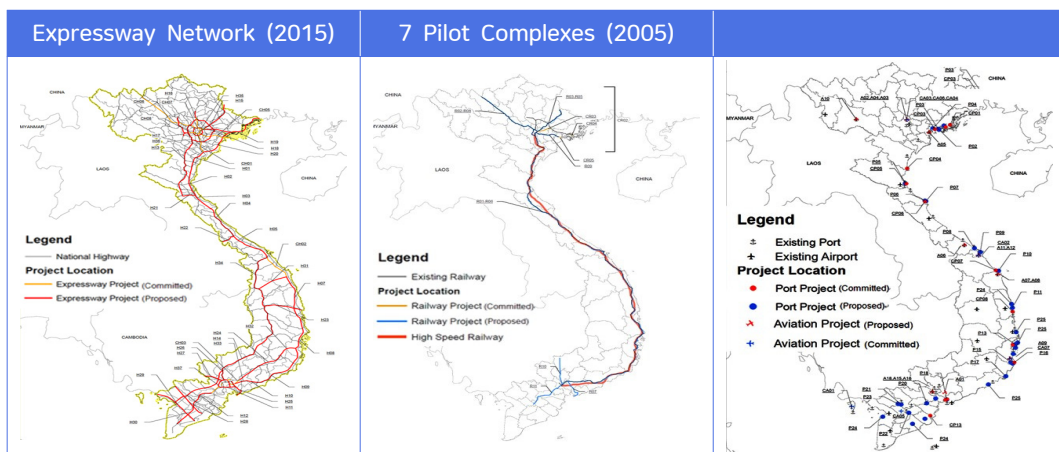
1) Vietnam Transportation Plan

- o Sectoral plans have been established to achieve socio-economic development strategies and sustainable development implementation strategies. The transportation sector has developed “The Comprehensive Study on the Sustainable Development of Transport System in Vietnam (2010, VITRANSS 2)”.
- o ‘VITRANSS 2’ is a comprehensive transportation development plan until 2020, which was

established with the assistance of JICA. Short, medium and long-term transportation strategies for each transportation system were developed and are underway with the approval from the prime minister.

- The road sector has 227 projects, including the construction and expansion of highways and public roads for the entire country (national roads 1A, 14E, 20, 21 and 47, etc.), the construction of bridges connecting the Mekong River (Dinh Vu, Vinh Thinh, Vam Cong, Cao Lanh, etc.) and traffic safety improvement plan for big cities such as Hanoi and Ho Chi Minh City.
- The railroad sector covers plans to build new railways between the northern and southern parts of Vietnam, to improve the old railway line to increase capacity and to construct the high-speed railway (HSR).
- The port sector has 68 inland waterways projects and 32 port expansion & improvement plans such as waterways, ports, safety & institutional improvement and maintenance.
- The airline sector has 26 projects including the new airport construction, the capacity enhancement of the existing airport and the navigation facility construction.

Table 8 | Transportation Planning in Vietnam



Source: The Comprehensive Study on the Sustainable Development of Transport System in Vietnam, JICA, 2010

2) Vietnam Railway Status

- o The total length is 2,632 km (62nd in the world). It consists of 6 main lines and other arterial lines. All lines are single-lined. 84% of meter gauges, 7% of international standard gauges, 9% of standard gauges and meter gauges combined and railway facilities, including locomotives, rolling stocks, and railroad bridges, are old.

- Major railway lines
 - Hanoi ~ HCMC
 - Hanoi ~ Lang Son
 - Hanoi ~ Lao Cai
 - Hanoi ~ Haiphong
 - Hanoi ~ Quan Trieu
 - Hanoi ~ Dong Dang
 - Kep, Cambodia ~ Uong Bi, Halong
 - Kep, Cambodia ~ Luu Xa

3) Vietnam's North-South Railway

- o The line was established during French colonial rule and was completed over a period of nearly forty years, from 1899 to 1936. It is a single-track, meter gauge (1,000 mm) line connecting from Hanoi to HCMC (191 stations, 5 times per day, approximately 34 hours taken for traveling) for a total length of 1,726 km. The average speed of the line is 60 km/h (40 km/h in old segments).
 - Fare: 2,116,000 VND (approx. ₩105,000) for luxury seats, 921,000 VND (approx. ₩46,000) for ordinary seats from Hanoi to Ho Chi Minh
- o The railway does not make a great contribution to the national arterial transport network, and only 7% of the total freight volume is transported by railway. The overall situation of the railway in Vietnam coexists with both poor side and the average side. In fact, the railway, which was destroyed during the Vietnam War is being temporarily repaired and are currently in use. Thus, most of the railway needs immediate revamping.
- o The railway density is 79.6km/10,000km². The dual standard gauge is only 527 km and the 2,105 km is the meter gauge track. The dual gauge is 237 km. The standard gauge and the dual gauge are mainly in the northern area and there is a total of 7 lines. The double Hanoi-Lao Cai Line is the dual gauge, composed of the standard gauge and the meter gauge, connecting to Kunming in China. The line played an important role during the Vietnamese War.
- o The Vietnam Railway Network is state-owned and is operated by Vietnamese Railway (Đường sắt Việt Nam), which has several subsidiaries related to the railway, telecommunications, education and other railway maintenance.
- o There are two railway lines between China and Vietnam. One line connects Haiphong with Kunming (Yunnan province) in the west, and the other line connects Hanoi with

Nanning in the east. The line connecting Kunming with the Vietnam border area is being converted into the only meter gauge and standard gauge in China.

- o The Vietnam Railway will be equipped with an international railway network linking Cambodia, Thailand, Malaysia, Singapore, and Laos.

4) Urban railway in HCMC

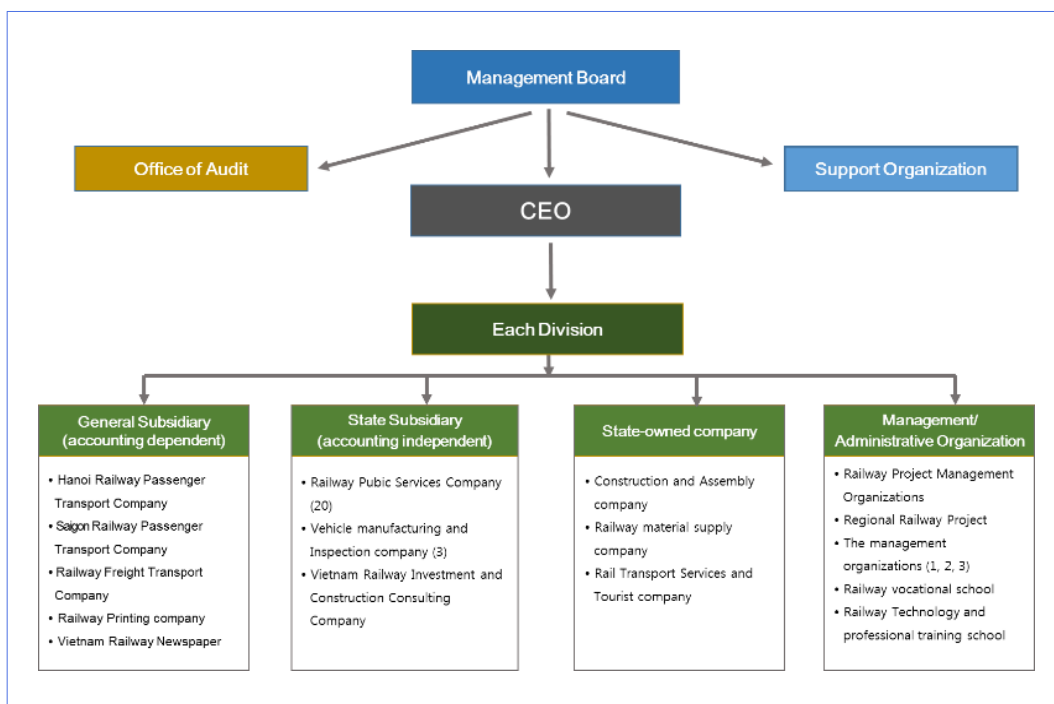
- o As economic development led to the rapid increase in road traffic volume in Vietnam, the chronic congestion and environmental deterioration are worsening. Ho Chi Minh City plans to construct multiple urban railway lines to reduce the road congestion. The Line1 project is the first full-scale railway construction project in Vietnam. JICA provided yen loans to the project on the condition that they utilize Japanese science and technology and Line 1 is under construction.

C. Vietnam Railway Status and Plan

1) Vietnam Railway Organization Status

- o MINISTRY OF TRANSPORT (MOT)
 - In 1989, the national railway network was reorganized into a state-owned enterprise, Vietnam Railways, reflecting the market principle. In March 2003, the Vietnam Railway Structural Reform Plan that designed to separate railway operations from national management activities was approved.
 - Accordingly, the Vietnam Railway Administration, under the Ministry of Transport (MOT), was established to oversee railway-related matters such as railway policy development and legal issues.
- o Vietnam Railway Corporation
 - The Vietnam Railway Corporation (hereinafter referred to as the "Vietnam Railway") is a state-owned enterprise that manages, utilizes and maintains the railway business and infrastructure.
 - During the structural reform in 2003, the Vietnam Railway was composed of one freight company (Railway Freight Transport Company) and two passenger transport companies (Hanoi Railway Passenger Transport Company & Saigon Railway Passenger Transport Company), each of which has its own business structure.
- o The organization chart of Vietnam Railway Corporation

Figure 3 | The Organization Chart of Vietnam Railway Corporation



Source: Vietnam Railway Corporation Website (<http://vn.com.vn>)

2) Railway Operation Status

o Current status of personnel and vehicle holdings

- The total number of employees of Vietnam Railway is about 46,000.
- The current status of rolling stocks holdings

Table 9 | Current Status of Personnel and Vehicle Holdings

Total	Steam Locomotive	Diesel Locomotive	Passenger Car	Freight Car
6,330 cars	19 cars	382 cars	1,057 cars	4,872 cars

Source: Vietnam Railway Corporation Web site (<http://vn.com.vn>),
Ministry of Transport Website, Vietnam (<http://mt.gov.vn/>)

o Annual Operating Status

Table 10 | Annual Operating Status

Classification	1999	2000	2001	2002	2003
Passenger Volume	9,251,539	9,805,514	10,627,419	10,782,203	11,586,383
Passenger Traffic (thousand people/kilometers)	2,721,903	3,199,943	3,426,124	3,697,231	4,041,714
Freight Transport Volume (Ton)	5,033,301	6,138,563	6,336,139	6,943,908	8,281,847
Freight Traffic (thousand ton/kilometers)	1,360,293	1,901,461	1,999,947	2,337,712	2,674,911

Source: Vietnam Railway Corporation Web site (<http://vn.com.vn>)
Ministry of Transport Website, Vietnam (<http://mt.gov.vn/>)

o Financial Status

- In 2002, total revenues amounted to 1,460,931 million VND, which increased by 14% from the last year (1,281,556 million VND).

3) Long-term Development Plan for Vietnam Railway

o Long-term Development Plan

- On May 20, 1996, the Vietnamese Prime Minister presented the “Plan” No. 42/TB₁” to guide the development strategy of Vietnam Railway Corporation toward 2000, 2010 and 2020.
- The government will provide funding for the railway development, and the funds will be recovered by charging facility fees. The plan also includes the investment support for railway infrastructure and diesel locomotive improvement facilities using ODA resources.
- On January 7, 2002, the Vietnamese government approved a comprehensive development plan by 2020 for the railway, telecommunications and transportation sectors in Vietnam.
- Vietnam plans to complete the double track line project between Hanoi-Vinh and Saigon-Nha Trang by 2020 and to build a new type of railroad that meets modern standards.
- As part of this plan, the Vietnamese government plans to build a double-track (1,435mm) for high-speed rail with the main line running from north to south to reduce the 10-hour travel time between Hanoi and HCMC.
- The line between Hanoi and HCMC is likely to be linked to the international rail network in the future. The comprehensive development plan also includes the construction of

circular railway networks in Hanoi and HCMC to form a seamless urban transport network.

Table 11 | Long-term Development Plan for Vietnam Railway

Category	Project	Description
Railway (2010)	1 Ha Noi ~ Ho Chi Minh City	Existing line improvement
	2 Ha Noi ~ Lao Cai	Existing line improvement
	3 Ha Noi ~ Hai Phong	Existing line improvement/ New Construction
	4 Ha Noi ~ Dong Dang	Existing line improvement
	5 Dong Anh ~ Thai Nguyen	standardization completed
	6 Kep ~ Thai Nguyen	Maintenance
	7 Kep ~ Cai Lan	Existing line improvement
	9 Yen Vien ~ Pha Lai	New construction
	10 Sai Gon ~ Loc Ninh	Construction
	11 Ho Chi Minh ~ Vung Tau	New construction
	12 Ho Chi Minh ~ Can Tho	New construction
Railway (2020)	1 Ha Noi ~ Ho Chi Minh City	Double track section
	2 Ha Noi ~ Hai Phong	Double Track
	3 Ha Noi ~ Lan Son	New construction
	4 Ha Noi ~ Lao Cai	Section improvement
	5 Ho Chi Minh ~ Vung Tau	New construction
	6 Ho Chi Minh ~ Loc Ninh	New construction
	7 Ho Chi Minh ~ My Tho ~ Can Tho	New construction
	8 Thai Nguyen ~ Yen Bai	New construction
	9 Di An ~ Chon Thanh ~ Dac Nong	New construction



Source: Vietnam Railway Corporation Web site (<http://vn.com.vn>)
Ministry of Transport Web site, Vietnam (<http://mt.gov.vn/>)

Table 12 | Vietnam Railway Development Plan for 2001~2010

Operation	Infrastructure
- Manufacturing locomotives (1,200 ~ 1,800 hp; 129km/h): 60~100 cars for meter gauge, 8~10 cars for standard gauge	- Strengthening the overall railway infrastructure - prevention of rock fall and ground collapse along the west line
- Manufacturing high-quality passenger cars (safe and reliable braking system; little noise): 500~1,000 cars	- Improving the old wooden structures on the north line
- Manufacturing special vehicles that can deliver vehicles, vegetables, fruits, food, etc.: about 1,000~1,500 cars	- Mechanization of track repair work, modernization of telecommunication signal system - Retrofitting piers and improving tunnels
- Manufacturing modifying/production facilities & repaired products	- Construction of the elevated railway between Hanoi and HCMC
- Constructing bogie cars through technology transfer & securing assembly line for manufacturing modern passenger cars	- A study on the construction of the standard gauge/high-speed line between Hanoi and HCMC

Source: Transport Sector Assessment, Strategy, and Road Map, ADB, 2012
Ministry of Transport Website, Vietnam (<http://mt.gov.vn/>)

o Vietnam Railway Development Plan for 2010~2020

Table 13 | Vietnam Railway Development Plan for 2010 ~ 2020

Operation	Infrastructure
- Substituting urban driving/commuter trains with high-quality/high-speed locomotives	- Constructing the Hanoi-HCMC standard gauge high-speed line & constructing the industrial railway line for the industrial zone
- Importing locomotive assembly facilities and advanced standard transportation trains production equipment	- Constructing the new line connecting the Trans-Asian Railway (TAR) Network with the Hanoi-HCMC line
- Manufacturing modern locomotives & constructing vehicle maintenance facilities	- Commencing the automatic train service • Electrification of Hanoi- Haiphong line

Source: Transport Sector Assessment, Strategy, and Road Map, ADB, 2012

D. HCMC Metro Planning and Status of Vietnam

o HCMC MRT has nine lines including three monorails and aims to be completed by 2030.

Table 14 | Development plan for Vietnam railroad 2010~2020

Line		Section	Operation Start
Line 1		L= 19.7km, 14 stations	2015 ~ 2020
Line 2	1stage	L= 11.9km, 11 stations	2018 ~ 2024
	2stage	L= 5.9km, 5 stations	~ 2030
Line 3	3A-1	L= 9.7km, 10 stations	~ 2030
	3A-2	L= 9.96km, 7 stations	2025 ~ 2030
	3B	L= 12.1km, 10 stations	~ 2030
Line 4	4	L= 37.6km, 33 stations	~ 2030
	4b	L= 5.2km, 4 stations	~ 2024
Line 5	1stage	L= 8.89km, 9 stations	~ 2026
	2stage	L= 14.56km, 13stations	~ 2026
6 Line		L= 5.6km, 7stations	2025 ~ 2030
Tramway 1		L= 12.8km, main 6 stations	~ 2030
Monorail 1		L= 19.1km	~ 2030
Monorail 2		L= 9.1km	~ 2030
BRT 1		L= 16.9km(Vo Van Kiet)	~ 2022

Source: Transport Sector Assessment, Strategy, and Road Map, ADB, 2012

3. HCMC Metro O&M Status

A. HCMC Metro MAUR Status of Vietnam

Table 15 | MAUR status

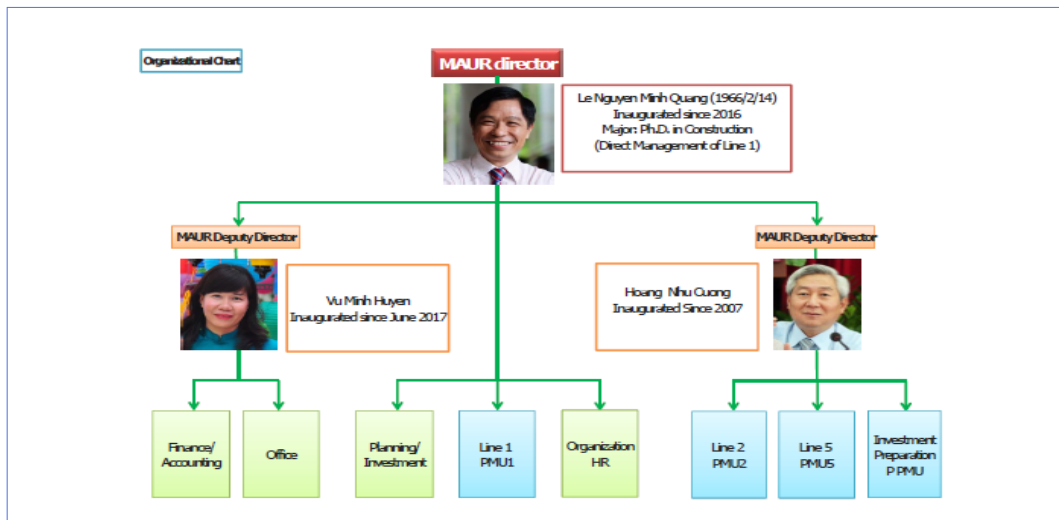
Category	Description
Established	2007/09/13(119/QĐ-UBND, HCMC People's committee's decision)
Title	Management Authority for Urban Railways
Organization	4 Departments and 4 PMUs
Total	229(40 Master degrees, 73Bachelor degrees, 7 college degrees, 9 Interns,
Executives	1 Director and 1 to 3 Deputy directors - Director/D/Director & Chief accountant are designated by People's Committee - Directly under People's Committee and guidance by central government
Responsibilities	- Plan for construction-operation-development of urban railway until 2020 to People's Committee and consultation on project investment, operation & development - Direct rule regarding consultation with international partners - Project implementation, detail plan, problem-solving and efficient resource use - Organization with PMU for project management and operation development - Land acquisition plan in cooperation with local government & privates

Source: HCMC-MAUR website (<http://www.maur-hcmc.vn>)

B. Organization Chart and Decision-Making Structure of MAUR

1) Organization Chart of MAUR

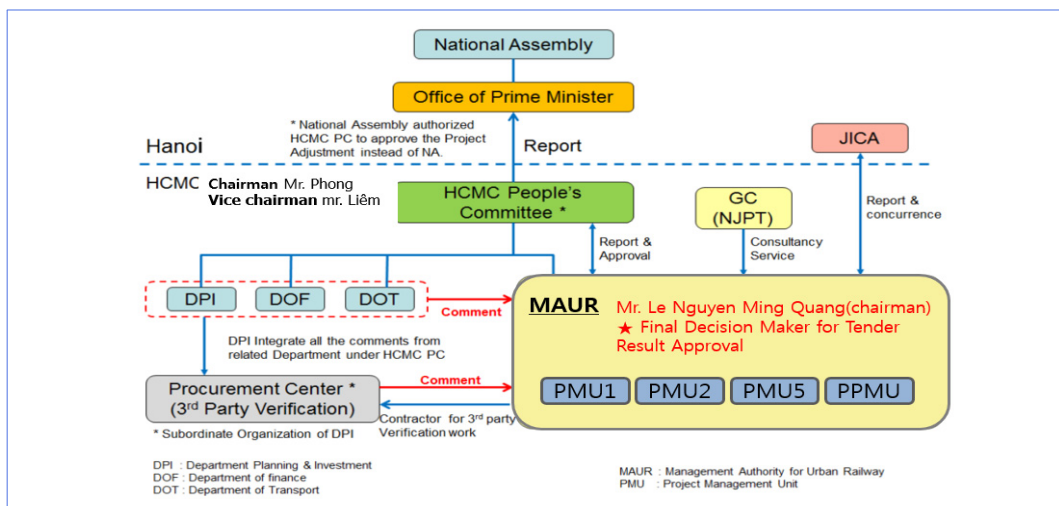
Figure 4 | Organization Chart of MAUR



Source: HCMC-MAUR Web site (<http://www.maur-hcmc.vn>)

2) MAUR Project Operation System (HCMC Line 1) and Decision-Making Structure

Figure 5 | MAUR Project Operation System (HCMC Line 1) and Decision Making Structure



Source: HCMC-MAUR Web site (<http://www.maur-hcmc.vn>)

IV. Preliminary Study on HCMC Metro Operation Management and Preparation

- o According to the urban railway construction plan of the Vietnamese government which was initiated to solve serious traffic problems, Ho Chi Minh City tried to prepare operation and management system of the urban railway, but HCMC had no experience in railway operation thereby faced difficulties. HCMC made a request to Japan for technical assistance (TA). The following data are the result reports on the TA provided by JICA to HCMC and MAUR: (1) Special Assistance for Project Implementation (SAPI) for Ho Chi Minh City Urban Mass Rapid Transit (UMRT) Line1, Eastern Section (2009), (2) Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban Railways in HCMC (2013), (3) SAPI for Ho Chi Minh City Urban Railway Construction Project (2016).

1. Special Assistance for Project Implementation (SAPI) for HCMC Urban Mass Rapid Transit (MRT) Line 1, Eastern Section (2009)

A. Scope of Technical Assistance

1) Support for establishing an implementation organization for operation and maintenance

- o The scope of support for establishing an operation and maintenance implementation organization includes: (1) definition of operation organization, (2) support for the legal and administrative procedure for establishing an operation organization, (3) support for preparing the required items for operation organization including an organization chart, work scope, finance plan, budget policy and fare policy.

2) Support for preparing a work road map covering commercial operation

- o The aim of this task is to make sure that the roadmap including commercial operation prepared by MAUR can be consistent with the roles of an operating organization derived from Task 1.

3) Development of detailed action plan for preparation of establishing an operation organization

- o The aim of this task is to give support for developing a detailed action plan of the roadmap that is completed in Task 2.

4) Seminars and consultation

- o The aim of this task is to hold a seminar on Task 1, 2, 3 and have a discussion on the establishment of an operating organization to ensure that the Vietnamese government can decide on the establishment of an operating organization without delay.

B. Result of Technical Assistance

1) Support for establishing an implementation organization for operation and maintenance

- o The result of support for establishing an implementation organization for operation and maintenance includes, (1) role of operation organization, (2) structure of operation organization, (3) ownership of company assets, (4) business area, (5) organization chart, and (6) finance plan, as follows:

Table 16 | Details of support for establishing an implementation organization for operation and maintenance

Classification	Description
Roles of organization	• Operation and management of a safe and reliable HCMC Metro
Structure of organization	• 100% invested by HCMC, No. 1 company limited
Ownership of company assets,	• Required to transfer all E&M and infrastructure assets from HCMC to an operator
Business area	• It is efficient for a new operator to operate all lines to be operated in HCMC.
Organization chart	NOTE: ^{#1} The functions of board of supervisors include supervising Chairman and General Directors and conducting internal audit. ^{#2} Includes parking lot services ^{#3} E&M: Electrical & Mechanical ^{#4} OCC: Operating Control Center
Finance plan	• As fare policy should be annually adjusted depending on the actual ridership, it is meaningless to discuss it in detail at this moment.

Source: SAPI for Ho Chi Minh City UMRT Line1, Eastern Section (2009)

2) Support for preparing a roadmap covering commercial operation

- o Because of the support for preparing a roadmap, given the pre-operation for commercial operation including test and commissioning, about 3 years is needed after an operator is established. The details of work roadmap are as follows.

Table 17 | Summary of Work Roadmap

Year	Description
By 2010	Establishment of Preparation Unit (PU) Analysis of the Vietnamese railway laws
2010~middle 2012	Development of business plan including organization plan and finance plan Preparation of company mission, vision, and charter Approval of HCMC
2012~middle 2013	Preparation of company rules and work manuals Establishment of operator Construction of company work process system (excluding subsidiary business)
2013~late 2015	Construction of work process system including subsidiary business Construction of office IT system Employment and education of operator's employees
From late 2015	Opening (commercial operation begins) ※ To be opened in late 2015 at the time of preparing the report

Source: SAPI for Ho Chi Minh City UMRT Line1, Eastern Section (2009)

3) Development of detailed action plan for preparation of establishing an operation organization

- o A detailed action plan for the preparation of establishing an operation organization was developed by dividing into HCMC People's Committee, Task Team (composed of 11 persons belonging to HCMC People's Committee and MAUR in accordance with the Vietnam Decision "4211/QDUBND", "5047/QD-UBND"), MAUR, and Preparation Unit (PU). Detailed work plan by the organization is summarized, as follows.

Table 18 | Summary of detailed work plan by organization

Classification	Description
HCMC People's Committee	Review and approval of reports submitted by MAUR and Task Team (Required to approve company investment prior to establishing an operator)
Task Team	Regular report to the HCMC People's Committee on the preparation of company foundation Review of documents prepared by the PU
MAUR	Organization of PU Increase of PU staff
PU	Analysis of railway laws and applicable laws Work on operator registration Preparation of operator's rules draft, etc.

Source: SAPI for Ho Chi Minh City UMRT Line1, Eastern Section (2009)

4) Seminars and consultation

o 5 seminars in total were held, and the details for each seminar are summarized as follows.

Table 19 | Summary of seminars and consultation

Classification	Description
1st seminar	Share of project schedule
2nd seminar	Check of operator organization, finance plan, and risk assessment Preparation of PU organization PU will work at the operator after it is established Request to JICA for additional TA regarding operator establishment
3rd seminar	Modified according to the change of work road map schedule
4th seminar	Consultation on operator's name Consultation on operator's staff, department, and title Check of detailed legal restrictions on operator establishment Consultation on finance plan including capital from the HCMC People's Committee
5th seminar	Consultation on the procedure for operator establishment Consultation on possibility of office IT system investment by JICA

Source: SAPI for Ho Chi Minh City UMRT Line1, Eastern Section (2009)

2. Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban railway in HCMC (2013)

o The aim of this TA on an operator foundation is to (1) establish an administrative system required for company establishments such as operator's rules and work manuals, and (2) strengthen the capacity of a PU by visiting Japan.

A. Scope of Technical Assistance (TA)

1) Administrative management and safety management

o The aim is to establish an overall action plan, define the scope of a TA, develop operator's rules and work manuals and establish safety management rules for the success of this TA.

2) Human resources

- o The aim is to support the rules on the function and authority of each department of the HCMC Metro operator and present a plan for recruiting employees who are qualified for each department, based on the example of the Japanese urban railway agencies.

3) Finance

- o The aim is to establish an accounting system, budget management system and procurement rules and conduct researches in securing financial stability of a company.

4) Sales

- o The aim is to study about terms and institutions for the organization and rules, general conditions of passenger transport, fare fixation and adjustment system and subsidiary business in sales.

B. Result of Technical Assistance (TA)

1) Administrative management and safety management

- o This task allowed Seoul Metro Consortium to clarify the roles of a PU, carry out training for strengthening its capacity, and establish the operator's rules and safety management rule. The result of the task is summarized as follows. (In this TA, the title of a PU was changed to the Preparation Unit for Setting up the O&M Company (PUC).

Table 20 | Summary of task results in the area of administrative management and safety management

Classification	Description
Strengthen capacity of a PUC	Study on literature survey of PUC (Procedure for company establishment, etc.) (Training in Japan) Experience in the urban railway operation and management of Japan (10 days in January 2012) - Lecture on the roles of an HQ, lecture on driver's qualification test, visit to control center and depot and experience in vehicle simulation, etc.)
Study on each department of operator	Study on internal rules on the Japanese urban railway companies after translating into Vietnamese Study on authority and responsibility of each department (Use of internal information provided by Saigon Bus Co.)
Study on safety management	Study on safety through examples of JR East and Osaka City metro Study on examples of accidents due to human errors (Enterprise safety management is required due to the Vietnamese's low awareness of safety)
Study on office IT system	Study on office IT system through the examples of Osaka City metro and Singapore MRT - IT system method: (1) Universal computer method the same as Osaka City metro (2) Package-type server and software method the same as SAP - Proposal for (2) package-type server and software method which is cost effective

Source: Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban Railways in HCMC (2013)

2) Human resources

- o This task allowed Seoul Metro Consortium to establish rules on the work scope of a personal organization including office regulations, labor mobilization plan, title classification and employment deployment. The details are summarized, as follows.

Table 21 | Summary of task results in the area of human resources

Classification	Description
Study on human resources organization	Used as reference data by obtaining the organization chart of the local Saigon Bus Co. Study on human resources based on the personnel regulations of Osaka City metro The personnel staff of Osaka City Metro paid a visit to HCMC for a local study. - Study on employee recruit plan, employee training plan, labor management and retirement
Labor mobilization plan	Need considering the employee's high turnover rate and annual decreasing rate Development of wage system depending on the education level of employees Estimation of the total employees (HQ and other offices, respectively)
Study on title classification	Study on the duty and job classification of the Japanese urban railway companies after translating into Vietnamese Study on differential payment by the class of position (Use of position and wage level based on the Japanese examples)
Study on employee deployment	Study on employee deployment regarding working hours and shift work of the Vietnamese companies, based on the Vietnamese railway and labor laws (Establishment of basic rules on shift work) Study on employee deployment plan considering the structure of a station (No. of gate, etc.) Estimation of the number of drivers using the total train operation hours (additional discussion required)
Study on driver's license	Use of the required training time data before commercial operation in Cairo and Singapore Study on driver's training time - Theoretical training and OJT for drivers are 400 hours, respectively, which is the Japanese standard. Study on driver's license issuing - Osaka City metro can't issue the Vietnamese driver's license (However, certificate of theoretical training course is issued)

Source: Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban Railways in HCMC (2013)

3) Finance

- o This task allowed Seoul Metro Consortium to establish an accounting system, budget management system and procurement rules and conduct researches in securing financial stability of a company. The details are summarized, as follows.

Table 22 | Summary of task results in the area of finance

Classification	Description
Study on financial laws	Study using the local management consultant - Study on the Vietnamese financial laws account standard and taxation system The financial staff of Osaka City metro visited Vietnam for financial study. Draft the articles of association of a finance-related company
Study on accounting system	Study on the accounting system of the Japanese urban railway companies - Necessary to study on the Vietnamese laws and accounting standard required for establishing an accounting system Study based on the accounting system data provided by the local Saigon Bus Co. Study on accounting items that affect revenue and expenditure (income, expenditure, depreciation, etc.) Development of in-house fund management system including collateralized debt Study on asset management system - Proposal for a draft of procurement rules using the office IT system Study on cash handling system using the cash handling system of the Japanese urban railway companies
Study on budget management system	Study on a budget plan and closing accounts of the Japanese urban railway companies, based on which an operator's budget plan was drafted. Study on a budget plan and closing accounts of Saigon Bus Co., and based on which an operator's budget plan was drafted.
Study on procurement rules	Study on procurement system of the Japanese urban railway companies and Saigon Bus Co., based on which operator's procurement rules were drafted. Study on material code development and inventory management system linkage plan - Survey on the asset list of the Japanese urban railway companies and it was used as reference data for developing an asset list of an operator. Preparation of material procurement system overview (Based on the Vietnamese laws and customary practice)
Study on securing financial stability	Preparation based on the current numerical values such as demand forecast, inflation and wage level on the basis of financial model developed in the SAPI Study Study on the policy for the debt of an operator and subsidy from the HCMC People's Committee - Calculation of loan and subsidy from the HCMC People's Committee

Source: Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban Railways in HCMC (2013)

4) Sales

- o This task allowed us to study about terms and institutions for the organization and rules, general conditions of passenger transport, fare fixation and adjustment system and subsidiary business in sales. The details are summarized, as follows.

Table 23 | Summary of task results in the area of sales

Classification	Description
Study on organization and rules in the area of sales	Study on the sales rules of the Japanese urban railway companies and Saigon Bus Co., based on which sales details of an operator were selected and organization rules were drafted Study on the guideline for cash handling at a station and station attendant's work
General conditions of passenger transport	Study on general conditions of passenger's transport of the Japanese urban railway companies after translating into Vietnamese - Draft general conditions of passenger transport, based on general conditions of passenger's transport of Osaka City metro Analysis of rules of VNR and Saigon Bus Co. - Acquisition and study of general conditions of passenger transport. Saigon Bus Co. has no general conditions of passenger transport and has only the agreement in accordance with the decision of the HCMC People's Committee. Study on the rules on general conditions of passenger transport - Draft rules on issuing various discount tickets and handling lost articles
Study on fare fixation and adjustment system	Study on fare system of the Japanese urban railway companies (Distance-based rate system, single rate system) Study on foreign urban railway fare system (London Zone system, Paris rate system) Study on the fare system of Saigon Bus Co. - Saigon Bus Co. uses the fare system decided according to the regulations of the HCMC People's Committee and it has no unique fare system. For Line 1, the ticket systems are all designed for IC card, and tickets are issued by the automatic vending machine. Study on the Japanese fare adjustment procedure (Study on the yardstick system) Study on the level of urban railway fare adjustment in Singapore and other countries Study on subsidy in case of deficit - The possibility of deficits due to less demand and high inflation and a plan for subsidy support from the HCMC People's Committee is required. - Necessary to prepare the basis of an operator's subsidy support according to the Vietnamese railway laws (Method to receive legal subsidy: Qualification of public company specified in Decree 31 and according to the Vietnamese railway laws)
Study on subsidiary business	Draft a plan for an operator's subsidiary business through the case study on subsidiary business of the Japanese JR East and Osaka City metro Draft the rules on lease business and advertisement business in the station through examples of Japan Investigate a candidate company for subsidiary business that can represent the operator for store operation in the station and advertisement in the train Case study on the subsidiary business of Saigon Bus Co. - Use Saigon Bus Co.-owned gas station as bus parking place and training center site for bus drivers

Source: Implementation Report on the Project for Support on Set up of Operation & Maintenance Company of Urban Railways in HCMC (2013)

3. SAPI for Ho Chi Minh City Urban railway Construction Project (2016)

o This TA regarding the establishment of an operator deals with the overall progress until the Decision on Establishment of HCMC Line 1 Operator was announced in December 2015 as well as technical assistance required for establishment of an operator. The overall progress of an operator is as follows.

Table 24 | Progress of operator establishment and registration (as of March 2016)

Period	Details
From Jul. 2013	Drafted the establishment of the HCMC Metro operator (MAUR)
	⇓
Oct. 24, 2014	Completion of proposal for establishment of the HCMC Metro operator (MAUR)
	⇓
Nov. 6, 2014	Submitted the proposal to the HCMC People's Committee (MAUR)
	⇓
Nov. 12, 2014	Made a request to Prime Minister for approval of the proposal for establishment of an operator (HCMC-PC)
	⇓
By Mar. 2015	Survey and discussion on the government's comments
	⇓
Apr. 21, 2015	Submitted the proposal for establishment incorporating the government's comment to Prime Minister (HCMC-PC)
	⇓
May 26, 2015	Prime Minister's approval for establishment of the HCMC Metro operator
	⇓
By Sep. 2015	Consultancy on the company established with the government Submitted the company establishment plan to the HCMC People's Committee (MAUR)
	⇓
Dec. 1, 2015	Decision on the company establishment announced by the HCMC People's Committee

Source: SAPI for Ho Chi Minh City Urban Railway Construction Project (2016)

A. Scope of Technical Assistance

1) Establishment and management of urban railway operator

- o The aim is to provide technical assistance for documentation on establishment and registration of an operator, strengthening the capacity of a PUC, deploying the employees of operation/maintenance department, sharing information on the construction project for the HCMC Line 1, sharing information on the establishment of the Hanoi urban railway operator and coordinating trainees to Japan.

2) Support for survey of urban railway regulatory agencies and research

- o The aim is to provide technical assistance for sharing the roles between the urban railway regulatory agencies and MAUR, organization, and work activities of the MAUR regarding the establishment of an urban railway operator, and safety management.

3) Support for strengthening capacity of operator's employees

- o The aim is to support the education curriculum for the urban railway operator's employees including the driver.

4) Support for TC2 preparation

- o This TA is categorized into 2 stages; insufficient part in this TA and the area requested by the MAUR. This TA deals with the preparation of 2-stage technical assistance to provide technical assistance continue until the HCMC Line 1 is opened.

B. Result of Technical Assistance (TA)

1) Establishment and management of urban railway operator

- o This TA discusses technical assistance for documentation on establishment and registration of an operator, strengthening the capacity of a preparation unit (PU), deploying the employees of operation/maintenance department, sharing information on the construction project for the HCMC Line 1, sharing information on the establishment of the Hanoi urban railway operator and coordinating trainees to Japan.
The details are summarized as follows.

Table 25 | Summary of the results of support for urban railway operator establishment and management

Classification	Description
Establishment of operator	Approval of Prime Minister for the establishment of the HCMC Metro operator (May 26, 2015) Decision on establishment of the HCMC Metro operator (Dec. 1, 2015)
Strengthen capacity of PUC	Increase of PUC staff from 5 to 9 (Additional 4 are part-timers) 9 trainees in total requested to join the training. OJT for accounting system through the local consultant (42 times)
Share information on the HCMC Line 1 construction project	Information on Line 1 office IT system, AFC system, control center, and operation rules were shared, but the in-depth discussion was not made. It will be dealt with in TC 2. Required to prepare fire protection manual (Emergency response manual, disaster-prevention procedure, etc.
Share information on the Hanoi urban railway project	Workshop for sharing information three times in total - Consultation on implementation of operator establishment process, sharing information on safety measures and contract method
Field trip to Japan	9 trainees will go on a field trip to Japan for 40 days, but the detailed schedule will be discussed later.

Source: SAPI for Ho Chi Minh City Urban Railway Construction Project (2016)

2) Support for survey of urban railway regulatory agencies and research

Table 26 | Summary of the results of support for survey on operator regulatory agencies and research

Classification	Description
Roles of operator regulatory agencies	Seminar on the roles of the MAUR as a subject that manages an operator through the Japanese example and Hanoi case study - At this moment, MAUR is the most appropriate agency. Detailed roles of HCMC and MAUR will be discussed later (TC2)
Roles of the MAUR	The human resources of a new operator will be organized, based on those of the MAUR. Detailed personnel deployment will be discussed later (TC2)
Safety management	Gather information through the Hanoi example The Japanese safety management system will be applied to an operator. - Seminar on the topic of safety management system of Japan

Source: SAPI for Ho Chi Minh City Urban Railway Construction Project (2016)

- o This TA discusses technical assistance for sharing the roles between the urban railway regulatory agencies and MAUR, organization, and work activities of the MAUR regarding the establishment of an urban railway operator, and safety management. The details are summarized as follows.

3) Support for strengthening capacity of operator's employees

- o The aim is to support the education curriculum for the urban railway operator's employees including the driver.

Table 27 | Summary of the results of support for strengthening capacity of an operator's employees

Classification	Description
Employee training (including driver)	RVC (Railway Vocational College) will be used for driver training, based on No.127/QD-BGTVT issued by MOT. Driver's license can't be issued in Japan (However, certificate of completion is issued)
Driver's license test	Share information on the driver's license test rules (31/2015/TT-BGTVT)

Source: SAPI for Ho Chi Minh City Urban Railway Construction Project (2016)

4) Support for TC2 preparation

- o This TA is categorized into 2 stages. This TA discusses an insufficient part in this TA and the area requested by the MAUR. This TA deals with the preparation of 2-stage technical assistance to provide technical assistance continues until the HCMC Line 1 is opened (TC 2 will begin 3 years before the opening of Line 1).

Table 28 | Summary of the results of support for TC2 preparation

Classification	Description
Registration of operator	The HCMC People's Committee needs to complete the registration of an operator prior to TC2, based on Decision on the establishment of an operator.
Strengthen capacity of PUC	JICA made a request for increase of staff (19 persons including new 4 in total) Organization chart of an operator needs to be prepared in advance.
Confirmation of opening date of Line 1	As a detailed preparation work including training can't be carried out while Line 1 opening time is not determined, it is necessary to check the opening date of Line 1.
How to train drivers	Currently, there is a discrepancy between Japan and Vietnam in driver's license issuance. - Vietnam made a request to the Japanese agency for issuing a driver's license through the OJT in Japan. - Driver's licenses issued in Japan can be changed to the Vietnamese driver's licenses in VNR.
Preceding subjects of PUC	Check if the existing preparation work for establishment of an operator conforms to the Vietnamese legal system and customary practice Study on job capacity and know-how at the stage of O&M As the opening date is delayed due to the late construction of Line 1, a continuous communication with the department related to Line 1 construction project is required.

V. Analysis of urban railway system O&M in Korea [focused on needs]

1. Analysis of the Vietnamese needs

A. MAUR Demands

o Investigation of the project requirements and needs for HCMC Metro O&M were conducted based on the SAPI reports and through consultations with MAUR. MAUR was interested in the know-hows and of the success stories of railroad operators, particularly Seoul Metro's operation system. The details of MAUR's requirements are summarized below:

Table 29 | Requirements for HCMC Metro O&M

Category	Description
Legal system for urban railway O&M	Urban railroad-related laws & regulations in Korea - O&M regulation based on relevant law - Legislation system, urban railway law, and railroad safety law
Driver's license system and training	Analysis of foreign railway vehicle driver's license system and process - Application of driver's license system to HCMC rail transit
Railroad safety approval system	Railroad operation and facility safety approval system - Railroad SMS, operation, O&M program, and RAMS
O&M organization and responsibilities	O&M organizations with responsibilities of Seoul Metro and Japanese railroad operators - Organization of railroad operators and responsibilities
Preparation for opening and test & commissioning	Laws about railroad operation and operation procedures - Cases of Seoul Metro Line 7 extension and Gimpo LRT - Test & commissioning procedures

Source: Agreement between SEOUL METRO Consortium - MAUR

- o Besides the above requirements, HURC1 was interested in Seoul Metro's O&M manual for it had no O&M guidelines yet. Furthermore, implementing an integrated fare system, life safety system for safe operation and regulations for excavation were also recommended.
- o Requirements in (Table 29) were addressed by MAUR in preparation for Line 1 operation. MAUR was interested in learning the cases of urban railway operators which are described in the later part of this report.

2. Urban Railway-Related Laws in Korea

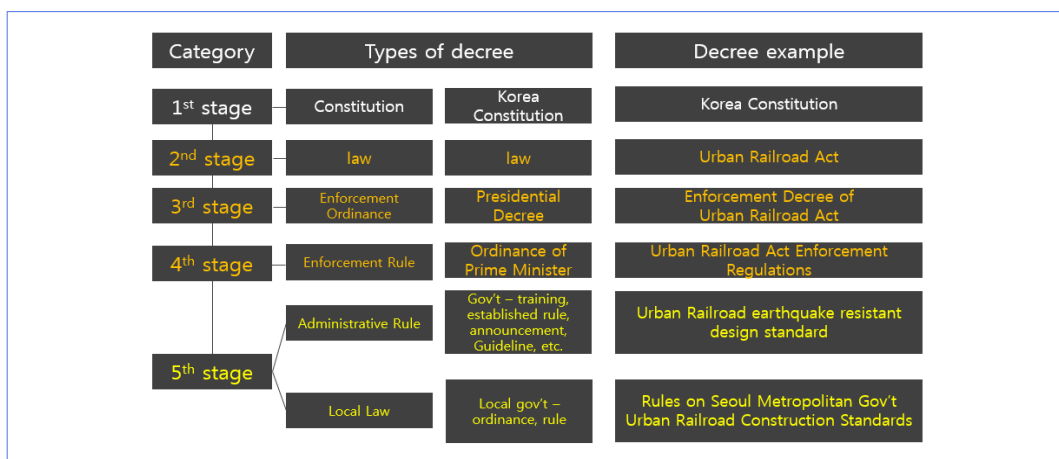
A. Legislation system in Korea

1) Administrative management and safety management

- o Korea has a statute law system (constitution, law, order, treaty, ordinance, and regulation).
- o Korea's law system comprises the constitution, laws to implement the constitution, presidential decree, prime minister's ordinance and administrative legislation.
- o An administrative regulation is a guideline for performing the duties or work process in the administrative organization.

2) Legal system

Figure 6 | Legal system in Korea



Source: National Law Information Center Website (2017), www.law.go.kr

B. Railroad-related Legislation Status

o Railroad-related laws in Korea are summarized as follows.

Table 30 | Railroad-related laws

No	Law	Area	Objective	Organization
1	Railroad Development Framework Law	Railroad industry	• To enhance the competitiveness of railroad industry, development foundation, operation efficiency and public interest and national economic development	KORAIL, KRNA
2	Railroad Enterprise Act	Railroad operation	• To establish the order and foundation for efficient operation, help develop the railroad industry and provide user's convenience	KORAIL Railroad enterprises
3	Railroad Construction Act	Railroad construction	• To establish the railroad network, build the railroad, legislate the laws for station area development and develop the public welfare	KRNA, railroad enterprises
4	Urban Railroad Act	Urban railroad operation	• To promote the urban railway for smooth traffic in urban area, operation efficiency and provide user's safety and convenience	Local government, SMRT, Urban railroad enterprises
5	Railroad Safety Act	Railroad safety	• To define the regulation for railroad safety and establish the safety system for public interest and welfare.	All railroad organizations
6	Tramway Transportation Act	Track business	• To secure the safety of rail facilities and efficient operation of rail transportation and operation.	Rail business enterprises
7	Special Act on Metropolitan Transport Management	Metropolitan Railroad	• To define the rule to deal with the transportation in an urban area in a comprehensive way.	Relevant organizations
8	Law on aviation, railroad accident investigation	Railroad accident	• To investigate and identify the cause of the railroad accident by aviation & railroad investigation committee so as to prevent the accident and secure the safety	All railroad organizations
9	Law on Operation by Public Agency	Public enterprise	• To establish the rule for management of public organization and responsibilities, efficient and transparent operation	KORAIL, KRNA
10	Local Public Enterprise Act	Local public enterprise	• To define the rule for management by local government or by corporation which will manage for rational management	Seoul Metro
11	Act on Private Investment in SOC	Private investor	• To promote the private investment in social infrastructure to build and operate it in efficient and creative way	Private investor

Source: National Law Information Center Website (2017), www.law.go.kr

C. Urban railway-related laws

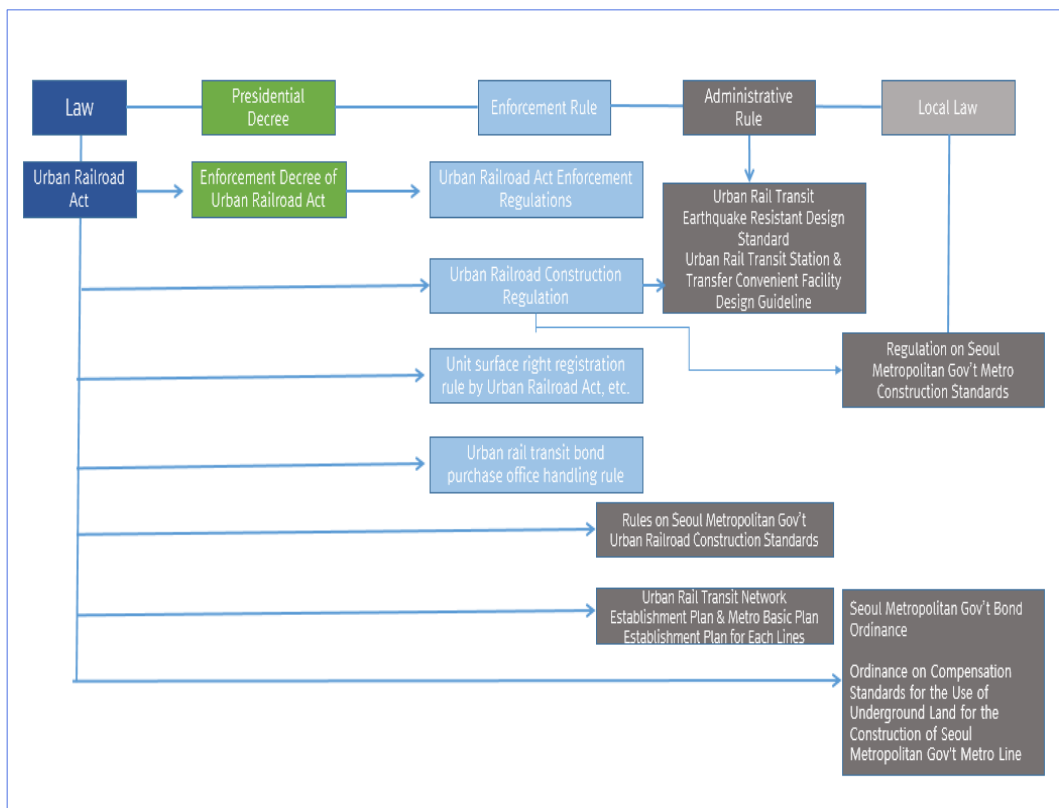
1) Objective and definition of Urban Railroad Act

o Urban Railroad Act is aimed to promote the construction of the urban railway and to rationalize the operation for smooth transportation in the urban area, thereby providing a safe and convenient system to all customers.

o "Urban railway" refers to the monorail, tram, linear induction motor, maglev train and other rail transportation means.

2) Structure of Urban Railroad Act

Figure 7 | Structure of Urban Railroad Act



Source: Ministry of Land, Infrastructure, and Transport (2017), Urban Railroad Act

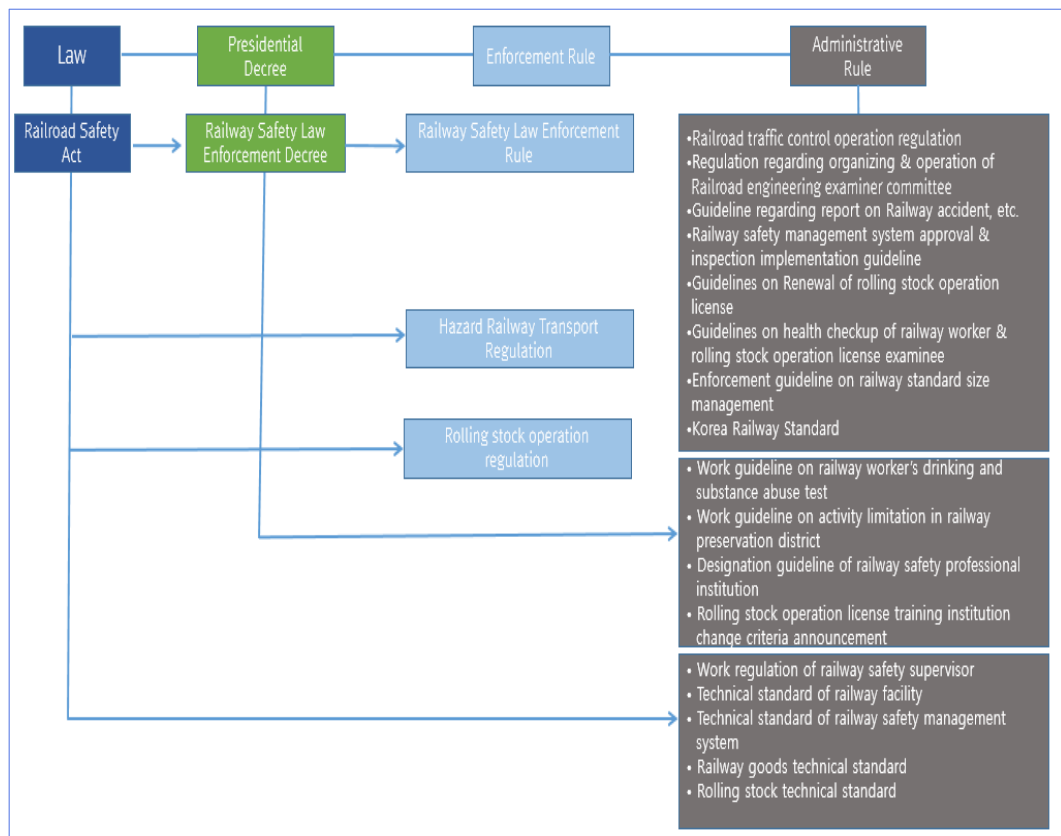
D. Railroad safety-related law system

1) Objective of Railroad Safety Act

o Railroad Safety Act defines the regulations necessary for railroad safety as well as establishing a railroad safety management system for enhancing the public welfare

2) Structure of Railroad Safety Act

Figure 8 | Structure of Railroad Safety Act



Source: Ministry of Land, Infrastructure, and Transport, (2017). Urban Railroad Act

3. Urban railway Driver's License System in Korea

A. License Type of Locomotive Engineer

o To be able to operate a train according to the Railroad Safety Act, driver's license must be issued by the Ministry of Land, Infrastructure, and Transport ("MOLIT"). The license is classified into 5 categories such as high-speed vehicles, Class 1 electric cars, Class 2 electric, diesel, and railway equipment.

o HSR license is needed to run a train at a high-speed of 200km/h and a class 1 electric locomotive license is needed for electric vehicles (locomotive by electric power). Electric car (railway vehicle by distributed electric power) for urban railway requires a class 2 electric car license and a diesel car license is needed for diesel locomotive (locomotive by diesel engine) on railway, diesel car (railway vehicle by distributed diesel power) and a steam locomotive (locomotive by steam engine). Railroad vehicle driver's license holder is qualified to drive a railway vehicle that runs at 25km/h or less at depot, regardless of type of vehicle. To drive another vehicle than that of designated on the license, drivers must complete a training session at the MOLIT.

Table 31 | Type of license and the vehicles

Classification	Description
License for High-speed train	High speed train Vehicle indicated by the railroad equipment license
License for Class 1 electric car	Electric locomotive Vehicle indicated by the railroad equipment license
Vehicle for class 2 electric car	Electric car Vehicle indicated by the railroad equipment license
License for diesel car	Diesel locomotive, diesel car, steam locomotive Vehicle indicated by the railroad equipment license
License for railroad equipment	Machine and instrument needed for construction and maintenance of railroad Railroad restoration equipment that runs railroad and road Vehicle that runs at 25km/h or less on dedicated railroad

Source: Article 11 of Railroad Safety Act enforcement regulation [Attachment1]

B. Procedure to Obtain a Class 2 Electrical Car's License

o To qualify for the railway vehicle driver's license, applicants must be over 19 years old and shall meet the requirements as indicated on the Railroad Safety Act. They must pass physical examinations and an aptitude test and must complete training courses organized by the MOLIT. Those who completed the training course shall obtain the driver's license through the test and shall receive the operation practice on the actual railway route prior to official driving of the train. The process to obtain the license for class 2 electric car is shown in Table 32.

Table 32 | Process to obtain the driver's license of railway vehicle

Classification	Process
Stage 1	Physical examination and aptitude test - Physical examination at MOLIT-designated hospital - Aptitude test at MOLIT-designated agency
Stage 2	Training at MOLIT-designated training institution - Class 2 electric car: 410 hours of technical education
Stage 3	Written examination - 4 times a year by Korea Transportation Safety Authority - 40 points per subject, 60 on average or higher (60 at least for railroad safety)
Stage 4	Skill test (those who passed written examination) - by KTSA - 60 points per subject, 80 points on average at least
Stage 5	License issued

Source: Article 11 of Railroad Safety Act enforcement regulation [Attachment 1]

C. Physical Examination

o Applicants must pass the physical examination at designated medical institutions.

o Physical examination for railway vehicle driver's license includes;

- General defect: Malignant tumour, hypertension, epidemics
- Nose, mouth, and throat: Communication function
- Skin: Skin problem, Hansen's disease
- Chest: Tuberculosis that may affect job performance
- Circulatory system: Kidney failure, and arrhythmia, etc.
- Digestive function: Chronic hepatitis, anaemia

- Urinary system: Chronic nephritis
 - Endocrine system: Thyroid, diabetes
 - Blood system: Leukaemia
 - Nervous system: Nervous system that may affect walking or sitting
 - Others: Limb disorder, hearing, sight and mental disorder
- o Based on the Article 40 of the enforcement regulation, drivers are obligated to get health examination every two years.
- Initial examination: Physical examination before mobilizing to the task.
 - Regular examination: Every other year after initial examination
 - Special examination: When the job performance is difficult due to railroad accident or disease at railroad operator's discretion.

D. Aptitude Test

- o Those who wish to obtain a driver's license according to the Article 15 of Railroad Safety Act shall pass the aptitude test hosted by MOLIT to identify the qualification as a railway vehicle driver.
- o Attitude test are carried out by a specialized agency designated by MOLIT and currently, KORIL is the only eligible agency in Korea.
- o Aptitude test includes multiple questionnaires and a response test. The first part is to check the intelligence, attitude, and personality while the second part is to check speed prediction, attentiveness (selective attention, attention allocation, and continuous attention), distance perception and stability.
- o And the driver shall undergo an aptitude test according to the Article 41 of enforcement regulation, which is categorized as below.
- Initial Test: Before starting the task
 - Regular Test: Every 10 years after initial test
 - Special Test: When difficult to perform the task due to railroad accident or disease at railroad operator's discretion.

E. Education and Training

- o Those who wish to obtain a railway vehicle driver's license shall take the training program as indicated by MOLIT to have the knowledge and ability for train operation in accordance

with the Article 16 of Railroad Safety Act.

- o MOLIT designates a training institution for train operation training and currently there are 6 institutions (3 by railroad operator and 3 in colleges) including the KORAIL training center.

1) Selection of trainees

- o Trainees are selected among those who have experience and of those who do not in the field of railroad, or among the students at colleges. The training course is classified depending on the trainee's career history. Trainees from the inexperienced group are selected via open competition and the students by recommendation from the dean.

Table 33 | Selection of trainees by institution

Category	Trainee	Selection	Test subject
Railroad operator	Inexperienced	Open competition	• Railway safety, Physics
	Experienced	Recommendation	• Eligibility
College	Inexperienced	Open competition	• Railway safety, physics
	Student	Recommendation	• Recommendation

Source: SK Cho (2014). "Study on empirical analysis of railway vehicle driver's license system, Graduate School of Information, Dongyang University

2) Training course for class 2 electric car license

- o Those who are over 19 years old meeting the requirements in the Article 11 of Railroad Safety Act and those who have experiences are classified into 4 categories as shown in Table 34 below.

Table 34 | Training curriculum and course for class 2 electric locomotive license

Curriculum	Hours	Subject
Unexperienced	410	
Experienced	Who worked for 1 year as train operation assistant or 2 years as assistant for electric car	• Field practice • Operation practice and simulation operation • Emergency measures
	Who worked for 3 years in railroad operation field	
	Railroad equipment license-holder	
	Diesel car or class 1 electric car license-holder	

Source: Article 20 of Railroad Safety Act [Attachment 7]

3) Training Institution's Training Subject & Training Time

o Training from the initially appointed training center includes both theoretical and technical training. However, theoretical training is currently closed. However, there are some institutions that voluntarily conduct theoretical training.

Table 35 | Training curriculum and course for class 2 electric locomotive license

Classification	Subject	Training Time	
		Inexperienced	Experienced
Theoretical Training & Others	Railway related law (inexperienced)	50	15
	Introduction to Metro System	50	15
	Structure & Function of Electric Car	120	55
	Introduction to Driving Theory	30	15
	Emergency Action	30	10
	Team Work Training & entrance/completion ceremony	10	-
	Theory Training Total	290h	110h
Functional Training	Site Training	410h	100h
	Driving Work & Simulation Training		
	Emergency Action Practice		
Total	Theory Training + Technical Training	700h	210h

Source: Seoul Metro (2013), Operation rules for railway vehicle driver's license training, Seoul Metro

F. Train Driver's License Exam

- o Those who wish to obtain railway driver's license must pass the MOLIT-organized driver's license test. The test is carried out by Korea Transportation Safety Authority empowered by MOLIT and the test is comprised of a written examination and a technical test depending on the category of license. For those who passed the written examination are entitled to sit in the technical test. The written test score is valid until December 31st of the 2nd year of the test date. Technical test is normally conducted with a simulator.
- o The subjects of the test for both experienced and inexperienced applicants for class 2 electric car are shown in Table 39. The test takers need to achieve 40/100 or more for each subject (60/100 for railroad-related law). Also, test takers need to achieve total average score of 60 or more. For the technical test, test takers need to achieve 60/100 or more for each subject and achieve total score of 80 or more on average.

Table 36 | Test subjects for class 2 electric car license

License	Written	Technical
Class 3 electric car license	Railroad-related law Urban railroad system general Structure & function of electric car Operation theory general Emergency measures	Preliminary inspection Braking Other equipment than brake Compliance with the signal, operation rule, signal/route Emergency measures

Source: Railroad Safety Act enforcement regulation [Attachment 10]

G. Overseas Train Driver's License

- o Obtaining a train license is mandatory in Japan, USA, Germany and France and in most other countries in the world. In Japan, the license is issued by the Ministry of land, infrastructure, transport, and tourism in accordance with the Article 21 of Railroad Business Act and the license is issued by the Federal government in the U.S. while in Germany and France, it is issued by the railroad operator.

1) Train Driver's License System in Japan

Table 37 | Procedure to Obtain Rolling Stock Driver's License in Japan

Classification	Description
Aptitude test and physical examination	Aptitude test for license
	Physical examination for license (JR-designated agency)
⇓	
JR Railroad training center	Lecture and test
	Technical test
⇓	
MOLITT	Application for license after passing the test
	Driver's license is issued and approved

Source: SK Cho (2014). "Study on empirical analysis of railway vehicle driver's license system, Graduate School of Information, Dongyang University

- o There are two ways to obtain a license. First, through the national examination by Ministry of Land, Infrastructure, Transport & Tourism (MOLITT) and second is through the examination by the agency designated by MOLITT. The procedure is shown in Table 37.
- o A 10-month training program at JR training center is required. Theoretical instruction for 3 months (400 hours) and technical training including emergency measures and depot inspection for 4 months (515 hours) is conducted.
- o For independent driving, separate OJT and practice and evaluation are required.
- o Curriculum
 - Information communication system, control system and signal system including ATS·ATC
 - Operation system as a safety system, the operation system of control center (including station operation system), emergency train stop (alarm system) and automatic train control and safety system
 - Driving while monitoring the train ahead at heavy traffic zone, train stop in right position, passenger safety and contact, signal check and operation considering operation conditions and the environment.

Table 38 | Subject and Schedule for Train Driver's License (JR, Japan)

Theory		Function	
Subject	Hours (h)	Subject	Hours (h)
Total	400	Total	515
Rolling Stock	119	onboard task	440
Operation rule	92	Emergency measures	50
Operation theory	60	Fundamentals	15
Signal and Track	42	Operation on mainline	10
Catenary	40		
Railroad general	21		
Inspection & emergency measures	18		
Safety management	8		

Source: SK Cho (2014). "Study on empirical analysis of railway vehicle driver's license system, Graduate School of Information, Dongyang University

2) Train Driver's License System in the U.S.

- o Preliminary hazard analysis (PHA) based on Railroad vehicle driver's license in the USA, MIL-STD-882(Military Standards 882: Military standard for system safety) includes safety evaluation, S/W safety, emergency safety which is defined by Railroad Safety Act. Driver's qualification system in railroad safety rule program is shown in Table 39. (SK Cho, 2014).

Table 39 | Rolling Stock Driver's License System in the U.S.

Classification	Description
Preliminary test	High school diploma, 21 years old at least Basic physical strength test Physical examination such as hearing, sight, etc. drug, alcohol abuse, criminal record
⇓	
Field workers	Theory and field practice
⇓	
License test	Operation function test Railroad-related laws & regulations
⇓	
License and Certification	Skill and laws Emergency response ability test Qualified when passing physical strength, drug/alcohol abuse Qualified when passing the test Retraining or dismissal when failed

Source: SK Cho (2014). "Study on empirical analysis of railway vehicle driver's license system, Graduate School of Information, Dongyang University

3) Train Driver's License System in the U.K.

- o The license in the U.K. follows Railway Safety Case, 1994 and London Underground shall submit the report to The Health and Safety Executive (HSE) accordingly and railroad operator shall review railroad safety regulation every three years and railway vehicle driver's license system is shown in Table 40.

Table 40 | Rolling Stock driver's license system in the U.K.

Classification	Description
Preliminary test	Physical conditions Memory test Hearing and sight test Personal interview
⇓	
Field workers	Theory and field practice
⇓	
License test	Law & regulation examination Knowledge on motor car and operation test Operation route examination
⇓	
Probation	License
⇓	
Certification	Operation of changed motor car (every 6 months) Medical check (every 5 years) Drug & alcohol abuse test (5% random test)

Source: SK Cho (2014). "Study on empirical analysis of railway vehicle driver's license system, Graduate School of Information, Dongyang University

- o Railroad safety system in the U.K. has a great effect on establishing the integrated EC system and attempts to integrate with the system in France and Germany and the license system tends to be integrated into line with the collapse of railroad boundary. Wurzburg Univ. in Germany integrated the studies on driver's license and certification system and developed the integrated management system module. (S.K. Cho, 2014).

4. Railroad Safety Approval System in Korea

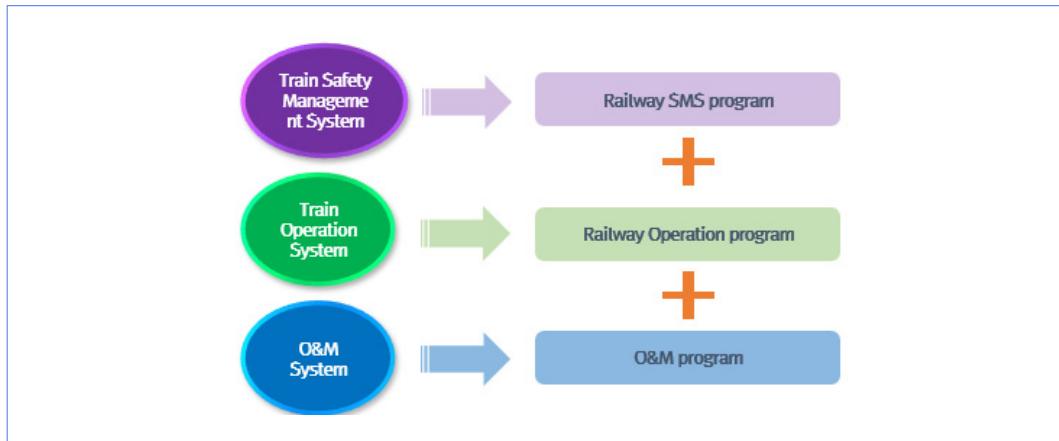
A. Overview of the Railroad Safety Approval System

1) Definition of railroad safety management system

- o Railroad safety management system refers to the organization of human resources, facilities, operation procedure and emergency response system required for railroad

operation and management. It consists of railroad safety management system (SMS), train operation system and maintenance system.

Figure 9 | Configuration of Railroad Safety Management System



Source: Office of Legislation

- Safety Management System (SMS)

A safety management organization, roles, and responsibilities, procedure, preparation, management and regulation to implement clear, systematic and preventive railroad safety management activities.

- Train operation system

A train operation organization, human resources, train operation method, procedure, plan, train and station task railroad control, railroad protection, maintenance of order and operation record for safe train operation.

- "Maintenance system"

An inspection, repair, replacement and improvement system for the safety of both the railway vehicle and facilities.

2) Railroad safety management system approval

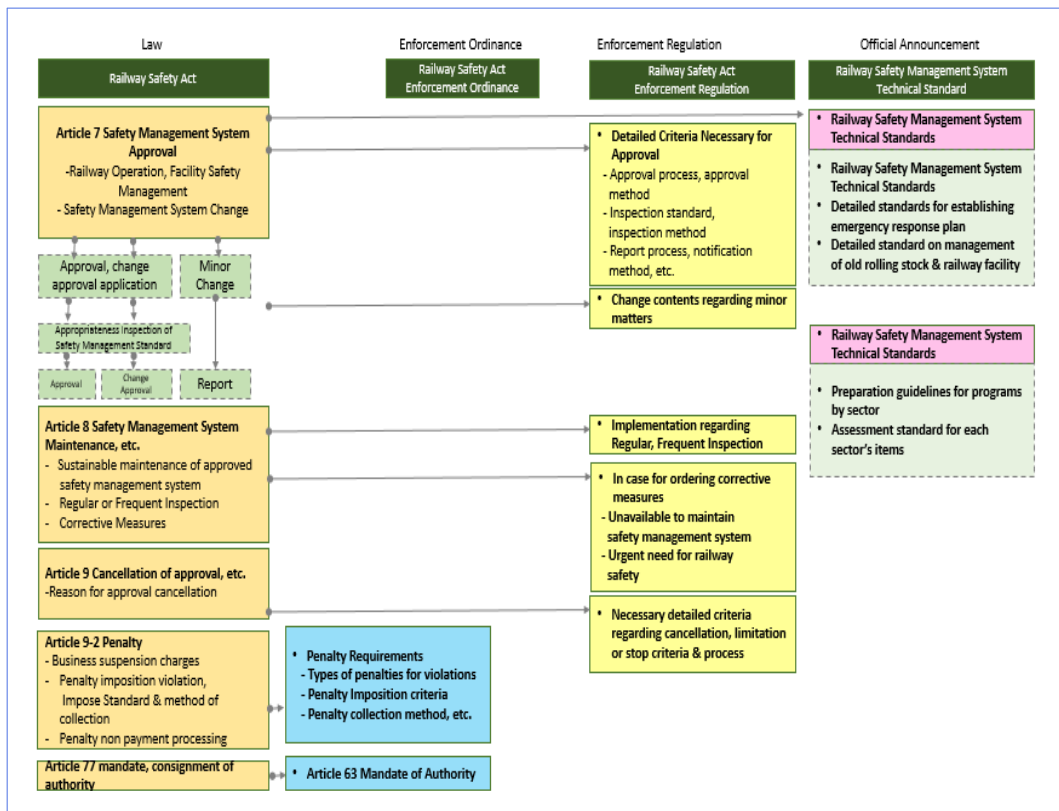
o Railroad Safety Act in Korea was revised with new enforcement regulation and guideline to authorize the eligible one for railroad operation and management.

o Revision of Railroad Safety Act for introducing approval system is as follows.

- [Article 7] Approval of safety management system: Approval for railroad operation and facility management to those who have safety management system
- [Article 8] Maintenance of safety management system: Regular or special inspection for sustaining safety management system
- [Article 9/9-2] Cancellation of approval/penalty: Suspension of business and penalty to induce voluntary safety management

o Revised railroad safety regulation to induce approval system.

Figure 10 | Railroad Safety Management System-Related Regulations



Source: Ministry of Land, Infrastructure, and Transport (2017), Railroad Safety Act

o Highlight of approval system

- Railroad operation and facility safety management including railroad safety management, risk management, accident investigation and report, internal inspection, emergency response 7& training, training, safety information, operation safety, vehicle and facility maintenance.

B. Major Management Work due to Approval of Railroad Safety System

1) Railroad SMS program

Table 41 | Railroad SMS program

Classification	Description
① Safety management policy	Safety policy Safety goal Safety plan Safety management review Safety system committee Role & responsibility
② Documentation	Operation procedure, manual, work standard supplement
③ Risk Management	Annual risk evaluation Initial risk evaluation New & extension route operation New operation, RS, facility Safety effect monitoring Change management
④ Compliance	Needs, operation procedure Intensive item monitoring
⑤ Investigation/Report	Internal report for risk & accident
⑥ Internal inspection	Review (safety system) Inspection(regular, special) Monitoring (safety goal, risk management, compliance)
⑦ Emergency response	Emergency response plan Emergency training & practice
⑧ Training	HR program Training plan
⑨ Safety information	Provision of safety information Risk assurance
⑩ Safety culture	Safety culture measuring program

Source: Seoul Metro (2017), Seoul Metro Safety Management Master Plan

2) Train operation program

Table 42 | Train operation program

Classification	Description
① Train operation manpower	• Appropriateness of train operation manpower (Human resource management)
② Qualification	• License and qualification management
③ Employee management	• Human error, drug, alcohol, fatigue
④ HR appropriateness	• Initial and regular review
⑤ Train operation plan	• Train operation plan (Medium & short-term transport plan)

Source: Seoul Metro (2017), Seoul Metro Safety Management Master Plan

3) Maintenance program

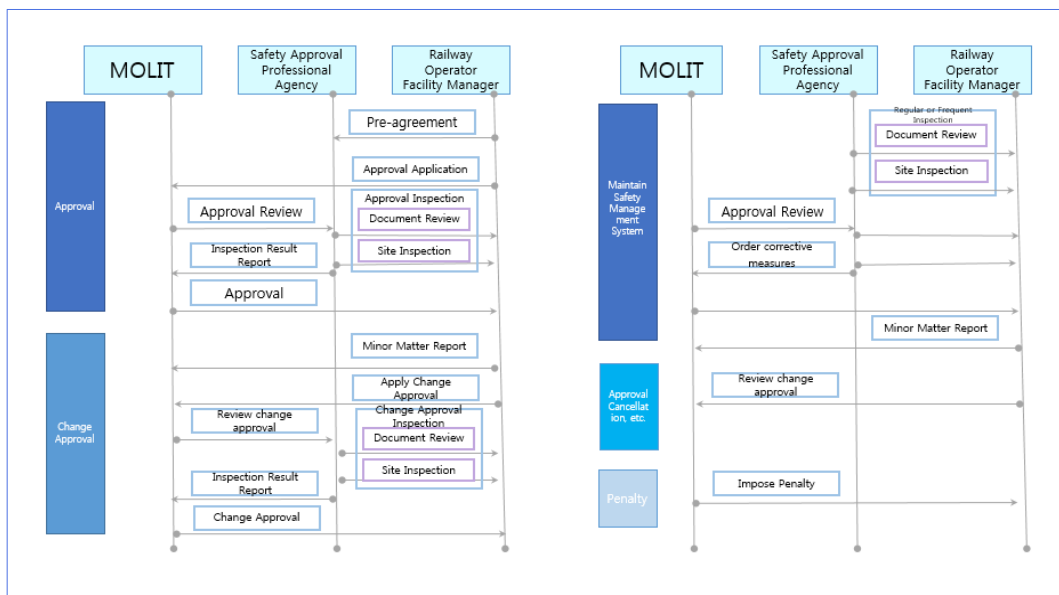
Table 43 | Maintenance program

Classification	Description
① Appropriateness of manpower	• Review of appropriateness
② Maintenance implementation plan	• Maintenance implementation plan (inspection, repair, refurbishment, replacement)

Source: Seoul Metro (2017), Seoul Metro Safety Management Master Plan

C. Railroad Safety Management System - Approval & Change Procedure

Figure 11 | Railroad Safety Management System – Approval & Change Procedure



Source: Ministry of Land, Infrastructure, and Transport (2017), Railroad Safety Act

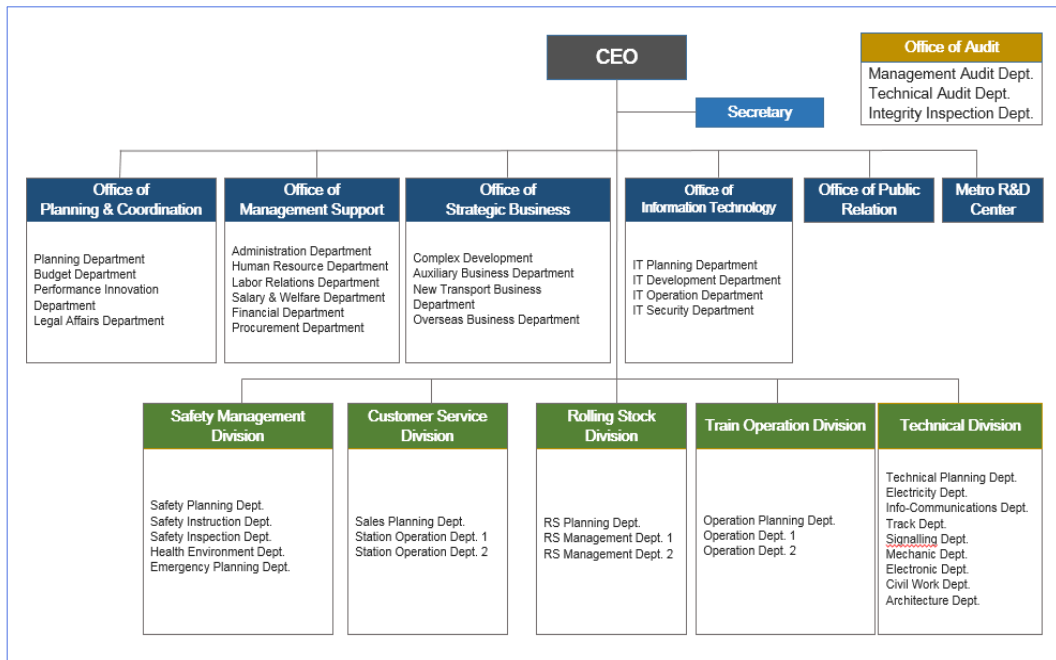
D. Implications

o Railroad SMS, train operation, and O&M program shall be specifically defined and approval of railroad safety management system is in need. In Korea, safety management system is established according to the revised Railroad Safety Act and RAMS, which is required by the railroad safety management system standard for voluntary systematic railroad safety management. Safety system shall be defined to specify the performance and RAMS goal.

5. Organization and Job Description of Seoul Metro

A. Organization Chart of Seoul Metro

Figure 12 | Organization of Seoul Metro¹



Source: Kim Tae Ho (2014). History of Seoul Metro for 20 years, Seoul Metro

B. Job description

1) Overall Safety Management Office

o Safety Management Department

- Safety accident prevention and countermeasure, railroad safety management system and safety training
- Overall accident management and zero-accident campaign
- Mock exercise organization (evaluation) and accident prevention training

o Investigation Department

- Operation accident & operation obstruction investigation to identify the cause

- o Health Environment Support Department
 - Health management and industrial safety health committee operation and safety rule management
- o Emergency Plan Department
 - Emergency plan, civil defense & reserves, and security management

2) Planning Control Office

- o Planning Department
 - Business management goal, mid & long-term plan and implementation plan for major tasks
 - Major projects development, CEO instruction management, debt management and emergency transportation plan
 - Collection of fare increase data, national and municipal assembly-related works
 - Organization management, reassignment, responsibilities by discipline
 - Board of directors, subsidiaries and organization management
- o Budget Department
 - Budgeting, adjustment, operation, debt management and med & long term financial plan
- o Performance Innovation Department
 - Performance indicators, measurement, and overall management
 - Management (Innovation) evaluation, analysis (statistics) deliberation and cost analysis
- o Legal Affairs Department
 - Legal suit, regulations, articles of association and by-laws

3) Management Support Office

- o General Affairs Support Department
 - Event, Ceremony organization, document control, vehicle and company building management
 - Current asset management, inventory, material supply schedule
- o Human Resource Department

- Manpower supply, employment, and personnel management
- Performance review, personnel committee operation, training plan
- o Labor-management cooperation Department
 - Collective bargaining & agreement and other labor-management affairs
- o Communication & Welfare Department
 - Overall welfare management, employee welfare plan
 - Wage, bonus and social insurance management
- o Financial Department
 - Cash, deposit and securities-related works and tax administration
 - Fund management, settlement, domestic financing, bonds, and funds implementation management
 - Construction and service contract, procurement contract
- o Information Plan Department
 - Development of management information system (SMRT-NEURO, UTIMS) and maintenance
 - EDPS, computer system (network) and security management

4) PR Office

- o PR plan, activities, and publication
- o Coordination with the press and response to the report

5) Technical Research Institute

- o Master plan for R&D, patent application, and intellectual properties
- o Technical localization & standardization and overall R&D management
- o Introducing the new technology in facility and vehicle, localizing the motor car parts
- o Developing vehicle operation technology and reliable maintenance technology

6) Strategic Business Division

- o Strategy development Department
 - Future strategic business, business feasibility analysis, overall plan
 - New route, LRT business, and new idea business
- o Incidental Business Department
 - Operation of leased and related facility, advertisement plan
 - Bond, dispossession proceedings, incidental and new business
- o Domestic business Department
 - Land for urban railway and facilities, building procurement, sale, and compensation
 - New route, LRT, and development of surrounding area
- o Overseas Business Department
 - Overseas cooperation and business

7) Customer Service Division

- o Strategic Marketing Department
 - Transport plan & goal, marketing, mid & long-term transport plan and demand analysis.
 - Fare system and increase, transportation-related regulations
 - Settlement of fare with other transportation means
- o Service Support Department
 - Supervision of business, passenger safety & operation accident prevention
 - Revenue management, transportation card, and fee
- o Customer Satisfaction Department
 - Station cleaning & disinfection and sanitary management
 - Passenger guide and sign at station
 - Voice of customer (VOC) analysis and customer satisfaction survey

8) Operation Division

- o Operation Plan Department

- Master plan, train schedule coordination, and overall control
- Operation agreement with other transportation means, rental, electric charge and operation regulation
- o Crew Support Department
 - Crew training, management, and work schedule
 - Operation security management and implementation plan
- o Rolling Stock Plan Department
 - Master plan, coordination and basic depot construction plan
 - Electric car supply, design, and contract
- o Rolling Stock Maintenance Department
 - Electric car maintenance plan, training plan & implementation
 - Electric car safety management, accident and failure management
 - Electric car inspection, light & heavy maintenance
 - Electric car cleaning, disinfection, and contract management

9) Technology Division

- o Technical Plan Department
 - Tunnel environment and working condition improvement
 - Estimate of demand for furnished material and supply plan
 - Urban Railroad energy conservation, carbon emission right, green gas target management
- o Electricity Department
 - Electrical facility operation, electric charge, and related works
 - Catenary power transmission & lighting and other electrical facilities
- o Mechanical Department
 - Station and mainline ventilation, sanitary, water supply, drainage
 - Station fire-fighting system and E/S & E/L
 - Fire prevention and USB real-time monitoring system operation
- o Signal Department
 - Signal facility operation
 - Signal facility inspection and operation guideline, failure and accident restoration measures

- o Communication Department
 - Communication facility operation
 - Communication facility inspection and operation guideline, failure & accident restoration measures
- o Electronic Department
 - AFC operation and control
 - Computer system (MIS network), office automation management
- o Civil Work Department
 - Civil structure improvement and operation and civil work contract
 - Urban railroad excavation work, connection passage, car parking facilities
 - Civil structure consignment (revised on 09.10.12)
- o Track Department
 - Track operation plan, safety measures, track improvement and operation
- o Architecture Department
 - Station, Depot building, and station refurbishment
 - Station environment design and station development & relocation

10) Audit office

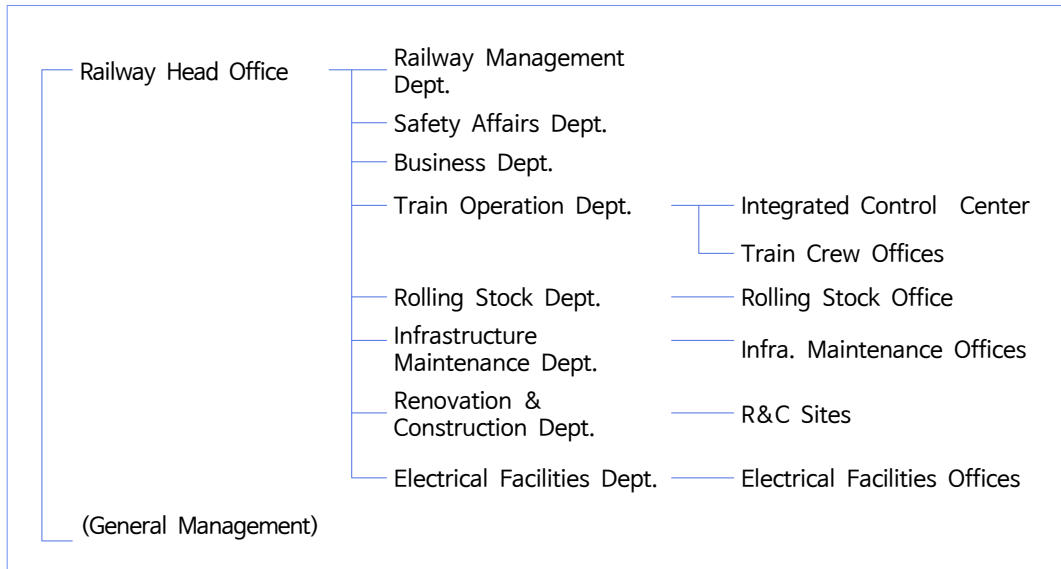
- o Work and financial audit, investigation of complaints
- o Integrity-related works

C. O&M Organization and Job Description in Japan

1) Tokyo Metro

- o Tokyo Metro is the successor of Tokyo Subway, which started operation since December 1927 at Ueno-Asakusa station. Tokyo Subway and Tokyo HSR were merged in January 1939 to start commercial operation of 14.3km-long Asakusa-Shibuya section, which was privately owned until April 2004. Currently, it is operating irrigation construction with another company.

Table 44 | Tokyo Metro Organization

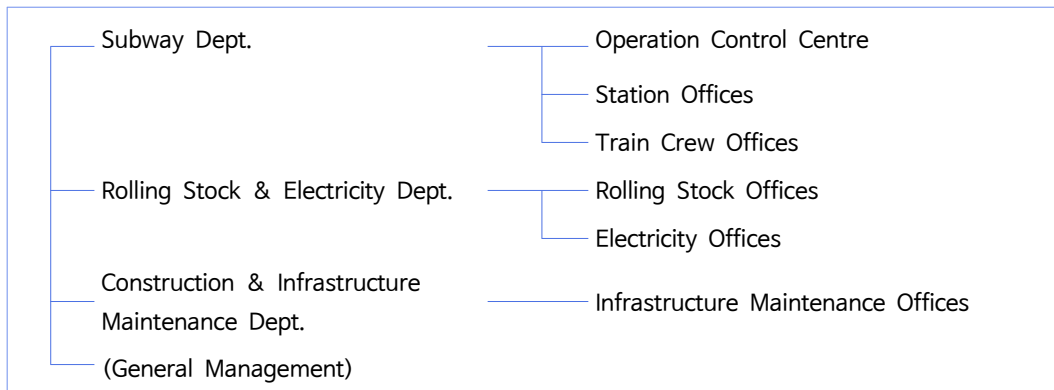


Source: JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line

2) Bureau of Transportation, Tokyo Metropolitan Government

- o Since the 2nd World War, subway construction permit was obtained in Tokyo and in December 1960, Oshiage-Asakusabashi, Asakusa line and in December 1968, Mita line and in December 1978, Shinjuku line was built and since then, it is in operation with other three lines except the Oedo Line.

Table 45 | Organization of Bureau of Transportation, Tokyo Metropolitan Government

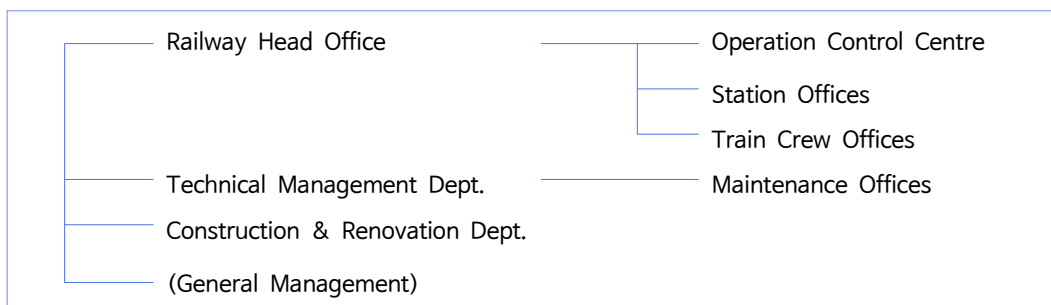


Source: JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line

3) Yokohama

- o In Yokohama, Line 1, Kamiooka-Isezakichojamachi (5.2km) was first built in December 1971 among 4 subways and Line 3, Kannai-Yokohama in September 1976. Lines 1 and 3 were extended and as a result, a 40.4km-long Blue Line was formed. A 13km-long Hiroshi-Nakayama, Line 4 Green Line started revenue operation.

Table 46 | Organization of Transportation Bureau, City of Yokohama

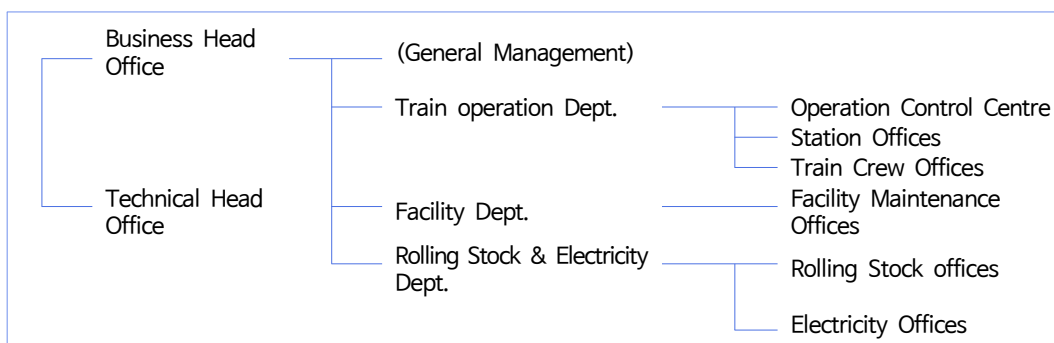


Source: JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line

4) Nagoya

- o Nagoya city adopted an urban plan to restore the city after the 2nd World War and in 1947, established the subway network plan and a 2.4km-long Nagoya-Sakae was built and in November 1957, Higashiyama line and in 1965, Meijoline, Nonami-Tokushige and Sakura-dori line started operation. Currently, Nagoya city is paying the lease fee to Link line for operation.

Table 47 | Transportation Bureau, City of Nagoya

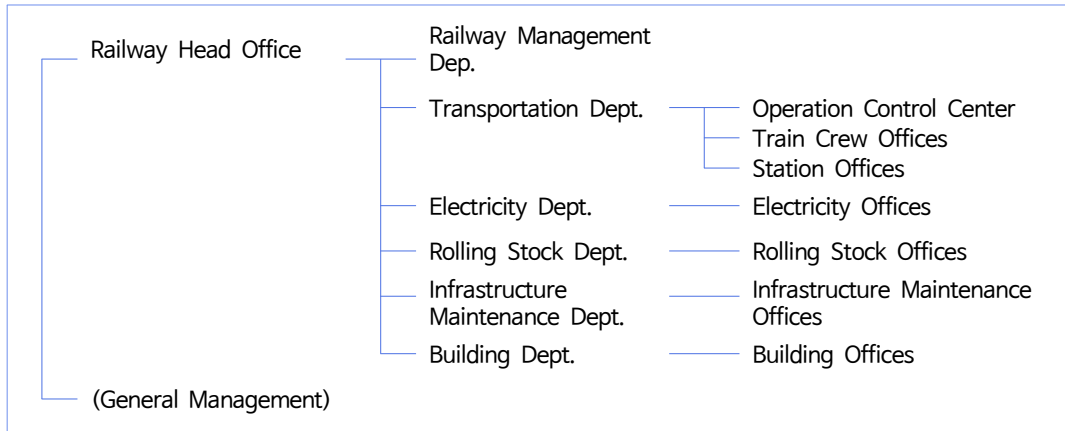


Source: JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line

5) Osaka

- o Osaka city adopted a 4-subway line plan which totaled 54.5km in 1925. Subway line Umeda-Shinsaibashi was the first city-owned railway. Currently, 8 lines are in operation.

Table 48 | Organization of Osaka Municipal Transportation Bureau

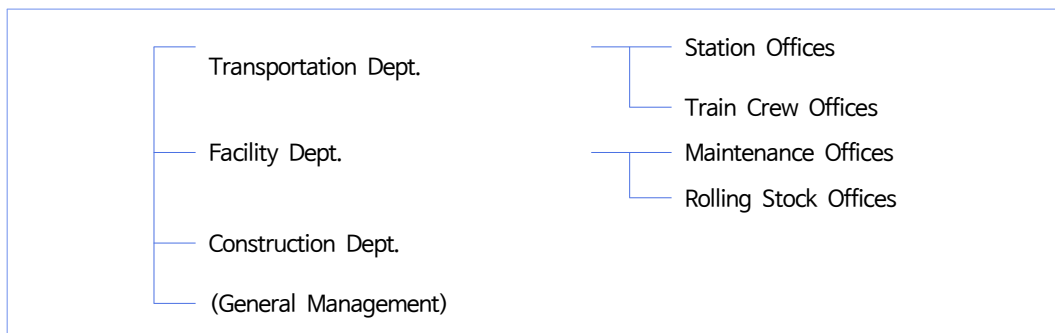


Source: JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line

6) Fukuoka

- o According to the subway construction plan established in 1974, a 9.8km-long Meinohama-Hakata and a 4.7km-long Nakasu-kawabata-Kaizuka were built. The entire route of Kuko line was commercialized in March 1993 and train operation started below the airport terminal. In February 2005, Nanakumaline at Hashimoto-Tenjin-minami started commercial operation and a 1.4km-long Tenjin-minami-Hakata is scheduled to complete in 2020.

Table 49 | Organization of Transportation Bureau, City of Yokoham



Source: JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line

D. Job Description of O&M Organizations

Table 50 | Job Description of O&M Organization

		Division/Department	Division of Major Duties
Head Office	General control division		General Affairs, Public Relations, Personal Affairs, Financial Affairs, Business Development, etc.
	Railway Headquarters	Railway Management Dept.	Management of Railway Headquarters
		Safety Affairs Dept.	Railway Safety Control and Transversal Engineering Control
		Business Operation Dept.	Management of Station Duties
		Train Operation Dept.	Train Operation Planning, Operation of Integrated Control Center, Train Crew Rotation Planning
		Rolling Stock Dept.	Control of Designing and Maintenance Planning for Rolling Stock
		Engineering Work Dept.	Maintenance Planning for Tracks and Civil Engineering Structures
		Electrical Facilities Dept.	Maintenance Planning for Power Supply, Signal/Telecommunication Facilities and Station Machines
		Renovation & Construction Department	Execution Control for Station Remodeling Projects, etc.
Worksite	Train Operation	Integrated Control Center	Control of Train Operation and Signal Handling
		Train Operation	Management of Station Crew
	Business Operation	Station	Station Duties such as Ticket Selling and Passenger Guidance (except Guarding and Station Cleaning)
	Maintenance/Management	Rolling Stock	Inspection of Rolling Stock/Control of Outsourcing
		Engineering Work	Inspection of Tracks and Civil Engineering Structures/Control of Outsourcing
		Electrical Facilities	Inspection of Power Supply, Signal/Telecommunication Facilities and Station Machines/Control of Outsourcing
	Renovation & Construction		Supervision of Station Remodeling Work, etc.

Source : JICA Experts Study for the Operations and Maintenance Structure of Mumbai Metro Line 3 Project in India

6. Preparations to start operation in Korea and examples

A. Laws related to opening preparation and operation procedure

1) Applicable laws

- o Preparations for operation shall be in accordance with applicable laws and procedures. Applicable laws include (1) Railroad Safety Act, (2) Enforcement ordinance and (3) Enforcement regulation and administrative rules includes MOLIT's integrated test & commissioning guideline. All preparatory process shall be based on applicable laws and regulations.

2) Provisions of applicable laws

- o Integrated test & commissioning shall be based on Railroad Safety Act and enforcement regulations thereof and consignment shall be in accordance with enforcement ordinance. Article 75-2 of enforcement regulation describes the review of T&C result and improvement measures, of which details are as follows.

Table 51 | Applicable laws and regulations

Category	Articles	Description
Railroad Safety Act	Article 38 (integrated test)	① Railroad operator shall conduct integrated test before starting normal operation when building a new line or improving existing line and report to MOLIT ② MOLIT shall review technical appropriateness, the safety of railroad facility and operation system and instruct to correct or improve as needed. according to Article 25-1 ③ Schedule & method of integrated test run according to 1) & 2) shall be determined by MOLIT
Enforcement Ordinance	Article 63 (Consignment)	2.1 MOLIT shall consign the following to KTSA according to Article 77-2 1~6. None 6-2. Review of test result according to Art 38-2 7. None ② ~ ④ None

Category	Articles	Description
Enforcement Regulation	Article 75 (Schedule & procedure)	① Integrated test run according to art 38-1 shall be carried out before starting revenue operation on route ② Integrated test run shall be carried out jointly with railroad operator who shall provide vehicle and manpower for the test when requested by facility manager unless there is any specific reason. ③ Railroad facility manager shall establish the test plan as below in cooperation with railroad operator 1~9. None ④ Railroad facility manager shall review the function and performance of railroad facilities jointly with railroad operator before starting integrated test run ⑤ Integrated test run shall be carried out in the following sequence. 1. Facility validation test: None 2. Test & Commissioning: None ⑥ Railroad facility manager, in the case of an upgraded line, may adjust the integrated test run schedule or exclude the part of the process in coordination with railroad operator. ⑦ Railroad facility manager, in case of integrated test run according to 5) and 6) above, shall check the test, test result and corrective measures taken jointly with railroad operator and report to MOLIT on result ⑧ Railroad operator shall correct or improve when indicated according to Art 75-2 and conduct integrated test again and report to MOLIT. In this case, part of integrated test run may be excluded. ⑨ Railroad operator when conducting integrated test run shall perform the following by safety manager. 1~5. None ⑩ Other detail procedure and method are determined by MOLIT notice.
	Article 75-2 (Review of test result and improvement instruction)	① Review of integrated test run result according to Article 38-2 shall be done in the following sequence. 1. Technical appropriateness according to Art 25-1 2. Safety of railroad facilities and train operation system 3. Appropriateness of normal operation preparation ② MOLIT may consult with the municipal government when reviewing the urban railway which is built and operated by those according to Art 3-2 of 「Urban Railroad Act」 or Art 24-2 or 42 of the same Act. A municipal government who was requested shall submit the comments within 7 days and no response within the period shall be considered no comment. ③ MOLIT may instruct the railroad operator to make correction or improvement as a result of review in 1) ④ Detail standard, procedure, and method regarding integrated test run result review shall be determined by MOLIT notice.

Source: National Law Information Center Website (2017). www.law.go.kr

3) Administrative regulation-Guideline for integrated test run

o Integrated T&C shall be based on administrative rules and in this regard, it is necessary to understand the goal, scope, and guideline. The guideline includes Chapter 1 General to 5 Safety management. Administrative rules are mainly based on Railroad Safety Act including those relating to integrated T&C.

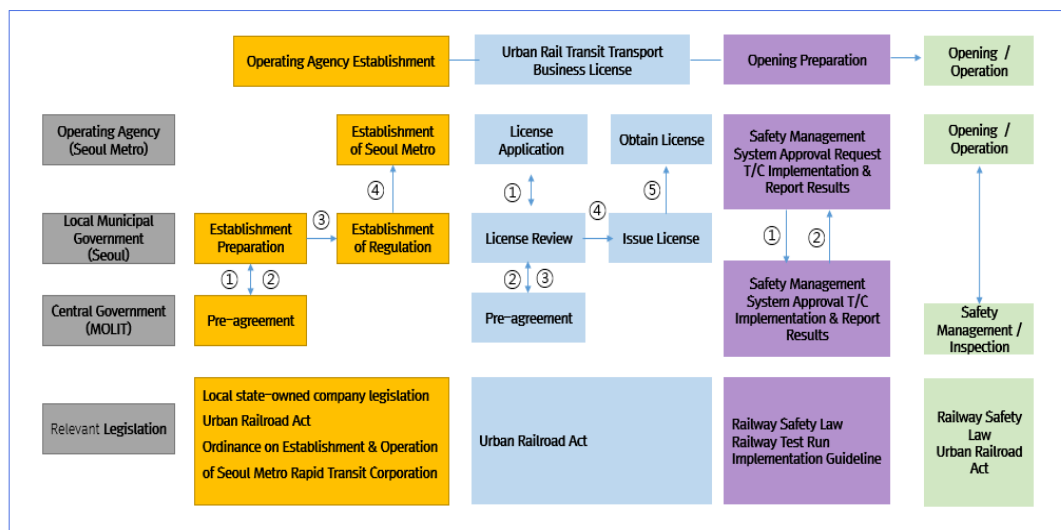
Table 52 | Guideline for Integrated T&C

Category	Description
Goal	Detail implementation for integrated T&C according to「Railroad Safety Act」
Scope	It shall be applied to reviewing integrated T&C to be carried out when building new line or upgrading existing line
Components	- 1. General - 2. Preparations for integrated T&C - 3. Implementation of integrated T&C - 4. Safety review - 5. Safety management

Source: Ministry of Land, Infrastructure and Transport (2017). Railroad Safety Act. MOLIT

4) Urban Railway Transit Operation Procedure

Figure 13 | Urban railway Operation Procedure



Source: Yoon Cheon Ju (2017). Status of Urban Railroad-related Laws in Korea. Seoul Metro

- o Preparatory procedure to launch urban railway operation shall start with establishing the operation organization, opening and operating and the responsibilities of the operator, local government and central government by stage are clearly defined. When the scope of the process to launch the operation is determined through consultation with the central government, local government (such as Seoul) approves it according to the procedure

〈Fig 13〉 shows the process and sequence which shall be carried out according to the applicable laws

B. Opening Case of Metros in Korea

1) Metro Line 7 Extension Opening

Figure 14 | Metro Line 7 Extension



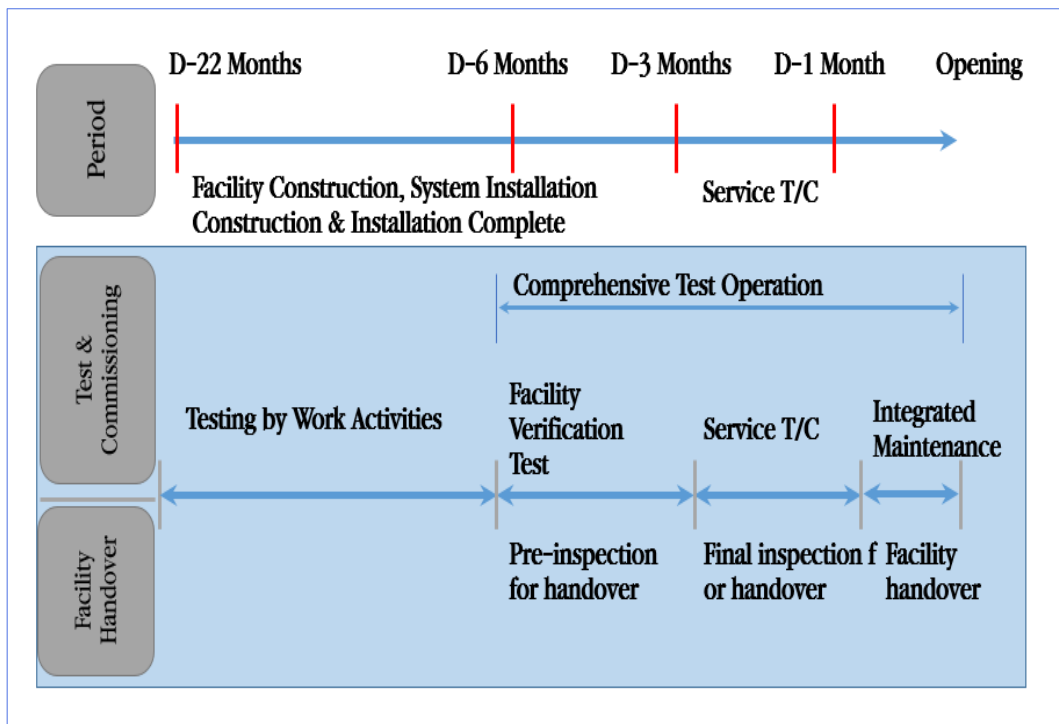
Source: Kim Gi Chun (2013). White Paper on Metro Line 7 Extension Opening. Seoul Metro

- o Line 7 extension implemented from December 31, 2004, until December 31, 2012, includes the route from Onsu (Line 7) to Bucheon city hall (Incheon Line 1). The total length is 10.2km with 9 stations. The project is summarized as follows.

(1) Test & Commissioning and Facility Handover Procedure

- o Test & commissioning and take-over process usually starts from D-22 M. The test is carried out from D-22 to D-6M and facility verification is carried out from D-6 to D-3 M for a test run. A test run is carried out for the last 3 months and integrated inspection is carried out for a month immediately before opening. Thus, integrated T&C is performed during the last 6 months.
- o The facility construction shall be completed 6 months before starting the handover process and preliminary inspection shall be completed 3 months before the final handover. Final inspection shall be finished 1 month before the final handover.

Figure 15 | Test Run and Facility Handover Procedure



Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(2) Method by Each Stage

- o Such process shall be carried out by stage as scheduled so as to prevent and supplement the potential problems. Appropriateness and functionality of the facilities shall be verified from D-22 M to D-6M before integrated test & commissioning. Integrated T&C shall comprise of (1) Facility verification test (2) test run and (3) integrated maintenance. Major works to be carried out as integrated T&C shall be as <Table 53>

Table 53 | Method by stage

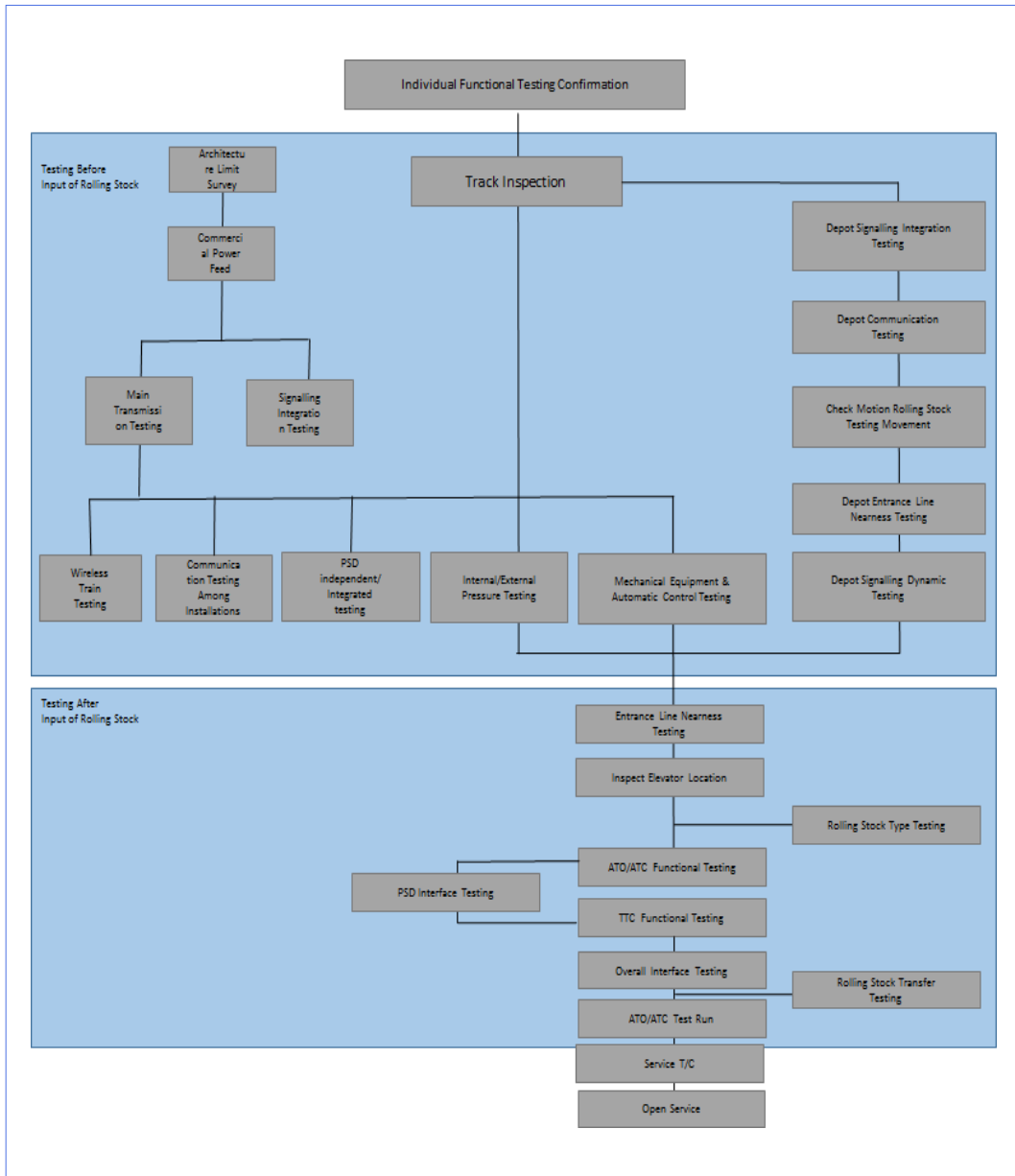
Stage		Description
Test by activity		• Appropriateness of construction, fabrication, and installation of the structure • Appearance, dimension, quantity and individual functionality
Integrated test run	facility validation (preliminary inspection)	• Readiness for test & commissioning • Interface with related systems after the test by activity
	Test & Commissioning (Final inspection)	• Problems during simulated revenue operation (normal, emergency) • Correction of the problems found validation test and schedule appropriateness
	Integrated inspection (hand-over)	• Final correction of the problems found test & commissioning and previous test

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(3) Process by Each Stage

- o For Line 7, it is divided into the first stage and the second stage based on the mobilization of rolling stock. The tests before mobilizing the RS include the building, track and signal system and after mobilizing the RS, it starts with energizing test, ATO/ATC function test and PSD interface test and the revenue test run is carried out after ATO/ATC test.

Figure 16 | Process by Each Stage



Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(4) Test & Commissioning and Facility Hand-Over Procedure

1) Satisfaction of the requirements of railroad integrated test run

Table 54 | Responsibilities for T&C and take-over procedure by stage

Stage	Description
Test by activity	- Compliance with the requirements of railroad structure and track facilities - All railroad structure, support, and mechanical & electrical safety clearance - Car dimension, clearance with railroad structure and facilities - Normal operation of wayside detectors - Operation of safety system at maintenance depot - Power supply circuit, power supply and cut-off procedure, implementation procedure - Field control of substation facilities and system - Substation power supply and work permit procedure - Catenary electrical return circuit connection - Catenary power supply system by section - Catenary height and deviation and electrical clearance - Catenary zoning system for power cut-off at the yard or depot. - Compatibility with the existing system and radio communication system compatible with the planned network. - Facility and wayside wire system operation - Safe operation of train control system and central control system - Track turn out and train control system operation - Emergency response procedure
Preliminary inspection	- Review of test result by railroad facility manager - Function and performance check to determine the integrated test run - Railroad construction schedule for integrated test run - Review of railway vehicle and manpower for integrated test run - Data required for train schedule according to Article 27 of railroad construction guideline
Facility validation	- Normal operation and safety of the railroad facilities - Operational appropriateness and connectivity between facilities and vehicle
Test & Commissioning	- Train operation system: Interface with signal, communication and train control system - Technical skill of railroad workers: Training and practice for train crews and drivers - Preparation for revenue operation: Operation facilities and passenger convenience facilities

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(5) Implementation plan for preparation for railroad opening

- o A detailed implementation plan for preparation is divided into 3 stages. The 1st stage includes the test by discipline and activity and facility verification support plan including the plan for test & verification period, facilities for the test, participants and detail test and verification plan. The 2nd stage is revenue test run plan, that is, train operation plan. Track access and occupation plan for safety, control, emergency operation plan and scenario are needed. Finally, final inspection and facility hand-over plan shall be developed and inspection period and participants shall be determined with the facilities for inspection and handover.

(6) Test run and facility hand-over in parallel

- o Test & commissioning and facility handover are implemented simultaneously. Thus, it may be carried out in parallel. During the test by activity and facility verification, function and performance of the facilities shall be verified and supplemented as needed and at T&C, problems with revenue operation shall be improved.

2) Gimpo LRT

(1) Operation preparations and project structure

- o Gimpo LRT under the management of Seoul Metro will be operated as 「Gimpo urban railway O&M」. Seoul Metro provides O&M and ancillary works at the cost 101.3 billion (excluding VAT) and expected to start operating on Nov 1, 2018. After 22 months of preparations, the service will be provided until Oct 31, 2023. Operation hours will be 05:30~25:00, 19.5 hrs/day and headway at an early stage will be 3 to 9 minutes.

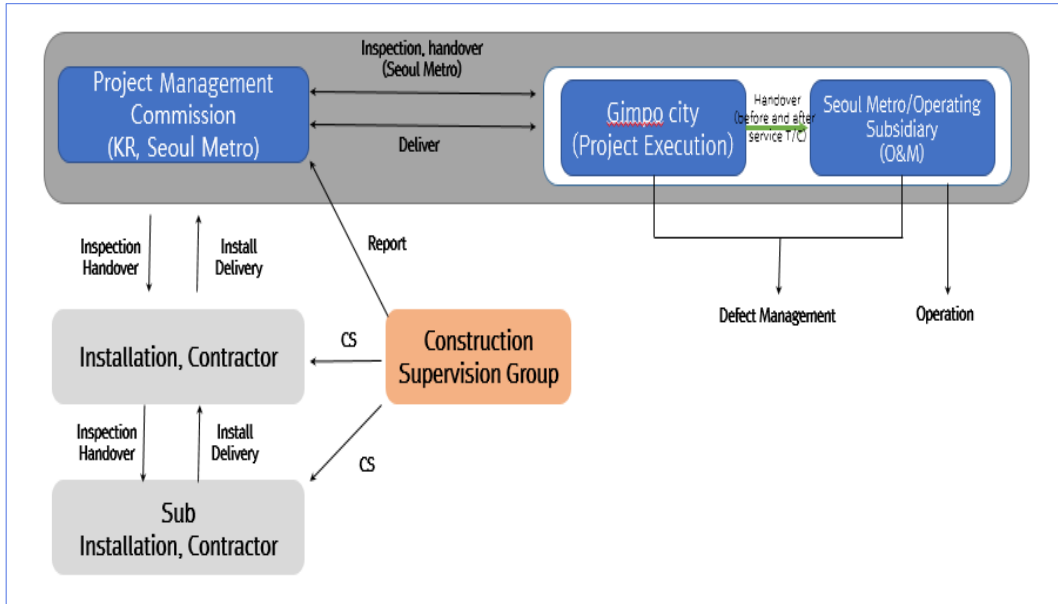
Table 55 | Project summary

Category	Description
Client	Gimpo city(PM: KRNA _ Seoul Metro)
Route	Han River New town (Yangchon depot) ~ downtown (Gulpo-Bukbyun) ~ Gimpo Airport (transfer)
Cost	₩1.5086 tri (LH 1. 2 + Gimp 0.3086)
Scale	23.67km, 10 stations (1 depot)
Rolling stock	46 cars 23 sets (steel wheel, AGT, completely unmanned)

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

- o Project management will be provided by KR and operation by Seoul Metro. Project structure of Gimpo LRT is as follows.

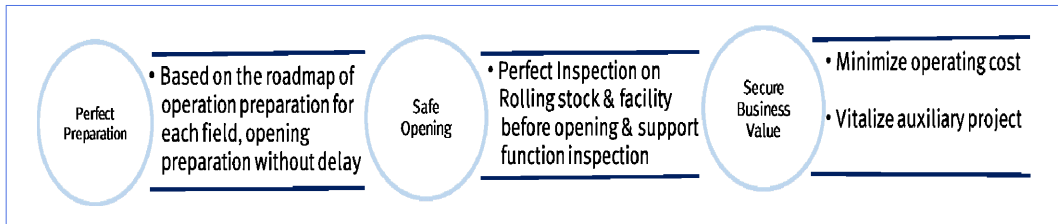
Figure 17 | Project Structure



Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

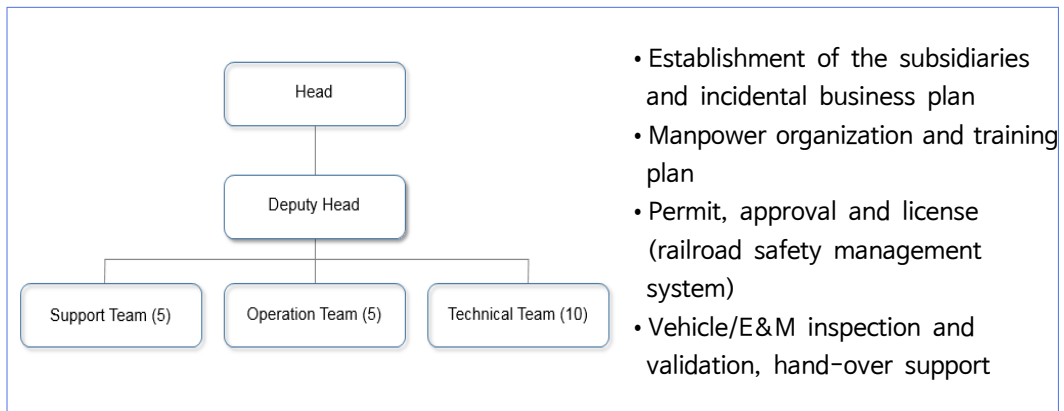
(2) Overview on Preparation for Operation

- o Push forward strategy of preparation for operation is to prepare operation by field without hindrance based on the plan. In the big picture, operation preparation is implemented focusing in 3 areas as follows: 'perfect preparation', 'safe opening service', and 'secure business value'. 'Perfect preparation' is successfully opening service on November 1st, 2018 by preparing opening service during each stage without hindrance. 'Safe opening service' is to perform perfect inspection on all available rolling stocks and facilities, etc. Additionally, focusing in operation preparation such as minimize operation cost and vitalize non-transport revenue to secure business value

Figure 18 | Push Forward Strategy for Gimpo LRT

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

- o The task force for operation preparation has three teams with total 22 members including team leader. It consists of support team (5), operation team (5) and technical team (10) under the control of team leader and assistant team leader. This task force will start with incidental business plan after subsidiary company is established. Organization and task of the task force are as follows.

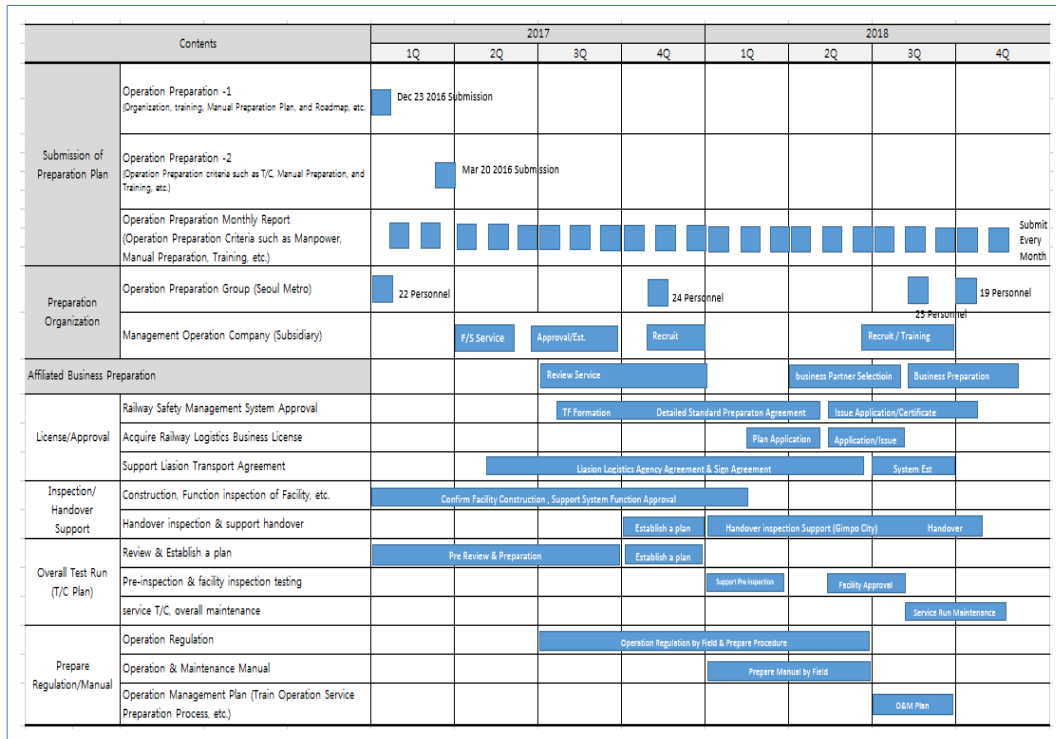
Figure 19 | Project structure

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(3) Operation preparation road map

- o Quarterly operation preparation roadmap is developed including the details from January 1, 2017 until the opening date in 2018. Included in the plan are submission of preparation plan, organization, incidental business plan, license/approval, inspection /handover support, integrated test & commissioning and preparation of the regulation/manual which are further detailed by sub-item. Roadmap with the goal by period is as follows.

Figure 20 | Operation Preparation Roadmap



Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(4) Manpower mobilization plan

Table 56 | Manpower mobilization plan

Category	Stage 1	2	3	4	5	6	after '20.
	'17.01.(D-22)	'17.11.(D-12)	'18.01.(D-10)	'18.08.(D-03)	'18.10.(D-01)	'18.11.(OpeningMonth)	(7 for HM)
Total	22	25	81	181	237	218	226
Team	22	25	25	23	19	-	-
Subsidiary	-	-	56	158	218	218	226

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

o Manpower will be mobilized for over 6 stages from D-22M from the task force and subsidiary company and after 2020, 226 persons including 8 for heavy maintenance will be mobilized and the details are shown in <Table 56>

(5) Establishment of the subsidiaries

- o A subsidiary company responsible for operation will be established in January 2018 in accordance with the Article 54 of Local Public Enterprise Act and the Article 47-2 of Enforcement Ordinance. Viewing in detail, investment feasibility study was conducted from April to June in 2017 and report to Seoul City and endorsement by Seoul City Council are scheduled to be from July to October in 2017 before establishment in January 2018. Operation organization at early operation stage includes the president, auditor, director, 1 office, 2 bureaus and 7 teams with total 226 persons.

(6) Recruitment (subsidiary for operation) - open competition

- o Recruitment of manpower will be conducted through open competition. It consists of 97 career positions, 36 entry-level positions and 85 contract-based positions and recruitment will be made over 3 times beginning in 2017 until 2018 according to the roadmap as needed and the details of recruitment plan are shown (Table 57).

Table 57 | Recruitment (subsidiary) - Open competition

Category		Total	1st(59)	2nd(102)	3rd(57)
Notice		-	'17.09~10	'18.04~05	'18.06~07
OJT		-	'17.11~12	'18.06~07	'18.08~09
Discipline		218	director (3), safety (13), technical (31), audit (2), control (10),	train safety control (69), technical (33)	passenger safety (32), technical (25)
Type	Experienced	97	52	33	12
	New	36	7	16	13
	Temp	85		53(train safety)	32 (passenger safety)

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(7) Training-Multi-functional convergent person

- o The initial training is intended to cultivate the instructor who will eventually become future trainers for the future trainees. Instructor training is categorized into train safety person,

central control and technical/train and training duration is different by category. The trainees who complete the training program for instructor will train both the experienced staffs and entry-level positions. License-holders are qualified for train safety and control only.

Table 58 | Curriculum

Category		Subject	Remarks
Train safety person	Instructor (Task Force)	• OJT through test run	• 2 weeks • another 2 weeks for validation
	Experienced/New (Operator)	• Route validation during integrated test run	
Central control	Instructor (Task Force)	• Manufacturer training → participating in inspection and hand-over process	• 5~8 weeks • another 3 weeks for manufacturer training
	Experienced/New (Operator)	• In-house & common training	
Technical / Rolling stock	Instructor (Task Force)	• RS and system function	• 4~8 weeks • another 4 weeks for manufacture training
	New employee (Operator)	• before assignment → technical & RS operation and maintenance • after assignment → operation experience, know-how, and field practice	

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

※ Train safety person/controller: license-holder

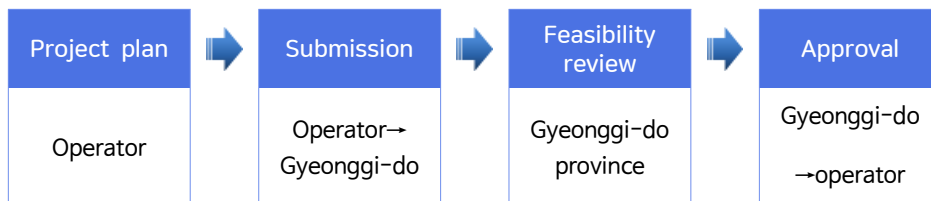
(8) Preparation for Affiliated Business

- o Push forward strategy for Gimpo LRT's operation preparation aimed not only transport business but to utilize non-transport affiliated business. Scope for early affiliated business was planned such as passenger convenient rental shop, advertisement, and storage, etc. Advertisement is currently planning in station, subway, and tunnel advertisement. Also, not only storage but other affiliated business' profit model is also initiated. If the manager prepares a business plan and submits the proposal, Gyeonggi province office, which is the parent agency of Gimpo LRT will review feasibility and appropriateness. Afterwards, it will go through the process of business approval.

Table 59 | Stage of preparation for Affiliated business

Period	Description
Jun.~Dec. 2017	Outsourcing for development including business method and profit model, etc.
Jan.~Mar. 2018	Decision-making on incidental business plan
Apr.~Jul. 2018	Selection of businessman
Aug. ~Oct. 2018	Preparation of business (Pre-operation task force, operator)

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

Table 60 | Project approval procedure

Source: Article 28-2 of Urban railroad

(9) Major legal approval requirements

o Major legal approval required includes (1) Railroad safety management system, (2) License for urban railway transit business. (3) Transportation terms & conditions and (4) Transport linkage. Details on official approval time and authority are summarized in <Table 61>

Table 61 | Major legal approval requirements

Classification	Applicant	Approval deadline	Approver
Railroad safety system	Operator	90 days before operation	MOLIT
Urban Railroad license	Operator	90 days before operation	City/Province
Transportation terms	Operator	90 days before operation	City/Province
Connection transportation	Gimpo operator	30 days before operation	Agreement

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

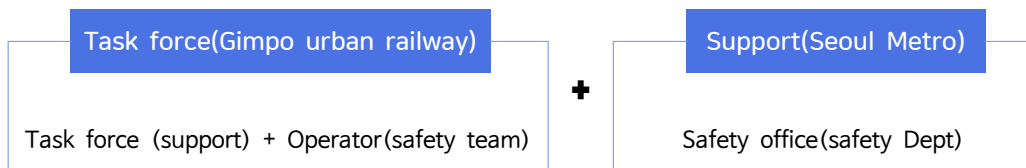
- o Approval of railroad safety management system is based on Article 7 of Railroad Safety Act and Article 2 of enforcement regulation and railroad safety management system standard. Application over 3 areas include railroad safety management system (SMS), train operation system and maintenance with total 124 items. Railroad safety management system contains safety management, train operation contains station control and train operation and maintenance contains vehicle, technology, civil and building work.

Table 62 | Approval of railroad safety management system

Safety management system (SMS)	Train operation system	Maintenance system
67 items	30 items	RS, civil, building 27 items

- o The organization is divided into implementation organization including operation preparation task force and operator and the support organization which will be the Seoul Metro safety control office. For approval as planned, early organization and operation are considered.

Table 63 | Task force/support organization (for stable approval process)



- o Approval procedure of certification system is planned to start from August 2017 and issuance of the certificate will begin in September 2018. Organization of implementation and support team will be planned starting September 2017 and the certificate will be issued to Gimpo LRT from March 2018 after consultation with Korea Transportation Safety Authority and document review and site investigation and approval by MOLIT.
- o 「Urban railroad transport business license」 will be applied to the city or province by submitting the urban railway transport business plan which shall be based on Article 26, 27 and 42 of Urban Railroad Act and Article 27 of enforcement ordinance. The plan will be submitted to Gyeonggi province in May after approval by Gimpo city in March 2018 and the license will be issued by Gyeonggi province in July. The agreement on transportation business will be made between Gyeonggi province and MOLIT.

- o Agreement on transportation linkage shall be based on Article 34 of Urban Railroad Act, which includes route connection, revenue-sharing and facility-sharing and operation. The agreement will be made in June 2018 after consultation between the parties in June 2017 and the system will be established by July 2018.

(10) Facility inspection, performance inspection and integrated test run

- o Integrated T&C and facility handover of Gimpo LRT will start from D-20M. Inspection of the facilities will start from D-20M for 10 months by concerned authority and the operator. For integrated T&C from D-6M, facility inspection, correction and test run will be carried out jointly by concerned authority and operator. Final inspection will be carried out by the operator until D-1M. Major tasks by stage are shown (Table 64).

Table 64 | Facility inspection, performance inspection, integrated test run

Facility inspection		Integrated test run			Maintenance	Opening
Test	Pre-inspection	Facility validation	Result	Test run		
D-20M (17.Mar~)	D-10M (18.Jan~)	D-6M (18.May~)	D-4M (18.Jul~)	D-3M (18.Aug~)	D-1M (18.Oct~)	D-day
Government/Operator		Test team(Government + Operator)			Operator	Operator

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

Table 65 | Major tasks

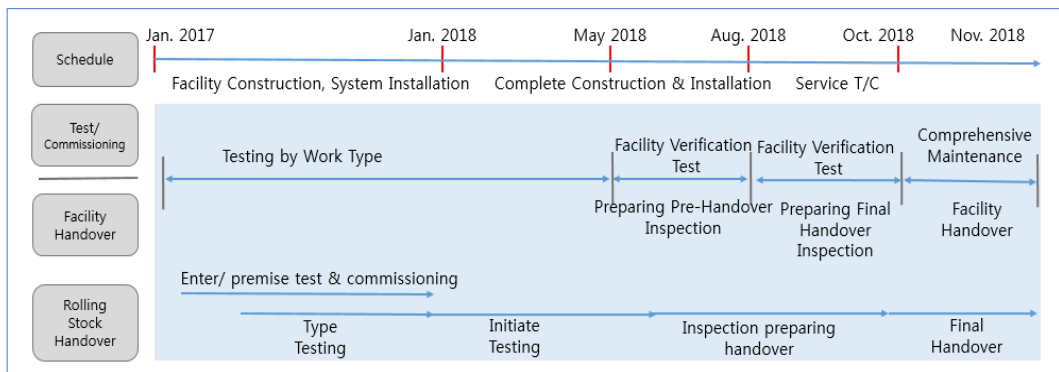
Classification		Work description	Remarks
Facility inspection	Test by activity	• Facility standard and safety & quality • System, network and communication system • Test by discipline, performance test by T&C plan	Government/operator
	Preliminary inspection	• Document review including facility function test • Test result review, facility safety inspection • Preparation for integrated test run	Government/operator
Integrated test run (test run)	Facility validation (preliminary hand-over)	• Facility operation and railroad safety • Operational appropriateness of vehicle • Facility-vehicle interface	Government/operator
	T&C (final hand-over)	• Problems with revenue operation • General connectivity and safety of facilities • Preparation for revenue operation	Government/operator
Integrated finish (facility hand-over)		• Report to MOLIT on integrated test run • Supplement for revenue operation • Station, RS, track and facility cleaning	Government/operator
Opening		Revenue operation	Operator

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

(11) Facility and train handover (Government → Operator)

- o Facility (system) handover shall be carried out for a month after completion and final inspection. It is intended to identify and supplement the problems as a result of Facility verification and test. Handover procedure is divided into two stages. First stage is implemented by system and discipline while the second stage is implemented jointly by the concerned authority and the operator. The objective of the handover process is to verify the facility functioning system and its performance during the test run. Operation is carried out by the experts in various fields and the KRNA team.

Figure 21 | Handover Procedure and Schedule



Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

- o Major tasks for each procedure are separated into facility inspection and handover process. Facility inspection includes the testing of the facilities and systems and supplement. Handover process includes a joint inspection to ensure the supplement from final inspection and final handover will follow accordingly.

Table 66 | Major Task Performed by Each procedure

Procedure		Major task	Responsibilities
Facility	validation	Test & inspection of facilities /system	• Test/inspection support • Preliminary inspection
	Supplement	Supplement after validation	• After notice & supplement, functional check and support
Hand-over	Inspection	Joint inspection by builder, government and operator	• Final inspection, supplement
	final hand-over	Handover certificate	• Hand-over and certificate • Support for handover

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

o Handover of rolling stock and inspection facilities will start from D-10M and the details are summarized in <Table 67> and <Table 68>.

Table 67 | Rolling stock and inspection facility handover procedure



Source: Article 28-2 of Urban Railroad Act

Table 68 | Rolling stock and inspection facility handover inspection

Category	Hand-Over inspection									T&C	Completion
	2018. 6				2018. 7					2018.8~9	2018.1
Week	1	2	3	4	1	2	3	4	5	Supplement	Final hand-over
Trainset	2	2	2	3	3	3	3	3	2		
Accumulative	2	4	6	9	12	15	18	21	23		

Source: Yoon Cheon Ju (2017). Gimpo LRT Pre-operation Plan, Seoul Metro

VI. Review of Other Case Studies in Korea

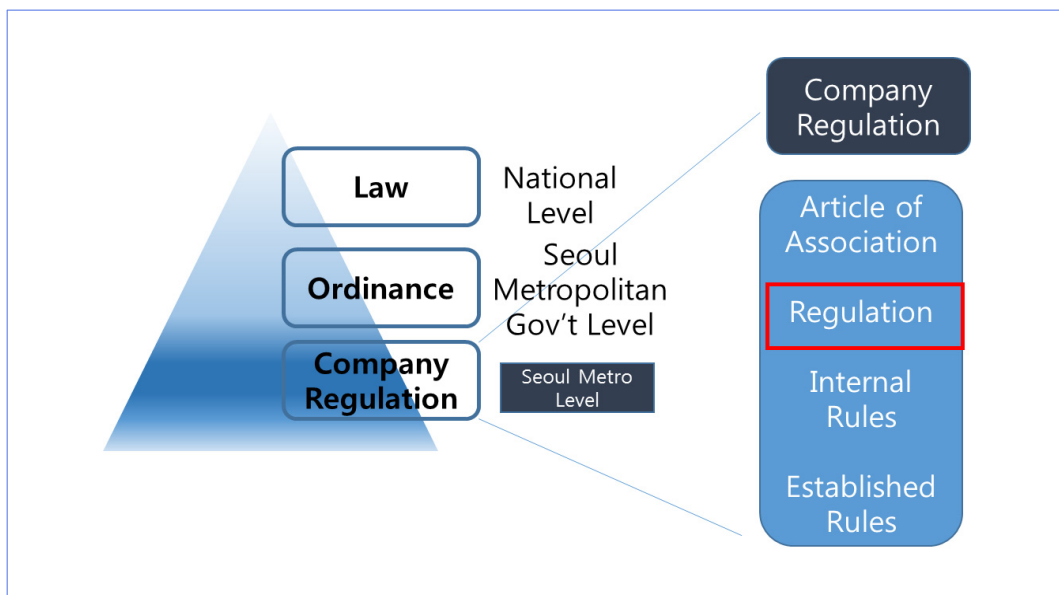
1. O&M-related Regulations

A. Significance of Regulation

1) Position of O&M-related regulations

o Regardless of its type and name, is codified as a criterion to be used as a reference in carrying out all the duties of the Seoul Metro.

Figure 22 | Position of O&M-related Regulations

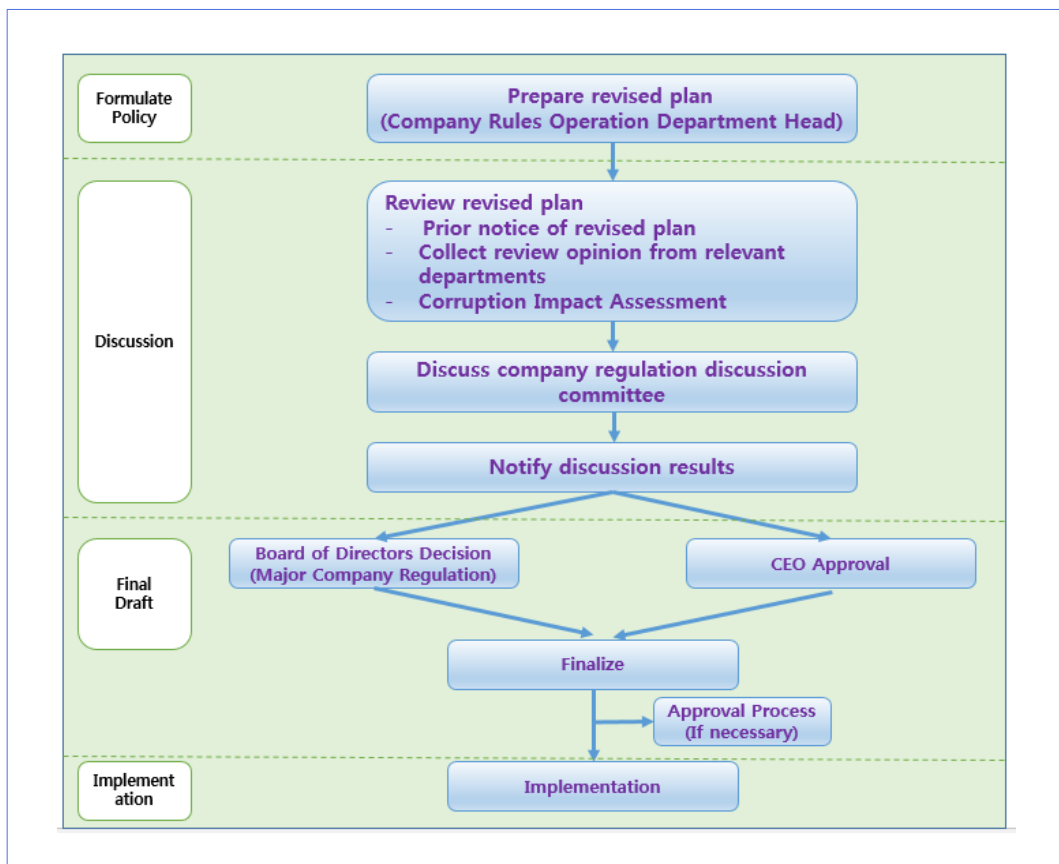


2) Components of Company Regulation

- o Articles of association: Basic principle including objective, organization and business scope.
- o Regulations: Set of frameworks regarding organization standard, responsibilities of all employees and the management policy.
- o Company Regulations: Standard below the Regulation stipulating the partial and limitative work process.
- o Rules: Rules below the Guideline which stipulates the procedure for regulation or bylaw.

3) Establishment/Revision Procedure of Company Regulation

Figure 23 | Establishment/Revision Procedure of Company Regulation



B. Cases of O&M Related Regulation: Seoul Metro

1) Components of Company Regulation: As of 2017. 1. 25

Table 69 | Components of Company Regulation

Articles of Association	Regulation	Bylaw	Rule
1	81	48	25

Source: Seoul Metro Data Seoul Metro Internal Rules (Jan. 25, 2017)

2) O&M-related regulations: 13 categories, 81 cases

Table 70 | Composition & Contents of O&M-related Regulations

No	Category	Title	Relevant discipline
1	Control	Control process operation	Control center
2	Wage	Overseas travel for official duties	HR Dept.
3		Short-term employee employment	Labor-management
4		Wage	Welfare Dept.
5		Welfare	Welfare Dept.
6		Seoul Metro employee's code of conduct	Management audit
7		Wage & Welfare	Welfare Dept.
8		Travel expense	HR Dept.
9		Annual pay	Performance Dept.
10		Budget account operation	Budget Dept.
11		Severance payment	Welfare Dept.
12		Employment	Labor-management
13		Uniform	Welfare Dept.
14		Code of ethics	Planning Dept.
15	Facility management	Building repair management	Building Dept.
16		Construction execution	Civil Eng Dept.
17		Mechanical equipment management	Mech Eng Dept.
18		Track maintenance	Track Dept.
19		Platform installation & operation	Safety support center
20	Signal communication	Platform door operation	Safety support center
21		Signal system repair	Signal Dept.

No	Category	Title	Relevant discipline
22	Signal communication	AFC maintenance	Electronic Dept.
23		Information communication operation	Communication Dept.
24	Safety management	Accident & failure investigation	Investigation Dept.
25		Safety management	Safety prevention
26		Safety health management	Health environment
27		Safety guide operation	Investigation Dept.
28		Disaster & safety management organization	Safety prevention
29	Business management	Electrical safety management	Electric Dept.
30		Auditing	Management audit
31		Management assessment	Performance Dept.
32		Record management	General Affairs
33		Planning management	Planning Dept.
34		Design operation	Arch Dept.
35		Civic complaint process	Customer satisfaction
36		Locker	Strategy development
37		Security process	Emergency plan
38		Incidental business	Incident business
39		Bylaw management	Legal Affairs
40		Office management	General Affairs
41		Seoul Metro administrative exemption	Management audit
42		Seoul Metro invention system	Technical Institute
43		Lawsuit process	Legal Affairs
44		Reward to the citizen system	Investigation
45		R&D operation & management	Technical Institute
46		Committee organization & operation	Planning Dept.
47		Aptitude test	Crew support Dept.t
48		Information system	Information plan
49		Proposal & suggestion system	Performance Dept.
50		Vocational sports promotion	General Affairs
51		Affiliated company management	Planning Dept.
52		Administrative information open system	General Affairs
53	Transport management	Accident settlement process	Customer satisfaction
54		Seoul Metro passenger service term	Strategic marketing
55		Transportation revenue management	Service support
56	Operation management	Lost-and-found process	Customer satisfaction
57		Guidance for drivers	Crew support Dept.
58		Operation process	Crew support Dept.

No	Category	Title	Relevant discipline
59	HR, training	Training & education	HR development
60		Short-term worker management	HR Dept.
61		Recommendation of skilled workers	HR Dept.
62		Labor management	HR Dept.
63		HR	HR Dept.
64		Personnel for Executives	HR Dept.
65		Executive recommendation committee	HR Dept.
66	Financial accounting	Contract	Contract Dept.
67		Goods Management	General Affairs
68		Property management	Domestic business
69		Accounting	Accounting Dept.
70	Electrical management	Electrical work and payment limit	Electric Dept.
71		Electrical facility installation	Electric Dept.
72		Electrical facility inspection & test	Electric Dept.
73		Power system operation	Electric Dept.
74		Power supply	Electric Dept.
75	Organization management	Approval system	Planning Dept.
76		Board of Director	Planning Dept.
77		Organization	Planning Dept.
78	Vehicle management	Electric car inspection	RS maintenance
79		Electric car management	RS plan
80		Electric car maintenance equipment	RS maintenance
81		Railroad vehicle manufacture	RS plan

Source: Seoul Metro Data_Seoul Metro Internal Rules (Jan. 25, 2017)

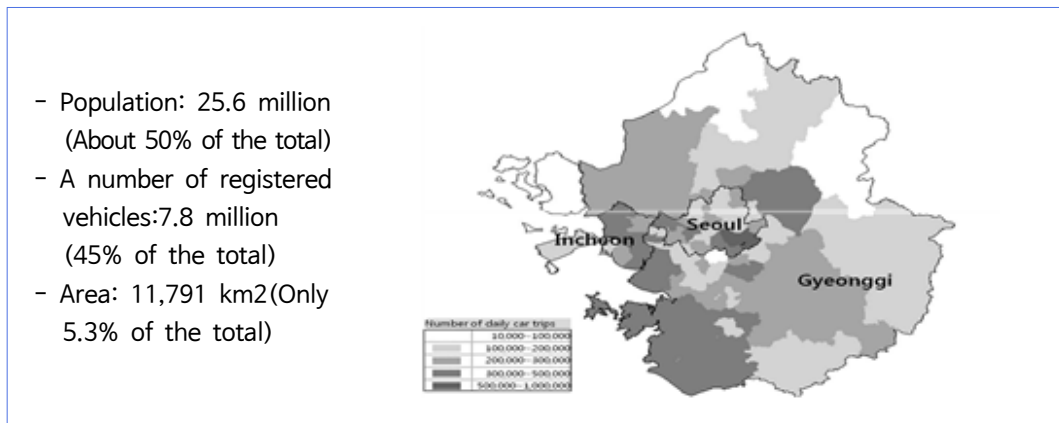
2. Integrated Fare System in Seoul

A. Current Status in Seoul

1) Metropolitan Area

o Metropolitan area is 11,791km² in terms of size taking up to 5.3% of Korea's total land area. It encompasses Seoul city, Gyeonggi Province and Incheon city where nearly half of Korea's population resides. The number of cars registered at the metropolitan area is 7.8 million which accounts for 45% of the national total.

Figure 24 | General Information of the Metropolitan Area

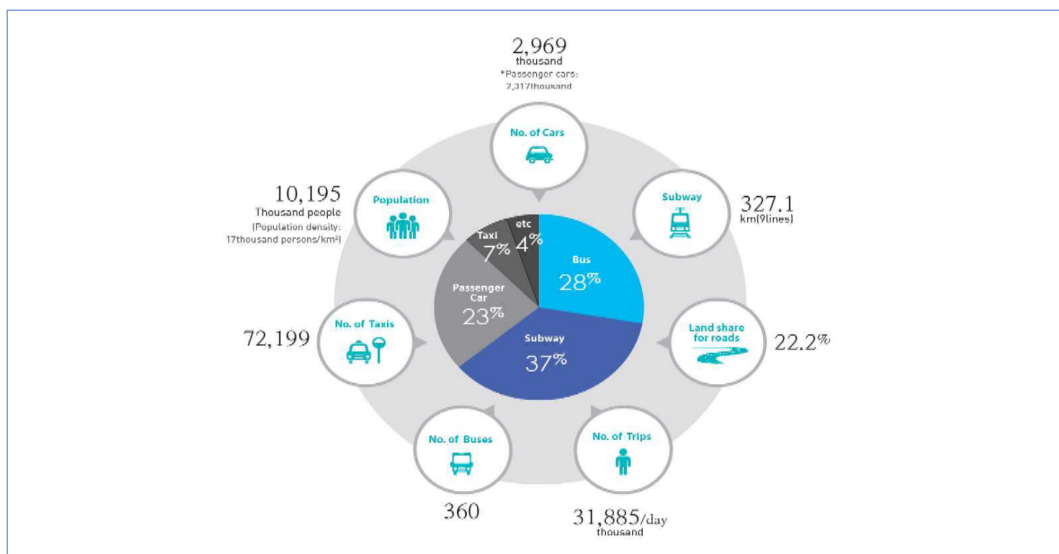


Source: Chang Yi (2017), *Public Transportation Reform in Seoul*, The Seoul Institute

2) Traffic in Seoul

- o The population of Seoul reaches 10.19 million with a population density 17,000 persons/km². Passenger car totals 2.96 million and as public transportation, taxi totals 72,199, bus 360 and subway runs 327.1 km daily.

Figure 25 | Transportation Means



Source: Chang Yi (2017), *Public Transportation Reform in Seoul*, The Seoul Institute

B. Implementation Background of Fare System Restructure

1) Weakened competitiveness of buses

o In the 1970s, a number of passengers per bus with a 60~70-person capacity reached 200 persons due to an explosive demand. Severe competition among bus companies resulted in paying lower wages to bus drivers and caused traffic congestion due to illegal parking which in the end decreased the overall demand, weakening the competitiveness of buses.

Table 71 | Cause of Declined Competitiveness of Bus

Low driver's wage

Average daily pay for transportation service workers (2003)

Category	Average daily pay (₩)
City bus	₩79,727
Cross-country bus	₩85,138
Express bus	₩109,677
Subway	₩119,565

Daily wage: ₩16,477

Traffic interruption by illegal parking

Traffic congestion

Source: Chang Yi (2017), *Public Transportation Reform in Seoul*, The Seoul Institute

C. Restructuring the Fare System

1) Implementation Measures

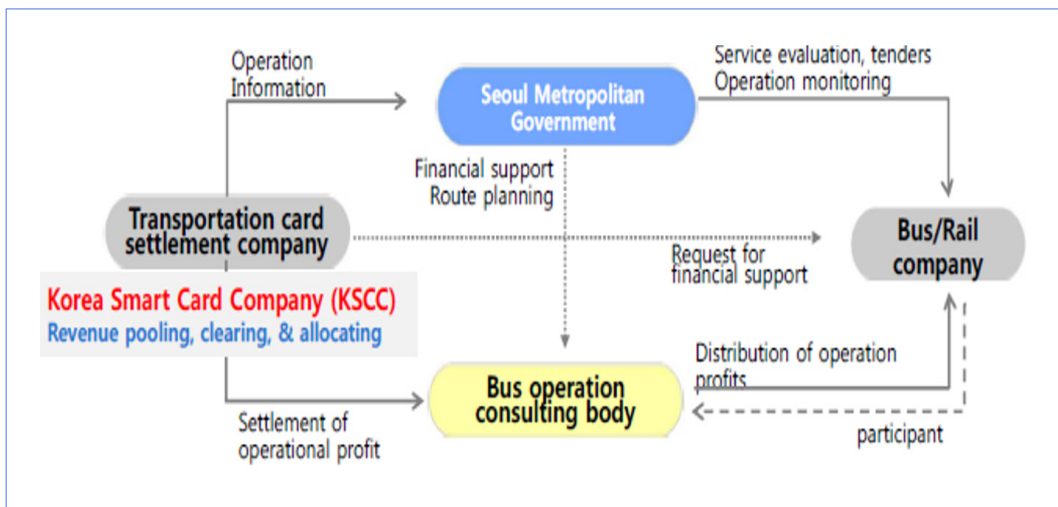
o Fare reconfiguration was made as part of public transportation innovation through the following procedures.

- Semi-public operation
- Separation into trunk and branch line
- Scientific operation management
- Expansion of a central bus-only lane
- Improvement of transfer center
- Introduction of a high-quality bus
- Support for integrated fare system
- Support for information communication technology
- Introduction of citizen's committee

2) Application Procedure

- o Transportation Card Company (Korea Smart Card Company, KSCC)
 - Operation information delivered to Seoul city
 - Operation cost designed by bus operation consulting agency
 - Financial support requested by bus & Railroad Company
- o Seoul Metropolitan Government
 - Financial support plan delivered to bus operation consulting agency
 - Service evaluation, bidding and operation monitoring of bus & railroad companies
- o Bus operation consulting agency
 - Profit-sharing with bus & railroad companies
- o Bus & railroad companies
 - Participation for consulting firm

Figure 26 | Integrated Fare System Application Procedure



Source: Chang Yi (2017), *Public Transportation Reform in Seoul*, The Seoul Institute

3) A distance-based integrated fare system

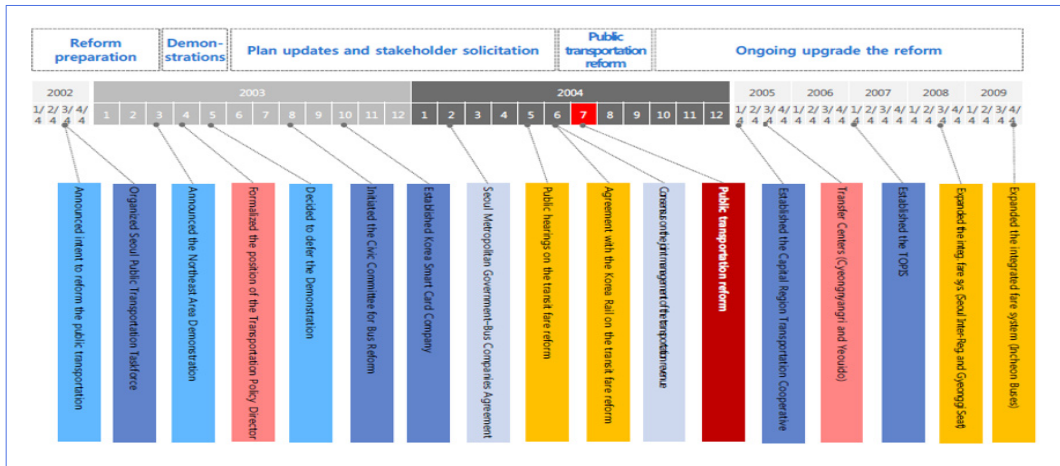
- o A free transfer from bus to bus and from bus to subway within a duration of 30 minutes (maximum transfer 5 times)
- o Subway (one-way)
 - Base rate 1,250KRW (10km) and 100KRW for every additional 5 km (up to 50 km). For more than 50 km, charge 100KRW for every additional 8 km.
- o Bus (one-way)
 - Base rate 1,200KRW (trunk line bus), 2,300KRW (inter-regional bus)
- o Expansion of fare system in metropolitan area
 - 2004. 7, Integrated fare system between Seoul urban bus and subway
 - 2007. 7, Integrated fare system between Seoul urban bus and Gyeonggi bus
 - 2008. 9, Integrated fare system among Seoul urban bus, subway, Gyeonggi bus and red bus
 - 2008. 10, Integrated fare system among Seoul urban bus, subway, Gyeonggi bus, red bus and Incheon Bus

D. Fare System Reconfiguration Stage

1) Fare system reconfiguration history

- o Preparation for public transport reconfiguration started in the early 2000s.
- o A plan was structured in 2003 and adjustment was made since then.
- o In 2004, agreement with bus companies, public hearings, and agreement with the railroad on fare system were made.
- o In 2005, Metropolitan Transportation cooperative was established. Cheongnyangni-Yeouido transfer center and Seoul Traffic Information Center (TOPIS) was established. Seoul-Gyeonggi-Incheon integrated fare system came into effect.

Figure 27 | Fare System Reconfiguration History



Source: Chang Yi (2017), *Public Transportation Reform in Seoul*, The Seoul Institute

2) Revision of legal system for fare system reconfiguration

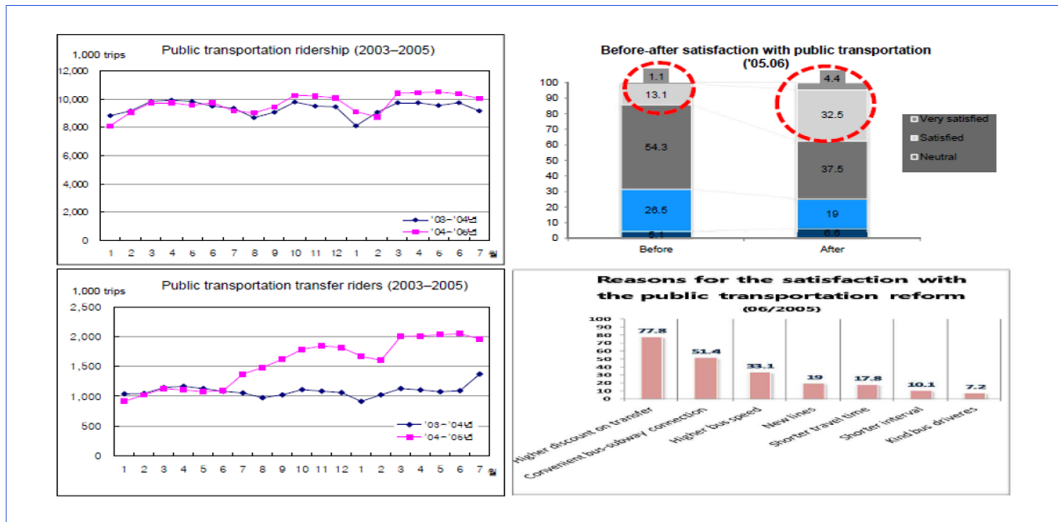
- o Passenger vehicle operation business law (based on joint revenue management)
 - Before revision: Financial support for low-income lines
 - After revision: Financial support for joint operation
- o Small & Medium Industry promotion fund and management
 - Loan for financial stability
 - Efforts for bus driver's welfare

E. Effect of Fare System Reconfiguration

1) Increase on transfer passenger and satisfaction with public transportation

- o Increase in public transport users to some extent
- o Significant increase in satisfaction level with public transportation usage: 13.1% → 32.5%
- o Increase in number of public transportation transfer passengers
- o This evaluation was highly due to the transfer discount rate and the convenient bus-subway connection

Figure 28 | Transfer Passenger and Satisfaction with Public Transportation



Source: Chang Yi (2017), *Public Transportation Reform in Seoul*, The Seoul Institute

3. Urban railway Disaster Prevention System

A. Establishing a Vision for Overall Safety Management

1) Change of paradigm in transportation policy

- o Transportation policy was previously centered around cars, favored the supplier and infrastructure, and it was focused on cost-efficiency, but in line with the changes in urban transportation, the value has transformed. From car-centered to human-centered, from supplier and infrastructure-favored to user operation innovation. Also, the paradigm has been established to set safety as priority by transferring from economy and efficiency oriented policy to attention to care and sharing

2) Construction of the Safest Urban railway

- o Measures to build a human-centered and safe urban railway operation system as well as to implement a diverse and optimal safety roadmap are as follows.
 - Citizen-participating safety culture and PR
 - 1,000 citizen-participating safety watching person
 - Safety campaign and broadcasting

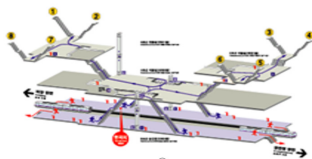
- Thorough preventive inspection and maintenance
- Comprehensive measure for replacing the electric car & deteriorated facilities.
- Diversified communication and sharing and reliable culture
- Comfort work environment

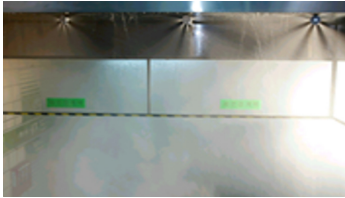
B. Facility Safety Equipment

1) Station safety system

o A safety system which is closely related to urban railway passengers is in good condition through regular inspection and maintenance. It includes;

Table 72 | Station Safety System

System	View	Remarks
Passenger evacuation route		At station
Portable lighting		5Lux, 60 minutes
Exit sign/lamp		Lamp at every 20m
Floor lamp		-
Voice guide		-

System	View	Remarks
Water screen		Smoke retardance (2m/s→0.6m/s)
Smoke control line		Smoke retardance by 30 seconds
Heat/smoke detector		Fire detector
Fire extinguisher (large/small)		Large : 20kg, 30m Small: 3kg, 20m
Hydrant (luminous sheet)		Easily distinguishable by luminous sheet
Fire apparatus connected to water line		-
Sprinkler at platform and lounge		-

Source: Kim Jong Ho (2017). Seoul Metro Safety Equipment and Safety Management Paradigm, Seoul Metro

2) Tunnel safety system

- o This is a system that prevents any disasters in the tunnel. Emergency lighting in case of power failure, fire-fighting equipment, and emergency communication system to call for rescue are installed.

Table 73 | Tunnel Safety System

System	View	Remarks
Tunnel emergency lighting		In case of blackout
Fire-fighting equipment (fire department connection)		In case of fire
Emergency telephone		In case of communication interruption

Source: Kim Jong Ho (2017). Seoul Metro Safety Equipment and Safety Management Paradigm, Seoul Metro

3) Onboard safety system

- o This is a system to prevent any accidents that may happen inside the vehicle, which is the most vulnerable sector within the field of safety. Safety systems for all passengers are the following.

Table 74 | Onboard Safety System

System	View	Remarks
Communication among three parties	The diagram illustrates a communication loop between three parties: the Driver (in the train cab), the Passenger (represented by a mobile phone icon), and the Station Staff (Control Center). Arrows indicate bidirectional communication between all three entities.	Communication among the passenger, driver and control center
Incombustible seat	A photograph of a modern train interior showing a long, upholstered seat with a patterned fabric cover, designed to be incombustible.	Incombustible material
Fire extinguisher and fire detector	This block contains three images: a red fire extinguisher mounted in a white cabinet, and two circular white fire detectors mounted on a yellow background.	Two fire extinguishers per car
Emergency door open cock	This block contains two images: a photograph of a red emergency door open cock (a handle with a red flag) and a blue diagram titled 'Train Fire Evacuation Method during emergency' showing a person using the handle to open a door.	PR on how to open the door in case of emergency

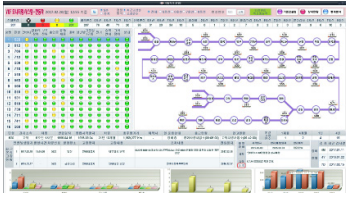
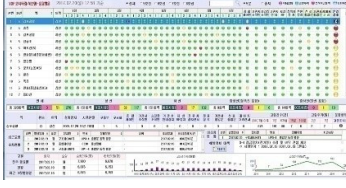
Source: Kim Jong Ho (2017). Seoul Metro Safety Equipment and Safety Management Paradigm, Seoul Metro

C. Establishment of Safety Policy

1) VOF system

o VOF (Voice of Facility) implementation measures are classified into (1) facility/part history data analysis, (2) repair/maintenance data analysis, (3) real-time monitoring, (4) Internet of things (IOT) for bidirectional control to focus on people's safety first.

Table 75 | Establishment of VOF system

Implementation plan	Example	Remarks
Safety index		Integration of 36 safety indices in urban railway Analysis of major causes/safety
Real-time monitoring (electric car)		Real-time operation of electric cars
Real-time monitoring (platform screen door)		Real-time situation of platform screen door

Source: Kim Jong Ho (2017). Seoul Metro Safety Equipment and Safety Management Paradigm, Seoul Metro

2) Improvement of emergency manual

- o Training based on passenger evacuation scenario is conducted at actual cabins and evacuation time is measured to establish the standard for the manual.
- o Improvements are made based on the existing emergency manual, golden time target, scope, response system and priority lists to minimize damage and to save more lives.

Table 76 | Improvement of Emergency Response Manual

Items	Existing	Improved
Application scope of accident type	Fire	Derailment, collision, fire, explosion, flood
Response system in emergency	Response by stage (Attention-caution-watching-serious)	Initial response with top priority (Level is adjusted by MOLIT)
Priority in initial response	Situation report Initial response Passenger evacuation	Situation propagation + people protection + Initial response (within 5 minutes)
Manual	Total 190 kinds	Total 132 kinds (minor failure, integration of similar/overlapped manual)

Source: Kim Jong Ho (2017). Seoul Metro Safety Equipment and Safety Management Paradigm, Seoul Metro

4. Process of Working Adjacent to Metro Area

A. Summary of Working Adjacent to Metro Area

1) Definition of railroad protection zone

- o Railroad protection zone is defined as below in accordance with Article 45 of Railroad Safety Act.
 - Within 30m from the railroad boundary (end of outer track)
 - Neighbouring excavation is the same as for railroad protection zone and for the tram, it shall be 10 m instead.

2) Railroad protection zone standard

- o It aims to protect the railroad facilities and train operation and it is classified as below in accordance with the Article 45 of Railroad Safety Act.
 - Changes in form and quality of the land and excavation
 - Extraction of soil, gravel, and sand
 - Planting
 - Construction, modification, and expansion of the building or artificial structure
 - Other behaviours that may interrupt railroad operation and safety.

3) Responsibilities for consultation and management of railroad protection zone

- o The manager of railroad protection zone (who receives the report) shall be the central government and KRNA for HSR, metropolitan and traditional railroad and local government and urban railway operator for the urban railway.

4) Management of working adjacent to metro area

- o Process of working adjacent to metro area is classified into the building work, connection passage, new line construction and other relevant works and is currently managed by Seoul Metro.
 - 200 cases annually (consultation)
 - Excavation is in process now at 100 sites along lines 5~8
 - Consultation and inspection by class (A+, A, B)

B. Consultation and Management of Working Adjacent to Metro Area

1) Classification

- o It is classified into A+, A, and B by SMRT and the responsible discipline are as follows.

Table 77 | Classification and Consultation & Management

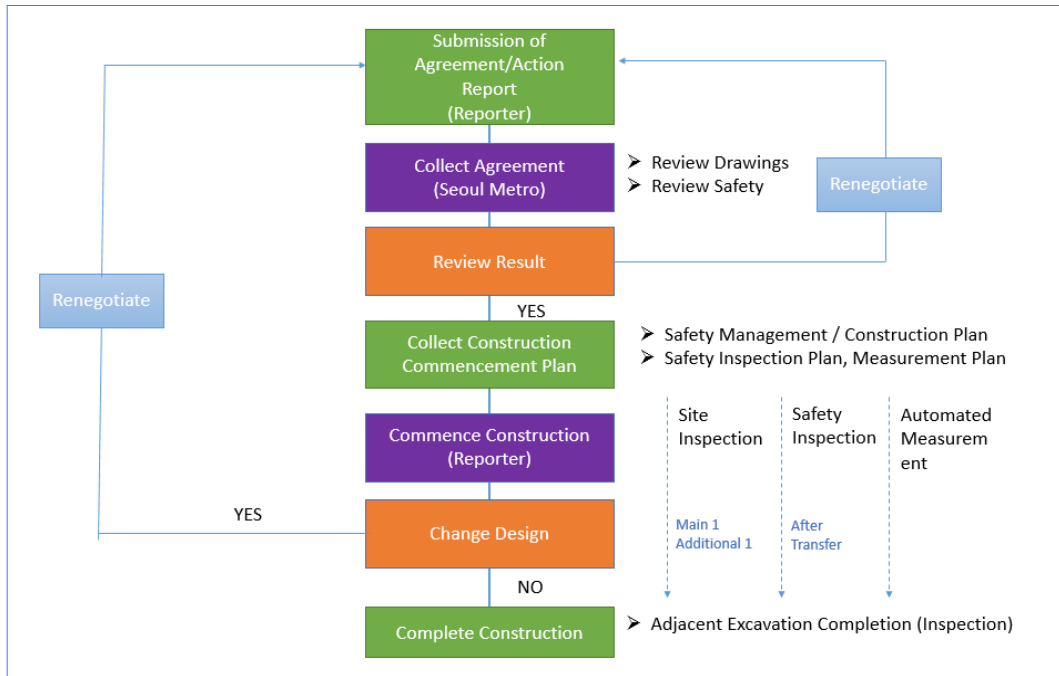
Class	Design stage		Construction stage		Remarks
	Consultation	Review	Dept.	Cycle	
Extra A	HQ (Civil Dept.)	Tech(Institute)	Facility Team	weekly	special
A		internally	Tech office (14 areas)	weekly	intensive
B		internally		monthly	normal

Source: Seoul Metro

2) Work process

- o Design and construction process of working adjacent to metro area is as follows.

Figure 29 | Work Process of Adjacent Excavation



Source: Seo Jung Ho (2017), Work Process for Metro Line 5, 6, 7, 8 Adjacent Excavation, Seoul Metro

3) Report on behavior

- o Required documents prior to working adjacent to the metro area include the following.
 - Blueprint of subway construction area-Geological survey report
 - Subway safety review report (Class A or higher)

4) Requirements for review

- o Safety requirements during excavation to protect the subway include the following.
 - Compliance with the technical comments
 - Compliance with design document, specification, and safety plan
 - Minimized blasting near subway and 0.3cm/sec or less
 - Prevention of ground loosening by installing the temporary facilities in a timely manner
 - Piling after pre-boring (to prevent impact, noise, and vibration)
 - Line marking to avoid boring immediately above the subway.
 - Temporary cut-off wall at connection section to prevent water penetration

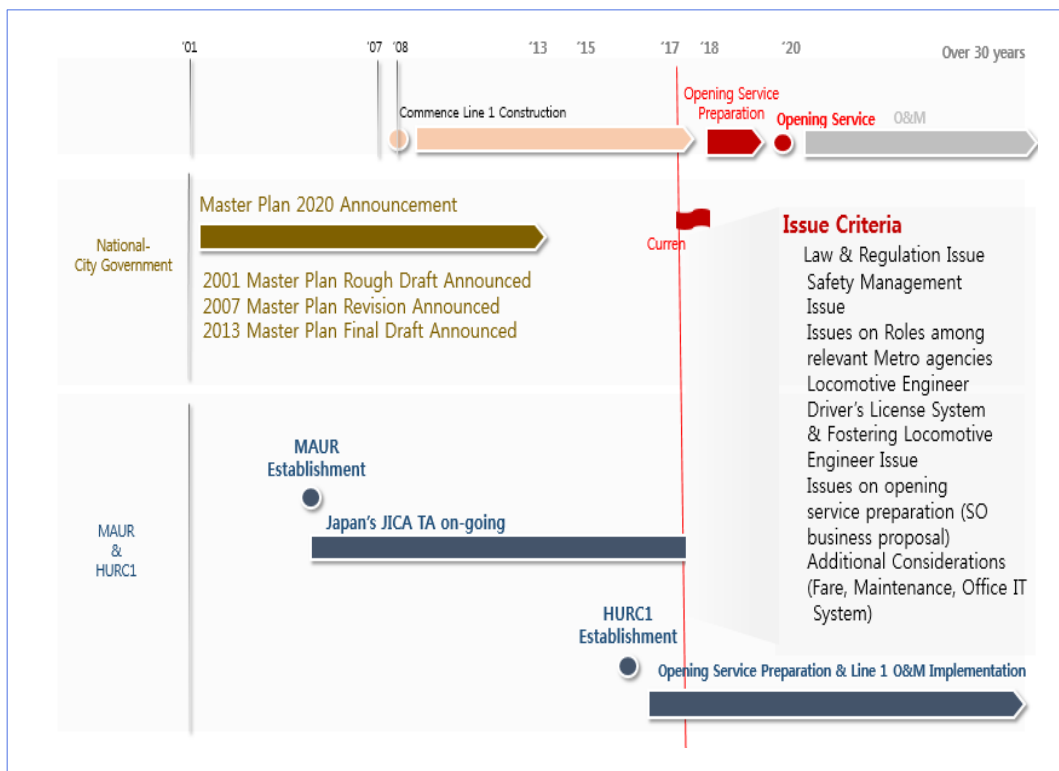
5) Safety Management Strengthening Plan

- o More strict safety management is needed due to the adjacent construction's trend in becoming more large, adjacent and complex. Measures to strengthen safety management are as follows.
 - Technical consultation of experts or verification from specialized agencies (Civil Engineering or Tunneling and Underground Space Association).
 - Monitoring of major activities and measurements including safety inspection of the subway always
 - To strengthen the safety management/construction plan, (1) Plan based on characteristics of underground urban railway (2) Temporary cut-off wall, (3) Safety status board at the site, (4) Sign at a ground level indicating the subway location, (5) Meeting before starting construction.

VII. Policy Recommendation

- o To help HCMC effectively implement O&M of urban railway, many issues were identified from HCMC Metro status and operation preparations as described in <Figure30>. Based on these issues, improvement was proposed in the areas of laws and regulation, safety management, role of urban railway operator, training for the drivers, operation preparation and additional considerations.

Figure 30 | Policy issues roadmap



1. Proposal of Urban Railway O&M-related regulations

A. Summary of Vietnamese O&M Enforcement Decree

- o Currently, there is only the standard enforcement decree of the Vietnamese urban railway O&M in written in Vietnamese. Therefore, translation of this enforcement decree was requested for railway experts to review. Original copy of this enforcement decree in Vietnamese is attached to the report in the appendix.
- o Standard enforcement ordinance for urban railway O&M was first implemented on 2016/12/19 according to technical standard, standard law, railroad law and government's enforcement ordinance 127/2015/ND-CP, VNRA and relevant bureau's request. As such, technical standard enforcement ordinance is 42/2016/TT-BGTVT indicating urban railway operation and maintenance which is categorized into (1) Common scope, (2) operation (3) facility maintenance (4) passenger car maintenance and (5) related enforcement agencies.

Table 78 | Summary of National Technical Standard for Urban Railway O&M in Vietnam

Category	Description
Common Scope	• Scope of law, subject for application and terms in regulation • Scope and definition of terms to be described
Railroad Operation	• No of cars, condition, operation hour, safety block, risk prevention, shunting, stop Signal-operation relations, display, command and method • Operation staff including controller, driver, station staff and crew
Facility Maintenance	• Principle, facility test run and inspection, patrol, structure inspection • Control, other facilities, equipment inspection, document control
Passenger Maintenance	• Maintenance condition, new & repaired car inspection and test run • Process depending on situation and inspection frequency and process
Enforcement Agency	• Responsible agency, approval agency (railroad bureau etc.) • O&M companies, group and individual and their responsibilities

Source: The Ministry of Transport (2016), Circular on National Technical Regulations on Urban Railway Operation and Maintenance

B. Proposal for Establishing Vietnamese Urban Railway O&M Regulations

(1) Need to elaborate on related laws & regulations

o Vietnamese 42/2016/TT-BGTVT standard enforcement ordinance was based on related railroad law and enforcement ordinance. Based on such enforcement ordinance, Vietnamese urban railway O&M will be established, which, however is insufficient to encompass all activities required for O&M. In Korea, O&M regulation is based on related laws and policies which however are more comprehensive than that of the Vietnamese. It is necessary to enact a more comprehensive law to accommodate more flexible regulation on urban railway. Applicable laws and regulations of Korea and Vietnam are summarized as below.

Table 79 | Comparison of railway enforcement decree in Korea and Vietnam

Category	Enforcement decree of Korea	Enforcement decree of Vietnam
Applicable laws	Railroad Service Act, Railroad Safety Act, Local Public Enterprises Act, Urban Railroad Act, Urban Railroad Driving Rules	Railway Act (14/2015/ND-CP), Technology Standard and Standard Act (127/2007/ND-CP) and enforcement decree
Content included	General provisions, law, procedure, criteria, etc.	Related definition and content

(2) Need for defining the work scope & responsibilities of higher level organizations in Vietnam

o For legislation of O&M regulation, it is essential to define the roles and responsibilities among the relevant authorities. Definition of the roles of relevant authorities will be described later in this chapter. However, the reason why this is very important in O&M regulation is that the role and responsibilities of concerned authorities are stipulated in the applicable laws and regulations. Particularly in Vietnam, the law on urban railway, besides Railroad Act, is not yet available. Before establishing the urban railway law, role and responsibilities of concerned authorities shall be defined to determine the position of related laws and regulations. To that end, MAUR shall keep coordinating with the concerned authorities such as the MOT and DOT for further consultation among the experts in urban railway on general regulation and technical issues as well.

(3) Korean cases and the need to define specific O&M rules

- o In Vietnam, legislation of urban railway law is at its early stage and revision of applicable laws and regulation is in under progress. For drafting the O&M regulation, the team including the engineers needs to be organized and to better understand the legal system, it is necessary to have consultation with the concerned authorities. Korea's railroad-related laws and regulations are as follows.

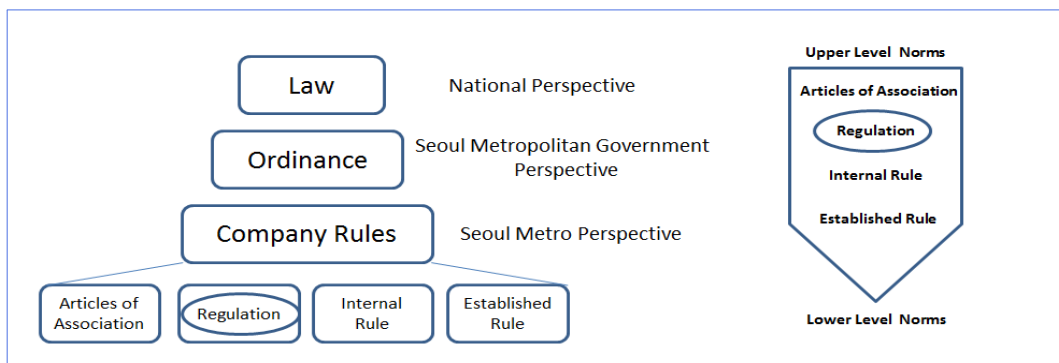
Table 80 | Korea's Railroad related Laws and Regulations

Korea's railroad-related laws & regulations
Local Enterprise Act, Urban Railroad Act, Railroad Enterprise Act, Railroad Safety Act, Urban Railroad Operation Rule, Act on Special Accounts for Transportation Facilities, Act on Contracts to Which local government is a Party
By-law on establishment & operation of Seoul Metro By-law on Seoul city tax reduction By-law on Seoul city railroad bond

Source: National Law Information Center Website (201&). www.law.go.kr

- o To establish a Vietnamese O&M regulation, understanding the Korean laws and regulation will be helpful. Korean railroad laws serve as the basis in carrying out operator's tasks and include the organization, employee's rights and obligations and guideline for management & operation and further details are described in by-law or internal regulations. Since the regulation to be developed will be applied not only to HCML Line 1 but also to the lines to be built in future, a thorough analysis is essential to set up the public transport plan based on HCMC Metro.

Figure 31 | O&M-related Regulations



- o Urban railway O&M regulation of Seoul Metro is categorized into 13 sectors which are further divides into 81 items while the role and responsibilities among the disciplines are clearly defined.
- o Vietnamese O&M regulation needs to be categorized by different operation including control, accounting, general affairs, HR, electrical, rolling stock and transport management. After further detailing the tasks, goal, scope and role, it shall be defined and related documents and formats shall be included for each item.

2. Proposal of modifying the railroad safety laws and RAMS

A. Introducing the Approval System for Railroad Safety Reinforcement

- o Railway safety laws in Vietnam are not systematically established and thus preparation and countermeasure to possible accidents are generally poor. As such, railroad safety law system needs to be outlined referring to Korean laws. Railroad safety law needs to be supplemented to introduce the approval system.

Table 81 | Supplement of Railroad Safety Act

Category	Procedures
[Article 7] Approval of safety management system	• Approval of qualification of those who have a certain level of safety management system for railroad operation and facility management
[Article 8] Maintenance of safety management system	• Regular /irregular inspection to check the maintenance of safety management system
[Article 9/9-2] Cancellation of approval/Penalty	• Encouraging voluntary safety management system through disciplinary action such as suspension or penalty.

- o Voluntary safety management system could be induced by the operator in a way by adding the above legal provisions. Approving the qualification to those with a certain level of safety management experience, it can induce independent management system of the operating agency. Of course, obligation for O&M shall follow due to independent management. If violated, there is a need for business suspension & penalty, etc. These processes can be induced by adding additional legal provision above. Independent safety management function by the operator is indispensable for stable safety management system.

B. Establishing the RAMS management system

1) Need of RAMS-based railroad safety management

- o RAMS refers to the reliability, availability, maintainability and safety of the system which the client desires to acquire. Safety service level is measured through this system and proposed to the client by stage. As HCMC Metro is the new transportation means, service with a high safety level is required. Service level is represented by SIL class and the need and importance have been proved worldwide.

Table 82 | RAMS summary

Category	Description
Reliability	• Design function & performance under normal maintenance and failure occurrence frequency
Availability	• Ratio of normal operation time to total operation time
Maintainability	• Time required to restore to normal operation or maintenance time
Safety	• Ability to maintain the damage to the staff and passengers to a certain level. • A process to establish the risk and maintain the system after identifying the potential risk and setting the safety goal.

Source: Kim Young Sang (2016). Presentation data on RAMS management of foreign railway vehicles, Seoul Metro

- o When it comes to HCMC, it lacks the experience with RAMS and related certification system. Thus, it is necessary to develop the railroad safety management system to incorporate RAMS data into “Railroad safety management technical standard” O&M when establishing the applicable laws and regulation as the case in Korea. According to the revised Korean Railroad Safety Act (2004.9) & (2012.12), risk evaluation and RAMS are included in railroad safety management requirements.
- o More importantly, RAMS needs to be introduced to enhance the safety management system. At the early stage of urban railway operation, interrelations among reliability, availability, maintainability and safety together with life cycle-based safety management system are very important and it is well defined in EN 50126. Particularly, EN50126 is difficult to understand for those without expertise. MAUR considers employing consultants but MAUR must keep in mind that experienced engineers are needed to understand the consultation to learn safety technology by themselves.

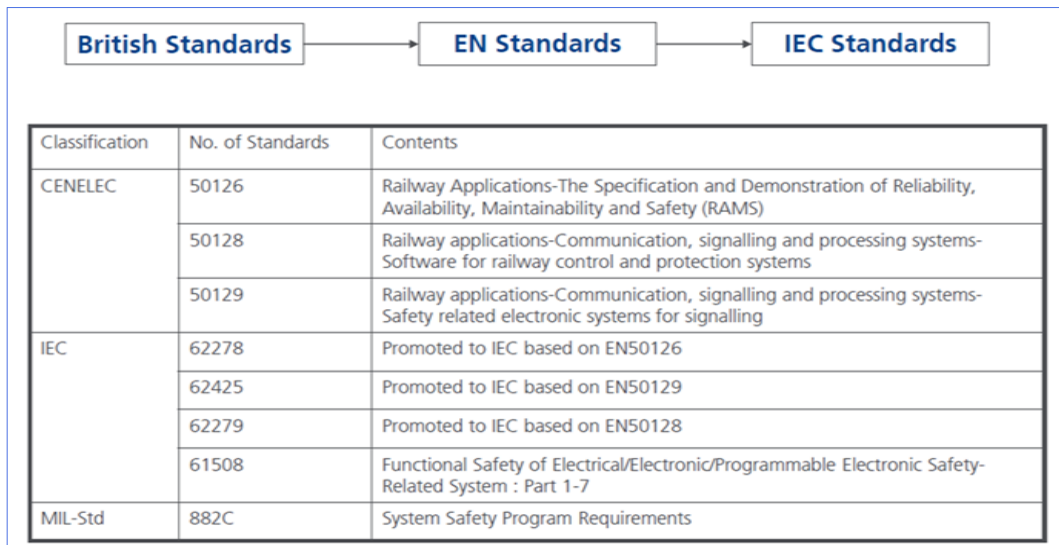
2) Need of training for RAMS management personnel

- o For the effective safety management through RAMS training program for the operator, RAMS invitation or visiting training course on a short-term basis. Also, there is a need to foster railway professionals by opening the class in railroad university on a long-term basis. In case of Vietnam, government could steadily foster safety management personnel by cooperating with relevant agencies such as VNRA. As shown from Korea's cases, Vietnam government should try hard on Metro operation with safety management expertise.

3) Benefit from application of RAMS international standard and the examples

- o RAMS helps reduce the maintenance cost and spare part cost and is being applied to aerospace, aviation, nuclear, automobile and chemical plant. Particularly, RAMS was introduced to railroad industry worldwide since the 1980s. It has become common to suggest RAMS requirements and goals. Also, require approval from the client and operating agencies to suppliers. Since it is stipulated in the core contract for the Gyeongbu HSR in Korea, asking the contractors to submit a RAMS analysis report has become a common practice.
- o In Korea where HSR, Maglev, ATP, CBTC and new technologies are applied, safety management system according to international standards has been generalized (EN 50126, EN50128, EN50129, EN50159, EN45545-2, NFPA130, BS 6853, EN15085-2).

Figure 32 | RAMS Standards



Source: Lloyd Register Asia Rail Website (2017). www.lr.org

- o EN50128(IEC62279), the international standard of RAMS guarantees safety-related software for railroad signal and control system. EN50129 (IEC62425) plays the role in approving the safety report of individual products. EN61508 is used for safety function of electronic products. It is necessary for MAUR to apply the system by referring to the foreign cases of RAMS. Examples of RAMS in Korea are summarized as follows.

Table 83 | Cases of RAMS (domestic/foreign)

Case	Description
Digital Track Circuit	• LS Industrial Systems and Techville acquired SIL4 Certification of the digital transceiver in 2013.
Balise	• YOOKYUNG Control acquired SIL4 Certification based on IEC62278, 62279, 62425, and supplied balise to Gyeongchun Line in 2011.
PSD	• POSCO ICT acquired SIL 4 Certification of metro PSD from the German international authorized agency TUV SUD in 2013 for the first time in Korea.
Almaty train control system	• Hyundai Rotem acquired SIL4 Certification of a radio communication-based train control signaling system which was supplied to Almaty Kazakhstan in 2014.

Source: Choi Yo Cheol (2015), Introduction to international standard-based railway RAMS and certification process and cases of application, System Engineering Journal

3. Defining the roles of HCMC Metro-related agencies

A. Establishing the Role of Operation Organization

- o The procedure until operation of an urban railway in Korea is divided into (1) establishing operation organization, (2) Obtaining transportation license, (3) Preparing for operation and (4) Opening and operation. Role of operation organization is classified into 4 categories as follows.

Table 84 | Pre-Operation Procedure by Urban Railway Operator in Korea

Category	Procedure
Establishment	• Establishment of operation organization • Operation organization according to the agreement between central and local government
License	• Applying for the license - Application to local government • Obtaining the license - Issued by local government
Preparation	• Preparation for revenue operation - Request for safety management system and test run and report - Test run and facility hand-over (with responsible agency)
Operation	• Opening and operation - Opening and operation according to Urban Railroad Act and operator's by law

Source: Yoon Cheon Ju (2017). Status of Urban Railroad-related Laws in Korea. Seoul Metro

- o JICA's technical support (TC2) at Stage 2 for preparing the operation and establishing the operation organization is being delayed because of the prerequisite for TC2 including designation of operator's CEO, organization, and the opening schedule has yet to be determined. Thus, it is necessary to develop the organization and manpower mobilization scheme, referring to the Korean case.
- o Particularly, approval of safety management system, test-run, and hand-over procedure shall be carried out at the stage of preparing the operation when the role of construction organization and operation organization is more than important. Test by discipline, facility inspection, test-run for revenue operation and facility hand-over shall be performed but given the current situation, it is difficult to perform such test run and hand-over procedure. Therefore, Ho Chi Minh's first ever urban railway could be successfully opened if the preparation is implemented in the systematic and professional manner by introducing Korea's test-run and hand-over practice and procedure.

B. Need for Defining the Role of Subordinate Organizations of People's Committee

- o When it comes to Korea, the roles of central and local government are clearly defined in urban railway operation procedure as described below.

Table 85 | Pre-operation Procedure of Central & Local Government in Korea

Category	Procedure and description	
	Central government	Local government
Establishing the operator	• Law on establishment of operation company	• Legislation according to the law and support for establishment
Urban railway license	• Review and consultation with municipal government on transportation license	• Review and issuance of license
Pre-operation	• Approval of safety management system and test-run report according to Railroad Safety Act and test-run guideline	• Surveillance of inspection, test-run and hand-over • Hand-over to operator
Revenue Operation	• Appropriateness of safety management according to Railroad Safety Act and Urban Railroad Act	• Surveillance of operator

Source: Yoon Cheon Ju (2017). Status of Urban Railroad-related Laws in Korea. Seoul Metro

- o In Vietnam, Ho Chi Minh People's Committee is responsible for investment in urban railway, bid and transport facility plan, but the support and role by stage from opening to operation of urban railway are not clearly defined. In case of Korea, role and responsibilities of local government from the establishment of operator to revenue operation are clearly defined thus conflict between preparations for revenue operation never occurs. For such reason, People's Committee shall define the roles and responsibilities of subordinate organizations in an orderly way, which will be applied not only on Line 1 but other upcoming railroad projects.
- o Also, there is a conflict on the surveillance right of HURC1 among DOT, DHA and MAUR. In Korea, when urban railway is built, subordinate organization of local government such as subway construction division plays a role of facility hand-over from construction stage to revenue operation, but once the revenue operation starts, the right and obligation are transferred to the operation organization, which will perform the operation independently. In case of HCMC, rather than putting HURC1 under the management of MAUR or DOT and just manage/supervise, considering relatively slow decision-making structure in Vietnam, it is more efficient to put HURC1 at the same level with sub organization of People's Committee. This will also help grow HURC1 into professional urban railway operating agency.

4. Driver's license test system and strengthening driver's capacity

A. Comparison of railway vehicle driver's license system in Vietnam/Korea

Table 86 | Procedure for Obtaining Rolling Stock Driver's License

Category	Korea	Vietnam
Stage 1	• Medical examination and aptitude test - At the hospital designated by MOLIT - Aptitude test at the agency designated by MOLIT	• Theory testing - General knowledge related to urban railway system - Expertise
Stage 2	• Training program at the agency designated by MOLIT - Class 2 electrical vehicle driver's license: 410 hours for technical education	• Function test 1 - Technical check before operation (Practice examination for technical inspection before commissioning, handling troubles and emergency situations)
Stage 3	• Written test - 4 times/year by KTSA - 40 point per subject and 60 points on average for pass the examination (Railroad Safety Act - 60 points at least)	• Function test 2 - Train driving practice examination
Stage 4	• Functional test [who passes the written test only] - by KTSA - 60 point per subject and 80 points on average for pass the examination	• Retest (Practice examinations for the candidates who fail to meet the requirements prescribed for one of two practical examinations in Step 2 or Step 3)

Source: Ministry of Land, Infrastructure and Transport (2017). Railroad Safety Act/Translation of Vietnamese Driver's License Test Regulation (2015)

o License system in Korea and Vietnam is similar in a large extent. However, in Korea, those who finish the training program at designated agencies and pass the written and functional test can be issued for the license. Meanwhile in Vietnam, it has a system that those who pass the written exam first and then those who pass the functional test are issued for the license. Functional test in Vietnam is divided into technical examination and train operation practice test. When failing either one of the functional tests, retaking the test is allowed in Vietnam. In case of Korea, test takers who passed the written test can take the remaining functional test until the end of December of the next two years.

- o Having qualified drivers are very important for the urban railway system will start operating in HCMC and Hanoi in 2020. To meet the operation deadline, testing schedule must be adjusted to nurture more qualified drivers and even to the licensed drivers, practice operation is needed. In Korea those who newly obtain the license must receive the on-the-job training on the route.

B. Driver's license system in Foreign Countries

- o In foreign countries, those who reach a certain age must pass the medical examination and aptitude test and receive training programs including theory and technical training, which are outlined in (Table 87).

Table 87 | Training Program for the Drivers in Foreign Countries

	Korea	Japan	UK	France	Germany	Spain
Age	• 19 at least	• 20	• 21	• 18	• 18	• Middle school
Medical	• O	• O	• O	• O	• O	• X
Aptitude	• O	• O	• O	• O	• O	• O
Theory	• Autonomy - No legal requirement	• 400hrs	• 9~189M theory _ technical combined	• 16 weeks	• 27weeks	• 12weeks
Technical	• Unexperienced: 410hrs • Experienced: 100hrs	• 515hrs		• 20weeks	• 9weeks	• 6weeks

Source : Kim Sa Gil (2006) : Institutionalization plan through a study on domestic & foreign railroad operator's qualification, The Korean Society for Railway

- o Korea requires 400 hours or 6,000km operation for obtaining the license while in foreign countries, a long-term theory and technical training are carried out and the test is to verify the qualification for the license.
- o In Korea, repetitive training is needed to o cultivate qualified drivers through systematic theory education and technical training to deal with emergency such as train breakdown or fire, the drivers who complete the training program at designated training agency are employed and operation practice are followed to apply the knowledge and function.
- o According to the current Railroad Safety Act, functional test is carried out by real vehicle or simulator selectively and in advanced countries, driver's simulator or CTC (Centralized

traffic control) are used for indirect practice. But operation practice on actual vehicles is more important because if the license is obtained by simulator testing only without real operation practice, it would cause the problem and thus the practice using the real vehicle shall be included in the training program.

- o According to the JR case, technical training is carried out at「Technology Academy (established in Mar 2009)」for a year for an in-depth training for the fundamental training and principle (mechanism) theory and practice are followed in cooperation with the college and core manufacturer before testing for the license. Also, it is a good idea where in the UK, applicant for operating agencies, interns and new employees are not only limited to simple licensing but can also receive the training over weekends and online training program for the relevant license (joint approval from railway operating agency) and obtain a university degree at the same time.

C. Training for CCMC urban rail drivers

- o To commence railway operation in 2020, having qualified drivers is very important. Training programs must start 6 months prior to official railway operation for potential candidates are to complete minimum 400 hours of training. Since the drivers for HCMC Line 1 will eventually become instructors for other lines, it is indispensable for successful opening and operation.
- o The drivers shall have expertise areas outside driving. There are many safety factors to consider with this new line thus safety training is mandatory. Training for the drivers shall be given the priority to start operating in 2020. Train operation simulator to be introduced from Japan shall be expedited and MAUR must check and ensure it is compatible with Line 1.

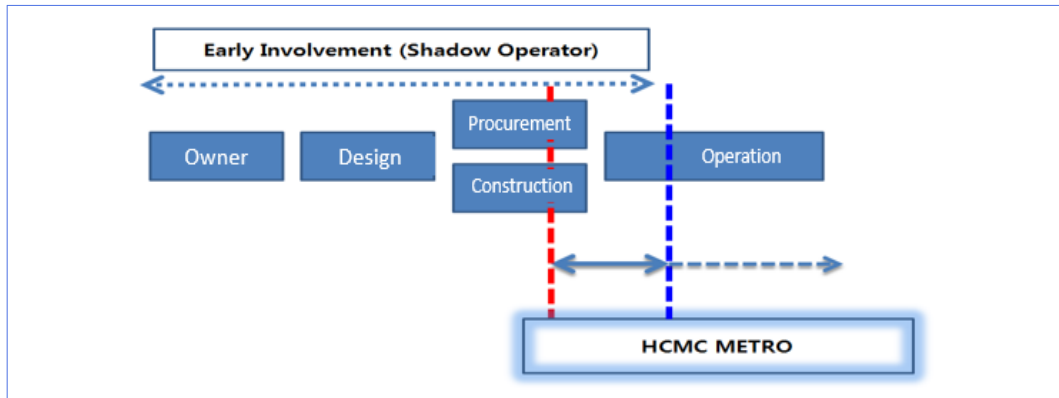
5. Proposal of introducing Shadow Operator

A. Shadow Operator for opening and operating

- o Looking at the current situation in HCMC Metro Line 1, the consultant who will provide assistance in O&M preparation is needed for successful opening service and operation. Many consulting services existed to help provide cities without any operation know-hows to open Metro service. Shadow Operator is one of the typical businesses. Shadow Operator is usually engaged from planning stage until starting operation but since HCMC metro

is already at the construction stage, Shadow Operator could be involved from construction stage until early operation stage and such consulting service may be extended to HCMC Line 4 and 5 and, Tan Son Nhat Airport Line

Figure 33 | Shadow Operator stage



- o Operator's intervention from the construction stage is very important. If the design or construction is implemented at contractor's discretion only, it would possibly cause unexpected problems during train or station operation. For instance, Hanoi Line 3 was reordered by ADB fund due to wrong design. For efficient operation, it shall be planned from client's viewpoint at the early stage. As HCMC Line 1 would influence on upcoming projects, importance of Shadow Operator is very high.
- o Shadow Operator is categorized into planning, design, construction, and operation stage. The goal of this project is to reduce the cost while increasing efficiency. When the client is involved at early stage, it is better to implement the project from the client's standpoint. Work scope by stage is summarized as follows.

Table 88 | Shadow Operator's work scope by stage

Stage	Description
Design	• Review and incorporation of whole design considering the operation
Construction	• Consultant from operator's viewpoint • Preparation of document for bidding
Operation	• Operation, maintenance and safety plan • O&M manual, guideline and work procedure • Training got O&M persons and test & commissioning

B. Examples of Shadow Operator

o Shadow operator system has been introduced for the operators who lack the abilities or experiences in construction and operation of urban rail systems. Cases of shadow operator worldwide are as follows.

Table 89 | Cases of Shadow Operator worldwide

Country	Region	Period	Work scope
Qatar	Doha	2015(24M)	• O&M development and concept. Ph-1 design and construction support (DB International)
Saudi Arabia	Makkah	2014(30M)	• Basic design review and manual(Prasarana)
Indonesia	Jakarta	2014(30M)	• Support for preparation of MRT operation & maintenance (Padeco)

o Jakarta MRT 1 which uses OMCS (Operation & Maintenance Consulting Service) is similar with utilizing the Shadow Operator and it overlaps with this project to a large extent. The Jakarta project established an O&M company 6 year to manage the bid contract which is noteworthy.

Table 90 | Comparison between Jakarta project and HCMC

	Vietnam	Jakarta
Section	19.1km (14 stations, 3 underground 11 above ground)	15.2km (13 stations 6above ground, 7underground)
O&M company	2015 (in 10 years)	2008 (in 6 years)
Tasks	Construction and preparation of O&M (currently under construction)	Construction and preparation of O&M (currently under construction)

o Work scope of Jakarta project with MRT1 OMCS includes train operation plan, O&M system and computer system. O&M system contains O&M organization, qualification of the employees, training, O&M regulation and guideline. In addition, preparation for operation, T&C, environment management, support for ancillary business and benchmarking from foreign projects. These works of OMCS are also required for HCMC to successfully commence the operation of its metro. After further comparison study on the example of the Jakarta MRT1 OMCS, it is required to incorporate the work scope required for operation and maintenance of all HCMC lines.

C. Need of shadow operator for HCMC urban rail Line 1

- o Looking at the current situation, it is difficult for HURC1 to accommodate the operation preparation alone to meet 2020 completion schedule. HURC1 O&M team has 10 members which seems insufficient, considering the GIMP LRT project which mobilized more than 20 experts for 2 years. Assistance by experienced operator which provides consulting service from the early stage must be indispensable. Dealing with the problems occurred after starting operation would cause more cost and time thus early mobilization of shadow operator is essential.
- o Metro Line 9 experience in Korea indicates the importance of Shadow Operator. Certainly, the construction stage cost is large but O&M cost after opening service takes much more big portion than the construction cost. o Shadow Operator's final goal is to maximize the efficiency and minimize the cost and thus operator's early intervention would reduce the cost and time as well as is indispensable for the success of operation. HCMC Line 1 requires urgent preparation means to meet the 2020 completion schedule and experienced operator who will save cost and time is more than important.

Figure 34 | Seoul Metro Line 9 CAPEX OPEX cost comparison



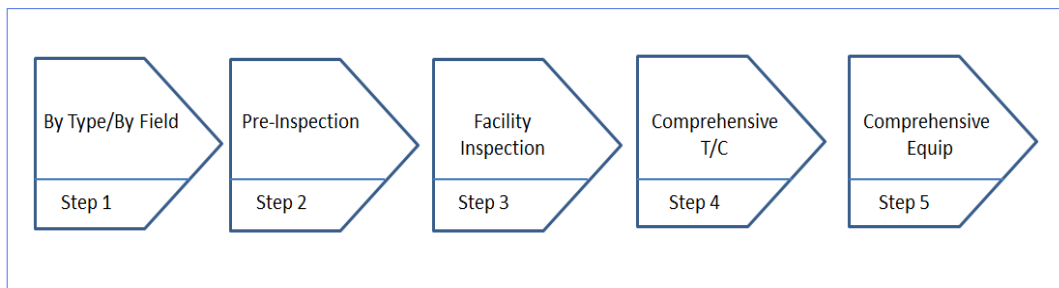
Source: Kim Moon Su (2013). Study on problem and improvement of Seoul's private investment project - based on Metro Line 9-, University of Seoul

- o To complete the project in 2020, KSP project alone is insufficient to support HCMC metro O&M thus the following project shall be carried out based on KSP policy. Jakarta project, which is similar to HCMC metro project; it is 5 years faster in terms of establishment of an operating company. To apply for a JICA loan Shadow Operator is indispensable and the need shall be notified to PDI continuously.

6. Recommendation to Urban Railway Transit's Integrated Test-Run

A. Need for applying Korea's case to HCMC project

Figure 35 | 5-stage integrated test-run



1) Integrated test run in Korea

- o In the case of Korea, 4 or more professional organizations with own responsibilities participate in final integrated test-run. Particularly at Stage 4 when the test runs simulating the revenue operation, it shall continue for 60 days at least. The period shall be determined practically in consideration of participant's roles and expertise and it is desirable to have sufficient time for an integrated test-run to identify potential problems.

2) Recommendation to integrated test-run in Vietnam

- o Railroad facility manager, a railroad operator, review team, central government, local government and the builder with own roles and responsibilities shall jointly participate. The more the participant, the more problems are identified to come up with the solutions. It is effective to eliminate the potential problems during revenue operation. Given the lack of experience and engineers in integrated test & commissioning for the urban railway system in Vietnam, an extended integrated T&C for systematic training opportunities are needed.

7. Proposal of additional considerations

A. Recommendation to O&M policy

1) Recommendation to O&M policy

- o The aim of operation & maintenance of urban railway is to realize and maintain the function of facilities as originally intended. Maintaining the function as specified in the drawing and specification is the fundamental goal of urban railway system operation. To that end, manpower organization, basic plan, regular inspection, and maintenance plan, replacement of material and equipment, identification and determination of the subject for maintenance shall be carried out in Metro operation organization.
- o NJPT will provide assistance for maintenance while staying at HCMC for 5 years. 5 years after starting operation is the most important period and HURC1 shall learn the maintenance technique to implement maintenance independently since then. But given increasing needs of maintenance, the effort shall focus on maintaining the maintenance ability. But in fact, the human resource including technical positions at HURC1 is insufficient. As such, securing qualified engineers and team is indispensable.

Table 91 | Area Requiring Additional Study (Maintenance)

Area	Description
Organization	• Appropriateness and economic analysis of maintenance organization
Plan	• Structure & equipment inspection plan and frequency plan • Replacement frequency, repair, additional cars and AFC in operation cost • Operation plan considering the transportation demand & capacity • Vehicle inspection and storage plan and train operation plan
Cost	• Appropriateness of the cost proposed by the client • Estimate of operation cost incorporating train operation plan and reduction measures • Estimate of facility O&M cost based on similar cases

B. Recommendation to integrated fare system

- o According to the SAPI report, the study on revenue and cost based on transportation demand, revenue and operation cost analysis is underway and the fare cost estimate and transportation revenue analysis accordingly.

- o And the study on an estimate of various costs (power, labor, water, repair, and maintenance) was conducted but the study on transportation strategy to link with other transportation modes, integrated fare collection, information management with related organizations or preparation for competition with existing public transportation system stays far behind. As such, the Recommendation to various fare policies (discount, fixed, commuter etc.) to increase the revenue and provide additional services are more than important. Besides, a study on system expansion and compatibility with other routes through the analysis of HCMC MetroAFC system is also required.

Table 92 | Area Requiring Additional Study (Integrated Fare)

Area	Description
Case study	• Incorporation of Korea's case study and know-how into local government policy • Proposal of integrated fare system with transportation modes or connections • Incorporation of local government's needs with Korea's policy and experience in the past about Metro fare system.
Ridership	• Analysis of case study on increased ridership and similar cases
Compatibility	• Compatibility with the fare system of other route or different transportation modes to be built in future

C. Recommendation to Office IT system

- o Office IT system is not mentioned specifically in the SAPI report but management information, document control, asset management and information management which are indispensable for urban railway operation have yet to be discussed and further study is needed.
- o A variety of IT systems are used for urban railway operation and the study on IP system for operation is needed, based on various IT systems of urban railway in Korea

Table 93 | Area Requiring Additional Study (Office IT system)

Area	Description
Case Study	• Establishment of the policy of HCMC Metro operator through the case study on IT system and program for urban railway operation
System Operation	• Policy for network integration and operation • Compatibility by line and linkage with government and transportation organizations
System Development	• Estimate of the cost of system development and operation program and maintenance • On-the-job training for efficient IT system and system developer

VIII. Conclusion

- o Ho Chi Minh City (HCMC) is the largest city as an economic and commercial center of Vietnam with about 9 million inhabitants. Recently, there have been serious social problems such as traffic congestion, stagnation and environmental pollution due to the rapid increase of ground transportation and continuous population increase because of urbanization, increasing social and economic losses. The Government of Vietnam and Ho Chi Minh City announced a public transportation master plan to 2020 in April 2013 in response to the rapidly growing demand for transportation infrastructure facilities and to reduce such social and economic losses. According to this plan, HCMC plans to build six urban railways, one tramway, and two monorail routes. Of the total nine routes, Line 1 is under construction by Japanese financial resources, and the other lines are currently in the feasibility survey, investor recruitment, and planning stage.
- o To support efficient operation and maintenance of the HCMC Metro through a KSP consulting project, we have analyzed the current state of the HCMC Metro project and its operation preparation and studied the operation and management experience and know-how of Korea, and presented cases applicable to HCMC. In addition, we have invited policy-makers of the project country for theoretical and field training in order to strengthen their ability and provided on-the-job training by dispatching our experts to the country, and consequently, a final report was held on site to advise a policy for HCMC Metro operation and maintenance.
- o This report presents following major issues from the state of the HCMC Metro project and its preparation for operation so that HCMC can efficiently manage urban railway operation.
- o First, legal and regulatory issues: The Enforcement Decree of the National Technical Standards on Urban Railway Operation and Maintenance of Vietnam, which was put into effect on December 19, 2016 had been made based on the relevant railway Act and its sub-ordinance, but it is not enough to establish various O&M regulations that make up the railway industry. The Enforcement Decree does not specify procedures and standards

of each item but it rather defines and explains each item, consequently being limited to control the future urban railway operation and maintenance system of Vietnam by law.

- o Second, safety management issues: There is a railway safety law in Vietnam, but the law is not systematically established, therefore being unprepared for accidents related to railway safety. Also, there is a lack of competence in safety management due to lack of knowledge and awareness of railway safety.
- o Third, issues related to the role of relevant organizations in the urban railway operation and maintenance: Urban railway is an important urban infrastructure that is responsible for the nation's public transportation. Therefore, the roles and responsibilities of relevant organizations about the construction and operation of urban railways should be clarified in detail in preparation for the operation of urban railways in various ways. However, as in Vietnam, the roles and responsibilities of HCMC People's Committee, MAUR, HURCI and the others are not set forth in detail, issues related to the management subjects and operational responsibilities of the operating company may arise after the opening of Line 1.
- o Fourth, training issues for engineers: There is no urban rail engine driver in HCMC. There is also a limit to the license system of urban railway engineers. Because there is no specialized training institution for systematic urban railway driving theory and practical training in place, the Vietnamese people are being trained in other countries like Japan. This will not meet the demand for rail engine drivers for the upcoming subsequent routes scheduled to open by 2030.
- o Fifth, opening preparation issues: Vietnam, without having any experience in preparing for the opening and operating urban railways, must have a consultant who systematically manages the opening preparation. Technical support for the opening preparation of Line 1 will be provided by Japan, but there should be more additional support than just technical support. Also, the fact that there is no preparation for the urban railway full system commissioning in place for the upcoming opening is a worry, too.
- o This report shows a total of six case studies of Korean urban railway O&M areas including urban railway O&M related laws, the engine driver license system and the railway safety approval system of Korea at the request of the project. A systematic analysis of the opening preparation procedures of Korea for the cases of the extension section of Seoul Subway Line 7 and Gimpo Light Rail Transit is presented, considering the upcoming opening of Line 1 of HCMC. The Seoul Metropolitan Government integrated fare system, the status of urban railway disaster prevention system and procedures of adjacent excavation work were added, too.

- o Five improvements for each sector are recommended based on the major issues and studies: Legal and regulatory arrangement; safe management; roles of urban railway operating organizations; engineer training; opening preparation; and other additional considerations.
- o First, regulatory arrangement for urban railway O&M: The definition and structure of the O&M regulations of Korea should be understood first. Regardless of the type and designation, the O&M regulations of Vietnam should be arranged based on the codified urban railway regulations of Korea as a standard for performing all operations of the operating company. This will not only apply to HCMC Line 1 but to subsequent lines, too. Therefore, it is necessary to establish such regulations first to prepare for any situations that may arise due to unclear regulations.
- o Second, improvement of laws related to railway safety and introduction of RAMS: Based on the Railway Safety Act of Korea, the safety management system of the operating organization can be introduced by adding the approval and maintenance of the safety management system, approval cancellation/fines, and others in the railway safety laws of Vietnam. In addition, a railway safety management system utilizing RAMS data for the arrangement of safety applicable laws should be in place by introducing a RAMS system. To this end, RAMS management personnel should be trained first by inviting a foreign RAMS expert in the short-term, and by establishing a RAMS department in railway-related universities in the long-term to train railway safety experts.
- o Third, clarification of the roles of HCMC Metro organizations: In Korea, the process of operating urban railways is stepwise, and the roles of the operating organization, the central government and the city government from the establishment of an operating company to the opening are clearly defined, hardly seeing issues arising from each stage. When the roles and responsibilities of relevant organizations are clearly defined, possible issues arising from the preparation for opening and operation of urban railways including approval of a safety management system, review of commissioning results and issuance of a license for transportation business may be reduced.
- o Fourth, good quality engineers are needed: Given HCMC Line 1 to be opened in 2020, it is urgent to have high-quality engineers. In Korea, an engine driver should have a minimum of 400 hours of practical experience prior to being mobilized for commercial operation, so trained engineers should be deployed at least six months before the opening. The engineers to be deployed for Line 1 should be especially high-quality engineers because they will be trainers for the following urban railway engineers.

- o Fifth, the introduction of a shadow operator who can help HCMC Metro for opening and operation preparation: HCMC who is not properly prepared for the opening of Line 1 needs to consult an expert who is very much aware of the HCMC Metro. Only systematic preparation for the opening allows a successful operation and maintenance of the urban railway and it can reduce operating costs, thus calling for the introduction of a shadow operator. In addition, as HCMC has no full system commissioning experience, it needs to determine the commissioning period if possible in order to systematically raise its capacity.
- o In addition to the above, suggestions on maintenance, an integrated fare system and an office IT system are introduced for efficient O&M of the HCMC Metro.
- o First, suggestions for maintenance: The first five years after the opening will be supported by Japan for maintenance, but HCMC needs to learn their own skills. They will have to carry out maintenance on their own after five years. Therefore, they need to strive to increase their own maintenance capacity, and the number of engineers of the operating company should be increased.
- o Next, suggestions on the integrated fare system: As each route to be built-in HCMC is differently financed, AFC system and even the type of a traffic card may vary. Therefore, a review should be carried out to prevent any problems in the compatibility of the fare collection system from arising, and technical support and consulting are additionally required in a bid to build an integrated fare collection system with other and linked means of transportation.
- o Finally, suggestions on the office IT system: An additional study on operational management programs including management information, document management, asset management and information management, which is essential to an operating company of urban railways should be carried out.
- o It is not easy for a country without any urban railway operation experience to realize the effective and successful operation of urban railways at once because the scope of urban railway operation management is very extensive and it is not limited to theories, but requires actual practice, too. However, if the active will of an actual support by the Vietnamese government and related organizations are in place based on the conclusion and suggestions of this report, an effective operation and management policy for Line 1 and subsequent lines will be established, which will also be linked to follow-up projects such as urban railway operation consulting and HCMC Metro operation projects. This will lead to the HCMC's safe and effective urban railway operation, contributing to strengthening the city's competitiveness and further to its economic development.

Attachment

1. Standard enforcement ordinance of Vietnamese urban railway O&M (127/2015/ND-CP)

CÔNG BÁO/Số 35 + 36/Ngày 12-01-2017	49
BỘ GIAO THÔNG VẬN TẢI	
BỘ GIAO THÔNG VẬN TẢI	CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
	<u>Độc lập - Tự do - Hạnh phúc</u>
Số: 42/2016/TT-BGTVT	Hà Nội, ngày 19 tháng 12 năm 2016
THÔNG TƯ	
Ban hành Quy chuẩn kỹ thuật quốc gia	
về vận hành, bảo trì đường sắt đô thị	
<i>Căn cứ Luật Tiêu chuẩn và Quy chuẩn kỹ thuật ngày 29 tháng 6 năm 2006;</i> <i>Căn cứ Luật Đường sắt ngày 14 tháng 6 năm 2005;</i> <i>Căn cứ Nghị định số 14/2015/NĐ-CP ngày 13 tháng 02 năm 2015 của Chính phủ quy định chi tiết và hướng dẫn thi hành một số điều của Luật Đường sắt;</i> <i>Căn cứ Nghị định số 127/2007/NĐ-CP ngày 01 tháng 8 năm 2007 của Chính phủ quy định chi tiết thi hành một số điều của Luật Tiêu chuẩn và Quy chuẩn kỹ thuật;</i> <i>Căn cứ Nghị định số 107/2012/NĐ-CP ngày 20 tháng 12 năm 2012 của Chính phủ quy định chức năng, nhiệm vụ, quyền hạn và cơ cấu tổ chức của Bộ Giao thông vận tải;</i> <i>Theo đề nghị của Vụ trưởng Vụ Khoa học - Công nghệ và Cục trưởng Cục Đường sắt Việt Nam;</i> <i>Bộ trưởng Bộ Giao thông vận tải ban hành Thông tư ban hành Quy chuẩn kỹ thuật quốc gia về vận hành, bảo trì đường sắt đô thị.</i>	
Điều 1. Ban hành kèm theo Thông tư này “Quy chuẩn kỹ thuật quốc gia về vận hành, bảo trì đường sắt đô thị” - Số hiệu: QCVN 93:2016/BGTVT.	
Điều 2. Thông tư này có hiệu lực thi hành từ ngày 15 tháng 01 năm 2017.	
Điều 3. Chánh Văn phòng Bộ, Chánh Thanh tra Bộ, các Vụ trưởng, Cục trưởng Cục Đường sắt Việt Nam, Thủ trưởng cơ quan, tổ chức và cá nhân có liên quan chịu trách nhiệm thi hành Thông tư này./.	
BỘ TRƯỞNG	
Trương Quang Nghĩa	

50

CÔNG BÁO/Số 35 + 36/Ngày 12-01-2017



CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM

QCVN 93:2016/BGTVT

**QUY CHUẨN KỸ THUẬT QUỐC GIA
VỀ VẬN HÀNH, BẢO TRÌ ĐƯỜNG SẮT ĐÔ THỊ**

*National technical regulations on urban railway operation
and maintenance*

HÀ NỘI - 2016

Lời nói đầu

QCVN 93:2016/BGTVT do Cục Đường sắt Việt Nam biên soạn, Vụ Khoa học - Công nghệ trình duyệt, Bộ Giao thông vận tải ban hành theo Thông tư số: 42/2016/TT-BGTVT ngày 19 tháng 12 năm 2016.

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QUY CHUẨN KỸ THUẬT QUỐC GIA VỀ VẬN HÀNH, BẢO TRÌ ĐƯỜNG SẮT ĐÔ THỊ

National technical regulations on urban railway operation and maintenance

1. QUY ĐỊNH CHUNG

1.1 Phạm vi điều chỉnh

1.1.1 Quy chuẩn kỹ thuật quốc gia về vận hành, bảo trì đường sắt đô thị (sau đây viết tắt là Quy chuẩn) quy định các yêu cầu kỹ thuật cơ bản về vận hành và bảo trì đường sắt đô thị, nhằm đảm bảo hoạt động giao thông đường sắt đô thị an toàn, thông suốt, thuận tiện cho hành khách cũng như giảm thiểu những tác động bất lợi đến cộng đồng.

1.1.2 Quy chuẩn này không áp dụng với đường sắt một ray tự động dẫn hướng và đường xe điện bánh sắt.

1.2 Đối tượng áp dụng

Quy chuẩn này áp dụng đối với tổ chức, cá nhân có liên quan đến công tác quản lý, vận hành và bảo trì đường sắt đô thị.

1.3 Giải thích thuật ngữ

Trong Quy chuẩn này, các từ ngữ dưới đây được hiểu như sau:

1.3.1 Bảo trì

Là tập hợp các công việc nhằm bảo đảm và duy trì sự làm việc bình thường, an toàn của công trình, phương tiện, thiết bị đường sắt đô thị theo quy định của thiết kế hoặc nhà sản xuất trong quá trình khai thác sử dụng. Nội dung bảo trì bao gồm một, một số hoặc toàn bộ các công việc sau: kiểm tra, quan trắc, kiểm định chất lượng, bảo dưỡng và sửa chữa nhưng không bao gồm các hoạt động làm thay đổi công năng, quy mô của công trình, phương tiện, thiết bị.

1.3.2 Chu kỳ kiểm tra

Là khoảng thời gian tối đa hoặc số kilomet vận hành tối đa phải tiến hành kiểm tra tùy theo chỉ tiêu nào đến trước.

1.3.3 Công trình đường sắt đô thị

Là công trình được xây dựng phục vụ giao thông vận tải đường sắt đô thị, bao gồm: kết cấu tầng trên đường sắt (ray, tà vẹt, phụ kiện liên kết ray tà vẹt, phụ kiện nối ray, ghi, kết cấu kiểu tấm bản, đá balát, lớp đệm subbalat - nếu có); kết cấu xây dựng (nền đường; cầu; cống; hầm; kè; rào chắn; hệ thống thoát nước không bao gồm thiết bị thoát nước; ga và đề pô không bao gồm thiết bị; các kết cấu khác); thiết bị điều khiển chạy tàu; hệ thống cấp điện và các công trình, thiết bị khác của đường sắt.

1.3.4 Tàu

Là toa xe, tập hợp toa xe có động lực hoặc không có động lực được ghép nối có đủ các điều kiện cần thiết để chạy tàu an toàn theo kế hoạch vận tải được cấp có thẩm quyền phê duyệt.

1.3.5 Biểu đồ chạy tàu

Là biểu đồ trong đó quy định giờ đi, giờ đến và hành trình của tất cả các đoàn tàu trong một (01) ngày đêm.

1.3.6 Đường sắt chính tuyến

Là đường sắt nơi tàu vận hành, cung cấp dịch vụ theo biểu đồ chạy tàu.

1.3.7 Đường phụ

Là đường sắt không phải đường sắt chính tuyến, bao gồm đường dừng đỗ tàu.

1.3.8 Nhà ga

Là nơi tàu dừng, đỗ, đón, trả khách; cung cấp các dịch vụ, tiện ích cần thiết cho hành khách đi tàu và lắp đặt các thiết bị, máy móc vận hành chạy tàu.

1.3.9 Kiểm tra

Là việc xem xét bằng trực quan hoặc thiết bị kỹ thuật chuyên dùng để đánh giá hiện trạng các công trình, phương tiện, thiết bị nhằm phát hiện các dấu hiệu hư hỏng, xuống cấp và có biện pháp nghiệp vụ xử lý kịp thời, đảm bảo an toàn chạy tàu.

1.3.10 Ngày kiểm tra định kỳ

Là ngày được lấy để làm quy định thời gian tiến hành kiểm tra cho từng thiết bị đường sắt hay bộ phận của thiết bị đó, được tính toán trên cơ sở đặc tính của thiết bị, mức độ chịu tác động từ điều kiện thời tiết khí hậu, các ảnh hưởng của môi trường xung quanh. Ngày kiểm tra định kỳ áp dụng cho thiết bị đường ray, công trình xây dựng, thiết bị cấp điện và thiết bị đảm bảo an toàn chạy tàu.

1.3.11 Độ lệch thời gian cho phép

Là khoảng thời gian lệch trước hoặc sau ngày kiểm tra định kỳ, được bố trí phù hợp với chu kỳ kiểm tra định kỳ nhằm đảm bảo chắc chắn việc kiểm tra được thực hiện, kể cả trong điều kiện bị hạn chế do ảnh hưởng của thời tiết, do có thi công trên đường ray hay bất cứ sự gián đoạn nào khác. Độ lệch thời gian cho phép áp dụng cho thiết bị đường ray, công trình xây dựng, thiết bị cấp điện và thiết bị đảm bảo an toàn chạy tàu.

1.3.12 Khu gian

Khu gian là đoạn tuyến đường sắt nối hai nhà ga liền kề.

1.3.13 Nhân viên điều độ chạy tàu

Là người trực tiếp chỉ huy chạy tàu theo biểu đồ chạy tàu, chỉ huy việc khắc phục sự cố chạy tàu, ra lệnh cảnh báo tốc độ tới các đơn vị liên quan, đình chỉ chạy tàu trên tuyến đường sắt phụ trách nếu thấy nguy cơ đe dọa mất an toàn chạy tàu.

1.3.14 Thiết bị điều khiển chạy tàu

Là thiết bị thông tin và tín hiệu để điều khiển chạy tàu.

1.3.15 Tín hiệu đường sắt

Là biểu thị điều kiện vận hành đối với lái tàu và các nhân viên đường sắt có liên quan khi chạy tàu. Tín hiệu đường sắt bao gồm: tín hiệu, hiệu lệnh và biển báo.

1.3.16 Tuần tra

Là công tác kiểm tra định kỳ dọc theo tuyến đường nhằm nắm rõ tình trạng bảo trì tuyến đường cũng như mọi thay đổi môi trường xung quanh dọc theo tuyến, thông qua đó đảm bảo tuyến đường luôn trong tình trạng chạy tàu an toàn.

1.3.17 Hệ thống điều khiển tàu tự động

Hệ thống điều khiển tàu tự động ATC (Automatic Train Control) bao gồm các hệ thống con:

- Hệ thống phòng vệ tàu tự động ATP (Automatic Train Protection);
- Hệ thống giám sát tàu tự động ATS (Automatic Train Supervision);
- Hệ thống vận hành tàu tự động ATO (Automatic Train Operation).

2. VẬN HÀNH TÀU**2.1 Vận hành tàu****2.1.1 Số toa xe tối đa được phép ghép nối**

Số lượng toa xe tối đa được ghép nối thành tàu phải đảm bảo phù hợp với tính năng, cấu tạo, sức kéo của toa xe cũng như thiết kế của công trình đường sắt.

2.1.2 Hãm tàu

a) Tàu phải sử dụng hệ thống hãm kết nối với tất cả các toa xe và đảm bảo tự động hãm khi toa xe bộ phận bị tách rời.

Đối với các sự cố của hệ thống hãm tàu, doanh nghiệp quản lý, khai thác, vận hành đường sắt đô thị có trách nhiệm căn cứ các văn bản pháp luật liên quan xây dựng và ban hành phương án giải quyết, xử lý sự cố.

b) Hệ thống hãm phải được kiểm tra định kỳ theo quy định của nhà sản xuất và khi ghép nối toa xe để lập tàu.

c) Lực hãm tàu phải đảm bảo đủ điều kiện cần thiết tương ứng với độ dốc của tuyến đường và tốc độ tàu.

d) Lực hãm tàu phải được xác định theo tỷ lệ phần trăm (%) giữa số trục có lực hãm trên tổng số các trục của tàu. Tỷ lệ này phải phù hợp với quy định của nhà sản xuất.

2.1.3 Vận hành tàu trên đường sắt chính tuyến trong khu gian

Chỉ có toa xe có đủ điều kiện mới được cho phép chạy trên đường sắt chính tuyến trong khu gian (trừ trường hợp dồn dịch toa xe).

2.1.4 Bảng giờ tàu

a) Bảng giờ tàu là bảng thông tin về thời gian mở tuyến, thời gian đóng tuyến và giờ tàu đến các nhà ga trong ngày.

b) Bảng giờ tàu phải được lập theo kế hoạch chạy tàu được cấp có thẩm quyền phê duyệt đối với từng tuyến.

c) Khi thời gian chạy tàu bị sai lệch so với bảng giờ tàu thì phải nhanh chóng khôi phục về đúng kế hoạch chạy tàu được cấp có thẩm quyền phê duyệt theo từng tuyến.

2.1.5 Phòng tránh tai nạn khi tàu khởi hành

Tàu chỉ được phép khởi hành khi cửa tàu được đóng hoàn toàn, cũng như hành khách và tàu được xác nhận ở tình trạng an toàn.

2.1.6 Các biện pháp đảm bảo an toàn vận hành tàu

a) Để đảm bảo an toàn chạy tàu phải sử dụng các biện pháp sau:

- (1) Sử dụng thiết bị đảm bảo an toàn giữa các tàu, cho phép dừng tàu hoặc giảm tốc độ chạy tàu tự động thông qua việc liên tục kiểm soát khoảng cách giữa các tàu hay tình trạng tuyến đường.
- (2) Sử dụng hệ thống thiết bị an toàn thay thế khi không thể áp dụng biện pháp như quy định ở (1).
- (3) Dựa vào khả năng tập trung quan sát của lái tàu khi không thể áp dụng biện pháp nêu tại (1) và (2). Dựa trên chỉ dẫn của nhân viên điều độ chạy tàu, lái tàu chạy tàu với tốc độ giới hạn, cho phép dừng tàu trong khoảng cách quan sát được với tàu đi trước.

b) Trong trường hợp chạy tàu cứu hộ, nếu tàu đó đã có các biện pháp an toàn được quy định riêng thì không phải tuân theo quy định tại Điểm a Khoản này.

2.1.7 Vị trí điều khiển của lái tàu

Lái tàu phải điều khiển tàu tại buồng lái phía trước của toa xe đầu tiên theo hướng vận hành, trừ các trường hợp sau:

- a) Khi lái tàu chạy tàu theo hiệu lệnh từ nhân viên trên buồng lái của toa xe đầu tiên.
- b) Khi còi và hệ thống hãm được điều khiển bởi một lái tàu khác (lái tàu thứ hai) trên buồng lái của toa xe đầu tiên.

2.1.8 Tốc độ vận hành tàu

Tàu phải chạy dưới tốc độ giới hạn đã được quy định trước cho từng tàu và cho từng khu gian, đảm bảo phù hợp với tình trạng của đường sắt và đường lấy điện, tính năng của toa xe, phương thức vận hành, tín hiệu đường sắt.

2.1.9 Chạy tàu lùi

Tàu không được phép chạy lùi ngược với hướng vận hành, trừ trường hợp việc chạy tàu lùi được thực hiện theo chỉ thị của nhân viên điều độ khi xảy ra sự cố, tai nạn.

2.1.10 Các biện pháp khẩn cấp để dừng tàu đến gần

a) Trong trường hợp phải dừng tàu do phát sinh chướng ngại cản trở chạy tàu, trên cơ sở xem xét cụ thể để hãm khẩn cấp tàu đang tới gần, phải hiển thị tín hiệu dừng tàu và áp dụng mọi biện pháp cần thiết để dừng tàu khác đang tới gần nhanh nhất.

b) Các trường hợp phải thực hiện phòng vệ tàu:

- Tàu trật bánh gây trở ngại cho tàu khác chạy trên tuyến đường liền kề.
- Phát sinh sự cố trên đường ray, đường lấy điện yêu cầu phải dừng tàu ngay lập tức.
- Các trường hợp khác theo quy định của văn bản quy phạm pháp luật có liên quan.

c) Các đơn vị vận hành đường sắt đô thị có trách nhiệm xây dựng các biện pháp phòng vệ khi dừng tàu.

2.1.11 Phong tỏa khu gian

Khi một đoạn đường sắt cần được phong tỏa để thi công hoặc bảo trì phải áp dụng các biện pháp dưới sự hướng dẫn của nhân viên điều độ chạy tàu hay nhân viên được giao trách nhiệm tương đương nhằm không cho tàu đi vào khu gian (trừ tàu sử dụng cho việc thi công hoặc bảo trì).

2.1.12 Phòng tránh rủi ro trong chạy tàu

Đơn vị vận hành đường sắt đô thị phải có trách nhiệm:

a) Xây dựng kế hoạch ứng phó trong trường hợp thời tiết xấu hoặc các hiện tượng tự nhiên khác đe dọa sự an toàn của tàu.

b) Xây dựng các biện pháp ứng phó kịp thời trong trường hợp xảy ra hỏa hoạn trong nhà ga ngầm hay trên tàu đang chạy trong khu vực ngầm nhằm đảm bảo an toàn cho hành khách và sơ tán kịp thời.

c) Có các biện pháp ứng phó đối với các yếu tố rủi ro khác do con người gây ra trong quá trình chạy tàu.

2.1.13 Dồn dịch

a) Dồn dịch toa xe (bao gồm dồn dịch tàu) phải được tiến hành theo một trong các phương thức sau đây:

- (1) Phương thức sử dụng tín hiệu;
- (2) Phương thức sử dụng hiệu lệnh;
- (3) Phương thức sử dụng chỉ báo (biển báo);
- (4) Phương thức sử dụng thiết bị điều khiển tự động toa xe.

b) Hoạt động dồn dịch toa xe không được phép gây cản trở đến hoạt động vận hành tàu.

- c) Đơn vị vận hành đường sắt đô thị phải quy định tốc độ dồn dịch.

2.1.14 Dừng đỗ của toa xe

Khi dừng đỗ toa xe, phải áp dụng các biện pháp cần thiết để tránh toa xe tự khởi động hay bị trôi do tác động bên ngoài.

2.1.15 Điều kiện vận hành tàu ở chế độ lái tàu tự động

Trường hợp vận hành tàu chế độ lái tàu tự động phải thỏa mãn các điều kiện sau đây:

a) Đường sắt được thiết kế cho phép ngăn chặn người không có nhiệm vụ hoặc động vật tự ý đi vào khu vực đường sắt, đồng thời đảm bảo không để xảy ra những tình huống nguy hiểm làm cản trở lộ trình của tàu; trên tàu có lắp đặt thiết bị cho phép dừng tàu tự động khi phát hiện chướng ngại trên đường sắt; áp dụng biện pháp đảm bảo an toàn chạy tàu.

b) Đường sắt được thiết kế cho phép ngăn chặn các nguy cơ từ đường sắt liền kề; có nhân viên trên tàu phụ trách các biện pháp khẩn cấp để phòng vệ tàu; trên tàu có lắp đặt thiết bị cho phép dừng tàu tự động khi phát hiện chướng ngại trên đường sắt liền kề.

c) Đường sắt được thiết kế cho phép trong các tình huống khẩn cấp, hành khách được sơ tán dễ dàng.

- d) Có các biện pháp phù hợp để đảm bảo an toàn cho hành khách trên ke ga.

- đ) Thiết bị lái tàu tự động phải bảo đảm tất cả các điều kiện sau:

- Không cho phép tàu khởi hành nếu chưa xác nhận sự an toàn của hành khách lên, xuống tàu.

- Có tính năng thiết lập tốc độ chạy tàu dưới mức tốc độ được hiển thị trên thiết bị đảm bảo giãn cách tàu, cũng như kiểm soát tốc độ tàu một cách êm thuận, qua đó đảm bảo an toàn chạy tàu.

- Cho phép tàu dừng một cách êm thuận, ở vị trí cho phép hành khách lên xuống tàu mà không gặp trở ngại gì.

e) Trong trường hợp không có nhân viên đường sắt trên tàu thì khoang hành khách phải được lắp đặt thiết bị cho phép hành khách liên lạc với trung tâm điều độ, hoặc có biện pháp khác để đảm bảo an toàn cho hành khách trong trường hợp khẩn cấp.

2.2 Tín hiệu đường sắt**2.2.1 Mối liên hệ giữa tín hiệu đường sắt và vận hành tàu**

Thiết bị tín hiệu phải bảo đảm tổ chức chỉ huy chạy tàu và dồn tàu được kịp thời, chính xác, an toàn và nâng cao hiệu suất chạy tàu.

2.2.2 Tín hiệu dừng tàu

a) Khi có tín hiệu dừng tàu, tàu phải dừng trước vị trí được chỉ định. Khi tín hiệu dừng tàu được thông báo quá muộn để tàu dừng tại vị trí yêu cầu hoặc khi vị trí cần dừng không được báo hiệu, tàu phải được khống chế dừng khẩn cấp.

b) Tàu phải dừng theo quy định tại Điểm a Khoản này không được phép chạy tiếp cho đến khi có tín hiệu tiếp tục hay nhận được chỉ thị cho phép tiếp tục chạy (trừ trường hợp sử dụng phương thức vận hành nêu tại Mục 3 Điểm a Khoản 2.1.6 của Quy chuẩn này).

2.2.3 Tín hiệu hiển thị không chính xác

Khi cùng một lúc tiếp nhận được nhiều tín hiệu khác nhau hoặc tín hiệu không rõ ràng thì phải chấp hành tín hiệu an toàn nhất.

2.2.4 Điều kiện hiển thị tín hiệu cho phép chạy tàu

Tín hiệu cho phép chạy tàu chỉ được hiển thị khi không có bất cứ cản trở nào trên lộ trình của tàu.

2.2.5 Các nội dung khác liên quan đến hiển thị tín hiệu

Ngoài các quy định được nêu từ Khoản 2.2.1 đến Khoản 2.2.3 của Quy chuẩn này các loại hình tín hiệu và phương thức hiển thị tín hiệu phải được quy định rõ từ trước để lái tàu và nhân viên trên tàu quan sát, nhận biết được.

2.2.6 Cấm cản trở tuyến đường khi có tín hiệu biểu thị cho phép chạy tàu

Khi có tín hiệu cho phép chạy tàu, không được cản trở đường đi của tàu.

2.2.7 Hiệu lệnh và biển báo

Loại hình và phương thức biểu thị của hiệu lệnh và biển báo phải được quy định rõ từ trước nhằm đảm bảo an toàn chạy tàu.

2.3 Nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị**2.3.1 Chức danh nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị**

a) Chức danh nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị bao gồm:

- Nhân viên điều độ chạy tàu;
- Lái tàu;
- Nhân viên phục vụ chạy tàu tại ga;
- Nhân viên hỗ trợ an toàn trên tàu.

b) Các chức danh nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị phải đảm bảo các tiêu chuẩn theo quy định của văn bản quy phạm pháp luật liên quan.

c) Đối với các tuyến đường sắt đô thị mới đưa vào khai thác, vận hành có công nghệ lần đầu sử dụng tại Việt Nam thì tiêu chuẩn chức danh nhân viên trực tiếp phục vụ chạy tàu trên các tuyến đường sắt đô thị đó được áp dụng theo tiêu chuẩn công nghệ của tuyến đường sắt đô thị thông qua đào tạo, chuyển giao công nghệ.

d) Đối với lái tàu trên các tuyến đường sắt đô thị mới đưa vào khai thác, vận hành có công nghệ lần đầu sử dụng tại Việt Nam, cơ quan nhà nước có thẩm quyền theo quy định của Bộ Giao thông vận tải tổ chức sát hạch và cấp giấy phép lái tàu sau khi các tuyến đường sắt đô thị này hoàn thành chạy thử nghiệm.

2.3.2 Đào tạo và huấn luyện nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị

Đơn vị vận hành đường sắt đô thị phải tổ chức đào tạo và huấn luyện đầy đủ cho tất cả các nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị, đảm bảo các nhân viên này có đầy đủ kiến thức và kỹ năng cần thiết.

2.3.3 Đảm bảo an toàn chạy tàu

a) Nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị phải thực hiện đúng quy trình chạy tàu và các quy định khác có liên quan, đảm bảo an toàn chạy tàu trên cơ sở vận dụng đầy đủ kiến thức, kỹ năng của mình và vận dụng tối ưu các thiết bị vận hành.

b) Đơn vị vận hành đường sắt đô thị không được phân công công việc cho nhân viên trực tiếp phục vụ chạy tàu cho đến khi xác nhận rằng các nhân viên này có đủ tố chất, kỹ năng và kiến thức cần thiết để thực hiện nhiệm vụ của mình.

c) Nhân viên đường sắt trực tiếp phục vụ chạy tàu đường sắt đô thị không được phép làm nhiệm vụ khi trong máu hoặc hơi thở có nồng độ cồn hoặc các chất kích thích mà pháp luật cấm sử dụng.

d) Lái tàu phải có giấy phép lái tàu được quy định trong các văn bản quy phạm pháp luật có liên quan, trừ trường hợp lái tàu tập sự được lái tàu đã có giấy phép trực tiếp hướng dẫn chạy tàu.

3. BẢO TRÌ CÔNG TRÌNH ĐƯỜNG SẮT

3.1 Nguyên tắc bảo trì công trình đường sắt

3.1.1 Công trình đường sắt phải được bảo trì theo quy trình để đảm bảo chạy tàu theo kế hoạch, an toàn cho hành khách đi tàu và người dân xung quanh, tránh tổn hại đến tài sản và môi trường.

3.1.2 Công trình đường sắt đô thị phục vụ chạy tàu phải được duy trì ở trạng thái phù hợp để đảm bảo an toàn.

3.1.3 Khi đường sắt chính tuyến không đảm bảo trạng thái như mô tả tại Điểm b), phải hạn chế tốc độ chạy tàu, hoặc thực hiện các biện pháp cần thiết khác để đảm bảo an toàn chạy tàu. Những đoạn tuyến này cần theo dõi đặc biệt và phải được giám sát chặt chẽ.

3.1.4 Thiết bị đảm bảo an toàn chạy tàu phải được bảo trì để luôn ở trạng thái hoạt động chính xác.

3.2 Kiểm tra và vận hành thử đối với công trình xây dựng mới, cải tạo hay sửa chữa

3.2.1 Công trình đường sắt đô thị trước khi đưa vào sử dụng phải được tiến hành chạy thử và nghiệm thu theo quy định của pháp luật có liên quan, trừ trường hợp chỉ sửa chữa nhỏ hoặc với đường phụ không ảnh hưởng đến đường chính tuyến.

3.2.2 Khi có thiên tai hay sự cố, hoặc không khai thác trong một thời gian nhất định thì công trình đường sắt phải được kiểm tra trước khi vận hành. Trường hợp cần thiết phải vận hành thử trước khi đưa vào sử dụng.

3.3 Tuân tra công trình đường sắt

3.3.1 Công trình đường sắt đô thị trên đường sắt chính tuyến phải được tuân tra tùy theo trạng thái của tuyến đường và thực tế chạy tàu. Tần suất, thời điểm, phương pháp tuân tra phải được quy định theo quy trình bảo trì và theo tình hình thực tế.

3.3.2 Khi tiến hành tuân tra nếu phát hiện sự cố gây mất an toàn chạy tàu phải thực hiện ngay các biện pháp xử lý thích hợp để đảm bảo an toàn và khắc phục sự cố.

3.3.3 Khi có nguy cơ xảy ra thiên tai gây mất an toàn chạy tàu trên đường sắt chính tuyến phải giám sát chặt chẽ tuyến đường đó, hạn chế tốc độ chạy tàu hoặc dừng chạy tàu trên đường sắt chính tuyến hay các khu đoạn có liên quan.

3.4 Kiểm tra kết cấu tầng trên

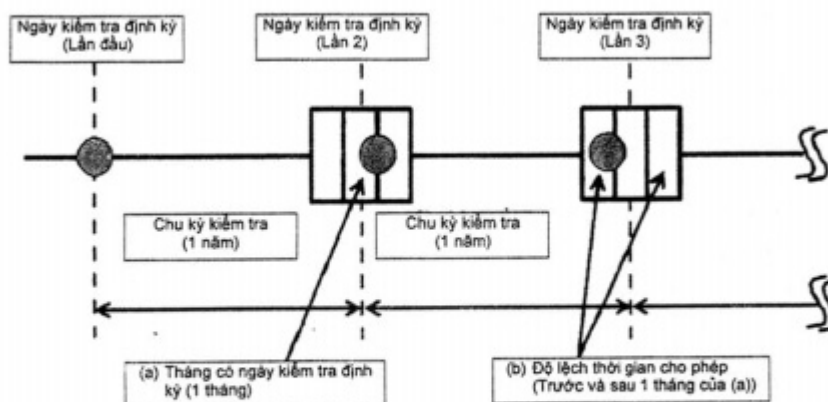
3.4.1 Tuân tra kết cấu tầng trên đường sắt

Tuân tra kết cấu tầng trên đường sắt được thực hiện bằng cách đi bộ hoặc sử dụng phương tiện chuyên dùng với tần suất tối thiểu năm (05) ngày một (01) lần trên đường sắt chính tuyến và hai (02) tuần một (01) lần trên đường phụ.

3.4.2 Chu kỳ kiểm tra định kỳ kết cấu tầng trên

a) Kiểm tra định kỳ kết cấu tầng trên đường sắt bao gồm kiểm tra tình trạng và cấu kiện cấu thành kết cấu tầng trên đường sắt. Chu kỳ, phương pháp, hạng mục kiểm tra được quy định phù hợp với chủng loại, cấu tạo và tình trạng sử dụng kết cấu tầng trên của mỗi tuyến đường sắt.

b) Kiểm tra định kỳ kết cấu tầng trên đường sắt được thực hiện tối thiểu một (01) năm một (01) lần, kể từ ngày kiểm tra định kỳ của kỳ kiểm tra trước, việc kiểm tra được thực hiện trong tháng có ngày kiểm tra tương ứng hoặc trước hay sau tháng đó với độ lệch thời gian cho phép là một (01) tháng.



Hình 1. Thời gian kiểm tra định kỳ (trường hợp chu kỳ kiểm tra là 1 năm)

c) Trên cơ sở xem xét tình trạng kết cấu tầng trên đường sắt, trong trường hợp phải rút ngắn chu kỳ kiểm tra nêu tại Điểm b Khoản này phải quy định chu kỳ kiểm tra mới tương ứng và thực hiện kiểm tra theo chu kỳ đó. Trong trường hợp này, độ lệch thời gian cho phép phải được thiết lập lại để phù hợp với chu kỳ kiểm tra mới.

d) Trường hợp thi công có quy mô lớn thay thế toàn bộ bộ phận công trình hoặc thiết bị lắp đặt, ngày kiểm tra định kỳ nêu tại Điểm b và Điểm c Khoản này áp dụng cho công trình sau thi công phải được quy định mới.

đ) Tạm dừng kiểm tra trong các trường hợp dưới đây:

- (1) Do xảy ra đồng bão, thiên tai hay tai nạn, sự cố.
- (2) Dừng kiểm tra để ưu tiên xử lý thiên tai hay tai nạn, sự cố tại địa điểm khác.

3.4.3 Tiêu chí đánh giá và biện pháp xử lý

Việc đánh giá kết cấu đường ray phải được thực hiện dựa theo các tiêu chí đánh giá quy định trong quy trình bảo trì và phải phù hợp với các tiêu chuẩn bảo trì.

Trường hợp kết quả đánh giá cho thấy tính năng đường ray không đáp ứng yêu cầu, tùy thuộc vào mức độ không đáp ứng phải thực hiện một hay thực hiện kết hợp các biện pháp xử lý sau:

- (1) Sửa chữa;
- (2) Theo dõi giám sát;
- (3) Hạn chế sử dụng.

3.5 Kiểm tra kết cấu xây dựng

3.5.1 Các hình thức kiểm tra

Công tác kiểm tra kết cấu xây dựng bao gồm:

- Kiểm tra ban đầu;
- Kiểm tra định kỳ;
- Kiểm tra đột xuất.

3.5.2 Kiểm tra ban đầu

Kiểm tra ban đầu được thực hiện đối với kết cấu xây dựng được xây dựng mới trước khi đưa vào sử dụng với mục đích xác định trạng thái kỹ thuật ban đầu. Kiểm tra ban đầu cũng được thực hiện đối với kết cấu xây dựng sau khi được tiến hành sửa chữa, nâng cấp quy mô lớn.

3.5.3 Kiểm tra định kỳ

a) Chu kỳ, hạng mục và phương pháp kiểm tra định kỳ kết cấu xây dựng được quy định phù hợp với chủng loại, cấu tạo công trình và tình trạng sử dụng công trình.

b) Kết cấu xây dựng được kiểm tra định kỳ tối thiểu hai (02) năm một (01) lần, kể từ ngày kiểm tra định kỳ của kỳ kiểm tra trước, việc kiểm tra được thực hiện trong tháng có ngày kiểm tra tương ứng hoặc trước hay sau tháng đó với độ lệch thời gian cho phép là một (01) tháng.

c) Ngày kiểm tra định kỳ nêu trên được thay đổi khi tiến hành nâng cấp cải tạo công trình ở quy mô lớn, với điều kiện công tác kiểm tra ở mức tương đương hoặc cao hơn kiểm tra định kỳ sẽ được thực hiện đảm bảo không vượt khỏi chu kỳ kiểm tra ban đầu của mỗi công trình hay bộ phận cấu thành công trình.

d) Trên cơ sở xem xét tình trạng công trình và các điều kiện khác, trong trường hợp phải rút ngắn chu kỳ kiểm tra nêu tại Điểm b Khoản này, phải quy định chu kỳ kiểm tra mới tương ứng và thực hiện kiểm tra theo chu kỳ đó. Trong trường hợp này, độ lệch thời gian cho phép được thiết lập lại để phù hợp với chu kỳ kiểm tra mới.

đ) Đối với công trình cầu phải được kiểm tra định kỳ bằng phương pháp kiểm tra trực quan. Đồng thời, sau một thời gian nhất định phải thực hiện một kỳ kiểm tra bằng trực quan một cách tỉ mỉ và kỹ lưỡng.

e) Công trình hầm phải được kiểm tra định kỳ bằng cách đi dọc đường hầm trong điều kiện đủ sáng để kiểm tra trực quan, ở một số đoạn hầm khi cần thiết phải dùng búa gõ để kiểm tra hay thực hiện các biện pháp kiểm tra khác tương đương. Đồng thời, sau mỗi hai mươi (20) năm phải thực hiện một kỳ kiểm tra định kỳ chi tiết để kiểm tra một cách tỉ mỉ và kỹ lưỡng.

f) Tạm dừng kiểm tra trong các trường hợp dưới đây:

- (1) Do xảy ra động bão, thiên tai hay tai nạn, sự cố.
- (2) Dừng kiểm tra để ưu tiên xử lý thiên tai hay tai nạn, sự cố tại địa điểm khác.

3.5.4 Kiểm tra đột xuất

Kiểm tra đột xuất được thực hiện bất cứ lúc nào khi thấy cần thiết để xác định các nguy cơ hư hại, xuống cấp của kết cấu xây dựng so với tiêu chuẩn thiết kế công trình.

3.5.5 Biện pháp xử lý đối với kết cấu xây dựng

Các biện pháp xử lý đối với kết cấu xây dựng như theo dõi, giám sát, sửa chữa, gia cố, khai thác hạn chế, cải tạo hay thay thế phải được thực hiện dựa trên kết quả kiểm tra công trình.

3.6 Kiểm tra hệ thống cung cấp điện sức kéo**3.6.1 Tuân tra hệ thống cung cấp điện sức kéo**

Tuân tra hệ thống cung cấp điện sức kéo phải được thực hiện trên cơ sở xem xét tình trạng khu gian và vận hành tàu với tần suất tuân tra tối thiểu bảy (7) ngày một (01) lần đối với hệ thống cung cấp điện trên cao và mười bốn (14) ngày một (01) lần đối với hệ thống cung cấp điện ray thứ ba.

Trong trường hợp nhà sản xuất quy định chu kỳ kiểm tra nhỏ hơn thì theo quy định của nhà sản xuất.

3.6.2 Kiểm tra định kỳ hệ thống cung cấp điện sức kéo

a) Chu kỳ, hạng mục và phương pháp kiểm tra định kỳ hệ thống cung cấp điện sức kéo được quy định phù hợp với chủng loại, cấu tạo của thiết bị và tình trạng sử dụng thiết bị.

b) Hệ thống cung cấp điện sức kéo được kiểm tra định kỳ theo chu kỳ như trong bảng 1 dưới đây. Việc kiểm tra được thực hiện trong tháng có ngày kiểm tra tương ứng hoặc trước hay sau tháng đó với độ lệch thời gian cho phép theo quy định tại Bảng 1.

Bảng 1. Chu kỳ kiểm tra và độ lệch thời gian cho phép của công tác kiểm tra định kỳ hệ thống cung cấp điện sức kéo

Loại thiết bị	Chu kỳ kiểm tra	Độ lệch thời gian cho phép
Thiết bị lấy điện, động cơ điện kéo, đường dây truyền tải điện, thiết bị biến áp để cung cấp cho vận hành tàu, các thiết bị bảo vệ máy biến áp và dây lấy điện... tại thời điểm bất thường và các thiết bị cấp điện quan trọng khác.	1 năm	1 tháng
Các loại thiết bị cấp điện khác	2 năm	1 tháng

Trong trường hợp nhà sản xuất quy định chu kỳ kiểm tra nhỏ hơn thì theo quy định của nhà sản xuất.

c) Ngày kiểm tra định kỳ nêu trên được thay đổi trong trường hợp tiến hành nâng cấp cải tạo thiết bị cấp điện ở quy mô lớn hoặc các tình huống tương tự, với điều kiện

công tác kiểm tra ở mức tương đương hoặc cao hơn kiểm tra định kỳ sẽ được thực hiện đảm bảo không vượt khỏi chu kỳ kiểm tra ban đầu của mỗi công trình hay bộ phận cấu thành công trình.

d) Tạm dừng kiểm tra trong các trường hợp dưới đây:

(1) Do xảy ra đồng bão, thiên tai hay tai nạn, sự cố.

(2) Dừng kiểm tra để ưu tiên xử lý thiên tai hay tai nạn, sự cố tại địa điểm khác.

3.6.3 Điện áp của mạch tiếp xúc

a) Đối với các tuyến dùng hệ thống cung cấp điện sức kéo một chiều 750 V hoặc một chiều 1500 V, các giá trị điện áp của mạch tiếp xúc quy định tại Bảng 2.

Bảng 2. Giá trị điện áp của mạch tiếp xúc

Giá trị định mức, V	Giá trị cao nhất, V	Giá trị thấp nhất, V
750	900	500
1500	1800	1000

b) Đối với các tuyến dùng hệ thống cung cấp điện sức kéo khác thì áp dụng theo quy định riêng được cấp có thẩm quyền phê duyệt.

3.6.4 Biện pháp xử lý khi kiểm tra thấy các bất thường

Khi kiểm tra, nếu phát hiện các bất thường có thể ảnh hưởng đến khả năng làm việc chính xác và ổn định của thiết bị, phải áp dụng các biện pháp như khôi phục, chỉnh bị, thay thế hay tạm ngừng sử dụng thiết bị.

3.7 Kiểm tra thiết bị điều khiển chạy tàu

3.7.1 Kiểm tra định kỳ thiết bị điều khiển chạy tàu

a) Chu kỳ, hạng mục và phương pháp kiểm tra định kỳ thiết bị điều khiển chạy tàu được quy định phù hợp với chủng loại, cấu tạo và tình trạng sử dụng thiết bị.

b) Thiết bị điều khiển chạy tàu được kiểm tra định kỳ theo chu kỳ, việc kiểm tra được thực hiện trong tháng có ngày kiểm tra tương ứng hoặc trước hay sau tháng đó với độ lệch thời gian cho phép theo quy định tại Bảng 3.

Bảng 3. Chủng loại thiết bị, chu kỳ kiểm tra, độ lệch thời gian cho phép thiết bị điều khiển chạy tàu

Loại thiết bị	Chu kỳ kiểm tra	Độ lệch thời gian cho phép
Thiết bị đóng đường, thiết bị đảm bảo giãn cách tàu, thiết bị hiển thị tín hiệu đường sắt, thiết bị liên khóa tín hiệu, thiết bị tự động phòng vệ chạy tàu quá tốc độ và các thiết bị điều khiển chạy tàu quan trọng khác	1 năm	1 tháng
Các thiết bị điều khiển chạy tàu khác không được nêu ở trên	2 năm	1 tháng

Trong trường hợp nhà sản xuất quy định chu kỳ kiểm tra nhỏ hơn thì theo quy định của nhà sản xuất.

c) Ngày kiểm tra định kỳ nêu trên được thay đổi trong trường hợp tiến hành nâng cấp cải tạo thiết bị điều khiển chạy tàu ở quy mô lớn hoặc các tình huống tương tự, với điều kiện công tác kiểm tra ở mức tương đương hoặc cao hơn kiểm tra định kỳ sẽ được thực hiện đảm bảo không vượt quá chu kỳ kiểm tra ban đầu của thiết bị điều khiển chạy tàu.

d) Trên cơ sở xem xét tình trạng thiết bị và các điều kiện khác, trong trường hợp phải rút ngắn chu kỳ kiểm tra nêu tại Điểm b Khoản này phải quy định chu kỳ kiểm tra mới tương ứng và thực hiện kiểm tra theo chu kỳ đó. Trong trường hợp này, độ lệch thời gian cho phép được thiết lập lại để phù hợp với chu kỳ kiểm tra mới.

đ) Tùy theo từng thiết bị hay bộ phận của thiết bị phải quy định chu kỳ mới (gồm chu kỳ kiểm tra và độ lệch thời gian cho phép) dài hơn chu kỳ kiểm tra nêu tại Điểm b) và thực hiện kiểm tra theo chu kỳ đó đối với các thiết bị dưới đây:

- (1) Thiết bị điều khiển chạy tàu có tính năng tự động khởi động thiết bị dự phòng khi xảy ra sự cố hoặc sắp xảy ra sự cố.
- (2) Thiết bị điện tử hay thiết bị được hàn kín, hoặc thiết bị được thay thế định kỳ để đảm bảo tính năng làm việc. Tính năng của các thiết bị này được đảm bảo trong thời hạn dài hơn so với chu kỳ kiểm tra nêu tại Điểm b).

e) Tạm dừng kiểm tra trong các trường hợp dưới đây:

- (1) Do xảy ra đồng bão, thiên tai hay tai nạn, sự cố.
- (2) Dừng kiểm tra để ưu tiên xử lý thiên tai hay tai nạn, sự cố tại địa điểm khác.

3.7.2 Biện pháp xử lý khi kiểm tra thấy các bất thường

Khi kiểm tra, nếu phát hiện các bất thường có thể ảnh hưởng đến khả năng làm việc chính xác và ổn định của thiết bị, phải áp dụng các biện pháp như khôi phục, chỉnh bị, thay thế hay tạm ngừng sử dụng thiết bị.

3.8 Kiểm tra các công trình, thiết bị khác

Chu kỳ, hạng mục và phương pháp kiểm tra định kỳ các công trình, thiết bị khác được quy định riêng phù hợp với chủng loại, cấu tạo và tình trạng sử dụng công trình, thiết bị.

3.9 Lưu hồ sơ

3.9.1 Tất cả các hoạt động kiểm tra, xây dựng, nâng cấp hay sửa chữa công trình đường sắt phải được lập hồ sơ và lưu giữ đầy đủ.

3.9.2 Hồ sơ liên quan đến kiểm tra định kỳ, xây dựng, nâng cấp và sửa chữa công trình đường sắt phải được lưu giữ theo quy định.

4. BẢO TRÌ TOA XE

4.1 Bảo trì toa xe

4.1.1 Bảo trì toa xe

Toa xe chỉ được phép vận hành sau khi được bảo trì đảm bảo các điều kiện về an toàn theo quy định của nhà sản xuất.

4.1.2 Đảm bảo an toàn toa xe

Toa xe phải được kiểm tra định kỳ các tính năng và được sửa chữa hoặc thay thế khi cần thiết nhằm đảm bảo an toàn vận hành theo quy định của nhà sản xuất.

4.2 Kiểm tra và vận hành thử toa xe chế tạo mới hoặc mới được sửa chữa

4.2.1 Toa xe chế tạo mới, mua mới, hoặc mới được nâng cấp, sửa chữa phải được kiểm tra và vận hành thử trước khi đưa vào sử dụng theo quy định của các văn bản quy phạm pháp luật có liên quan. Trong trường hợp chỉ thực hiện cải tạo, sửa chữa nhỏ, có thể bỏ qua bước vận hành thử.

4.2.2 Khi toa xe gặp sự cố trật bánh hay các sự cố khác, hoặc toa xe đã không khai thác trong một thời gian nhất định, phải kiểm tra toa xe đó và nếu cần thiết phải vận hành thử trước khi đưa vào sử dụng.

4.3 Kiểm tra và biện pháp xử lý đối với toa xe

4.3.1 Nội dung kiểm tra toa xe

a) Các bộ phận chính của toa xe phải được kiểm tra định kỳ tùy chủng loại và tình hình sử dụng theo quy định của nhà sản xuất, bao gồm: giá chuyển hướng; thiết bị động lực; thiết bị lấy điện; động cơ điện kéo; thiết bị điều khiển; máy biến áp chính và các thiết bị kèm theo; thiết bị hãm; thiết bị cung cấp điện phụ trợ và các động cơ phụ trợ; các rơ le, van điện từ và dây dẫn; máy nén khí và các thiết bị kèm theo; thân xe và khoang hành khách; thiết bị báo hiệu, liên lạc và phát thanh trên tàu; các thiết bị hiển thị; bộ móc nối các dụng cụ đo.

Trong trường hợp các toa xe đã được kết nối thành đoàn tàu thì phải tiến hành kiểm tra tính năng của hệ thống hãm đồng bộ, kiểm tra tình trạng máy móc, thiết bị, kiểm tra mức tiêu thụ điện năng. Đối với toa xe được giám sát bằng thiết bị giám sát toa xe thì có thể thực hiện kiểm tra tàu bằng các thiết bị này.

b) Trong trường hợp không thể tiến hành kiểm tra do xảy ra thiên tai, sự cố, có thể tạm dừng kiểm tra tàu và sẽ tiếp tục công tác kiểm tra khi điều kiện cho phép.

c) Đơn vị vận hành đường sắt đô thị phải quy định nội dung và thời điểm kiểm tra dựa trên tình hình sử dụng, phương thức thiết kế, phương thức quản lý, tình hình lưu thông của tàu và thực hiện kiểm tra theo quy định đó.

4.3.2 Chu kỳ kiểm tra toa xe

a) Toa xe phải được kiểm tra định kỳ theo chu kỳ tương ứng với từng chủng loại, cấu tạo và tình trạng sử dụng toa xe khác nhau theo quy định của nhà sản xuất. Quy định này không áp dụng cho các bộ phận toa xe có tính năng chống mài mòn và có độ bền cao, đảm bảo tính năng được duy trì trong thời hạn dài hơn so với chu kỳ quy định.

b) Trong trường hợp không thể tiến hành kiểm tra do xảy ra thiên tai, sự cố vận hành có thể tạm dừng kiểm tra và sẽ tiếp tục công tác kiểm tra khi điều kiện cho phép.

4.3.3 Nội dung, phương pháp kiểm tra tổng thể và vận hành thử toa xe

Tùy theo cấu tạo, tính năng và tình hình sử dụng toa xe phải tiến hành kiểm tra các hạng mục: bộ phận chạy, thiết bị hãm, thiết bị điện thông thường, thiết bị khí nén thông thường, thân xe, khoang hành khách và các thiết bị khác theo quy định tại Bảng 4.

Bảng 4. Nội dung, phương pháp kiểm tra tổng thể và vận hành thử toa xe

Nội dung kiểm tra	Phương pháp kiểm tra
I. Kiểm tra tổng thể	
(a) Tình trạng lắp đặt của từng bộ phận thiết bị	(b) Đo lường
(b) Thiết bị gạt vật cản và độ cao của miệng vòi xả cát	
(c) Tính năng điều khiển của thiết bị lấy điện	
(d) Tính năng điều khiển và bảo vệ của thiết bị trong mạch điều khiển.	(đ) Thử nghiệm điện trở cách điện và Thử nghiệm độ bền điện môi
(đ) Đặc tính cách điện của mạch điện (ngoại trừ các mạch sử dụng ắc quy, chất bán dẫn...)	
(e) Tính năng hoạt động của thiết bị hãm	(f) Đo lường
(f) Sự rò khí nén của thiết bị điều khiển hãm gió và các thiết bị khí khác	
(g) Công suất của máy nén khí và tính năng của các thiết bị kèm theo (bao gồm bộ điều áp và van an toàn)	(g) Đo lường
(h) Độ nghiêng thân xe	(h) Đo lường
(i) Tính năng hoạt động của thiết bị đóng cửa tự động.	
(j) Tính năng chiếu sáng của các thiết bị chiếu sáng	(m) Đo lường
(k) Tính năng hoạt động của thiết bị báo hiệu, liên lạc và phát thanh	
(l) Tính năng hoạt động của từng thiết bị hiển thị	
(m) Độ cao của coupler liên kết	

(n) Đặc tính và tính năng hoạt động của hệ thống ATC, ATP, ATS, ATO (o) Quản lý tải trọng tính của bánh xe (p) Thùng xe (q) Hệ thống điều hòa không khí và thông gió (r) Bộ phận móc nối liên kết điện, khí giữa các toa xe	(n) Đo lường
II. Vận hành thử (a) Năng lực khi khởi động, tăng tốc và giảm tốc (b) Tính năng chính của thiết bị hãm (c) Độ ồn và rung lắc bất thường (d) Tình trạng hiển thị của các dụng cụ đo (đ) Tính năng của thiết bị vận hành tàu tự động (e) Tình trạng của thiết bị... sau khi vận hành thử (f) Tình trạng của các ổ bi trên các động cơ điện kéo (g) Tình trạng của thiết bị trong mạch điện chính (h) Sự phát nhiệt, rò rỉ dầu ở bạc đạn trục bánh xe (i) Tính năng hoạt động của thiết bị ghi dữ liệu trạng thái vận hành tàu.	

4.3.4 Biện pháp xử lý

Trong trường hợp kết quả kiểm tra cho thấy tàu và toa xe không đảm bảo các tính năng cần thiết theo quy định, phải áp dụng các biện pháp như chỉnh bị, sửa chữa, thay thế hay tạm ngừng sử dụng.

4.3.5 Lưu hồ sơ kiểm tra

a) Tất cả các hoạt động kiểm tra, nâng cấp hay sửa chữa toa xe theo quy định trên phải được lập hồ sơ và lưu giữ đầy đủ.

b) Hồ sơ liên quan đến kiểm tra định kỳ toa xe phải được lưu giữ cho đến khi kết thúc hoàn toàn đợt kiểm tra định kỳ diễn ra sau đó áp dụng cho toàn bộ toa xe.

5. TỔ CHỨC THỰC HIỆN

5.1 Cục Đường sắt Việt Nam có trách nhiệm chủ trì, phối hợp với Vụ Khoa học - Công nghệ và các cơ quan chức năng khác kiểm tra việc thực hiện Quy chuẩn này trong phạm vi cả nước.

5.2 Các đơn vị quản lý vận hành, bảo trì đường sắt đô thị có trách nhiệm phổ biến, hướng dẫn các đơn vị trực thuộc, các tổ chức, cá nhân tham gia hoạt động đường sắt đô thị thi hành Quy chuẩn này.

5.3 Ủy ban nhân dân các tỉnh, thành phố trực thuộc Trung ương có đường sắt đô thị tổ chức xây dựng và phê duyệt các quy trình về vận hành, bảo trì đường sắt đô thị theo quy định của pháp luật và Quy chuẩn này, bảo đảm phù hợp với từng tuyến; chủ trì, phối hợp với các cơ quan có liên quan tổ chức thanh tra, kiểm tra việc thực hiện Quy chuẩn này.

5.4 Trong quá trình thực hiện, nếu có khó khăn, vướng mắc, các cơ quan, đơn vị báo cáo về Bộ Giao thông vận tải xem xét, giải quyết.

- 2.1.7 Vị trí điều khiển của lái tàu
- 2.1.8 Tốc độ vận hành tàu
- 2.1.9 Chạy tàu lùi
- 2.1.10 Các biện pháp khẩn cấp để dừng tàu đến gần
- 2.1.11 Phong tỏa khu gian
- 2.1.12 Phòng tránh rủi ro trong chạy tàu
- 2.1.13 Dồn dịch
- 2.1.14 Dừng đỗ của toa xe
- 2.1.15 Điều kiện vận hành tàu ở chế độ lái tàu tự động
- 2.2 Tín hiệu đường sắt
 - 2.2.1 Mối liên hệ giữa tín hiệu đường sắt và vận hành tàu
 - 2.2.2 Tín hiệu dừng tàu
 - 2.2.3 Tín hiệu hiển thị không chính xác
 - 2.2.4 Điều kiện hiển thị tín hiệu cho phép chạy tàu
 - 2.2.5 Các nội dung khác liên quan đến hiển thị tín hiệu
 - 2.2.6 Cấm cản trở tuyến đường khi có tín hiệu biểu thị cho phép chạy tàu
 - 2.2.7 Hiệu lệnh và biển báo
- 2.3 Nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị
 - 2.3.1 Chức danh nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị
 - 2.3.2 Đào tạo và huấn luyện nhân viên trực tiếp phục vụ chạy tàu đường sắt đô thị
 - 2.3.3 Đảm bảo an toàn chạy tàu
- 3. BẢO TRÌ CÔNG TRÌNH ĐƯỜNG SẮT
 - 3.1 Nguyên tắc bảo trì công trình đường sắt
 - 3.2 Kiểm tra và vận hành thử đối với công trình xây dựng mới, cải tạo hay sửa chữa
 - 3.3 Tuần tra công trình đường sắt
 - 3.4 Kiểm tra kết cấu tầng trên
 - 3.4.1 Tuần tra kết cấu tầng trên đường sắt
 - 3.4.2 Chu kỳ kiểm tra định kỳ kết cấu tầng trên
 - 3.4.3 Tiêu chí đánh giá và biện pháp xử lý
 - 3.5 Kiểm tra kết cấu xây dựng
 - 3.5.1 Các hình thức kiểm tra

- 3.5.2 Kiểm tra ban đầu
- 3.5.3 Kiểm tra định kỳ
- 3.5.4 Kiểm tra đột xuất
- 3.5.5 Biện pháp xử lý đối với kết cấu xây dựng
- 3.6 Kiểm tra hệ thống cung cấp điện sức kéo
 - 3.6.1 Tuân tra hệ thống cung cấp điện sức kéo
 - 3.6.2 Kiểm tra định kỳ hệ thống cung cấp điện sức kéo
 - 3.6.3 Điện áp của mạch tiếp xúc
 - 3.6.4 Biện pháp xử lý khi kiểm tra thấy các bất thường
- 3.7 Kiểm tra thiết bị điều khiển chạy tàu
 - 3.7.1 Kiểm tra định kỳ thiết bị điều khiển chạy tàu
 - 3.7.2 Biện pháp xử lý khi kiểm tra thấy các bất thường
- 3.8 Kiểm tra các công trình, thiết bị khác
- 3.9 Lưu hồ sơ
- 4. BẢO TRÌ TOA XE
 - 4.1 Bảo trì toa xe
 - 4.1.1 Bảo trì toa xe
 - 4.1.2 Đảm bảo an toàn toa xe
 - 4.2 Kiểm tra và vận hành thử toa xe chế tạo mới hoặc mới được sửa chữa ..
 - 4.3 Kiểm tra và biện pháp xử lý đối với toa xe
 - 4.3.1 Nội dung kiểm tra toa xe
 - 4.3.2 Chu kỳ kiểm tra toa xe
 - 4.3.3 Nội dung, phương pháp kiểm tra tổng thể và vận hành thử toa xe
 - 4.3.4 Biện pháp xử lý
 - 4.3.5 Lưu hồ sơ kiểm tra
- 5. TỔ CHỨC THỰC HIỆN

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