MASS RAPID TRANSIT AUTHORITY
THAILAND

SPECIAL ASSISTANCE
FOR
PROJECT IMPLEMENTATION
FOR
BANGKOK MASS TRANSIT DEVELOPMENT PROJECT
IN
THAILAND

FINAL REPORT

SEPTEMBER 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS, CO., LTD.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank	
AFC	Automatic Fare Collection	
AG	Automatic Gate	AFC System
AO & IT	Automated Office & Information Technology	
AR	Automatic Reversal	
ARL	Airport Rail Link	Thailand
ARS	Automatic Route Setting	
ATC	Automatic Train Control	
ATP	Automatic Train Protection	
ATR	Automatic Train Regulation	
ATM	Automatic Teller Machine	
AVM	Add Value Machine	AFC System
BLO	Build-Lease-Operation	
BLT	Build-Lease-Transfer	
BMA	Bangkok Metropolitan Administration	Thailand
BMC	Bangkok Metropolitan Council	Thailand
BMCL	Bangkok Metro Public Company Limited	Thailand
BMR	Bangkok Metropolitan Region	Thailand
BMS	Building Management Services	Civil E&M
BOT	Build-Lease-Transfer	
BOO	Build-Owned-Operate	
BOT	Build-Operate-Transfer	
BRT	Bus Rapid Transit	
BPU	Business Promotion Unit	
B/S	Balance Sheet	
BTO	Build-Transfer-Operation	
BTS	Bangkok Transit System	
BTSC	Bangkok Transit System Corporation	
CA	Concession Agreement	
CASS	Controlled Access Security System	
CAT	City Air Terminal	
CBI	Computer Based Interlocking	
CBT	Capacity Building Training	
CBTC	Communications Based Train Control	
CCH	Central Clearing House	AFC System
CCR	Central Control Room	
CCS	Central Computer System	
CCTV	Closed Circuit Television	
CDRC	Corporate Debt Restructuring Committee	Malaysia
CMLT	Commission for the Management of Land Traffic	Thailand
CMMS	Computerized Maintenance Management System	
COTS	Components-of-the-Shelf	
CPS	Central Processing System	
CR	Conductor Rail	3rd Rail Traction Power
CRU	Customer Relation Unit	

CTC	Central Traffic Control	
CWE	Collaboration with Engineer	
DfT	Department of Transport	U.K.
DMRC	Delhi Metro Rail Corporation	India
DOTC	Department of Transport and Communication	The Philippines
DSCR	Debt Service Coverage Ratio	
DTCP	Department of Town and Country Planning	Thailand
DVD	Digital Video Disc	
DWE	Depot Workshop Equipment	
EDSA	Epifanio de los Santos Avenue	The Philippines
EIA	Environmental Impact Assessment	
EMC	Electromagnetic Compatibility	
ERL	Express Rail Link	Malaysia
ERP	Electronic Road Pricing	
E&M	Electrical and Mechanical Equipment	
FCI	Facility Condition Index	
FCDU	Foreign Currency Deposit Unit	The Philippines
FME	Foreign Material Exclusion	
FY	Fiscal Year	
GDP	Gross Domestic Product	
GOT	Government of Thailand	Thailand
GTZ	German Technical Agency for Cooperation	Germany
HR	Human Resource	
HQ	Head Quarter	
ICR	Inception Report	
IFC	International Finance Cooperation	
IMTI	Integrated Multi Multi-Modal Travel Information System	
Infracos	Infrastructure Companies	U.K
ISC	Infrastructure Service Charge	U.K
ISP	Initial System Project	
IT	Information Technology	
ITR	Interim Report	
JBIC	Japan Bank for International Cooperation	Japan
JNR	Japan National Railway	Japan
JR	Japan Railway Company	Japan
JRTT	Japan Railway Construction, Transport and Technology Agency	Japan
KfW	Kreditanstalt fÜr Wiederaufbau	Germany
KLIA	Kuala Lumpur International Airport	Malaysia
KPI	Key Performance Indicator	
KTM	Keretapi Tanah Melayu (Malayan Railways)	Malaysia
LAU	Legal Affairs Unit	
LCC	Life Cycle Cost	
LIBOR	London Inter-Bank Offered Rate	
LRT	Light Rail Transit	Singapore
LRT	Light Rail Transit	
LRTA	Light Rail Transit Authority	The Philippines

LS0H	Low Smoke Zero Halogen (Indoor Cables)	
LTCB	Land Transport Control Board	Singapore
LTA	Land Traffic Transport Authority	Thailand
LTCB	Land Transport Control Board	U.K.
MAS	MRT Assessment Standardization	Thailand
M&E	Mechanical & Electrical	
MIR	Metropolitan Intercity Railway Company	Japan
MLITT	Ministry of Land, Infrastructure, Transport and Tourism	Japan
MLR	Metropolitan Lending Rate (of Bangkok Bank)	Thailand
MMC	Maintenance Management Center	
M-MAP	Mass Rapid Transit Master Plan in Bangkok Metropolitan Region	
MOI	Ministry of Interior	Thailand
MOT	Ministry of Transport	Thailand
MOT	Management of Technology	
MPC	Monetary Policy Committee	Thailand
MRT	Mass Rapid Transit	
MRT	Metro Rapid Transit	The Philippines
MRTA	Mass Rapid Transit Authority	Thailand
MRTC	Metro Rail Transit Corporation	Singapore
MRTC	Metro Rail Transit Corporation	The Philippines
MTA	New York Subway System, Metropolitan Transport Authority	USA
MTR	MTR Corporation Limited	Hong Kong
NESDB	National Economic and Social Development Board	Thailand
NPL	Non-performing Loan	
NPV	Net Present Value	
O&M	Operation and Maintenance	
OCC	Operations Control Centre	
OCMLT	Office of the Commission for the Management of Land Traffic	Thailand
ODA	Official Development Assistance	
OEM	Original Equipment Manufacturer	
OJT	On-the-Job-Training	
OTP	Office of Transport and Traffic Policy and Planning	Thailand
PA	Public Address	
PABX	Private Automatic Branch Exchange	Telephone System
PASMO	Pass net & More (Tokyo City Rechargeable Ticketing System)	AFC System in Japan
PDMO	Public Debt Management Office of Ministry of Finance	Thailand
PGS	Parking Guide System	
PIDS	Passenger Information Display System	
P/L	Profit and Loss Statement	
PPP	Public Private Partnership	
PMO	Project Management Offices	
POST	Point Of Sales Terminal (In Ticket Office)	
PRU	Public Relation Unit	
PSC	Public Sector Comparator	
PSO	Public Service Obligation	Thailand
PRU	Public Relation Unit	
PTC	Public Transport Council	Singapore

PTR	Playback Training Room	
PTT	Push To Talk (Radio)	
PSD	Platform Screen Doors	
PUTRA	Projek Usahasama Transit Ringan Automatik	Malaysia
QA/QC	Quality Assurance/Quality Control	
RAFID	Radio Frequency Identification	
RapidKL	Rangkaian Pengangkutan Integrasi Deras Sdn Bhd	Malaysia
RATP	Regie Autonome des Transports Parisiens	France
RER	‘seau Express Regional	
ROE	Return on Equity	
RVT	Remaining Value Terminal	
SARL	Suvarnabhumi Airport Rail Link	Thailand
SC	Station Computer	AFC System
SCADA	Supervisory Control And Data Acquisition	
SEO	State-Owned Enterprise	
SEPO	State Enterprise Policy Office, Ministry of Finance	Thailand
SFPU	Strategic Financial Planning Unit	
SMRT	SMRT Corporation	Singapore
SMRT	SMRT Corporation	Singapore
SOR	Station Operation Room	
SOW	Scope of Works	
SPAD	Signal Passing Accident Danger	
SPNB	Syarikat Prasarana Negara Berhad	Malaysia
SRT	State Railways of Thailand	Thailand
SSS	Service Sub Station	Power System
STAR	Sistem Transit Aliran Ringan Sdn Bhd	Malaysia
STIF	Syndicate Transports dIle-Feance	France
SWOT	Strengths, Weaknesses, Opportunities, Threats Method	
TA	Technical Assistance	
TAC	Track Access Charge	
TCS	Train borne Communications System	
TfL	Transport for London	U.K.
TIM	Ticket Issuing Machine	
TO	Ticket Office Room	
TOD	Transit Oriented Development	
TOR	Terms of Reference	
TSS	Traction Sub Station	Power System
URMAP	Urban Rail Master Plan	Thailand
VfM	Value for Money	
VoIP	Voice over Internet Protocol (Communications Systems)	
WWI	World War I	
WWII	World War II	
YMR	Yokohama Minatomirai Railway Company	

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Japan International Cooperation Agency (JICA) currently undertakes a study, titled "The Study on Financial Framework in Mass Transit System Project in Thailand", with the objective to identify the directions and issues for the nearest assistance from Japan in mass transit system development in the host country. Following issues on MRTA Blue Line were reported in the course of the study.

a. Concession contract between Mass Rapid Transit Authority (MRTA) and Bangkok Metro Public Company Limited (BMCL) on Operation and Maintenance (O&M) has been effective since the line started revenue service. However, ridership of the line (revenue side) is still much below the original forecast as the network development is far behind the URMAP (Urban Rail Transportation Master Plan).

b. Contract scheme for the line extension and future lines may be reviewed and revised in such a way that MRTA will collect the fare revenue and pay the fixed amount to the concessionaire for their O&M works. MRTA aims to streamline their railway management through i) improvement of technical capabilities, ii) rationalization of rail business, and iii) promotion of non-core business.

c. MRTA employed private finance scheme in installation of railway system (including rolling stocks). On this occasion, MRTA tendered the installation contract, encompassing 25 years of O&M after commencement of revenue service, only with minimal technical specifications. As the result, detailed technical specifications were prepared by the supplier of the system.

d. Technical transfer for MRTA by the supplier seems to have undertaken ineffectively and insufficiently. Therefore, O&M activities and railway system procurements are carried out at the initiatives of the supplier.

From the above issues, MRTA recognizes that they will face the significant difficulties in developing the railway network, especially in extending the existing lines by themselves, using the same system as the one in operation.

It is anticipated that mass transit development in Bangkok Metropolis will make the most of private finance schemes as the case of Blue Line. In fact, Government of Thailand (GOT) already made its decision on the use of private finance for the development of Purple Line Project, in which loan agreement with Japanese Government was concluded in 2008.

Given the above background, MRTA is fully aware of the importance to enhance technical capabilities in management of:

1. Technical specification and tender documentation of railway M&E systems, and;
2. Operation and maintenance activities by way of planning and supervising

JICA herein dispatches a mission to propose the improvement methods and make suggestions on future directions in order to avoid above issues in MRT development under Japanese ODA loan.

1.2 Objective of the Study

In order to enhance MRTA's technical capabilities in technical specification and tender documentation of railway M&E systems (particularly rolling stock, signaling, and telecommunication) as well as in management of system maintenance and operation activities by way of planning and supervising, and eventually to realize an effective and efficient operation of the Mass Transit System in Bangkok, the objectives of the Study are:

(1) To analyze existing circumstances of M&E system procurement, operation and maintenance of mass transit facilities by MRTA, BCML and suppliers

(2) To develop a roadmap for MRTA's capacity development on M&E system procurement, operation and maintenance of mass transit systems

1.3 Scope of the Study

To meet the above objectives, scope of the study shall cover:

(1) Review of current situation and future prospects of MRT network development in Bangkok

(2) Review and assessment of MRTA's technical capabilities

(3) Development of a roadmap for MRTA's capacity building

Study Team recognizes the following issues corresponding to each of the above item:

1. Preconditions of MRTA's capacity development, i.e. "when" and "which lines" will be covered by MRTA, shall be clarified in accordance with the latest network plans.

2. Insufficiency and inadequacy in organizational functions, human resources, skill development and training programs as well as technical competencies shall be analyzed, if any.
3. Goals, issues, and challenges of the capacity development shall be well incorporated in the roadmap, scenarios, and action plans. Also, development of a roadmap shall be extended to entire sequence of implementation, monitoring, and refining by MRTA's own staff.

1.4 Counterpart Agency

Counterpart agency for the Study is Mass Rapid Transit Authority of Thailand (MRTA).

CHAPTER 2 EXISTING CIRCUMSTANCES AND FUTURE PROSPECTS OF MASS TRANSIT DEVELOPMENT IN BANGKOK

This chapter covers a comprehensive review of development plans and project studies on Mass Transit Systems in Bangkok. The Study Team reviewed and updated proposed and planned projects of each concerned agency, especially focusing on the plans/proposals that are directly concerned to future directions of MRTA.

2.1 Legal Framework and Government Policy

2.1.1 Relevant Agencies

The following government agencies and state enterprises are related to policies and projects of the urban railway system in Thailand.

(1) **The Office of Transport and Traffic Policy and Planning (OTP) is** responsible for formulating transport and traffic plans and working out transport safety measures along with the national transport under the Ministry of Transport. OTP submits its opinions to the National Transport Policy Board on the formulation and amendment of the laws on the national land transport and legislation for transport and traffic management.

(2) **The Office of the Commission for the Management of Land Traffic (OCMLT)** is consists of key Ministers and the Governor of Bangkok as members and OTP as secretariat, provides advice and makes plans for integrated transportation systems. The Commission for the management of Land Traffic (CMLT) was an independent office in MOT, but it was transferred to be under OTP.

(3) **The National Economic and Social Development Board (NESDB)** is responsible for formulating a five-year development plan, formulating policies and strategies for key development issues, analyzing budget proposals and related agencies under the Office of Prime Minister. As for the Public Private Partnership (PPP) project involving new assets, a feasibility study report should be submitted to NESDB.

(4) **Mass Rapid Transit Authority of Thailand (MRTA)** is a state enterprise which oversees MRT projects. MRTA used to be under the Prime Minister's Office, but was recently transferred to MOT on 9 October 2002. According to the Mass Rapid Transit Authority of Thailand Act 2000 (MRTA Act), MRTA is authorized to operate Mass Rapid Transit Systems within the Greater Bangkok Area and other provinces, or between the provinces and to run businesses related to the MRT enterprise. MRTA granted a

concession of the first MRT line in Bangkok, the Blue Line, to the Bangkok Metro Public Company Limited (BMCL). MRTA holds a 25% share of BMCL.

(5) **The Bangkok Metropolitan Administration (BMA)** is the local city government of Bangkok Province. BMA granted a concession of the Green Line, Light Green Line, Gray Line and Light Blue Line to the Bangkok Mass Transit System Public Company Limited (BTSC).

(6) **The Public Debt Management Office (PDMO)** is responsible for general affairs of public debt management policy and supervision under the Ministry of Finance.

(7) **The State Enterprise Policy Office, Ministry of Finance (SEPO)** is responsible for the investment scheme of the High Speed Train project uses the PPP scheme, which is being studied by the PPP committee.

(8) **The State Railway of Thailand (SRT)** is a state enterprise operating the national railway network under the Ministry of Transport.

2.1.2 Relevant Committees

The following committees are related to policies and projects of urban railway systems in Thailand.

(1) **MRT Committee** was established by the Ministry of Transportation to oversee construction works of MRT lines in 2006 and to confirm the form of MRT operating concessions and how they would be financed.

(2) **MRT Subcommittee** a subcommittee focusing on finance and operations of MRT lines under this committee which was chaired by PDMO, was also established to integrate and standardize the approaches of the three government agencies responsible for MRT concessioning, for exsample, MRTA, SRT and BMA.

(3) **The Policy and Management Committee for MRT** (**P&M Committee**) in the Bangkok Metropolitan Region was established in July 2007. This committee is a high-level policy committee chaired by the Prime Minister and includes such members as the Minister of Finance, Minister of Transport, Governor of BMA, Secretary General of NESDB, Secretary General of State Council and so on.

2.1.3 Ownership of Each Line

Each existing and planned mass transit system is or will be managed as follows:

(1) **BTSC Sky Train** – managed by BMA,

(2) **MRT Blue Line** – managed by MRTA

(3) **Airport Rail Link, and Red Line** – managed by SRT

2.1.4 Relevant Acts

(1) PPP Act

The Act on Private Participation in State Undertaking B.E. 2535 (1992), or PPP Act, stipulates the framework and government procedures of PPP projects. The Act stipulates the project approval process as follows:

- The Act is applicable to the projects over 1,000 million baht
- The agency of the project owner will present the results of the study and analyze the project in depth according to the NESDB's conditions and forward those determinations to the Ministry
- In case of Projects over 5,000 million baht. It is necessary to employ a consultant.
- The Ministry of Finance will consider the results of the study and analyze the project and present it to: i) new projects will be presented to NESDB for consideration, ii) the projects that already have the funding will be presented to the Ministry for consideration.
- In the case of new projects: If the NESDB agrees: the project will be presented to the cabinet for approval. If the NESDB disagrees : the agency of the project owner will be informed and if the agency of the project owner disagrees with NESDB, the owner's agency must present it or additional explanation to the Minister for presentation to the cabinet for further consideration.
- In the case of the projects that already have funding: If the Ministry of Finance agrees: it is presented to the cabinet for consideration. If the Ministry of Finance disagrees :they must inform the agency of the project owner and if the agency of the project owner disagrees with Ministry of Finance, the owner's agency must present its opinion or additional explanation to the Minister for presentation to the cabinet for consideration.
- NESDB or the Ministry of Finance have to consider the project within 60 days from the day that it received the project and if this deadline is not met it is regarded as agreement with the project.
- When the cabinet agrees with the project, the project owner must draft a notice to invite the private sector to participate in the operation and draft the scope of the project and the important conditions that have to be added in the agreement. If the project budget is over 5,000 million baht, a consultant must draft the scope of the project and prepare an

opinion for an estimate in selecting the private sector entity (entities) that will participate in the project.

- The agency of the project owner must appoint the members for the committee(not over 12 persons) that will consist of:

Committee Members	
The representative from the Ministry	Chairman
The representative from The Ministry of Finance	Committee
The representative from the Office of the Council of State	Committee
The representative from the Office of the Attorney-General	Committee
The representative from the NESDB	Committee
The representative from the Office of the Budget	Committee
The representative from the other Ministries (2 Ministries/1 person)	Committee
The experts (not over 3 persons)	Committee
The representative from the agency of the project owner 1 person	Committee

According to the PPP Act, this committee has the following duties.

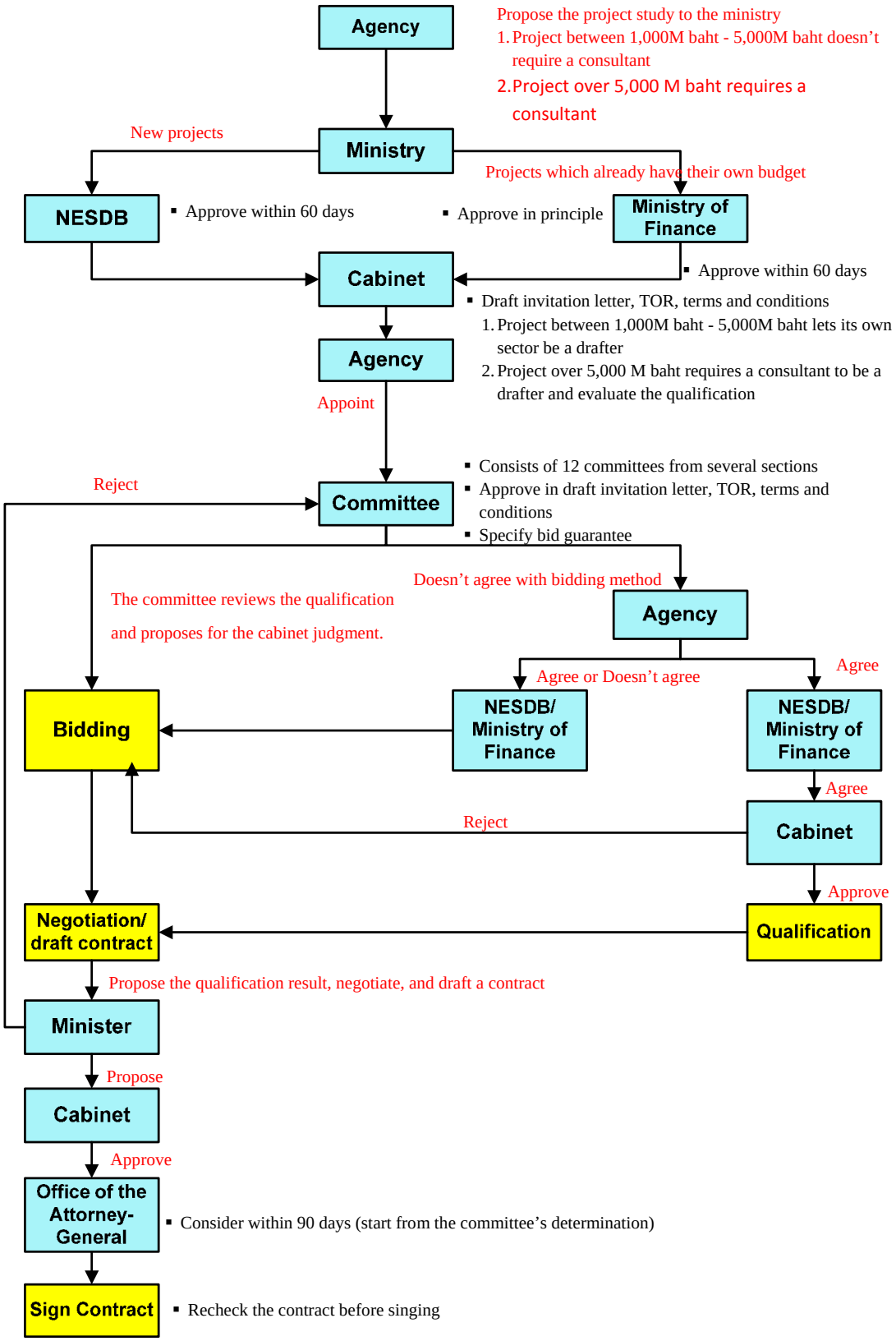
▪ To approve draft invitation letter, TOR and scope of works.

▪ To specify the bidding and contract guarantees.

▪ To Selection of bidders

▪ To consider other issue relating to the project.

Organization chart of the governmental agencies related to the MRT System is as shown in the following figure 2.1.



Source: SAPI Team Estimate

Figure 2.1 – Approval Process of PPP Project

2.2 Existing Mass Transit Network

Since the 1970s, the Thai government and Bangkok Metropolitan Administration (BMA) made and have promoted a plan of developing MRT lines in the Bangkok Metropolitan area with the purpose of solving the traffic congestion and environmental issues in this area.

Two urban rail lines are currently operating and one urban rail line is to be opened in 2010.

(1) **SkyTrain** - The first urban rail line in Bangkok, Bangkok Transit System (BTS), which is also called SkyTrain or the initial Green Line, was officially opened in December 1999. The BTS was wholly privately financed. The Bangkok Transit System Corporation (BTSC) operates the SkyTrain under the concession agreement with the Bangkok Metropolitan Administration (BMA).

(2) **Blue Line** – The second MRT line, the Blue Line, was opened in August 2004. The Blue Line was financed jointly by the public sector and the private sector. The national government funded the civil works and a private consortium, the Bangkok Metro Company Ltd. (BMCL), provided electrical & mechanical equipment (E&M) and rolling stock. BMCL operates the line under the concession agreement with the Mass Rapid Transit Authority of Thailand (MRTA).

(3) **ARL** - The Suvarnabhumi Airport Rail Link (ARL) linking from the Suvarnabhumi Airport to the urban area of Bangkok, which is to be owned and operated by the State Railway of Thailand (SRT) was opening on 23 August 2010.

Mass Transit Network Plan in Bangkok is as shown in the following figure 2.2.

Source: OTP November 2009

Figure 2.2 – Mass Transit Network Plan in Bangkok

2.3 Present Status of Each Project Plan

The first urban railway master plan for Bangkok Metropolitan Region (BMR), the "Conceptual Mass Rapid Transit Implementation Master Plan Project (CMIP)", was formulated by OCMLT in 1996.

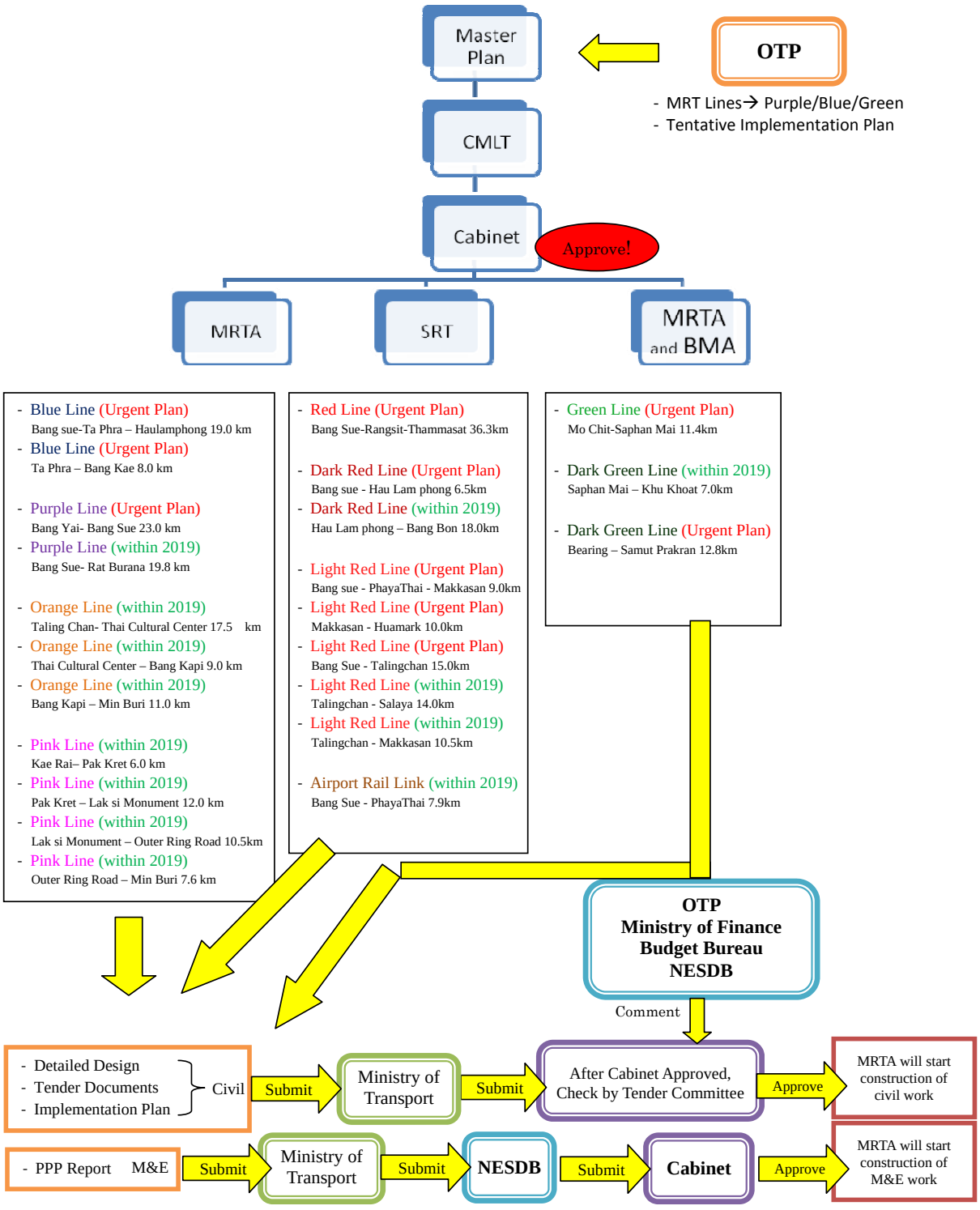
(1) **URMAP 1 -** CMIP and the "Additional Feeder Routes Plans under the Mass Transit Feeder System Study" were integrated under the Urban Rail Transportation Master Plan (URMAP 1) by OCMLT in 2001. URMAP 1 plan provided a framework for subsequent planning and engineering studies and implementation of individual projects and programs. URMAP 1 sought to make best use of existing rail lines and facilities as part of an optimum urban railway system for BMR.

(2) **URMAP 2** – In September 2004, OTP formulated the succeeding master plan "URMAP 2" based on URMAP 1, and then, the Government approved this new master plan. After the refinement works, Cabinet approved a revised master plan in June 2005. The plan aimed to develop 7 lines, namely the extension of BTSC Skytrain and blue line, and new development of the dark green, red north-south, red east-west (ARL), orange and purple lines, with total length of 277 km by 2012. While investment cost for civil work was supposed to be wholly financed by the government, the investment cost for E&M and rolling stock was planned to be jointly financed by the government and private concessionaires.

Under the plan, high priority was given to upgrading of the rail link connecting central Bangkok and the newly developed Suvarnabhumi Airport located in Bangkok's eastern suburbs (ARL 28km) as well as the existing Don Muang International Airport located in city's northern suburbs (Red Line 21km). In addition, the completion of the ring-shaped blue line in central Bangkok, and the extension to the Northeast (Purple Line) and Southwest (Red Line) were expected to form the backbone of the MRT network in Bangkok.

(3) **M-MAP** – OTP prepared the latest master plan following URMAP 2, which is called Mass Rapid Transit Master Plan in Bangkok (M-MAP).

The latest status of each project plan included in this M-MAP is shown in the following figures 2.4 and 2.5. This is the result of an interview survey with OTP and is not presented in the published documents.



Source: SAPI Team Estimate

Figure 2.3 – Latest Status of Bangkok MRT Projects by Railway Authority

Depend on regulation, Detail Design and Tender Documents of projects are not necessary cabinet's approval. Even if, MRTA has to submit these documents to the cabinet conventionality.

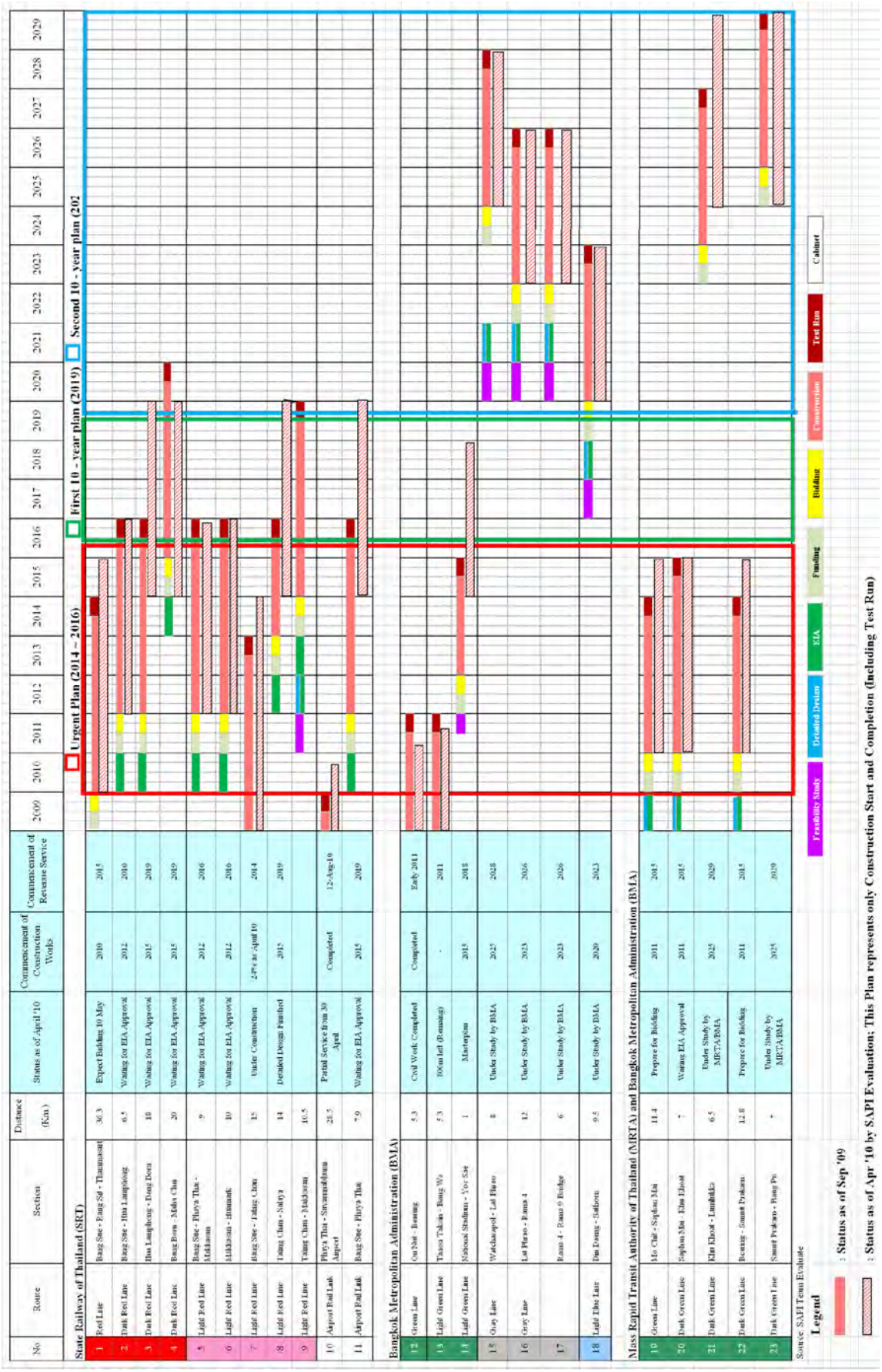


Figure 2.4 - Latest Status of Each Project Plan (1)

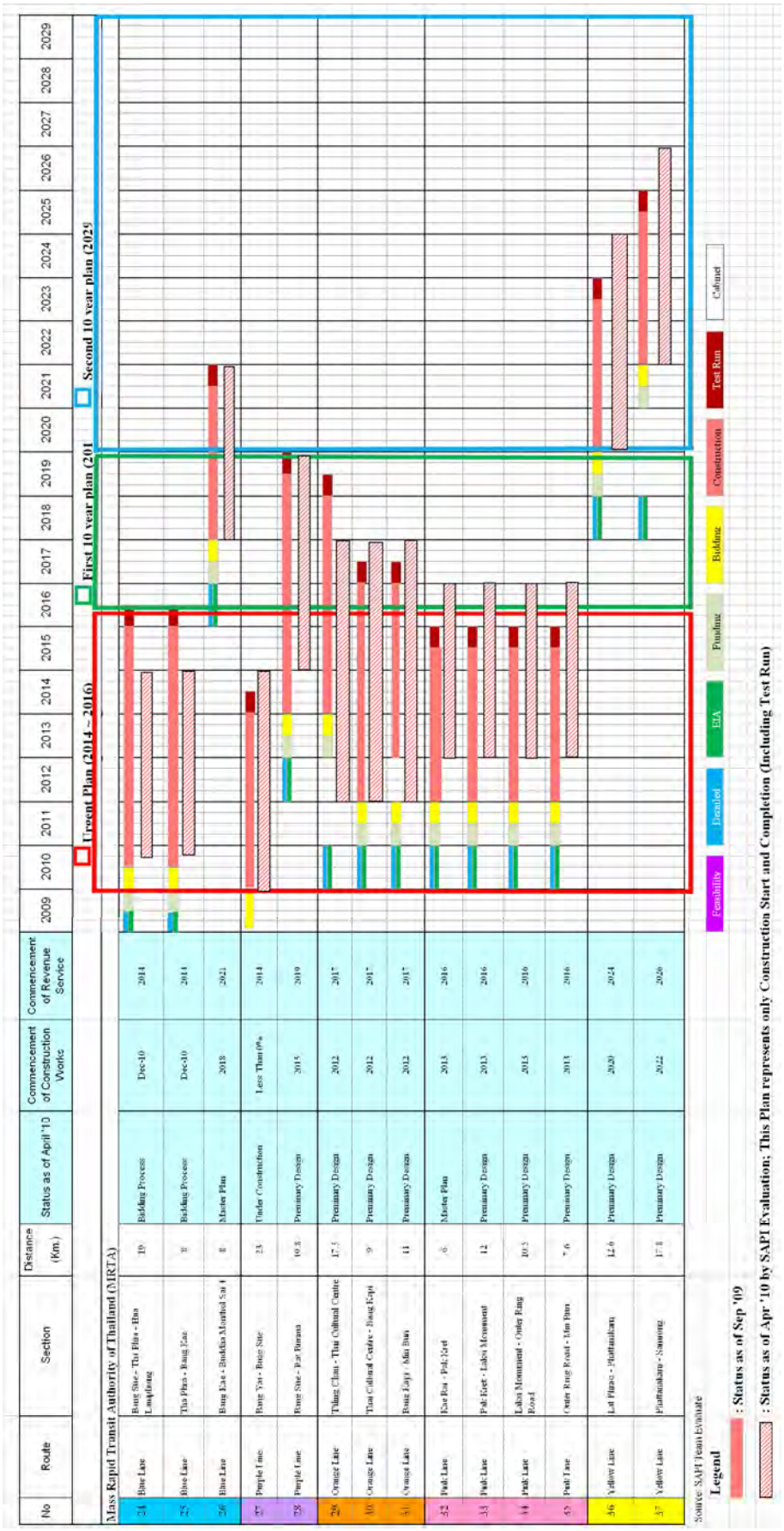


Figure 2.5 - Latest Status of Each Project Plan (2)

Table 2.1 Latest Status of SRT Projects (Urgent Plan, Within 2019, Within 2029)

No	Project (Section)	Outline	Latest Status
1	**(Urgent Plan)** **Red Line (Bang Sue-Rang sit-Thamnasant) 36.3 km**	2010 Start - 2014 Completion CT, Elevated/At Grade, Cost=69.4 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.1)
2	**(Urgent Plan)** **Dark Red Line (Bang Sue-Hua Lamphong) 6.5 km**	2012 Start - 2016 Completion CT, Elevated/Open Trench, Cost=13.2 Billion Baht	▪ Waiting for EIA approval ▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.2)
3	**(within 2019)** Dark Red Line (Hua Lamphong-Bang Born) 18.0 km	2012 Start - 2016 Completion CT, Elevated, Cost=25.5 Billion Baht	▪ Delayed, to start construction 2015 ▪ Refer to Fig. 2.4 (No.3)
4	**(within 2029)** Dark Red Line (Bang Born-Mahachai) 20.0 km	2016 Start - 2020 Completion CT, Elevated, Cost=32.5 Billion Baht	▪ Waiting for EIA approval ▪ 2015 start construction ▪ Refer to Fig. 2.4 (No.4)
5	**(Urgent Plan)** Light Red Line (Bang Sue-Phaya Thai-Makkasan) 9.0 km	2012 Start - 2016 Completion CT, Elevated/Open Trench, Cost=12.4 Billion Baht	▪ Waiting EIA Approval ▪ Land Acquisitions are not yet finished (2 places). ▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.5)
6	**(Urgent Plan)** Light Red Line (Makkasan-Huamark) 10.0 km	2012 Start - 2016 Completion CT, Elevated, Cost=11.4 Billion Baht	▪ Waiting for EIA approval ▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.6)
7	**(Urgent Plan)** **Light Red Line (Bang Sue-Taling Chan) 15.0 km**	2009 Start - 2013 Completion CT, Elevated/At Grade, Cost=15.5 Billion Baht	▪ The progress is 34% for civil work. ▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.7)
8	**(within 2019)** Light Red Line (Taling Chan-Salaya) 14.0 km	2014 Start - 2016 Completion CT, At Grade, Cost= 10.0 Billion Baht	▪ Delayed, to start construction 2015 ▪ Refer to Fig. 2.4 (No.8)
9	**(within 2019)** Light Red Line (Taling Chan-Makkasan) 10.5 km	2015 Start - 2019 Completion CT, Underground, Cost=36.2 Billion Baht	▪ Waiting for EIA approval ▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.9)
10	Airport Rail Link (Phaya Thai-Suvamnabhumi Airport) 28.5 km	2010 Completion	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.10)
11	**(within 2019)** Airport Rail Link (Bang Sue-Phaya Thai) 7.9 km	2012 Start - 2016 Completion CT, Elevated,	▪ Delayed, to start construction 2015 ▪ Refer to Fig. 2.4 (No.11)

Source: SAPI Team Estimate

Table 2.2 - Latest Status of BMA Projects (Urgent Plan, Within2019, Within 2029)

No	Project (Section)	Outline	Latest Status
12	**Green Line (On Nut-Bearing) 5.3 km**	2009 Start - 2011 Completion MRT,	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.12)
13	**Light Green Line (Tanaon Taksin-Bang Wa) 5.3 km**	2009 Start - 2011 Completion MRT,	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.13)
14	**(within 2019)** Light Green Line (National Stadium-Yos Sae) 1.0 km	2013 Start - 2015 Completion MRT, Elevated, Cost=1.3 Billion Baht	▪ Delayed, to start construction 2015 ▪ Refer to Fig. 2.4 (No.14)
15	**(within 2029)** Gray Line (Watcharapol-Lat Phrao) 8.0 km	2025 Start - 2028 Completion LRT, Elevated, Cost=8.9 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.15)
16	**(within 2029)** Gray Line (Lat Phrao-Rama 4) 12.0 km	2023 Start - 2026 Completion LRT, Elevated, Cost=15.3 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.16)
17	**(within 2029)** Gray Line (Rama 4-Rama 9 Bridge) 6.0 km	2023 Start - 2026 Completion LRT, Elevated, Cost=7.6 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.17)
18	**(within 2029)** Light Blue Line (Din Daeng-Sathom) 9.5 km	2020 Start - 2023 Completion LRT, Elevated, Cost=12.9 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.4 (No.18)

Source: SAPI Team Estimate

Table 2.3 - Latest Statuses of MRTA and BMA Projects (Urgent Plan, Within 2019, Within 2029)

No	Project (Section)	Outline	Latest Status
19	**(Urgent Plan)** Green Line (Mo Chit-Saphan Mai) 11.4 km	2011 Start - 2014 Completion MRT, Elevated, Cost=33.2 Billion Baht	▪ 2011 Start, Dec 2015 Operation Cost=36.5 Billion Baht ▪ Refer to Fig. 2.4 (No.19)
20	**(within 2019)** Dark Green Line (Saphan Mai-Khu Khoat) 7.0 km	2011 Start - 2015 Completion MRT, Elevated, Cost=15.0 Billion Baht	▪ The process is the same situation as last year. ▪ Refer to Fig. 2.4 (No.20)
21	**(within 2029)** Dark Green Line (Khu Khoat-Lumlukka) 6.5 km	2024 Start - 2027 Completion MRT, Elevated, Cost=10.8 Billion Baht	▪ 2025 start construction ▪ Refer to Fig. 2.4 (No.21)
22	**(Urgent Plan)** Dark Green Line (Bearing-Samut Prakam) 12.8 km	2011 Start - 2014 Completion MRT, Elevated, Cost=25.9 Billion Baht	▪ 2011 Start, Dec 2015 Operation Cost=28.0 Billion Baht ▪ Refer to Fig. 2.4 (No.22)
23	**(within 2029)** Dark Green Line (Bearing-Samut Prakam) 7.0 km	2026 Start - 2029 Completion MRT, Elevated, Cost=10.2 Billion Baht	▪ 2025 start construction ▪ Refer to Fig. 2.4 (No.23)

Source: SAPI Team Estimate

Table 2.4 - Latest Status of MRTA Projects (Urgent Plan, Within 2019, Within 2029)

No	Project (Section)	Outline	Latest Status
24	**(Urgent Plan)** Blue Line (Bang Sue-Tha Phra-Hua Lamphong) 19.0 km	2010 Start - 2016 Completion MRT, Elevated/Underground, Cost=55.7 Billion Baht	▪ 10 Nov 2010 Start, Feb 2016 Operation ▪ Bang Sue – Tha Phra Cost=24.8 Billion Baht
25	**(Urgent Plan)** **Blue Line (Tha Phra-Bang Kae) 8.0 km**	2010 Start - 2016 Completion MRT, Elevated, Cost=23.4 Billion Baht	▪ Hua Lamphong – Bang Khae Cost=83.1 Billion Baht
26	**(within 2029)** Blue Line (Bang Kae-Buddha Monthol Soi 4) 8.0 km	2018 Start - 2021 Completion MRT, Elevated, Cost=13.2 Billion Baht	▪ The process is the same situation as last year. ▪ Refer to Fig. 2.5 (No.26)
27	**(Urgent Plan)** **Purple Line (Bang Yai-Bang Sue) 23.0 km**	2010 Start - 2014 Completion MRT, Elevated, Cost=59.8 Billion Baht	▪ 10 Nov 2009 Start, Aug 2014 Operation Cost=60.1 Billion Baht ▪ Refer to Fig. 2.5 (No.27)
28	**(within 2019)** Purple Line (Bang Sue-Rat Burana) 19.8 km	2014 Start - 2019 Completion MRT, Elevated/Underground, Cost=66.8 Billion Baht	▪ 2015 start construction ▪ Refer to Fig. 2.5 (No.28)
29	**(within 2019)** Orange Line (Taling Chan -Thai Cultural Centre) 17.5 km	2014 Start - 2019 Completion MRT, Underground, Cost=64.9 Billion Baht	▪ 2012 start construction ▪ Refer to Fig. 2.5 (No.29)
30	**(within 2019)** Orange Line (Thai Cultural Centre-Bang Kapi) 9.0 km	2012 Start - 2017 Completion MRT, Underground, Cost=47.6 Billion Baht	▪ The progess is the same situation as last year. ▪ Refer to Fig. 2.5 (No.30)
31	**(within 2019)** Orange Line (Bang Kapi-Min Buri) 11.0 km	2013 Start - 2017 Completion MRT, Elevated, Cost=25.5 Billion Baht	▪ 2012 start construction ▪ Refer to Fig. 2.5 (No.31)
32	**(within 2019)** Pink Line (Kae Rai-Pak Kret) 6.0 km	2012 Start - 2015 Completion MRT, Underground, Cost=7.5 Billion Baht	▪ 2013 start construction ▪ Refer to Fig. 2.5 (No.32)
33	**(within 2019)** Pink Line (Pak Kret-Laksi Monument) 12.0 km	2012 Start - 2015 Completion LRT, Elevated, Cost=14.0 Billion Baht	▪ 2013 start construction ▪ Refer to Fig. 2.5 (No.33)
34	**(within 2019)** Pink Line (Laksi Monument-Outer Ring Road) 10.5 km	2012 Start - 2015 Completion LRT, Elevated, Cost=9.4 Billion Baht	▪ 2013 start construction ▪ Refer to Fig. 2.5 (No.34)
35	**(within 2019)** Pink Line (Outer Ring Road-Min Buri) 7.6 km	2012 Start - 2015 Completion LRT, Elevated, Cost=7.9 Billion Baht	▪ 2013 start construction ▪ Refer to Fig. 2.5 (No.35)
36	**(within 2029)** Yellow Line (Lat Phrao-Phattanakam) 12.6 km	2020 Start - 2023 Completion LRT, Elevated, Cost=16.6 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.5 (No.36)
37	**(within 2029)** Yellow Line (Phattanakam-Samrong) 17.8 km	2022 Start - 2025 Completion LRT, Elevated, Cost=21.5 Billion Baht	▪ The progress is the same situation as last year. ▪ Refer to Fig. 2.5 (No.37)

Source: SAPI Team Estimate

2.4 Future Prospects of MRTA Lines

2.4.1 First 10 Years Plan

The Blue Line extension and the Purple Line are progressing as urgent plans. However, the study also covers the middle to long term futures including "First 10 years plan", promoted the following eight projects as determined by the Thai government.

Each project in the first 10 years plan is approved by the cabinet (Chairman; the prime minister) individually such as Purple Line was approved on 7 February 2010 and Blue Line Extension was approved on 8 May 2010.

First 10 Years Plan – 8 Projects

Purple Line (Bang Sue-Rat Burana) 19.8 km, Cost = 66.8 Billion Baht,
Orange Line (Taling Chan-Thai Cultural Centre) 17.5 km, Cost = 64.9 Billion Baht,
Orange Line (Thai Culture Centre-Bang Kapi) 9.0 km, Cost = 47.6 Billion Baht,
Orange Line (Bang Kapi-Min Buri) 11.0 km, Cost = 25.5 Billion Baht,
Pink Line (Kae Rai-Pak Kret) 6.0 km, Cost = 7.5 Billion Baht,
Pink Line (Pak Kret-Laksi Monument) 12.0 km, Cost = 14.0 Billion Baht,
Pink Line (Laksi Monument-Outer Ring Road) 10.5 km, Cost = 9.4 Billion Baht,
Pink Line (Outer Ring Road-Min Buri) 7.6 km, Cost = 7.9 Billion Baht,

These plans are for completion by 2019 according to M-MAP. Civil constructions are supposed to start from 2012 through 2014. Most of the F / S have been finished. It will be an extension of eight lines (Purple Line, Orange Line, Pink Line), totaling approximately 93km and total project cost of 243,400 million baht (USD 7,650 million). MRTA have been making plans for the Green Line, however, this project that should be completed by 2019 is not included above. MRTA have planned of Green Line (Mo Chit – Sa Pan Mai Section L=11.4 km) for civil works and M&E work plan cooperate with BMA.

To put this into perspective, the Tokyo Metro Line operates a total length of 183km with eight lines. Bangkok's "First 10 years plan" proposes eight MRTA lines to be constructed within seven years or about half that of the total Tokyo Metro network. It appears that finance of this would be a difficult task for the Thai government, even with financial assistances from overseas.

2.4.2 Category of Each MRTA Project

Given the above situations, the preconditions set for the capacity building of MRTA, lines that MRTA will handle in the future, i.e. “when and which lines will be covered by MRTA", is built up in three (3) layers, namely:

(1) **Immediate Projects** - Immediate projects include the Purple Line (Bang Sue – Bang Yai) and the Blue Line Extension.

(2) **Expected Projects** - Expected projects include the Pink Line and Orange Line, as well as further extension of the Purple Line Extension.

(3) **Potential Projects** – Potential projects include the Yellow Line, Blue Line Extension (Bang Kae – Buddha Monthol Sai 4) and further extension of other MRTA lines mentioned above.

Future Prospects of MRTA Lines

Existing	■ Blue Line ISP	Total Network: 20 km
Immediate Projects	■ Purple Line (Bang Sue – Bang Yai) ■ Blue Line Extension (Tha Phra – Bang Kae)	Total Network: 70 km In 5 years time
Expectant Projects	■ Pink Line ■ Orange Line ■ Purple Line Extension (Bang Sue – Rat Burana)	Total Network: 163 km In 10 years time
Potential Projects	■ Blue Line Extension (Bang Kae – Buddha Monthol Sai 4) ■ Yellow Line ■ Further Extension of other MRTA Lines	Total Network: 204 km In 20 years time

2.4.3 Description of Each Project

(1) **Purple Line (23+19.8 Km)** - The Purple Line is a new heavy mass rapid transit passenger line between Bang Yai and Bang Sue. Actually, it is a brand new double track mass rapid transit railway between Bang Yai and Tao Poon and the initial Blue Line is extended from Bang Sue to Tao Poon to allow a passenger connection between the two MRTA lines. It should be noted that there shall be no through operation and passengers will transfer from the Purple Line high level to the Blue Line lower level by stairs, escalators and elevators.

The Purple Line (Tao Poon – Rat Burana) is an extended section of the Purple Line (Bang Yai – Bang Sue) with 19.8 km. (L=13.2 km underground) and 16 stations (5 underground). This

section will start at Tao Poon station going south into Samsen road passing the new Paliament, National Library, Bang Lumpu, Ratanakoshi Island and cross underneath Chao Phraya River at Phra Pok Klao Bridge into Thonburi side passing Wong Wian Yai and terminating at Rat Burana station.

(2) **Blue Line Extension (19+8+8 Km) -** The Blue Line extension is in two parts. The first part is to complete the circle by extending the Blue Line at Tao Poon to the existing Blue Line station at Hua Lamphong (19Km). There is also an extension of the Blue Line southwards under the river and underground along Petchakasem Road between Tha Phra to Bang Khae (8Km). The BTS Extension Taksin Road to Bang Wa shall have an interconnecting station at Bang Wa with the Blue Line extension as part of the URMAP Transportation Planning for Bangkok. The difficulty here will be how to integrate the existing Blue Line train operations controlled by BMCL as the Concessionaire and the new train operations of the Extension systems yet to be decided.

The Blue Line Extension (Bang Kae – Buddha Monthol) is an extension of the Blue Line (Hua Lumpong – Bang Kae section) into the western part of Bangkok. The length is 8 km, with 4 stations all elevated structure. The alignment goes along the island of petch Kasem Road and terminating at Buddha Monthol Sai 4 area.

(3) **Pink Line (36 km, 24 stations)** – This line serves for travel demand to the new Government Complex on Chaeng Wattana Road, Nontaburi Government Complex, and supports the growth development in the north of Bangkok. It can be the feeder for the Purple Line, Dark Green Line, and Orange Line. Sections of the Pink line are Khae Rai-Pak Kret, Pak Kret-Lak Si Monument, Lak Si Monument-Outer Ring Road, and the Outer Ring Road Min Buri.

(4) **Orange Line (37.5 km, 29 Stations)** - This line is a mass transit railway partly underground and partly elevated between Taling Chan and Min Buri. The line aligns from west to east and it can easily be connected with primary and secondary lines. Sections of the Orange line are Taling Chan – Thailand Cultural center-Bang Kapi (improved from the BMT in the Bang Bumru-Din Daeng section). Of interest, the Orange Line shall use the remaining area of the existing Blue Line depot and so some additional workshops and maintenance staffing shall be required to fulfill MRTA Orange Line depot. The rolling stock and signaling systems may not be the same and so some control of segregation to ensure the correct spare parts are used on the correct vehicles and the maintenance and operating procedures may be different, so additional training and technology transfer shall be essential.

(5) **Yellow Line (30.4km, 21 stations)** – This line runs along Ladprao and Srinakarin Roads, to serve travel demand in high density residential areas along Ladprao Road, a community in

the east of Bangkok that has grown from Suvarnabhumi Airport development and also serve the community and commercial area along Ladprao Road, around Chok Chai 4, the Lam Sali, Bang Kapi area, Srinakarin Road, Pattankarn Road, On Nut Road, Sam Rong Road and Bang Na Road areas. Passengers from this line can connect to the MRT Blue Line, Orange Line, Red Line, Airport Rail Link and Green Line. Sections of the yellow Line are Ladprao – Pattnakarn and pattnakarn – Sam Rong.

CHAPTER 3 TECHNICAL AND CONTRACTUAL CONSIDERATIONS IN PROCUREMENT AND INSTALLATION OF RAILWAY SYSTEMS

It is clear that the most significant issue that hinders MRTA's technical capacity development is lack in technical and contractual considerations taken in the tender documents of Blue Line ISP.

The objective of this chapter is to analyze the consequences of ineffective concessionaire/ supplier management and assess the provisions made by MRTA for coming projects.

The following contents cover comprehensive review of MRTA Blue Line ISP, Blue Line Extension Project, and Purple Line Project as well as overseas mass transits for comparison, focusing on technical and contractual issues in procurement and installation of railway systems.

The assessment of technical aspects was carried out in three stages.

Table 3.1 - Assessment of Technical Aspects

Section	Subject	Study Objective/Content
3.1	Blue Line ISP and System Overview	• Quick review of the project and the system
3.2	Tender Documents for Blue Line ISP and Purple Line	• Study Team reviewed the process of defining technical specifications among MRTA, the Concessionaire, and the Supplier at the time of tendering. This exercise is to assess if any differences were made in the Employer's Requirements by MRTA and installed system by the Supplier in contrast to the Employer's intention. • Study Team summarized the input and output information of each system device that can be read from these documents. This exercise is to promote MRTA's better understanding of installed M&E system that may be useful for future system expansion. • Study Team reviewed the draft tender document for Purple Line to assess the improvements and provisions made in these documents, taking the issues identified in Blue Line ISP into consideration.
3.3	Dependency of M&E Systems in System Expansion	• Study Team reviewed dependency of M&E system in system expansion to promote MRTA's better understanding of future system procurement.

3.1 The Blue Line ISP

3.1.1 Description of the MRT System

In August 1997 construction work began on this 21 km underground full metro with 18 stations; it finally opened for trial service in April 2004. In December 2001, an European supplier was awarded the contract to build 19 three-car trains for this line and to provide the necessary operating equipment.

A 1-station extension from Bang Sue to Tao Pun is planned to create an interchange with the future Purple Line; the Blue Line would be on surface at Tao Pun station.

The standard Blue Line station has an island platform on level -3. Sam Yan, Silom and Lumphini stations have side platforms on different levels, each with trains to Bang Sue on level -2, and trains to Hua Lamphong on level -4, whereas Bang Sue and Khlong Toei stations have two side platforms on the same level. Thailand Cultural Centre is much bigger than other comparable stations: the Blue Line stops on level -3, while level -2 is prepared to accommodate the Orange Line in the future. The surface Blue Line depot is connected directly to both Thailand Cultural Centre and Phra Ram 9 stations. A track connection between Blue and Orange Lines will be made via this depot.

3.1.2 Contract Scheme

The MRT (Mass Rapid Transit), sometimes referred to as the Bangkok Metro, is Bangkok's underground metro system. It was constructed under a concession concept. Most civil infrastructure were provided by the government sector, Mass Rapid Transit Authority of Thailand (MRTA) and handed over to their concessionaire under a 25-year concession agreement. Bangkok Metro Company Limited (BMCL) is the only private sector company that won a bid in MRTA's concession contract for the blue line. As MRTA's concessionaire, BMCL provides M&E equipment, including electrical trains, signalling systems, SCADA, communication, PSD, etc for the subway project and fully operates the system. To maintain the system, BMCL has subcontracted in 10 years to the M&E system supplier since system opeing and 7 years maintenance contract to two local maintenance services for north and south line. The metro has a fleet of 19 trains; the 19th train entered service in October, 2007 after a major accident.

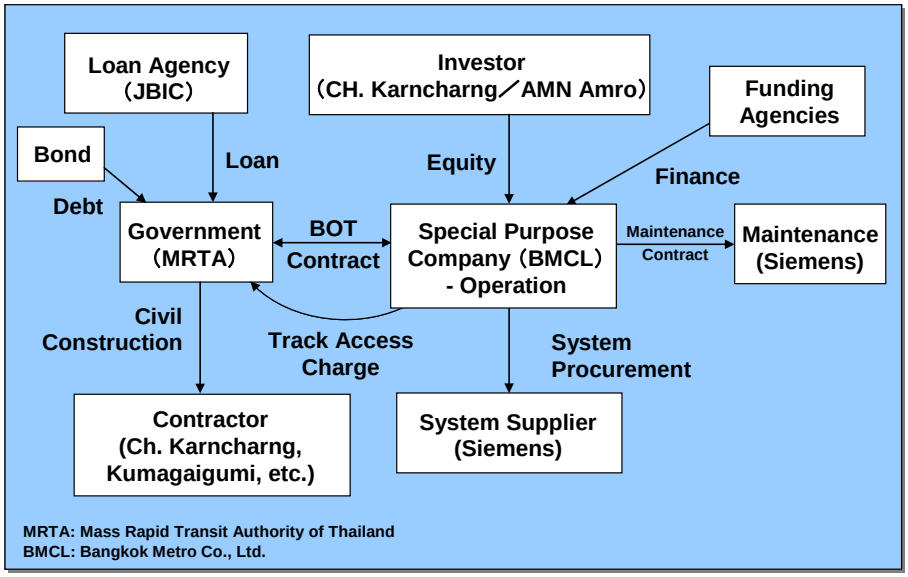


Figure 3.1 - Contract Scheme of MRT Blue Line ISP

Ownership of each railway facility is:

- MRTA: Civil structure, station facilities, and depot civil structure
- BMCL: Railway system (E&M), depot (equipments), and rolling stock

Concession agreement was made between BMCL, the O&M contractor, and MRTA.

3.1.3 MRTA Act

MRTA Act was set force in 2000.

- This Act contains i) establishment, capital and reserves, ii) board and governor, iii) construction of MRT System including pre-construction stage (planning, survey, and preliminary design), construction stage (use of immovable property for mass transit), and post-construction stage (maintenance and safety of MRT system), iv) concession, v) passengers, vi) finance, accounting and audit, vii) supervision and control, and viii) penalties.
- This Act does not include any of technical standards and regulations.
- MRTA shall have the power to carry out following activities

(1)	to have ownership, possess or have other real rights
(2)	to create right or to execute any juristic act within or outside the country
(3)	to collect fares, service charges or fees for using properties, services and facilities in the MRT business
(4)	to determine safety measures of train operation and the safety and good order in train travelling as well as in using and maintaining rolling stock or properties and providing services or facilities in train operation or train travelling
(5)	to borrow money within or outside the country
(6)	to issue bonds or other instruments for investment
(7)	to form a limited company or a limited public company for the purpose of carrying out the business related to or incidental to the MRT business
(8)	to hold shares of a limited company or a limited public company for the benefit of the businesses related or incidental to the MRTA business
(9)	to invest or to form a joint venture with other persons for the benefit of the businesses related or incidental to the MRTA business
(10)	to grant concession of all or part of MRT business to a private individual
(11)	to develop the immovable properties of MRTA as necessary for the benefit of the services of MRT business
(12)	to perform other activities in connection with or in relation to the achievement of the objectives of MRTA

3.1.4 Technical Regulation

- MRTA is one of core agencies, along with BMA and SRT, for developing mass transits in Bangkok Metropolis. The efficiency of mass transit network in Bangkok is of crucial importance. However, services offered by each line are yet to be integrated and the level of services is solely determined by each agency.
- Until now, MRTA accumulates those applied in Blue Line ISP and Purple Line Project in the format of “Technical Standard Manual” as described below and this is the sole regulation that the contractors have to follow apart from contract agreements.
- It is expected in future that the agency will work for gradually aligning technical regulations and establish common safety objectives which all MRTA lines must achieve. The railway industry in Thailand is characterized by a lack of domestic technical regulation. The creation of an integrated mass transit network will entail putting in place monitored common technical regulations.
- Rail policy on technical regulation is often centered on national considerations in overseas. It appears to be essential for MRTA, BMA, and SRT to establish compatible technical and security regulations in mass transit development.

3.1.5 Technical Standards

The Team has studied several mass transit railways including Bangkok MRTA (Design Standard Manual), MTRC Hong Kong, MRT Singapore and London Underground Limited (LUL).

From these mass transit railways the standards used on the systems were predominantly European Standards. The lists of standards for Signalling, Communications, Power and Trackworks, and Rolling Stock were compiled and attached to this report.

In reviewing these standards, some observations and conclusions can be drawn as follows:

- Majority of standards are European due to the fact the original consultants were European and the awarded Contractors are also predominantly European, although some rolling stock was supplied from Japan and Korea, as well as the UK,, Spain and France.
- However, some Thai Industrial Standards were applicable and are required to be followed as a requirement of law in Thailand.
- Other standards are acceptable to MRTA provided the tenderer's can demonstrate the proposed standards are equivalent to or better than the standards in the technical specifications.
- However, the majority of improvements and addition of new standards has been lead in Europe where there is a lot of competition. In USA, Australia and Japan, competition is not so great and technology has not progressed so much in railway technology. Therefore standards from Europe have been adopted in Thailand. This may be a problem for some suppliers from those countries although it should be noted that China has adopted European standards of manufacture and control.
- Where JICA or other loan agencies are sponsoring railway projects, International Competitive Bidding (ICB) procurement rules apply. This means all suppliers should be eligible to tender for the projects and this may be a problem in demonstrating equivalent or better than standards from the Contract specifications, particularly where the standards are written in a different language.
- MRTA's technical standards on rolling stock align wide range of specifications and dimensions that is fully based on Blue Line ISP. This is useful for Blue Line Extension, but may be lack in flexibility when used for different lines that employ different technologies.
- These standards have no particular problem to secure competitiveness for system suppliers. The crucial problem is not the standards themselves but the fact that these

documents are not stored and controlled properly by relevant divisions/sections of the agency.

3.2 Tender Documents of Blue Line ISP and Purple Line Project

The Team firstly assessed tender documents including Employer's Requirements, technical specifications, and concession agreement of the existing systems and identified issues in procurement of M&E systems under concession scheme. The Team afterwards reviewed draft tender documents of Purple Line project to study how those issues identified in Blue Line ISP will be addressed.

3.2.1 Documentation Process

Whole documentation structure between MRTA, BMCL and suppliers are summarized as below.

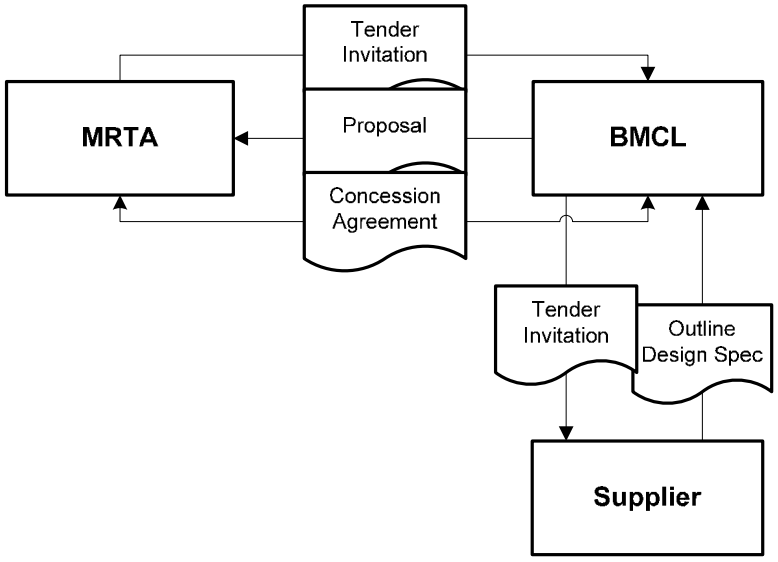


Figure 3.2 – Documentation Process

Process of preparation, review, and approval of technical specifications between MRTA, BMCL and suppliers is summarized as below.

- **Tender Document**, composed of Invitation to Tenderer (Vol.1), Condition of Contract (Vol.2), Employer's Requirement (Vol.3), Outline Specification (Vol.4), Drawings (Vol.5) , was prepared by the European consultants hired by MRTA for Blue Line ISP. This document is in general well organized and readable. Quick review of these

documents gives the impression that tenders are fully responsive to the requirements set by the Employer.

- **Concession Agreement** is an agreement made between MRTA and BMCL, in which MRTA offers incentives (in terms of commercial rights and obligations) to BMCL in exchange for the corporation investing in that project.
- **Outline Design Spec** was prepared by the supplier and reviewed and cross-checked with Employer's Requirement finalized by BMCL and technical performance specifications.

3.2.2 Employer's Requirements and Performance Specifications

BMCL tendered the contract of M&E systems procurement and associated services based on Employer's Requirement prepared by MRTA. In the Blue Line ISP as a general concept, the specifications are only performance specifications and the specifications of equipment can be treated as "Supplier-led".

In general, Technical Specifications are either functional specifications or performance specifications (Table 3.2). It is normal practice to use output specifications, particularly for railway M&E systems, if the Employer expects innovation within the tender or the Employer is not clear what is available within the market.

Table 3.2 – Type of Technical Specifications

Type of Technical Specification	Characteristics
Functional Specifications	• Functional specifications are the typical answer to the expected results and to the requirements resulting from them. They describe all external characteristics and connection interfaces which must be achieved by the contract. • The functional specifications contain specific information regarding the functional requirements of the contract including i) Purpose, ii) Inputs, iii) Processes, and iv) Outputs
Performance Specifications	• The performance specifications specify the requested performance, by setting detailed input/output requirements for the product they refer to. • Examples of ways in which such requirements are measured include, i) Processing capability: volume of inputs to be managed per each unit of time, ii) Accuracy: number of error-free outputs, iii) Availability: the period of time during which a solution may be used, as a per cent rate of the period of time during which it may supposedly be used. • The specification of a performance requirement is not always easy. Specifying the requirement at the appropriate performance level is also an important issue. • If the requirement is defined at a performance level which is too high, then meeting this requirement shall be very costly. In contrast, if the requirements defined are too low, then user expectations shall not be achieved, resulting in negative (financial and other) impacts.

In reviewing these Employer's Requirements and Performance Specifications, some observations and conclusions can be drawn as follows:

(1) Future Line Extension

- Provisions were clearly made in Vol. 2 and Vol. 3 of tender documents for future line extension as follows. However, it is arguable if these clauses have a sufficient function to bind the concessionaire in an efficient manner.

Volume 2 – Conditions of Contract

11.0 Supply, Operation and Maintenance of the Extensions to the Initial System

It is the intent of the MRTA to construct extensions to the Initial System in the future, [Bang Su to Phra Nangklao Bridge Section (11 km) and Hua Lamphong to Bang Khae Section (13 km)]. The award of a concession for the supply and installation of M&E equipment and for the operation and maintenance of the extensions shall be by separate tender. The Concessionaire shall cooperate with the MRTA in connection with the said tender by furnishing to the MRTA data related to Initial System operations, ridership, revenues, costs, and other technical interface and publicly disclosed data deemed relevant by the MRTA. The Concessionaire shall have no right to operate the extensions unless selected through the normal tendering process.

The Concessionaire shall provide for Depot access of the extension rolling stock and shall coordinate the technical requirements of the Depot so that the Depot can, with minimum modification, be used to accommodate and provide support for the maintenance of the rolling stock and other equipment for the extensions. The Concessionaire will, if required, provide this service at fair and competitive rates under the coordination of the MRTA.

(Continued)

Volume 3 – Employer's Requirements

2 OPERATING REQUIREMENTS AND SCOPE OF WORK

2.1Introduction

2.1.1 General

The Contractor shall have total responsibility for all activities required for the operation of the MRTA Blue Line Initial System Project (ISP). (Continued)

The Contractor shall note that, in accordance with Clause 11.0 of the Conditions of the Concession, it is the Employer's intention to construct extensions to the Initial System in the future, from Bang Su to Phra Nangklao Bridge and from Hua Lamphong to Bang Khae, (the Blue Line Extension Project). Appendix 20 to these Employer's Requirements provides advance information (which is not to be construed as being either definitively accurate or exhaustive at the time of Tender) about operational compatibility and interfacing between the Blue Line Extension Project and the Initial System Project. As a minimum, the design of the Works shall take into consideration the Blue Line Extension Project requirements for the following systems: i) ATC, ii) AFC, iii) SCADA, iv) Radio, and provision shall be made for ease of expansion and interfacing between the two Projects such that costly duplication or retrofitting of system components can be avoided in the future. The Contractor shall demonstrate to the MRTA that the design and the

proposed provisions will meet the intent of the above requirements. Other systems such as (but not limited to) power supply, communication bearers, CCTV, etc. shall also be examined in the same manner. In most cases it is anticipated that it will be sufficient for the Contractor to design the M&E Equipment to be extensible (for example, spare printed circuit board locations within PABX equipment racks), but some elements of the Initial System Project may need to be designed and equipped by the Contractor with the full capacity eventually needed by the combined operation of Initial System and the Blue Line Extension (for example, spare conductors in communication and control cables, and spare conduits in ductbanks).

(2) Functional or Constructive Specification

- Original Employer's Requirement prepared by MRTA was to a large degree functional (lower degree of freedom for supplier design), while the same used by BMCL for the tendering of system suppliers was rather constructive (higher degree of freedom for supplier design), but did not address such issues as patent braking systems on rolling stock and introduction of "closed" systems that prevent "Interoperability" with other suppliers. This could be treated as the main reason for "Supplier-led" design, where the supplier maximizes its hold on the technology and the expansion of the initial system railway. However, this only applies to the Blue Line and does not influence other railway lines, as MRTA does not intend to interconnect future lines with the Blue line.
- The change was made probably because of the difference in policy and objective of system procurement between the two parties, but still within the scope of concession agreement. Possible reasons for the change from functional to constructive include the following:

(1) To be in line with the requirement as per ICB procurement guidelines

(2) To give suppliers greater opportunity for innovation, as they are free to offer solutions that in their view best meets the requirement

(3) To keep costs down by suppliers proposing their already developed systems. In Blue Line ISP, suppliers had to comply with the contract requirement of in-service proven system for minimum 2 years.

(4) To get more opportunity to pass risk onto the supplier, as they have responsibility for the way the requirement is met

- This constructive approach (where the supplier has a freedom to propose their "closed technology") initially is good for the original supplier in general, but future extensions of the same line are prohibitive unless the original system is replaced at the time of extending the line similar to the BTS Skytrain extensions and specifications should not be too detailed, but must address Interoperability and "Open" systems technology,

especially Components-of-the-Shelf (COTS) sourced locally in Thailand and must be controlled by Thai Laws and Standards and/ or International Standards where Thai Standards do not exist to achieve the procurement objective.

- These specifications shall be drafted by experts, who are familiar with the technology/products in the market, their availability and the cost for their acquisition/use. Above all, these specifications are tailored to suit the overall objective and specific objectives, and with the target result and its environment of each project. For instance, technical specifications in other projects are drawn as follows:

Manila LRT 1, Philippines – Detailed performance specifications under design build scheme

Technical specifications prepared for capacity expansion project under design build scheme specified detailed performances ranging from xxx to yyy. Suppliers have to comply with plenty of requirements on operating over the existing system, compatibility with first-generation systems, compatibility with existing maintenance equipments, and more.

These conditions are different from Blue Line ISP, i.e. the nation's first underground mass transit system in a stand-alone basis without any system integration requirement with existing lines.

Japan Railways, Japan – Simple functional specifications

Technical specifications Japanese railway companies are written in extraordinary simple format, generally limited to basic dimensions and performance requirements. This is a result of long history in domestic procurement with a limited choice of suppliers. Employers and suppliers have an implicit understanding that the system shall be equivalent to already installed systems unless otherwise specified.

In conclusion, it is partly true that Employer's Requirement of Blue Line ISP was finalized in a simple and constructive manner and this was the reason for "Supplier-led" design. However, this suitably met the procurement objective set by the Concessionaire under the agreement with MRTA. It should be noted that giving much details in specification to avoid "Supplier-led" design does not lead the success in procurement: the tender is likely to become less competitive and accordingly much more costly (this is obviously in contrast to the existing procurement policy). If MRTA still intends to promote "Employer-led" design, MRTA needs to hire experts in-house, who are familiar with the technology/products in the market, their availability and the cost for their acquisition/use. In general, only those experts, who have extensive working experiences in international suppliers, have a qualification. It is clear that these experts are hardly available in local market.

3.2.3 Supplier's Design Document

Design documents prepared by the supplier were reviewed and cross-checked with Employer's Requirement finalized by BMCL and technical performance specifications. Outline Designs were made in such a way to respond and ensure "back-to-back" with the Employer's Requirement by BMCL. Therefore, it is sure in principal that all the supplier designs complied with the performance specifications (Note that suppliers are allowed to propose other equivalent systems in case performance specifications are unable to be met with some reasonable justifications).

Table 3.3 - An Example of Supplier's Design Document

Employer's Requirement	**4.2.9.1 The signalling system shall provide the following functions:** • **The trainborne unit to provide braking supervision including first a warning of overspeed and then application of the train emergency brakes if the warning is not correctly acted upon.** • **(Continued)**
Supplier's Design Document	The Driver MMI Function is performed entirely within the ATC Display Units. The Driver MMI Function is responsible for displaying information relating to the following: • the actual speed; • when in the SM, ATO and AR modes, the permitted speed and, where appropriate, the target speed and the target distance; • the "driving state" (stopped, moving under power, coasting, or braking); • the driving mode (signalling modes only); • where the AR mode has been selected, an "AR allowed" indication or, alternatively, an "AR accepted" indication; • whether the train has stopped within the accuracy "window" required by for door release (see section Automatic Train Protection Function above). 8.2.1.4.2.2. Inputs The inputs to the ATC Trainborne Function are: • [s]: the air-gap signal; • [t]: status of driving controls, doors and emergency brake applications, required for the ATP Function; • [v]: inputs from driver; • [x]: inputs from diagnostic equipment. 8.2.1.4.2.3. Outputs The outputs from the ATC Trainborne Function are: • [t]: emergency brake application invocations and door release signals from the ATP Function; • [u]: commands to control tractive effort, service brake applications, door opening, and suppression of the driver's safety device from the ATO Function; • [v]: visual indications and audible warnings to the driver from the Driver MMI Function; • [w]: outputs to the PTI function; • [x]: outputs to diagnostic equipment.

The Blue Line ISP was the first underground railway in Thailand and this was a completely new railway. Therefore, the majority of the Concessionaire (BMCL) designs were based on the System Supplier's proven systems and the MRTA Consultants specifications.

All of the M&E Systems were described in varying degrees of detail and observations and comments on those systems are shown below:

(1) Signalling System

- In general the documentation was well presented and constructed giving a good degree of information concerning the equipments of the signalling system and its operation. However, the amount of actual detail was missing and only the Outline Design was available for review.
- The Outline design document takes requirement statements made in the Consultants specifications and puts them in bold where the Concessionaire is trying to show compliance to the specifications. This is useful for identifying compliance with the specification statements although the degree of actual compliance and how such compliance is achieved could not be determined from this documentation.
- Many items of the Outline Design are particularly proprietary equipments only known to this particular supplier therefore "Open" technologies are not proposed so any extension of such systems and in particular the signalling train control system cannot be extended by any other similar train control system supplier.
- In general the quality of the documentation was good and sufficiently informative to allow a good description of the systems and their performance, features and functions.

(2) Communications System

- The Communications System is supported by an OTN (Open Transmission Network) which used to be a propriety system of the Supplier, but now is not and is today considered "Open" technology.
- Again, many statements taken from the Consultants specifications are highlighted in bold
- The Blue Line is an underground railway system and therefore there are some additional requirements of the Communications systems such as CCTV monitoring of emergency escape routes in the tunnel sections, SCADA controls for ventilation fans in case of fire etc.
- The Radio system does not specify which technology shall be used. However for the Purple Line TETRA Technology has been specified as the preferred technology for

Thailand. BTS and SRT are also specifying TETRA technology instead of GSM-R technology.

- The requirements of the radio system are more onerous on the Blue Line due to the railway being underground instead of elevated as in the Purple Line.
- The broadband transmission system used as the backbone transmission system for the Communications Systems is the Supplier's proprietary system. This cannot be specified for the Purple Line as "Open" technology is required to avoid the Supplier monopoly.
- The Communications Systems shall have a service proven design life of only ten (10) years. Technology is rapidly progressing and while this seems reasonable the Purple Line expects a minimum design life of 15 years.
- Positive Train Identification (PTI) is also a propriertary the Supplier's system, where positive identification of each train is made via the radio system.

(3) Power Supply

- Again, many statements taken from the Consultants specifications are highlighted in bold
- The Power system of the Blue Line is similar to the Purple Line except the LV voltage of 380 3 phase is typically European and in Thailand 416 3 Phase is the industry standard norm.
- Unlike the Communications Systems design life of only 10 years, the Power Supply equipment is required for long design life typically of 30 years.
- Traction power is 750 volts DC, 3rd rail and this technology is quite normal for mass transit railways that require high acceleration of the trains to reach high speed before breaking at the next station, typically 1km apart.
- The Stray current protection system however shall be totally different between the Blue Line and the Purple line. The Blue line is an underground tunnel railway and therefore the track fastening system is totally different being direct fixation fastening (DFF) on the tunnel track bed. On the Purple line however, the rails shall be fastened to raised plinths to raise the trains away from the elevated viaduct guideway and the harmful effects of DC stray current. A stray current collector system shall be installed in the raised plinths and grounded directly to a dedicated earthing system provided by the civil contractors.

(4) Trackworks

- The trackworks is slightly different in that the Blue line uses direct fixation fastening to a flat tunnel track bed. The Purple Line rails will be fastened by (DFF) onto raised plinths.

- Rail size on the Blue Line is UIC54. The rail size on the Purple Line and the Blue line extension shall be UIC60 1E.
- Again, many statements taken from the Consultants specifications are highlighted in bold

(5) Rolling Stock

- In general document is well presented with sufficient information.
- Employers' requirement is refer in the document for cross check but requirement for rolling stock is very general. In other words any rolling stock will comply the requirement but it doesn't say that proposed rolling stock is not good quality.
- Train consist is three car with two motor car and 1 trailer car. Capacity of one traction motor is 230kW and it achieves high performance comparing with Japanese standard commuter train. (ex. 6M5T with traction motor 95kW for 231 series of Yamanote Line)
- Length of Rolling Stock is not consistent with load case of Civil section.

3.2.4 Process Analysis of Each System Device

MRTA will continue the procurement of M&E systems under PPP scheme, accordingly the system design remains to be under the direct responsibility of concessionaires/suppliers. However, better understanding of the installed system is essential for MRTA to become more responsible for future system procurement and eventually to manage the assets as the facility owner.

In this connection and following the Terms of Reference of this study, the Team reviewed input and output process of each system device installed in Blue Line ISP. Following relations can be read from supplier's document.

Table 3.4 - Input/Output Process of Each M&E System

Category	Parts	Input		Output	
		Item	Device of Origin	Item	Device of Destination
Signaling System	CTC	Timetable Data	Timetable Computer	Requests for Timetable Data	Timetable Computer
		Train Identification Data	Positive Train Identification	control status	Traffic Controllers
		Control Command	Traffic Controllers	Fault Cancellation Command Journey Time Command	ATC Trackside
		Status Information	ATC Trackside	Route to be set, Point to be moved etc.	Interlocking
		Status Information	Interlocking		
	Train Detection	None		"physically clear" or "physically occupied" status	Interlocking
				"physically clear" or "physically occupied" status	ATC Trackside
	Interlocking	Route to be set, Point to be moved etc.	CTC	"logically clear" or "logically occupied" status	CTC
		"physically clear" or "physically occupied" status	Train Detection	"logically clear" or "logically occupied" status	Local Controller (if local control panels are provided)
		Status information	Points	Controls for points	Points
		Status information	Signals	Controls for signals	Signals
				diagnostic data	Diagnostic equipment
				"logically clear" or "logically occupied" status	ATC Trackside
	ATC Trackside	"physically clear" or "physically occupied" status	Train Detection	diagnostic data	Diagnostic equipment
		"logically clear" or "logically occupied" status	Signal Control	Air-gap signal	ATC Transmission
		Emergency Stop status	Emergency Stop Plungers	Local control enable, open short/long train	PSD

Category	Parts	Input		Output	
		Item	Device of Origin	Item	Device of Destination
		AR status	AR Plungers		
		Diagnostic data	Diagnostic equipment		
		Door closed and locked	PSD		
	ATC Transmission	Air-gap signal	ATC Trackside	Air-gap signal	ATC Trainborne
		Air-gap signal	ATC Transmission		
		Traction Status	Traction Controller	Command for tractive effort control	Traction Controller
		Brake Status	Brake Controller	Service brake command Emergency brake command	Brake Controller
		Door status	Door controller	Door release signal	Door Controller
		traction and brake command	Drivers Controller	Indication, Warnings	Driver MMI
		Diagnostic command	Diagnostic equipment	diagnostic data	Diagnostic equipment
	Positive Train Identification	Train Identification data	PTI Transmission	Train Identification data	CTC
	PTI Transmission	Train Identification data	ATC Trainborne	Train Identification data	Positive Train Identification
Rolling Stock	Brake Controller	Brake command	Driver's Console	Air pressure	Brake Cyslinder
		Service brake command Emergency brake command	ATC Trainborne	Brake Status	ATC Trainborne
		Brake compensation command	Traction Controller		
	Traction Controller	Tractive effort command	Driver's Console	tractive current	Traction Motor
		Command for tractive effort control	ATC Trainborne	Traction Status	ATC Trainborne
	Door Controller	Door open/close command	Driver's Console	Door open/close command	Door actuator
		Door release signal	ATC Trainborne	Door status	ATC Trainborne
PSD	PSD	Local control enable, open short/long train	Signalling system (ATC Trackside)	Door closed and locked	Signalling system

Note: input/output information on telecommunication systems are not indicated in supplier's documents.

Following figure shows the interface between the systems.

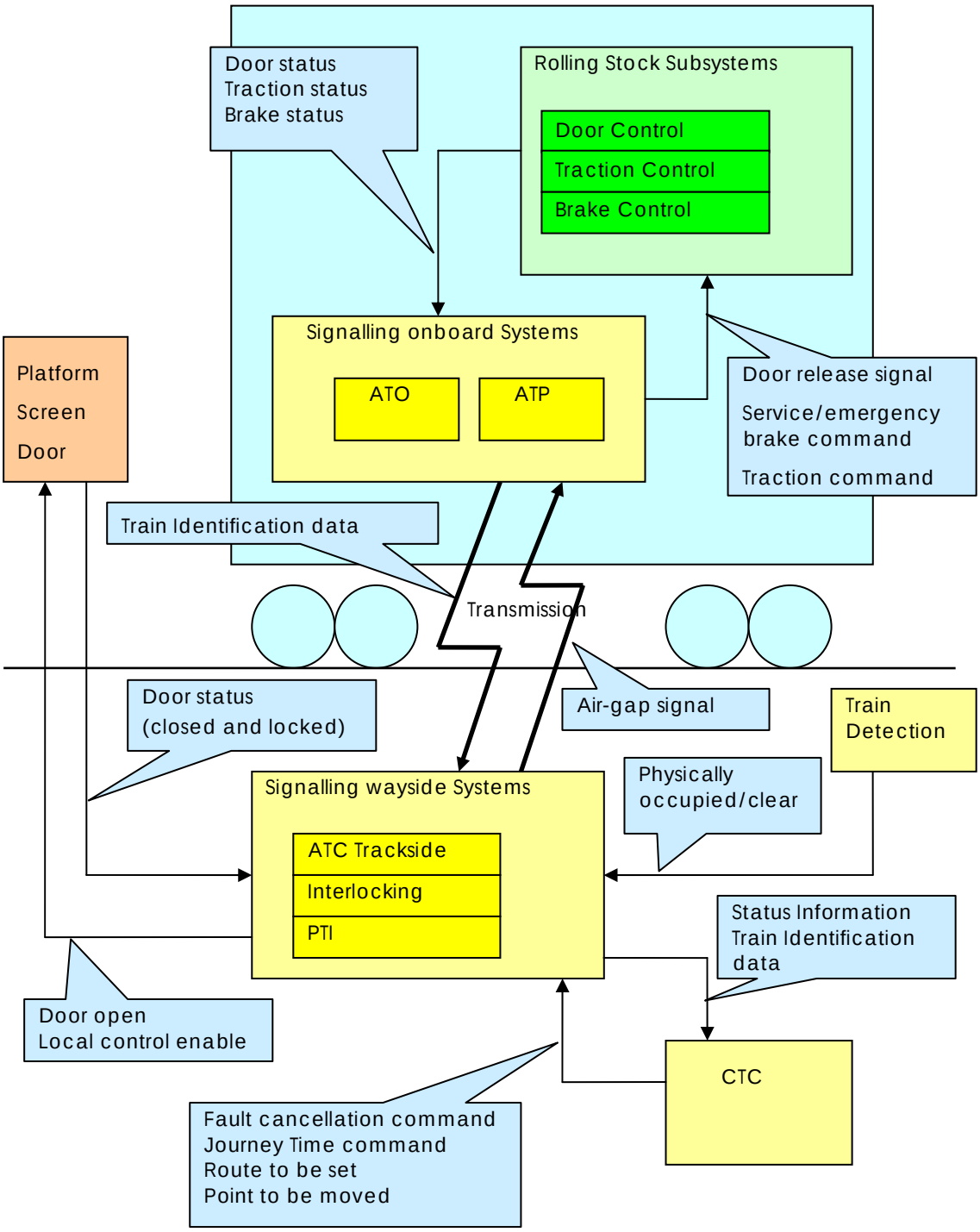


Figure 3.3 - Interface between Each Subsystem

3.2.5 Tender Documents of Purple Line Project

Although the Employer's Requirements and performance specifications of Blue Line ISP were developed in an appropriate manner, the concession contract gave room to reduce

visibility for MRTA. Now MRTA has a plan to build necessary provisions in the concession agreement of Purple Line so that they can include in their contracts to require their concessionaire to provide better visibility into the procurement and installation of the system as described below

(1) Supplier Nomination

Discussions were held whether to include "One Supplier Nomination" clause in the concession agreement for Purple Line to ensure better visibility in procurement. In this clause, one concessionaire is obliged to nominate just one supplier (in a most strict case) thought to give outstanding performance. Also, the proposed supplier shall not be nominated by other tenderers.

This approach may allow MRTA to select the supplier and preferred technology at their own decision in more strict way than the procurement in Blue Line ISP. However, it was recently withdrawn and changed to "Multiple Suppliers Nomination" (one supplier or more).

(2) Specified or Unspecified Technology

The Purple Line was going to be funded by JICA so the specifications are performance specs only as required by ICB.

Now it is the Thai government, there is an argument whether to let the contractor conform specific technology against JICA ICB or decide technology to be installed. Whether Driver or Driverless Train Operations, CBTC or not CBTC signalling with Fixed, moving block etc are the main subject for discussion.

Communication Based Train Control (CBTC)

This is in actual use in 14 lines in the world, and a system under development is used on a further 23 lines. It is mainly used for monorails and subways, and has two different radio methods. The inductive loop (IL) method, which uses inductive radio near tracks, has been often introduced, but these days the trend is shifting to the radio frequency (RF) method that uses spatial waves in line with the European Train Control System (ETCS) standards. Among the 14 lines that have already put CBTC in practical use, 11 lines are of the IL method and three lines are of the RF method.

(3) Integration and Compatibility Issues

There is no requirement to join different lines together. This was agreed with MRTA recently and any such restriction was removed from the Purple Line Contract documents. There is no requirement to ensure integration and compatibility between lines. This is to allow competitive bidding and avoid the monopoly of one supplier.

Key discussions made and considerations taken in this regard can be summarized in the table below:

Table 3.5 – Integration and Compatibility Issues

System	Discussions made/Considerations taken
Rolling Stock	• MRTA recently removed a requirement in the Rolling Stock Performance Specifications that stated the Rolling Stock must be the same as the Initial Systems (Blue Line). • However, for extension of an existing line, the Rolling Stock passenger doors must be the same dimension and spacing because of the platform screen doors.
Signalling	• There can be no interoperability because of Industrial Patents etc. There is an opinion that each line should be a different system so that business comparisons can be made between the systems in terms of performance, reliability, O&M costs etc. • However, this means each line should have their own spare parts stores and different training and O&M procedures etc. • However, for extension of an existing line, the signalling ideally should be the same to allow seamless through travel across extension borders else the passengers may have to change trains or each train is equipped with both types of signalling system with some form of change over at extension boundaries. • To address this MRTA has requested the Consultants to provide a Fair Pricing Agreement for Signalling in the Purple Line tender documents.
Communication	• Radio technology must be in line with the Communications Authority of Thailand announcements, rules, and regulations. Radio channels shall be allocated by the authority. MRTA should agree specifications and channel bandwidths for all future lines requirements with the Communications Authority to include in their project specifications. • Interfaces with public telephone services such as AIS, TOT etc must be clearly identified and specifications and requirements in line with those public telephone operators guidelines. • Backbone Transmission Network (BTN) fiber optical communications cables should be full duplex offering dual redundancy by diverse routing of the cables along the route and inside buildings. • SCADA, although traditionally a requirement of the Power Systems supplier, should be under the Communications Systems suppliers responsibility as most SCADA equipment is electronic and all interfaces are with the Communications Systems supplier, using the BTN. By keeping the SCADA system under the Communications Systems supplier, this large Interface is reduced considerably avoiding compatibility and systems Integration issues.

System	Discussions made/Considerations taken
Automatic Fare Collection	• For AFC the Thai government is studying proposals for a "Common Ticket" policy similar to other "Common Ticketing" systems in other Asian cities such as Hong Kong and Singapore. Future projects should take these requirements and specifications (when available0 to form part of the Scope of the Works of the Concessionaire or contractor. • MRTA intends to make the Purple Line and Blue line ticketing systems compatible so passengers on both lines only need to buy one ticket or use a common stored value ticket compatible for both lines. • This would be only a temporary arrangement until the government specifications are available and a "Common Clearing House" for all revenue is set up and revenue sharing formula is agreed between all transportation authorities.
Building Equipment Services	• For any new line project, the procurement of such station building equipments such as elevators, escalators, lighting, fire protection systems, etc should be under one supplier to ensure commonality of these equipments for the entire line. This reduces training and spare parts needs and gives a universal presentation in all stations that passengers can associate with that line.

(4) Fair Price Agreement

To avoid unreasonable increase in costing of original supplier, particularly on Signalling, train control systems and rolling stocks, MRTA has requested the Consultants to provide a Fair Pricing Agreement for Signalling in the Purple Line tender documents. This means that the original supplier shall have entered into an agreement to provide and install their equipment on any line alteration of extension of the original line at an agreed "Fair Price".

This approach cannot address "supplier monopoly", but only for that one line and not others and is the best option for the passengers and reduces the amount of spare parts required and no additional training necessary, so should be cheaper than open tendering where a new system may win the extension works. All other M&E Systems are not affected as all others can be patched together without any reduction of performance.

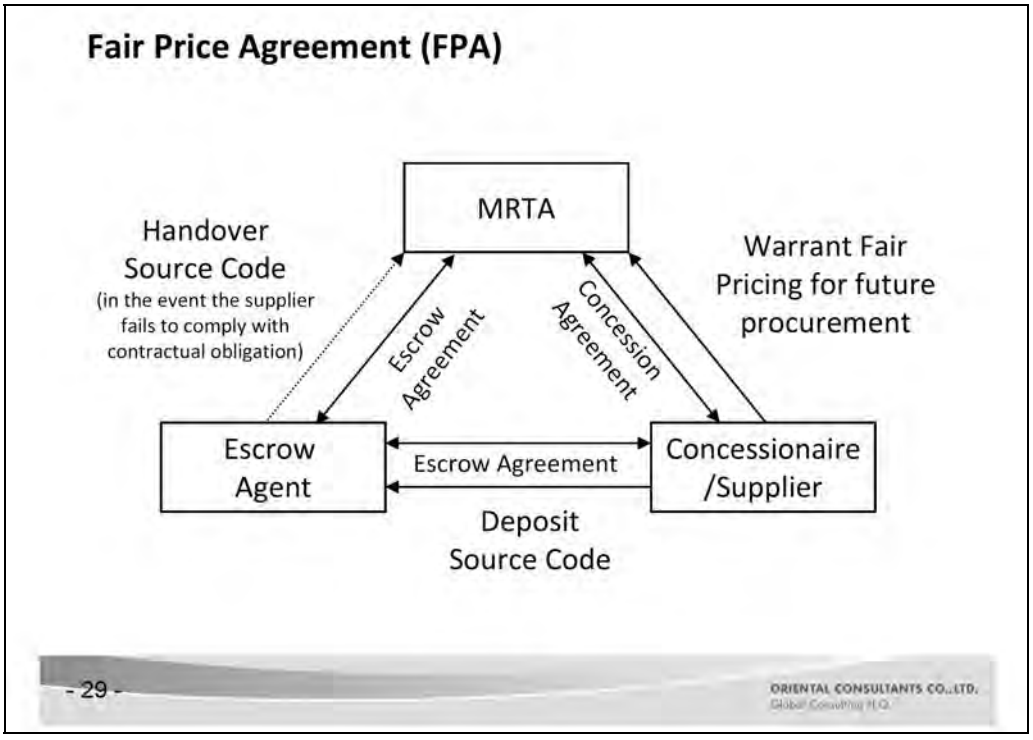


Figure 3.4 – Fair Price Agreement

(5) Local Procurement

Equipments and services should be procured in Thailand as far as possible to provide employment and trade inside Thailand for Thai companies, offering immediate availability of spare parts and engineering backup services by Thai engineers. This concept offers employment for the Thai people, but also reduces costs by avoiding import duties on foreign goods. Some foreign equipment and components used in the past by some railway authorities are not available in Thailand, but the Thai Customs Authorities do not allow such goods to be imported rendering these systems and equipments obsolete, so local procurement wherever possible is recommended. Financial Loan Agencies may need to consider this and review their Procurement guidelines as necessary.

(6) Components Off-the-shelf (COTS)

In connection to local production, the concept of components off the shelf (COTS) are proposed by the Consultants preparing tender documents.

To avoid Obsolescence of Computerised hardware and software, the latest “state-of-the-Art” systems and software should be chosen, particularly where the components are off the shelf. Technology is moving so fast, it is hard to consider design lifecycles of more than 5-10years although it is normally a requirement for these systems to have a design life of 15years at the present.

A common procurement policy with defined specifications, including size, colour etc should be set up by MRTA for all COTS equipments such as computer monitors, keyboards, CCTV Cameras, Controlled Access Security Systems (CASS), Automated Operation & Information Technology (AO&IT) systems etc.

This will allow all Thai suppliers to be aware of MRTA requirements and to tender for such equipment procurements minimizing training needs and spare part holdings and offering a universal presentation of equipments in control rooms, stations etc for all lines.

(7) Benchmarking

The "Benchmark" group is a group of mass transit railway authorities (including MTRC, Hong Kong, MRT Singapore, London Underground Limited, UK, RATP, France ad the new York Sub-way Authority to name a few) that get together every year and share their experiences, successes and failures to allow the group to share and improve together their operations and maintenance services. This is a useful tool that would allow MRTA to share their experiences, successes, and failures together in an open way to allow all in the group to learn and improve their systems accordingly. This could be included as technology transfer and paid for by the Concessionaire.

(8) Others

Provisions are also to be made for effective technology transfer and robust monitoring and reporting systems directly between the actual operating systems to the MRTA. These factors relevant to capacity building of MRTA are described in Chapter 4.

3.3 Dependency of M&E Systems in System Expansion

MRTA seems to have an over-focused or even misleading perception that existing Blue Line is absolutely depending on the "closed technology" installed by the supplier. It sometimes leads to the unrealistic request for disclosure of information on supplier's intellectual properties such as interface protocols or source codes of electrical and mechanical systems.

It is true that some components of M&E systems are, once installed, depending on the original supplier at the time of system expansion. However, the degree of dependency is different in each system component. In this connection, the Team studied the dependency of M&E systems in system expansion in order to promote the adequate appreciation for MRTA and eventually to remove the sense of threats against "supplier monopoly". The Team suggests that this sort of technical capacity is required in minimum for the MRTA staff in M&E Department.

3.3.1 Interface among M&E Systems

Each M&E system has some interfaces, although level of dependency varies, with other M&E systems to compose an entire mass transit system. To understand this inter-relationship, interfaces among each M&E system are summarized in the table below.

Table 3.6 - Interface Matrix of M&E Systems

	Technical Interface Items	1. Track Work (TRW)	2. Rolling Stocks (RST)	3. Train Control and Signalling Systems (SIG)	4. Power Supply System (PSY)	5. Communication Systems (COM)	6. Automatic Fare Collection System (AFC)	7. Depot Workshop Equipment (DWS)	8. Platform Screen Doors (PSD)
	Information interface / Physical interface								
1.	Track Work (TRW)							X	
2.	Rolling Stocks (RST)	X		X		X			
3.	Train Control and Signalling Systems (SIG)	X	X			X			X
4.	Power Supply System (PSY)	X	X	X		X			
5.	Communication Systems (COM)		X	X	X		X		X
6.	Automatic Fare Collection System (AFC)				X				
7.	Depot Workshop Equipment (DWS)		X	X	X	X	X		
8.	Platform Screen Doors (PSD)		X						

Physical interface - dimensional fitting or electrical matching such as voltage or currency
Information interface – exchange of information

Exchanging information data in each system are indicated as follows.

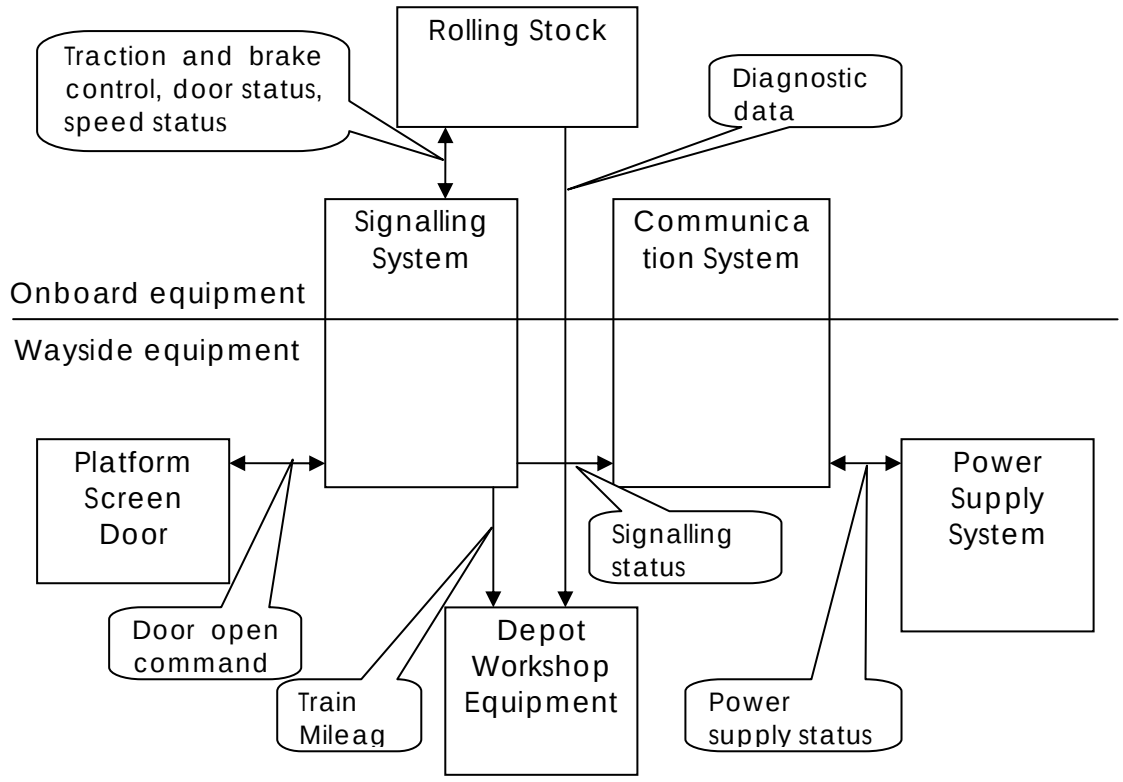


Figure 3.5 - Information Interface among M&E Systems

3.3.2 Level of Dependency of M&E Systems

Based on the experience and practices in the procurement of M&E systems in mass transit projects, level of dependency of M&E systems can be summarized in the following table.

Table 3.7 – Level of Dependency of M&E Systems

No.	System	Level of Dependency				Interface with other systems
		A	B	C	D	
1	**Rolling Stocks (RST)**			X		SIG, PSI, COM, PWS, PSD
2	**Train Control and Signalling Systems (SIG)**	X				RST, COM, DWS, PSD
3	**Power Supply System (PSY)**					RST, COM, DWS
3.1	Traction Power Supply (TPS) (Sub-station side)			X		
3.2	Third Rail (track side)				X	
3.3	Auxiliary Power Supply				X	
3.4	SCADA System			X		
4	**Communication Systems (COM)**					RST, SIG, PSY, AFC, DWS, PSD
4.1	Backbone Transmission Network			X		
4.2	Master Clock System			X		
4.3	Radio Communication System			X		
4.4	Passenger Information System			X		
4.5	Telephone System			X		
4.6	Closed Circuit Television (CCTV) System			X		
4.7	Public Address (PA) System			X		
5	**Automatic Fare Collection System (AFC)**		X			COM
6	**Depot Workshop Equipment (DWS)**			X		RST, SIG, PSY, COM
7	**Platform Screen Doors (PSD)**				X	RST, SIG, COM

Legend:
A: Practically impossible to interface among different systems
B: Different systems can be interfaced with modification to existing systems
C: Different systems can be interfaced with only minor modification to existing systems
D: Each system is stand alone and not dependant on other system/equipment.

3.3.3 Level of Difficulty in M&E System Expansion

At the time of line extension, newly installed systems for system expansion (expanded system) shall be fitted with existing system, and existing systems, as well, need modification to integrate with expanded systems. Following table indicates the level of consideration required for expanded systems and the same for modification of existing systems. In the

following table "Expanded System" indicates the level of consideration required for fitting with the existing system to secure compatibility at physical interface or information interface, while "Existing System" indicates the level of modification required in existing systems.

Table 3.8 – Level of Difficulty in M&E System Expansion

No.	System	Level of Dependency			
		Expanded System		Existing System	
		Physical	Information	Physical	Information
1	**Rolling Stocks (RST)**	**B**	**C**	**D**	**D**
2	**Train Control and Signalling Systems (SIG)**	**C**	**A**	**D**	**A**
3	**Power Supply System (PSY)**				
3.1	Traction Power Supply (TPS) (Sub-station side)	**C**	**B**	**D**	**D**
3.2	Third Rail (track side)	**B**	**D**	**D**	**D**
3.3	Auxiliary Power Supply	**D**	**D**	**D**	**D**
3.4	SCADA System	**D**	**B**	**D**	**B**
4	**Communication Systems (COM)**				
4.1	Backbone Transmission Network	**C**	**B**	**C**	**B**
4.2	Master Clock System	**C**	**B**	**C**	**B**
4.3	Radio Communication System	**C**	**B**	**C**	**B**
4.4	Telephone System	**C**	**B**	**C**	**B**
4.5	Closed Circuit Television (CCTV) System	**C**	**B**	**C**	**B**
4.6	Public Address (PA) System	**C**	**B**	**C**	**B**
5	**Automatic Fare Collection System (AFC)**	**C**	**B**	**D**	**B**
6	**Depot Workshop Equipment (DWS)**	**-**	**-**	**B**	**C**
7	**Platform Screen Doors (PSD)**	**B**	**B**	**D**	**D**

Legend:
New System
A: Practically impossible for the not same supplier as existing system
B: Difficult but possible when sufficient information is provided.
C: interface is required but no difficult.
D: Each system is stand alone and not dependant on other system/equipment.
Existing System
A: Practically impossible for the not same supplier as existing system
B: Modification is required but possible when sufficient information are provided.
C: Modification is required but no difficulty.
D: Each system is stand alone and not dependant on other system/equipment.

Also, technical interface between existing system and expanded system can be summarized in the following table.

Table 3.9 – Technical Interface Matrix

	Technical Interface Items	1.	2.	3.	4.	5.	6.	7.
	Existing System / Expanded System	Rolling Stocks (RST)	Train Control and Signalling Systems (SIG)	Power Supply System (PSY)	Communication Systems (COM)	Automatic Fare Collection System (AFC)	Depot Workshop Equipment (DWS)	Platform Screen Doors (PSD)
1.	Rolling Stocks (RST)	C	B	B			B	
2.	Train Control and Signalling Systems (SIG)	C	A		C		C	
3.	Power Supply System (PSY)	B		C	C			
4.	Communication Systems (COM)	C			B		C	
5.	Automatic Fare Collection System (AFC)				B	B	C	
6.	Depot Workshop Equipment (DWS)	---	---	---	---	---	---	---
7.	Platform Screen Doors (PSD)		B		B		C	

A: Intensive interface and high dependency with the linked system
B: Less intensive than A. but strong interface with the linked system
C: Little interface with the linked system

3.3.4 Minimal Technical Specifications for System Expansion

Taking the above dependency into account, following considerations and technical specifications are at least required for expansion of each M&E system.

(1) Rolling Stocks

In order to ensure the operability of different Rolling Stocks running on the existing tracks, technical specifications shall clearly define the following items:

Table 3.10 – Minimal Technical Specifications for System Expansion (RST)

Compatibility with existing systems	Interface Level	Minimal Technical Specifications for System Expansion
with existing alignment and trackworks	B	• Track gauge • Structure gauge • Curving performance • Axel load
With existing RST	C	• Coupler type/height
with existing SIG	B	• Deceleration of emergency brake
with existing PSY	B	• Location of power collector • Working voltage • Peak power consumption
with existing DWS	B	• Rolling stock maintenance equipments including lifting jack, wheel press machine, wheel re-profiling machine, test benches, etc.
with existing PSD	B	• Location of side door

MRTA is able to procure rolling stocks even from other suppliers/manufacturers if the above items are clearly indicated and appropriately incorporated in the technical specifications.

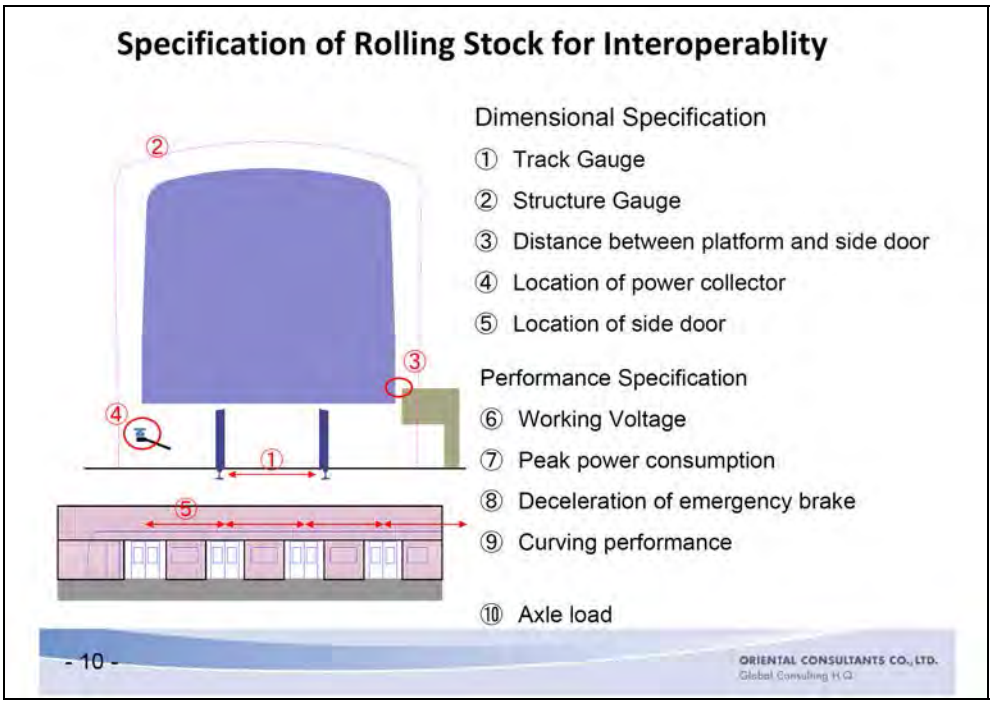


Figure 3.6 – Specification of Rolling Stock for Interoperability

(2) Train Control and Signalling Systems

Train control and signaling systems have intensive interfaces and high dependency with other systems, which often lead "supplier monopoly" once the system is being installed.

Table 3.11 – Minimal Technical Specifications for System Expansion (SIG)

Compatibility with existing systems	Interface Level	Minimal Technical specifications for System Expansion
with existing SIG	A	• Interface with existing and new wayside system shall be compatible. • Transmission between onboard and wayside equipment shall be compatible.
with existing RST	C	• EMC
with existing COM	C	• EMC
with existing DWS	C	• Compatibility with DWS equipments for maintenance of signaling system

Integration and compatibility issues are crucial especially at the interface between rolling stock and signaling systems as depicted in the following figure.

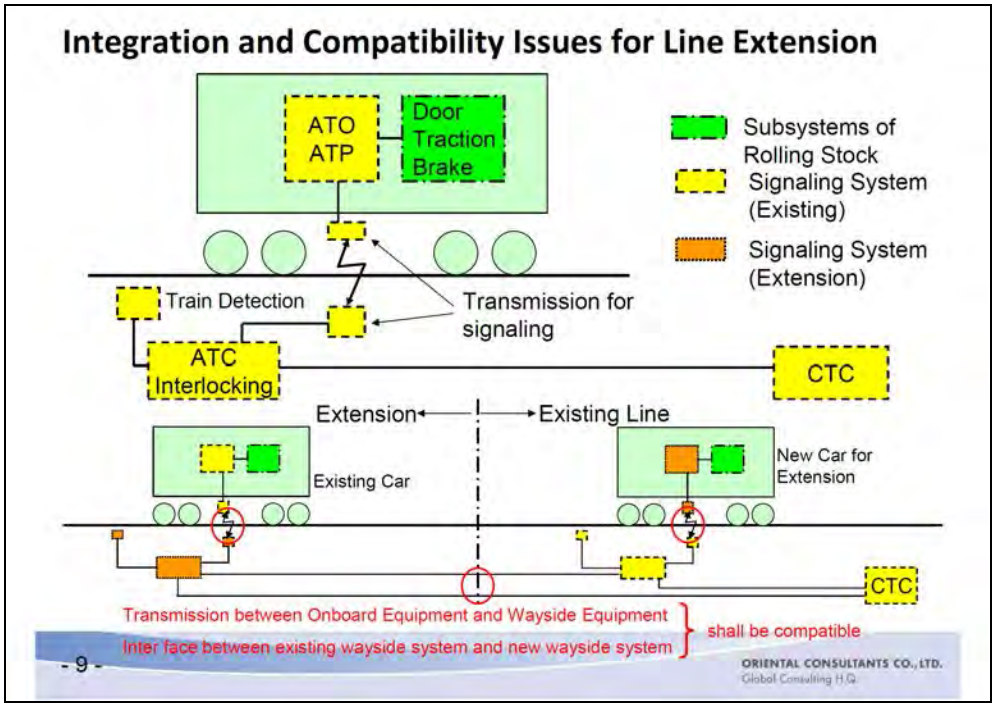


Figure 3.7 – Integration and Compatibility Issues for System Expansion

Given the high degree of interface and dependency issues, several approaches can be dealt with in order to procure signalling and train control systems in system expansion (providing that supplier of existing system = Supplier A, supplier of system expansion = Supplier B in this case example).

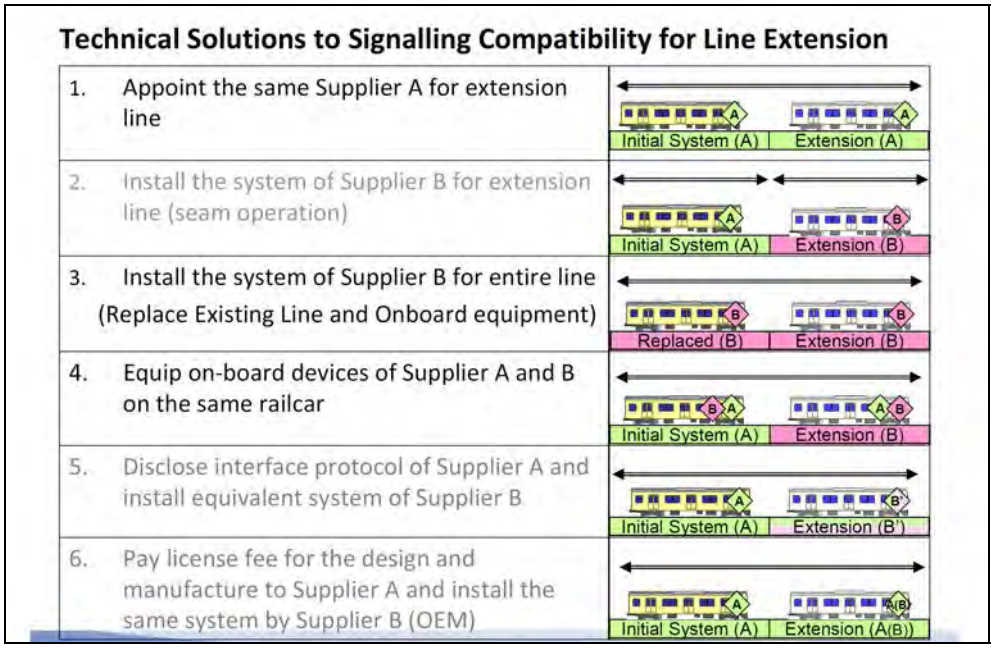


Figure 3.8 – Technical Solutions to Signalling Compatibility for System Expansion

As a general practice, solutions 1, 3, and 4 are reasonable. Although Option 2 requires extensive investment to replace the systems for the entire line, the signalling system of BTS is currently being changed to a new supplier as the result of disputes over the pricing for line extension. The BTS and BMA have in place a "Fair Pricing Agreement" with the new supplier for all future extensions at an agreed price including inflation formulae over 5 year renewable periods up to a maximum 15 years. It is considered that after 15 years, technology will have advanced and changing the system to a newer technology does not require the FPA to be extended past 15 years, unless the Rail Authority wants to. It should also be emphasized that the supplier is bound by the agreement to supply, but the Rail Authority is not bound to employ for future extensions. Nomination of a single supplier is not normally allowed under Thai government procurement rules.

Meanwhile solutions 5 and 6 are hardly acceptable for suppliers. It is anticipated that suppliers would be reluctant to allow these to happen, since these solutions deeply concern their intellectual properties such as interface protocols or source codes.

Interface Protocol and Source Code

Interface Protocol – is the system used to interface say the OCC Central Traffic Control system (which is non-safety critical) to the Computer Based Interlocking (CBI, which is safety critical. In short an Interfacing protocol is how to interface two or more systems together.

Source Code – is like a password or certain procedure to gain access to a software programme.

In this regard, the JICA Study on PPP Framework reported as follows.

When disclosure of information regarding electrical and mechanical system is discussed between concessionaire and supplier, software source code of the system is overly focused. The source code is the supplier's intellectual property and disclosure becomes costly. In maintenance work at railway operation, software source code is not needed. The role of maintenance is to find whether software has any defect. If a failure of equipment is caused by failure of software source code, suppliers may willingly fix the failure without charge. This procedure should be included in a supplier contract in detail.

The team totally agrees with the above. No supplier will agree to release safety critical software Source codes to the Employer. This is for the Employers own good as any modification of the software may make the system dangerous and cause an accident.

The supplier also protects themselves by not giving such codes to the employer. The codes on their own are useless and other documentation, procedures and software tools would be necessary to successfully modify such software, which must be verified and validated by electronic V&V system to meet International Safety Standards such as EN50128.

For non-safety critical software, it may be possible, but again the codes on their own are useless and documents, procedures and tools would be necessary.

(3) Power Supply System

For the expansion of power supply system, it is at least required that nominal voltage shall be same and supply capacity shall be sufficient for the operation. Also, minor modifications of existing SCADA system are necessary to integrate with the systems to be installed.

Table 3.12 – Minimal Technical Specifications for System Expansion (PSY)

Compatibility with existing systems	Interface Level	Minimal Technical specifications for System Expansion/Comments
with existing PSY	C	• Nominal voltage shall be the same as existing line.
with existing RST	B	• Supply capacity shall be sufficient for required operation.
with existing COM	C	• Communication system interface for SCADA system shall be compatible, using Backbone Transmission Network (BTN))

(4) Communication System

The majority of Communication systems are interoperable as the latest systems are all based on Industry standards because suppliers sell their technology all over the world. Most systems employ :open" technology and simple patching of systems is possible provided the standards are the basis of both systems, old and new. Different backbone transmission systems can be patched together or extended using COTS. Different radio systems likewise can be patched

together provided the same protocols, i.e. TETRA (for Thailand) technology is being employed. PA and PIDS and to some extent "Standalone" except for onboard train, but again different systems can be patched together.

Table 3.13– Minimal Technical Specifications for System Expansion (COM)

Compatibility with other systems	Interface Level	Minimal Technical specifications for System Expansion/Comments
with existing COM	B	• 2 systems can be patched together provided they are using the same technology, i.e. GSM-R or TETRA (for Thailand).
with existing RST	C	• EMC
with existing SIG	C	• EMC
with existing DWS	C	• Compatibility with DWS for maintenance of equipments for Communication system.

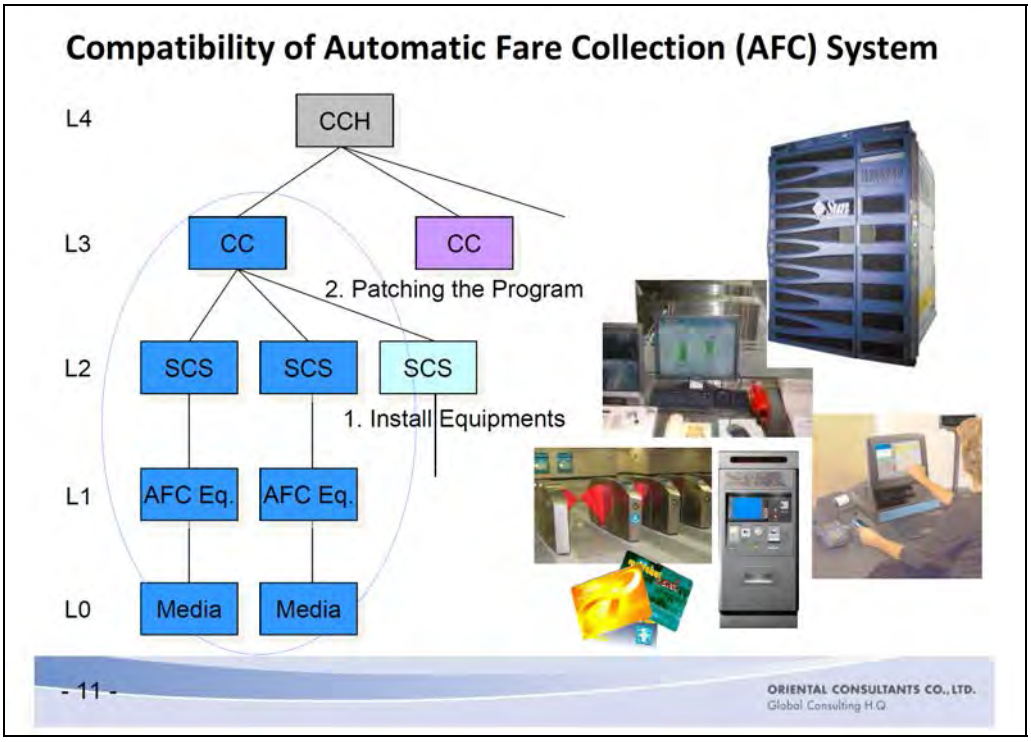
(5) Automatic Fare Collection System

AFC system has 4 levels of operation, i.e. Level 0 - Fare Media, Level 1 – AFC Equipments, Level 2 – Station Computer System (SCS), and Level 3 - Central Computer System (CCS), but if an "Open" AFC system is required so that passengers can travel over multiple transport systems with a single ticket, then 5 levels are required using a Central Clearing House (CCH).

For expansion of AFC systems, it is required to correspond with same media (ticket and token), though it does not rely on specific suppliers. Data transmission system from/to computers itself is open technology. Modifications are required for existing Ticket Vending Machine, Ticket Office Machine and Automatic Gate in order to include extended stations and for the Central Computer System to integrate with the expanded systems. Not only equipment installation, but also patching the program can be executed by other suppliers than that installed the initial system.

Table 3.14 – Minimal Technical Specifications for System Expansion (AFC)

Compatibility with other systems	Interface Level	Minimal Technical specifications for System Expansion/Comments
with existing AFC	B	• Media (ticket and token) is normally specified to Industry standards for dimensions of the card or Token. • The type of software normally is Type A, B or C. These software protocols are Industry Standard's and usually type A & C are used in Railway applications.
with existing DWS	C	• Compatibility with DWS equipments for maintenance of signaling system



(6) Depot Workshop Equipment

Level of dependency on existing depot workshop equipment for system expansion is, in general, not significant compared to other M&E systems. In the event newly procured rolling stocks are not identical to existing railcars, some equipments may not fit with new rolling stocks such as lifting Jacks, under-floor wheel lathe and train wash, test bench, connector, and capacity.

Table 3.15 – Minimal Technical Specifications for System Expansion (DWS)

Compatibility with other systems	Interface Level	Minimal Technical specifications for System Expansion/Comments
with existing DWS		• Maintenance equipments including Trainwash, Wheel Lathe, and Lifting jack systems tend to be designed specifically for the initial application system. • However, the wheel lathe software can be reprogrammed using the suppliers software tools if the issue is addressed in the procurement specifications. There is a risk of removing responsibility from the original supplier if this is done by others, and that issue should be considered carefully. • Lifting Jacks, if of the mobile type can be used on other Rolling Stock, provided the weight limits are not exceeded and type of lifting securement is compatible between jack head and Rolling Stock jacking points

Compatibility with other systems	Interface Level	Minimal Technical specifications for System Expansion/Comments
		• The Trainwash is normally universal and procurement requirements should be specified to be in accordance with MRTA Structure & Loading gauge.

(7) Platform Screen Door

Platform Screen Doors (PSD) are designed and manufactured interfacing with the Rolling Stock supplier. Each lines PSD may be particular to that line and its Rolling Stock. This is due to the door pitch, i.e. distance between centres of doors to the next doors with a total of 4 x double sliding doors per side of each car. The end car doors may not be the same as the middle cars although it is desirable that all door pitches are identical on all cars to allow expansion of the train consist from 3 to 4, 5 & 6 car trainsets in the future.

The only way to ensure compatibility is to demand the dimensions of the original design are met, but this is too onerous for other suppliers and the tender price will always be in favour of the original supplier against ICB procurement guidelines.

Table 3.16 – Minimal Technical Specifications for System Expansion (PSD)

Compatibility with other systems	Interface Level	Minimal Technical specifications for System Expansion/Comments
With existing RST	B	• Location of side door
with existing DWS	C	• Compatibility with DWS equipments for maintenance of signaling system

The team studied overseas practices of technical and contractual solutions for line extension as summarized in the following table. Details of each practice are available in Appendix 3-1.

3.3.5 Future Perspective – towards Open Technology

"Supplier monopoly" problem is still the situation today. Some grouping of suppliers under a European Union agreement has been formed, for mass rapid transit, toward open technology. ETCS (European Train Control System) is an attempt to realize technology solution that allows different suppliers to extend or modify or interface with any other suppliers systems.

ETCS (European Train Control System) is included in ERTMS (European Rail Traffic Management System) now under development mainly by the EU. The ETCS project is very large, with many different members taking part, such as railway operators, the railway industry, railway institutes in Europe, and organizations from the EU and member countries. The system is classified into three levels. Level 1 and Level 2 that enables radio transmission

of train detection using track circuits have already been put into practical use; but actual use of Level 3, a radio train control system, is under progress.

3.4 Lessons Learned and Recommendations for Coming MRTA Projects

- Original Employer's Requirement prepared by MRTA was to a large degree functional (lower degree of freedom for supplier design), while the same used by BMCL for the tendering of system suppliers was rather constructive (higher degree of freedom for supplier design). This could be treated as the main reason for "Supplier-led" design.
- The change was made probably because of the difference in policy and objective of system procurement between the two parties, but still within the scope of concession agreement. It should be noted that there are several advantages to introduce "constructive approach".
- Design documents prepared by the supplier were reviewed and cross-checked with Employer's Requirement finalized by BMCL and technical performance specifications. Outline Designs were made in such a way to respond and ensure "back-to-back" with the Employer's Requirement by BMCL. Therefore, it is sure in principal that all the supplier designs complied with the performance specifications.
- Better understanding of the installed system is essential for MRTA to become more responsible for future system procurement and eventually to manage the assets as the facility owner.
- Discussions were held whether to include "One Supplier Nomination" clause in the concession agreement for Purple Line to ensure better visibility in procurement. This approach may allow MRTA to select the supplier and preferred technology at their own decision in more strict way than the procurement in Blue Line ISP.
- Fair Pricing Agreements for rolling stock and some systems such as Signalling and AFC are a useful measure to ensure problems with compatibility and integration of systems is minimized.
- In connection to local production, the concept of components off the shelf (COTS) are proposed by the Consultants preparing tender documents of Purple Line. This is to avoid Obsolescence of Computerised hardware and software, the latest "state-of-the-Art" systems and software should be chosen, particularly where the components are off the shelf.

- The “Benchmark” group is a useful tool that allows Mass transit railway Authorities to share their experiences, successes, and failures together in an open way to allow all in the group to learn and improve their systems accordingly.
- The Team studied the dependency of M&E systems in system expansion in order to promote the adequate appreciation for MRTA and eventually to remove the sense of threats against “supplier monopoly”. It is suggested that this sort of technical capacity is required in minimum for the MRTA staff in M&E Department.
- Choosing one supplier for each individual line, i.e. Purple. Orange, Blue etc is useful to reduce compatibility and integration issues, but also to allow useful comparison studies between each line/supplier and their systems measuring such performance indicators as reliability, availability and maintainability of then systems.

CHAPTER 4 REVIEW OF MRTA ORGANIZATION AND TECHNICAL CAPACITIES

The purpose of this Chapter is to present the current status of the organizational aspects of MRTA, more precisely:

1. to understand the authorities and responsibilities of MRTA/BMCL and how to interact in day-to-day operation and maintenance activities,
2. to discuss the nature of the organization that would be mandated to implement the Purple Line and Blue Line Extension Projects as well as to supervise operation and maintenance activities of these lines under each cost scheme,
3. to report the latest programs of human resource management in MRTA,
4. to present skill development and training programs for MRTA staff,
5. to assess the effectiveness of technical transfer programs carried out in Blue Line ISP,
6. to present the findings of consciousness surveys with technical staff in MRTA, and
7. to present existing capacity constraints and ways and means of addressing them

The assessment of organizational aspects was/to be carried out in three stages.

Stage 1: Review and research - Firstly, this involved a study of the existing organization. In addition, it comprised capturing of information on the existing organizational mandate, structure, key positions, reporting relationships, key policies, etc and comparing the information against other fully functioning mass transit services in overseas. Secondly, tasks and responsibilities of MRTA and the concessionaire under Net and Gross Cost Scheme were listed, ranging from planning policies to auditing actual performance of the rail services. This exercise aims to capture the input for MRTA's capacity building.

Stage 2: Discussion with MRTA - This is completed only partly. This exercise will continue during the next visit. The end result of this exercise will be to gather MRTA perceptions on the strengths and weaknesses of the existing organization and to identify strategies to manage the systems in consequence of effective reforms of the organization and human resource.

Stage 3: Objective Verification - The information collected will be compiled, analyzed, and documented in a draft report form. The views and opinions of the technical consulting team will be added for an objective assessment. This final report therefore, is the end-product of a joint effort of the objective analysis made by MRTA and the consulting team.

4.1 Roles and Responsibilities of MRTA

4.1.1 Current Concession Contract

As MRTA's concessionaire, BMCL provides M&E equipment, including electrical trains, signalling systems, SCADA, communication, PSD, etc for the subway project and fully operates the system. BMCL gives concession contract on rolling stock, signaling and telecommunication, maintenance, and training to local staff on tern-key basis with Siemens. The 6th package given by BMCL is for the concession contract of 25 years of railway system maintenance. 18 months of operation system (OPS) support plus 10 years of system maintenance are included in this contract.

In accordance with the concession contract, MRTA/BMCL/maintenance contractor organize regular meetings, where Key Performance Indicator (KPI), “Availability” of the whole railway system, actual operational headway, train speed, delay record and other achievements are reported. Based on the achievements reported, MRTA evaluates the performance of BMCL.

Also, MRTA clearly mentioned in the contract that they must get involved in entire O&M activities performed by BMCL and maintenance contractors. In this regard, Coordinating Committee was established in order to:

- Regulate and give suggestions for operation activities by BMCL
- Report management and work progress of BMCL to government organizations

4.1.2 Future Operation Modality - Gross Cost Scheme and Beyond

(1) “Net” to ”Gross” cost concession scheme managing Organization

MRTA has developed its activities and operations, different from what its management originally had wished, as a supervising agency managing project on the basis of operation contracts with the concessionaires starting with the current Blue Line under the so-called “Net cost concession scheme” basis. Under this “net-cost scheme” the concessionaire assumes full responsibilities in operating the railway and MRTA simply receives the commission / fee that have created the feeling and atmosphere within the authority to get closer the “practical” operations.

Thus the new Purple Line project has been prepared under the so-called “Gross cost concession scheme” where MRTA will directly collect passenger fare whereas the concessionaire will stay an operator receiving technical fee for the operations. MRTA will be more responsible for the railway operations but its role still stays as “supervision, monitoring

and control" of the concessionaire. MRTA still stay "indirectly" responsible for the railway operations.

Purple Line Project

Phase A of the Purple Line, Bang Yai to Bang Sue, is a priority project that will provide MRT service between Bangkok and Thon Buri along the East-West Corridor. The Project will initially only include Phase A, while MRTA should consider appropriate modification terms and conditions to cater for the Phase B extension at a later stage.

In October 2007, the Cabinet passed a resolution approving MRTA to undertake the civil work (31,217 million Thai Baht), engage a project manager (1,248 million Thai Baht), and procure the land (9,314 million Thai Baht) and also approved the use of PPP to deliver the Project. The budget has been adjusted afterwards by the Cabinet's resolution in June 2008 in which the civil work obtained 36,055 million Thai Baht and land acquisition obtained 9,209 million Thai Baht and the Cabinet's resolution in January 2009 increasing budget for engaging a project manager to 1,678 million Thai Baht.

In January 2010, Thai Government announced that a gross cost model would be used for the Project. This effectively means that the Government will be retaining patronage risk with respect to the Project and in turn paying the private sector contractor payments in the form of Unitary Payments to provide the required services.

(2) Toward a Direct Operator

MRTA management has shared their view of their future vision, in line with the "Master Plan", to be a direct operator as long as the political and economic environments allow them. The MRTA staff, through the interviews conducted by the Consulting Team across the departments, expressed their strong interests to develop their career with a high morale backed up with their good academic and professional background prior to joining MRTA.

(3) Railway Business Development

The railway businesses, in general, since its expansion of the industry in 19th century, have been developing from the railway core operations with its strong expertise on the railway engineering as well as the operational supervision, evaluation, management and control activities, then dealing with travel comfort and pleasure, safety and security, environment, and further onto the IT based ticketing, fare collection and settlement system serving also as a managerial information tool. This can be illustrated as the vertical and horizontal integration process of a railway institution.

The railway industry around the world, however, has been introducing re-organizing or re-shaping to introduce a more effective operations and a clear responsibilities among different types of operations. Some auxiliary services such as the rolling stock and station clean-up, station security, ticketing, IT services are outsourced. Holding company options have been used when a railway has a few lines and/or its business has a wide range of activities.

Those vertical and horizontal disintegrations are considered as a way to make clear the responsibilities of each activity and at the same time to aim more effective operations. One should note as the key feature in those cases that the railway companies always keep their main operations and their management under their direct control and thus they maintain their institutional capacity within the organization.

Furthermore, air and shipping transportation industries where companies operate in a very competitive market, they have been introducing outsourcing some of the activities to dedicated service companies. Some cases are found in airplane cabin or vessel crew on board, security staff, IT development staff is dispatched under the outsourcing contracts.

(4) MRTA – Reverse Order Development

In the case of MRTA's history, the authority has developed its activities and would like to develop itself in a "reverse order development" that causes great difficulties in understanding their core competencies and also to build their own capacity. In fact, the supervision, evaluation, management and control activities will be most effectively performed on the basis of the real practices on the ground and its experience. MRTA does not have such experience and thus no expertise within their institution.

Given the above future operation modality, possible type of contract would be, i) Operation and Maintenance Concession under PPP Net Cost Scheme, ii) Operation and Maintenance Concession under PPP Gross Cost Scheme, iii) Direct Operation and Contracting Maintenance, and iv) Direct Operation and Direct Maintenance, and v) Direct Operations with Contractual and Outsourcing as illustrated in the following table. It should be noted that the policy has to be approved by the cabinet or the high level if either iii), iv), or v) is the case against the existing policy of PPP concession scheme.

Table 4.1 – Type of Contract

Type of Contract	Definition
Concession O&M (PPP Net Cost)	• The government manages civil infrastructure delivery using private sector contractors; government engages the private sector to provide electrical and mechanical (E&M) assets and trains and to undertake operation and maintenance (O&M) through a concession; • The government leases civil infrastructure to the concessionaire; • The government sets safety standards and fare structure; • The concessionaire determines services to be provided and retains fare and other revenue, in which; and additional payments may need to be made by the government to the concessionaire to cover revenue shortfall, or the reverse if revenue exceeds costs.

Type of Contract	Definition
Concession O&M (PPP Gross Cost)	• The government manages civil infrastructure delivery using private sector contractors; • The government engages the private sector to provide E&M and trains and to undertake O&M through a concession; government sets safety and service standards, service levels, and fare structure and level; • The government pays the concessionaire an amount equal to the costs the concessionaire incurs in providing agreed services as established through a competitive, quality-based tender; and • The government retains all fare revenue.
Direct O & Contract M	• The government manages civil infrastructure and E&M systems using private sector contractors; • The government engages in overall operation activities by their own staffing; • The government contracts with external entity to provide maintenance services;
Direct O&M	• The government manages civil infrastructure and E&M systems using private sector contractors; • The government engages in overall operation and maintenance activities by their own staffing;
Direct Operations with Contractual and Outsourcing	• The government manages civil infrastructure and E&M systems using private sector contractors; • The government engages in overall operation activities by their own staffing for core operations but some non-core operations are contracted out or outsourced; • The government contracts with external entity to provide maintenance and other railway related services ;

4.1.3 Railway System Company Tasks and Duties

Following table shows the list of tasks each party has to be responsible for the service operation and maintenance. This is the key to which tasks an individual party can access, review, handle and ultimately how a task is routed and approved. Therefore, this exercise aims to capture the input for MRTA's capacity building.

Table 4.2 – Railway System Company Tasks and Duties

No.	Task Category	Description of the Task Category
I.	Management	To formulate policies, prescribe and promulgate the rules and regulations for the attainment of the objectives of the Authority Implements, enforces, and applies the policies, plans, standards, guidelines, procedures, decisions, rules and regulations issue
II.	Administration	The administration-related departments and section shall advise and assist the Governor in the formulation and implementation of rules and regulations necessary to carry out the objectives and policies of the authority concerning Administrative, Finance
III.	Operation	To ensure the safe, reliable and efficient operating of the railway and satisfactory service to the passengers on a day-to-day basis
IV.	Maintenance	To perform the daily and the long term planning and execution of scheduled and unscheduled, preventive and corrective maintenance actions to ensure overall systems are ready for required operation at all times
V.	Engineering & Construction	Advise and assist the Governor in the formulation and implementation of rules and regulation necessary to carry out the objectives and policies of the Authority concerning engineering. Monitor and be counterpart of Consultants and supervise Contractors

(1) Management Tasks and Duties

This includes the tasks and duties of i) general, ii) internal auditing, iii) safety, environment and security & rescue, iv) legal affairs, v) planning and strategy, vi) management information system, vii) business development, and viii) public relation. Highlights of the change in the management tasks and duties of MRTA upon introduction of Gross Cost Scheme are shown below:

Direct setting of fare structure and fares - Under the Blue Line the Concessionaire sets the fare structure and fare rates as the Concessionaire is taking all the risks for revenue generation. Under Gross Cost Scheme, MRTA is taking the risk, so MRTA will set the fare structure and fare rates.

Public Relation – MRTA will monitor the Concessionaire performance through evaluation of customer satisfaction surveys (CSS) and mystery shopper surveys (MSS) to report on station cleanliness, staff helpfulness, and others. These surveys will be conducted by the Concessionaire.

Table 4.3 – Tasks and Duties (I. Management – 1. General, 2. Internal Auditing, 3. Safety, Environment and Security & Rescue)

Case		A: Authority C: Concessionaire/Contractor							
		Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
	Tasks	A	C	A	C	A	C	A	C
I	**Management**								
	To formulate policies, prescribe and promulgate the rules and regulations for the attainment of the objectives of the Authority Implements, enforces, and applies the policies, plans, standards, guidelines, procedures, decisions, rules and regulations issued, prescribed or adopted by Government.								
1	**General:**								
1	• Formulate the plans and policies related to the administration/management and operation of the existing MRT Lines Systems and the future MRT Systems;	☑		☑		☑		☑	
2	• Implement, enforce, and apply the policies, plans, standards, guidelines, procedures, decisions, rules and regulations issued, prescribed or adopted by the Office of the Prime Minister, Minister of Finance, Ministry of Transport and Communications, Governor of BMA, Secretary general of NESDB, and the Secretary General of State Council;	☑		☑		☑		☑	
3	• Define fare structure;		☑	☑		☑		☑	
4	• Manage the affairs of MRTA in accordance with applicable laws, orders, rules and regulations;	☑		☑		☑		☑	
5	• Spearhead the conduct/execution of studies concerning the expansion of the MRT System's network and the other related development requirement in consultation and coordination with appropriate agencies;	☑		☑		☑		☑	
6	• Spearhead the conduct of periodic performance, operational and financial audit to ensure the effective and efficient use of resources in the accomplishment of tasks and the achievement of goals and objectives of the Authority;	☑		☑		☑		☑	
7	• Plan, develop and conduct public relations programs and activities of the Authority.	☑		☑		☑		☑	
8	• Implement, enforce, and apply the policies, plans, standards, guidelines, procedures, decisions, rules and regulations issued, prescribed or adopted by the MRTA;	☑		☑		☑		☑	
9	• Oversee the enforcement and implementation of safety and security rules and regulations set by the Authority;		☑		☑	☑		☑	
10	• Plan, develop public relations programs and activities	☑		☑		☑		☑	
11	• Conduct public relations programs and activities		☑		☑	☑		☑	
12	• Operate and maintain the entire railway system.		☑		☑	☑		☑	
2	**Internal Auditing**								
1	• Advise the Governor on all matters relating to management control and operations audit;	☑		☑		☑		☑	
2	• Review and appraise systems and procedures/processes, organizational structure, assets management practices, financial and management records, reports and performance standards of the agency/units covered;	☑		☑		☑		☑	
3	• Analyze and evaluate management deficiencies and assist top management by recommending realistic courses of action;	☑		☑		☑		☑	
4	• Conduct management and operations audit of MRTA activities and determine the degree of compliance with their mandate, policies, government regulations, established objectives, systems and procedures and contractual obligations;	☑		☑		☑		☑	
5	• Conduct separate evaluation of the effectiveness of the internal controls of management systems such as the human resource management system, financial management system, quality management system, risk management system and their sub-systems;	☑		☑		☑		☑	
6	• Evaluate the effectiveness, efficiency, economy, and ethical conduct of operations, including the appraisal of the operating system and their sub-systems	☑		☑		☑		☑	
3	**Safety, Environmental and Security & Rescue**								
1	• Formulate safety and security programs, policies, rules, regulations, instructions and schedules;		☑		☑	☑		☑	
2	• Approve the safety and security programs, policies, rules, regulations, instructions and schedules;			☑					
3	• Develop and maintains logical, sufficient and integrated systems for tactical planning and monitoring security intelligence of the Safety Security Division;	☑		☑		☑		☑	
4	• Periodically monitor, review and evaluate the safety & security codes to ensure its continued effectiveness;	☑		☑		☑		☑	
5	• Supervize the monitoring compliance of the security contract requirements specifically on the number of deployed security personnel and enforces safety and security guidelines	☑		☑					
6	• Ensure and monitor compliance of the security contract requirements specifically on the number of deployed security personnel and enforces safety and security guidelines		☑		☑	☑		☑	
7	• Administer health services to the Authority and provides first-aid treatment to passengers in case of accidents;		☑		☑	☑		☑	
8	• Conduct investigations whenever there is a violation of policies and procedures and other actions that may constitute breach to security committed by passengers, employee and contracted security personnel;		☑		☑	☑		☑	
9	• Develop and implement environmental plan and ensure MRTA compliance to standards and guidelines set by Ministry of Environment through the Secretary General of NESDB in protecting the environment.	☑		☑		☑		☑	

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

Table 4.4 – Tasks and Duties (I. Management – 4. Legal Affairs, 5. Planning and Strategy, 6. Management Information System, 7. Business Development, 8. Public Relation)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
I Management								
4 Legal Affairs								
1 • Act as legal consultant/legal counsel and give legal advice on official matters;	☑		☑		☑		☑	
2 • Represent the Agency, the Governor and other officials of the Authority in civil or criminal cases arising from the performance of official duties before the court/administrative bodies/tribunals;	☑		☑		☑		☑	
3 • Conduct legal research work and studies on legal queries and renders opinion on such matters;	☑		☑		☑		☑	
4 • Review and recommend approval of contracts entered into by the Authority;	☑		☑		☑		☑	
5 • Review/undertake drafting of proposed rules, regulations, orders, circulars, and other regulatory measures regarding operational activities of the Authority.	☑		☑		☑		☑	
5 Planning and Strategy								
1 • Formulate corporate goals/objectives, policies, short and long term corporate plans and programs for the Authority;	☑		☑		☑		☑	
2 • Search, identify and analyse alternative ways of implementation and determine the extent to which developmental projects may affect the Authority's corporate goals and objectives;	☑		☑		☑		☑	
3 • Prepare project feasibility studies for identifies projects including an investigation of the market, its technical, financial, economic and operational viability;	☑		☑		☑		☑	
4 • Prepare all necessary documents for the approval, financing and execution of developmental projects, including negotiations with external (both local and international) financial institutions;	☑		☑		☑		☑	
5 • Collect, analyse and process corporate and project data to evaluate corporate and project performance against set targets, standards and parameters to be able to make appropriate recommendations as may be required.	☑		☑		☑		☑	
6 Management Information System								
1 • Define, design, test, and modifies necessary software components of information systems as maybe required;	☑		☑		☑		☑	
2 • Develop, test, deploy and implement computer programs and applications to meet defined organizational needs;	☑		☑		☑		☑	
3 • To maintain databases to support the operations, management and decision functions of the organization;	☑		☑		☑		☑	
4 • Evaluate, review, recommend and acquire appropriate software and hardware and related equipment to enhance capability and performance of existing IT equipment and infrastructure;	☑		☑		☑		☑	
5 • Provide rapid response inquiry to users of workstations and data communication facilities to help resolve difficulties they may encounter in making effective use of the equipment/facilities; and	☑		☑		☑		☑	
6 • To troubleshoot and rectifies faults in the Authority's various IT facilities including servers and workstations.	☑		☑		☑		☑	
7 Business Development								
1 • To conduct research, feasibility studies, data gathering, statistical analysis and formulates/develops plans and programs for **non-rail revenue** generated activities.		☑	☑		☑		☑	
2 • To monitor the research, feasibility studies, data gathering, statistical analysis and formulates/develops plans and programs for **non-rail revenue** generated activities.	☑							
3 • Conduct assessment on current business development and concessions and recommend the trend most advantageous to MRTA;	☑		☑		☑		☑	
4 • Prepare statistical projections and analysis on business of non-rail revenue generated transactions;		☑	☑		☑		☑	
5 • Formulate, prepare, develop and/or recommend policies, rules, procedures and/or regulations for the evaluation, review and implementation of proposals;	☑		☑		☑		☑	
6 • Oversee and initiate the proper implementation of approved non-rail revenue generated transactions for the MRTA lines;		☑	☑		☑		☑	
7 • Identify and prepare reports on available and potential assets, areas/spaces for allocation and evaluation on the highest/best used for possible business opportunities.		☑	☑		☑		☑	
8 Public Relation								
1 • Formulate an effective and efficient information program through mass media (print, radio and television) to achieve greater public awareness of the Authority's programs and projects;	☑		☑		☑		☑	
2 • Implement an effective and efficient information program through mass media (print, radio and television) to achieve greater public awareness of the Authority's programs and projects;		☑		☑	☑		☑	
3 • Address complaints, requests and inquires pertaining to the services of the MRT are promptly attended to		☑		☑	☑		☑	
4 • Ensure that complaints, requests and inquires pertaining to the services of the MRT are promptly attended to	☑		☑					
5 • Handle all activities relating to media, press conference, interview etc.	☑		☑		☑		☑	
6 • Approve customer survey plans and monitor implementation of surveys			☑					
7 • Conduct customer surveys		☑		☑	☑		☑	

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

(2) Administration Tasks and Duties

This includes the tasks and duties of i) human resource management, ii) supply and procurement, iii) asset management, iv) budgeting and financial planning, v) accounting, and vi) treasury. Highlights of the change in the administration tasks and duties of MRTA upon introduction of Gross Cost Scheme are shown below:

Approval of training plan – In the draft tender document of purple line, the concessionaire is mandated to inform their training program for MRTA and get a prior approval from MRTA.

Approval of maintenance plan – See (4) Maintenance Tasks and Duties.

Revenue collection and remittance – See (3) iii) AFC Service Tasks and Duties.

Table 4.5 – Tasks and Duties (II. Administration – 1. Human Resource Management, 2. Supply & Procurement)

Case			A: Authority C: Concessionaire/Contractor							
			Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks			A	C	A	C	A	C	A	C
II	**Administration**									
	The administration-related departments and section shall advise and assist the Governor in the formulation and implementation of rules and regulations necessary to carry out the objectives and policies of the authority concerning Administrative, Finance, and Planning									
1	**Human Resource Management**									
1	• Provide assistance to management and various units in their manpower concerns/requirements;		☑		☑		☑		☑	
2	• Prepare administrative reports to provide management and other offices with information necessary for decision-making processes such as manpower planning and organizational development;		☑		☑		☑		☑	
3	• Formulate and develop human resource related guidelines and monitors the implementation of such guidelines to ensure conformance and consistency;		☑		☑		☑		☑	
4	• Coordinate with other government offices relative to personnel hiring, recruitment and selection processes and procedures;		☑		☑		☑		☑	
5	• Study and analyse personnel programs, policies and procedures relative to recruitment, selection, placement;		☑		☑		☑		☑	
6	• Formulate and implement company policies and procedures, rules and regulations, relative to discipline, attendance, work performance and all manpower related issues; and		☑		☑		☑		☑	
7	• Implement training program for trainers			☑		☑	☑		☑	
8	• Approve training plan for technical and non-technical personnel of MRTA.			☑	☑					
9	• Prepare, conduct and oversee training for technical and non-technical personnel of MRTA.			☑		☑	☑		☑	
2	**Supply & Procurement**									
1	• Supervise the Concessionaire in the preparation and undertaking of supplies storage and distribution plans and programs and supervise the periodic inspection, issuance and monitoring of delivered office supplies and materials;		☑		☑					
2	• Prepare and undertake of supplies storage and distribution plans and programs and supervise the periodic inspection, issuance and monitoring of delivered office supplies and materials;			☑		☑	☑		☑	
3	• Supervise and monitor the Concessionaire to maintain and update the pertinent documents related to the periodic inspection, issuance and monitoring of delivered office supplies and materials;		☑		☑					
4	• Maintain and update the pertinent documents related to the periodic inspection, issuance and monitoring of delivered office supplies and materials;			☑		☑	☑		☑	
5	• Supervise and monitor the Concessionaire to prepare and carry out disposal plans of excess or supplies no longer needed by MRTA, records, documents or files;		☑		☑					

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

Table 4.6 – Tasks and Duties (II. Administration – 2. Supply & Procurement)

Case			A: Authority C: Concessionaire/Contractor							
			Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
	Tasks		A	C	A	C	A	C	A	C
II	**Administration**									
2	**Supply & Procurement**									
6	• Prepare and carry out disposal plans of excess or supplies no longer needed by the Concessionaire and MRTA, records, documents or files;			☑		☑	☑		☑	
7	• Supervise and monitor the Concessionaire to administer contract agreements with janitorial services contractors and prepare performance evaluation for monitoring and control purposes;		☑		☑					
8	• Administer contract agreements with janitorial services contractors and prepare performance evaluation for monitoring and control purposes;			☑		☑	☑		☑	
9	• Supervise and monitor the Concessionaire to prepare and execute schedule of service vehicles and dispatching of drivers.		☑		☑					
10	• Prepare and execute schedule of service vehicles and dispatching of drivers.			☑		☑	☑		☑	
11	• Supervise and monitor the Concessionaire to plan and procure local and foreign spare parts, material, tools and equipment, office furniture, fixtures and equipment;				☑					
12	• Plan and procure local and foreign spare parts, material, tools and equipment, office furniture, fixtures and equipment;			☑		☑	☑		☑	
13	• Prepare requested budget and payment of procured items, brokerage, customs and bank charges relative to the procurement of spare parts, materials, tools and equipment;			☑		☑	☑		☑	
14	• Monitor the Maintenance Contractor on requested budget and payment of procured items, brokerage, customs and bank charges relative to the procurement of spare parts, materials, tools and equipment;			☑	☑		☑			
15	• Monitor the Maintenance Contractor to prepare report on assigned purchase request to various canvassers of the procurement team for its immediate canvassing.			☑	☑		☑			
16	• Prepare report on assigned purchase request to various canvassers of the procurement team for its immediate canvassing.			☑		☑		☑	☑	
17	• Supervise the control of inventories and the issuance of spare parts;				☑					
18	• Responsible for the control of inventories and the issuance of spare parts;			☑		☑	☑		☑	
19	• Coordinate with end users every concerns that hampers the immediate canvassing of requested items and if goods and services are accepted;			☑		☑		☑	☑	
20	• Prepare technical evaluation, budget adjustments memoranda and other communications necessary to expedite the canvassing process;			☑		☑		☑	☑	
21	• Approve technical evaluation, budget adjustments memoranda and other communications necessary to expedite the canvassing process;				☑		☑			
22	• Prepare annual materials/spare parts budget (local and imported) for the operation and maintenance of the system;			☑		☑		☑	☑	
23	• Assist in managing the procurement process;			☑		☑		☑	☑	
24	• Supervise and monitor the Concessionaire to transfer and inspect delivered tools and equipment, communications and AFCS equipment in coordination with concerned department or division;			☑	☑		☑			
25	• Transfer and inspect delivered tools and equipment, communications and AFCS equipment in coordination with concerned department or division;			☑		☑		☑	☑	
26	• Supervise and monitor the Concessionaire/contractor to in turn supervise the periodic inspection and monitoring of maintenance tools and equipment, communications and AFCS equipment in coordination with concerned department or division;			☑	☑		☑			
27	• Supervise the periodic inspection and monitoring of maintenance tools and equipment, communications and AFCS equipment in coordination with concerned department or division.			☑		☑	☑		☑	
28	• Audit/approve status reports of the maintenance of the tools and equipment;				☑		☑			
29	• Prepare status reports and recommend actions to be taken for the maintenance of the tools and equipment;			☑		☑		☑	☑	
30	• Supervise and monitor the Concessionaire when implement policies relative to the usage and disposal of the tools and equipment, communications and all AFCS equipment.			☑	☑					
31	• Implement policies relative to the usage and disposal of the tools and equipment, communications and all AFCS equipment;			☑		☑	☑		☑	
32	• Act as custodian of, periodic inspection of and procurement of insurance for systems maintenance tools and equipment, communications and AFCS equipment and registration and licensing, office furniture, fixtures and equipment, and motor vehicles and its registration;			☑		☑	☑		☑	

Note:

☑ *Executing*

☑ *Task NOT able to perform under current capability*

Table 4.7 – Tasks and Duties (II. Administration – 3. Asset Management, 4. Budgeting and Financial Planning, 5. Accounting, 6. Treasury)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
II Administration								
3 Asset Management								
1 • Prepare plans and programs for the improvement and full utilization of real properties, buildings and facilities under their scope of responsibility;	☑		☑		☑		☑	
2 • Inspection and monitoring of buildings or facilities improvement projects including fabrications and the like in coordination with the concerned department or division.	☑		☑		☑		☑	
3 • Prepare status reports and recommend actions to be taken for the maintenance and improvement of the buildings, facilities and structures under their scope of responsibility; and	☑		☑		☑		☑	
4 • Prepare policies on proper disposal and disposes office furniture, fixture, equipment, and motor vehicle, scrap materials from demolished buildings or structures or facilities no longer needed by Concessionaire or MRTA in coordination with the concerned units.	☑		☑		☑		☑	
4 Budgeting and Financial Planning								
1 • Prepare, update and implement short, medium and long-term financial plans and programs of MRTA;	☑		☑		☑		☑	
2 Strategic planning, analysis, review, evaluation and recommendations for financial arrangements, packaging and relationship building with relevant financial intermediaries and also possible investors on the basis of the Public-Private Partnership scheme approach.	☑		☑		☑		☑	
3 • Prepare briefing materials/presentation documents and other requirements in the deliberation of the budget and/or project appraisal;	☑		☑		☑		☑	
4 • Forecast financing sources in coordination with other units in determining the adequacy of funds and allocates available funds to programmed expenditures or activities;	☑		☑		☑		☑	
5 • Evaluate expenditures proposals vis-à-vis actual expenses, current and planned activities/program/projects and prepares financial performance;	☑		☑		☑		☑	
6 • Prepares the budgetary requirements of staffing requirements and projects.	☑		☑		☑		☑	
5 Accounting								
1 • Undertake the preparation and analysis of financial statements and supporting schedules/reports;	☑		☑		☑		☑	
2 • Prepare Tax declaration submissions;	☑		☑		☑		☑	
3 • Provide technical advice to management on accounting matters for management decision-making and during budget deliberations.	☑		☑		☑		☑	
6 Treasury								
1 • Monitor cash balances from all sources such as but not limited to rail and non-rail revenues, borrowing and fund releases;	☑		☑		☑		☑	
2 • Adopt and monitor and efficient system of collection, deposit and disbursements of agency funds, and reports periodically on the agency's financial position;	☑		☑		☑		☑	
3 • Take charge of the custodianship of cash, cash items, bonds accountable forms, land titles and other important documents of the Authority;	☑		☑		☑		☑	
4 • Prepare the payroll and electronic register for payment of salaries, monthly remittance of employees loans and statutory deductions, maintains and updates cashbook for various expenses;	☑		☑		☑		☑	
5 • Manage early pullout of ticket bins/roving activities during revenue hours and determines the quantity and types of magnetic tickets required for operations;		☑		☑	☑		☑	
6 • Verify daily rail revenue collections, remittances and deposits;		☑	☑		☑		☑	
7 • Supervise collection and remittances of unsold tickets from stations personnel and prepares reports related to revenue and ticket collections;			☑					
8 • In-charge of revenue collection and remittances of unsold tickets from stations personnel and prepares reports related to revenue and ticket collections;		☑		☑	☑		☑	
9 • Verify daily rail revenue collections, remittances and deposits.		☑	☑		☑		☑	
10 • Determine the amount of investible funds taking into account available bank balances and disbursement priorities;	☑		☑		☑		☑	
11 • Manage placement of investment, maturities of government securities and monitor hold out securities;	☑		☑		☑		☑	
12 • In-charge of collection and deposit of cash from leases, rentals and other non-rail revenue;	☑		☑		☑		☑	
13 • Monitor maturing domestic loan obligation, LC's and trust receipts line and in-charge in payment of principle/interest;	☑		☑		☑		☑	
14 • Earmark funds on various disbursement documents.	☑		☑		☑		☑	

Note:

☑ *Executing*

☑ *Task NOT able to perform under current capability*

(3) Operation Tasks and Duties

This includes the tasks and duties of i) train operations, ii) station operations, iii) traffic control, and iv) automated fare collection system (AFC) services. Highlights of train operation tasks and duties of Purple Line under Gross Cost Scheme are summarized as follows:

Timetabling - MRTA will control and approve service hours including Peak and Off Peak hours. While timetabling on the Blue line is the responsibility of the Concessionaire, MRTA will have direct control and approval of the daily Timetable based on the Concessionaires yearly business plan under Gross Cost Scheme. Timetable shall initially be based on the forecast passenger numbers, then minimum train kilometre will be set by MRTA based on approved daily timetable. Train Km actual against the Timetable shall be performance monitored. Any change of the Timetable must be requested from MRTA to reduce or increase train availability dependant on actual patronage.

Setting the number of rolling stock - The initial number of rolling stock procured shall be in accordance to the forecast passenger numbers. However, actual number of trains running may be reduced if actual patronage is not in line with forecast numbers, but only with MRTA approval.

System assurance - MRTA will have a power to approve System Assurance Plan and Safety Plan. The railway system must function reliably and safely to attract patronage, therefore MRTA shall set quality & system performance targets and monitor directly to ensure the Concessionaire is providing an attractive service to passengers. System reliability, availability and maintainability shall be calculated by the supplier and declared in line with the Contract specifications.

RAMS - MRTA shall set and measure the systems RAMS by Direct Performance Measurement (DPM) through the systems failure reporting systems. MRTA shall set the performance targets for each system and the actual performance shall be reported monthly. Any failure to achieve performance targets may be financially penalized or in the worse case terminated.

Fare Collection - All fare revenue shall be the property of MRTA. Whether using their own staff or the Concessionaire staff to issues tickets and collect the revenue directly is still under discussion. The first concept using MRTA staff seems workable, but the problems will come if “Common Ticketing’ between the Purple line & the Blue line is introduced as the Blue Line is Net Cost, where BMCL own the revenue and pay MRTA 10% back. The formula for sharing the revenue across the two lines and paying each party must be established. To solve this problem, the Thai Government has suggested that to bring in “Common Ticketing across

all Transit systems, it may buy back BTSC and BMCL Contracts and control all transit systems directly

Table 4.8 – Tasks and Duties (III. Operations – 1. Train Operations, 2. Station Operations)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
III Operations								
1 Train Operations								
1 • Advise and assist the Governor in the formulation and implementation of rules and regulation necessary to carry out the objectives and policies of the Authority concerning operations;	☑		☑		☑		☑	
2 • Develop system and train operating plans, policies, and strategies to ensure efficiency and effectiveness;		☑		☑	☑		☑	
3 • Approve system and train operating plans, policies, and strategies to ensure efficiency and effectiveness;			☑					
4 • Provides technical assistance to the Governor, as may be requested.	☑		☑		☑		☑	
5 • Provide safe and efficient train services		☑		☑	☑		☑	
6 • Supervise and monitor the Concessionaire to coordinate with the Traffic Management Unit regarding train movements service interruption and train service;			☑					
7 • Coordinate with the Traffic Management Unit regarding train movements service interruption and train service;		☑		☑	☑		☑	
8 • Monitor the replacement of Train Drivers using prepared approved duty roster, train preparation procedures, injection/ejection (insertion/removal) of trains and arrival/departure of trains at/from terminals based on approved train service schedule;		☑		☑	☑		☑	
9 • Inspect and certify the fitness of Train Operations personnel prior to their deployment on scheduled service and shall also handle evaluation of job performance and recommend policy directions for the Section;		☑		☑	☑		☑	
10 • Recommend rerouting in cases of breakdowns to prevent unnecessary delays in revenue service.		☑		☑	☑		☑	
11 • Prepare and implement work schedules to ensure smooth flow of train operations at the revenue line;		☑		☑	☑		☑	
12 • Supervise and monitor the Concessionaire to handles train operation in accordance with prescribed timetables and instructions and reports any abnormality along the line.	☑		☑					
13 • Handle train operation in accordance with prescribed timetables and instructions and reports any abnormality along the line;		☑		☑	☑		☑	
14 • Ensure that the passengers aboard the train comply with safety rules and regulations.		☑		☑	☑		☑	
2 Station Operations								
1 • Implement the fare collection, including the refund procedure;		☑	☑		☑		☑	
2 • Operate the PAM and directly responsible for the station computer operations, monitoring of equipment, sale of discounted tickets including recording, accounting and turnover of cash/excess collected tickets;		☑		☑	☑		☑	
3 • Supervise and monitor the Concessionaire to promote quality frontline service;	☑		☑					
4 • Promote quality frontline service;		☑		☑	☑		☑	
5 • Assign and adjust manpower schedules, including the retraining/retooling/recycling of Station Tellers and Transport Officers;		☑		☑	☑		☑	
6 • Assist passengers particularly senior citizens, disable and handicapped and attends to their travelling needs at the station platforms/automatic gates and ticket vending machine area;		☑		☑	☑		☑	
7 • Coordinate with the traffic operations and train crew as the need for train skipping is necessary;		☑		☑	☑		☑	
8 • Supervise the inspection of physical facilities in terminals/stations;	☑		☑					
9 • Inspect physical facilities in terminals/stations;		☑		☑	☑		☑	
10 • Implement crowd control measures and monitor passenger ridership.		☑		☑	☑		☑	
11 • Monitor the efficiency of station facilities and services to sustain its commitments to the valued riding public;		☑		☑	☑		☑	
12 • Monitor the accounting and turnover of cash/excess collected tickets;		☑	☑		☑		☑	
13 • Accept problematic tickets;		☑	☑		☑		☑	
14 • Remit tickets sales to the Treasury.			☑		☑		☑	

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

Table 4.9 – Tasks and Duties (III. Operations – 3. Traffic Control)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
III Operations								
3 Traffic Control								
1 • Supervise the Concessionaire to monitor, control and/or coordinate train movements, rail vehicles and maintenance work on the line facilities;			☑					
2 • Monitor, control and/or coordinate train movements, rail vehicles and maintenance work on the line facilities;		☑		☑	☑		☑	
3 • Facilitate the resumption of normal rail services in case of service interruption;		☑		☑	☑		☑	
4 • Supervise the Concessionaire to check equipment at terminals and stations as well as the presence of personnel in the revenue line;	☑		☑					
5 • Check equipment at terminals and stations as well as the presence of personnel in the revenue line;		☑		☑	☑		☑	
6 • Provide information on service or traffic interruption including the status of daily operation along the revenue line, including the connecting and depot areas;		☑		☑	☑		☑	
7 • Prepare manpower schedule, including the retraining/retooling/recycling of traffic personnel;		☑		☑	☑		☑	
8 • Formulate/implement procedures, operate and attend to manoeuvring of trains at turn-back facilities;		☑		☑	☑		☑	
9 • Coordinate with other offices regarding electric matters, train schedules and work clearance;		☑		☑	☑		☑	
10 • Supervise the Concessionaire to monitor train departure and arrival to ensure punctuality of schedule;	☑		☑					
11 • Monitor train departure and arrival to ensure punctuality of schedule;		☑		☑	☑		☑	
12 • Coordinate with train drivers and maintenance personnel for intervention of defects and failures of rolling stock, signalling, telecommunications, tracks, and other equipment/facilities at the mainline;		☑		☑	☑		☑	
13 • Monitor contingency plans in the event of a blocked revenue service; to clear the line and maintain the continuity of revenue service or minimize delays;			☑					
14 • Implement contingency plans in the event of a blocked revenue service; to clear the line and maintain the continuity of revenue service or minimize delays;		☑		☑	☑		☑	
15 • Monitor train movements using the CCTV at the Depot stabling yard, maintenance hall and at the Mainline Platform;		☑		☑	☑		☑	
16 • Supervise and monitor the Concessionaire to operate, control and monitor SCADA;			☑					
17 • Operate, control and monitor SCADA		☑		☑	☑		☑	
18 • Monitor the proper coordination with power supply company with regards to power interruptions and power resumption and computes power consumption and projections;			☑					
19 • Coordinate with power supply company with regards to power interruptions and power resumption and computes power consumption and projections;		☑		☑	☑		☑	
20 • Perform electrical dispatching/switching activities/switching procedures to minimize revenue service delays;		☑		☑	☑		☑	
21 • Supervise and monitor the Concessionaire to formulate timetable and train driver schedules.			☑					
22 • Formulate train driver schedules.		☑		☑	☑		☑	
23 • Supervise and monitor the Concessionaire to formulate timetable	☑							
24 • Formulate timetable		☑	☑		☑		☑	

Note:

☑ *Executing*

☑ *Task NOT able to perform under current capability*

Table 4.10 – Tasks and Duties (III. Operations – 4. AFCS Service)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
III Operations								
4 Automated Fare Collection System (AFCS) Services								
a) Revenue and Production Reconciliation								
1 • Supervise and monitor the Concessionaire to maintain AFCS accounting records and other AFCS related documents, and updates and records ticket sales and production;	☑							
2 • Maintain AFCS accounting records and other AFCS related documents, and updates and records ticket sales and production;		☑	☑		☑		☑	
3 • Reconcile daily and monthly ticket sales/revenue in each line as against the Central Computer System (CCS) generated reports;		☑	☑		☑		☑	
4 • In-charge of mopping activities after revenue operations;		☑	☑		☑		☑	
5 • Prepare accurate and timely financial reports/analysis, as well as preparation of non-financial reports for management use and guidance;		☑	☑		☑		☑	
6 • Reconcile ticket production report as against the CPS/CCS generated reports;		☑	☑		☑		☑	
7 • Reconcile ticket inventory against the actual physical count of tickets.		☑	☑		☑		☑	
b) Ticket Production								
8 • Sort tickets and encodes it using Ticket Sorting and Issuing Equipment/Encoder-Sorter machine;		☑	☑		☑		☑	
9 • Check, count, seal and record processed tickets;		☑	☑		☑		☑	
10 • Prepare daily ticket production reports;		☑	☑		☑		☑	
11 • Release tickets;		☑	☑		☑		☑	
12 • Receipt captured and returned tickets from the Line Operators;		☑	☑		☑		☑	
13 • Handle and store ticket inventory;		☑	☑		☑		☑	
14 • Reconcile ticket production as against daily ticket balance records.		☑	☑		☑		☑	
c) Automated Fare Collection System Administration								
15 • Upgrade/develop software and monitor its performance;		☑		☑	☑		☑	
16 • Maintain and monitor Automated Fare Collection computer system, and manage and monitors file server and database;		☑	☑		☑		☑	
17 • Train on AFCS application, analyse problem of tickets procedures;		☑	☑		☑		☑	
18 • Coordinate and supervise the maintenance contractor on the maintenance/repair of AFCS equipment;		☑	☑		☑		☑	
19 • Operate CPS/CCS Operator and Maintenance Consoles,		☑	☑			☑	☑	
20 • Identify miscoded tickets and assist in reconciliation of tickets production		☑	☑			☑	☑	

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

Performance Evaluation using Key Performance Indicator (KPI) - Under Gross Cost, MRTA shall set KPI's and impose financial penalties or ultimately termination of contract if performance is not maintained at an acceptable level. Most KPI's will be "Direct Performance Monitored (DPM) where the systems shall report automatically in real time all failures and the MRTA shall have a "Shadow" system that monitors the Contractors reporting systems so that MRTA know what is going on at any time in their own O&M office.

MRTA can change KPI's if they wish dependant on the performance of the Contractors systems.

(4) Maintenance Tasks and Duties

Maintenance tasks and duties of Purple Line under Gross Cost are summarized as follows:

Staffing - Staffing numbers shall be initially set and monitored by MRTA, while the Concessionaire shall report staffing numbers monthly.

Scheduling - Maintenance schedules for systems shall be in line with the suppliers recommendations and the Concessionaire shall submit all schedules for MRTA approval.

Maintenance Management Center (MMC) - The Concessionaire shall control all maintenance activities from the Maintenance Management Center (MMC) located in the Purple Line depot. MRTA shall directly monitor the Concessionaires to the approved maintenance schedules by MRTA staff positioned in the MMC. The Concessionaire shall be responsible to procure and operate an Asset Management Workstation in the MMC, which shall log every rolling stock & system equipment components and maintenance requirements to inform the maintenance management when equipment needs maintenance and keeps a record of all assets on the railway. Failures and maintenance activates achieved or not achieved shall be reported monthly.

Direct Workstation - A direct workstation connection between the Engineering Controllers Workstation shall be provided in MRTA Headquarter to monitor failures and their rectification. The Workstation shall also show the entire Purple line and train location/status.

Table 4.11 – Tasks and Duties (IV. Maintenance – 1. Rolling Stock Maintenance)

Case		A: Authority C: Concessionaire/Contractor							
		Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
	Tasks	A	C	A	C	A	C	A	C
IV	Maintenance								
1	Rolling Stock Maintenance								
1	• Prepare plan of Rolling Stock Maintenance;		☑	☑		☑		☑	
2	• Approve plan of Rolling Stock Maintenance;	☑							
3	• Monitor progress implementation of all maintenance activities related to rolling stock;		☑	☑		☑		☑	
4	• Formulate policies and guidelines in the maintenance of rolling stock;		☑		☑	☑		☑	
5	• Approve policies and guidelines in the maintenance of rolling stock;		☑	☑					
6	• Implement policies and guidelines in the maintenance of rolling stock;		☑		☑		☑	☑	
7	• Inspect repair maintenance activities of the maintenance contractor related to rolling stock;		☑		☑	☑			
8	• Prepare work procedure of Rolling Stock Maintenance;		☑	☑		☑		☑	
9	• Approve work procedure of Rolling Stock Maintenance;	☑							
10	• Monitor system trouble of rolling stock from report of train crew, station crew, maitnance personel or onboard monitoring system.		☑		☑		☑	☑	
11	• Analyse rolling stock trouble by monitoring of system trouble or accident record from operation section and prepare the countermesures;		☑		☑		☑	☑	
12	• Approval of special repairs and corrective maintenance activities		☑	☑		☑		☑	
13	• Repare the rolling stock in case of trouble on revenue line;		☑		☑		☑	☑	
14	• Monitor Maintenance by using CMMS;	☑		☑		☑		☑	
15	• Monitors the performance of the contractor and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works.		☑	☑		☑		☑	
16	• Cleaning and washing of the train;		☑		☑		☑	☑	
17	• Manoeuvre trains in depot and workshop		☑		☑		☑	☑	
18	Rolling Stock Maintenance		☑		☑		☑	☑	

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

Table 4.12 – Tasks and Duties (IV. Maintenance – 2. M&E Subsystems, 3. Track Works Civil and Structures)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
IV Maintenance								
2 M&E Subsystems								
1 • Prepare plan of M&E subsystems;		☑	☑		☑		☑	
2 • Approve plan of M&E subsystems;	☑							
3 • Monitor progress implementation of all maintenance activities related to M&E subsystems;		☑	☑		☑		☑	
4 • Formulate policies and guidelines in the maintenance of M&E subsystems;		☑		☑	☑		☑	
5 • Approve policies and guidelines in the maintenance of M&E subsystems;		☑	☑					
6 • Implement policies and guidelines in the maintenance of M&E subsystems;		☑		☑		☑	☑	
7 • Inspect repair maintenance activities of the maintenance contractor related to M&E subsystems;		☑		☑	☑			
8 • Coordinate with the Maintenance Contractor regarding activities related to the maintenance of electronic equipment, facilities and building;		☑		☑	☑			
9 • Implement of all maintenance activities related M&E subsystems		☑		☑		☑	☑	
10 • Implement of all maintenance activities related to facilities, buildings, and E&M systems under MRTA's jurisdiction;	☑		☑			☑	☑	
11 • Inspect repair and maintenance activities of the maintenance contractors of M&E subsystems;		☑		☑	☑			
12 • Monitor Maintenance by using CMMS;	☑		☑		☑		☑	
13 • Monitors the performance of the contractor and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works.		☑	☑		☑		☑	
3 Track Works Civil and Structures								
1 • Prepare standard, rule, criterion of track maintenance;		☑	☑		☑		☑	
2 • Approve standard, rule, criterion of track maintenance;	☑							
3 • Implement of all maintenance activities related to facilities, buildings, and E&M systems under MRTA's jurisdiction;	☑		☑			☑	☑	
4 • Inspect repair and maintenance activities of the maintenance contractors of civil works and buildings facilities;	☑		☑		☑		☑	
5 • Cordinate with section of M&E wayside subsystems regarding maintenance schedule;		☑		☑		☑	☑	
6 • Prepare work schedule of track work;		☑		☑		☑	☑	
7 • Implement track work;		☑		☑		☑	☑	
8 • Planning of maintenance of track work vehicles;		☑		☑	☑		☑	
9 • Implement of maintenance of track work vehicles;		☑		☑		☑	☑	
10 • Monitor Maintenance by using CMMS;	☑		☑		☑		☑	
11 • Monitors the performance of the contractor and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works.		☑	☑		☑		☑	

Note:
☑ *Executing*
☑ *Task NOT able to perform under current capability*

(5) Engineering and Construction Tasks and Duties

Engineering and Construction tasks and duties in each operation and maintenance scheme is illustrated below: Changes are found between Net and Gross Cost Scheme in the tasks and duties of maintenance resource management (See (4) Maintenance Tasks and Duties) and training of personnel as a provision will be made to give authority to MRTA to approve the training plan proposed by the concessionaire.

Table 4.13 – Tasks and Duties (V. Engineering & Construction)

Case	A: Authority C: Concessionaire/Contractor							
	Concession O&M Net-Cost		Concession O&M Gross-Cost		Direct O Contract M		Direct O&M	
Tasks	A	C	A	C	A	C	A	C
V Engineering & Construction								
Advise and assist the Governor in the formulation and implementation of rules and regulation necessary to carry out the objectives and policies of the Authority concerning engineering. Monitor and be counterpart of Consultants and supervise Contractors in activities such as:								
1 • Feasibility Studies;	☑		☑		☑		☑	
2 • Detailed Project Reports;	☑		☑		☑		☑	
3 • Techno-Economic investigations;	☑		☑		☑		☑	
4 • Site surveys;	☑		☑		☑		☑	
5 • Supply of basic engineering and detailed designs and working drawings for construction of the system;	☑		☑		☑		☑	
6 • Equipment selection therein and manufacture of rolling stock and equipment, including their components, spares, assembles and sub-assemblies of all kinds and disciplines;		☑	☑		☑		☑	
7 • Monitor material management;			☑					
8 • Material management;		☑		☑	☑		☑	
9 • Preparation of specification and tender documents;	☑		☑		☑		☑	
10 • Tender evaluation;	☑		☑		☑		☑	
11 • Purchase assistance of all materials and goods pertaining to such projects;		☑		☑	☑		☑	
12 • Expediting inspection and testing, construction supervision, project management, commissioning, operation and maintenance,	☑		☑		☑		☑	
13 • Approve training plan of personnel and any such other services.		☑	☑		☑		☑	
14 • Training of personnel and any such other services.		☑		☑	☑		☑	

Note:

☑ *Executing*

☑ *Task NOT able to perform under current capability*

4.2 Current Organization Structure of MRTA

4.2.1 Implementation and Management Structure

(1) MRTA Act

Mass Rapid Transit Authority of Thailand ("MRTA") was founded in 1993, under the Royal Decree Establishing the Mass Rapid Transit Authority, B.E. 2535 (1992) and its following and replacing MRTA Act, B.E. 2543 (2000) ("MRTA Act 2000" or "the Act"). MRTA is a state enterprise overseeing MRT projects and operations. MRTA used to be under the Prime Minister's Office, but was recently transferred to Ministry of Transport.

(2) MRTA Business

MRT business is defined, at the Section 4 of the Act, "the construction, expansion, restoration, improvement, repair or maintenance of MRT system, MRT operation, the arrangement for passengers' car parks and the provision of services or facilities, and the undertaking of other businesses incidental thereto". It further stipulates, in the Section 7 of the Act that MRTA shall be a juristic person with the following objectives:

(1) to carry out the MRT business in Bangkok and its vicinity including any other provinces as prescribed in the Royal Decree or to operate an intercity service therein;
(2) to study, analyze and prepare a project or plan related to the MRT business for the improvement and modernization thereof;
(3) to carry out businesses related to the MRT business or other business beneficial to MRTA and passengers using MRT services;

(3) MRTA Activities

To implement those businesses, MRTA is given the power (Section 9) to carry out activities within the scope of its objectives under Section 7 and such power shall include the followings:

(1) to have ownership, possess or have other real rights;
(2) to create right or to execute any juristic act within or outside the country;
(3) to collect fares, service charges or fees for using properties, services and facilities in the MRT business;
(4) to determine safety measures of train operation and the safety and good order in train travelling as well as in using and maintaining rolling stock or properties and providing services or facilities in train operation or train travelling;
(5) to borrow money within or outside the country;
(6) to issue bonds or other instruments for investment;

(7) to form a limited company or a limited public company for the purpose of carrying out the business related to or incidental to the MRT business; provided that more than forty-nine per cent of the total registered capital of such limited company or limited public company shall not be held by an alien under the law on alien businesses;

(4) MRTA Business Development

For any MRT business development, MRTA will submit a plan to OTP. Based on this plan, OTP will provide recommendations to the Cabinet for consideration. After the Cabinet approval, MRTA is authorized to grant the concession for the whole or part of a MRT line to a concessionaire through the public procurement procedures. However, the concessionaire must be a Thai juristic company/ partnership which has sufficient capital, machines, equipment and experts in modern technology and have other qualifications as prescribed in the Ministerial Regulation issued by Ministry of Transport.

(5) MRTA Policy Statement

With a view to confirm its policy, MRTA presents, through its annual report, its key issues including its operational policy to conduct the projects focusing on the economic and social returns (1.1.), promote and seek opportunities for additional value creations and income generations (2.2. and 2.3), and seek good satisfaction and security of passengers (3.1. and 3.2.) among others.

1.	**Mass Rapid Transit System Development**
1.1	Operate mass rapid transit projects under public service obligation by focusing on the economic and social returns
1.2	Accelerate the implementation of the MRT projects as approved by the Cabinet to be completed according to the set goals
1.3	Prepare to provide appropriate MRT service in principal cities
2.	**Finance and Investment**
2.1	Seek financial support for the MRT project construction with regard to the infrastructures to be adequate for public service obligation
2.2	Promote value creation from MRT system development including commercial development
2.3	Expedite generating additional revenue by asset management in the forms of immovable property development or other related businesses as necessary
2.4	Manage the organization with efficiency in order to reduce operating expenses
2.5	Lay down appropriate guidelines for solving financial problems
3.	**System Service**
3.1	Provide the integration of MRT system and other transport systems by taking account of the customers' satisfaction
3.2	Provide MRT service by focusing on the passengers' security

3.3	Continually conduct proactive public relations for the passengers' understanding of the objectives and benefits of MRT service and future plans/projects
4.	**Organizational Management**
4.1	Develop the organization to be excellent in MRT service as well as good corporate governance
4.2	Carry out the works by holding to good corporate governance principles and focusing on the benefits of customers and the common public
4.3	Apply information technology to increase the operating efficiency
4.4	Conduct studies, research and development of operation in various aspects to increase service efficiency
4.5	Work out to obtain full and adequate legal authority in order to protect the passengers and MRT system
4.6	Ensure the provision of knowledge and technology transfer about MRT design, construction and its business management

Source: MRTA Annual Report 2008

(6) Possible Business and Operations

According to the MRTA Act 2000, MRTA is authorized to operate Mass Rapid Transit Systems within the Greater Bangkok Area and other adjacent provinces or among the provinces, and to run businesses related to the MRT operations. Firstly, it should be noted that MRTA is authorized to directly operate its lines and its related businesses. Secondly, the expected role of MRTA contributing to the Greater Bangkok Area development is quite significant. MRTA's ways and manners of the engagement in the railway operations and related businesses may need to be re-examined accordingly in light of its expected and possible roles in line with the expansion of MRT lines network in the long-run.

4.2.2 MRTA – a Reverse Order Development History

(1) Railway System Development History

The general world trend in the railway system has been illustrated as the history and development of ***vertical and horizontal integration*** at the beginning since its birth in 19th century. All the activities from railway planning, construction, engineering, equipment, signaling, rolling stock to operations and maintenance including ticketing, station administration to track maintenance were fully undertaken under one organization. As for the management and supervision of operations, they were conducted as a part of its activities, which implies that the internal technical and operational capacities were easily built and shared as its common know-how and disseminated within the organization.

Later, in line with the modernization efforts in 1950s and 1960s, particularly to respond to the economic and financial requirements, many railway systems took options for ***streamlining measures*** such as outsourcing and/or contracting out some parts, quite often from auxiliary or supporting activities, to the third parties. This trend has further been accelerated with the information and communication technology development.

One factor in considering the railway system streamlining is its ***pubic good nature***. Public transport service is their primary role and responsibilities to be carried out with affordable fare level to passengers that quite often put the railway system into their conflicting requirement such as efficiency or feasibility. When one considers a new line construction, the infrastructure particularly civil work requires huge amount of funding. That quite often leads to a ***Public-Private-Partnership approach*** in railway project under which, the public sector will look after the infrastructure and the private sector will be responsible for superstructure, i.e. rolling stock, equipment and signaling work as well as railway operations.

One should note here, however, that the railway organizations, in general, have kept the ***core businesses within*** them. Daily railway operations and its supervision are kept within the organization whereas services such as rolling stock and track maintenance activities are often outsourced.

The Study Team considers that for a railway organization to experience, stock and share those developmental stages for their managerial, technical and administrative management as well as the morale of the organizations. This ***comprehensive railway management and operations*** are discussed more in Chapter 5 along with the future implications.

(2) A Reverse Order History at MRTA

MRTA has been given legally full and comprehensive power to engage itself in the railway business under the MRTA Act. In fact, the Study Team confirmed the strong wish by the part of MRTA management to conduct direct operations. In spite of their wish, the history of MRTA operations is considered as a ***Reverse Order Development***.

Under those MRTA legal framework given on its business, objectives and activities stipulated in the Act, MRTA has been developing its projects and operations starting with an opening of its Blue Line in 2004 on the basis of MRTA's concession agreement with 25 year-term on the first MRT line in Bangkok, the Blue Line, to the Bangkok Metro Public Company Limited ("BMCL"). MRTA holds a 20% share of BMCL.

Its ***first development stage*** began with the Blue Line. The line was originally planned with an option to be conducted by MRTA by themselves as their direct operation. It ended up with the current ***"Net Cost Concession Scheme"*** under which, MRTA has been so far managed

well but facing with great difficulties in understanding their core competencies and also to build their own capacity. The MRTA is operating under the ***"indirect" management and "remote"*** supervision circumstance with the railway operations.

MRTA staff are not having any experiences of train operations, having access to onsite supervision except some training occasions, monitoring the concessionaire's operations only remotely and evaluating their activities virtually only through paper reporting from the concessionaire.

MRTA has been experiencing difficulties in accumulating, stocktaking, sharing and using experiences for the future without having direct access to the operations. It cannot expect to have a well established internal human and information resources without having a directly responsible operation. Furthermore, under this "Net Cost Concession Scheme", MRTA only receives the concession rent / fee and thus it is not engaged in the economic and operational feasibility.

The second stage, under the new Purple Line project, will bring an improved managerial and supervising role to MRTA with the newly introduced ***"Gross Cost Concession Scheme"*** where MRTA will directly collect passenger fare. The concessionaire will stay an operator receiving technical fee for the operations. MRTA will be more responsible for the railway operations but its role still stays as "supervision, monitoring and control" of the concessionaire. MRTA still stay ***"indirectly" responsible*** for the railway operations.

In fact, the supervision, evaluation, management and control activities will be most effectively performed on the basis of the ***real practices on the ground and its experience***. MRTA staff does not have such experience and thus no expertise within their institution. MRTA management expressed their strong wish and interest in their direct operations in the future planned lines to which the Study Team showed its shared feeling for a better and efficient management and operations of MRTA lines.

The expected third stage will be as MRTA management expressed, it will be, in line with the "Master Plan", a ***direct operator*** as long as the political and economic environments allow them. The MRTA staff, through the interviews conducted by the Study Team across the departments, expressed their strong interests to develop their career with a high morale backed up with their good academic and professional background prior to joining MRTA.

This direct operation will give sufficient managerial, technical and administrative capacities to MRTA. The Study Team will define that MRTA's regularlization or normalization stage is completed in terms of railway system expertise, knowledge and skills can be internalizaed. Then, it may go into the ***fourth stage*** of the streamlining. contracting-out, or out-sourcing stage.

With the direct operational experience, as a comprehensive operator, MRTA may choose a wide variety of options what and how they would be engaged with its public transportation operator and associated operations, as well as one of the key players in the Greater Bangkok Area regional development. That may be called the ***fifth and comprehensive stage***.

4.2.3 Organization Structure

MRTA, established in 1993 having a status of state enterprise under the Ministry of Transport, is responsible for the implementation of projects on Mass Rapid Transit System in the Greater Bangkok Area with about 60 staff members. The total number of MRTA staff including those top management people has grown to the current level of about 550.

MRTA currently has a structure headed by the Governor appointed by the council of Ministers He is supported by four Deputy Governors. Each of them has its own supervising departments functionally divided; a) Strategy and Planning (71 staff), b) Engineering and Construction (137 staff), 3) Operations (264 staff) and 4) Administration (75 staff). Total staffing strength of 547 is deployed excluding the Governor. (See Appendix 4-1: MRTA Organization Chart) Each department is headed by a department director who, in turn, reported by a few division chiefs. Further, each division often has two or more sections headed by section chiefs. The average size of the section, the smallest unit, is about 2-5 staff except the four security divisions having about 30 staff members each.

Table 4.14 – Age and Years at MRTA by Staff Level

	Average age	Ave No of yrs at MRTA
Top management	56.1	14.1
Senior management (Director)	53.5	15.2
Middle management (Div Chief)	50.6	12.7
Senior Operational staff (Sec Chief)	40.6	10.1
Junior Operational staff	35.6	7.0

Other characteristics of MRTA organization are highlighted as follows:

Work Culture - Most of its senior staff including and above department director level have been working more than 10 years and some of them joined when MRTA was established. This has given strong confidence shared among the senior members at MRTA, whereas the operational level staff members were mostly hired rather recently and having about 5-10 year experience on average for each department. Since MRTA is rather new organization, an open, interactive and knowledge-sharing communication atmosphere has been well disseminated and practiced in the authority.

Attractive MRTA Positions - MRTA has been offering relatively a competitive compensation package for its new recruitment compared with other public administration positions. MRTA, in general, adopts vacancy and need based post recruitment and thus do not offer any annual / regular recruitment. The new recruited staff members usually have college degrees with relevant academic or professional background and are rather highly motivated thanks to the attraction of the MRTA business as a new field in the country.

Highly Motivated Staff - Majority of MRTA staff keep their high motivation but have some concern on their career path how they accumulate their knowledge and skills particularly from technical aspects. This is due mainly to the indirect supervision intervention due mainly to the limited access to the key information or difficulties that most of the operating activities and information are held by the concessionaire.

Staffing Strength - The existing Blue Line is run by the MRTA, BMCL and maintenance contractor (Siemens and others). The 21 km of the route is operated by close to 1,200 staff members (MRTA + BLCM + maintenance contractors), which brings the per route kilometer staff strength close to 57. This staff strength is perceived to be higher than international benchmark for their actual scope of works.

Particularly, personnel in Rescue and Security Department, which comprises almost half of the entire organization, seem to have some duplicates of the tasks carried out by BMCL (This could be from the MRTA's policy to maintain the quality of transport service in high standard).

However, given the magnitude of their works for implementation of Purple Line and Blue Line Extension Projects and following management of revenue service, man-power and workload will be better balanced in the future.

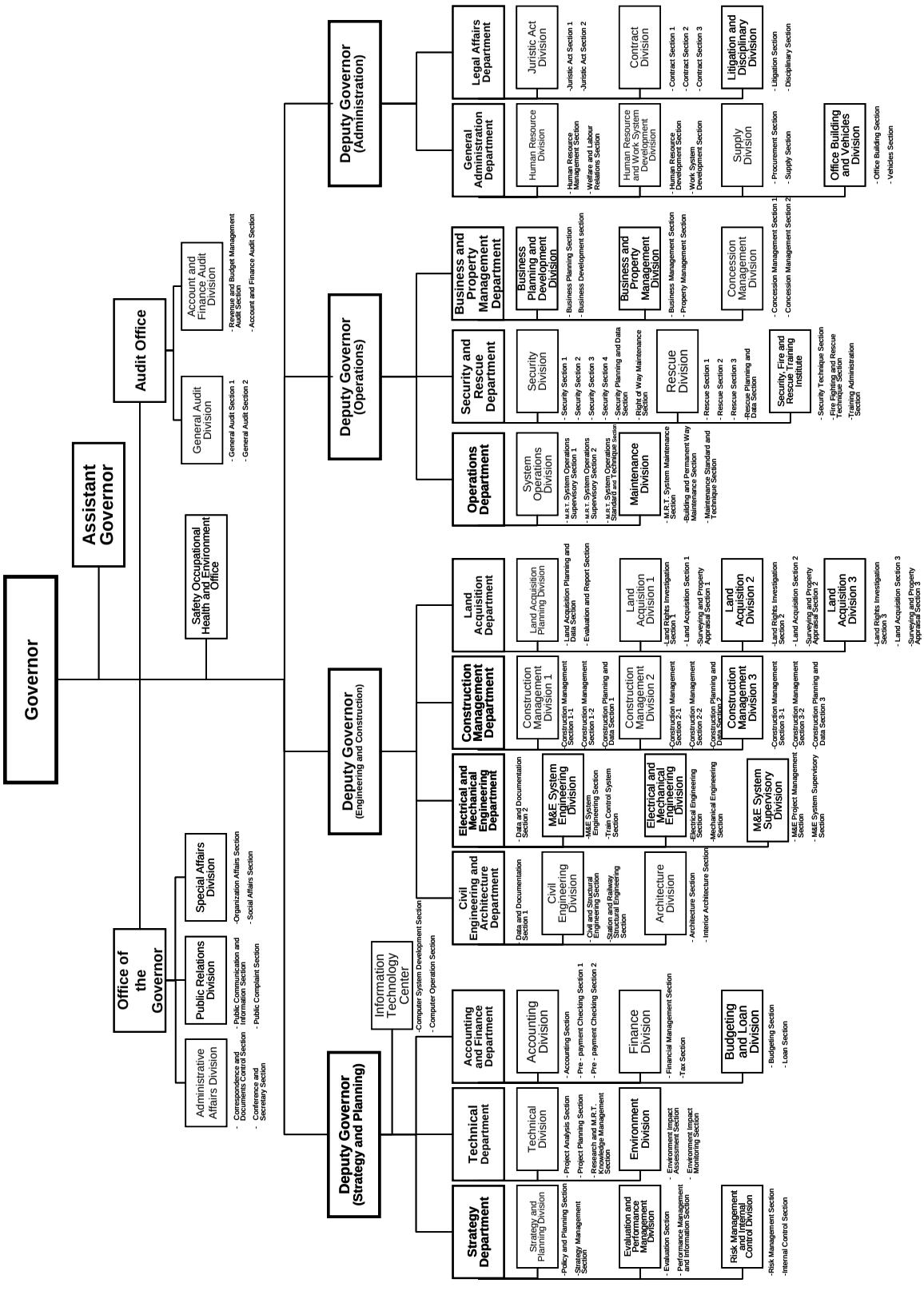


Figure 4.1 – Implementation and Management Structure

4.2.4 Responsibilities of Each Organizational Unit and Personnel

This section briefly reviews and assesses the structure of job and human resource allocation in MRTA organization.

(1) Responsibilities of Each Organization Unit

Departments that relate to the M&E system and O&M activities are Engineering and Construction Department and Operations Department. Key responsibilities of each department are presented in Appendix 4-2:

These descriptions are well made in general. However, it may need to be further detailed in order to divide tasks into jobs, specify the appropriate department for each job, determine the optimum number of jobs in each department, and delegate authority within and among departments.

(2) Job Description

MRTA gave an opportunity to MRTA officers to prepare Job Description by themselves about their responsibilities and present to commander for consideration and adjustment of the same according to their policies and goals.

In 2009, MRTA hired a local consulting firm to evaluate the job performance, prepare a compensation structure of each position, and refine job descriptions for MRTA to improve according to theory, scope of work and operation.

Job Description includes, Attribution, Job Purpose, Responsibility, Key Performance Indicator (KPI), Key Success Factor, Occupational Health & Safety Management, Sub-ordinate's Responsibility, Authorization, Working Relation, Key Competency, and Job Specification. Job Qualification is also drawn in the format. E&M Department and O&M Department are composed of engineers from the background as given in Appendix 4-3.

This format is well composed in general. However, these descriptions are often underspecified, having ambiguities, and duplicating between several positions in different levels. This is probably because the human resource consultant prepared the descriptions without having an expertise or a good understanding in engineering, implementation, and management of urban mass transit. Also because, although the Division Directors and Section Chiefs seem to have a clear understanding, the scope of work of MRTA is not well understood by their subordinates.

It makes managers feel more difficult to give structure to each staff through job specialization, organization, and establishment of patterns of authority and span of control. Also, organizing

the process of structuring human and physical resources becomes less effective and less efficient.

(3) Work Structure and Categories

As the tasks for project implementation and services increases, it becomes more difficult for individual staff to do their job well. In this connection, MRTA streamlined the work structure and categories to handle the increased workload and developed a "Job Mapping" as illustrated in Appendix 4-4.

Again, although the document is well structured, it gives an impression that it would be more useful once descriptions of jobs are clearly defined and specialized.

4.2.5 Human Resource Management

MRTA's Human Resource Management is structured from the 3 components:

(1) Recruitment and manpower planning
(2) Measurement and performance evaluation
(3) Compensation and benefit management

(1) Recruitment and Manpower Planning

Some observations and comments on recruitment and manpower planning of MRTA are presented below:

Recruitment Policy - The development of recruitment policies for the various staff levels depends on the field of expertise. Results from the study indicate that recruitment policies for management level are done from inside MRTA (the staff taken over from ex-Highway Authority) in most cases, while the policies for all staff levels are done from outside MRTA in general. To overcome the budget constraints, new employment may become more on a contract basis than before.

Recruitment Market - Whether recruitment policies and practices take place at internal or external levels, getting people with the right expertise is a difficult task. Recruitment of MRTA engineering staff is mostly from the open market, private construction companies, government organizations (such as local electric power agency), and academic campuses. With the particularity of railway engineering and short history of electric urban railway in Thailand, experienced personnel in several fields, especially signaling, trackwork, and rolling stock, are unlikely to be available in the domestic market.

Therefore, MRTA recruits personnel who have related experience, not deeply related though, such as design, installation, and project management of building service and power distribution projects. Their stance is to train such staff to develop general skills and knowledge on Mass Transit Systems.

Hiring Methods - In this connection, Study Team looked at the hiring methodologies that MRTA employs. The prevailing hiring methods in MRTA are external advertisement in the public media, head hunting and internal advertisement. Using outside recruitment agencies seems not to be very popular, probably because it is generally costly and understood that this type of expertise can only be found internally. Online advertisement and online applications through the website seems to become popular these days. Both could be very quick and economical methods of recruiting certain categories of staff.

Advertising of Vacant Posts - Ways and means of advertisement includes internal and external advertisement. Level of posts ranges from basic level posts to senior or professional posts. The post of top management levels are normally filled from internal resources.

Study Team will further request for the following specific elements regarding recruitment in a next step to evaluate the recruiting strength of MRTA:

i) Average time it takes to fill vacant posts from the time a post is advertised,

ii) Percentage of successful candidates that decline to take up appointments,

iii) Percentage of new recruits that leave the organization before completing years of service,

iv) Whether organizations conduct interviews with candidates that do not take up appointments,

v) Whether organizations conduct exit interviews.

Job Rotation – Generally speaking, specialization increases worker efficiency. However, overspecialization may result in workers' loss of interest and reduction in productivity. One solution to this is to switch jobs within the organization so that the personnel can acquire wide-ranges of knowledge and perform multiple tasks. MRTA uses this concept selectively. Particularly, back and forth between E&M Department and O&M Department was active for the last few years. However, the concept may change once a person having a different policy takes the position of Governor.

(2) Measurement and Performance Evaluation

Measurement and performance evaluation methods of MRTA are shown below:

Previous Performance Evaluation Criteria - MRTA had been using the previous performance evaluation criteria that was prepared in 2001. Several issues were found in the criteria, such as:

- The evaluation system is unable to reflect the achievement of the policies and goals.
- The evaluation system is unable to undertake performance measurement of the private sector.

Therefore, MRTA improved the evaluation system of Directors of Department or equivalent as well as operation officers so that it can reflect the operational improvement of the organization more clearly and more precisely.

Performance Review Tools - MRT has established key performance areas for various levels of staff and employees agree on periodic targets to be assessed in their direct reports. Only top management is subject to take performance review at present. However, MRTA has already established key performance areas and targets set by the management level and a consulting firm for the supervisory/professional level staff and operational level staff.

Performance review tools include the following factors:

Work Behavior – It involves self-initiated, anticipatory action aimed at changing either the situation or oneself. Examples include taking charge to improve work methods, proactive problem solving, using personal initiative, making goals, and proactive feedback seeking.

Key Performance Indicator (KPI) – KPIs are quantifiable measurements, agreed to beforehand, that reflect the critical success factors of individual responsibilities and tasks.

Competency – Competency is a standardized requirement for an individual to properly perform a specific job. It encompasses a combination of knowledge, skills and behavior utilized to improve performance.

Performance Review Criteria - MRTA intends to improve the performance evaluation of executive in the position of Director of Department, Director of Office, and above. Work performance is evaluated by i) Key Performance Indicators (KPI) that relate to the achievement of work (weight 90/100), and ii) individual work behavior (weight 10/100). Performance of officer level staff is evaluated by i) KPIs (weight 50-70/100) and ii) competencies with the weighting criteria (weight 30-70/100)

Frequency of Reviewing Staff Performance - Periodic performance reviews, when appropriately used, can help MRTA to minimize the impact of failures, address staff development and training issues, review organizational processes and systems, motivate and reward staff, and even others.

MRTA has a plan to conduct quarterly and half yearly performance reviews for different categories of staff. It is recommendable that the monthly or quarterly reviews are cumulated for the purpose to be used for the annual assessment.

In the years to come, MRTA intending to adapt to truly performance-based cultures must conduct reviews more frequently in order to ensure that performance is closely monitored and remedial action taken promptly.

Skill Development and Training Programs - Skill development and training programs are planned by Human Resource Development Section under Human Resource and Work System Development Division. MRTA introduced "Competency Based Training" from 2008, where each staff is required to develop core, managerial, functional, and technical competency. However, MRTA has an intention that training for managerial and technical competency should be facilitated with the assistance from overseas. CBT is an approach to vocational education and training that places emphasis on what a person can do in the workplace as a result of completing a program of training. The establishment of the program is under progress. MRTA set up 4 competencies as a first step.

Table 4.15 – Competencies of MRTA Staffs

Core Competency	• Ethics • Working as a team • Working according to standard for excellent • Focus on the need of customer • Ongoing development • Innovation • Communication • Seeking to know
Managerial Competency	• Having a vision in operation • People Management skill • Strategic and analytical thinking • Knowledge in the business • Solving problem and decision making • Leadership
Functional Competency	• IT skill for engineering • Preparing the official letter • Rules, regulations, & laws about operation • English knowledge for engineering
Technical Competency	• Technical sense • Engineering knowledge about MRT system • Engineering knowledge about MRT system maintenance • Engineering knowledge about MRT operation and service • Correspondence and document control skill

(3) Compensation and Benefit Management

Compensation and benefit management is one of the key factors for organizations to attract and retain competent staff. In this connection, a study was conducted on a number of issues

linked to compensation, including how the employee compensation structures are determined, the attractiveness of the salary structures and how performance-based payments are addressed.

According to MRTA Act, the Governor has an authority to change the salary level within the range regulated by the Board and with approval from the Council of Ministers. However, in reality, it seems that government decision on budgeting and resource allocation becomes a significant intervention to set the level of compensation of MRTA staff.

The total salary costs of entire organization is currently THB 16.8 million per month (= USD 520,000 at exchange rate as of May 2010) in 2010 or THB 216 million (USD 6.7 million) according to the actual performance in the previous year. MRTA requests THB 256 million (USD 7.9 million) for the fiscal year of 2011 to cover the wage payment of additional recruitment. However, it is anticipated that the amount of budget to be allocated will be set lower than that of previous year due to the government (MOF) policy.

Similar to the common practice, individual wage rate of MRTA is lower than that of private companies (say 30-40% lower), losing their competitiveness in recruiting highly experienced personnel.

With lack of experienced engineers in certain expertise, it is important that MRTA improve their compensation and benefit structure in order to be able to attract and retain competent employees. However, the Team has a perception that KPIs given in the developed job descriptions are anyhow not properly linked to the performance of MRTA staff. This could be on the ground that job descriptions contains plenty of ambiguities in the tasks and responsibilities of each personnel.

As for the frequency of reviewing their compensation structures, MRTA undertake it once annually. It appears that a frequency of the review is considered as the standard.

Table 4.16 – Wage Rate Comparison between Private Company and MRTA

Job	Net Monthly Income	Notes	Gross Monthly Ave. Income	Compulsory Deduction[1]	Weekly Hours
Engineer Ave. Salary	USD 756	Power Distribution Engineer, Men Employee	THB 32,655	7%	48 Hours
Engineer	N/A	E&M, M&E Engineer, Men Employee	THB 18,400[2]	N/A	40 Hours

Source: Based on MRTA and Thailand Household Economic Survey (2005)

[1] The compulsory deductions include income tax, municipal tax, provincial/state income tax, social security (pension plan, medicare), compulsory additional insurance, etc.
[2] A staff with 10 years working experience

4.3 Current Activities of Technical Personnel in MRTA

As the current contracts between BMCL and its maintenance contractors have not been provided, the accurate description of the maintenance activities of the Concessionaire are not yet fully known. However, based on the interviews to some maintenance staff of MRTA , job descriptions of BMCL's staff, and on common practices on this type of contractual schemes, a basic assumed description is provided herein.

Based on the comparison between railway system company tasks and duties studied in 4.1.3 and the result of survey on current O&M activities of Blue Line, it becomes more clear what tasks MRTA is not able to perform under current technical capabilities.

4.3.1 Construction and Planning Activities

Construction and planning activities about railway systems, currently dealing with Purple Line and Blue Line Extension Projects, are under the responsibility of E&M Engineering Department. Their works include two prominent fields: i.e. i) M&E system engineering (signaling, communication, rolling stock, train control system etc.) and ii) E&M system engineering (building service).

Main activities performed by this department for the two projects at present are to control and supervise the works of consultants. Intensive review and assessment works of draft tender documents of Purple Line Project are tasked to and being carried out by the officer-level staff of this department. Several staff commented to the Team that the current workload does not make much problems for them unless they have to work for additional projects.

Their work style is characterized by the slogan "working as a team". Most of the staff in the same section/department have common job functions, where clear task segregation is avoided. This is probably because top managements of MRTA have an intention to let the engineering staff to have more opportunities to learn railway engineering in general, rather than to obtain an expertise in a certain field.

In this connection "job rotation", particularly from Operation Department to E&M Department, had been done several months ago. Now many of the staff in E&M Department just started their career in this field, some of them are even not familiar with their scope of works.

It was found through interview survey that they are highly capable to control and supervise the consultants' works of E&M (building service) systems mainly because of their similar experiences in ex-jobs and facilities extended for their skill development and trainings. On the other hand, M&E system engineering, particularly in the field of signalling and rolling stocks, is the weak point of their technical capacity. This is natural, given the facts that MRTA has

almost no access to the actual operation and maintenance service, technical transfer program from the concessionaire was not effectively carried out, and there is no other opportunity to get the training in M&E systems. Learning resources are limited to lecture books, internet searching, or asking to senior management level staff, just helping them understand the fundamentals.

They are facing problems to understand the basics of railway systems engineering, so there is a question if they equip effective and sufficient review and assessment functions and will be able to take initiatives in supervising procurement and installation of M&E systems in a subsequent stage.

A summary of activities related to current construction and planning activities performed by E&M Department of MRTA is summarized below:

MRTA Construction and Planning Activities (E&M Department)

M&E System

- Preparing TOR of M&E consultant, contractor or concessionaire (Coordinating for each parties in M&E, Reviewing TOR provided by consultant for purple line project)
- Preparing the tender documents especially the invitation to tender, the instructions to tenderer and the particular specification for M&E and Rolling Stock Contracts
- Reviewing and assessing tender documents and coordination with the consultant.
- Controlling and supervising the works of consultants, contractors, suppliers, and concessionaire in the part of M&E/Rolling Stock according to the contract agreement and other relevant work
- Coordinate with Construction Management Department for purple line project

E&M System (Building Service)

- Monitoring controlling and inspecting electrical and mechanical system for building service of all MRTA projects
- Designing, preparing technical regulations and standards, supervising supply, production, installation and testing related to mechanical system of building service
- Controlling and supervising the performance of consultants and contractors
- Reviewing and assessing tender documents about Mechanical system (Building service) for Blue Line extension project

4.3.2 System Operation Activities

(1) BMCL Operation Activities

BMCL has a contract with MRTA to operate the MRT Blue Line of Bangkok. Therefore, all of the system operation activities are in principal performed by BMCL.

A summary of activities related to operation performed by BMCL is, according to job descriptions of BMCL, summarized below:

BMCL Operation Activities

- Ensuring the safe, reliable and efficient operating of the railway and satisfactory service to the passengers on a day-to-day basis
- Ensuring safety and integrity of system operations according to applicable laws and regulations
- Taking care for the operational policy and standards
- Maintaining and implementing the Safety Management System.
- Monitoring the performance of the Control, Station and Train Crew
- Continuous monitoring of the railway performance
- Ensuring emergency preparedness, safety management and accident investigation
- Dealing with railway incidents and emergencies
- Control and monitoring of all operational activities on the line and within the Depot
- Resolving customer concerns and complaints
- Planning daily and long term business planning

(2) MRTA Operation Activities (Operation Department)

MRTA is basically responsible for planning, monitoring, and provisioning the contractors as written in the concession agreement No.6. There is a word "provisioning" but from interview surveys with MRTA staff, the Team can conclude that "provisioning" in the job description means only "Monitoring" the BMCL's operation which are:

BMCL's Center Control Room (CCR) - There are 5 officers from BMCL taking care the operation in CCR room for the whole day. If there is any error or bad incident, they will get the report immediately. This job can be divided into 2 shifts (from 6.30 -14.30 and 14.30-22.30). These 5 persons have shifts. Besides, they also have responsibilities in the office as shown in the schedule given. However, that time is usually used to monitor passenger stations (SOR).

BMCL's Station Operation Room (SOR) - MRTA staff can only monitor because it was written in the agreement that MRTA will not interrupt BMCL task. So the participation can be only to check the document, station checklist, take care public area and area around the station, etc and then to make a report. When the officer who makes the report realizes that there is an error, he will report to his superior, and then higher level consequently.

BMCL's Training Operator (TO) - this kind of monitoring means checking the readiness of the driver. This is done by just checking check list of BMCL.

As well as the definition of "provisioning", the word "Planning" doesn't mean the planning for instruct BMCL's operation. It's just an approval for the planning proposal from BMCL.

4.3.3 System Maintenance Activities

(1) BMCL Maintenance Activities

BMCL has a contract with MRTA to operate and maintain the MRT Blue Line of Bangkok, and it has made 4 subcontracts for maintenance, namely: rolling stock and E&M equipment; civil works; station facilities; and track works. The contract for the rolling stock and E&M maintenance contract was signed with the OEM of the rolling stock and signaling system, Siemens AG.

As the most sophisticated and critical maintenance activities are those related to the rolling stock and E&M system, this paper focuses only on that contract, assuming that the other three contracts are similar in nature and scope.

A summary of activities related to maintenance performed by BMCL is summarized below:

BMCL Maintenance Activities

- Monitor progress implementation of all maintenance activities related to the entire system;
- Coordinate with various government or private agencies for the proper implementation of all maintenance activities of the maintenance contractor, if necessary;
- Review reports of repair maintenance activities of the maintenance contractor;
- Monitor the performance of the contractor and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works;
- Manage the provision of fault and defect reporting data and information from CCR via SCADA;
- Co-ordinate the interface between Operations and Maintenance contractors (including the planning of track possessions during the allocated maintenance time);
- Initiate carrying out a technical evaluation of incidents;
- Undertake the management and administration of maintenance contractors;
- Ensure that the system integrity on the basis of engineering standards is safeguarded;
- Perform the daily planning and co-ordination of scheduled maintenance actions within the maintenance window of the operation day;

- Liaises in case of an incident on site with the rescue group of the maintenance contractor; and
- Perform the long term (yearly and monthly) and short term (weekly) planning of scheduled maintenance and the co-ordination between the maintenance contractors and the traffic department.

Level of Outsource - There are several types of outsourcing maintenance contracts, and they are best illustrated by the actual approach to three basic questions: what to maintain/repair; how to do be done, and when to do be done.

The most probable approach used by BMCL-Siemens is to contract all of the above steps, thus giving control over the development of equipment maintenance strategies (i.e. Preventive and Corrective Maintenance programs) to the maintenance contractor (Siemens). In this instance, the contract must be structured around the achievement of desired outcomes in terms of equipment performance, with the contractor being given latitude to achieve this to the best of his ability.

Maintenance Plan and Procedures - Under this scheme, the main activity of BMCL would be monitor the maintenance contractor by compliance or not compliance of given Key Performance Indicators (KPI). It is doubtful that BMCL could have the power to approve any Maintenance Plan and Procedures as general rule, unless perhaps of major emergency repairs, or when maintenance activities could hamper operation activities. Hence, BMCL might be in a position to approve Maintenance Plan in relation to daily schedules, but not frequencies (the when mentioned above).

Supply, procurement and management of spare parts - According to the result of interviews with MRTA staff, the Maintenance Contractor is bound to provide a certain unknown stock of spare parts (both capital and consumables) for a certain period of time for the preventive maintenance. However, in case of rehabilitation or special repairs, the Contractor would request a reimbursement of the required spare parts. The specifications, volume, and cost of those parts are not for approval of BMCL, and BMCL has only to purchase those parts, usually from the OEM, which is in turn the Maintenance Contractor. This scheme does not encourage the "localization" of spare parts and/or the open canvassing of similar parts from different suppliers that could lead to cost savings.

The experience in other railways systems is that the supply of spare parts for rehabilitation or special repairs should be bid out, where the incumbent Maintenance Contractor is allowed to bid. This scheme encourages cost savings by canvassing the parts from several reputable suppliers.

(2) MRTA Maintenance Activities (Operation Department)

Roles of maintenance division can be divided into 3 main jobs as they have 3 sections: i) M.R.T. System Maintenance Section, ii) Building and Permanent Way Maintenance Section, and ii) Maintenance Standard and Technique Section.

MRT System Maintenance - In the case of MRTA, except for buildings related to non-core business such as park-and-ride, the activities on maintenance of the railway system are even more restricted that those of BMCL, where its engineers are informed thru monthly and annual reports, and daily by print outs of the CMMS, but without the possibility of having more access to information and control of the maintenance. This is per-se not good or bad, it is correctly applied from the contractual conditions. However, in view of long term future role of MRTA, when system would be turned over to them, it is advisable that the level of knowledge and experience of its engineers would be considerable higher to take charge of the actual maintenance.

MRTA could still sub-contract maintenance activities in the future, but with wider attributions to monitor and supervise the Contractor.

Contents of BMCL Monthly Report

In "Article 22.3 Agreement on the report" under the concession agreement between MRTA and BMCL, and in Annex 7 Part 2: MRTA's Requirement - Functional Topics 2.5.2 page 19, it is defined that the Company must submit the report in agreed format to MRTA every month since the first month of revenue service. The content of the report includes the following items.

Part 1 - Report on operation service

Subject 1: Analysis of the Blue Line Transit Service
Subject 2: Report on number of passengers
Subject 3: Report on security
Subject 4: Report on performance of the train service
Subject 5: Report on the BMCL Company

Part 2 - Report on maintenance

Subject 1: Report on reliability of the MRT system
Subject 2: Report on maintenance plans

Building and Permanent Way Maintenance – This section is mainly responsible for maintenance of park & ride facility. The staff in this section has to monitor CMMS (Computerize Maintenance Monitoring System) which BMCL's sub-contractors insert the data in when they perform their maintenance tasks. It shows the activities that sub-contractors have been done which is easy to monitor and follow up the progresses. BMCL and MRTA are used to have a meeting with contractor twice a month discussing the problems (every field:

civil, mechanical. etc) and then find the best solutions together (It has been canceled since last December).

Maintenance Standard and Technique - This section was set up 2 years ago to be technical supporting section. The staff in this section is always a consultant and gives some advice to other maintenance sections when they face some difficult technical problems. MRTA staff is responsible for making a report for both E&M (building service and facilities) and M&E (Mechanical & Electrical: signaling, rolling stock, etc) and measuring BMCL's KPI (Key Performance Index). However, this is different of what has been indicated in Job Descriptions made for this position two years ago.

Some other observations on MRTA maintenance activities are indicated below:

Access to System - Monitoring some systems such as in SOR or workshop requires permission from BMCL first. (Without a permission, MRTA staff can only walk around but cannot cross a yellow line.) But if MRTA staff wants to go further (inside the equipment area) or wants people from MRTA to operate or test the equipments, it is necessary to ask BMCL an agreement or permission.

Authority to Issue Approval – Several MRTA staff suggested that MRTA should have a right to approve or reject. (Now MRTA can do nothing with BMCL decision.) To do so, the policy has to be approved by the cabinet or the high level. (The provision of direct approval is made in draft tender document of purple line at present)

Manual Standard - BMCL sent the copy of manual standard to MRTA, MRTA check only the result after those equipments had been already repaired. Although MRTA is allowed to monitor during the maintenance process, this cannot happens as MRTA has no night shift personnel. MRTA could report, in writing, any activity in Maintenance or Operation if it is not according to standards, however, that case has not occurred yet.

Monitoring Tool - MRTA has the responsibility to monitor Maintenance of M&E system, using SAP program and on-site audit. Some MRTA commented that the operating this SAP program is a difficult task.

4.3.4 Technology Transfer Programs

Technology capabilities encompass various abilities from project planning to learning day-to-day operation and maintenance. Technology transfer is always undertaken in any mass transit projects in Thailand in order to enhance the local technology capabilities.

The Team reviewed technology transfer programs mandated in the contract agreement between MRTA and BMCL with an assessment of the program contents and an evaluation of the achievements and effectiveness of the programs.

(1) Training Course

In 2003, MRTA assigned Operation Department staff to learn and receive technology transfer for the operation and maintenance of existing Blue Line System by attending the training programs provided by BMCL/Supplier. The course and number of participants from MRTA are summarized below:

Table 4.17 – Courses of Technology Transfer

Course (Attendees)	Subjects Learnt
Station Controller (2 staff)	The course covers the duties of station controller including: • Supervises the entrances, concourse areas and platforms, including staircases, elevators & escalators and ticket barriers • Supervises passenger flows • Opens and closes the station • Supervises the staff employed at the station to provide courtesy and prompt service to the public • Carries out booking-on and booking-off of station staff • Prevents unauthorised stay on station premises • Inspects the station at specified intervals and checks that the platforms, passages, stairs, elevators and escalators are not obstructed • Checks station facilities that they are in working order • Observes the monitors, fire alarms and other equipment status panels in the Station Operations Room & at certain defined places • Informs the Engineering Controller about malfunctions of equipment • Supervises the dissemination of operating information to station staff • Informs the Line Controllers of any occurrences which may have an influence on the operating situation • Provides access for maintenance staff according to pre-defined schedules • Ensures the public are kept advised by the use of announcements • Responds appropriately to alarms (from both the public, staff and equipment) • Informs passengers about relevant changes of operation at the particular station (e.g. change of platform) • Responds to incidents and emergencies in stations and train disruptions • Acts as Incident Manager as required • Other duties as required
Train Operator (2 staff)	The course covers the duties of train controller including: • Is responsible for the safety of trains and the safe operation of the train • Preparing trains for service by carrying out specified checks

Course (Attendees)	Subjects Learnt
	• Follows operations procedures if trains leaving service • Carries out instructions of the Line & Depot Controller • Decides when trains are ready to depart safely from platforms • Supervises the train runs in ATO-mode and drives trains in other modes of operation, if ordered to do so • Stables trains in the stabling area of the Depot and other stabling locations • Shunts trains, the Maintenance Working Vehicle and the shunting locomotive in the depot area and on the line, if required • Drives trains in Wash Mode through the Washing Plant • Hands over trains at the handing over point • Informs the Line & Depot Controllers of any occurrences which may have an influence on the operating situation • Reports faults to the Line & Depot Controller and rectifies minor faults, where applicable • Other duties as required
Line controller (2 staff)	The course covers the duties of line controller including: • Supervises and controls Operations on the line in order to maintain the timetable and ensure the safety of train runs • Informs the Chief Controller of any operating conditions deviating from regular Operations • Acts according to Rules and Procedures in case of irregularities and incidents • Executes instructions of the Chief Controller • Communicates with the Train Operators on the line or in the Depot deemed necessary for safe train runs and with Train Crew Controllers for crew redeployment • Reports failures to the Engineering Controller • Liases with the Station Controllers in case of irregularities and incidents • Liases with the Station Controllers in case of malfunctions of any station equipment • Liases with the Train Crew Controllers • Supervises and controls all movements to, from and within the Depot Area in order to support the scheduled services and to ensure safety of Operations • Maintains the stabling order in the Depot area • Monitors train runs through the Washing Plant • Makes announcements to stations in case of irregularities or incidents • Handling Track Possessions • Other duties as required

Course (Attendees)	Subjects Learnt
Engineering Controller (1 staff)	The course covers the duties of engineering controller including: • Centrally Monitors the equipment and in case of failure conveys failure reports and respective requests for unscheduled maintenance to the Maintenance Management Centre. • Controls the power supply system and the tunnel ventilation system and monitors other technical systems via SCADA in the CCR. • Coordinates for actual maintenance tasks the interface between Operations and Maintenance. • Co-operates with the MEA (Electricity Authority) • Monitors the fault reporting system • Liases with Operations, Maintenance and other engineering services requiring shunting locomotive or Maintenance Work Vehicle, track possessions, temporary isolation of line sections and equipment • Mobilises the technical emergency team in case of a major incident • Works as Maintenance Controller according to the shift plan • Other duties as required
Signaling Technology Transfers (1 staff)	For Signaling Technology Transfers, a MRTA staff was sent to train with BMCL staff in the topic of Railway electrical system and Signaling in Germany, where he attended lectures for about 1 month to build knowledge on the Railway signaling technology. Also, he was trained for 3 months at Japan sent by MRTA with JICA funding.

Source: Based on Interview with training attendees and human resource department

(2) Training Flow

Firstly, BMCL sent representatives (in the positions called KI, Key Instructor) to train with the Suppliers. KI staff were expected to be good instructors who have a good understanding of what they learned and be able to teach other staff. After KI staff had already acquired sufficient knowledge form suppliers, they consequently transferred the knowledge to other BMCL staff as well as MRTA staff without any assistance from suppliers.

The following figure shows that BMCL's training schedule has two steps. Level of these two trainings seems to be different from the fact that the first training from the Suppliers to BMCL was composed of scheduled programs for only KI and provided by foreign suppliers, while the second was for other BMCL staff as well as MRTA's staff provided by KI immediately after they finished their course.

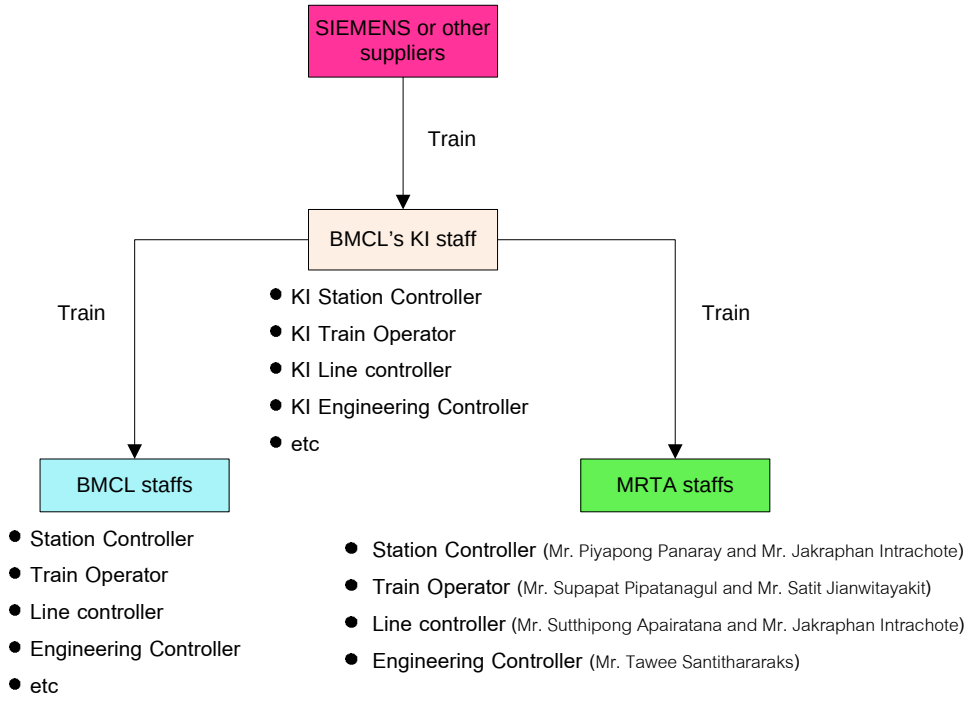


Figure 4.2 – Training Structure of Blue Line ISP

(3) Training Modules

Materials of technology transfer programs obtained from MRTA are organized in a manner shown below, and made available in Appendix 4-5 of this report.

Information made available regarding technology transfer programs of Blue Line ISP
1.1 Date of training program
1.2 Subject of the training course or agenda (training module)
1.3 Trainer designation (the one who was trainer)
1.4 Name and position of trainees/attendees
1.5 General observations on the effectiveness of the course or the objective for each training courses
1.6 Availability of the training materials/handouts in MRTA
1.7 Details for each file and handout.

Some observations on the above technology transfer programs are shown below:

- Training programs and their materials are well organized in general. However, these programs were basically designed for BMCL staff to learn the minimal basics in order to perform day-to-day operation and maintenance (though note that, for the maintenance, large degree of initiatives are taken by the supplier). It may be effective enough for BMCL staff as they can deepen their understandings through the actual experiences of practice and getting their hands dirty on daily activities. On the contrary, MRTA have no

direct access to the system under the concession contract, so they had no chance to combine the theory they leant with practice. The problem is laid on the activities after the training, but not really much on the contents of the program.

- According to the terms and conditions of the Concession Agreement of Blue Line ISP, BMCL only informs MRTA when technology transfer shall be done and what the topic is. (Several MRTA staff even claimed that BMCL did not tell MRTA the exact dates to hold trainings, making them difficult or even unable to arrange their time for attendance). MRTA has no control and cannot request changes. If MRTA does not accept, they will miss that opportunity and there shall be no penalty against BMCL.
- In this connection, provisions is to be made in the tender documents of Purple Line Project. MRTA intends to include a clause where the Concessionaire is mandated to get prior approval from MRTA regarding the training agenda, schedule, and attendees. This means the Employer has control and not the Concessionaire. This new clause also states how transfer technology events ought to be delivered by the Concessionaire to the Employers staff. Details of the provisions made in the draft tender documents will be further studied subsequently, once MRTA is ready for discussion.
- Some documents collected from MRTA contain missing information. The training materials may have been prepared whether by the Supplier staff or improved or adapted by BMCL staff. The process of preparing the training materials should be interviewed further.

4.3.5 Preliminary Capacity Review and Assessment

For the purpose to preliminarily review and assess the internal technology capabilities, the Team conducted a series of interviews with all of the technical staff in MRTA, both in E&M Department and O&M Department. Summary of findings is presented below:

(1) Understanding of Scope of Works

Although the Division Directors and Section Chiefs seem to have a clear understanding of the roles and scope of the work of their respective section, it appears that for their subordinates, the scope of work is not very clear. Throughout the interviews, many times confusing or incomplete descriptions were given. Sometimes roles were overlapped with other sections.

It is even less clear what would be the possible roles of each section in the future under different contract schemes. It is unknown the reason why such lack of understanding, but there are several factors that might converge to create this situation:

- New created sections with unclear role or overlapping roles
- New assignment for certain engineers or managers due to high rotation of assignments within MRTA
- Lack of guidance from manager to engineer. Specific job assignments without understanding of overall scope of works

It is desirable to improve the knowledge of the staff regarding, not only his personal role, but the entire section's role, division's, and department's in order to have a clear understanding of the work to be done in the present and also in the future.

(2) Understanding of Contractual Obligations with Concessionaire

In view of the variety of replies regarding what and how to monitor the activities of the concessionaire, and what and how MRTA should carry out business in the future, it became clear that there is not a full understanding of the contractual obligations of each party in the Concession Agreement.

It is understandable that some capable engineers would like to do certain activities that are out of limits for them now, but such activities are under the responsibility of the concessionaire, and they will be, even under different type of concession agreement. The reasons behind such contractual clauses, if necessary, should be explained to concerned personnel in MRTA.

(3) Current Capabilities

Based on the interviews carried out on the personnel of MRTA in charge of Operation Department, it was observed that majority of them carry out their current job in a proper and professional manner. When asked if they could perform the job of their counterparts in BMCL, they all agree that they are capable of doing such work. However, most of them wish to have technical capability to perform the work of employees or managers of the maintenance contractor (Siemens).

Taking into consideration that for the short or medium term, the objectives of MRTA is to supervise future operators and maintenance contractor, it can be concluded that the current capability, if not being already appropriate for some staff, it requires some training in specific areas to enhance managerial and technical capabilities.

It must be mentioned that the number of staff should be increased, especially for the MRT System Maintenance Section, which currently has only 2 persons. At least one knowledgeable engineer per each subsystem is required, plus section head.

(4) Way Forward

Although this report does not have the intention to evaluate the psychological reasons behind some of the responses to this questionnaire, it could be said that a great level of frustration among MRTA O&M Department staff is present towards the concessionaire, in the sense that the staff feel being underestimated on their capabilities, and left outside the management of a system (the railway line) which their consider to be rightful owners. This frustration leads to request and propose, by the MRTA staff, certain contractual schemes and particular functions that are incompatible with a gross-cost scheme.

As mentioned before, seminars in which the legal and contractual conditions of present and future concessions must be carried out to concerned staff of MRTA for better understanding. Further, proper training planning shall be proposed and carried out as part of the roadmap to enhance the capability of MRTA as owner and supervisory agency of railway policies and practices.

4.4 Lessons Learned and Recommendations for Coming MRTA Projects

- The new Purple Line project has been prepared under the so-called “Gross cost concession scheme” where MRTA will directly collect passenger fare whereas the concessionaire will stay an operator receiving technical fee for the operations. MRTA will be more responsible for the railway operations but its role still stays as “supervision, monitoring and control” of the concessionaire. MRTA still stay “indirectly” responsible for the railway operations.
- Although the Division Directors and Section Chiefs seem to have a clear understanding of the roles and scope of the work of their respective section, it appears that for their subordinates, the scope of work is not very clear. It is even less clear what would be the possible roles of each section in the future under different contract schemes.
- In view of the variety of replies regarding what and how to monitor the activities of the concessionaire, and what and how MRTA should carry out business in the future, it became clear that there is not a full understanding of the contractual obligations of each party in the Concession Agreement.
- It is understandable that some capable engineers would like to do certain activities that are out of limits for them now, but such activities are under the responsibility of the concessionaire, and they will be, even under different type of concession agreement. The

reasons behind such contractual clauses, if necessary, should be explained to concerned personnel in MRTA.

- In this connection, the Team prepared a list of tasks each party has to be responsible for the service operation and maintenance. This is the key to which tasks an individual party can access, review, handle and ultimately how a task is routed and approved. Therefore, result of this exercise is useful to capture the input for MRTA's capacity building.

It becomes clear that, learning from Blue Line ISP, several provisions are being made in the draft tender documents of Purple Line Project. Comments from the consultant involved in the tender documentation are presented below:

- Robust monitoring and reporting systems directly between the actual operating systems to the MRTA are essential in monitoring & controlling the Concessionaire and should form part of the Scope of the Works of the Concessionaire to provide such systems.
- Approval of the Concessionaires Training programme is essential to ensure MRTA's needs are addressed and not just what the Concessionaire considers MRTA needs.
- Approval of the Concessionaires Technology Transfer programme is essential to ensure MRTA's needs are addressed and not just what the Concessionaire considers MRTA needs.
- Positions for MRTA in the Maintenance Management Center should be allocated to allow MTRA direct access to the management and day to day operations of the center similar to "on the job" training.
- A central MRTA Training School may be advisable as MRTA begins to grow with dedicated and well trained instructors for both operations and maintenance works. Systems training can be centralized as the principles of most systems are consistent and only the actual hardware and software may differ between different systems. A central training center can ensure the MRTA message and priorities of its staff are given in a consistent way to all managers and staff.
- It must be mentioned that the number of staff should be increased, especially for the MRT System Maintenance Section, which currently has only 2 persons. At least one knowledgeable engineer per each subsystem is required, plus section head.

CHAPTER 5 IMPLICATIONS FOR FUTURE DIRECTIONS AND ROADMAP FOR TECHNICAL CAPACITY BUILDING

This chapter offers further insights on future prospects of MRTA organization and capacity building needs and concerns coming from the previous chapters and beyond. With a comprehensive review on the nature of railway business and development process, this chapter aims to highlight the particularity of the MRTA case and clear the way for sound development of the organization, including the closer focus on non-technical issues.

5.1 Railway Business, Organization & Operations Development

- ***Urban / Suburban Railway Business Historical Development having both Public and Private Good Nature***

5.1.1 Business Development

(1) Railway Business Integrated Development

The railway system, in general, since its initial stage of the industry in the 19th century , has been developed firstly from the "railway core operations" by accumulating knowhow with its strong expertise on the railway planning, construction and engineering as well as the operational supervision, evaluation, management and control activities, then in recent years dealing with travel comfort and pleasure, safety and security, environment, and further, particularly after 1980s onto the IT based ticketing, fare collection and settlement system serving also as a managerial information tool. This can be illustrated as the **vertical and horizontal integration** process of a railway system.

(2) Railway Business Streamlining

The railway industry around the world, particularly since 1950s from USA, has been re-organizing or re-shaping its system to introduce a more effective operations and a clear responsibilities among different types of operations. This could be characterized as its **streamlining, outsourcing or contracting out** process.

Some services such as the rolling stock and track maintenance in engineering fields, station ticketing, security, clean-up services on station management, and IT system development on some applicable operations are outsourced. When implementing, holding company structure options have been applied when a railway has a few lines and/or its business with a wide range of activities or de facto merger in seeking better efficiency by introducing common planning and strategy, public relation services, and workforce, parts and tool supply in operations and maintenance, etc.

(3) Main Businesses to be Kept

Those vertical and horizontal streamlining efforts are considered as a way to make clear the responsibilities of each activity and at the same time to aim more effective operations. One should note as the key feature in those cases that the railway companies always keep their main operations under their direct control and thus they maintain their institutional capacity within the organization. Railway engineering on rolling stock and equipment, signaling and train operations are evidently considered as the main businesses. Furthermore, public transport industries, such as air and shipping transportation industries where companies operate in a very competitive market, they have been also introducing some of the activities to dedicated service companies. Some popular cases are found in airplane cabin or vessel crew on board, security staff, IT development staff is dispatched to those companies under the outsourcing contracts.

5.1.2 Public and Private Good Nature of Railway Business

- Global Trend towards Public-Private-Partnership Approaches

(1) Renewed Role of Railway Systems

Following the large-scale construction of motorways and airline network after WWII in US, Europe and Japan, railway transport became less popular and replaced with air and road transport started taking large market shares from mid- and long-haul passenger trains. As for the short distance urban and suburban passenger trains as well as the urban tramways have kept its importance as a strong transport mean providing mass rapid transport services as well as easing urban traffic congestions, and further in coping with the global warming. With the 1964 introduction of the Shinkansen in Japan, trains could again have a dominant position on intercity travel. During the 1970s, the introduction of automated rapid transit systems allowed cheaper operation and as a result, many light rail projects, some of which have been upgraded from the tramway systems were developed around the world. In particular, the mass rapid transit system has been quite effective in Asia.

(2) Asian City Development and Railway

Many large cities in Asia, with their strong economic development since 1980s, have been steadily growing its population and expanding its sphere, put importance on their regional economic development with strong importance put on its urban and suburban transport system. In fact, this regional development history and the contribution of urban / suburban railway system in Japan can be considered as the best practice case possibly applicable to those Asian cities including Bangkok.

Both mid- and long-haul transport like the cases of high-speed trains like Shinkansen and short- and urban and suburban transport such as mass rapid transit or tramways play an important role not only providing mean of public transport but also contributing to national and regional developments.

(3) Public-Private Partnership Concept

Most of those developments have been, in the past, solely by the public sector initiatives. However, the more pressure on the national and regional governments on the social development public expenditure, like education, heath care or environment, and also for infrastructural development needs, in recent years, have given more budgetary pressure and constraints on the economic and infrastructure development.

(4) PPP Project Development

That is where, in recent year, the Public-Private Partnership ("PPP") policy framework has been promoted in many countries. This PPP approach was initially developed to reduce the public debt burden and to provide more opportunities for private sectors. The original PPP scheme has been developed as a new financial scheme to reduce with the financial dependence on the government whereas the private sector is expected to bring new funding availability based on the future cash flow arranged, quite often, in the form of project finance or cash flow based finance on the basis of economic and financial viability of the projects envisaged. In case of the traditional public sector activities such as telecommunication, airline, motorway, and air and sea port development, PPP projects have been relatively easy to confirm and forecast feasible options due mainly to the nature of their public and private sector using those systems

(5) Public Transport Sector PPP

The public transport, passenger traffic in particular, has been considered rather not viable due mainly to the strong public good nature of its business and thus the passenger fare quite often is kept low. To overcome this difficult policy challenge, several governments have been introducing a wider concept of PPP approaches to the public transport sector. If one considers the urban / suburban railway system, the revenue flow from the core railway passenger fare is rather limited or kept low under the public transport policy, and thus it is quite difficult to achieve a good sustainable viability only from core railway business. As associated railway business opportunities, a number of initiatives have already taken such as parking facilities offered as a part of "Park-and-Ride" system, advertisement promotion with trains and stations, and further, in-station retail shop renting, but the contribution to the revenue has been marginal or limited in most of the case.

(6) Japanese Model of PPP

Urban / suburban railway system, however, has been given role to contribute to the regional development. Along with the economic and social expansion plans, railway system could engage and collaborate with the urban, suburban and regional developments. This case is well applied to Japanese private railway companies as well as Hong Kong and Singapore mass rapid transit systems. In the case of Japanese companies, they made investments prior to the railway plans to coordinate well the local governments, property developers for business, commercial and residential developments, educational and leisure planners. The private railways even sometime developed by themselves in creating those future demands. The case of Japanese private sector railways will be discussed later in this chapter.

5.2 Possible type of Legal and Contractual Arrangements

5.2.1 Reverse Order Development and Beyond

As reviewed in Chapter 4 MRTA Organization, MRTA has developed its projects and organization since its establishment in “Reverse Order” manner. MRTA, under the legal framework, is given full authority, but the first operating Blue Line has been managed under the Net Cost Concession Scheme” leaving the difficulties to MRTA to supervise and control with a “remote” and “indirect” manners with relatively unsuccessful ridership and revenue results.

With the substantial policy change, MRTA moves to “Gross Cost Concession Scheme” for the planned Blue Line extension and Purple Line projects. This is a big step for MRTA to get closer to “Direct Operations” but MRTA will still struggle without having a direct touch.

In the longer-term, MRTA management stressed their strong wish, as long as the environment permits, to operate under the direct ownership in one or more of their future lines. After reaching that end, it will be easily move further to exercise different contractual, outsourcing and other options.

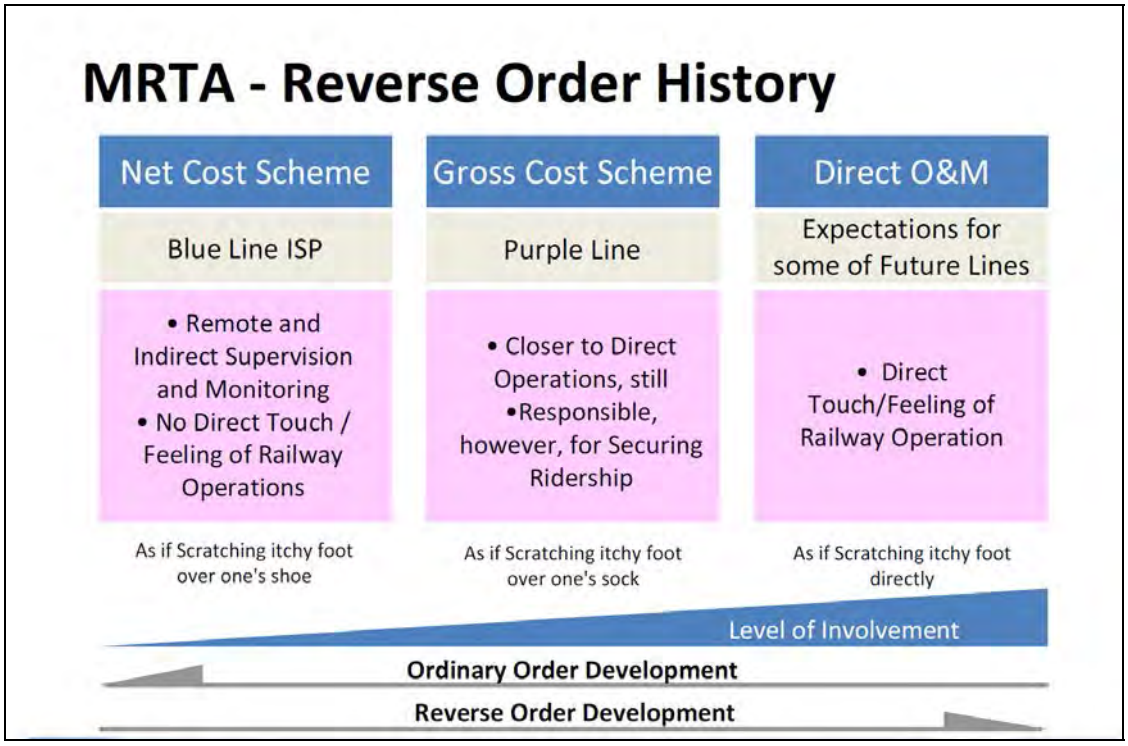


Figure 5.1 – Reverse Order History of MRTA

5.2.2 Possible Type of Contracts

Given the above future operation modality, possible type of contracts would be,

Possible Type of Contracts

i) Operation and Maintenance Concession under PPP Net Cost Scheme,
ii) Operation and Maintenance Concession under PPP Gross Cost Scheme,
iii) Direct Operation and Contracting Maintenance,
iv) Direct Operation and Direct Maintenance, and
v) Direct Operation and New Manner of Contracting / Outsourcing,

(See also Table 4.1 – Type of Contract)

Any key decisions on type of contracts require mutual consensus building among stakeholders and shall be endorsed by the Cabinet. Especially when a non-concession scheme, i.e. iii), iv), or v) of above, is intended for some future lines, broad based debate as a first step shall be organized among key stakeholders including MOT, NESDB, SEPO and others.

5.3 Global Trend of MRT Services

- Seeking both Public Transport Objectives and Business Viabilities

5.3.1 Global Trend Review

(1) Revenue Enhancement

Before proposing future direction of MRTA, it would be worthwhile reviewing the global trend of the mass rapid transit services particularly focusing on the PPP approaches taken. PPP scheme was originally developed to reduce the government budgetary burden by seeking private sector engagement and investment where the public sector mainly intervenes with its policy support and enabling legal environment. More concrete cases is discussed later in this Chapter.

In case of the urban / suburban railway systems, in addition to the budge burden, it is further given tough and challenging objectives such as the safety, security, comfort and punctuality for travel, under the passenger fare scheme that has been kept rather low due to its public transport nature. Under this challenging and conflicting objectives, railway companies have been asked to achieve each target. One can note some of the railway systems around the world have been making remarkable challenges and achievement although the outcomes are rather mixed.

Some of the world trend and features are as follows.

Core Business Revenue Enhancement Measures

One of the common measures adopted by a number of Special Tickets such as,

- Weekly / Monthly pass with discount,
- Train fare and Park & Ride combined tickets/passes,
- Off-Peak time discount tickets/passes and Peak time with fare premium ticket/pass,
- Off-Peak tickets/passes tied up with suburban commercial properties
- Family passes for parents and children,
- Elderly and Handicapped people, passes with discount,
- Tourist pass for one day to one week with some discount,
- Tourist tickets with luggage carry services,
- Tourist pass tying up with commercial retail shops with some discount coupons,
- Special tickets with premium (e.g. New Year, National Day etc.)

In some cases where **Special Train Services** are offered

- Express / rapid service trains,

- Trains with special classes (e.g. the first class services),
- Trains with reserved seat services,
- Special shopping car in a train with valet services from/to shopping centers and home station car parks
- Special car in a train reserved for elderly / children / women,
- Accompanying services for the handicapped passengers
- Mid-night trains (weekdays, special days – New Year's eve, New Year day etc.)

Associated Business Opportunities to Generate Additional Revenue

In addition to the Core Operations, several Associated Business Opportunities derived directly from the Core Railway Operations. Some examples are;

- Park & Ride System
- Station Direct Access Right Sale with Business, Commercial and/or Residential Properties
- Business, Commercial and/or Residential Property development above the stations and the depots
- Advertisement in the train / wrapping around the trains
- Advertisement in the train station concourses
- In-Station retail shops, Bank ATMs
- Wireless LAN Services on the train and stations
- Railway / Train museums and galleries

(2) Railway Company Streamlining Efforts

Streamlining efforts continue in many companies. Core operations (i.e. activities related to pure transportation service) are under their direct management but part of operations and maintenance activities could be the first line to be outsourced for the railway companies that started as "direct operators". That may include engineering activities such as track maintenance, rolling stock repair and maintenance, electricity management, operational activities such as station and security management, and further in administration activities as well. (One shall note that these railway companies, on the other hand, had to make intensive efforts to impede loss of institutional memory as an engineering expertise.)

(3) Public-Private Partnership Approach Continues on Regional Development

Governmental budget pressure still continues, but different manner of PPP scheme approaches have been actively taken. The most popular cases can be found in the case of urban, suburban and regional development particularly its collaboration with local or regional governments as well as coordination with line ministries other than Ministry of Transport.

Collaboration with External Stakeholders

As for the regional development, the expected counterparts and partners are not only limited to the public sector.

- **Business and commercial, property development companies** often engaged in regional development. For example, suburban business and commercial developments will contribute the reverse traffic. Most of the commuters during the weekdays will move from the city center residential areas to those suburban business and commercial developments. For a railway company it is essential to be a part of those developments from their conceptual planning stage.
- **Local Facilities of Central Administrations** such as public healthcare and pension administration, tax authorities quite often hire a large number of officials. With a view to reduce their budgetary burden of the office rent, or being asked by the Ministry of Finance to mobile their asset value, those labor intensive administration occupying large space in the central part of the capital often are asked to move to suburban areas.
- **Residential property developers** are natural counterparts for future plan implementations together with local / regional governments as well as business and commercial property developers.
- **Sport, leisure and event planners** presenting entertainment activities may generate spot demands. Sport events organized in stadiums such as football, baseball, boxing, tennis, and other cultural facilities of music concerts, ballet, dance, drama and other theatre performances, graduation ceremonies etc offer good opportunities to run special trains and generating additional revenues.
- **Universities and other Educational Facilities, and Hospitals** have been offering good traffic equalizing impact. Universities, schools and other educational facilities located in suburban areas bring a high level of reverse traffic during the weekday. Both public and private university and hospital management as well as central education and health ministries are the counterparts.
- **Hotel Owners, Operators and Reservation Chain Service Companies** play also important roles to offer accommodation mainly for business, commercial users of the railway. They also facilitate tourists, leisure and cultural facility users. Wherever they are located in the central part of the cities or in suburban areas, hotels produce certain amount of passenger traffic.

- **Air Terminal and Long-haul Train and Bus Operators and Terminal Operators** provide also regular passenger traffic to/from the terminals with the town center. Passengers often make their journey with no luggage in hand after handing over their luggage at the terminal to be carried by a third-party luggage transport company to their home or hotel and vice versa.
- **Local Business Communities** are often supporting the developing new communities alongside the new line development. Small shop owners help business, commercial, residential and/or educational commuters their daily needs by providing daily meals, newspapers and others.
- **Feeder Traffic Operators** such as bus operators, taxi companies and other transport mean providers are indispensable in providing additional transport means from/to railway stations.

From a Pure Railway Operator to Regional Transport Facilitator

Railway companies naturally consider themselves as passenger or freight traffic specialist. The view and expectation of the general public have been changing. Business, commercial, educational and residential passengers expect railway companies to assume more important responsibilities as the transport facilitator and coordinator by developing collaboration with hose stakeholders above.

(4) Non-Railway Business Investor and Operator Role

In some cases, railway companies sometimes are engaged in Non-Rail Businesses. Most of the business opportunities stated above in the External Stakeholders could be, under this environment, planned and operated as railway company activities, Non Rail activities such as business, commercial and residential developments, particularly in the case of Japan, have been helping viability of the private sector railway companies. In case of both Singapore and Japan, the feeder traffic such as buses and taxis are operated under the same holding structure by the dedicated business groups. Those non-rail businesses contribute to increase business returns and in some cases the return out of non-rail businesses have impacted to reduce the passenger fare.

5.3.2 Mixed Results around the World

(1) United States

New York Subway System, Metropolitan Transport Authority (“MTA”), is a rapid transit system owned by the City of New York and leased to the New York City Transit Authority, a subsidiary agency of the Metropolitan Transportation Authority. It is one of the oldest and most extensive public transportation systems in the world, with 468 stations in operation

369km of routes, translating into 1,056 km of revenue track operating 24/24 hours. In 2009, the subway had over 1.58 billion rides, averaging over five million on weekdays.

The operational services have been improving since 1970s from its worst by introducing new stainless steel based rolling stock and also the Smart Card system. In 2005, the New York Subway System hit a 50-year record with ridership of 1.45 billion to till the USA hit with the Lehman shock in September 2008. MTA has been continuously facing with the ridership constraint.

(2) France

The Régie Autonome des Transports Parisiens ("RATP") is the major transit operator responsible for public transportation in Paris and its surroundings. It is under the authority of the Syndicat des transports d'Île-de-France (STIF), the Paris region transit authority. Its operational divisions include the Paris Métro system, part of the RER, a full network of the bus system, and three tram lines around the circular roads in the city.

The Paris Métro is the rapid transit metro system in Paris. station architecture, influenced by Art Nouveau. It has 16 lines, mostly underground, and a total length of 214 km served with 300 stations. The first line opened in 1900 during the Paris Expo. The system expanded quickly until WWI and the core was completed by the 1920s. Extensions into suburbs were built in the 1930s. The network reached saturation after WWII. The Paris Métro then introduced newer trains to allow higher traffic. Further improvements are limited by the design of the network, such as short distances between stations.

The solution was a second network, the RER commuter rail, developed from the 1960s. Paris is the second busiest metro system in Europe. It carries 4.5 million passengers a day, and an annual total of 1.5 billion (2009). Paris Metro continues its effort to expand its network with its newly opened Lin4 14 as well as RER Lingne E, both further target suburban area commuters.

(3) Singapore

Singapore Mass Rapid Transit ("SMART"), is one of the highly performing rapid transit systems. SMRT Corporation is a publicly listed transport operator incorporated on March 2000 to form multi-modal public-transport operators in Singapore. It is the second-largest public-transport company in Singapore. It operates MRT, bus, taxi and other public-transport services through wholly-owned subsidiaries. SMRT Trains Limited is a rail operator and a fully-owned subsidiary of SMRT operating three lines with 107.2km of the length. It was originally incorporated on August 1987. SMRT started services on Singapore's first MRT section. SMRT currently manages MRT services on most of MRT lines.

SMRT's financial record shows a strong performance not only on their MRT operations but also from its commercial property rental revenue as well as advertising activities. The rental revenue, in fact, represents 22.8% of the total operating profit in 2008 where its sales represent only 6.6%.

Table 5.1 – Financial Record of Singapore Mass Rapid Transit

SMRT	FY2008			
	Rev		Ope Prf	
	Sin$ m	%	Sin$ m	%
MRT	474.0	53.9	134.0	70.9
LRT	9.0	1.0	0.0	0.0
Bus	207.0	23.5	(5.0)	(2.6)
Taxi	72.0	8.2	(6.0)	(3.2)
Rental	58.0	6.6	43.0	22.8
Advertising	23.0	2.6	14.0	7.4
Total	**879.0**	**100.0**	**189.0**	**100.0**

(4) India

The Delhi Metro is a rapid transit system serving the National Capital Region of India. The network consists of five lines with a total length of 125.7km. The metro has 107 stations of which 17 are underground. It has a combination of elevated, at-grade and under- ground lines and uses both broad gauge and standard gauge rolling stock. Delhi Metro is being built and operated by the Delhi Metro Rail Corporation Limited ("DMRC"). As of April 2010, DMRC operates more than 100 trains daily with a frequency of 3 to 4.5 minutes. The metro has an average daily ridership of over a million, and has carried over a billion commuters in seven years since its inception.

The Delhi Metro is being built in phases. Phase I completed 65.1km, of which 13.0km is underground and 52.1km surface or elevated. The inauguration of the part of the Blue Line marked the completion of Phase I on October 2006. Phase II of the network comprises 128 km with 79 stations with the first section opened in June 2008 and a target completion in 2010. Phases III (112 km) and Phase IV (108.5 km) are planned to be completed by 2015 and 2021 respectively, with the network spanning 413km. Based on those new line construction, DMRC has begun its new initiatives in offering its engineering know-how to other Indian cities.

5.4 Best Practices and Lessons Learned from Japan's Private Railway Companies

5.4.1 Overall View – Private Railway Companies

In Japan, there are 16 large private railway companies[1] operating Japan's three major cities, Tokyo, Nagoya and Osaka. Since its beginning of their history, most of them have been operating as urban, suburban and regional train operators since the beginning of 20th century. All 16 companies represent about 10% of total passenger ridership in Japan and thus play an important role.

Historically those private sector railway companies started their operations in line with the industrialization of the country that had begun since the later part of 19th century. This trend was accelerated since, in particular, the Kanto earthquake that took place in 1923 that killed over hundred thousand people in Tokyo and also damaged over 60% of houses in Tokyo Metropolitan area. After the earthquake, new residential areas were developed with the initiatives of those private sector railway companies. Most of them were engaged in the residential property development first, then moved onto commercial properties, leisure facilities, and in recent years in business property developments.

Table 5.2 – Financial Record of Japanese Private Sector Railways

Japanese Private Sector Railways	as at FY2008 (March 2009)										
	Group					Railway Operations					
	Sales	Assets	Grp Co	Biz Profit	% to Total	Rail way	Sta	Rolling Stocks	Psgrs	No Psnl	Ave Age
	JPYbn	JPY bn	no	JPYbn	%	Km	no	no	mio	no	yrs
Tobu	602	1,404	94	160	73	463	203	2,012	878	4,340	42.8
Seibu	607	1,586	80	103	61	177	92	1,282	629	3,145	40.0
Keio	420	692	36	84	80	85	69	874	637	2,033	39.6
Odakyu	555	1,310	46	117	74	121	70	1,102	717	2,876	39.1
Tokyu	1,304	2,011	168	148	56	103	98	1,163	1,065	2,531	36.1
Tokyo Metro	381	1,266	12	337	97	195	179	2,665	2,322	7,883	n.a.
Kinki	968	1,861	50	165	59	508	294	1,938	594	7,716	42.2
Hankyu	684	2,307	98	102	59	147	91	1,311	619	1,393	42.4
Total (16)	**7,799**	**17,613**	**-**	**1,634**	**-**	**2,868**	**1,842**	**17,288**	**9,548**	**46,553**	**-**

[1] Japan Railway ("JR") companies are legally classified as private but since they are still special private sector entities and the line net work are serving both long-haul to urban / suburban lines, they are not usually classified as private sector companies.

5.4.2 Japanese Private Railway Companies

Japanese private railway companies above have its unique but sustainable development they have achieved till now. The following is to introduce some representative companies introducing their features with particular attention on their railway business and non-rail business development.[2]

(1) Tobu Railway

Tobu has the largest line network in Tokyo area with its extensive network of 463km in the northern part of the Kanto plain where Tokyo is located in the southern end. It originally started with freight operator bringing rice, lumber, cement and silk from the north down to Tokyo. Having Nikko, one of the most popular interests, Tobu participated in the tourism development around the area by investing into hotels and also served the passengers with the special express services. After WWII, Tobu benefited the rapid residential development and thus engaged in not only residential development but retail businesses through department stores and supermarkets.

Tobu – Heritage and Zoo & Playland

Nikko is a well known touristic place for both Japanese and foreign visitors. Nikko has a word heritage Toshogu shrine and other historical attractions as well as Chuzenjiko Lake is another key feature to visit Nikko. In recent years Tobu has well managed to have a special express operation to run from Shinjuku, one of the central terminals in Tokyo and Nikko in collaboration with JR East to gear up their core railway businesses.

Prior to that, along with the rapid expansion of Tokyo Metropolitan area, Tobu constructed and opened a zoo in the northern suburbs of Tokyo. Tobu also set up Kids' Park, an Amusement Park and Natural Forest Park nearby. Those set of attractions worked successfully to increase their weekend traffic.

Nikko Heritage

Zoo and Playland

[2] For more information, visit following weblinks;

(1) Tobu Railway	http://www.tobu.co.jp/foreign/tobulineguide/index.html
(2) Seibu Railway	http://www.seibu-group.co.jp/railways/tourist/english/index.html
(3) Keio Railway	http://www.keio.co.jp/english/index.html
(4) Odakyu Railway	http://www.odakyu.jp/english/
(5) Tokyu Railway	http://www.tokyu.co.jp/global/index.html
(6) Tokyo Metro	http://www.tokyometro.jp/global/en/
(7) Kinki Railway	http://www.kintetsu.co.jp/foreign/english/index.html
(8) Hankyu Railway	http://rail.hankyu.co.jp/en/

(2) Seibu Railway

Seibu has its network spreading north-west of Tokyo with its aggressive development in promoting leisure facilities such as two theme parks, cycle racing course, but also successfully inviting several university campuses along side of the line. The Seibu group aggressively developed their businesses in resort development not only in Tokyo but throughout Japan, as well as retail chain including department stores, supermarkets and convenience stores. It further developed their businesses on the electronic event ticketing services through their convenience store chains. These non-rail business investments are resulted in the low contribution of the railway business profit registering only 61%.

(3) Keio Railway

Keio is a relatively small among its peer railway companies with shorter length of railways and carrying less number of passengers having its network in the western part of Tokyo. The company has made a big jump in its railway and non-railway business in connection with the Tokyo Tama New Town project started in 1960s, known as the biggest regional development targeting over 3,000ha with a new population creation of about 342,000. Along with the Project, Keio applied a new line extension and started its passenger service since 1974. Due to the revenue and profit brought over to Keio group, the train operation managed to decrease its fare.

Tama New Town Project

The Tama province, a hilly vast area spreading in the south west of Tokyo was known as a very inconvenient area due to the lack of public transport. Tokyo Metropolitan Government, lined up with the Public Housing Corporation, took their initiatives to plan and implement an over 3,000ha residential, commercial and cultural development with a new population of about 342,000. Both Keio and Odakyu applied new lines going through the New Town area and both of the lines opened in 1974.

Both companies have been actively engaged in non-railway businesses. Starting with residential and commercial development, **Keio** and **Odakyu** developed business and educational development as well. Now we see many headquarters and regional offices of the major companies as well as several universities and high schools opened in the area. Town planners aimed a harmonized “living”, “working”, “learning” and “resting” environment. Keio has gained a lot from those non-railway business development and thus they reduced the train fare to return their profit to passengers.

(4) Odakyu Railway

Odakyu is known for its special express service known as the Romance Car service by taking advantage of the line. It goes down to the south-western part of Tokyo and connecting with Hakone known for its beautiful scenic areas around Ashinoko-lake as well as a number of hot spring spas. By having those popular destinations, Odakyu further developed its involvement by investing the whole tourism system around Hakone including, local buses, cable cars and ropeways to visit those sites as well as several hotels and traditional inns.

(5) Tokyu Railway

Tokyu originally started its business with a small line carrying gravels to Tokyo city center from a river flowing through in the southern border of Tokyo after the Kanto earthquake in 1923 stated as above. It grew its group business through by a high-class residential area development called as Den-en Chofu, a rural city in southern part of Tokyo originally developed in 1910s. With a great success of the city, Tokyu further developed by extending and creating new residential development in line with its main line connecting Tokyo and Yokohama as well as the new towns in Yokohama.

Tokyu has been most proactive in seeking non-rail business opportunities. It has over 160 group companies engaged in housing, hotel and resort, department store and other retail outlets, commercial properties and construction engineering. Thus their railway business dependence is only 56%.

Tokyu, Keio, Tokyo Metro – Shibuya Mark City

Shibuya station is one of the most popular terminals in Tokyo where Tokyu, Keio and Tokyo Metro and JR Lines bring passengers over 150 million a day. Shibuya is also known for a town for youngsters and a number of new fashion items are spread from this town.

Three private railway companies agreed to develop their stations to be converted a modern and attractive business and shopping center with their landmark Shibya Mark City completed in 2000 above their stations.

Tokyu used to have a small terminal station but prior to the plan implementation, it moved to an underground station connecting with Tokyo Metro.

Shibuya Mark City has a business hotel with 400 rooms, 65 retail shops and 27,300m2 of office spaces rented out to companies. It also has a long-haul bus terminal connecting over 40 different destinations.

(6) Tokyo Metro

Tokyo Metro has the largest network in Tokyo subway system. It was founded as a public corporation to develop subway system in Tokyo area with its special status. The company was reorganized as a privatized company but still the government holds 53%, and Tokyo Metropolitan Government has 47% stake and thus. Because of its historical background and business nature, they do not have the potential property business opportunities as are the cases in other private sector railways. Tokyo Metro, however, has been aggressively investing into station concourse retail business development by providing the major station concourses for rent. This initiative has been quite successful and it plans more new outlets.

(7) Kinki Railway

Kinki has the largest network of railway totaling over 500km lines in Kansai region between Osaka and Nagoya. It developed its comprehensive network through a series of mergers and acquisitions. Kansai region has also been developed in both commercial and residential developments. Kinki, having already two popular tourism destinations, the one called Ise Shrine, the highest rank shrine in Japan, as well as Shima peninsula known for synthetic pearl production as well as Nara and Kyoto, both historical towns within its network.

(8) Hankyu Railway

Hankyu, an Osaka based railway company, is known for its entrepreneurial chairman, Ichizo Kobayashi who opened its first line in 1910. Since the line was based in Osaka towards then the rural areas, Kobayashi developed the idea in creating residential town, new hot spa springs, as well as an art college and its theatre. Non rail business development has always been its strong driving force of the company and the 59% contribution rate of railway business demonstrates this principle.

Hankyu and Takarazuka Development

Ichizo Kobayashi is known for his aggressive management style at the beginning of the history of Hankyu. Hankyu line initially connected Osaka and Takarazuka, then a small town and the alongside the line, most of the areas were undeveloped. In fact he had made advance investment prior to the application. As soon as the line opened in 1910, he promoted residential development and a new hot spa, opened a zoo and a music college by 1913 later developed to a music theatre. His development style was replicated by other private railway companies known as "Kobayashi model".

5.4.3 Strength of Japanese Railway Companies

Most of those railway companies have been showing strong performance. Common features of those best practices with particular focus on non-technical aspects are as follows;

(1) Technical Aspects

Seek Maximum Efficiency Achieving Safety and Comfort

They perform, with their maximum level of efficiency but at the same time to achieve the tough targets of safety and comfort measures.

Japanese Railway Companies do not feel satisfied with what manufactures have in catalogue but require and develop together with manufacturers what they need for maximum efficiency achieving safety and comfort. Such a constant effort of Research & Development is the backbone for the breakthrough technology.

(2) Managerial Aspects

Started as Direct Operator - All the private railway companies began their operations as the di1rect operator. They accumulated their expertise, knowledge and skills in managing their

core railway operations first. Some companies, from the beginning, knew that non railway businesses would bring larger income generation opportunities, but the key principles were to manage railway operations by themselves.

Maximizing Railway Operational Assets - Each company has been making their efforts, in addition to their core railway business, the railway company has been seeking to make maximum use of the railway operational assets. The platform to concourse, the surface above the stations and direct access link/bridges with business, commercial and residential properties, those associated railway assets are, for example, possible to generate more value and income flow.

Expanding its Non-Railway Operations - It is important how a railway system can contribute to suburban / regional developments. Residential, commercial and business properties, educational facilities, sport and leisure activities and events could be developed in line with a regional development plans. This has been the way for Japanese private sector railway companies to develop their operations and played an important role in the suburban / regional developments. Those non railway activities are not necessarily done directly by railway companies as were the case in Japanese, but it is a meaningful and valid argument that a railway company to take part in those suburban / regional developments proactively.

Direct Operator to Holding Company Structure - Many of those Japanese railway companies have created holding company structure to manage their wide spread railway, associate railway and non railway operations.

(3) Organizational and Human Resource Aspects

High Morale supported by the Life-time Employment - Japanese companies, in general practice, new staff members are recruited under the life-time employment system giving them a good and comfortable assurance. In return, staff would demonstrate a high morale and royalty to the company.

Hands-on / On the Job Training - Japanese tend to appreciate more hands-on skills than theory and knowledge gained through books. The best way to gain good skills is done via hand-on and on-the-job-training ("OJT") from senior engineers / staff members serving long in the company. Training center based training are meaningful but the real cases are invaluable comparing with the virtual ones.

Cross Sectional Rotation – MOT & CWE - Junior staff members, whatever background they have, are posted in both engineering / technical divisions and economic / operational / administrative divisions during the course of their initial ten years or so career stream in

Japanese railway companies. For example a new recruitee with railway engineering background would go through the following stream;

- Trained on general orientation about 1-2 months in the training center, then
- Posted as a station staff for about 2 years,
- Assigned as a train conductor for about 2 years after training,
- Posted as a train driver for about 1-2 years after the exam,
- Assigned as a depot engineers or HQ staff, station master, then,
- Appointed as an economist as HQ staff ….

This cross sectional rotation is known as “Management of Technology” (“MOT”) or “Collaboration with Engineers (“CWE”). MOT is applied to those who have engineering / scientific background who may have good theoretical and practical expertise but do not have sufficient knowledge on managing projects and tasks. It is essential for engineers to have a good ability to plan, execute and supervise projects. For the staff with economic / legal / marketing background, the reverse situation would occur. They may not have enough technical knowledge and understanding to manage projects and tasks. For both cases, it will not only be the knowledge and skills but also understanding of the working environment, attitudes to face with projects, and human chemistry.

Regular Job Rotation - People appreciate a staff serving for the same job and being knowledgeable on specific fields. However, this may generate issues on how to enhance institutional capacity on the basis of knowledge and skills sharing. With a view to avoid the knowledge fall-out, regular job rotation with adequate knowledge / technology transfer between predecessor to successor is an effective option for a company.

5.5 Case Study – Tokyu Corporation and Minato Mirai (MM) Line

- A Case of a Concession Scheme in Japan

5.5.1 Overview of Tokyu Corporation

- Strong Enthusiasm for Proactive Business Development

The Tokyu Group was first established as the "Meguro Kamata Electric Railway Co." in 1922, made up of 277 companies and 9 corporate bodies including 10 listed companies and its business fields were transportation businesses, real estate businesses, retail businesses, leisure-service business and hotel businesses as of the end of March 2009.

Tokyu Corporation, as the core business of Tokyu Group and based on the Railway Business that is involved in "urban development" stayed close to the foundation of the business. Tokyu Corporation has been promoting businesses in various areas closely related to the daily lives of everyone over the years.

In April 2009, Tokyu Corporation newly formed the "Group Operational Headquarters" to further promote "The investigation for the portfolio of stable business for the group" which was made the top priority task of the current management plan. To date, "Retail Operational Headquarters" has had unified management of the related retail business-consolidated subsidiaries such as Tokyu Department Store, Tokyu Store and Tokyu Malls Development.

The Group's main subsidiary companies are drawn below. Detailed organization structures of the Tokyu Corporation are shown in Appendix 5.1.

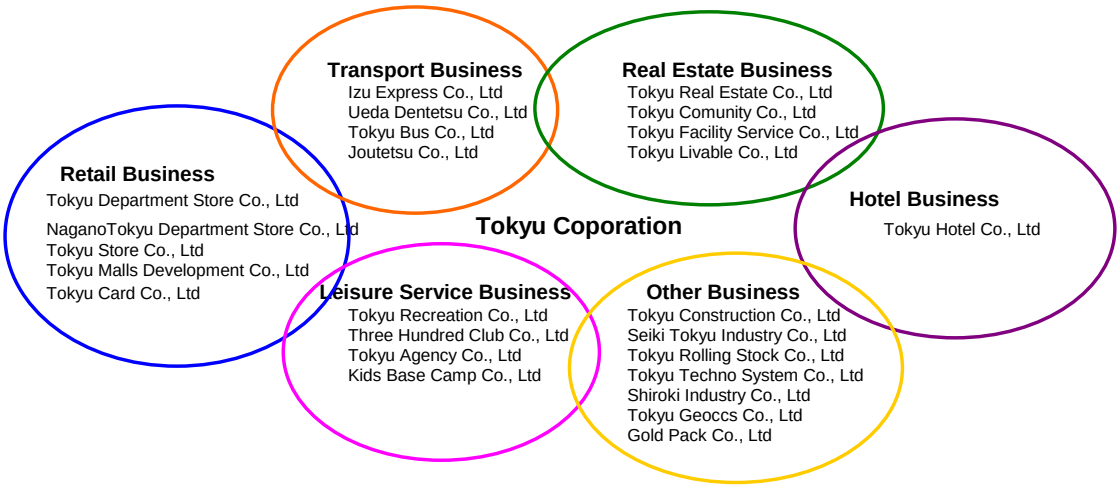


Figure 5.3 - Tokyu Group's Main Subsidiary Companies

The Group's corporate development is illustrated below. The history implies that it takes considerable time for the railway company to expand their fields to non-core businesses.

Table 5.3 – Tokyu's Corporate Development

1907:	- Denen-Toshi Line is opened.
1921:	- Keita Gotoh becomes director of the Musashi Railway.
1922:	- Ikegami Line is opened.
1923:	- Meguro Line is opened.
1925:	- Setagaya Line is opened.
1926:	- Toyoko Line is opened.
1927:	- Oimachi Line is opened.
1937:	- Gotoh's company, by then named Tokyu Corporation, builds an underground link from the Shibuya district to the Shinbashi district in Tokyo.
1948:	- The Tokyu Department Store Company is formed.
1949:	- Gotoh lists Tokyu on the Tokyo stock exchange.

1953:	- Tokyu begins developing the Tama Denentoshi area in Tokyo.
1960:	- Tokyu enters the hotel business.
1961:	- Tokyu forms Toa Domestic Airlines and Tokyu Agency, an advertising agency.
1980:	- Tokyu begins a period of aggressive overseas expansion.
1987:	- Tokyu Cable Television is formed.
2000:	- The Tokyu Group announces a major restructuring, to be led and overseen by Tokyu Corporation. - Tamagara Line is opened.
2001:	- Tokyu partners with Lend Lease Corp. of Australia to form a real estate investment firm.
2004:	- MM Line is opened.

5.5.2 Overview of MM Line

Yokohama Minatomirai Railway ("YMR") is a joint venture railway company among Yokohama City Government as the major shareholder with 63% of stake with other private sector companies including Tokyu. Its underground Minatomirai Line ("MM Line") has 4.1 km of length between Yokohama and Motomachi- Chukagai calling at six stations.

It started its operation in February 2004. The line terminal Yokohama is directly connected with Tokyu Toyoko Line with its terminal Shibuya. Both Tokyu and MM Line rolling stock are running through from Shibuya till Motomachi- Chukagai terminal of MM Line. All the infrastructure civil work, railway M&E systems, and rolling stocks were constructed or procured by YMR.

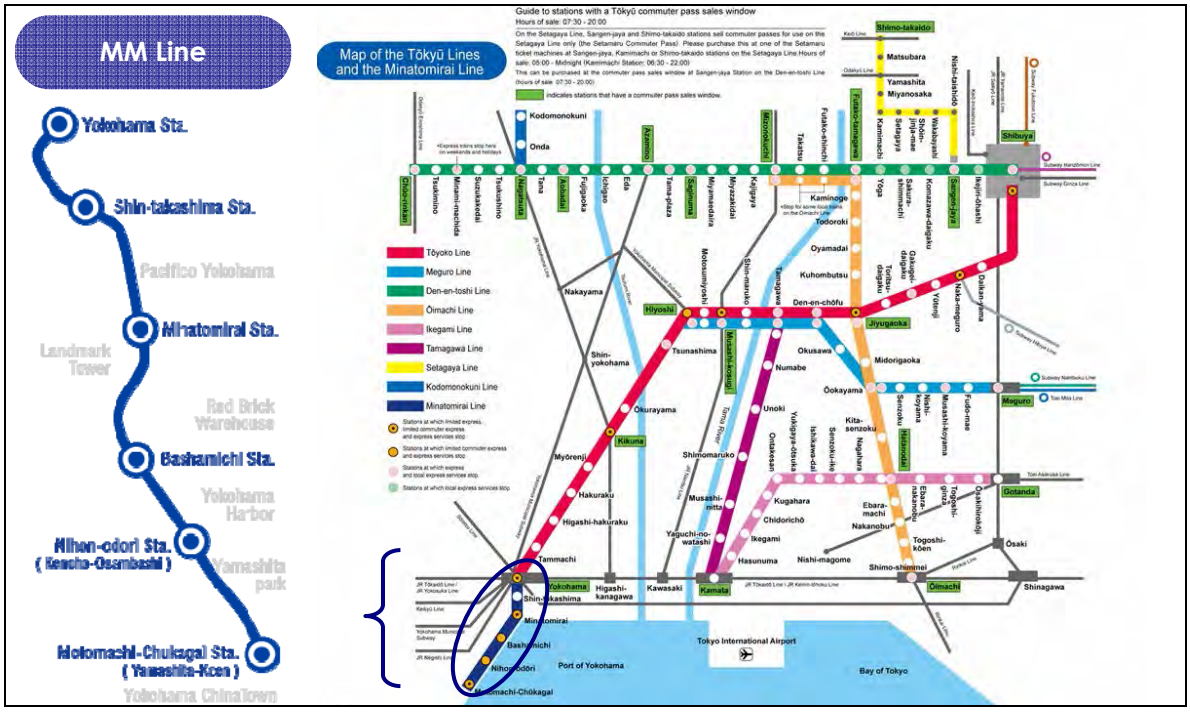


Figure 5.4 - Tokyu Railway Network and MM Line

Table 5.4 - Overview of MM Line

Opened	February 2004
Owner	Yokohama Minatomirai Railway Company (YMR)
Operator	YMR, Tokyu (Concessionaire)
Line length	4.1 km, 6 Stations, Fully Underground
Track gauge	1,067 mm
Electrification	1,500 V DC, overhead catenary
Ridership	153,000/day (2008)

Although the Minatomirai Line runs entirely underground, it is separate from the Yokohama Municipal Subway, which is operated by the Yokohama City Transportation Bureau. The YMR is a third-sector railway company funded by Yokohama City and Tokyu Corporation.

Table 5.5 – YMR's Corporate Development

Mar. 1989:	The company is established to develop the Minatomirai line.
Apr. 1990:	The Minatomirai Line is categorized as a first class railroad.
Nov. 1992:	Construction begins on the Minatomirai Line.
Aug. 1997:	The company acquires the Kodomonokuni Line.
Feb. 2004:	The Minatomirai Line is opened.
Mar. 2007:	PASMO, a common ticketing system, is introduced.

Business lines of YMR include, i) urban railway transportation business, ii) retail business (station stand, restaurant, advertisement, and travel agent), iii) real estate-related business (sales, appraisal), and iv) relevant business of the above.

5.5.3 Concession Agreement

(1) Agreement between Yokohama City and YMR

The whole concession scheme is drawn in the following figure.

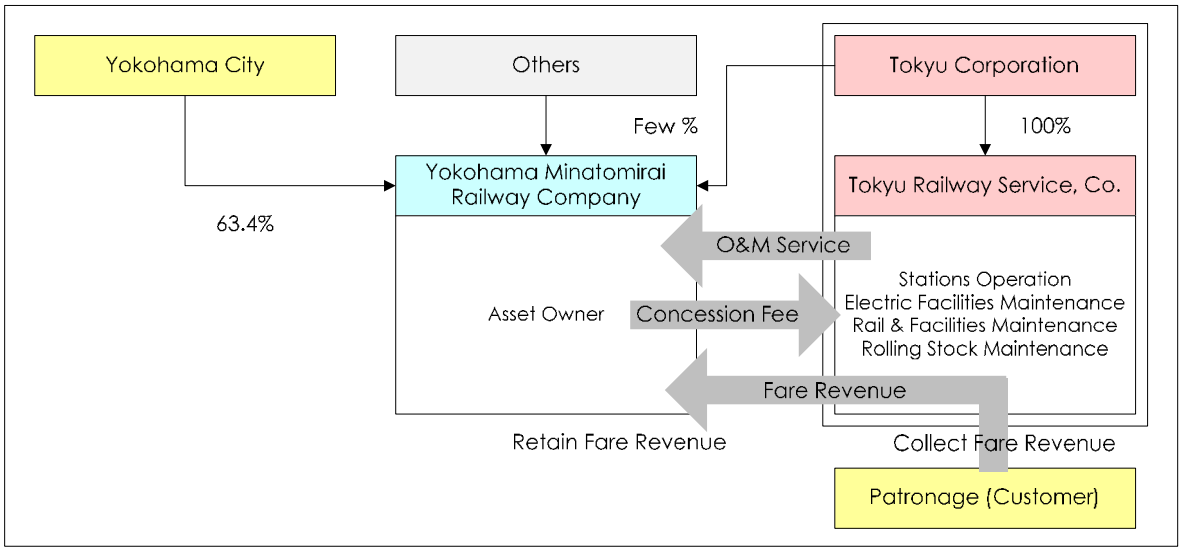


Figure 5.5 – Concession Contract Scheme of MM Line

When YMR commenced operation of MM Line, an agreement was entered into by and between Yokohama City and YMR to ensure accountability about serving public interests and

share the following key managerial goals with clear quantitative targets. YMR takes periodical review by Yokohama City as compared to the managerial goals.

YMR's Managerial Goals

- Ensure safety operation without serious accidents
- Achieve ridership target of 154,000 per day by 2011
- Achieve non-core revenue target of about USD 3.3 million by 2011
- Reduce the concession fee for train operation and station operation to lower than USD 5 million by 2011
- Enhance the farebox ratio to higher than 1 by 2011
- Reduce the ratio of revenue per personnel cost of YMR to 5% by 2011

(2) Agreement between YMR and Tokyu Corporation

As for the operation and maintenance of MM Line, YMR signed a comprehensive cooperation concession agreement with Tokyu. The outline of the concession contract is given below. It should be noted that the scheme is similar to Gross Cost Scheme where YMR has the market risk and needs to take measures to enhance revenues through its core and non-core businesses.

Table 5.6 – Outlines of Concession Contract between YMR and Tokyu

Management Scheme	• YMR manages civil infrastructure, rolling stock and E&M delivery using private sector contractors; • YMR engages Tokyu to undertake O&M through a concession; • YMR pays the concessionaire an amount equal to the costs the concessionaire incurs in providing agreed services; • Tokyu undertakes all fare collection on behalf of YMR and YMR retains all fare revenue.
Rolling Stock	• YMR owns its rolling stock Class Y500. • Tokyu trains have running rights on the MM Line. • It is expected a straight-through operations with a Tokyo Metro Line in future. Management scheme is yet to be discussed.
Operations and Maintenance	• YMR is directly responsible for operations, including the setting of safety and service standards, service levels, and fare structure and level; • Traffic Control is done by Tokyu from its Centralized Traffic Control room. • The track, rolling stock, and M&E subsystem maintenance are carried out by a Tokyu group company.
Operational Personnel	• All train drivers and conductors are from Tokyu under the Cooperation Agreement between YMR and Tokyu.

5.5.4 Managerial Challenges

Latest audits undertaken by Yokohama City pointed out the following three issues on YMR's management of MM Line. It is anticipated that MRTA will face similar issues in not so much distant future, as the situation of the two authorities have several common features.

As the (1) and (2) of the issues have been discussed previously, this section focuses on human resource aspect of YMR and aims to consider the ways to enhance internal capacities under the concession scheme.

Issues Indicated by Yokohama City

It is of extreme importance for YMR;

(1) to enhance profitability in order to reduce the burden for repayment of interest-bearing debt.

(2) to form a strategic development model along with the regional expansion

(3) to establish a human resource strategy from a long-term perspective

(1) Organization Structure of YMR

YMR's organization is divided into two, the Business Administrative Department and Operation Department. The Operation Department is in charge of coordinating and supervising the concessionaires in accordance with the concession contract.

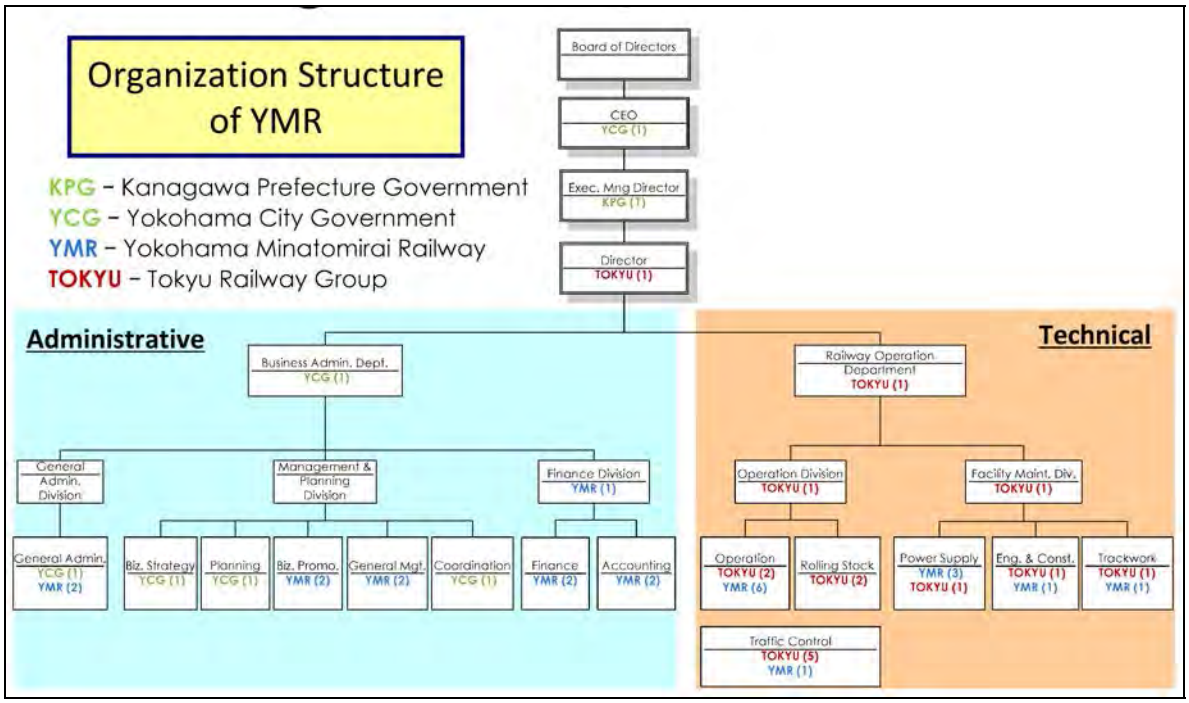


Figure 5.6 – Organization Structure of YMR

The total number of the management and staff are currently 44. Half of them are seconded staff from Yokoyama City Government and the remaining half is the secondees from Tokyu, and finally the remaining, the one quarter of total, is the staff directly hired by YMR. In the longer run, the proper staff are expected to grow gradually with their professional expertise.

Table 5.7 – Breakdown of YMR Employees

	Biz. Admin. Dept.	Operation Dept.	Total
Regular Employee	10	11	21
Secondment from Yokohama City	7	0	7
Secondment from Tokyu Corporation	0	13	13
Secondment from Tokyu Railway Service	0	2	2
Temporary Employee	1	0	1
Total	**18**	**26**	**44**
Employees per route kilometer			**10.7**

Table 5.7 – Age Distribution of YMR Employees

Classification	Ave. Age	Age Distribution				
		< 30	30s	40s	50s	60s
Full Employees	43.8	3	11	16	10	3
Regular Employees	38.2	3	7	7	2	0

(2) Training of MM Line Staff

When a new staff is recruited for MM Line, they are all seconded to Tokyu for 2-3 years. In the same manner as the Tokyu's new staff, i.e. after 1-2 month training center education, they are dispatched to a station, then to train depot and other engineering divisions before moving back to MM Line. This secondment system can offer young YMR staff hands-on experience that YMR cannot do within the organization. At the same time, by working closely, secondees from Tokyu may provide technical assistance and technology transfer for YMR.

(3) Career Path

Typical career path of YMR regular employees as well as Tokyu Corporation are given below. It should be noted that technical staff start their career with hands-on and OJT style trainings as discussed in 5.4.3. (Also, comprehensive company-wide career stream at Tokyu is given in Appendix 5.2.)

Table 5.8 – Career Path Examples (YMR)

Employee (Electrical Engineer) of Yokohama Minatomirai Railway Company (1) (An example of Tokyu employees seconded to YMR)	
2007/4/01:	Joined Yokohama Minatomirai Railway Company (white-collar college graduates), he was assigned Transport Division, Transport Department.
2007/10/01:	Secondment to Tokyu Corporation as station clerk
2008/7/01:	Motosumiyoshi Conductor Section (conductor)
2008/11/04:	Tokyu Driving School (driving school for driver licenses)
2009/8/04:	Motosumiyoshi Train Section (driver)
2009/12/01:	Transportation Command Office (Commander Operation)
2010/4/01:	Transport Department Transport Division, Yokohama Minatomirai Railway Company reinstatement
Employee of Yokohama Minatomirai Railway Company (2) (An example of Yokohama City employees seconded to YMR)	
- Employee over 50 generally works for YMR until retirement age. - The young employees work for YMR for a period between 3 and 5-year. - In most cases, employees come from non-core railway-related fields.	

Table 5.8 – Career Path Examples (Tokyu)

Employee of Tokyu Corporation (1) (An example of Rolling Stock Department, Director of Inspection and Repair Division)	
1987/4/01:	Joined Tokyu Corporation (Department of Mechanical Engineering Science
1987/4/16:	Yokohama Station
1987/7/16:	Shin-Ishikawa Service Station
1987/11/16:	Nagatsuda Workshop
1988/4/16:	Nagatsuda Inspection Depot
1989/2/16:	Rolling Stock Division (Headquarter)
1991/7/01:	Nagatsuda Workshop
1993/6/16:	Nagatsuda Inspection Depot
1995/4/16:	Rolling Stock Division
1997/7/16:	Customer Service Promotion Department
2001/4/01:	Rolling Stock Division
2002/4/01 :	Inspection and Repair Division
2005/4/01 :	Secondment to Tokyu Railway Service
2006/8/01 :	Manager of Inspection and Repair Division
Employee of Tokyu Corporation (2) (An example of manager of Communication Division, Department of Communication)	
1989/4/01 :	Joined Tokyu Corporation (School of Electrical and Electronic Engineering)
1989/4/16 :	Futago-Tamagawasono Station
1989/7/16 :	Secondment to Tokyu Cable Television
1990/4/16 :	Circuits Section
1990/10/16 :	Signal Section
1991/4/16 :	Communications Section
1992/3/16 :	Electrical Construction Office
1995/1/16 :	Communication Division (Headquarter)
1999/1/16 :	Human Resource Department, Capacity Building Division

2000/7/16 :	Media Business Division
2002/3/16 :	Electrical Construction Office
2004/3/01 :	Station Service System Division (Headquarter)
2004/10/01 :	Communication Division
2006/7/01 :	Electric Power Division
2008/1/01 :	Electrical Construction Office
2009/4/1 :	Manager of Communication Division

(4) Need of HR Strategy from a Long-Term Perspective

As a railway business proprietor, YMR is responsible for supervising the operation and maintenance of MM Line in a long term with sufficient organizational and staffing strength within the organization. In this connection, it is essential to establish a human recruitment and resource development strategy from a long-term perspective.

However, in fact, YMR relies on Tokyu for operational personnel at present. Dispatched personnel from Tokyu generally is replaced by another in 3 years period. Similarly, Business Administrative Units, except Financial Department, consist of the personnel dispatched from Yokohama City and regular turn-over takes place. Therefore, YMR is aware that they start to face difficulties in accumulating technical know-how and internal resources. Now YMR attempts to increase the ratio of regular employee and provide enriched internal and external training programs.

5.6 Preconditions for Capacity Building Roadmap

Preconditions for capacity building roadmap, based on the studies presented from Chapter 2 to Chapter 5, reflecting MRTA management vision and strategy in long-run, would be illustrated as follows. Short-term and long-term roadmaps, embodied in accordance with the preconditions, are demonstrated in Chapter 6 and Chapter 7 respectively.

Table 5.9 - Preconditions for Capacity Building Roadmap

Short-term Objectives • Supervising Purple and Blue Line project implementation • Building and incorporating required capacity for Gross Cost Scheme • Managing Purple and Blue Lines under each concession scheme • Starting regional development collaboration	**Chapter 6 Short-term Roadmap**
Medium-term Objectives • New lines under construction • Managing additional lines under concession scheme • Preparing upcoming direct operation • Expanding regional development on non-railway business	**Chapter 7 Long-term Roadmap**

Long-term Objectives • Completing new lines construction • Building and incorporating required capacity as a direct operator • Managing total 5 lines under different contract scheme • Gaining non-railway businesses contribution	

5.7 Lessons Learned and Recommendations for MRTA's Future

- Most of public transport developments have been, in the past, solely by the public sector initiatives. However, the more pressure on the national and regional governments on the social development public expenditure have given more budgetary pressure and constraints on the economic and infrastructure development. That is where, in recent year, the Public-Private Partnership ("PPP") policy framework has been promoted in many countries.
- The public transport, passenger traffic in particular, has been considered rather not viable due mainly to the strong public good nature of its business and thus the passenger fare quite often is kept low. To overcome this difficult policy challenge, several governments have been introducing a wider concept of PPP approaches to the public transport sector.
- In the case of Japanese PPP model, urban / suburban railway system has been given role to contribute to the regional development. Along with the economic and social expansion plans, railway system could engage and collaborate with the urban, suburban and regional developments. They made investments prior to the railway plans to coordinate well the local governments, property developers for business, commercial and residential developments, educational and leisure planners. The private railways even sometime developed by themselves in creating those future demands.
- Most of major Japanese railway companies have been showing strong performance. Common features of those best practices are that they i) seek maximum efficiency achieving safety and comfort, ii) started as a direct operator, iii) maximize railway operation assets, iv) expand its non-railway operations, v) created holding company structure, vi) have high morale supported by the life-time employment, vii) conduct hands-on on-the-job training, viii) introduce cross sectional job rotation system, and ix) maintain regular job rotation system.

- YMR, the asset owner of MM Line, is a similar organization as MRTA. The total number of the management and staff are currently 44. Half of them are seconded staff from Yokoyama City Government and the remaining half is the secondees from Tokyu, and finally the remaining, the one quarter of total, is the staff directly hired by YMR.
- The secondment system at YMR can offer their young staff hands-on experience that YMR cannot do within the organization. At the same time, by working closely, secondees from Tokyu may provide technical assistance and technology transfer for YMR. In the longer run, the proper staff are expected to grow gradually with their professional expertise.
- Learning from the Japanese cases, dispatching MRTA staff for 1-2 years to the Concessionaire, other direct operators, maintenance contractors etc, and asking them to acquire hands-on experience is strongly recommended. This secondment will be very effective for the areas that MRTA not having sufficient experience, knowledge and skills.

CHAPTER 6 SHORT-TERM ROADMAP – TO TECHNICAL AND CAPACITY READINESS FOR GROSS COST SCHEME

This chapter provides a short-term roadmap for the efficient and effective management of Purple Line (and extended Blue Line) under Gross Cost Scheme, illustrating how to improve technical capacity based on training needs assessment and internal resource development strategy.

6.1 Approach - Methodology and Assumptions

6.1.1 Methodology

The methodology to develop a roadmap is given below. After the Team assessed training needs and internal resources taken into account the desired future state of MRTA, target end state was identified and plan of actions and milestones were designed. Finally, the Team developed a roadmap to determine a path to reach there.

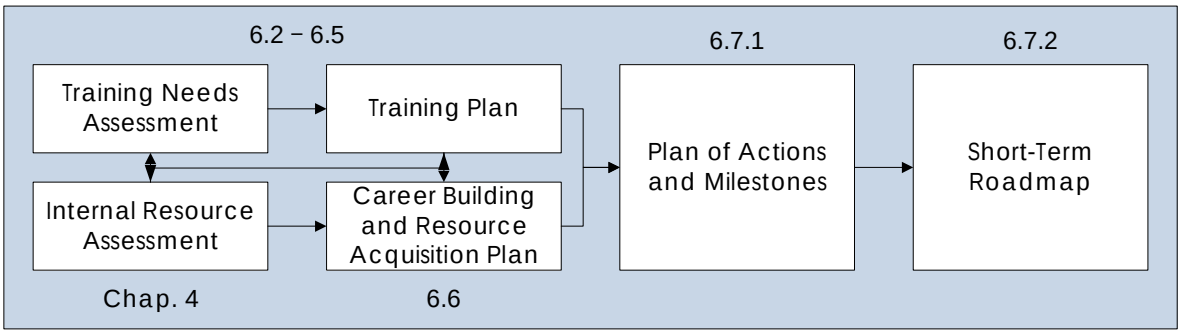


Figure 6.1 – Methodology to Develop the Short-Term Roadmap

Training Needs Assessment aims to identify which capacity gaps will be addressed through training, and which ones through on-the-job training. The following diagram shows the steps that lead to finding training needs. The output of this exercise is presented in the form of **Training Plan**.

Internal Resource Assessment was carried out through interviews with all the engineering staff in MRTA and reported in Chapter 4. This chapter offers **Career Building and Resource Acquisition Plan** to align and develop internal resource to grow the technical capabilities within the organization through providing suitable career stream for young engineers or hiring experienced experts from external labor market as an immediate solution.

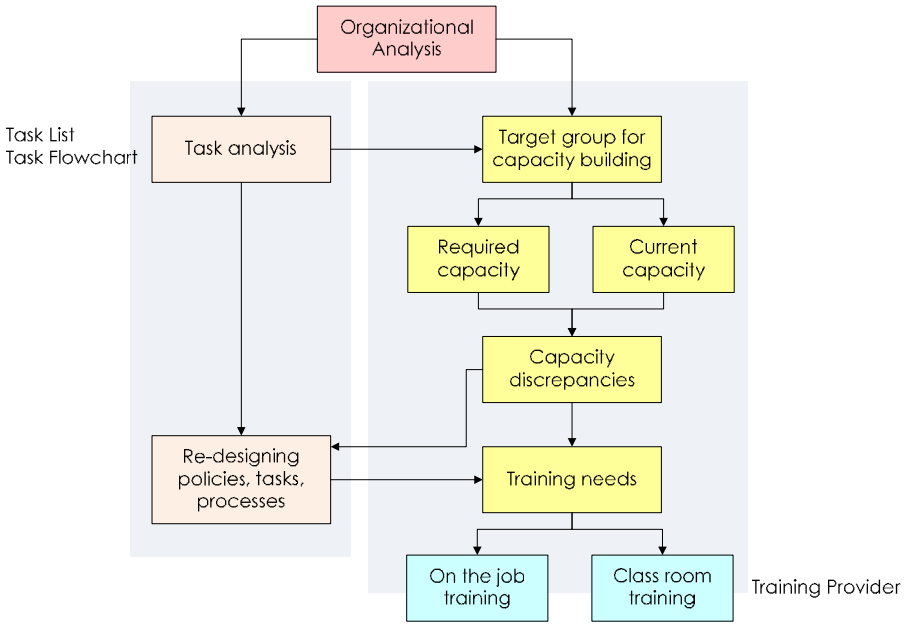


Figure 6.2 – Training Needs Assessment Flowchart

6.1.2 Assumption

Within the framework of the Short-term in this Chapter, the Action Plan and the Roadmap targets Purple Line (and Blue Line Extension) and will cover the period until around three years after the opening of the Purple Line.

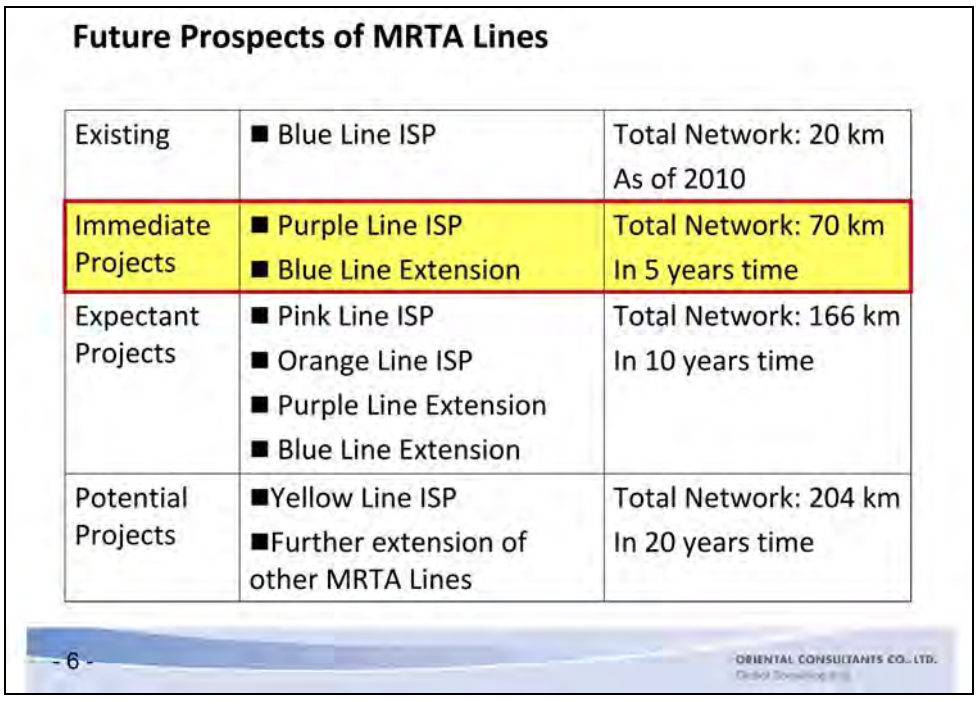


Figure 6.3 – Assumptions of Short-Term Roadmap

6.2 Future Tasks and Required Capabilities

To identify the required capabilities, this section describes the activities and tasks to be carried out by the Authority (MRTA) under a BOT-PPP Agreement based on Gross-Cost Scheme. The description is subdivided into Operation and Maintenance activities.

6.2.1 Operation Activities

(1) Target Group

Roles of operational division can be divided into 3 main jobs as they have 3 sections: i) M.R.T. System Operations Supervisory Section 1, ii) M.R.T. System Operations Supervisory Section 2, and ii) M.R.T. System Operations Standard and Technique Section.

(2) Future Tasks

a) Management Scheme

MRTA would have a contract with the Concessionaire to operate any given line under Gross-Cost scheme of MRT Railway System of Bangkok at least in the short-term. Therefore, all of the system operation activities are in principal performed by the Concessionaire.

In this context, the MRTA is basically responsible for monitoring and supervising the Concessionaire on its operation and maintenance activities as written in the Concession Agreement.

b) Tasks Performed by MRTA

The most relevant tasks to be performed regarding operation matters are, but not limited to, listed below:

Table 6.1 – Operational Tasks Performed by MRTA

Train Operation	• Advise and assist the Governor in the formulation and implementation of rules and regulation necessary to carry out the objectives and policies of the Authority concerning operations; • Approve system and train operating plans, policies, and strategies to ensure efficiency and effectiveness; • Provides technical assistance to the Governor, as may be requested; • Supervise and monitor the Concessionaire to coordinate with the Traffic Management Unit regarding train movements service interruption and train service; • Supervise and monitor the Concessionaire to handles train operation in accordance with prescribed timetables and instructions and reports any abnormality along the line;

Station Operation	• Supervise and monitor the Concessionaire to promote quality frontline service; • Supervise the inspection of physical facilities in terminals/stations; • Supervise the Concessionaire to monitor the accounting and turnover of cash/excess collected tickets;
Traffic Control	• Supervise the Concessionaire to monitor, control and/or coordinate train movements, rail vehicles and maintenance work on the line facilities; • Supervise the Concessionaire to check equipment at terminals and stations as well as the presence of personnel in the revenue line; • Supervise the Concessionaire to monitor train departure and arrival to ensure punctuality of schedule; • Supervise and monitor the Concessionaire to operate, control and monitor SCADA; • Monitoring train driver schedules; • Formulate timetable;
AFC Service	• Maintain AFCS accounting records and other AFCS related documents, and updates and records ticket sales and production; • Reconcile daily and monthly ticket sales/revenue in each line as against the Central Computer System (CCS) generated reports; • In-charge of mopping activities after revenue operations (after daily operation is finished, collect all tickets sold and unsold, and cash, etc. from the stations) • Prepare accurate and timely financial reports/analysis, as well as preparation of non-financial reports for management use and guidance; • Reconcile ticket production report as against the CPS/CCS generated reports; • Reconcile ticket inventory against the actual physical count of tickets. • Sort tickets and encodes it using Ticket Sorting and Issuing Equipment/Encoder-Sorter machine; • Check, count, seal and record processed tickets; • Prepare daily ticket production reports; • Release tickets; • Receipt captured and returned tickets from the Line Operators; • Handle and store ticket inventory; • Reconcile ticket production as against daily ticket balance records; • Maintain and monitor Automated Fare Collection computer system, and manage and monitors file server and database; • Train on AFCS application, analyze problem of tickets procedures; • Coordinate and supervise the maintenance contractor on the maintenance/repair of AFCS equipment; • Operate CPS/CCS Operator and Maintenance Consoles, • Identify miscoded tickets and assist in reconciliation of tickets production

(3) Task Flow

A general task flow for operation activities is shown in Figure 6.4.

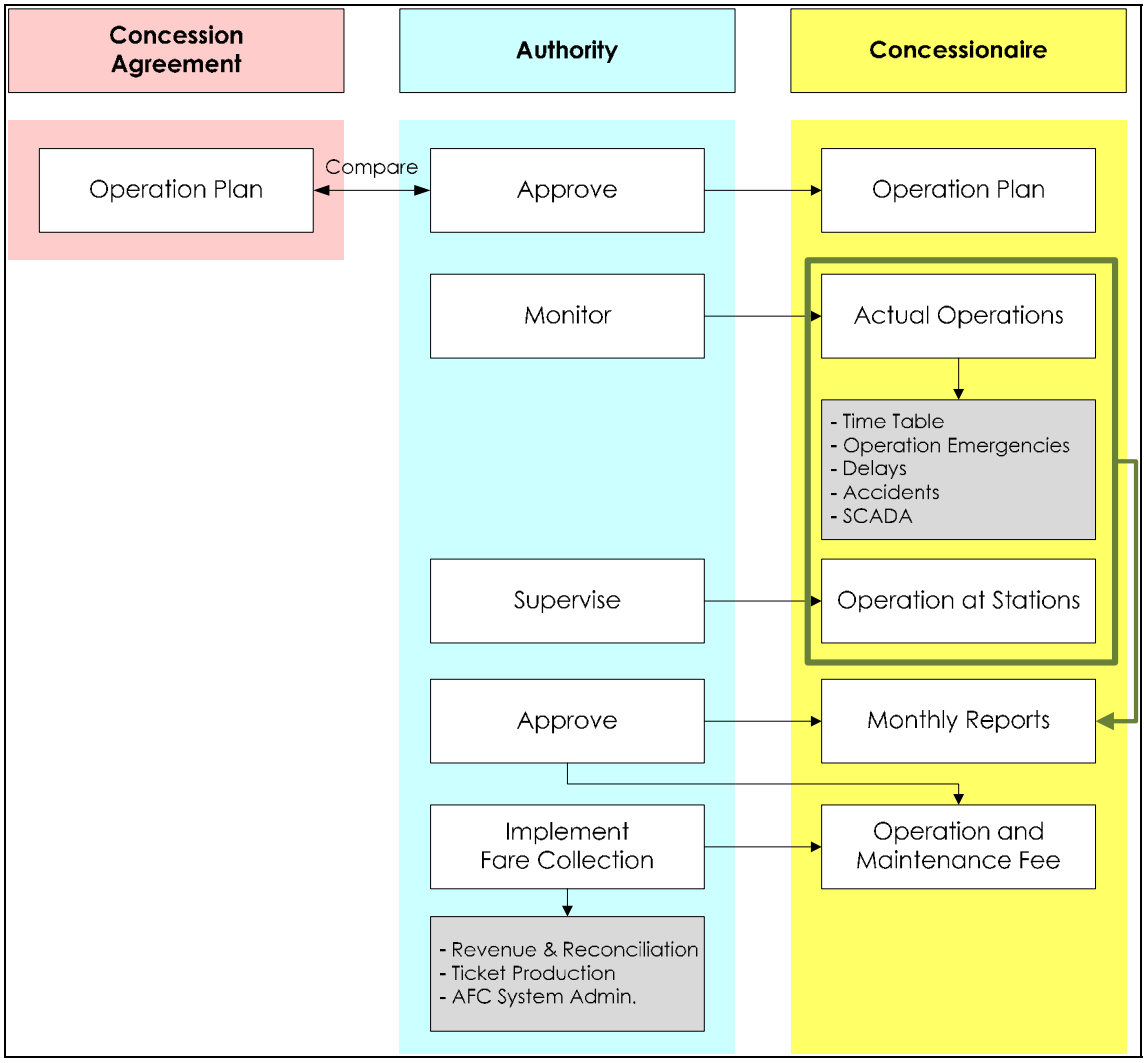


Figure 6.4 General Task Flow for Operation Activities

(4) Job Descriptions

Some of the above-listed tasks would be performed in specific locations by the assigned MRTA personnel which are described below:

a) Central Control Room (CCR)

It has been envisaged that a representative of MRTA would be provided with a workstation set mirrored that of the CCR Chief Controller workstation inside the CCR. In this way the MRTA staff would be able to monitor, in real time, all aspects of the system operation, which would be closely monitored by MRTA.

Moreover, MRTA would be able to overrule/control the Concessionaire's operations if needed or wished, for example in cases of emergency. However, it is advisable that this

attribution should be used with the most self restraint and good judgment as over-ruling the Concessionaire would result in the transfer of responsibility.

The MRTA staff assigned to this position should supervise that the operation activities are according to the approved Train Operation Plan, and periodically report. The time spent at the CCR should not be only for supervision, but also for familiarization and learning of all aspects of the railway operation, as training for future responsibilities.

b) Station Operation Room (SOR)

Every station has an SOR. The SOR is the control room for the station and contains Building Services Workstation controlling and monitoring lighting, air-conditioning (of Equipment rooms) and Fire Prevention and Controlled Access Security Systems. The SOR has surveillance CCTV of cash handling rooms, platforms and concourses and station elevator and escalators entrances.

If the Station has a Signalling Interlocking, the SOR shall have a Local Control Workstation, where is the OCC CCR is not available, the Station Operator can take local control of the Interlocking and keep train services running, albeit it in a degraded mode. Transfer of CCR/Local Control is highly controlled requiring a mutual offer/acceptance between the two control centers to achieve transfer of control to and from the CCR.

The SOR is also the central reporting and control point for all station and security staff and the Emergency Services. The Concessionaire normally supervises the station activities from the SOR and MRTA may request a position in the SOR to observe the Station Operations, similar to the CCR MRTA Position.

The MRTA staff assigned to this position should supervise that the operation activities are according to the approved Station Operation Plan, and periodically report. The time spent at the SOR should not be only for supervision, but also for familiarization and learning of all aspects of the station operation, as training for future responsibilities.

c) Ticket Office Rooms (TO)

Activities related to the revenue collection might be a responsibility of MRTA, thus, those related tasks would be performed in the TO’s and Cash Handling Rooms. For other tasks unrelated to revenue collections, MRTA staff can only monitor as not to interrupt the Concessionaire activities, reporting to MRTA senior staff about any issue occurring in the stations.

d) Playback Training Room (PTR)

Inside the Operations Control Center (OCC) there would be a Playback Training Room that features a Line Controller's Workstation same as that of the actual CCR. This workstation will be used for training purposes of MRTA staff in association with a train movement simulator, where they would be able to experience actual operations activities, under normal and emergency situations.

The workstation can also playback DVD recordings from the signalling technicians terminals and onboard train CCTV Surveillance system and also have the ability to be switched into the CCR Server network and act as a "Fall-back" OCC CCR Workstation to operate trains if the OCC is not available.

6.2.2 Maintenance Activities

(1) Target Group

Roles of maintenance division can be divided into 3 main jobs as they have 3 sections: i) M.R.T. System Maintenance Section, ii) Building and Permanent Way Maintenance Section, and ii) Maintenance Standard and Technique Section. Of these three sections already existing in MRTA, the M.R.T. System Maintenance Section would increase its scope of works and responsibilities under a gross-cost scheme.

(2) Future Tasks

a) Management Scheme

Similar to the existing Blue Line ISP, MRTA would have a contract with concessionaries to operate and maintain the future MRT Railway Lines in Bangkok under PPP cum gross-cost scheme.

Most probably also, outsourcing maintenance contracts will be put in place. The most probable approach would be to contractually give control over the development of equipment maintenance strategies (i.e. Preventive and Corrective Maintenance programs) to the maintenance contractor. In this instance, the contract must be structured around the achievement of desired outcomes in terms of equipment performance, with the contractor being given latitude to achieve this to the best of his ability.

b) Tasks Performed by MRTA

Under the gross-cost scheme, the main activity of MRTA would be monitor the concessionaire and maintenance contractor by compliance or not compliance of given Key Performance Indicators (KPI). However, additional control over maintenance activities

would be given to MRTA, as it could have the power to approve Maintenance Plan and Procedures, Corrective Maintenance, Special Repairs, Purchase of Capital Spare Parts, and Monthly Reports.

Table 6.2 – Maintenance Tasks Performed by MRTA

Rolling Stock Maintenance	• Approve plan of Rolling Stock Maintenance; • Monitor progress implementation of all maintenance activities related to rolling stock; • Approve policies and guidelines in the maintenance of rolling stock; • Prepare work procedure of Rolling Stock Maintenance; • Approve special repairs and corrective maintenance activities; • Monitor Maintenance by using CMMS; • Monitors the performance of the contractor and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works
M&E Subsystems Maintenance	• Prepare plan of M&E subsystems; • Monitor progress implementation of all maintenance activities related to M&E subsystems; • Approve policies and guidelines in the maintenance of M&E subsystems; • Implement of all maintenance activities related to facilities, buildings, and E&M systems under MRTA's jurisdiction; • Monitor Maintenance by using CMMS; • Monitors the performance of the contractor and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works.

(3) Task Flow

A general task flow for maintenance activities is shown in Figure 6.5.

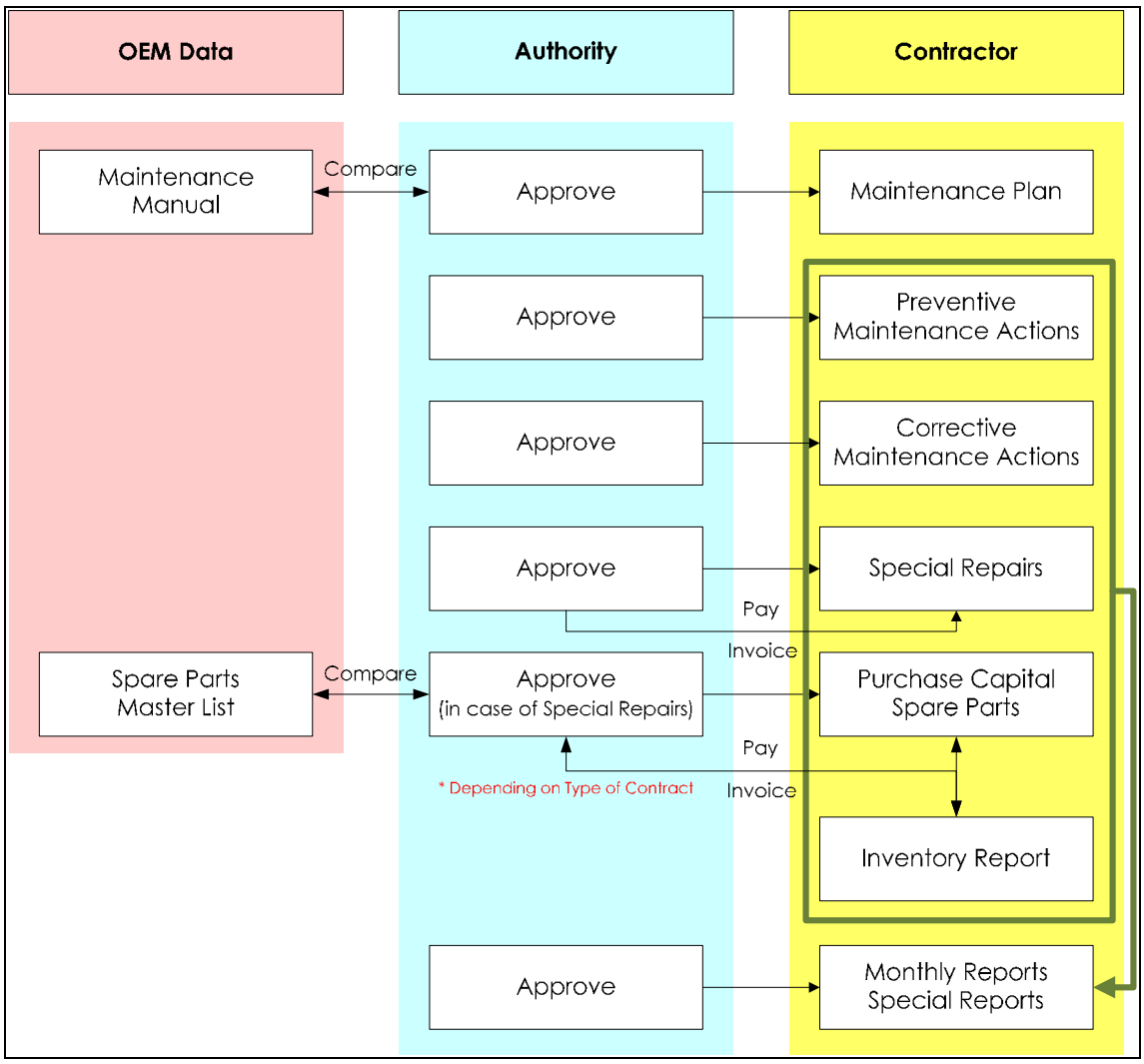


Figure 6.5 - General Task Flow for Maintenance Activities

The first activity to be performed by the MRTA Maintenance staff would be the approval of the Maintenance Plan submitted by the newly selected Concessionaire. This approval is based on a review of the Maintenance Plan vis-à-vis with the Maintenance Manual of the Original Equipment Manufacturer (OEM). The MRTA staff should be able to understand the differences between the two documents and judge accordingly.

During the implementation of maintenance activities by the Concessionaire, MRTA would, in general terms, monitor the maintenance activities by means of approving the Monthly Report. Monthly Report includes all activities performed during a month period. The Preventive Maintenance activities performed during a month, and reported in the Monthly Report, should be compared with the activities approved in the Maintenance Plan. However, with the

exception of the Preventive Maintenance, other activities such as Corrective Maintenance and Special Repairs should be approved on their own merit. MRTA staff should be able to understand the nature, need, and methodology of such repairs, and judge for proper approval. Usually, special repairs are urgent in nature, therefore, the approval should be done in the shortest time possible.

Although a fix quantity of spare parts should be provided by manufacturer at the beginning of the implementation of a project, unscheduled special repairs or long term future replenishment of spare parts stock would be approved by MRTA maintenance staff. Understanding of assets management of the CMMS would be required for the approval of spare parts purchases.

In general, except for buildings related to non-core business such as park-and-ride, the activities mentioned above are the ones that MRTA maintenance staff would carry out, where its engineers could monitor the maintenance activities thru monthly and annual reports, daily by print outs of the CMMS, and direct observation of jobs, without the possibility of interference on daily activities, but having power to approve maintenance plan and unscheduled maintenance works. This is per-se not good or bad, it is correctly applied from the contractual conditions.

However, in view of long term future role of MRTA, when system would be turned over to them, it is advisable that the level of knowledge and experience of its engineers would be considerable higher to take charge of the actual maintenance.

(4) Job Descriptions

Some of the above-listed tasks would be performed in specific locations which are described below:

a) Computerized Maintenance Management System (CMMS)

A CMMS software package maintains a computer database of information about the concessionaire's maintenance operations. This information is intended to help maintenance workers do their jobs more effectively (for example, determining which equipment (refers to rolling stock, M&E subsystems, etc) require maintenance and which storerooms contain the spare parts they need) and to help management make informed decisions (for example, calculating the cost of equipment breakdown repair versus preventive maintenance for each equipment, possibly leading to better allocation of resources). CMMS is also used to verify regulatory compliance of the contractor by the Authority.

CMMS produces status reports and documents giving details or summaries of maintenance activities.

The activities that the Maintenance personnel of MRTA would perform related to CMMS are to monitor that the maintenance activities of the contractor are according to the approved Maintenance Plan; that the submitted Monthly Report is according to the outputs of CMMS, so to facilitate the approval of the said Monthly Report; and to compare inventory of spare parts with spare parts requests by the Contractor for purchase approval of said spare parts.

Any personnel of the organization (Authority or Concessionaire might have access to CMMS but each user have limited access depending on their usage.

Components of a CMMS

a) Work orders

Scheduling jobs, assigning personnel, reserving materials, recording costs, and tracking relevant information such as the cause of the problem (if any), downtime involved (if any), and recommendations for future action. Typically, the CMMS schedules preventive maintenance automatically based on maintenance plans and/or meter readings. The typical activities reported by the software are:.

- **Inspection** - Details condition of assets.
- **Preventive maintenance** - Keeping track of preventive maintenance jobs, including step-by-step instructions or check-lists, lists of materials required, and other pertinent details. Produce records of work done and materials used, keeping comprehensive history records of maintenance of each equipment.
- **Corrective Maintenance** - Incidence of failure, details of repairs completed and repairs "to do". Preventive maintenance tasks are often undertaken during breakdown repair and so preventive maintenance tasks need to be rescheduled.

b) Asset management

Recording data about equipment and property including maintenance activities, specifications, purchase date, expected lifetime, control accounting of assets, purchase price, depreciation rates, etc, warranty information, service contracts, service history, provide maintenance budgeting and costing statistics, spare parts and anything else that might be of help to management or maintenance workers. The CMMS also generates metrics such as the Facility Condition Index (FCI) to measure effectiveness of asset management.

c) Inventory control

Management of spare parts, tools, and other materials including the reservation of materials for particular jobs, recording where materials are stored, determining when

more materials should be purchased, tracking shipment receipts, and taking inventory.

d) Safety

Management of permits and other documentation required for the processing of safety requirements. These safety requirements can include lockout-tagout, confined space, foreign material exclusion (FME), electrical safety, and others.

b) Maintenance Management Center (MMC)

The Maintenance Management Center (MMC) is the nerve centre of the Railway Maintenance organization; it is responsible for keeping track of all equipment in operation.

The MCC keeps track of all equipment and coordinates with key units throughout the operations, maintenance and engineering activities so that maintenance, when needed, can be planned, coordinated and expedited to minimize delays and down time.

The MMC locates and manages the resources (the necessary personnel) within the company who can provide whatever maintenance, trouble-shooting, or parts assistance that is needed to support the operational phase of the railway operation. The MMC provides technical support and trouble shooting assistance to maintenance technicians, engineers, and managers, available 24 hours a day, 7 days a week.

MRTA would allocate engineers to this center to monitor maintenance activities. The activities are limited to observe & report. Approvals are made at Department Director level.

6.2.3 Engineering and Construction Activities

(1) Target Group

Construction and planning activities about railway systems, currently dealing with Purple Line and Blue Line Extension Projects, are under the responsibility of E&M Engineering Department. Their works include two prominent fields: i.e. i) M&E system engineering (signaling, communication, rolling stock, train control system etc.) and ii) E&M system engineering (building service).

(2) Future Tasks

Main activities performed by this department for the two projects at present are to control and supervise the works of consultants and contractors.

Now that the Purple Line project has started, MRTA staff are to take part by working closely with the Concessionaires suppliers initially in their design and planning offices and later on-site checking installation works safety and quality as outlined in the Project Contract.

However, in general terms, for future new projects the tasks would be to monitor and supervise the Consultant and Contractor, if applies, to the following stages of a project:

Table 6.3 – Engineering and Construction Tasks Performed by MRTA

- Feasibility Studies;
- Detailed Project Reports;
- Techno-Economic investigations;
- Site surveys;
- Supply of basic engineering and detailed designs and working drawings for construction of the system;
- Equipment selection therein and manufacture of rolling stock and equipment, including their components, spares, assembles and sub-assemblies of all kinds and disciplines;
- Monitor material management;
- Material management;
- Preparation of specification and tender documents;
- Tender evaluation;
- Purchase assistance of all materials and goods pertaining to such projects;
- Expediting inspection and testing, construction supervision, project management, commissioning, operation and maintenance,
- Approve training plan of personnel and any such other services.
- Training of personnel and any such other services.

During the implementation (construction) of a new line, or any other project related to the MRTA system, such as rehabilitation or expansion of the system, etc, the Engineering and Construction Division would create specific Project Management Offices (PMO). PMO is created as the organization to be in charge of the actual implementation of the project and liaison with Consultant, Contractor, and other concerned stakeholders.

The main scope of works of the PMO is summarized below:

Table 6.3 – Main Scope of Works of PMO

- Reviewing the Consultants design methods, standards and criteria used in the preparation of the design;
- Assuring that Contractor's work complies with the plans and specifications of the contract by conducting regular site inspections;
- Monitors work accomplishment of the contractors;
- Analyzes and interprets financial statements/reports;
- Responsible for all matters relating to taxes-related transactions;
- Responsible for the safekeeping of all project records and correspondence;
- Coordinates with MRTA Accounting Division and Auditing regarding financial transactions of the PMO;
- When financed by ODA loans, coordinates with the ODA Bank's Representatives regarding the PMO's disbursements;

- Prepares all financial reports other than the PMO's financial statements as may be required by MRTA and fiscal authorities/other agencies;
- Monitors and assists in the verifications of disbursement.

(3) Task Flow

N/A

(4) Job Description

The particular role of some of the departments is mentioned below:

a) Office of the Project Manager

Shall be in charge of the supervision and management of all the functions of the Project Management Office. Shall be in charge of community relations during project implementation and setting-up of an efficient management operation of system for the PMO.

b) Financial Services

Shall be in charge of the Budget, Accounting and Disbursement functions of the PMO. Generate pertinent financial reports of the PMO.

c) Administrative Services

Shall be in charge of all Personnel, Legal, Property, Supplies and Liaison matters of the PMO. Generate inventory reports, personnel appraisal and other pertinent reports.

d) Civil / Structural Services

Shall be in charge of all the civil and structural aspects of the project to include review of design, supervision of excavation, foundation works, steel fabrications, structural works, trackworks, and pre-cast elements fabrication. Generate pertinent reports.

e) Electro-Mechanical Services

Shall be in charge of the electrical, mechanical, signaling, telecom and fabrication works of the Project. Design review and supervision of the above mentioned works for the duration of the project. Generation of required reports.

6.2.4 Administrative Activities

(1) Target Group

Two departments are jointly involved in administrative activities, namely Administration Department and Strategy and Planning Department.

(2) Future Tasks

Under Gross Cost Concession Scheme, MRTA takes the risk, so MRTA will set the fare structure and fare rates, where as, under the Blue Line the Concessionaire sets the fare structure and fare rates as the Concessionaire is taking all the risks for revenue generation. The ridership increase policy, strategy and related marketing, promotion activities would be vitally important for MRTA.

(3) Task Flow

Administrative task activities under Gross Cost Scheme is yet to be elaborated until now. MRTA should shortly start detailed analysis of the change in administrative tasks and their process under Gross Cost Scheme. The first step is to summarize the result of this task analysis in a task flow diagram covering entire task activities, including task goals.

(4) Job Description

Job descriptions of administrative tasks shall be then improved after a job analysis. For the better capacity management, job description needs to identify the knowledge, skills, and attitudes required to perform the job correctly.

6.2.5 Required Capabilities

MRTA has started its Purple Line project with its planned opening in 2016 or in five-year time after the construction starts. This new line will be contracted under the Gross Cost Concession Scheme, whereas the current Blue Line opened in 2004 MRTA has been supervising the operation based on the Net Cost Concession Scheme under which MRTA only receives the concession fee and thus it is not engaged in the economic and operational feasibility.

The fundamental change taking place under the Gross Cost Concession Scheme, MRTA will directly collect passenger fare. The role of the concessionaire will be an operator receiving technical fee for the operations. Under this Scheme, MRTA will be more responsible for the railway operations but its role still stays as supervisor, monitor and controller of the concessionaire who runs train operations. MRTA still stay indirectly responsible for the railway operations.

In summary, required capabilities in the short-term can be drawn as follows:

Required Capabilities in Summary

1. Technological Capabilities from project planning to day-to-day operation (including revenue collection) & maintenance (including supply & procurement),
2. Financial Management on treasury, cash management, asset and liability management and short-term investment,
3. Strategic Planning on suburban / regional development, collaboration with local governments, businesses and communities,
4. Legal Management on contractual management, procurement process and negotiation skills,
5. Public Relation Capacity such as public communication, corporate social responsibility

6.3 Current Capacity Constraints and Factors behind Capacity Discrepancies

6.3.1 Current Capacity Constraints

The current structure and the capacity of each unit have been reviewed in Chapter 4. In considering MRTA's current capacity constraints, following factors should be taken into consideration; (More detailed assessment are given in Appendix 6.1 in the form of SWOT analysis).

(1) Institutional Aspect

Current capacity constraints from an institutional standpoint are as follows;

Current Capacity Constraints – (1) Institutional Aspect

- Key decisions making at government on the eventual changes
- An "indirect" management and a "remote" supervision circumstance under given concession scheme
- No access to the system and no opportunity to gain hands-on experience.

Way Forward

- Getting closer (but still indirect) to direct operations upon introduction of Gross Cost Scheme
- Making provisions to have authorities of direct monitoring and approval of the concessionaire's activities
- Creating the opportunity to gain hands-on experience

(2) Contractual Aspect

Current capacity constraints from a contractual standpoint are as follows;

Current Capacity Constraints – (2) Contractual Aspect

- No control over training/technical transfer provided by the Concessionaire
- Very little control over the Concessionaires O&M activities
- Very little or no competition for concession contract of Blue Line ISP
- Insufficient legal capability on contractual management, procurement process and negotiation skills

Way Forward

- Having the authority of direct approval of Concessionaires training and technology transfer programme
- Having the authority of direct approval of Concessionaires O&M plans and activities
- Undertaking robust performance monitoring using incentive/penalty tools
- Preparing the condition of Prequalification with careful consideration of provable number of qualified bidders
- Building legal management and negotiation skills

(3) HR Recruiting Aspect

Current capacity constraints from a human resource recruiting standpoint are as follows;

Current Capacity Constraints – (3) HR Recruiting Aspect

- Difficulties in finding internal resource persons due to the concession scheme nature
- Weak labor market in railway engineering sector due to relatively short history of urban mass transit systems
- Not too much attractive offers made vis-à-vis private sector companies due to the nature of state enterprise and financial constraints
- Mismatch between TOR and actual work
- Too high expectation without good understanding of "indirect" nature of MRTA operations

Way Forward

- Creating the opportunity to gain hands-on experience
- Offering clear career stream / path to gradually increase internal resource
- Hiring experienced experts as in-house consultants on contract basis
- Better understanding of legal and contractual conditions of present and future concessions

(4) HR Development Aspect

Current capacity constraints from a human resource development standpoint are as follows;

Current Capacity Constraints – (4) HR Development Aspect

- Trainings not well organized, planned
- Trainings rather fragmented in response to Dept / Staff needs
- Difficulties in finding internal resource persons due to the Net Cost Scheme nature
- Trainings rather personal objectives, and not institutional ones
- Not clear career stream / path offered to staff

Way Forward

- Strategic training design and development
- Strategic career building planning and implementation

6.3.2 Factors behind Capacity Discrepancy

Following factors are identified as the causes of capacity discrepancy;

Three Factors behind capacity discrepancy

1. Issues brought up from the difference between the current Net and Gross Cost Concession Scheme, firstly,
2. Fields deriving from MRTA's reverse order development resulted in the non-existence or availability of the internal resources, secondly, and
3. Areas originated in MRTA's short history on the newly developed railway business in the country and not having sufficient time to establish a common "knowledge base" in spite of the existing relatively high morale and royalty.

(1) Capacity Constraints due to the Net to Gross Cost Scheme Change

Unclear Role of Units- Although the senior and mid-level management staff members seem to have a clear understanding of the roles and scope of the work of their respective sections, it appears that for their subordinates, the scope of work is not very clear. Some of them are the units with unclear role or overlapping roles, frequent changes of assignments, and lack of guidance from manager to engineer on the specific job assignments without understanding. It is desirable for the staff members to improve the knowledge on the entire unit's role in order to have a clear understanding of the work to be done in the present and also in the future.

Limited Contractual Knowledge - Regarding what and how to monitor the activities of the concessionaire, and what and how MRTA should carry out business in the future, the staff knowledge on the contractual obligations of each party in the Concession Agreement is limited.

It is understandable that some capable engineers may consider themselves not having enough background. However, in front of the Concessionaire, having a sufficient legal and procurement knowledge and some negotiation and legal process skills are critical. In light of several new line projects, it is critical and essential for the MRTA staff not only in Engineering and Construction but also Operations and Maintenance and other units.

Insufficient Technical Capacity - For the units responsible for operations and maintenance where the Concessionaire supervision is the main activities, some of the staff members have non-engineering background. However, to conduct their operational activities, it is essential

to have some engineering and technical understandings. Giving opportunities to non-engineers to gain some technical capability are considered essential.

(2) Capacity Constraints due to the MRTA's Reverse Order Development

Furthermore, under this "Net Cost Concession Scheme", MRTA only receives the concession rent / fee and thus it is not engaged in the economic and operational feasibility.

MRTA is given legally full and comprehensive power to engage itself in the railway business under the MRTA Act. In spite of the strong wish expressed by the MRTA management, the history of MRTA operations has been developed in a **Reverse Order Development**. While the railway business has been developed, in most of the cases around the world, by the railway system owner. They are primarily the railway operator and grant concessions and/or outsourcing of some activities to the concessionaires or contractors.

This implies that MRTA, very unfortunately has been experiencing a regular development history. From the beginning of their operations, they were asked to assume their responsibilities under the "Net Cost Concession Scheme". MRTA is operating their railway in an **"indirect" management and a "remote" supervision circumstance** having no hands-on experience. Because of this, it is virtually impossible for MRTA to build up internal human resources available for proper managerial, technical, operational and financial management experience.

The new Gross Cost Concession Scheme is a big step forward in getting closer to a direct operation. MRTA will be consequently responsible for "Ridership Increase" and "Securing Revenue" as stated above listed in iii) Operation at the Capabilities by Tasks above. It is understood as a process of a long-term orientation through **acquiring hands-on experience** for future "Direct Operations" at one or more of the planned lines.

(3) Capacity Constraints due to the MRTA's Short History

In spite of the short history, MRTA has been making effort to create an open, interactive and knowledge-sharing communication atmosphere but not reached to establish a firm **corporate culture** shared commonly among the management and staff members yet. This leads to some key human resources management issues deriving from its short history.

MRTA successfully offer a good attraction in the labor market as a newly born railway businesses in Thailand. MRTA has been offering relatively an **attractive compensation package** for its new recruitment compared with other public administration positions. The

new recruited staff members are **highly motivated** thanks to the attraction of the MRTA businesses.

Majority of MRTA staff keep their high motivation but have some concern on their career path how they accumulate their knowledge and skills particularly from technical aspects. Discrepancy between their daily tasks and the advertised TOR during the recruitment seems to take place. Ad hoc job rotations, fragmented training opportunities, detailed KPI introduction may leave staff members cultivate some frustration with the uncertain career stream for their future in the long run.

The indirect supervision and intervention due mainly to the **limited access** to the key information or difficulties have given **some frustrations** to the staff since most of the operating activities and information are held by the Concessionaire.

Most of those points above may be expected positive development thanks to the present and future effort of MRTA management in spite of its relatively **short history**. In spite of budgetary constraint as a state enterprise, the first solutions to keep up the morale of the staff have been offered in the form of the training.

Capacity Building, however, for the benefit not only for personal but also institutional objectives could be achieved through common efforts in establishing a **harmonized corporate culture**, **clear professional expertise** and the **career stream assurance** in the medium- and long-term.

6.4 Immediate Needs for Training

6.4.1 Training Modules by Task Group

The upcoming Gross Cost Concession Scheme will require a higher responsibility to MRTA covering from managerial to technological, operational and administrative aspects.

As the Purple Line is expected to open in five years, a number of training programs should be offered to quickly build up the capacity of the MRTA staff. These immediate training needs include, but not limited to, the modules given in the following tables;

It should be noted that in fact, the supervision, evaluation, management and control activities will be most effectively performed on the basis of the real practices on the ground and its experience. MRTA staff does not have such experience and thus no expertise within their institution. It may take considerable time, but accumulating real practices through hands-on OJT style training will be the single solution to be able to supervise the concessionaire in the real sense of the term.

Table 6.4 – Training Modules by Task Group

No.	Task NOT able to perform under current capability	Capacity required to perform the task	Target key personnel (Dept./Div./Section)	Training content	Training provider
1.	**[Administration / Supply & Procurement]** Supervise and monitor the Concessionaire to plan and procure local and foreign spare parts;	1.Monitor Spare Parts stock levels through the CMMS 2.Identify Long Lead Items that need to be oredered well in advance 3.Review the Concessionaire procurement schedules and ensure rlebvant spare parts are ordered on time to arrive when needed in accordance with maintenance schedules in the CMMS 4.Identify items that can be procured locally and raise awareness to the Concessionaire as necessary 5.Carryout on-the-spot audits of spare parts inventories to check accuracy of CMMS stock holdings to actual holdings in stores.	•Maintenance Division / MRT System Maint. Section •Supply Division / Procurement Section	1.Basic Introduction and appreciation of M&E Systems 2.Basic Introduction to the CMMS and Stores Ordering Function 3.Basic Introduction to Quality Assurance & Control Awareness and Auditing Methods	1.Internal MRTA 2.BMCL Supplier 3.Outsourced (Bangkok)
2.	**[Administration / Supply & Procurement]** Approve technical evaluation, budget adjustments memoranda and other communications necessary to expedite the canvassing process;	1.Review the Concessionaire's technical evaluations, budget adjustments memoranda and other communications necessary to expedite the canvassing process and raise comments or approve as necessary. 2.Carryout technical studies and calculations to confirm the Concessionaires Technical evaluations are sound and correct. 3.Examine any budget adjustments against the original Bill of Quantities unit prices set in the CMMS against inflation data and assess correctness of price or raise concerns back to the Concessionaire for re-evaluation and/ or justification 4.Write reports with comments and recommendations to the Maintenance Division Manager for final consideration and any comments before approval is given	•Maintenance Division / MRT System Maintenance Section •Supply Division/ Procurement Section	1.Basic and Intermediate and Advanced Introduction and appreciation of M&E Systems 2.Basic Introduction to the CMMS 3.Basic Financial Management Course	1.Internal MRTA 2.BMCL Supplier 3.Internal MRTA
3.	**[Administration / Supply & Procurement]** Supervise and monitor the Concessionaire when implement policies relative to the usage and disposal of the tools and equipment, communications and all AFCS equipment.	1.Monitor the activities of the Concessionaires maintenance staff against approved O&M Manuals to identify any concerns on the usage and disposal of tools and equipment, communications Systems and AFC System equipment and short falls and raise any concerns to the Concessionaire for action. 2.Review maintenance reports and identify trends in usage of tools and equipment and Communications systems and AFC System and raise concerns as necessary to the Concessionaire for action. 3.Carryout on-the-spot audits of maintenance staff maintaining equipment on-site or in the depot workshops against approved O&M Manuals to ensure correct procedures are being carried out and completed correctly in a timely manner and raise concerns to the Concessionaire at maintenance planning meetings. 4.Complete audit reports and raise concerns as necessary and ensure all reports are included in Monthly Performanc Report to MRTA HQ	•Maintenance Division / MRT System Maintenance Section •Assets Management Division (non existing), or Business & Property Management Division	1.Basic Introduction and Intermediate appreciation of M&E Systems 2.Basic Introduction to the CMMS 3.Basic Quality Assurance and Auditing Course 4.Basic Man Management Skills	1.Internal MRTA 2.BMCL Supplier 3.Outsourced 4.Outsourced
4.	**[Administration / Supply & Procurement]**	1.1. Monitor the activities of the Concessionaires maintenance staff against approved O&M Manuals to identify any concerns on the	•Maintenance Division / MRT System	1.Basic Introduction and Intermediate	1.Internal MRTA 2.BMCL Supplier

No.	Task NOT able to perform under current capability	Capacity required to perform the task	Target key personnel (Dept./Div./Section)	Training content	Training provider
	Supervise and monitor the Concessionaire when implement policies relative to the usage and disposal of the tools and equipment, communications and all AFCS equipment.	usage and disposal of tools and equipment, communications Systems and AFC System equipment and short falls and raise any concerns to the Concessionaire for action. 2.Review maintenance reports and identify trends in usage of tools and equipment and Communications systems and AFC System and raise concerns as necessary to the Concessionaire for action. 3.Carryout on-the-spot audits of maintenance staff maintaining equipment on-site or in the depot workshops against approved O&M Manuals to ensure correct procedures are being carried out and completed correctly in a timely manner and raise concerns to the Concessionaire at maintenance planning meetings. 4.Complete audit reports and raise concerns as necessary and ensure all reports are included in Monthly Performance Report to MRTA HQ	Maintenance Section •Assets Management Division (non existing), or Business & Property Management Division	appreciation of M&E Systems 2.Basic Introduction to the CMMS 3.Basic Quality Assurance and Auditing Course 4.Basic Man Management Skills	3.Outsourced 4.Outsourced
5.	**[Administration / Supply & Procurement]** Verify daily rail revenue collections, remittances and deposits;	1.Using the AFC Central Computer, print out daily revenue transactions reports against revenue actually received from each station. 2.Identify shortfalls and discrepancies and investigate all as necessary and complete transaction discrepancy reports for the auditors 3.Raise concerns to the MMC concerning any problems and unusual events or failure trends affecting the Revenue collection, remittances and deposits system for corrective action	•Treasury (non-existing) •System Operation Division •Accounting Division / Accounting Section	1.Basic Introduction and Advanced appreciation of AFC System and in particular the Station Computers and Central Computer reporting lines and auditing features. 2.Basic Financial Management Course	1.BMCL Supplier 2.Internal MRTA
6.	**[Administration / Treasury]** Supervise collection and remittances of unsold tickets from stations personnel and prepares reports related to revenue and ticket collections;	1.Supervise MRTA Staff in the selling of tickets in stations and cash handling staff in the cash rooms preparing change drawers and maintaining stocks of tickets in ticket issuing machines (TIM) and in the Ticket Offices. 2.Supervise collection of used tokens from the gate machines and reloading in token holders for TIM's 3.Observe staff on CCTV monitoring system in their daily activities and identify any concerns of fraud and raise any concerns with Security Staff and investigate as necessary 4.Complete daily revenue collections, remittances and deposits to MRTA Finance Dept for correspondence against Central Computer Printouts 5.Complete reports on staff concerns such as fraudulent activities to MRTA Human Resources department and Finance Department higher management.	•Treasury (non-existing) •System Operation Division •Accounting Division / Accounting Section	1.Basic Introduction and Advanced appreciation of AFC System 2.Basic Financial Management Course 3.Basic Man Management Skills	1.BMCL Supplier 2.Internal MRTA 3.Outsourced
7.	**[Operation / Train Operation]** Approve system and train	1.Review Train Operation plans, policies and strategies proposed by the Concessionaire to ensure maximum efficiency and effectiveness and make comments as necessary and discuss with	•System Operation Division / MRT System Operation	1.Basic Introduction and appreciation of Timetable Generation	1.BMCL Supplier 2.BMCL Supplier 3.Internal MRTA

No.	Task NOT able to perform under current capability	Capacity required to perform the task	Target key personnel (Dept./Div./Section)	Training content	Training provider
	operating plans, policies, and strategies to ensure efficiency and effectiveness;	the Concessionaire and resolve any issues before issuing approval. 2.Observe the general operation of trains under normal operations and identify and problems or blockages effecting the efficiency of the system and maintenance of headways to the timetable schedules. 3.Observe the general operation of trains under abnormal degraded operations and identify and problems or blockages effecting the efficiency of the system and maintenance of headways to the timetable schedules. 4.Study current train operating plans, policies and strategies in current force and identify improvements that could be made to the Concessionaire and raise to the Concessionaire and Operating department higher management.	Supervisory Sections	System in CTC 2.Basic and Intermediate and advanced Introduction to Train Operation, Train Schedule Planning and Contingency Planning 3.Basic Introduction to the Signalling Systems	
8.	**[Operation / Train Operation]** Supervise and monitor the Concessionaire to coordinate with the Traffic Management Unit regarding train movements service interruption and train service;	1.Supervise and Monitor the Concessionaire in the Central Control Room in their Traffic Management duties in accordance with the approved Train Operation plans, policies and strategies proposed to ensure maximum efficiency and effectiveness and make comments as necessary and discuss with the Concessionaire and resolve any Traffic Management issues. 2.Observe the general operation of trains under normal operations and identify and problems or blockages effecting the efficiency of the system and maintenance of headways to the timetable schedules. 3.Observe the general operation of trains under abnormal degraded operations and identify and problems or blockages effecting the efficiency of the system and maintenance of headways to the timetable schedules. 4.Review and consider "Contingency Plans" for emergency conditions and observe effectiveness of the system and the Concessionaires staff under abnormal and emergency conditions and advise and support the Concessionaires Operators and/ or take control and direct the Operators using MRTA Authority.	•System Operation Division / MRT System Operation Supervisory Sections	1.Basic Introduction and appreciation of Timetable Generation System in CTC 2.Basic Introduction to Train Operation, Train Schedule Planning and Contingency Planning 3.Basic Introduction to the Rolling Stock and Signalling Systems 4.Basic Man Management Skills	1.BMCL Supplier 2.BMCL Supplier 3.Internal MRTA 4.Outsourced
9.	**[Operation / Traffic Control]** Supervise and monitor the Concessionaire to operate, control and monitor SCADA;	1.Supervise and Monitor the Concessionaire in the Central Control Room in their SCADA Engineering duties in accordance with the approved Train Operation plans, policies and strategies proposed to ensure maximum efficiency and effectiveness and make comments as necessary and discuss with the Concessionaire and resolve any SCADA Engineering issues. 2.Observe the general operation of trains under normal operations and identify all SCADA requirements to ensure safe operation is maintained at all times. 3.Observe the general operation of trains under abnormal degraded	•System Operation Division / MRT System Operation Supervisory Sections	1.Basic Introduction and appreciation of Timetable Generation System in CTC 2.Basic Introduction to Train Operation, Train Schedule Planning and Contingency Planning 3.Basic Introduction to	1.BMCL Supplier 2.BMCL Supplier 3.Internal MRTA 4.Outsourced

No.	Task NOT able to perform under current capability	Capacity required to perform the task	Target key personnel (Dept./Div./Section)	Training content	Training provider
		operations and identify and problems or blockages effecting the efficient usage of power and isolation of the trackside Conductor rail setions as necessary to protect detrainment passengers and/ or maintenance and train crews. 4.Review and consider "Contingency Plans" for emergency conditions and observe effectiveness of the system and the Concessionaires staff under abnormal and emergency conditions and advise and support the Concessionaires SCADA Controllers and Engineers and/ or take control and direct the SCADA Engineers using MRTA Authority.		the Rolling Stock and Signalling Systems 4.Basic Man Management Skills	
10.	**[Maintenance]** Supervise and monitor the Concessionaire to operate, control and monitor Maintenance CMMS;	1.Monitor and Supervise the Concessionaires Maintenance Management Centre staff and engineers in their daily maintenance management duties against approved O&M Manuals and Maintenance Schedules and the approved policies and procedures of the MMC. 2.Monitor the use and operation of the CMMS from the MRTA Terminal and observe all maintenance activities such as scheduling, fault reporting, maintenance works reporting, asset management and stores ordering against approved policies, strategies and procedures. 3.Write weekly maintenance reports to MRTA Maintenance Division management on efficiency and correct operation of the MMC and any comments or recommendations how better to carry out the daily routines on any systems under the CMMS and MMC control	•Maintenance Division / MRT System Maintenance Section	1.Basic Introduction to the CMMS 2.Intermediate Operation and Maintenance of the CMMS 3.Advance Operation and Maintenance of the CMMS 4.Basic Man Management Skills	1.BMCL Supplier 2.BMCL Supplier 3.BMCL Supplier 4.Outsourced
11.	**[AFC Service]** Reconcile daily and monthly ticket sales / revenue in each line as against the Central Computer System (CCS) generated reports;	1.Using the AFC Central Computer, print out daily ticket sales/revenue transactions reports against revenue actually received from each station. 2.Identify shortfalls and discrepancies and investigate all as necessary and complete transaction discrepancy reports for the auditors 3.Raise concerns to the MMC Manager concerning any problems and unusual events or failure trends affecting the Revenue collection, remittances and deposits system for corrective action	•System Operation Division / AFC Section (non-existing)	1.Basic Introduction and Advanced appreciation of AFC System and in particular the Station Computers and Central Computer reporting lines and auditing features. 2.Basic Financial Management Course	1.BMCL Supplier 2.Internal MRTA
12.	**[AFC Service]** Supervise the reconciling of ticket inventory against the actual physical count of tickets.	1.Visit each station and supervise ticketing staff to carry out audits and spot checks on ticket media inventories against stock lists and identify any discrepancies in actual ticket media stocks against asset management records in the CMMS 2.Write reports on all audits to the MRTA System Operation Division raising any concerns, shortfalls and recommended actions	•System Operation Division / AFC Section (non-existing)	1.Basic Introduction and appreciation of AFC System 2.Basic Introduction to the CMMS 3.Basic Man Management Skills	1.BMCL Supplier 2.BMCL Supplier 3.Outsourced

No.	Task NOT able to perform under current capability	Capacity required to perform the task	Target key personnel (Dept./Div./Section)	Training content	Training provider
13.	**[AFC Service]** Supervise the reconciling of ticket production as against daily ticket balance records.	1.Where ticket media shortfalls are recognised, supervise the transfer of additional ticket media from the stores to the relevant station and instruct MMC staff to update the CMMS Asset Management Register of the transfer. 2.Identify when Ticket media stocks in the stores are low and the need for procurement of new stacks are required to the MMC Manager. 3.Oversee and supervise the procurement process against approved policies and ensure sufficient stocks are replenished in a timely manner. 4.Report all such findings and actions taken with expected replenishment dates and amounts to the Maintenance Division on a weekly/monthly basis.	•System Operation Division / AFC Section (non-existing)	1.Basic Introduction and appreciation of AFC System 2.Basic Introduction to the CMMS 3.Basic Man Management Skills	1.BMCL Supplier 2.BMCL Supplier 3.Outsourced
14.	**[AFC Service]** Supervise the Concessionaire to maintain and monitor Automated Fare Collection computer system, and manage and monitors file server and database;	1.Observe the maintenance reports of all AFC systems and equipment from the CMMS. 2.Supervise and monitor the Concessionaire's staff in the maintenance of the AFC system 3.Visit every station and observe the public operating the AFC equipment and identify any problems or weaknesses in the system. 4.Review the policies and procedures agreed for the management of file servers and databases, and especially back-up of the data bases incase of failures. 5.Write reports and make recommendations to the Maintenance Division where discrepancies or problems have been observed with recommendations and solution on how to address problems	•System Operation Division / AFC Section (non-existing)	1.Basic and Intermediate Introduction and appreciation of AFC System 2.Basic Introduction to the CMMS 3.Basic Man Management Skills	1.BMCL Supplier 2.BMCL Supplier 3.Outsourced
15.	**[Maintenance]** Approve policies and guidelines in the maintenance of rolling stock and M&E subsystems;	1.Review proposed policies and guidelines in the maintenance of Rolling Stock from the Concessionaire and make comments or approve as necessary until all policies and guidelines are revised to MRTA satisfaction. 2.Carryout on-the-spot audits of the Concessionaires maintenance staff carrying out maintenance on Rolling Stock against the approved policies and guidelines and write audit reports on all findings and raise "non-conformance" reports to the Concessionaire for resolution and closure. 3.Monitor the CMMS Rolling Stock maintenance reports and identify failure trends that may be due to unseen deficiencies in the policies and guidelines on Rolling Stock maintenance and write reports and recommendations to the Maintenance Division Manager	•Maintenance Division / MRT System Maintenance Section	1.Basic and Intermediate and advanced Introduction and appreciation of Rolling Stock and M&E Systems 2.Basic Introduction to the CMMS	1.BMCL Supplier 2.BMCL Supplier
16.	**[Maintenance]** Approve policies and guidelines in the	1.Review proposed policies and guidelines in the maintenance of Trackworks from the Concessionaire and make comments or approve as necessary until all policies and guidelines are revised	•Maintenance Division / Building and Permanent Way	1.Basic Introduction and appreciation of trackworks	1.BMCL Supplier 2.BMCL Supplier

No.	Task NOT able to perform under current capability	Capacity required to perform the task	Target key personnel (Dept./Div./Section)	Training content	Training provider
	maintenance of track works;	to MRTA satisfaction. 2.Carryout on-the-spot audits of the Concessionaires maintenance staff carrying out maintenance on-site on the Trackworks against the approved policies and guidelines and write audit reports on all findings and raise "non-conformance" reports to the Concessionaire for resolution and closure. 3.Monitor the CMMS Trackworks maintenance reports and identify failure trends that may be due to unseen deficiencies in the policies and guidelines on Rolling Stock maintenance and write reports and recommendations to the Maintenance Division Manager	Maintenance Section	2.Basic Introduction to the CMMS	
17.	**[Administration / HR Management]** Implement training program for trainers	1.Create In-house training programme for MRTA staff as necessary to ensure trainees can understand and carryout their work effectively and efficiently. 2.Propose training programmes and schedules to Division managers requesting comments and their requirements for what courses 3.Deliver effective training to MRTA staff as necessary to the required standards and carryout weekly and final examinations, bot academic and practical to evaluate the Trainee's understanding of the information and systems instructed on. 4.Complete training reports of each individual to the relevant divisional managers with feed-back 5.Review Pass/Fail rates and identify weaknesses in training materials or delivery of instruction and make improvements to address all weaknesses and compile monthly reports to MRTA Human Resources Division.	Human Resources Division	1.Basic Instructor Training 2.Basic, Intermediate and Advanced Introduction and appreciation of *Relevant System(s)* to carry out training of others on.	1.Outsourced 2.BMCL Supplier
18.	**[Maintenance]** Monitors the performance of the Concessionaire and oversee the proper implementation of Quality Assurance/Quality Control of all maintenance/repair works.	1.Review the Concessionaire's Quality Manual, Guidelines and Procedures concerning the maintenance of all systems works. 2.Review previous audit reports and carryout detailed audits of the standards of maintenance on-site and in the depot of all maintenance/repair works 3.Make out audit reports and raise non-conformance reports (NCR's) where necessary with the Concessionaire and agree corrective actions towards closure of the NCR's as necessary. 4.Carryout audits on the Concessionaires QA/QC system with the Concessionaires Quality Manager and identify any weaknesses and raise NCR's. 5.Ensure all NCR's are closed out to MRTA satisfaction within the stipulated time in the Concessionaire's approved Quality manual.	•Maintenance Division / MRT System Maintenance Section	1.Basic Introduction and appreciation of M&E Systems 2.Basic Introduction to the CMMS 3.Basic Introduction and appreciation of civil E&M systems	1.Internal MRTA 2.BMCL Supplier 3.Internal MRTA

6.4.2 Training Modules Common to Some Different Sections

Training modules, common to some different sections, are shown as below:

Table 6.4 – Training Modules Common to Some Different Sections

No.	Training Module	Training Provider
1	Basic Introduction and appreciation of M&E Systems	Internal MRTA
2	Basic Introduction to the CMMS and Stores Ordering Function	BMCL System Supplier
3	Basic Introduction to Quality Assurance & Control Awareness	Outsourced
4	Basic Financial Management Course	Internal MRTA
5	Basic Quality Assurance and Auditing Course	Outsourced
6	Basic Introduction and Advanced appreciation of AFC System	BMCL System Supplier
7	Basic Financial Management Course	Internal MRTA
8	Basic Introduction and appreciation of Timetable Generation System in CTC	BMCL System Supplier
9	Basic Introduction to Train Operation, Train Schedule Planning and Contingency Planning	BMCL System Supplier
10	Basic Introduction to the Signalling Systems	Internal MRTA
11	Basic Introduction to the Rolling Stock	Internal MRTA
12	Basic Introduction and appreciation of Power & SCADA Systems	Internal MRTA
13	Basic Introduction to the FRACAS System	BMCL System Supplier
14	Basic Man Management Skills	Outsourced
15	Basic Introduction to the M&E Systems	BMCL System Supplier
16	Basic Introduction to the trackworks	BMCL System Supplier

6.5 Training Design and Development

6.5.1 Training Philosophy

(1) Current Capacity Building Training at MRTA

With a view to increase its capacity, MRTA has introduced a wide variety of training programs including overseas training at their suppliers. Those training program subjects and contents seem to be adequate in many cases but there are some cases focusing too much on the operational aspects due to the fact that MRTA does not have reasonable access under the current concession agreement conditions.

More supervision, management and control oriented training are needed to reinforce and be ready for the Gross cost scheme operations for Purple line, but due to the historical reasons as stated above, internally established knowledge and skills are still very limited.

There are, however, ways to develop MRTA's institutional capacity through their staff members. The key approaches are;

Key Approaches to Develop MRTA's Institutional Capacity

1. To make maximum use of "External Trainers and Consultants",
2. To enhance internal dissemination, knowledge-sharing and cross-nurturing system, and
3. To reflect in the staff performance evaluation system on those training and dissemination.

(2) Capacity Building Training Principles

Effective capacity building trainings ("CBT") mean the trainees / participants fully understand the contents and they are empowered to exercise what they have acquired.

It is quite often observed that trainings are conducted in a unilateral manner that "the trainers talk, and the trainees listen to him." Human memory may disappear rather soon. What a trainee learned at the training may not be easily copied or exercised. When one conducts a capacity building training, it is important to conduct it under A-W-K-S principles as shown below to avoid the knowledge and skills acquired by the trainees to disappear so that trainees have high level of awareness and strong willingness of the tackle with the subject. It will not only the knowledge the trainees would learn but also skills for them to implement. The knowledge and skills will be replicated and shared with firm confidence within MRTA.

Capacity Building Training Principles (A-W-K-S Principles)

Trainees / Participants to:

- Recognize what they need (Awareness)
- Raise their strong wishes to learn (Willingness)
- Understand what are the substance (Knowledge)
- Practice and gain how to do (Skills), and
- Be empowered to apply what they acquired with confidence

CBT implementation approach should be done in a manner that trainees seriously participate in the training programs and they are able to express and share what they think freely and finally what they have acquired are practically applied and get reasonable recognition from the seniors. The PIONEER approach simply illustrates how a CBT should be organized to attain the expected outcomes.

Capacity Building Training Implementation Approach (PIONEER Approach)
• Practical - not conceptual, not theoretical, easy to apply • Interactive - not unilateral, not in a one side communication from trainers • Open - providing environment for knowledge, skills and comments to be shared openly • Networking - opportunities to network among trainers and with outside professionals • Evolutional - looking forward and encouraging innovations • Entrepreneurial - encouraging creativity and innovations • Rewarding - recognizing participation and implantation and rewarding by management as a part of performance evaluation

Training should be structured to offer practical key operational Issues for trainees to understand and let them practice to be empowered with their confidence.

Participants are able to build and incorporate knowledge and skills into their operations as their own expertise, and contribute to sustainable development.

Supervisors are to show commitments to their staff via encouraging their attendance without giving other tasks during training period, giving staff related tasks / jobs to be harmonized with the training contents, and participate in sessions to directly see the progress and outcomes.

Trainers are coach, guide, mentor, or shepherd, and not professor or teacher. They provide unilateral information and knowledge, assist participants, incorporate new knowledge and skills, and feel them confident in conducting tasks by themselves without help or assistance by the trainers.

(3) Training Implementation and Impact Assessment

Capacity Building Training (CBT) implementation and its impact can be best described by introducing a key word “Linkage”

CBT Linkage	
CBT Linkage with Actual Work	CBT is an essential tool to build up institutional and staff capacity. The real capacity will only be, however, is confirmed when the trained knowledge and skills are used in the tasks of the trainees at their professional front.
CBT Linkage with Interactive Modes	The effectiveness should be higher when a training is organized under the principles of AWKS and PIONEER as stated above with a hands-on or OJT methods featuring on the interactive mode of the training.

CBT Linkage	
CBT Linkage with Unit	The best and common practice for the effective training outcomes are to ask trainees to draft, present and discuss with the unit / division / department colleagues. The trainee should be informed of his/her requirement before participation. When the staff comes back to the office, they organize a debriefing session with the unit. A knowledge sharing, dissemination and discussion will also be helpful not only the trainee but also other colleagues to understand the outcomes of the CBT.
CBT Linkage with Performance	MRTA management is about to start their application of performance evaluation tool. The CBT outcomes to be incorporated in the performance record initially input by the staff would be the key information of CBT and the staff free comments how the attended CBT has been useful and applied to the staff tasks.

6.5.2 Class Room Training

(1) Need for Basic Training Course

At the moment some MRTA staff have little experience or knowledge of railway systems in detail and only have a basic understanding delivered by the Blue Line Concessionaire and M&E Supplier (Siemens) or what they have read in training courses literature.

To raise the awareness of MRTA staff to the required levels of understanding, some more senior staff who have a greater understanding could become Key Trainers (on a part-time basis) to deliver basic training courses to prepare MRTA staff for the start of the M&E Contract expected early 2011.

(2) Making a Start

Selection of Key Trainers is the first step and must be carefully assessed as not everyone can stand in front of others and deliver clear and understandable information at the level low enough that junior staff would understand. As a training course proceeds, the Key Trainers can assess the level and capability of the students being tutored and raise or lower the level of language and technical jargon as necessary and the speed of delivery of the information.

If senior staff chosen for Key Trainer duties has any concerns on how to deliver training courses, some outsourced Basic Trainer courses are available in Bangkok that MRTA could send their Key Trainer's to (See Appendix 6.2). A typical Basic Trainer course should take approximately 2-3 weeks to complete, provided selected staff have the ability to meet the standards required to pass the Basic Trainer course. Not all staff may be suitable to deliver training courses and selection of the right people is essential.

(3) Basic Introduction to M&E Systems

The M&E Systems are made up of 7 basic sub-systems being, i) Rolling Stock, ii) Signalling Systems, iii) Communications Systems, iv) Power Systems, v) Automatic Fare Collection, vi) Depot Workshop Equipment, and vii) Platform Screen Doors.

It may not be possible to have one Key Trainer with sufficient experience and knowledge to deliver all of the M&E systems listed above. Therefore it may require several Key Trainers specialising in individual system disciplines to deliver different sections of the M&E System separately.

It may also be too much for trainees to fully comprehend in one go reaching saturation point of information after only a few systems have been explained and demonstrated. For this example though, we will consider that all M&E Systems shall be delivered under one training course and explain the typical modules, duration, sequence and target times for training delivery to new recruits and junior engineers.

The systems are delivered as modules and so there are seven (7) modules in total forming the M&E Systems for the MRT Purple Line. Summary of the course modules are given in the following table and compete information is available in Appendix 6-3.

Table 6.5 - Course Modules in Sequence[1]

Training Modules	Duration	Course Outline
Module 1: Rolling Stock	2 weeks	Appreciation of Rolling Stock design, construction and testing including Interfaces, Safety standards and life cycle costs
Module 2: Signalling Systems	2 weeks	Appreciation of Signalling Systems design, system architecture, construction and testing including Interfaces with other systems, Safety standards, Operation & Maintenance requirements and life cycle costs
Module 3: Communications Systems	2 weeks	Appreciation of Communications Systems design, system architecture, construction and testing including Interfaces with other systems, Safety standards, Operation & Maintenance requirements and life cycle costs
Module 4: Power Systems	1 week	Appreciation of Power Systems design, system architecture, construction and testing including Interfaces with other systems, SCADA, Safety standards, Operation & Maintenance requirements and life cycle costs

[1] The sequence can be varied dependent on the discipline required

Training Modules	Duration	Course Outline
Module 5: AFC System	1 week	Appreciation of the AFC System design, system architecture, construction and testing including Interfaces with other systems, Safety standards, Operation & maintenance requirements and life cycle costs
Module 6: Depot Workshop Equipment	3 days	Appreciation of Depot Workshop Equipment installation and testing including Interfaces with other systems, Operation & Safety standards, maintenance requirements and life cycle costs.
Module 7: Platform Screen Doors	2 days	Appreciation of Communications Systems design, system architecture, construction and testing including Interfaces with other systems, Safety standards, Operation & Maintenance requirements and life cycle costs

(4) Job Assignment after Basic Introduction

Once a student has successfully completed the seven (7) modules or anyone individual module, it is important that the student is given time to consolidate the experience and amount of information received and given tasks related to the training given. Ideally the students position in the MRTA Organisation allows for use of the training in daily job responsibilities and further On-the-Job training and working (part time or full time) on the new MRT Purple Line project from the design stage through to commissioning and starting of the Operation Service period is highly recommended.

6.5.3 Hands-on / OJT Style Training

(1) Need for Hands-on / OJT Style Training

As noted previously, the supervision, evaluation, management and control activities will be most effectively performed on the basis of the real practices on the ground and its experience. MRTA staff does not have such experience and thus no expertise within their institution. In this connection hands-on / OJT style training is absolutely required for MRTA staff.

On the Job Training ("OJT") Style Training is known as one of the most effective ways to acquire new knowledge and skills. “Hands-on” or “Over-the-Shoulder” training is also quite efficient though it could be rather costly.

(2) Making a Start

Again, selection of Key Trainers is the first step and must be carefully assessed. The OJT does not need any specific training room by definition. An OJT can be exercised in an office

or a workshop or a factory. Trainees will exercise the actual cases and learn directly from the trainer.

A hands-on training would start by demonstrations and presentations by the trainer, and then practicing by the trainee followed by the further practice with the advice and help from the trainers would finally reach to a point where the participants feel confident as acquired knowledge and skills on the subjects they learned. In both methodologies, the key points is not delivering speech or explaining text to the trainees. The passive manner of the trainees will not achieve any objectives envisaged.

An OJT training can be arranged to respond to the trainees' current needs or concerns. Both MRTA management and the trainers may, prior to the following module, agree to the trainee's subjects/tasks to be pursued during the training period among his/her current responsibilities.

(3) Training through Purple Line Project

Now that the Purple Line project has started, it is recommended that all staff that shall oversee the Concessionaire Operation Services Period (26 years O&M) should take this valuable and rare opportunity to take part by working closely with the Concessionaires suppliers initially in their design and planning offices and later on-site checking installation works safety and quality as outlined in the Project Contract Phase 1 of the Works.

This type of On-The-Job training is invaluable and gives MRTA staff an insight into the detailed system architecture and their interfaces so that later during the Operation Service Period, information observed and or received/printed out can be easily understood and the root causes of problems determined.

The number of places reserved in the Contract are limited (See following table) and so Division Managers need to have the future organisation known and the staff who shall be positioned in the organisation and give these staff first priority in working with the suppliers.

A typical number of staff for M&E systems based on previous projects in Asia are given below:

Table 6.6 – Typical Number of Staff for M&E Systems for Project Implementation

System	Discipline	Sub-system	No. of staff	Remarks
Rolling Stock	Mechanical	Body Design & Construction and Air-conditioning	1	Ideally based in the RS Factory abroad
	Mechanical	Underframe and Bogie design and Construction	1	Ideally based in the RS Factory abroad
	Electrical	Traction Power, Rectifiers, Auxiliary power Train Controls, Train lines and general electrical wiring & lighting	1	Ideally based in the RS Factory abroad
	Electrical	Braking & Propulsion Package and Interfaces with Signalling Systems	1	Ideally based in the RS Factory abroad
Signalling Systems	M&E	OCC/CTC and SOR & Interfaces with Comms, SCADA, Power and BMS	1	Design Office, Factory & Site
	M&E	ATC & Interfaces with Rolling Stock and Comms Systems Trainborne Comms system	1	Design Office, Factory & Site
	M&E	CBI & Interfaces with Comms and PSD and Civil	1	Design Office, Factory & Site
	M&E	Wayside Equipment & Interfaces with Trackworks and Civil	1	Design Office, Factory & Site
Commu-nications Systems	M&E	BTN & Interfaces with Signalling, SCADA, AFC and Civil BMS	1	Design Office, Factory & Site
	M&E	Master Clock & CCTV	1	Design Office, Factory & Site
	M&E	PA, PIDS & TCS	1	Design Office, Factory & Site
	M&E	Telephone PABX and Public PABX and Interfaces with Private Operators	1	Design Office, Factory & Site
	M&E	Radio and Interfaces with NTC and Emergency Services	1	Design Office, Factory & Site
Power	M&E	Power Supply HV , TSS and SSS and Cabling & Interfaces with CR Contractor	1	Design Office, Factory & Site
	M&E	SCADA & Interfaces with Civil BMS and Comms Systems	1	Design Office, Factory & Site
AFC	M&E	CC and Interfaces with Blue Line and Comms systems	1	Design Office, Factory & Site
	M&E	Stations Equipment, RVT, AVM, AG, TIM, POST and SC & Interfaces with Civil BMS and Comms Systems	1	Design Office, Factory & Site
PSD	M&E	Mechanical	1	Design Office, Factory & Site
	M&E	Electrical	1	Design Office, Factory & Site
DWE	M&E	Mechanical	1	Design Office, Factory & Site
	M&E	Electrical	1	Design Office, Factory & Site

MRTA Civil staff have already started this process being located out in the Contractors site offices and Operations and Maintenance Division staff should prepare for the start of the M&E Concession Contract, which is targeted to start early 2011.

All staff cannot understand all systems immediately and divisional managers should interview their staff to recognise their strengths and weaknesses on different systems, especially Rolling Stock, Signalling Systems and Communications Systems. Staff chosen for these complicated systems should have some basic understanding from the Blue Line or other railway authority. Starting from zero knowledge, it will be difficult to keep up with the development of the designs, which must not be slowed down by MRTA staff asking basic questions and delaying the Works to an already very tight project schedule.

6.5.4 Training Locations

MRTA' new headquarters is planned to spare a Training Center. This MRTA Training Center will be the prime location for training. However, as described above an OJT' is not necessarily held at the Training Center.

As one option, it is worth mentioning of training opportunities in Japan at Japanese private sector railway companies. Learning from their vast experience on the managerial, technical, operational subjects as well as capacity development issues would be very meaningful.

A general listing of training location is as follows;

- MRTA Training Center with simulators and mock-ups
- Short-term Onsite Training (at office, stations, depot, workshop, or external expert's office)
- Secondment / Staff Exchange (MRTA staff to be dispatched to a company under the SEP)
- External Experts / Firms Office
- Dedicated Skills Training Firms

Besides, it would be worth considering to arrange the training / technology transfer programs through:

- Closing a deal with the existing concessionaire to undertake end-concession technology transfer ahead of schedule
- Making a new training contract with the existing concessionaire or similar railway operators

6.6 Career Building and Resource Acquisition Plan

There are a few policy recommendations that Study Team have been developing on the basis of some best practices around the world, particularly from Japanese private sector railway companies. It should also be noted that JR companies which were privatized in 1987 have been adopting the similar policy and strategy on career building and resource acquisition plan after the private railway companies. These are presented as follows (See also 7.4, Possible Career Streams).

6.6.1 Regular Job Rotation

Institutional capacity building on the basis of knowledge and skills sharing is essential. Regular job rotation system with adequate knowledge / technology transfer from the predecessor to the successor is an effective option for a company, preferably under the life-time employment environment that can expect a higher morale and royalty of the staff.

Such regular job rotation period, taken from the examples from Japan and other countries, is usually set between 3-5 years. One or two years could be too short for a staff to absorb the unit task, whereas over 5 years posting in the same unit / position may be sometimes considered redundant or difficulties in making knowledge and skills transfer to keep up the institutional memory.

6.6.2 Cross Sectional Rotation

Junior staff members may be expected to exercise their own specific expertise. From institutional development point of view, to understand the whole organization and its strategy, to acquire practically technical, administrative knowledge and skills, are more useful from a long-term perspective. Whatever the background they have, they are expected to be posted in both engineering / technical divisions and economic / operational / administrative divisions during the course of their initial ten years or so for their and the institutional development.

6.6.3 MOT and CWE

For engineers it is essential to understand a good level of “Management of Technology” on business management and project planning and supervision as well as economic, finance, accounting and legal issues. For economists or non-engineers it is also meaningful to have a good “Collaboration with Engineers” consideration on engineering approach and thinking, and understanding on the technical issues for better management

6.6.4 Secondment to Professional Firms

Dispatching MRTA staff for 1 -2 years to professional firms (e.g. to Japanese railway companies) and asking them to acquire knowledge and skills for the fields that cannot find internal resources, such as;

- Operation of a Mass Transit Railway System
- Maintenance of Mass Transit M&E Systems and Rolling Stock
- Experience & knowledge of other types of M&E Systems and Rolling Stock
- Business Planning and Development
- Financial Management (Banks, Cash Management),
- Strategic Planning (Local governments, Consulting Firms, Property Developers, Retail Business Firms),
- Strategic Financial Planning (Banks, Capital Markets, PPP Finance),
- Business Promotion (Retail Chains, Manufacturing Companies)

6.6.5 Head Hunting of External Resources

Certain expertise requiring immediate needs, that cannot be identified internally or some specific knowledge and skills requiring longer term to acquire, the head hunting from the external resources is an option, for example;

- M&E Systems Specialists with Training Experience
- Rolling Stock Specialists with Training Experience
- Trackworks and Conductor Rail Specialists with Training Experience
- O&M Specialists with Training Experience
- Regional Development Coordination
- Financial Management and
- Strategic Financial Planning

6.7 Short-term Roadmap

Within the framework of the Short-term in this Chapter, the Action Plan will cover the period till three years after the opening of the Purple Line by when a substantial knowledge on the Gross Cost Schemes has been well accumulated and ready for subsequent new line projects, one of which might be a line planned to be operated as MRTA's direct operation.

6.7.1 Short-term Future CBT Milestones and Benchmarks

The Action Plan will cover the period till three years after the opening of the Purple Line by when a substantial knowledge on the Gross Cost Schemes has been well accumulated and ready for subsequent new line projects, one of which might be a line planned to be operated as MRTA's direct operation.

Table 6.7 – Future CBT Milestones and Benchmarks (Period I)

Period	**Period I (Present till Purple Line Opening)**	
Milestone	• Completion and Opening of Purple Line	
CBT Subject	Contents	Benchmark
[Existing Operations under Net Cost Scheme]		
Strategy and Planning	1. Operation Integration[2]	1. Request training from system suppliers or/and the Concessionaire
Engineering & Construction	2. Training in details on track work	2. Request training from Trackworks Contractor
	3. Training in details on signaling, communication and rolling stock systems	3. Request training from Siemens and visit signalling and Rolling Stock factories
	4. System Procurement Strategy	4. In-house training workshops with Finance and Legal departments
	5. Dependency of M&E Systems in System Expansion	5. a. Visits different suppliers in Thailand (Bombardier, Alstom, Westinghouse, and Siemens) to understand the problems and differences with each suppliers system b. In-house workshop study group on findings and solutions

[2] Although there shall be no direct integration of the Blue Line and Purple Line in terms of train operation, some system are integrated with a hierarchy of control & monitoring in normal and degraded situations such as the PA/PIDS and CCTV systems of the Comms between Blue Line OCC and Tao Poon SOR. Operating staff will need to have detailed instructions/procedures on what to do in normal and emergency conditions and engineers understand how the systems act.

Operation and Maintenance	6. Training on actual operation of foreign railway systems, similar to MRT 7. Basic concepts and theory for each maintenance system and equipment 8. Railway Management and Computer Management (CMMS) 9. Real experience from other foreign supplier	6. Send staff to both Non-Japanese and Japanese MRTs 7. a. In-house training on basic Introduction to M&E Systems b. Hands-on training in M&E Workshop training rooms 8. Request In-house training from BMCL 9. a. Request visit to SRT and BTS to experience other systems used for the same tasks. b. Visit other suppliers in Thailand such as Bombardier, Alstom, Westinghouse, Thales and Siemens
Administration	10. Maintenance Resource Control (Supply & Procurement of Spare Parts) 11. Legal Management - Basics - Concession / Procurement 12. Legal Management – Advanced - Key Issues and Negotiation	10. a. Staff to attend External QA/QC training courses. b. CMMS Training Course In-house 11. Organize an introduction seminar to staff (once a year) 12. a. Organize workshops for E&O, O&M and Legal staff once a year b. Send staff to Legal firm
[New / Reoriented Operations with Gross Cost Scheme]		
Business Promotion	13. Business Promotion and Marketing 14. Property Development basics 15. Event organization basics	13. a. Expand public and private stakeholder network b. Organize seminar on Marketing for staff (twice a year) 14. Send trainees under the Staff Exchange Program to gain property development project, and expand human network 15. same as above
Public Relation	16. Public Communication Principles 17. Public Communication in English, (and key languages) 18. Mass Media and Media Relation	16. Organize courses twice a year and make regular publications 17. Organize group / individual lessons and courses and qualification test every year 18. Send staff to media for a S/T training and hold regular press conference (every quarter)
Customer Relation	19. Customers' Satisfaction Theory and Practice 20. Public Communication Principles 21. Statistics and Data Handlings	19. Organize a seminar once a year 20. Invite Pub Com Professors and organize workshops 21. Send staff to Concessionaire

Financial Strategy	22. Accounting and Cash Management	22. a. Send staff to Thai banks to learn Cash Management and Asset Liability Management b. Invite CPA twice a year on the accounting principles
Automatic Fare Collection	23. AFC Service and Treasury 24. Treasury 25. Common Ticketing Technology	23. In-house Training 24. In-house workshop meetings with Finance Department and Legal Department 25. a. Thai Government Guidelines b. Arrange Technology Transfer Visits to Country with Common Ticketing systems and request visit to Mass Transit Railway Authority/Operator

Table 6.8 – Future CBT Milestones and Benchmarks (Period II)

Period	**Period II (from Purple Line Opening till three years later)**	
Milestone	• Operating both Purple Line and Blue Line • Start CBT Activities related to Direct Operations	
CBT Subject	Contents	Benchmark
[Existing Operations under Net Cost Scheme]		
Strategy and Planning	1. Operation Integration	1. Request training from system suppliers or/and the Concessionaire
Engineering & Construction	2. Training in details on track work signaling and rolling stock systems 3. System Procurement Strategy 4. Dependency of M&E Systems in System Expansion	2. a. Request training from Trackworks Contractor b. Request training from Siemens and visit signalling and Rolling Stock factories c. In-house training 3. In-house training workshops with Finance and Legal departments 4. a. Visits different suppliers in Thailand (Bombardier, Alstom, Westinghouse, and Siemens) to understand the problems and differences with each suppliers system b. In-house workshop study group on findings and solutions

Operation and Maintenance	5. Training on actual operation of foreign railway systems, similar to MRT 6. Basic concepts and theory for each maintenance system and equipment 7. Railway Management and Computer Management (CMMS) 8. Real experience from other foreign supplier	5. Send staff to both Non-Japanese and Japanese MRTs 6. a. In-house training on basic introduction to M&E Systems b. Request In-house training from BMCL 7. Request visit to SRT and BTS to experience other systems used for the same tasks.
Administration	9. Maintenance Resource Control (Supply & Procurement of Spare Parts) 10. Legal Management - Basics - Concession / Procurement 11. Legal Management – Advanced - Negotiation	8. Send staff on Man Management Training courses in Thailand. 9. Organize an introduction seminar to staff (once a year) 10. a. Organize workshops for E&O, O&M and Legal staff once a year b. Send staff to Legal firm
[New / Reoriented Operations with Gross Cost Scheme]		
Business Promotion	12. Business Promotion and Marketing 13. Property Development basics 14. Event organization basics	11. Send staff to public and private partners under Secondment 12. Dispatch staff to property developers 13. Dispatch staff to the event organizers
Public Relation	15. Public Communication Principles 16. Public Communication in English, (and key languages) 17. Mass Media and Media Relation	14. Organize courses twice a year 15. a. Organize group / individual lessons and courses, b. Organize qualification test every year to aim more than half of staff are qualified with good English proficiency for the task 16. Send staff to media for a S/T training and hold regular press conference (every quarter)
Customer Relation	18. Customers' Satisfaction Theory and Practice 19. Public Communication Principles 20. Statistics and Data Handlings	17. Organize a seminar once a year 18. Invite Public Comms Professors and organize workshops 19. a. Send staff to Concessionaire b. Organize seminars and workshops for relevant staff twice a year
Financial Strategy	21. Accounting and Cash Management	20. a. Send staff to Thai banks to learn Cash Management and PPP Financing b. Invite CPA twice a year on the accounting principles

Automatic Fare Collection	22. AFC Service 23. Treasury Control 24. Common Ticketing Technology	21. In-house Training 22. In-house workshop meetings with Finance Department and Legal Department 23. a. Thai Government Guidelines b. Arrange Technology Transfer Visits to Country with Common Ticketing systems and request visit to Mass Transit Railway Authority/Operator

6.7.2 Short-Term Roadmap

Based on the above study results, the Team has developed a strategic roadmap to technical and capacity readiness for Gross Cost Scheme. Also, this short-term roadmap covers the period till 3 years after the commencement of Purple Line operation as a secondary phase.

This short-term roadmap incorporated ten capacity building opportunities as given below:

1. **Training by MRTA internal key trainers** – Basic/introductory technical training could be provided by experienced senior MRTA staff, say section chiefs. Candidates of key trainers should take "training for key trainers" course from direct operators or suppliers.
2. **Training by external training providers** – Foreign direct operators or suppliers can offer tailor-made training programs for the rail personnel to gain professional know-how.
3. **Training by recruited experts with training experience** – Hiring experts with training experience, probably on contract (part-time) basis so as not to intensify budget pressure, would be reasonable choice for MRTA to immediately obtain a training resource as well as to increase internal capacity.
4. **Training through Purple Line and Blue Line Construction Project** – For the MRTA staff to join each project as a PMO member, this is valuable and rare opportunity to take part by working closely with the Concessionaires suppliers in their design and on-site checking installation works safety and quality.
5. **Technology transfer by Purple Line and Blue Line concessionaire** – During the construction period, the Concessionaire will arrange Technology Transfer visits to country with M&E systems/rolling stock and request visit to Mass Transit Railway Authority/Operator, say once a three months.
6. **Training by Purple Line and Blue Line concessionaire** – About one year before testing and commissioning of M&E systems/rolling stock, the Concessionaire will

provide a series of training modules, similar to the ones implemented for Blue Line ISP (See Appendix 4.5) for MRTA staff to familiarize with the installed systems.

7. **Training through line operation and maintenance management under Gross Cost Scheme** – As mentioned in 6.2, MRTA will have direct control over Purple Line Concessionaire's operation and maintenance activities through robust performance monitoring tools. MRTA staff in Operation Department will be able to gain practical know-how through line management.

8. **Training through secondment to professional firms** – For the MRTA staff who will not directly participate in construction projects, such as Operation Department Staff, this would be the best solution to gain hands-on experience under the concession scheme circumstance. Secondment to concessionaires / foreign direct operators / maintenance contractors for a period of 2-3 years is proposed. These staff are expected to become key trainers for MRTA upon completion of the secondment period.

9. **Training through benchmarking group activities** – As described in 3.2.5 (7), benchmarking group is a group of mass trainsit railway authorities and a useful tool that would allow MRTA to share their experiences, successes, and failures together in an open way to allow all in the group to learn and improve their systems accordingly. Periodical workshop activity is organized quarterly or twice a year.

10. **Training using simulators/mock-up at MRTA training center** – Training center with simulators/mock-up facilities is proposed either at Purple Line Ban Yai Depot or old headquarter building. MRTA staff can get trained with virtual experiences.

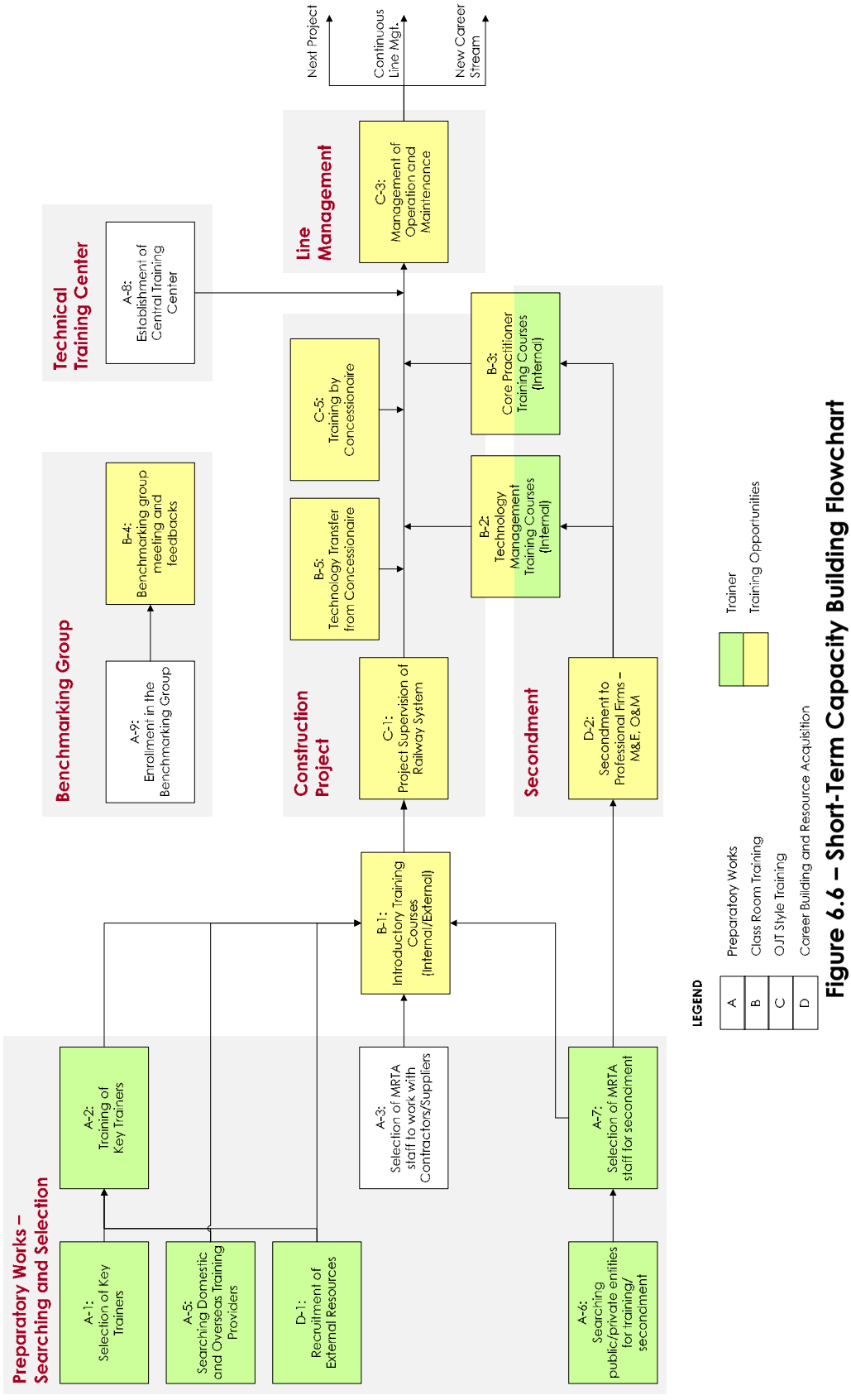


Figure 6.6 – Short-Term Capacity Building Flowchart

Short-term Roadmap

Program \ Calender Year	Dept./Unit Concerned	2010				2011				2012				2013				2014				2015				2016				2017			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Milestones by Period		Period I (Present till Purple Line Opening) - Completion and Opening of Purple Line																				Period II (from Purple Line Opening till 3 years later) - Operating both Purple Line and Blue Line - Start CBT Activities related to Direct Operations											
CBT and HR Development Program																																	
Capacity Assessment and CBT/HR Dev't Program by JICA SAPI Study																																	
Review of SAPI Proposal and Action Planning by MRTA																																	
A. Preparatory Works																																	
A-1 Selection of Key Trainers	EM, OM																																
A-2 Trainings of Key Trainers	EM, OM																																
A-3 Selection of MRTA Staff to work with Purple Line Contractors/Suppliers	HR, EM, OM																																
A-4 Selection of MRTA Staff to work with Blue Line Contractors/Suppliers	HR, EM, OM																																
A-5 Searching Domestic and Overseas Training Providers	HR, EM, OM																																
A-6 Training Contract Negotiation with Public/Private Entities	HR, EM, OM, AD																																
A-7 Selection of MRTA Staff for Secondment	HR																																
A-8 Establishment of Central Training Center	CS, EM																																
A-9 Enrollment in the Benchmarking Group	OM																																
B. Class Room Training																																	
B-1 Basic Training Courses (Internal/External)	HR, EM, OM																																
B-2 Intermediate Training Courses (Internal)	HR, EM, OM																																
B-3 Advanced Training Courses (Internal)	HR, EM, OM																																
B-4 Benchmarking Group Meeting and Feedbacks	EM, OM																																
B-5 Technology Transfer from Purple Line Concessionaire	EM, OM																																
B-6 Technology Transfer from Blue Line Concessionaire	EM, OM																																
C. OJT Style Training																																	
C-1 Supervision of Purple Line Railway System	EM																																
C-2 Supervision of Blue Line Railway System	EM																																
C-3 Purple Line Operation and Maintenance Supervision	OM																																
C-4 Blue Line Operation and Maintenance Supervision	OM																																
C-5 Training by Purple Line Concessionaire	EM																																
C-6 Training by Blue Line Concessionaire	EM																																
D. Career Building and Resource Acquisition																																	
D-1 Recruitment of External Resources	HR, EM, OM																																
D-2 Secondment to Professional Firms - M&E, O&M	EM, OM																																
D-3 Secondment to Professional Firms - Financial Management	AD																																
D-4 Secondment to Professional Firms - Business Promotion	AD																																
D-5 Introduction and Undertaking of Regular Job Rotation System	HR, EM, OM, AD																																
New Lines Construction Project																																	
PL. Purple Line Project																																	
PL-1 Contract Negotiation and Agreement of Civil Works		Completed																															
PL-2 Civil Works																																	
PL-3 Contract Negotiation and Agreement of M&E Works and O&M																																	
PL-4 M&E Works																																	
PL-5 Commissioning and Trial Run																																	
PL-6 Revenue Operation																																	
BL. Blue Line Extension Project																																	
BL-1 Contract Negotiation and Agreement of Civil Works																																	
BL-2 Civil Works																																	
BL-3 Contract Negotiation and Agreement of M&E Works and O&M																																	
BL-4 M&E Works																																	
BL-5 Commissioning and Trial Run																																	
BL-6 Revenue Operation																																	

* (Note 1) HR - Human Resource Division, EM - E&M Division, OM - O&M Division, AD - Administration Department, CS - Construction Department

* (Note 2) Expected Schedule as of September 2010

Ad-hoc basis

Figure 6.7 – Short-Term Roadmap

CHAPTER 7 LONG-TERM ROADMAP - TO SUSTAINABLE VALUE CREATION

According to the latest Greater Bangkok Master Plan, MRTA will have an extended full network covering the Bangkokian suburban region and play an important role as the main railway transport service provider. It is therefore prudent to establish a strategic development scenario for the organization in the form of a long-term roadmap. In this context, this chapter offers a 20-year roadmap for sustainable growth of MRTA and its mass transit network.

This roadmap intends to give a clear idea of where the MRTA will be heading over the twenty years and how they can get involved in managing the mass transit network.

This roadmap is not only described for technical capacity but also a 'more than technical capacity' factor to create sustainable values through integration of core and non-core business.

7.1 Diverse Railway Business and Development Scenario

The following is a description of the future MRTA on or around 2030 to demonstrate in what way and manner MRTA would be able to contribute to its network area. MRTA, as the key player on the Greater Bangkok Metropolitan Area development, continues efforts to expand its network to operate five lines under the M Plan by 2030.

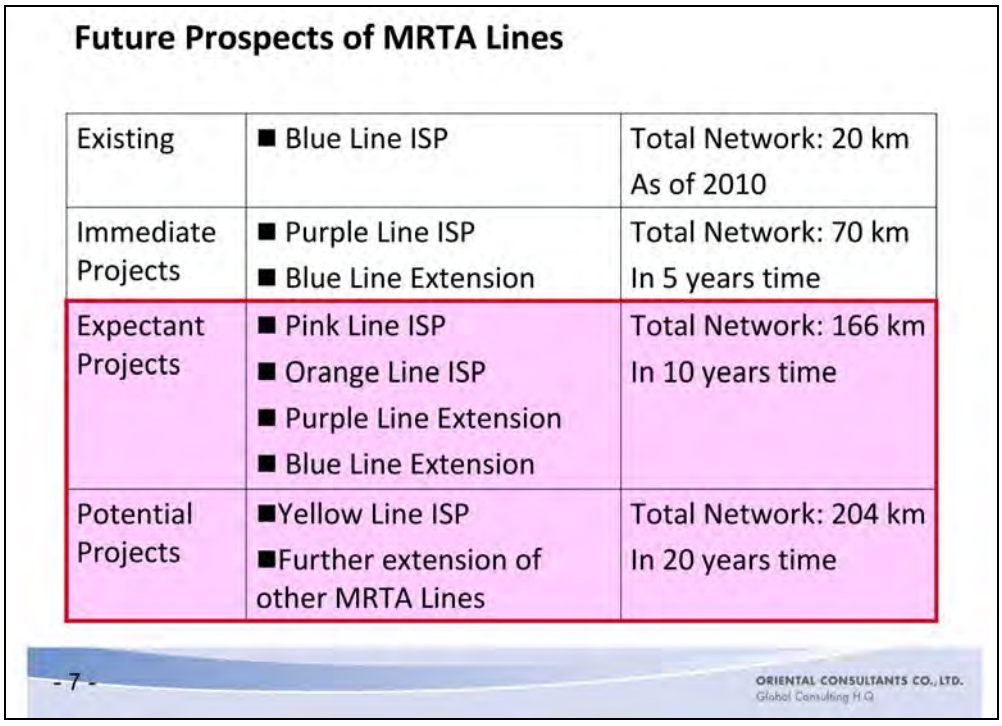


Figure 7.1 - Assumptions of Long-Term Roadmap

The Bangkokian suburbs and regions will be developed alongside with the expansion of MRTA network. According to the plan, the Greater Bangkok Metropolitan area covering 50 km sphere with an expected population of 14.8 million.

MRTA is providing its frequent railway services to the passengers. The area will have been developed as a good mixture of business, commercial, residential, educational, cultural and recreational zones with frequent residents, business commuters, shoppers as well as students, visitors and tourists.

Taking the above conditions into account, long-term future of MRTA encompasses the following scenarios.

Table 7.1 – Summary of Long-Term Scenarios

Core Railway Operation	
Management Framework	Concession or Direct Operation
Traffic Management	Centralized Traffic Control over Entire Network
Networking	Direct through Operation or Integration at Interchanges
Fare Integration	Common Ticketing and beyond
Engineering & Procurement	Partial Localization
Treasury Operation	Passenger Fare & Cash Management Service Expertise
Associated Railway Business	
Intermodal Transfer Development	Enhanced Multi-Modal Transportation Link
Retail Business Development	Station Concourse Retail Shops and More
Public Relation Activities	Strategic Public Relation Agency
Non Railway Business	
Enrichment of Living Environment	Residential Developments and E-cash Solutions
Enrichment of Work Environment	Office Relocation to Newly Created Areas
Enrichment of Education Environment	School Relocation to Newly Created Areas
Enrichment of Relaxing Environment	Leisure Market Development
Legal Framework	
Private Sector Participation	Proactive Collaboration under Wide Range of PPP
Corporate Structure	Holding Company based Group Structure

7.1.1 Core Railway Operations

(1) Management Framework

In 20 years time, MRTA will be responsible for managing five or six lines with a total route length of 200 kilometers. As the current MRTA Act allows the authority to operate by itself or give concession to private entities, MRTA will have a few different ways of railway operations.

Management Framework Scenario – Concession or Direct Operation

a. MRTA remains to give concessions to private entities for entire MRTA lines.
b. MRTA operates one or two lines as a direct operator, whereas private entities operate others lines under each concession contract.
c. MRTA buys back lines that they give concessions and operate entire MRTA lines as a direct operator.

a. Concession for Entire Network

MRTA remains to operate their railway under concession scheme in an indirect management and a remote supervision circumstance. With full focuses on their supervision activities, MRTA will be able to streamline their workforce as the case of YMR in Japan.

b. Direct Operation for One or Two Lines

Some lines will be operated under the Net Cost Concession Scheme, another under the Gross Cost Concession Scheme and others as Direct Operator. By having experience as the railway operator, MRTA is able to directly accumulate expertise on railway engineering from rolling stock, traffic control and station management.

c. Direct Operation for the Entire Network

This scenario would allow MRTA with relatively little effort to bring in common ticketing, direct through operation, and integrated traffic control systems across the mass transit network. However, buying back BTSC and BMCL Contracts and control all transit systems directly will incur intensive capital expenditure and require vast organization.

Choice of the above alternatives leads to a completely different scenario that will be embodied in the long-term roadmap. As the government policy may change to allow MRTA to actually operate their own railway directly, rather than just being the Administrating Authority, the long-term roadmap should show a path to improve preparedness for direct operation being in line with the MRTA's desire.

(2) Traffic Management

Traffic Management Scenario – Centralized Traffic Control over Entire Network

MRTA can coordinate connecting lines services and manage incidents of entire network effectively and efficiently through Centralized Traffic Control.

MRTA is able to coordinate connecting lines services including informing passengers in Interchange stations of problems on whichever lines clearly. Through centralized control of the entire railway system, MRTA can manage incidents and mobilize central emergency services, police and fire services to accident points. These advantages lead to a reliability growth and eventually to a higher customer satisfaction.

However, there are some considerations that would have to be addressed in a centralised traffic Control Center arrangement as follows:

Table 7.2 – Issues on Centralized Traffic Center Arrangement

Management Scheme Issue	Issues associated with different management schemes, particularly when MRTA operates 1 or 2 lines as a direct operator and others are operated by Concessionaires
Security Issue	All Lines control in one place becomes a large target vulnerable to accidental loss of control through fire, or acts of terrorism. Therefore security of the building would be paramount to avoid paralyzing the entire network.
Control Transfer Issue	Local control at each lines Interlocking stations in case of the CTC not being available would still be required. Arrangements to transfer control between CTC and Local control would need to be considered with a minimum od exchange/accept switching arrangements.

When the Purple Line opens, there will be two OCC/CTC centers at Huay Kwang and Bang Yai. As other line projects progress such as the Orange Line, some consideration of when would be the best time to combine all of the lines traffic controls under one Central Traffic Control Center. Ideally this should be done as soon as possible as part of the Scope Of Works (SOW) of a new line project saving the redundancy of another Line CTC Center.

(3) Networking

Networking Scenario – Direct through Operation or Integration at Interchanges

a. MRTA is offering convenient transport service with direct through operation.

b. MRTA is offering enhanced integration between lines at their interchange stations.

a. Direct Through Operation

MRTA, with its full and dense network, is providing the most advanced fast, comfortable and safe travel to its passengers. Although there shall be no direct integration of the Blue Line and Purple Line in terms of train operation, straight through operations may be envisaged in some future MRTA lines by using a train running into other lines so that the passengers do not have to change the trains during their journey. This has been implemented with MRTA's efforts to harmonize their lines to give maximum comfort and thus the higher ridership has been achieved.

b. Integration at Interchange Stations

Direct through operation is not envisaged between Blue Line and Purple Line partly because MRTA has an intention to secure fairness for potential concessionaires/suppliers in future and avoid unnecessary dependence on certain suppliers and the Concessionaire that already installed their systems or participate in operation of existing line. Therefore, keeping independency of each line could be a strategic alternative for MRTA, even though convenience for passengers may be lowered to some extent. In this connection, it is essential to enhance integration at their interchange stations should this scenario be selected.

From technical points of view, direct connection and operation between two or more lines has its advantages and disadvantages as follows:

Table 7.3 – Advantages and Disadvantages of Direct Through Operation

Advantages
• Common use of depot maintenance facilities where more than one line has common types of rolling stock • Reduction in Investment costs of a new depot for every line • Reduction in staff training and centralization of spare parts stores and warehouses
Disadvantages
• Different lines may have different operators/Concessionaires and then the sharing of the depot and maintenance costs would need to be considered. • Priority between Operators/Concessionaires for maintenance services, especially where the service is not to known routine schedule may cause problems and delays/cancellations of some lines services. • Technical problems such as the dimensions of different trains not being exact

and therefore correct positioning of a train at a stations platform screen doors may not be possible.
- Train Control & Signaling Systems cannot achieve interoperability at this time due to each supplier protecting its systems by using proprietary software protected by Industrial Patents ensuring no other supplier can copy and integrate their system to another supplier's.

For these reasons above, it is not envisaged that physically connecting lines together and operating trains would be cost effective and could lead to supplier monopolies in the supply of rolling stock and signalling systems. However, policy may change as the mass transit network expands and passengers become more conscious about travel time and convenience.

(4) Fare Integration

Fare Integration Scenario – Common Ticketing and beyond

MRTA offers smart cards that can be used for varieties of public transport payments as well as shopping and living purposes.

A wide variety of tickets / passes are offered to respond to the smooth and comfortable travel to passengers. Bangkok Metro Smart Cards are widely used as electric money so that the card holders can use those not only for railway tickets as common ticket for other railways and buses, but also as payment means for MRTA park & ride payments and other public transport and taxis as well as for shopping and living purposes.

However, from the technical and managerial points of view, several issues have to be addressed across a wide spectrum of suppliers of transportation providers and generally such a scheme should be led by the government to bring all providers together and create legislation that allows all providers to be treated fairly.

The Purple Line and Blue Line shall have "Common Ticketing' between the two lines to allow the use of only one type of SMART Token or SMART Card to be used across the two lines. The Purple Line AFC Supplier shall interface with the Blue Line AFC supplier and basically the Purple line AFC system shall follow and integrate with the Initial Blue Line system under the direction of the MRTA. This is not technically difficult, but some issues concerning the central MRTA Clearing House and sharing of collected revenue between the Purple Line and Blue Line Concessionaires would need to be addressed between MRTA and the Concessionaires.

Further work would need to be done when the government announces it intends to proceed with the implementation of a "Common Ticketing" system and the MRTA central Clearing House may become redundant or would need to modification to allow the governments CCH to interrogate and determine revenues between the Purple Line and the Initial Blue Line with clear lines of auditable traceability.

It is known that the Thai government through the Office of Transport and Traffic Policy and Planning (OTP) has engaged some consultants to study and write an implementation strategy report for recommendation to the Thai government. A further group engaged by the OTP is studying the technical aspects and if such information was accepted and agreed by the Thai government, implementation of a "Common Ticketing" system in Bangkok could be achieved in the next 5-10 years, dependent on the amount of support it received from government officials and the support of service providers.

(5) Engineering and Procurement

Engineering and Procurement Scenario – Partial Localization

MRTA is able to develop equipments and material supplies with mechanical material suppliers locally.

MRTA will be the most experienced railway company on most of the engineering work, rolling stock, signaling equipment, communication technology and fare collection system. MRTA takes lead in rolling stock, signaling equipment and communication technology, and thus it has developed its equipment and material suppliers jointly with mechanical material suppliers locally. Some parts are repaired at MRTA depot workshops and some materials are produced nearby. This activity helps mechanical expertise to be built up further and serving as a good training facility for junior engineers.

This idea may require intensive efforts to change industrial structure, but is in line with the government policy to localize part of the system manufacturing in railway sector. As its first step, a common procurement policy with defined specifications, including size, colour etc. should be set up by MRTA for all Components-of-the-Shelf (COTS) equipments such as computer monitors, keyboards, CCTV Cameras, Controlled Access Security Systems (CASS), Automated Operation & Information Technology (AO&IT) systems etc.

This will allow all Thai suppliers to be aware of MRTA requirements and to tender for such equipment procurements minimizing training needs and spare part holdings and offering a universal presentation of equipments in control rooms, stations etc for all lines.

(6) Treasury Operation

Treasury Operation Scenario – Passenger Fare and Cash Management Service Expertise

MRTA has developed a good financial management know-how.

MRTA will be the connoisseur of passenger fare management, i.e. cash management and quasi cash management service professional. Starting since 2015 when the Purple Line open, it will be directly handling the fare collection, short term cash investment with the help of

banks to generate investment returns, make more active marketable securities investment to use maximum of their Asset and Liability Management expertise built during the next 15 years. This experience is well applied to the development of Smart Card business.

7.1.2 Associated Railway Business

(1) Intermodal Transfer Development

Intermodal Transfer Development Scenario – Enhanced Multi-Modal Transportation Link

MRTA functions as a core transport hub of urban multi-modal transportation.

MRTA pioneered its Park and Ride services to facilitate suburban residents or business commuters. MRTA railway multi-modal transportation link will be widened with buses, taxis and tuk-tuk. Bicycle riders commuting from their houses to the MRTA stations. MRTA's initiatives are very appreciated to support the anti-global warming campaign to passengers. They can ride trains with their bicycles without any additional charges.

Singapore MRT – Welcome Bicycle Riders

Singapore MRT experimented "Fold it and Ride it" trial campaign to encourage bicycle riders to use SMRT trains and buses without any additional charge in 2008. Seoul Metropolitan Subway also introduced a similar system in 2010. Passengers can ride on the subway without any charge with their bicycles.

(2) Retail Business Development

Retail Business Development Scenario – Station Concourse Retail Shops and More

MRTA offers vast variety of service in the premise of each station and concourse.

Passengers not only walk-in and ride on the train but they wait for trains for a while or even spend their time in the station. A station is a place to meet, eat, enjoy and refresh for people with convenient transportation means. MRTA will be able to plan and cater more retail shop space in the concourse and the platform on the new lines after 2015. Each station and concourse, and also some corresponding walkway is designed to facilitate MRTA passengers by providing vast variety of service. Some of them are city hall branch office for civil services, convenience stores and other small shops selling fashion, food and beverage, toiletry goods and cosmetics, travel agencies, hair saloons, bank ATMs, etc.

JR East "Ecute" – In-Station Shops and Restaurants

JR East opened its first "Ecute" in the concourse of JR Omiya station, a regional hub station connecting with a few JR lines and two private railways. Located about 30 minute ride from Tokyo downtown areas, Omiya is a popular place for changing trains to local ones servicing homes of commuters to Tokyo. Many passengers spend time to wait for 15-30 minutes for relaxing, eating light snacks, sipping coffee, buying fashion items for their own, snacks for family, flowers for friends etc. JR expanded its Ecute stations to five by 2010. Private sector railway companies have been following the success of JR East.

(3) Public Relation Activities

Public Relation Activities Scenario – Strategic PR Agency

MRTA has PR Agency starting from Advertisement in the Train.

MRTA, like other railway companies, make spaces in the train, on the platform and concourse available for advertisement. Knowing well the passengers psychology and mind set, MRTA will be able to advise those who wish to make their advertisement in the MRTA facilities. This enables MRTA to establish its own PR agency to promote not only the ridership but also giving professional advisory services to their business customers, and planning and organizing events to mobilize a big mass with their abundant experience in handling a large number of passenger traffic.

7.1.3 Non Railway Business

MRTA, in association with the central and local governments, commercial and residential developers and financial institutions have been involved in the Greater Bangkok Metropolitan Area Development since the beginning of the history of the authority. Similar to other metropolitan area development in other countries, advanced and harmonized "Living", "Working", "Learning" and "Relaxing" environment creation has been the key slogans of MRTA and those promoting institutions. MRTA take part in those large scale suburban developments in many different manners.

(1) Enrichment of Living Environment

Enrichment of Living Environment Scenario – Residential Developments & E-cash Solutions

MRTA creates diversified traffic through residential developments and E-cash solutions

For "Living", many residential developments will take place together with a number of commercial and retail shops are open to offer enjoyable living. Residents commute easily to MRTA stations with buses, taxis, tuk-tuk on foot supported well local feeder transport means. For shopping, those commuter / residents also enjoy the all-in-one Smart Card / Credit Card / Electric Money Card / Bank ATM Card for their easy shopping and riding for any use.

(2) Enrichment of Working Environment

Enrichment of Working Environment Scenario– Office Relation to Newly Created Areas
MRTA creates reverse traffic and alleviate traffic congestion by leading office relocation.

As for "Working", lots of business property developments could be realized and many companies will move their offices from congested Bangkok downtown to the newly created areas alongside the MRTA lines. Many workers in those business areas are also residents. They enjoy no congestion, close and short go back and forth between their home and working locations. Some people commute from the downtown Bangkok that helps the reverse traffic and increase ridership of MRTA.

(3) Enrichment of Education Environment

Enrichment of Education Environment Scenario – Strategic School Location
MRTA creates reverse traffic and alleviate traffic congestion by leading school location.

"Education" is always important human resource investment for a country. The education system, from primary to university level education as well as vocational training, adult education and life-long learning are the success to a country development. In line with the township development projects, a number of schools and universities are carefully positioned in the area. Same as the case in "Working", university and school students are commuting from this suburban area and from all around Bangkok. MRTA offers, in peak hours, a special car reserved for children to protect and assure their safety travel trusted from their parents.

(4) Enrichment of Relaxing Environment

Enrichment of Relaxing Environment Scenario – Leisure Market Development
MRTA creates weekend traffic through leisure market development.

"Relaxing" is also an essential part of suburban / regional development. Natural parks will have been developed in the area for Bangkokian weekend, hotels and other resort accommodation are made for business persons and tourists, sport and cultural facilities will be

developed in the area. For large scale events in particular, MRTA railway services assure safe and rapid move of spectators by offering additional special service trains.

7.1.4 Legal Framework

(1) Private Sector Participation

Private Sector Participation Scenario – Proactive Collaboration under Wide Range of PPP

MRTA collaborates with business, commercial and residential partners and stakeholders in Private Sector.

By year 2030, MRTA is known as the key player in Bangkok Metropolitan development with its proactive collaboration under the wide range of PPP approach. Without having a close coordination with the public sector administration on the regional development planning, together with the inter-ministry coordination in the Public Sector in getting their strong policy support, and also business, commercial and residential partners and stakeholders in the Private Sector, the success of and appreciation to MRTA cannot be achieved.

Due to the less competitive nature vis-à-vis other transport means, public sector commitment has been increasing in many countries but facing with strong budget pressure. Under such circumstance, the privatization solution was presented and some countries opted to take this option to privatize transport industries but in most of the cases the privatization scenario did not work. The key reasons for this failure were, firstly, the government rather hastened in going away the heavy budgetary burdens and receiving the sale proceeds to compensate the budget deficit, and, secondly, the management capacity and morale at the privatized company did not change or no professional management was not appreciated properly.

Currently, the Public-Private-Partnership approach is very popular as an alternative solution for the sector like transport where a large scale infrastructure is needed. The conventional view of PPP scheme applied to the railway transport is defined that the physical infrastructure and civil work is prepared by the public sector and the rolling stock, equipment and traffic control are prepared by the private sector. The public sector, as the owner of the infrastructure, will lease / contract out to private sector concessionaire the railway operations.

As demonstrated in 5.4 “Best Practices and Lessons Learned from Japan’s Private Railway Companies”, intensive and proactive collaboration under the new style of PPP approach with local government, business and residential communities should be envisaged in long-term future.

Proactive Collaboration with Private Sectors – Practices from Japan

The conventional view of PPP scheme applied to the railway transport is confined to "vertical separation". However, Japanese railway companies are rather exceptional case. They are private from the right beginning but planned and extended their network during the course of the development stage of the regional economy, and thus they could gain the benefit and compensate their huge infrastructure investment by non-railway businesses.

Their historical development is quite different from the other cases but the key characteristics is the fact that they all have their network in large urban / suburban areas Their network advantage has been helping them engage them in a variety of Associated Railway and Non-Railway business opportunities as seen above.

JR East, one of the privatized Japanese railway companies from Japan National Railway in 1980s, has been successful having a dense urban and suburban network covering the largest Tokyo, Yokohama areas but also serving northern part of the mainland Honshu where most of the areas are considered rural.

Their high-speed mid-range Shinkansen train network is less advantageous compared with the most profitable Tokaido Sinkansen connecting between Tokyo and Osaka, but contributing to their good performance.

Their efforts are particularly known for their Associated Railway Businesses fully utilizing their assets and their locations as shown above as JR East Ecute case for example.

(2) Corporate Structure

Corporate Structure Scenario - Holding Company based Group Structure

MRTA manages and conducts comprehensive operations under a holding company.

For MRTA to manage a wide variety of activities, it is possible to organize MRTA in a group headed by a holding company under which the core railway, the associated railway, and the non-railway businesses can be managed. By keeping the core railway operations and the main planning, financial and human resource strategic management at the group holding company, the entire group can most efficiently conduct comprehensive operations.

The reverse order development MRTA had at the beginning of its history has now been fully regularized and MRTA has a fully fledged railway and the related business company group. The managing and supervising expertise are also fully established, and a number of MRTA staff are dispatched or seconded in those affiliated companies with its own specialized fields. This de facto spin out and decentralization trend will also help reduce the organizational demographic pressure through MRTA's expansion process.

7.2 Strategic Challenges and Constraints

7.2.1 State Enterprise Status Challenge

MRTA is a state enterprise under the MRTA Act. The current scope of work is limited to the Core Railway and Associated Railway operations discussed above. They also need to follow public procurement rules and procedures in the same manner as the public administration. The Study Team does not envisage to propose any legal framework changes but if one considers the role and contribution the MRTA can play in terms of the Greater Bangkok Metropolitan Development, the legal framework might need to be revisited.

(1) Joint Initiatives between Public and Private Sectors

Narrow Path Ahead – Two Edges of a Sword

Some best practices shown above discussed the success stories of Japanese private sector companies as well as ex-JR companies. Their backgrounds are different but the goals and objectives to achieve are similar to each other.

That is by taking the public good nature of railway transport by providing the railway services in the most effective manner into full consideration, the private business opportunities related to the core, associated and non-railway business opportunities contributing suburban / regional development as well as offering a higher degree of comfort to passengers can be sought.

On the one edge, the railway company should consider the safety, punctuality and comfort of travel in the affordable manner to the general public with the friendliness to environment. They are not expected to facilitate to the people in a restricted or limited manner. The other side of the edge, the railway, like the case of suburban / regional development, the railway company will begin to discuss with the central and local governments on the planning on the regional development as a public transport service provider, but when it comes to particular development, most of the business opportunities need to be implemented by the private sector.

(2) The Option of Privatization

MRTA can not and should not expect any high economic return out of the core railway operations, but may expect or more frankly high economic return to maximize the related revenue for MRTA without sacrificing the public good nature. One option to come out from this too tough challenge is to the privatization. While the ministry level policy making and regulatory body functions, the execution and implementation agency could be run privately or under the private sector operation framework.

7.2.2 Operational Challenges

(1) Direct Operation and Confidence

It has bee discussed several times that one of the difficulties on the managerial, technical and administrative difficulties of MRTA staff. Under the reverse order development that MRTA has so far, the staff members have limited, remote and indirect access to the railway operations. The best way to cure and build strong confidence and expertise is for MRTA to be the Direct Operator at least in one of the planned projects. With this full, physical and direct access and responsibility will make MRTA to be an established group of management team with comprehensive and strategic visions, the hands-on engineers with high caliber and expertise, the top-notch administration, financial and legal specialists.

(2) Centralized Traffic Control

When the Purple Line opens, there will be two OCC/CTC centers at Huay Kwang and Bang Yai. MRTA shall carefully consider the ways to achieve efficient traffic control over multiple lines. Ideally MRTA should initiate the work on this subject as soon as possible as part of the Scope Of Works (SOW) of a new line project saving the redundancy of another Line CTC Center. However, MRTA shall address issues associated with different management schemes, particularly when MRTA operates 1 or 2 lines as a direct operator and others are operated by Concessionaires.

(3) Direct Through Operation

Ideally MRTA can offer the most fast and convenient transport services by direct through operation. However, one must bear in mind that co-existence of different management schemes makes it difficult to realize and this could lead to supplier monopolies in the supply of rolling stock and signalling systems.

(4) Fare Integration

The Purple Line and Blue Line shall have “Common Ticketing’ between the two lines to allow the use of only one type of SMART Token or SMART Card to be used across the two lines. Accordingly several issues have to be addressed across a wide spectrum of suppliers of transportation providers and generally such a scheme should be led by the government to bring all providers together and create legislation that allows all providers to be treated fairly.

7.2.3 Organizational Challenges

(1) Toward a “Group” Structure

Once MRTA experiences the direct operations at the end of the reverse order history, it may start branch out, outsource, contract out some of the operations with full confidence on their

supervising role. The best structure to manage and supervise a wide variety of activities that MRTA would be able to envisage a group structure with a holding company on the top.

Under the umbrella of the holding company, the construction, engineering, operations, maintenance, cash management, administration divisions could be independent unit company with the planning, strategy, overall HR management and financial capacity would remain in the holding company.

The spinning out step can be taken step by step when such operations are well matured as servicing unit to others. While MRTA remains as a state enterprise, it is required to follow the national rules applied to this type of profession. Once a group company is created as a private sector entity, the staff members working in those companies do not have to follow the rules or even in some cases, the private sector market based package could be offered.

(2) Transition "Trap"

One caveat to be presented here is, during the period of "transition", say three to five years, the institutional memory will stay at MRTA as déjà-vu experience but as the time go by, it inevitably fade out. To avoid this institutional memory disappearance, MRTA should adopt a well established Staff Exchange Program under which MRTA staff members are dispatched to the concessionaires and vice versa to share and cross-nurture the knowledge and skills in common as well as the group corporate culture and style.

(3) Organizational Demography

While new line projects are undertaken one by one, and a new line starts its operation one by one, the size of the MRTA organization is deemed to be larger under this continuous project development and implementation for the next twenty or so years. While regular and accelerated recruitment takes place during those period, MRTA staff number will increase that may end up in 10-year or 20-year period, the managerial and senior level staff members in most of the departments with about 40 to 50 years old will reach higher demographic position vis-à-vis other age groups. Their contribution should be appreciated but when the new line project is over, the system may not need expertise for the construction of new lines and its related activities any more.

(4) Overstaffing

At one time, particularly when all the projected lines are completed its construction work and opened for public, the overstaff issues will apparently come up. Thus, it is worthwhile encouraging the spin-out of staff from the earlier stage or MRTA should create subsidiaries or quasi-group companies to let them absorb but also keep the expertise of MRTA.

(5) Streamlining Efforts

To manage this, there are at least two options and MRTA will need to pave the ground from now before it needs to deal with a bunch of people without tasks. The first group of seasoned engineers having good "Construction" expertise, could be retrained in the operations and maintenance or, if the environment allows, to the associated railway or the non-railway operations requiring "construction / building / making" expertise. The other group of the experienced generalists could find their outlets in those associated and non-railway business activities.

7.2.4 HR Recruitment Challenges

(1) Regular Hiring

Regular hiring is essential. Ad hoc hiring may be the best solution for some urgent needs or for very specific needs but it may cause demographic humps in the age groups in MRTA that may generate difficulties in promotion particularly in the managerial positions. This regular hiring will benefit in keeping up the high motivation and sincere royalty of the staff. Head hunting of the new areas such as a position related to the planning of the non-railway operation will be virtually impossible to find the existing internal resources or staff personnel to be trained neither.

(2) Regular and Cross Sectional Rotation

The regular / periodical job rotation is important for staff career streaming. The average period of "stay" in one unit would be most suitable around 3-4 years. Institutional memory on the basis of knowledge and skills sharing can be developed with regular job rotation. Regular job rotation system with adequate knowledge / technology transfer from the predecessor to the successor is an effective option for a company, preferably under the life-time employment environment that can expect a higher morale and royalty of the staff.

Cross Sectional Rotation is, from institutional development point of view, to understand the whole organization and its strategy, to acquire practically technical, administrative knowledge and skills, are more useful from a long-term perspective. Whatever the background they have, they are expected to be posted in both engineering / technical divisions and economic / operational / administrative divisions during the course of their initial ten years or so for their and the institutional development.

(3) Secondment to Professional Firms

Dispatching MRTA staff for 1-2 years to professional firms and asking them to acquire knowledge and skills for the fields that cannot find internal resources. This secondment will

be very effective for the areas that MRTA not having sufficient experience, knowledge and skills.

The cases like an overall management training at a Japanese railway company, the cash management from Thai banks, or the legal trainee to a law firm would be most practical and useful. This secondment can also be arranged in a form of Staff Exchange Program. MRTA may receive trainees from the partner companies.

7.2.5 Capacity Building Training Challenges

(1) OJT Style Training

Hands-on / On-the-Job training is far better or essential in order to MRTA staff to acquire through direct and physical interfaces than theory and knowledge gained through books. The best way to gain good skills is via a hands-on and on-the-job training from senior engineers / staff members serving long in the company.

(2) Training Program

Training Programs needs to be responding to the institutional needs to enhance the capacity of the MRTA staff. Contents of training programs are described in the previous chapter.

(3) Debriefing and Knowledge Sharing Duty

Conventional lecture style training or observer type training opportunities are OK for new knowledge or classically proven areas but should be offered with “Exam” to confirm the understanding since the memory would disappear rather quickly.

Except for the subject requiring all the staff members at MRTA participate in, it should organize a dissemination, report-back session as soon as the participating staff returns his/her office.

(4) Proper Staff Performance Evaluation

The evaluation system should also take the participation to the training as well as the level of understanding into account. The duty of MRTA Management is not simply offering training opportunities to its staff. The Management needs to offer practical and necessary training and to evaluate the relevance of their training course how they are useful from managerial viewpoints. During the course of the staff performance evaluation, validity, usefulness and applicability should be discussed and both need to be held accountable.

7.3 Organizational Development

7.3.1 Adaptive Organization Structure

MRTA will need to establish an adaptive and flexible organizational structure for its future to fully mobilize experience and expertise acquired through the direct operations and widen its active participation to suburban and regional development.

As for the projected lines and their operations, and also reflecting the future vision of MRTA, one can draw possible organizational structures of MRTA for a long-term visionary concept to conduct the core railway and non-railway businesses in full scale.

7.3.2 Overall Planning

A strong and overall planning capacity is expected not only to confirm MRTA's vision and overall strategy and each key operations, i.e. the Core Railway, the Associated Railway and the Non-Railway businesses. In short-term perspective, the Business Planning leading to the MRTA's involvement in suburban / regional development is proposed. For a long-term perspective, a closer involvement by MRTA is naturally expected. For the Greater Bangkok Metropolitan Development, the role of MRTA will be critical for business, commercial, residential, sport and culture developments.

7.3.3 Business Promotion Unit

Under the Net scheme, the business promotion activities to increase ridership is handled by the concessionaire but they are not asked to provide strategic approach to promote MRTA ridership in collaboration with current and future capital investment opportunities. Gross cost scheme, MRTA is expected to have a strong Business Promotion Unit ("BPU") which is currently assumed by the concessionaire with the Net cost scheme. BPU will be responsible for promotional external activities to increase, levelize and encourage use of trains alongside the lines.

Some cases but not limited are to:

- Promote suburban business and commercial premises development to increase "reverse traffic" during the peak hour period,
- Introduce educational and research institutions such as universities in suburban areas to encourage "reverse traffic",
- Develop discussion with sport / culture / social event organizers and local developers and communities to hold related events particularly during the off-peak hours, and offer, if appropriate, additional train services to accommodate in response to the strong demand, and

- Offer a spacious parking space and encourage local bus, taxi and tuk-tuk operators to easily route their traffic to the nearest stations.

At this stage, BPU will not be engaged in real estate development project itself. It will stay as initiator or facilitator function to offer better, smooth and comfortable transport mean through MRTA lines to those developers, organizers and also to spectators, participants, tourists etc. Under the current set-up, BPU will best fit to be a part of Strategy and Planning departments.

7.3.4 Public Relation Unit

Public Relation Unit ("PRU") currently constitutes a part of secretariat office of the Governor and is responsible for public relation both internal and external organization, providing news and advertisements, and coordinating with mass media. Under the new Gross scheme, RPU's role in dealing with the general public and also the media will be more important. PRU, particularly in close coordination with BPU above, to make timely and attractive announcements, as well as necessary pre-warnings. PRU will also coordinate with CRU below and address issues to be informed through public communication channels.

7.3.5 Customer Relation Unit (from Public Complaint Unit)

There is a unit called Public Complaint Section at the Governor's secretariat office with three staff. With the introduction of Gross scheme, a more direct window with the passengers and other stakeholders of MRTA would be necessary and reinforced. The Customer Relation Unit ("CRU") will be functioning as a one-stop shop window of MRTA for inquiries, complaints, comments and suggestions. An appropriate information sharing / response system will be needed to be established to monitor those inquiries and to share information among the related parties to improve the overall service quality. The detailed demarquation between the concessionaire(s) and CRU should be determined in each of the concession agreements.

7.3.6 Strategic Financial Planning Unit

In addition to the existing Finance Division mainly looking after for day-to-day and annual financial management, a unit called Strategic Financial Planning Unit ("SFPU") will be responsible for strategic planning, analysis, review, evaluation and recommendations for financial arrangements, packaging and relationship building with relevant financial intermediaries and also possible investors on the basis of the Public-Private Partnership scheme approach. Though the practical needs are rather limited but SFPU and BPU need close coordination. While BPU mainly focuses on the physical / hard infrastructure side of issues, SFPU will reviews and analyzes from financial arrangement and viabilities.

7.3.7 Automatic Fare Collection Units

Automatic Fare Collection ("AFC") Units is a new unit to start under Gross scheme being in charge of AFC service tasks and part of treasury tasks. Responsibilities of the unit includes i) supervising and monitoring the Concessionaire to maintain AFCS accounting records and other AFCS related documents, and updating and recording ticket sales and production, ii) reconciling daily and monthly ticket sales/revenue in each line as against the Central Computer System (CCS) generated reports, iii) supervising and monitoring the Concessionaire to reconcile ticket production report as against the CCS generated.

7.3.8 Legal Affairs Unit

Legal Affairs Unit ("LAU") needs its strengthening on the Concession Agreements / Procurement with some basic knowledge on the Negotiation skills. LAU staff members will consist of staff with a strong legal background and also the engineers responsible for concession agreements and procurement strategy. LAU staff members are also to build up a negotiation skills.

7.4 Possible Career Streams

7.4.1 General Principles

General Principles applied for the career stream of staff are:

Career Stream - General Principals:

- Hiring made through Regular Recruitment
- Hired under the Life-time Employment Contract
- Regular Job Rotation
- Cross Sectional Rotation
- Active "Secondment" or "Traineeship" s

7.4.2 Case Studies - Career Stream Models

Four cases are shown to explain the typical case.

Assumptions of Career Stream Models:

The assumptions for the both cases are;

A university graduate with bachelor degree and has a few year experience in a Thai institution. The staff is around 25-26 years old. This is an average image of a new recruitee to MRTA who is expected to work for MRTA for about 30 years.

(1) Mechanical and Electrical Engineering Staff

This case deals with a Mechanical and Electrical Engineering staff, with an E&M engineering background, starting with his/her first assignment at Operations unit for about three years to acquire basic understanding, knowledge and skills. He/She may be sent to the Concessionaire or direct operator for three years to understand the ways how they are engaged in the maintenance supervision and control of M&E system suppliers. After acquiring the basic knowledge, the staff will return to MRTA and posted to the new line construction unit as a section chief for about 4-5 years. During that period, the staff will accumulate know how on technical specification control and supervisions of manufacture, installation, testing and commissioning by the supplier as well as how to manage tasks. Upon completion of the project, the staff will be assigned to operation and maintenance supervision as the division chief. For the following career, He/She can offer a good technical advisory on planning and strategy tasks.

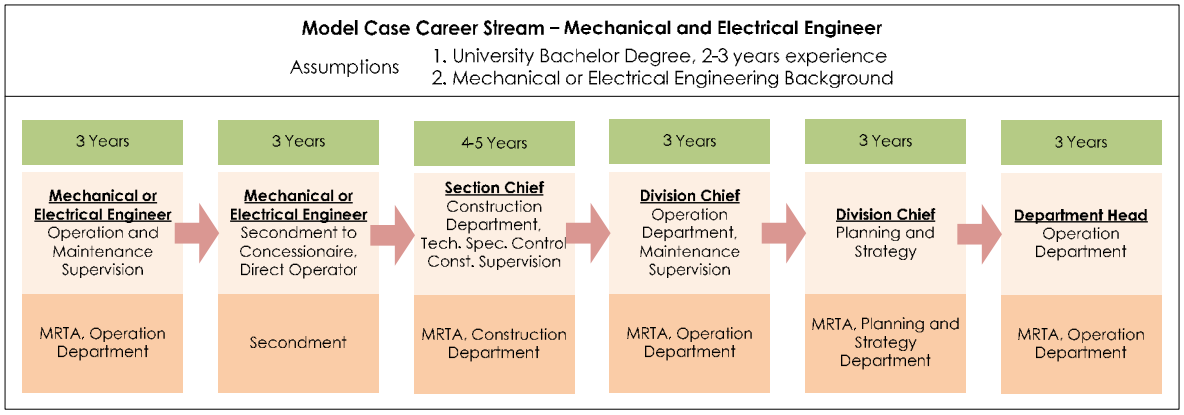


Figure 7.4 – Career Stream Model (1) Mechanical and Electrical Engineering Staff

(2) Rolling Stock Operation and Maintenance Staff

This case deals with a Rolling Stock Operation and Maintenance staff, with an Electrical or Mechanical engineering background, starting with his/her first assignment at Operations unit for about two years to acquire basic understanding, knowledge and skills. He/She may be sent to a railway maintenance contractor for two years to gain hands-on experience in the light and heavy maintenance of rolling stock at depots and workshops. After acquiring the basic knowledge, the staff will return to MRTA and posted to the new line construction unit as a section chief for about 3-4 years. During that period, the staff will accumulate know how on technical specification control and supervisions of manufacture, installation, testing and commissioning by the supplier as well as how to manage tasks. Upon completion of the project, the staff will be assigned to maintenance supervision as the division chief.

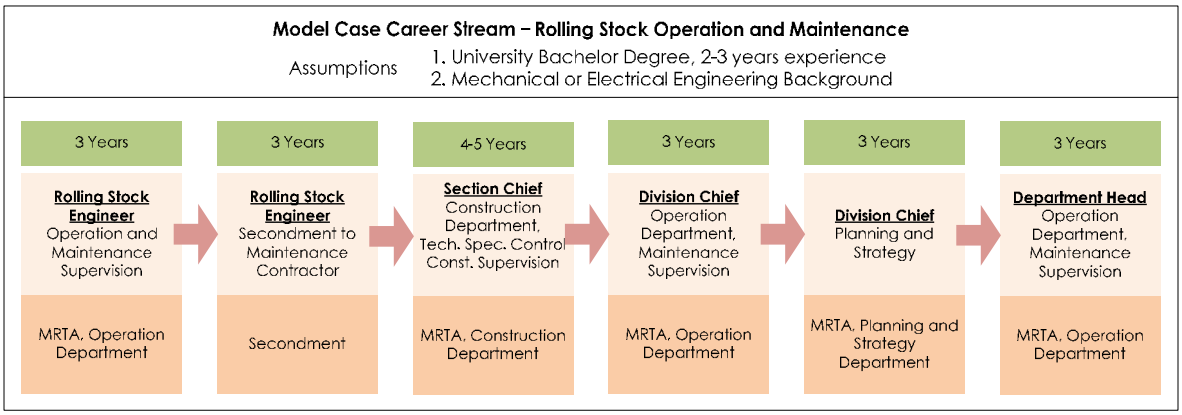


Figure 7.5 – Career Stream Model (2) Mechanical and Electrical Engineering Staff

(3) Marketing and Business Promotion Staff

This case deals with a Marketing and Business Promotion staff, either with an engineering or economist background, starting with his/her first assignment at Operations unit for about four years to acquire basic understanding, knowledge and skills. He/She may be sent to a property development firm, retail store chain or a local government for a year or two to understand the ways how they are engaged in the suburban / regional development. After acquiring the basic knowledge and establishing good network, the staff will return to MRTA and posted to the new line concession and tender process unit as a section chief for about 3-4 years. During that period, the staff will accumulate know how on those issues as well as how to manage tasks. Then the staff will be assigned to the regional development as the section chief responsible for the regional stakeholder relationship building and networking from MRTA's view point.

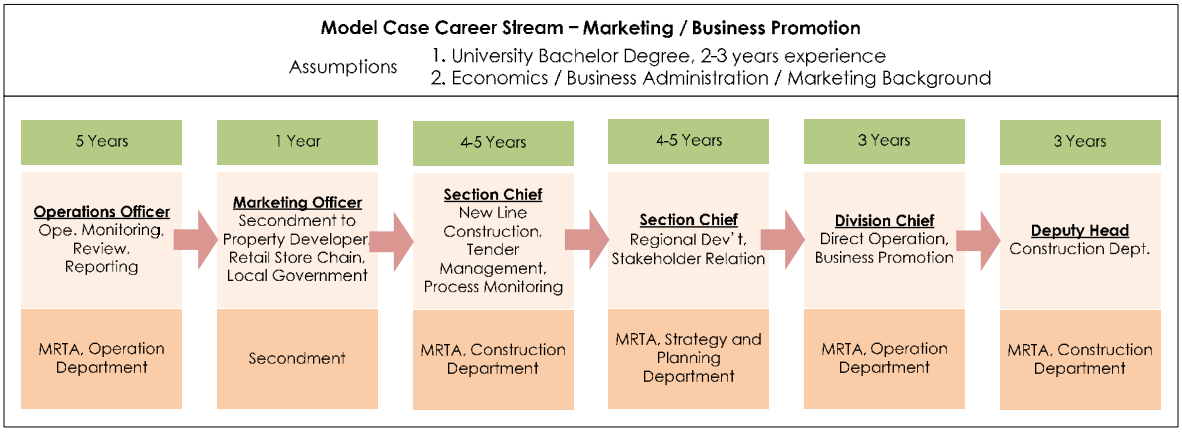


Figure 7.6 – Career Stream Model (3) Marketing & Business Promotion Staff

(4) Accounting and Financial Management Staff

This case deals with an Accounting and Financial Management staff. After acquirement basic skills of the Cash Management with Gross Cost Concession Scheme in the Accounting Unit

for about 3-4 years, then assigned to work for AFC Unit at Operations. Understanding the daily cash flow and the short term cash investment, then seconded to a Thai bank to gain knowledge on the Asset-Liability management for two years. When the staff comes back to MRTA, a position in the Planning unit to be responsible for Financial Planning where long-term financial strategy is performed.

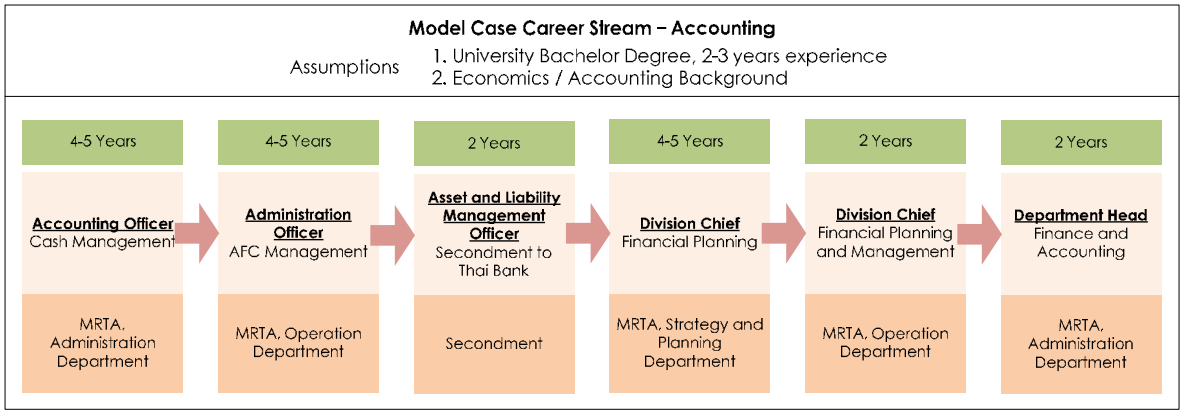


Figure 7.7 – Career Stream Model (4) Accounting & Financial Management Staff

7.5 Long-Term Roadmap

Based on the above study results, the Team has developed a strategic roadmap to sustainable value creation from a long-term perspective. This long-term roadmap covers the period till

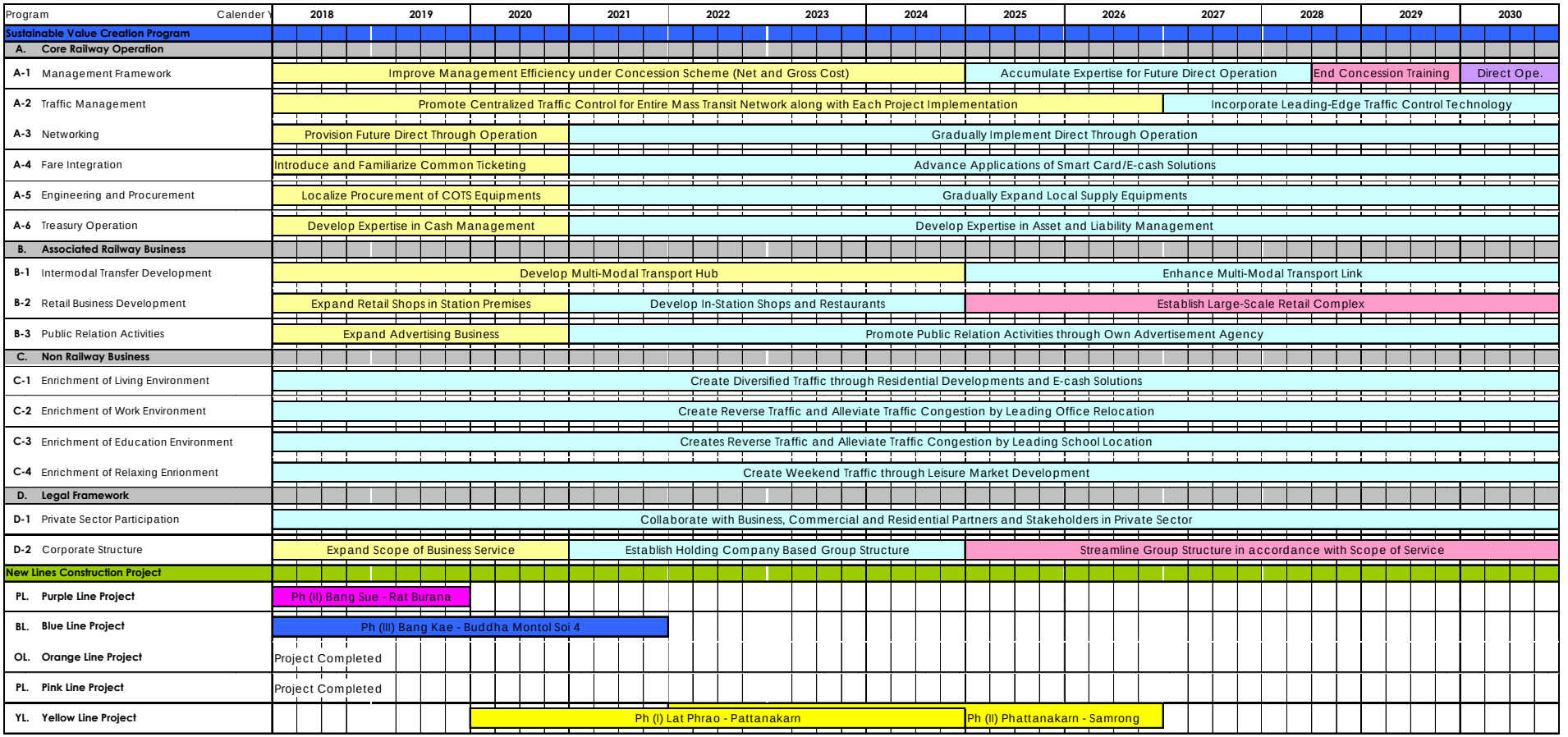


Figure 7.8 – Long-Term Roadmap

APPENDIX

APPENDIX

3.1 MRTA TECHNICAL STANDARDS

MRTA technical standards of Blue Line ISP given in each tender document are summarized below:

Signalling System

Category	Parts	Law, Regulation, and Standard			
		International Standard	Domestic Standard	Regulation for Operation	Other
	CBI				
	ATC	ERTMS			
	Train Detection	EN50238			
	Wayside Equipment				
	Onboard Equipment				
	Power Supply				
	System Assurance	EN50126			
	RAMS	EN50126			
	Software	EN50128			
	Signalling Principles			MRTA	
	Operating Rules & Regulations			MRTA	
	Hardware	EN50129			
	Interfaces				
Rolling Stock	ATC				
	Radio				Thai Government
	DMI				
	Train Detection	EN50238			
	Emergency Brake				
Communica-tion Systems	BTN	**International Standard** ISO/IEC 8802.3 (IEEE 802.3), ISO/IEC 8802.5 (IEEE802.5), CCITT, ISO 9314 FDDI, ISO/IEC 8802.5 (IEEE802.5)			
	PA	**International Standard** ISC 60849, EIA310-C, BS5839, BS6259, BS7443			
	PIDS	TCP/IP			
Platform Screen Doors	PSD detection and open/close commands	NFPA 130			
Trackworks	Alignment/PSR	EN13848-1			
	Exothermic Wire Connections	IEEE 837			
	ATC Wayside Balise				
	IRJ's	UIC 864-2 UIC 864-3 UIC 864-4 ASTM A490			
	Turnouts/Point Machines				
SCADA	Traction Power		MEA Rules & Regulations		

Category	Parts	Law, Regulation, and Standard			
		International Standard	Domestic Standard	Regulation for Operation	Other
Civil E&M	LV Power		TIS		
	Standby Power Loading				
	Room Facilities/ Air-Con/Fire Prevention/ Suppression Earthing & Bonding	NFPA 130			
	Cable Routes/Cable ways/Protection	NFPA 101 NFPA 130	TIS		

Telecommunication System

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
Communica-tion Systems	BTN Ethernet	ISO/IEC 8802.3 (IEEE 802.3) ISO/IEC 8802.5 (IEEE802.5) CCITT ISO 9314 FDDI ISO/IEC 8802.5 (IEEE802.5)			
	Optical Transmission	ITU-T G957 ITU-T G958 ETSI			
	TETRA Radio	IEC 60079 TETRA 1 ETSI TS 100-300 392-15 EN 303 035-1			
	Master Clock	ITU-T G811 RFC1305 (Version 3).			
	Telephone PABX				
	PA	ISC 60849 EIA310-C BS5839 BS6259 BS7443			
	CCTV	MPEG-4			
	PIDS	TCP/IP			
	TCS				
	SMS				
	CASS				
	OA&IT	ISO 17799			
	Software	EN50126 EN50128 EN50129 EN50159-1&2			

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
		IEC62278 IEC62279 IEC62280			
	Ingress Protection from moisture	IEC60529			
	Electronic Equipment onboard Railway Vehicle	IEC571 IEC60077 EN50155			
	Earthing	EN50122-1 EIT 2001-45			
	EMC/EMI	89/336/EEC EN50081-2 EN50121-2 EN50121-3 EN50121-4 EN50123 IEC61000-1 IEC61000-4			
	Conducted Immunity Level	EN50082-2 IEC61000-3			
	Electrostatic Discharge	IEC61000-4-2			
	Fast Transient Bursts	IEC 61000-4-4			
	Standard CD Format	ISO 9660			
	Power Surge	IEC 61000-4-5			
	RAMS	EN50125 EN50129 IEC62278 IEC62279 IEC62280			
	Environmental Conditions for Electronic Equipment	ETS 300 019-2-5			
	Material		TIS		
	Cables	ISO/IEC 11801 IEC 60228 IEC 287 IEC 364-5-523 BS7443 LS0H			
Rolling Stock	Electronic Equipment onboard Railway Vehicle	IEC571 IEC60077 EN50155			
	PA				
	Radio	ETS 300 019-2-5 ETSI TS 100-300 392-15 EN 303 035-1			
	PIDS				
	TCS				
Train Control & Signalling	BTN				
	PA				
	PIDS				

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
Platform Screen Doors	PSD Communications				
SCADA	Traction Power				
Thai Government Communica-tions Authority	Allocation of Radio Frequencies				
Public Telephone Companies	Public Telephone				
Civil E&M	LV Power				
	Standby Power Loading				
	Room Facilities/ Air-Con/Fire Prevention/ Suppression Earthing & Bonding				
	Cable Routes/Cable ways/Protection				

Power Systems

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
Power System	HV Switchgear	IEC298 IEC517	MEA		
	HV Power	EN50163 IEC61000-3-13	MEA		
	Standby Generator				
	UPS	EN50091-1 EN50091-2 IEC EN62040 IEC EN 60146			
	Batteries	IEC896-2 BS6290-4 DIN43534			
	Protection and Measuring facilities				
	DC Switch Gear	IEC61992			
	Transformers & Rectifiers	IEC60044 BS3938 IEC726 IEC146-1-1	MEA		
	Fuses	BS88			
	Metering		MEA		
	Step & Touch	IEC479			
	Safety & Earthing	EN50122-1 EN50124-1	MEA EIT2001–45		

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
		IEC62128 IEC61024-1 IEC61312-1			
	Harmonics	IEC61000-3-6			
	Power cables	IEC502 IEC840 IEC287	MEA		
	Trackside Section Switches	EN60529 IP54	MRTA?		
	SCADA	NFPA130			
Rolling Stock	HV Power	EN50163			
Train Control & Signalling	If Track Circuits, Fault levels EMC/EMI	EN50121-4			
Trackworks	CR System				
	Traction Bonding				
Civil E&M	LV Power				
	Standby Power Loading				
	Room Facilities/ Air-Con/Fire Prevention/ Suppression Earthing & Bonding				
	Cable Routes/Cable ways/Protection				
	Main Workshop Emergency Isolation Switches				
MEA	HV Power				
	Rules & Regulations				
	Fault Levels				
	HV Maintenance				

Trackworks

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
Trackworks	Rails	UIC 54 E1 UIC60 E1 EN13674-1			
	Fastening System	AREMA 136RE AREMA 115RE EN13481-1 BS2789			
	Rail Seat Pads	UIC 864/5 BS 903: Part C2			
	Concrete Sleeper	EN13230-1 EN13230-2			

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
	Turnouts	EN 13232 EN 13674-2 EN 13674-1			
	Buffer Stops				
	Welds				
	Rail Joints	UIC 54 UIC60 UIC 864-2 UIC 864-3 UIC 864-4 TJ 57 VDV 600 ASTM A490			
	Rail Expansion Joints (REJ)	EN 13232-8 UIC 33			
	Guard Rails	UIC 33			
	IRJ's	UIC 864-2 UIC 864-3 UIC 864-4 ASTM A490			
	Alignment	EN13848-1			
	Noise		NESDB 70dB		
	Emergency Power isolation Switches in Main Workshop				
	Solid Insulators	ASTM D149 BS 923, Part 1			
	Stinger System				
	CR System Gaps				
Rolling Stock	CR System Pickup Shoe				
	CR System Gaps				
	Depot main Workshop Stinger System				
	Gauge curves and gradient				
	Gauge Widening				
	Noise Suppression				
	Rail Resistance				
Signalling	Wire to Rail Connections				
	Turnouts/Point Machines/ Gauging				
	Rail Bonding				
	IRJ's				
Civil E&M	Plinth Shear Keys				
	Stray Current Earthing & Bonding				
	Alignment				
	Depot Workshop Raised Inspection Tracks				

Rolling Stock

Category	Parts	Law, Regulation, and Standard			
		International standard	Domestic Standard	Regulation for Operation	Other
Rolling Stock	Protective provisions relating to electrical hazards	EN 50153			
	Kinematic Envelope	UIC 505 1/5			
	Fire Protection	DIN 5510			
	Ride Quality	ISO 2631			
	Bogie	EN 10103			
	Environmental Conditions	EN10104			
	Electrical Equipments	EN 50125			
	Railway Electronics	EN 50155			
	Motor	IEC 571			
	Cabling	IEC 60349			
	Testing	EN 50343			
	Shock and Vibration	IEC 61133			

3.2 TECHNICAL SPECIFICATIONS OF BLUE LINE

Technical specifications of Blue Line ISP given in each tender document are summarized below:

Items		Concession Tender Document by MRTA		Contract document by BMCL	Concession Agreement between MRTA & BMCL	Outline Design by Supplier
		Employer's Requirement	Outline Specification	Particular Specification	Employer's Requirement	
	passengers per hour per direction	16,000 at opening				
	passengers per hour per direction	40,000 ultimate		40,000	40,000	
	minimum overall average speed	35km/h				
	Service interval range	3 to 4 minutes at opening				
	Service interval range	2 min. ultimate				
Train composition			Unit of th3 cars. Maximum 6 vehicles			3car A-C-A 6car A-C-B-B-C-A
track gauge						1435mm
	Max. gradient in mainline					5%
	Max. gradient in depot					5%
Dimensions						
	Train Length (3car)					65,100mm
	Train Length (6car)					129,600mm
	maximum width		3.2m	3.2m		3,120mm
	maximum height		3.7m	3.7m		3,860mm
	maximum length over couplers		more than22m less than 24m	more than22m less than 25m		21,800mm(Acar)
						21,500mm(Bcar)
						21,500mm(Ccar)
	Floor height			1,100mm (nominal floor height)		1,160mm
	doorway clear opening					1,400mm
	width of emergency door					730mm
	distance between bogie centre			less than17m		14,800mm
			UIC505-1/5 or equivalent	UIC505 - 1/5		
	minimum clearance between the kinematic envelope and the structure gauge		more than 125mm not include platform	more than 125mm not include platform		
	clearance between carbody and platform			less than 95mm		
Passenger Capacity per car						Acar Bcar Ccar
	Seated					42 42 42
	Standees AW2					206 222 222
	Standees AW3					247 266 266
	Standees AW4					329 355 355
	Total for AW2					248 264 264
	Total for AW3					289 308 308
	Total for AW4					371 397 397
Passenger Capacity per train set						3car set 6car set
	Seated					126 252
	Standees AW2					634 1300
	Standees AW3					760 1558
	Standees AW4					1014 2078
	Total for AW2					760 1552
	Total for AW3					886 1882
	Total for AW4					1140 2330
Weight						
	Target Weight					maximum axle load 15.4t at 8/m^2 passengers
	Tare weight Acar					37.3t
	Tare weight Bcar					36.8t
	Tare weight Ccar					32.5t
	Mass			not more than 1.7ton/meter		
	maximum permissible static load per axle			17t		
	difference in weight measured from bogie pivot centre to bogie pivot centre		less than 1.5%	less than 3% (testing under IEC1133)		

	difference in weight measured from one side of the Vehicle to the other		less than 1%	less than 4% (testing under IEC1133)		
Power Supply						
	Nominal Voltage		750V	750V		750V D.C.
	Tolerance					900V … 500V D.C.
	Lowest Working Voltage		525V (-30%)	600V		650V D.C.
	Highest Working Voltage		900V (+20%)	900V		900V D.C.
	Voltage to guaranty the performance		650V～900V	650V～900V		
	minimum abnormal voltage			525V		
Performance						
	Maximum safe over speed, fully worn wheel					85 km/h
	Maximum service speed	80km/h all train formations	80km/h	80km/h	80km/h	80 km/h
	Mean service braking rate from 80 to 0 Km/h		0.9m/s^2	0.9m/s^2		0.9m/s^2
	Emergency braking rate		1.2m/s^2	1.2m/s^2		1.2m/s^2
	Maximum variation in braking rate		0.1m/s^2	0.1m/s^2		
	Maximum jerk rate in acceleration or braking		0.75m/s^3	0.75m/s^3		0.75m/s^3
	Maximum acceleration		1.3m/s2	1.3m/s^2		
	average acceleration rate from 0 to 60km/h		0.9m/s2	0.9m/s^2		0.9m/s^2
	Minimum proportion of motored axles		67%	more than 60%		
	stopping distance (service brake)		300m +0-10%			
	stopping distance (emergency brake)		240m			
	stopping distance (emergency brake)		320m			
	condition to guaranty service brake		maximum load at maximum gradient wind speed 115km/h			
	Emergency Rescue Performance,	able to start at worst case gradient, travel to nearest			able to start at worst case gradient, travel to nearest	
Train resistance for calculation						
	train resistance (Ra)		Ra = A + BV + CV^2	Ra = A + BV + CV2		
			V = speed km/h	V = speed km/h		
			A = 3520 N	A = 3520 N		
			B = 30.56 N/km/h	B = 30.56 N/km/h		
			C = 2.28 N/ (km/h)^2 in tunnel	C = 2.28 N/ (km/h)2 in tunnel		
			C = 1.07 N/ (km/h)^2 outside	C = 1.07 N/ (km/h)2 outside		
Ride quality			Stable at 120% of maximum speed			
	Bogie stability test			UIC 515		
	Ride quality measurements			ISO 2631		
Bogie						
	Gauge					1,435mm
	Back-to-back wheel gauge					1,360mm
	Wheel Base			less than 2.6m		2,300mm
	Wheel diameter (new)					850mm
	Wheel diameter (worn)					775mm
	Rotating resistance		less than 0.1 of wheel load	less than 0.1 of wheel load		
	maximum cant		5degree	5degree		
	maximum permitted wheel unloading		50%	60%		
	Bogie weight					7,750kg 5,600kg
	Maximum design speed					85km/h
	Maximum permissible axle load					15,400kg
	wheel					monoblock type (UIC 812-3)
	corresponding rail profile					UIC54
	fatigue life					at least 40 years
	material of axles					UIC 811 A4
	strength analysis					UIC 515-3
	wheel pressing					UIC 813

	Bearing					tapered roller bearing 130x220x150 nodular iron GGG50 EN 1563
	maximum permissible static load per axle		17.5 t.	17t		
	maximum permissible static load per wheel		9.1 t.	8.85t		
	vertical direction		Fv = 2(M1+M2+M4)g N	Fz=2(M1+M2+M4)g N		
	transverse direction		Ft = 2F1 N	Fy = 2F1 N		
	longitudinal direction		Fl= 5M5g N	Fx= 5M5g N		
			g = acceleration due to gravity (9.81m/s^2)	g = acceleration due to gravity (9.81m/s2)		
			M1 = tare mass of body in operational conditions, kg	M1 = tare mass of body in operational conditions, kg		
			M2 = crush loading, number of passengers x 65 kg	M2 = crush loading, number of passengers x 60 kg		
			M4 = bogie sprung mass, kg	M4 = bogie sprung mass, kg		
			F1 = maximum net lateral track force exerted on the track by a wheelset, N	F1 = maximum net lateral track force exerted on the track by a wheelset, N		
			M5 = total bogie mass, kg	M5 = total bogie mass, kg		
	vertical direction		Fx = (1± 0.3) (M1+M2)g/2 N	Fz = (1+ 0.3) (M1+M2)g/2 N		
	transverse direction		Fy = ±0.3 (M1+M2)g/2 N	Fy = +0.3 (M1+M2)g/2 N		
			g = acceleration due to gravity (9.81m/s^2)	g = acceleration due to gravity (9.81m/s2)		
			M1 = tare mass of body in operational conditions, kg	M1 = tare mass of body in operational conditions, kg		
			M2 = crush loading, number of passengers x 65 kg	M2 = crush loading, number of passengers x 60 kg		
	Headstock vertical		± 20g	± 20g		
	transverse		± 3g	± 3g		
	longitudinal		± 5g	± 5g		
	Centre vertical		± 10g	± 10g		
	transverse		± 1.5g	± 1.5g		
	longitudinal		± 5g	± 5g		
	Axlebox vertical		± 50g	± 50g		
	transverse		± 5g	± 5g		
	longitudinal		± 5g	± 5g		
	Headstock vertical		± 10g	± 10g		
	transverse		± 1.5g	± 1.5g		
	longitudinal		± 0.2g	± 0.2g		
	Centre vertical		± 5g	± 5g		
	transverse		± 1g	± 1g		
	longitudinal		± 0.2g	± 0.2g		
	Axlebox vertical		± 25g	± 25g		
	transverse		± 3g	± 3g		

Wheels, Axles And Axleboxes		ISO 1005 Part 3	ISO 1005 Part 3		
Steel grade		UIC 811-Grade A1 condition N	UIC 811-Grade A1 condition N		UIC 811Grade A4
Wheel diameter					
Lubricator Device		Between 12 and 25% of wheels	Between 12 and 25% of wheels		
current collectors		bottom contact type			
minimum impact energy		500J			
Earth Return Device		each axel			
interval of exchanging brake pad			not less than 6 months		
parking brake			50% of brake actuators		
Vehicle Body					
Material	Aluminum alloy or stainless steel		BS 8118 (In case Aluminum Body)	Aluminum alloy or stainless steel	
Construction		monocoque structure	monocoque structure		
Difference of body bending frequency and bogie pitching frequency		minimum 1Hz	minimum 1Hz		
load case to be considered					
Compressive force underframe on anticlimber		1,200 kN	1,200 kN		
Compressive force at coupler mount		1,200 kN	1,200 kN		750kN (absorbed by coupler)
Compressive force between wind sill and underframe		300 kN	300 kN(coupler centre - 350mm)		
Compressive force at cantrail height		300 kN	300 kN		
tensile force at coupler mount		800 kN	800 kN		
strength of carbody					VDV 152 "Recommendations for the strength calculation of passenger vehicles to BOStrab"
distributed downwards vertical load		F = 1.5 (M1 + M2) g N			
		g = acceleration due to gravity, 9.81 m/s^2			
		M1 = tare mass of body in operational conditions, kg			
		M2 = crush loading, number of passengers x 60 kg.			
cycles for fatigue load		10^7			
vertical load		Fv = (1 ± 0.15) (M1 + M3) g N	Fz = (1 + 0.15) (M1 + M3) g N		
transverse load		Ft = ± 0.15 (M1 + M3) g N	Ft = + 0.15 (M1 + M3) g N		
		g = acceleration due to gravity (9.81 m/s^2)	g = acceleration due to gravity (9.81 m/s2)		
		M1 = tare mass of body in operating condition	M1 = tare mass of body in operating condition		
		M3 = normal loading, number of passengers x 65 kg	M3 = normal loading, number of passengers x 60 kg		
Roof skin			Without permanent deformation at 120kg / 750mm		

vehicle ends				absorption of collision energy in a progressive manner such that repair is reduce to minimum	
absorption of colligion energy by coupler and draftgear		less than 20km/h	less than 15km/h		
absorption of colligion energy by anticlimber		20km/h～24km/h	～24km/h		
absorption of colligion energy by deformation of outside of bolster		24km/h～60km/h	24km/h～40km/h		
irregularities of structure		1.5mm ／ 1m	1.5mm ／ 1m		
Footsteps				to access from track level cab and each body side	
load		200kg	200kg		
length, width		450mm,200mm			
minimum service life			6 years		
fade by service life			less than10%		
magnesium content (in case aluminum body)		less than 1%			
Attachment of equipment to the body					
Load case					
longitudinal direction		Fx = 5m g N	Fx = 3m g N		
transverse direction		Fy = 1m g N	Fy = 1m g N		
vertical direction (up)		Fz = C1mg N	Fz = C1mg N		
vertical direction (down)		Fz = C2mg N	Fz = C2mg N		
		m = mass of item of equipment (kg)	m = mass of item of equipment (kg)		
		g = acceleration due to gravity (9.81 m/s$^{2)}$	g = acceleration due to gravity (9.81 m/s2)		
		C1 = 1.0 at the end of the vehicle, decreasing linearly to 0.5 at the middle of the vehicle.	C1 = 1.0 at the end of the vehicle, decreasing linearly to 0.5 at the middle of the vehicle.		
		C2 = 3.0 at the end of the vehicle, decreasing linearly to 1.5 at the middle of the vehicle.	C2 = 3.0 at the end of the vehicle, decreasing linearly to 1.5 at the middle of the vehicle.		
Proof Load Case		1.15 x working load case	1.15 x working load case		
Ultimate Load Case		1.5 x working load case	1.5 x working load case		
longitudinal direction		Fx = m(± ax) N	Fx = m(± ax) N		
transverse direction		Fy = m(± ay) N	Fy = m(± ay) N		
vertical direction (down)		Fz = m(1 g+ az) N	Fz = m(1 g+ az) N		
		m = mass of item of equipment (kg).	m = mass of item of equipment (kg).		
		g = acceleration due to gravity (9.81 m/s^{2}).	g = acceleration due to gravity (9.81 m/s2).		
		ax ay and az are accelerations as defined below.	ax ay and az are accelerations as defined below.		
		ax = 0.2 g	ax = 0.2 g		
		ay = 0.015 g	ay = 0.15 g		
		az = 0.15 g	az = 0.15 g		

Glass				BS857 (excl. front window)		
Windscreen			laminated high-impact resistant safety glass	laminated high-impact resistant safety glass		
	Strength		withstand shooting iron cube of 70～75mm 0.9kg with 220km/h	withstand shooting iron cube of 70～75mm 0.9kg with 220km/h		
Gangway height			1,900mm (minimum)	1,900mm (minimum)		1,980mm Clear Height
						1,900mm Minimum Clear Height
gangway width			1,450mm (minimum)	1,450mm (minimum)		1,400mm Nominal width
Coupler						
	outer end		automatic coupler	automatic coupler		
			allowing automatic mechanical coupling and uncoupling of units			
	intermediate		semi-permanent coupler			
	cycle of coupling			2500		
Propulsion controller			All equipment shall be generally in accordance with IEC Documents			
	circuit-breaker		IEC 56 and 77	IEC77		
	standard for electronic devices			EIC571		
	type of traction motor		3 phase asynchronous motor	3 phase asynchronous motor		
	standard for traction motor		IEC 349	IEC 349		
	traction motor rating (one hour)					
	traction motor rating (continuously)					
	insulation		Class 200	Class 200		class 200
						IEC 349-2, VDE 0535, VDE0530
	Noise level of traction motor					IEC 60349-2
	Contactors, and Conventional Electromagnetic Equipment		IEC 77	IEC 77		
	time after removal of voltage to safety level		2min. To 45V	2min. To 45V		
	reactor		IEC 310	IEC 310 (transformer and reactor)		
	Electronic printed circuit boards		IEC 297.			
	dynamic brake		regenerative and rheostatic			
	slip-slide protection		operative in motoring and service braking	wheel slide protection - service and emergency brake		
	brake resistor			IEC 322		
	transient voltage		IEC 411-3			
	Control and Monitoring System		IEC 571			

	Traction performance		failure of up to 33% of the motors permit the train to continue to operate to next terminal.	failure of up to 25% of the motors permit the train to continue to operate to next terminal.		
	step change one air/dynamic brake level		less than 2 sec.			
	response time from coast to friction brake or dynamic brake			1.6 second		
	response time between initiation and commencement of emergency brake			0.7 second		
	Climatic condition of VVVF					-25deg to 40deg relative humidity up to 93%
	Vibration and shock requirements for VVVF					EN 501235-1 IEC 60068-2-64,2-27 IEC 61373
	IGBT converter					IEC 61287-1
	VVVF withstand voltage					3000V
	Faults detection interface					RS232C
Auxiliary Power Supply						
	limits of voltage variation		IEC 77			
	converters		IEC 146-2 and 571-3	IEC 411-5, IEC 146-2 and 571-3		
	Electronic equipment		IEC 571			
	capacity		2 train sets			
	Output					4 phase(3 phase + 1 neutral) AC 400V, 50Hz, 200kVA
	efficiency of the auxiliary converter			more than 80%		
	DC output supply			110V ±5%		
	ripple voltage			not exceed 2%		
	AC output three-phase supply			within ±5% of nominal voltage		
	harmonic distortion			not exceed 8%		
	power factor			0.85		
	delay time for load shedding on non-essential loads		30 seconds	30 seconds		
	Battery		Nickel Cadmium type			1.2V 80 cells approx. 140Ah
			IEC 623 class M or equivalent			
	capacity for emergency case (essential load)		90min(state of charge of battery 80%)	60min(state of charge of battery 72%)		
Side Passenger Door						
	time for evacuation					45 second AW3 condition
	type					electrical operated bi-parting outside sliding door
	clear width					1400mm
	clear height					1900mm
	opening closing time					2.5+-0.5 sec
	door closing force					200N
	water tightness test					DIN 566
clear headroom of cab front door						1700mm
cab saloon door clear width						810mm
	clear height					1980mm
passenger seat						42 each car
illumination of passenger saloon						300Lux. 0.7m 500Lux. 1.7m
ventilation						6 m^3/h per passenger
ventilation in case of power down						0.5m^3/sec 60min

ambient condition of air conditioning system						40℃ 55.5%RH
Air Conditioning System						
	target temperature					up to 35℃:25℃
working voltage of DC auxiliary equipments				-30% to +15% of nominal voltage		
Pneumatic Equipment						
	Pressure of Air Compressor					10 bar - 8.5 bar
	Capacity of main reservoir					100l per each car
	underframe piping					DIN 59753
	air reservoir (aluminum)					DIN EN 286-4
Lighting						
	Illumination level of emergency light		20 Lux at egress points and 5 Lux elsewhere			
	Illumination level in the cab		UIC leaflet 651			
	FRONTEND LIGHTING		UIC leaflet 534 OR			
	Distance of visible of tail light			300m		
	minimum viewing angle			45°		
	minimum distance of two lamps			1.3m		
Noise Requirement						
	interior noise at stationary					70dB
	interior noise at 80km/h					74dB
	exterior noise at stationary					74dB
	exterior noise at 80km/h					80dB
Fire Protection						
	Fire Protection					DIN 5510

3.3 CASE STUDIES OF M&E SYSTEM EXPANSION

Some practices of M&E system expansion at the time of line extension are studied and summarized as follows. This exercise gave the lesson that faced to the similar issues due to the dependency of M&E system, every project had to seek ways to reduce the reliance to the supplier of the initial phase.

Bangkok BTS Extension (Taksin – Bang Wa), Thailand

	Main Description	Remarks
General description of the railway authority/operator (concerned parties)	Bangkok Metropolitan Authority (BMA) To employ an Contractor to supply 4 new stations, 5.3km of double trackworks and all M&E Systems, including building services for a 5.3km extension of the 2nd BTS Silom Line.	
General description of the railway system and supplier	This 2nd Silom Line extension is due to be opened in 2012 representing 5.3km and 4 stations.	The Tendering announcement was made in April 2010 and contract award is due in September 2010.
Conflicts and difficulties faced at the time of extension and replacement	The civil elevated viaduct was constructed from 2005-2008. The BMA employed a civil contractor to construct the 5.3km elevated viaduct, but no trackworks or M&E systems suppliers.	The reason for not employing the Trackworks and M&E as the concept at the time was to start the civil works and employ trackworks and M&E later, but due to political unrest the trackworks and M&E systems was not awarded on time and the civil structure has been finished for some time.
Selection of supplier at the time of extension and replacement	The tender documents for the 4 stations, trackworks and M&E systems is complete and ready for selling to tenderer's.	The M&E Systems does not include rolling stock as the BTSC has placed an order directly with a Chinese/Canadian JV being CNR/Bombardier employing Siemens bogies.
System integration and compatibility issues at the time of system installation	The largest problem is the compatibility and system integration of the signalling system. The 1st extension of the Silom Line was Bombardier with their Cityflo 450 CBTC system. The initial Silom Line was Siemens, but under the resignalling scheme, Siemens shall be replaced with the Bombardier Cityflo 450 CBTC system in 2010. Therefore the technical specifications lean towards the Bombardier system in specification, but not directly in name as the BMA cannot appoint direct suppliers under government procurement rules. The technical evaluation will take the tenderer's proposals in how compatibility shall be achieved. Any other supplier but Bombardier will cause large incompatibility problems and	The AFC system shall not form part of this project contract and the AFC system shall be supplied under BTSC to ensure compatibility and integration of this extension AFC system to the existing AFC system.

	Main Description	Remarks
	system integration difficulties, especially in developing safety and system assurance. This is Confidential	
System integration and compatibility issues after system installation	Provided Bombardier is chosen for the signalling system, no real interface or integration issues are envisaged as all other systems can be technically achieved.	No issues are envisaged as long as Bombardier are awarded the signalling system
Contractual binding to avoid supplier monopoly	The tender documents have been written to be as "Open" as possible. Interfacing tables are included to ensure al interfaces are identified and known during the tendering process. The specifications have been written in such a ay that the performance requirements of the extension lean towards Bombardier for the signalling, but not so much that other signalling suppliers could not pass the technical evaluation.	It is considered that in the E-Auction process any other signalling supplier except Bombardier could not achieve the lowest price against Bombardier due to the integration and compatibility problems that other suppliers would face. This is Confidential
Policy to secure competitiveness of each supplier	Tender documents are written to be "Open" and all suppliers should be able to tender. This is in line with the Thai Government procurement guidelines.	Under Thai procurement guidelines, there must be atleast 2-3 bidders. If there is only one tenderer, the contract cannot be awarded under government rules.
Comments extracted from relevant parties	BMA are please with the decision to replace the initial system and have a FPA in place with the new supplier for all future extensions.	FPA's are actually not legal for government tendering of new projects.

MRTC, Hong Kong

	Main Description	Remarks
General description of the railway authority/operator (concerned parties)	Mass Railway Transit Corporation (MTRC) Hong Kong. To employ Contractors to design and build the initial system, the Island Line	
General description of the railway system and supplier	The 1st railway line of a total 3 was opened in 1979. In 1989 all 3 lines were completed representing 43.2km, 38 stations and 671 train cars. The initial signalling system, including Automatic Train Protection (ATP) and Automatic train Operation (ATO) and Automatic Train Supervision (ATS) was supplied by Westinghouse. Rolling Stock was procured from Camel Metro, UK. The AFC system was supplied by CUBIC.	

	Main Description	Remarks
Conflicts and difficulties faced at the time of extension and replacement	In the early nineties, MTRC requested Westinghouse to make some changes to its initial signalling system. Westinghouse quotes were too high and MTRC Managers decided to take the opportunity to tender for new suppliers. ALSOM (France) won the project and replaced the existing Westinghouse signalling system across all 3 lines while keeping the train services running without interruption. This meant only work on the track could be done between 01:00am – 5:00am each night, but the new system was successfully commissioned in 1995. ALSTOM were also successful in winning the New Airport Railway Signalling System contract and the new railway opened in 1997. Now all 4 lines were ALSTOM. In 1998 a new line called the Tuen Kwan O Line, was tendered. MTRC Management took the conscious decision to choose another signalling supplier to allow business comparisons to be made between different systems. Siemens successfully won that project, but no work was started in the first 12 months. On questioning Siemens managers, they replied they had quoted too low a price and could not make a profit. Subsequently systems specifications were cut and features and function reduced to allow Siemens to complete the work. In 2005 MTRC won a project to provide a short 3km line from its airport railway to the new Disneyland Resort. Using the same business case, MTRC chose a 3rd supplier (ALCATEL) to provide Hong Kong with its first "Driverless" railway.	
Selection of supplier at the time of extension and replacement	Switching to new supplier Allowing 3 different systems by 3 different suppliers	Performance and reliability studies are carried out regularly to assess and identify the strengths and weaknesses of each system against the other 2 systems.
System integration and compatibility issues at the time of system installation	Each of these 4 lines has little connection with the others. This is the ideal situation to avoid compatibility problems. However, to reduce spare parts holdings, Components of the Shelf (COTS) are required by MTRC so that standardization of non-specialised equipments can be provided, i.e. same type (and colour and size) of computer monitors, keyboards, lighting, air conditioning, etc.	
System integration and compatibility issues after system installation	N/A	

	Main Description	Remarks
Contractual binding to avoid supplier monopoly	N/A	
Policy to secure competitiveness of each supplier	This means each line must maintain its own spare parts with no sharing, although most parts can be shared if the Owner creates a "Master" specification for such items as computers, monitors, lighting, printers, etc. This technique was successful on Lines 3, 5 &13 of the Paris Metro (RATP).	
Comments extracted from relevant parties	MTRC Managers are pleased with the results of their decisions to diversify their systems to ensure they were not dependant on only one supplier. Standardisation of specifications for common equipments was the idea of RATP in France and due to its success, MTRC adopted the same approach. This knowledge came through the "Bench marking" group where several mass transit rail authorities come together every year to share experiences, and performance statistics of their systems so that all members can benefit from each others successes and failures.	

Manila Line North Line Extension (NEX) Project, Philippines

	Main Description	Remarks
General description of the railway authority/operator (concerned parties)	Light Rail Transit Authority (LRTA) is a Philippine government agency (a Government Owned and Controlled Corporation), linearly under Department of Transportation and Communication, and in-charge of the operation, maintenance and expansion (new projects) of Manila Light Rail Transit system (currently Lines 1 and 2).	Responsible for the existing Manila LRT Line 1 and 2, the on-going Line 1 North Extension Project, prospective Line 6 (Line 1 extension going to Cavite) and other lines under study.
General description of the railway system and supplier	The existing Manila LRT Line 1 has the following system characteristics; 1. Rolling Stock- 3 types (referred to as 'generations'). **1st generation** was manufactured in Belgium, commissioned early 1984, with a total of 64 vehicles (21 three-car trains); **2nd generation** was manufactured in Korea, with propulsion technology from AD Trans Sweden, commissioned in 1998, with a total of 28 vehicles (7 four-car trains); 3rd generation was manufactured in Japan, commissioned in late 2006, with a total	For the NEP the following works are included; 1. Rolling Stock – no additional vehicles under Line 1 NEP 2. Signaling System – for the extended line totaling more than 5 Km. – new system will be provided By TEWET Germany (including interface/integration)

	Main Description	Remarks
	of 48 vehicles (12 four-car trains). 2. Signaling System – recently upgraded (totally replaced) in 2006 using axle counter technology from Siemens Germany. 3. Telecommunication System – includes the following; ▪ Trunked Radio - Analog System (Tait) installed under the Line 2 Project ▪ SCADA System – new installation (Motorola) under Capacity Expansion Project (CAPEX)-2007 ▪ CCTV System – new installation (Bosch) under CAPEX-2006 ▪ FOTS/SDH(TMS) – new installation under CAPEX Project-2006 for communication backbone/ Tellabs ▪ Master Clock System – new installation (Gorgy) under CAPEX-2006 ▪ PA System – complete replacement/ Bosch ▪ PABX – improved/upgrade Ericson ▪ UPS – new installation/ APS ▪ AFC LAN – new installation ▪ Lightning Protection – new installation/ ERITEC 4. AFC – recently upgraded all hardware and software, Original System is by Thales System of France 5. Track Works – the existing system ballasted type; mostly by Kein 6. OCS – 750 VDC overhead line- double contact wire; 7. Power Supply – existing system / incoming 34.5 KV AC, 750 VDC, 480 VAC and 240 VAC;/ ACEC Belgium and ABB Germany/	3. Telecommunication System - for the extended Line 1 NEP; • Trunked Radio – New/Digital (TETRA) System by Motorola to completely replace the existing system. • SCADA – for all new system and upgrade of software to facilitate seamless integration to existing system. • CCTV – for all new Stations and for existing RSS. Exactly the same brand and system allowing full integration. • FOTS/SDH (TMS) – for all new Stations and the extended line. Exactly the same brand and system allowing full integration. • Master Clock – for all new Stations. Exactly the same brand and system allowing full integration. • PA System – for all new Stations. Exactly the same brand and system allowing full integration. • UPS – for all Telecom Equipment. The same brand as in Line 1. • AFC LAN – for AFC of new stations. Same set-up and interconnection to existing AFC LAN. • Lightning Protection – for all new stations. Same brand as in existing Line 1. 4. AFC System- installed in new stations. New supplier and equipment, including provision for prospective use of contact less system. 5. Track Works – track works for the extension was non-ballasted (concrete slab track, with resilient rubber boots on twin block sleepers and floating slab for special track works (turn-outs). Track materials by DAXI-FDP JV of Belgium 6. OCS – 750 VDC overhead line - double contact wire-typical of existing OCS. 7. Power Supply – typical of existing system / incoming 34.5 KV AC, 750 VDC, 480 VAC and 240

	Main Description	Remarks
		VAC (with open loop of 6.6 KV as additional feature); Equipment by new supplier (ABB China & Germany, Transformer by PHILEC and AREVA (Turkey), etc)
Conflicts and difficulties faced at the time of extension and replacement	1. Signaling System (EMS-1) ▪ Unreasonable increase in costing of original supplier. ▪ Limited proponent for performing the project ▪ Difficulty for seamless integration ▪ Very short project implementation time 2. Telecommunications (EMS-2) ▪ SCADA has to upgrade the operating software, with implication to existing warranty. ▪ Existing PABX model is already being phased out. Contractor proposed full replacement (with a new brand). Has to resolve integration with old telephone system. ▪ Trunked Radio System- full replacement with digital (TETRA) system due poor performance of present units and the expected phase-out of existing operating frequencies. Difficulties in transition and retrofitting of the new units to old vehicles. 3. AFC (EMS-3) ▪ Unreasonable increase in costing of original supplier ▪ Limited proponents to perform for the project ▪ Integration of system including provisions for contact-less system. 4. Power Supply (CP-C) ▪ Limitations imposed on the option of service connection by utility company (MERALCO) to ensure the redundancy of supply ▪ Limitation imposed by the utility company for the provision of proposed HV loop	
Selection of supplier at the time of extension and replacement	Signaling System (EMS-1) ▪ After several failures of Bidding, LRTA opted to proceed for a negotiated Bid with supplier (as allowed for under government procurement policy) . Telecommunication (EMS-2) ▪ Supplier was selected via competitive bidding	

	Main Description	Remarks
	AFC (EMS-3) ▪ Supplier was selected via competitive bidding Power Supply (CP-C) ▪ Supplier was selected via competitive bidding Track Works (EMS-4) ▪ Supplier was selected via competitive bidding	
System integration and compatibility issues at the time of system installation	Signaling System (EMS-1) ▪ Data on hand is still limited as negotiations only recently completed and Concept/Preliminary designs still being developed. Telecommunication (EMS-2) ▪ Warranty concerns for existing SCADA equipment due to upload of new software as part of integration process. AFC (EMS-3) ▪ Software integration to existing system/ communication protocol to allow seamless integration. Validation is still on-going Power Supply (CP-C) ▪ No major issue Track Works (EMS-4) ▪ Provision of Special Floating Slab due to Common Station design concept resulted in large cost increase.	
System integration and compatibility issues after system installation	Same as above	
Contractual binding to avoid supplier monopoly	N/A	
Policy to secure competitiveness of each supplier	N/A	
Comments extracted from relevant parties	N/A	

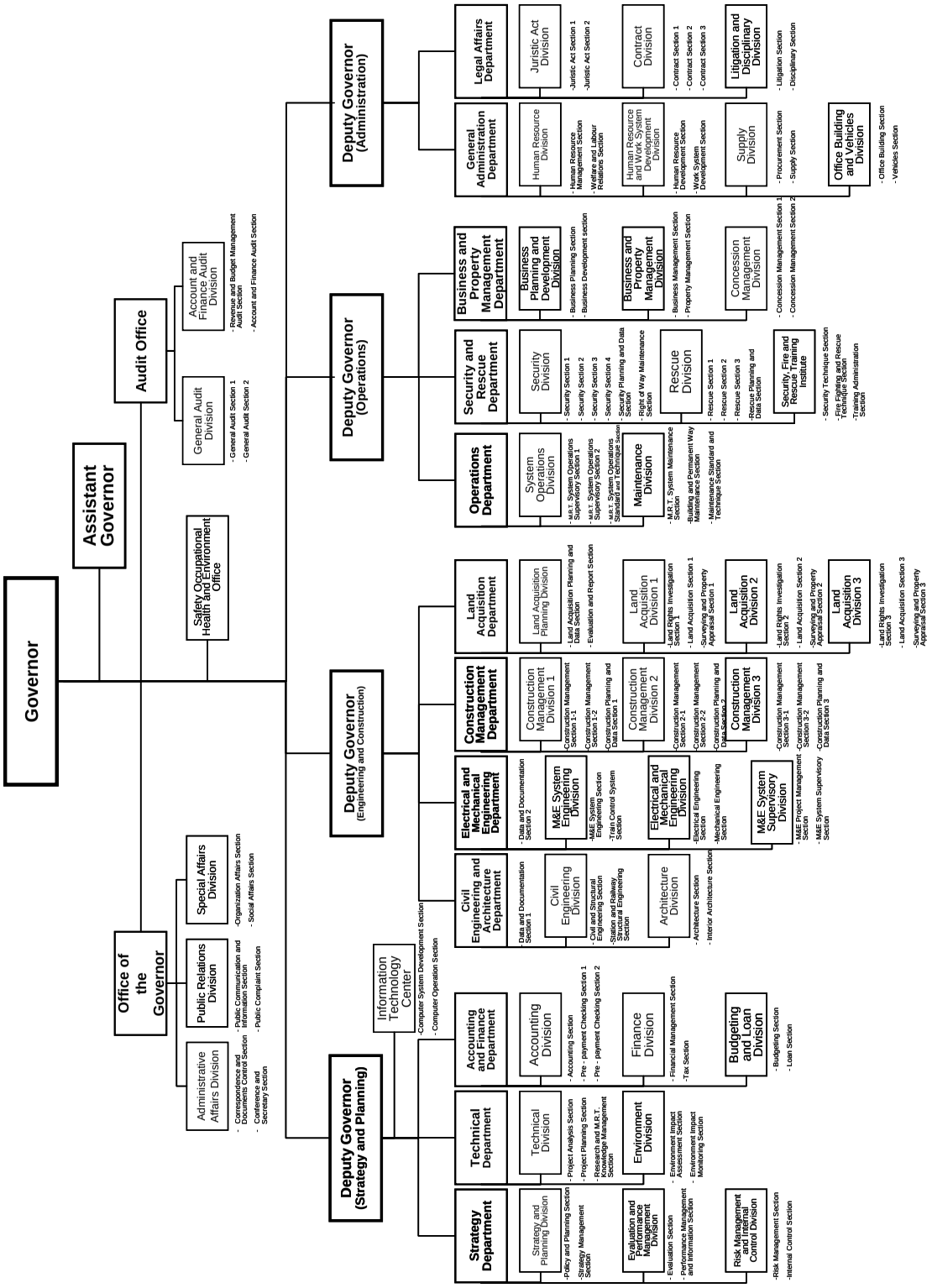
Sofia Metro, Bulgaria

	Main Description	Remarks
General description of the railway authority/operator (concerned parties)	Operator is Metropoliten Company whose share is 100% owned by the Municipality of Sofia. It was previously one of the departments of the Municipality of Sofia.	
General description of the railway system and supplier	Sofia Metro is equipped with the EZ-M system, a Bulgarian variant of a Russian relay Interlocking System. Signalling system is wayside and on board. The speed supervision and train protection functions are provided by the ALS-ARS system. Transmission system is based on Cisco equipment. AFC is a Bulgarian own system. Telephone system is Ericsson MXOne. SCADA system is Linux based. Rolling stock is from Russia of Russian SNIP standard.	
Conflicts and difficulties faced at the time of extension and replacement	Metropoliten Company wanted to use the latest system when the extension was in the design stage. But it was not changed because the interface of the existing system and the latest system in the same line was very complicated and expensive.	
Selection of supplier at the time of extension and replacement	The suppliers were all same as previous ones. We have no idea how Metropoliten Company decided those companies.	
System integration and compatibility issues at the time of system installation	As mentioned above, Metropoliten Company abandoned to update the existing system to the latest one.	
System integration and compatibility issues after system installation	It seemed to be a good decision for Metropoliten Company not to have changed the system from the existing system 8 years ago. The existing Russian system is stable and robust enough.	
Contractual binding to avoid supplier monopoly	Metropoliten Company fixed the suppliers as the nominated contractor in the Contract. Bulgaria is such a small country that no competitors exist, otherwise Siemens. We have no idea how Metropoliten Company decided those companies and prices.	

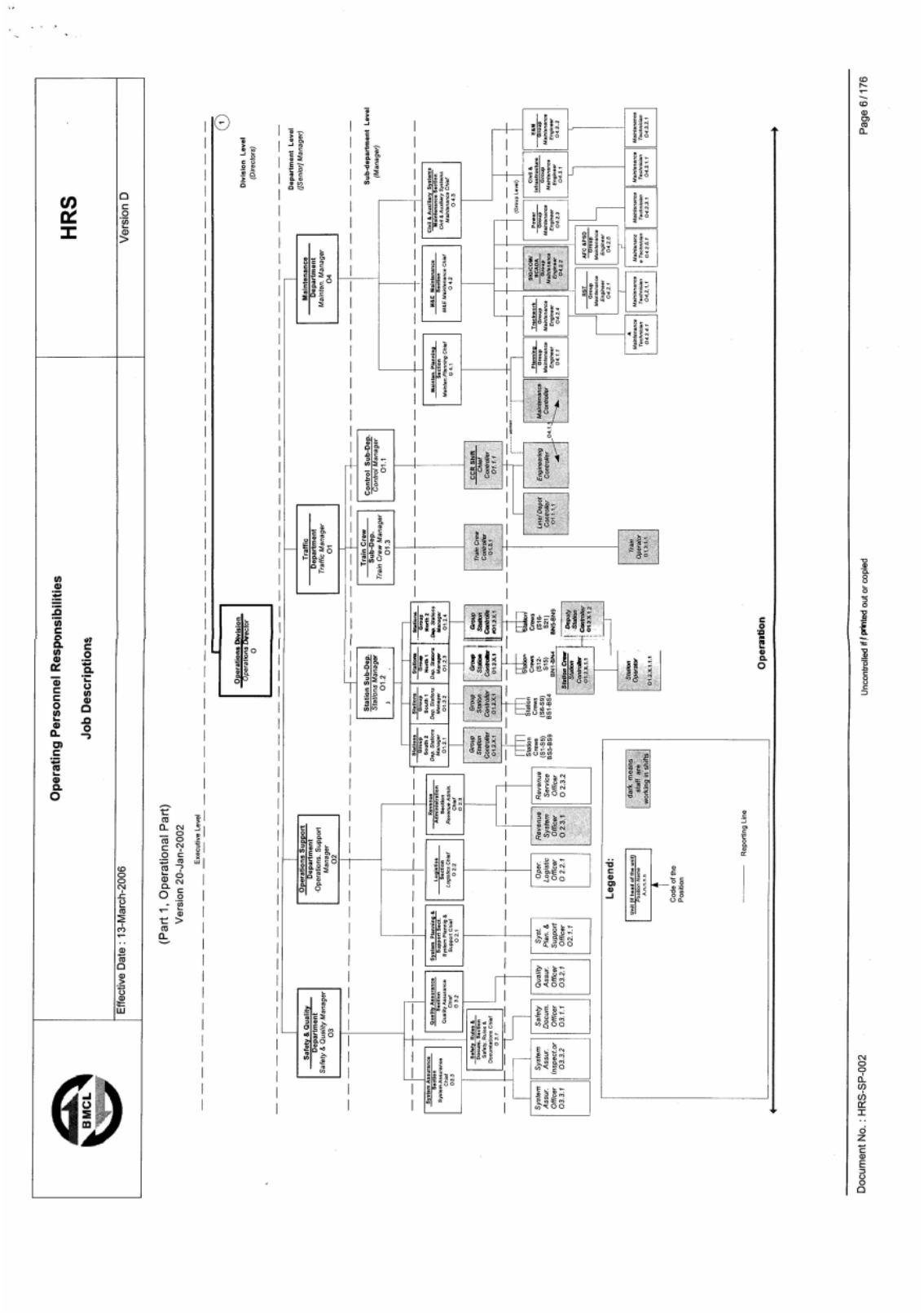
	Main Description	Remarks
Policy to secure competitiveness of each supplier	New line is under construction in Sofia Metro. Each different line should be considered to employ different system.	
Comments extracted from relevant parties	The choice of the system is depending upon which kind of rolling stock is employed. The system should be changed if the other rolling stock is employed.	

4.1 ORGANIZATION CHARTS

MRTA



BMCL


BMCL
Operating Personnel Responsibilities
Job Descriptions
HRS
Effective Date : 13-March-2006
Version D
(Part 1, Operational Part)
Version 20-Jan-2002
Executive Level
Division Level (Directors)
Department Level (Control/ Manager)
Sub-department Level (Manager)
Operations Division Operation Director O
Operations Support Department -Operations. Support Manager O2
Safety & Quality Department Safety & Quality Manager O3
Traffic Department Traffic Manager O1
Maintenance Department Maintec. Manager O4
Station Sub-Dep. Stations Manager O1.2
Control Sub-Dep. Control Manager O1.1
Train Crew Sub-Dep. Train Crew Manager O1.3
Legend:
Code of the Position
dark, means staff are working in shifts
Reporting Line
Operation
Uncontrolled if printed out or copied
Document No. : HRS-SP-002
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4.2 FUNCTIONS OF EACH ORGANIZATIONAL UNIT

Functions of each organization unit are summarized below:

Department	Division	Section	Position	Key Responsibilities
		Information Technology Center ***	Computer System Development Section	Is responsible for • Planning for the model scheme about Information Technology. • Planning and developing for information technology budgeting. • Development plan for Information Technology personnel. • Information system development. • Information system monitoring and maintenance. • Giving advices for using the information system. • Database management and development. • Website management and development. • Technical service and Information technology training programs. • Supporting activities for other sections.
			Computer Operation Section	Is responsible for • Planning for the model scheme about Information Technology. • Planning and developing for information technology budgeting. • Studying analyzing designing and monitoring for host computers, backup data and communication network systems. • Data security. • Monitoring and maintenance for computers and equipments • Computer technical supporting. • Technical service and Information technology training programs. • Supporting activities for other sections.
Deputy Governor (Strategy and Planning)	Strategy Department	Strategy and Planning Division	Policy and Planning Section	Is responsible for • Planning the strategies and directions of the development of the organization • Assigning the policies • Setting the objectives for the whole organization • Strategic planning • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
			Strategy Management Section	Is responsible for • Planning the policies and making it to be in practice • Analyzing, monitoring, and evaluating strategic plans • Assessing the outcome for overall operations • Supporting activities for other sections
		Evaluation and Performance Management Division	Evaluation Section	Is responsible for • Reporting the outcome and performance of overall operations • Monitoring and evaluating the strategies as the State Enterprise plan • Supporting activities for other sections
			Performance Management and Information Section	Is responsible for • Monitoring and evaluating strategic the outcome as it was identified • Planning for the direction of the outcome management • Supporting activities for other sections
		Risk Management and Internal Control Division	Risk Management Section	Is responsible for • Analyzing, evaluating, and managing risks for overall organization • Reporting the risk management plans • Advising other sections for the good practice in risk management • Supporting activities for other sections
			Internal Control Section	Is responsible for • Cooperating, controlling, evaluating, and Improving the Internal Controlling system • Controlling the quality of the Internal Controlling system • Supporting activities for other sections
	Technical Department	Technical Division	Project Analysis Section	Is responsible for • Studying and analyzing the overall transportation projects such as economics, finance and investment • Studying and analyzing the infrastructure projects as written in the act of Parliament of the public private partnership, PPP (B.E 2535 Ver.) • Supporting activities for other sections
			Project Planning Section	Is responsible for • Studying and analyzing types and directions of the sky train and other related transportations • Studying the suitability of the engineering projects • Estimating the project investment • Project planning • Investment planning

Department	Division	Section	Position	Key Responsibilities
				• Asking for approval to carry out the projects • Supporting activities for other sections
			Research and M.R.T. Knowledge Management Section	Is responsible for • Researching, gathering information, and Knowledge managing which related to M.R.T. system • Providing the information for introduction and distribution • Supporting activities for other sections
		Environment Division	Environment Impact Assessment Section	Is responsible for • Studying, analyzing, and evaluating the environment impact for each project • Issuing the regulations for reducing the environment impact • Supporting activities for other sections
			Environment Impact Monitoring Section	Is responsible for • Monitoring and investigate the environment impact for each project • Monitoring and investigate the environment impact of contractors' and concessionaires' regulation both during under construction and operation • Supporting activities for other sections
	Accounting and Finance Department	Accounting Division	Accounting Section	Is responsible for • Accounting • Preparing balance sheet, income statement , and other financial budgeting • Supporting activities for other sections
			Pre - payment Checking Section 1	Is responsible for • Considering and checking the payments for construction cost, land acquisition cost, consultant cost, and other procurement cost • Supporting activities for other sections
			Pre - payment Checking Section 2	Is responsible for • Considering and checking the payments for Salary, wage, overtime pay, compensation, loan, fringe benefit, and other cost • Supporting activities for other sections
		Finance Division	Financial Management Section	Is responsible for • Financial management • Financial planning • Reserving budget • Financial risk management • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
			Tax Section	Is responsible for • Making selling, buying and other tax report • Supporting activities for other sections
		Budgeting and Loan Division	Budgeting Section	Is responsible for • Budget planning and also setting the statement of expenditure • Budget analyzing • Monitoring and evaluating expenditure budget • Budget reporting • Proposing the budget methods • Supporting activities for other sections
			Loan Section	Is responsible for • Providing the lenders or other sources of investment fund • Planning the loan agreements and conditions • Loan reporting • Controlling and Monitoring loaning status • Supporting activities for other sections
Deputy Governor (Administration)	General Administration Department	Human Resource Division	Human Resource Management Section	Is responsible for • Providing job descriptions. • Selection and employing the new recruitments. • Providing registration and worker profiles. • Revising and improving the regulations for employees. • Performance assessment for employees. • Payment management. • The processes of receiving the insignia given by the King. • Acceptance for trainees. • Hiring labors and employees. • Supporting activities for other sections
			Welfare and Labor Relations Section	Is responsible for • Welfare and fringe benefits. • Organizational cultural and relationship activities. • Revising and improving the regulations about welfare, right and duties between employers and employees. • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
		Human Resource and Work System Development Division	Human Resource Development Section	Is responsible for • Strategic planning and operational planning for human developments. • Employee evaluation. • Supporting activities for other sections
			Work System Development Section	Is responsible for • Developing the human resource system. • Developing the progress plan for individual employees in order to promoting the achievement in their position. • Developing the supporting plan for important job positions. • Work assessment and income structure assessment. • Organizational knowledge management. • Supporting activities for other sections
		Supply Division	Procurement Section	Is responsible for • Planning and managing for procurement and suppliers providing. • Recording and developing of the service list for clients. • Supporting activities for other sections.
			Supply Section	Is responsible for • Planning, registering, controlling, managing and allocating the materials and equipments for facilitating the other working sections. • Supporting activities for other sections
		Office Building and Vehicles Division	Office Building Section	Is responsible for • Monitoring and managing the building area and nearby places for facilitating the other working sections. • Supporting activities for other sections
			Vehicles Section	Is responsible for • Monitoring and managing the vehicles for facilitating the other working sections. • Supporting activities for other sections.
	Legal Affairs Department	Juristic Act Division	Juristic Act Section 1	Is responsible for • Collecting, studying, analyzing and developing law, regulation and standard for efficiency performance of organization. • Giving suggestions and advices for operation according with the law, regulation and standard. • Supporting activities for other sections.
			Juristic Act Section 2	Is responsible for • The same as Juristic Act Section 1.

Department	Division	Section	Position	Key Responsibilities
		Contract Division	Contract Section 1	Is responsible for • Collecting, studying, analyzing and developing consultant contract, procurement contract, concessionaire contract and the contract associated with organization. • Giving suggestions advices and diagnoses for law and regulation problems. • Management of working processes according to the law, regulation and standard. • Supporting activities for other sections.
			Contract Section 2	Is responsible for • The same as Contract Section 1.
			Contract Section 3	Is responsible for • The same as Contract Section 1.
		Litigation and Disciplinary Division	Litigation Section	Is responsible for • Collecting, studying and analyzing law and suing the lawsuit in civil court, criminal court and administrative court. • Giving suggestions, advices and diagnoses for the problems according to the prosecution process of the law. • Supporting activities for other sections.
			Disciplinary Section	Is responsible for • Collecting, studying and analyzing administrative practices. • Compulsion of administrative penalties. • Giving suggestions, advices and diagnoses for the problems according to the administrative penalties. • Supporting activities for other sections.

Department	Division	Section	Position	Key Responsibilities
Deputy Governor (Engineering and Construction)	Civil Engineering and Architecture Department		Data and Documentation Section 1	Is responsible for • Documentary Management • Collecting data, statistical data, and gathering other necessary information • Monitoring and evaluating the overall operations • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
		Civil Engineering Division	Civil and Structural Engineering Section	Is responsible for • Planning, Controlling, Monitoring, evaluating, and managing the construction Projects • Design the construction structure such as maintenance center, buildings, and also geotechnical drawing for MRT • Setting the design criteria and construction conditions • Bidding documentation • Construction cost estimating • Setting the safety regulations in MRT work zone safety • Supporting activities for other sections
			Station and Railway Structural Engineering Section	Is responsible for • Planning, Controlling, Monitoring, evaluating, and managing the railway construction and linkage building • Setting the safety regulations in MRT work zone safety • Designing the railway systems for MRT and other related projects • Setting the design criteria and construction provisions • Bidding documentation • Construction cost estimating • Supporting activities for other sections
		Architecture Division	Architecture Section	Is responsible for • Planning, Controlling, Monitoring, evaluating, and managing the architectural drawing and specification for MRT and other related projects • Setting the design criteria and provisions • Setting the construction conditions • Construction cost estimating • Supporting activities for other sections
			Interior Architecture Section	Is responsible for • Planning, Controlling, Monitoring, evaluating, and managing the Interior architectural and landscape architectural • Designing the project brands, signs, and posters for MRT and other related projects • Setting the design criteria and provisions • Setting the construction conditions • Construction cost estimating • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
	Electrical and Mechanical Engineering Department		Data and Documentation Section 2	Is responsible for • Documentary Management • Collecting data, statistical data, and gathering other necessary information • Monitoring and evaluating the overall operations • Supporting activities for other sections
		M&E System Engineering Division	M&E System Engineering Section	Is responsible for • Planning, designing, and setting the design criteria and provisions for the trains, fare collection systems, power supply system, platform doors, safety boards and signs, and other related system for MRT Projects • Design the construction structure such as maintenance center, buildings, and also geotechnical drawing for MRT • Setting the safety criteria and service standard • Consultant supervising • Supporting activities for other sections
			Train Control System Section	Is responsible for • Planning, designing, and setting the design criteria and provisions for the signal systems, communication systems, train control systems, SCADA system, railway power systems, and railway control devices • Consultant supervising • Supporting activities for other sections
		Electrical and Mechanical Engineering Division	Electrical Engineering Section	Is responsible for • Planning, designing, and setting the design criteria and provisions, for electrical system • Procuring, manufacturing, installing, and testing all electromechanical and electrical devices, and other facilities • Consultant and contractor supervising • Supporting activities for other sections
			Mechanical Engineering Section	Is responsible for • Planning, designing, and setting the design criteria and provisions, for electrical system • Procuring, manufacturing, installing, and testing all mechanical devices, ventilation devices, and other facilities • Consultant and contractor supervising • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
Deputy Governor (Engineering and Construction)		M&E System Supervisory Division	M&E Project Management Section	Is responsible for • Planning and carry out the projects as the conditions in the investment plan • Setting the scope of work • Consultant qualification and supervising • Contractor, supplier, and concessionaire qualification • Establish the train assembly plant • Supporting activities for other sections
		Civil Engineering Division	M&E System Supervisory Section	Is responsible for • Consultant, contractor, supplier, and concessionaire controlling and supervising in M&E system • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
Deputy Governor (Operation)	Operations Department	System Operations Division	M.R.T. System Operations Supervisory Section 1	Is responsible for • Planning, Monitoring and controlling for MRT services • Providing the facilities in MRT station according to the contracts and standards • Supporting activities for other sections
			M.R.T. System Operations Supervisory Section 2	Is responsible for: • The same as M.R.T. System Operations supervisory section 1
			M.R.T .System Operations Standard and Technique Section	Is responsible for • Studying, establishing the standards for operation • Planning, monitoring, measuring and analyzing the processes and analyzing the achievement of developing programs for internal operator • Controlling the internal activities for this section • Collecting, monitoring and revising the transportation schedule and information • Writing the summary reports • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
		Maintenance Division	M.R.T .System Maintenance Section	Is responsible for • Planning, monitoring and maintenance of M.R.T. system according to the international standards and contracts • Supporting activities for other sections
			Building and Permanent Way Maintenance Section	Is responsible for: • Planning monitoring, controlling and maintenance for structural components, electrical system, mechanical system and other facilities in the M.R.T. station, M.R.T. building, and parking area according to the international standards and contracts • Supporting activities for other sections
			Maintenance Standard and Technique Section	Is responsible for • Studying and establishing the maintenance standards • Planning, monitoring, measuring, and analyzing processes and performance of maintenance programs • Personnel's' efficiency developing programs • Internal controlling, collecting, monitoring for maintenance information and problem solving • Writing the summary report for operating maintenance • Supporting activities for other sections
	Security and Rescue Department	Security Division	Security Section 1	Is responsible for • Study, collecting, planning, and identifying the managing policies which coordinating with mercenaries, concessionaires, and relevant persons in order to increasing security for riders and local people • Security work involve saving peace and keep situation being in order around M.R.T. area • Monitoring for M.R.T. districts Supporting activities for other sections
			Security Section 2	Is responsible for • The same as Security Section 1
			Security Section 3	Is responsible for • The same as Security Section 1
			Security Section 4	Is responsible for • The same as Security Section 1

Department	Division	Section	Position	Key Responsibilities
			Security Planning and Data Section	Is responsible for • Studying, planning, analyzing, and collecting the statistical data for security benefits around M.R.T. district • Identifying and developing for security standards • Monitoring, controlling and assessment for security performance • Supporting activities for other sections
			Right of Way Maintenance Section	Is responsible for • Monitoring, supervising and preventing the invading into the M.R.T. system through the gate, air relief tower, and including the other place in the M.R.T. district which are indicated in construction allowance for work zone safety • Supporting activities for other sections
		Rescue Division	Rescue Section 1	Is responsible for • Monitoring, supervising, and coordinating to the mercenaries, concessionaires, and other relevant persons in planning processes • Studying and analyzing for developing preventive policies for dealing with emergency circumstances in M.R.T. district • Fire fighting and rescuing work • Resolving and mitigating emergency circumstances in M.R.T. district • Mitigating public hazard • Supporting activities for other sections
			Rescue Section 2	Is responsible for • The same as Rescue Division 1
			Rescue Section 3	Is responsible for • The same as Rescue Division 1
			Rescue Planning and Data Section	Is responsible for • Studying, planning, analyzing and collecting statistical data for benefits of recuing, fire fighting, public hazard relieving, and other emergency circumstances preventing • Establishing and developing the response policies • Monitoring, controlling, evaluating the rescuing performance • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
		Security, Fire and Rescue Training Institute	Security Technique Section	Is responsible for • Training, promoting for knowledge about safety and defensive skill for internal and external organization • Developing the knowledge domain for supporting the responsibility of the security sections • Supporting activities for other sections
			Fire Fighting and Rescue Technique Section	Is responsible for • Training, promoting for knowledge about fire fighting, rescuing, emergency resolving, and public hazard relieving for internal and external organization • Developing the knowledge domain for supporting the responsibility of the rescuing section • Supporting activities for other sections
			Training Administration Section	Is responsible for • Advertising and promoting the training programs • Driving the training programs by providing the trainees and trainers, providing the training area, training documents, and other educational instruments • Supervising and maintenance for training instruments • Supporting activities for other sections
	Business and Property Management Department	Business Planning and Development Division	Business Planning Section	Is responsible for • Establishing the operation plan • Studying transportation system and its facilities • Employing the consultants • The relevant works about sub committees • Developing information system for business • Risk management • Satisfaction and marketing survey • Marketing • Budgeting • Operational evaluation and writing operational summary report • Identifying Performance Index • Personnel development • Managing Inventory and durable article supplying • Researching, analyzing, and collecting the information involved to the business planning • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
			Business Development section	Is responsible for • Business developing processes • Establishing implementation, processes, and operation plans for business purposes • Establishing the criterions and regulations for employing the manager in managing building area, advertising area, trading area, and rest room area • Establishing the appropriate revenue • Negotiating and establishing the agreements and business contracts • Developing the transportation system and its facilities • Request for allowance of constructing the linkage between the station and external building • Providing the managers for building and parking area • Researching, analyzing, and collecting the information involved to the business developing • Supporting activities for other sections
		Business and Property Management Division	Business Management Section	Is responsible for • Managing business, service and parking area, including collecting toll and other fee in trading area in M.R.T district • Collecting the information about expense and revenue • Monitoring and controlling according to the quality standards • Monitoring the transportation system and its facilities • Researching, analyzing, and collecting the information involved to the business management • Supporting activities for other sections
			Property Management Section	Is responsible for • Managing the contract • Request for temporary allowance • Collecting toll, fee, service payment, and revenues for using properties and attaining some advantages • Making withdrawal for public utilities payment • Managing Inventory and durable article supplying for this section • Researching, analyzing, and collecting the information involved to the properties management • Supporting activities for other sections

Department	Division	Section	Position	Key Responsibilities
		Concession Management Division	Concession Management Section 1	Is responsible for • Monitoring, supervising for M.R.T. concession management, including to any benefits involving to the passenger fare, according to the contract and law • Supporting the operation of committees or sub-committees who involving in the concession • Customer services • Supervisory for passenger belonging • Collecting concession revenue • Researching, analyzing, and collecting the information involved to the concession management • Supporting activities for other sections
			Concession Management Section 2	Is responsible for • Monitoring, supervising for M.R.T. concession management, including to any benefits involving to the commercial development according to the contract and law • Supporting the operation of involving committees • Coordinating between concession participants • Customer services • Collecting concession revenue • Researching, analyzing, and collecting the information involved to the concession management • Supporting activities for other sections

4.3 JOB QUALIFICATION

According to the requirements indicated in Job Description, E&M Department and O&M Department are composed of engineers from the following background.

E&M Department

No.	Designation	Min. Academic Qualification	Minimum Experience	License	Source of Recruitment
1	Director of E&M Eng. Department	Bachelor/Master of Eng. (Electrical /Mechanical)	At lease 3-5 years of experience in management as a director	Professional License (Associate Mechanical/Electrical Engineer)	
2	Director of E&M Eng. Division	Bachelor/Master of Eng. (Electrical/ Mechanical)	At lease 3-5 years of experience in management as a director	Professional License (Associat1e Mechanical/Electrical Engineer)	
3	Chief of Electrical Eng. Section	Bachelor/Master of Eng. (Electrical)	Working experience at least 7 years	Professional License (Associate Electrical Engineer)	
4	Chief of Mechanical Eng. Section	Bachelor/Master of Eng. (Mechanical)	Working experience at least 7 years	Professional License (Associate Mechanical Engineer)	
5	Electrical Engineer	Bachelor/Master of Eng. (Electrical)	Experienced in design, installation or management of electrical systems	Professional License (Associate Electrical Engineer)	Open market
6	Mechanical Engineer	Bachelor/Master of Eng. (Mechanical)	Experienced in design, installation or management of mechanical systems	Professional License (Associate Mechanical Engineer)	Open market

Source: MRTA

O&M Department – System Operation Department

No.	Designation	Min. Academic Qualification	Minimum Experience	License	Source of Recruitment
1	Director of Operation Department				
System Operation Division					
2	Director of System Operation Division	Bachelor/Master of Eng. in Electrical, Mechanical or Computer Sc.	Experienced in designing, construction or maintenance as a manager	N/A	
System Operation Division, Supervisory Section 1					
3	Section Chief	Bachelor/Master of Eng. in Electrical or Mechanical	At lease 5-7 years of experience in design, control, installation and maintenance of electrical or	N/A	

			mechanical system		
4	Engineer	Bachelor/Master of Eng. in Electrical, Mechanical or Computer Sc.	Experienced in electrical or mechanical engineering	N/A	

Source: MRTA

O&M Department – System Maintenance Division

No.	Designation	Min. Academic Qualification	Minimum Experience	License	Source of Recruitment
System Maintenance Division					
1	Chief of System Maintenance Division	Bachelor of Eng. or higher degree	Experienced in designing, construction or maintenance of E&M system and MRT system	N/A	
System Maintenance Division – System Maintenance Section					
2	Section Chief	Bachelor of Eng. or higher degree	Same as above	N/A	
3	Engineer	Bachelor of Eng./Industrial Education or higher degree	Same as above	N/A	
Maintenance Standard and Technique Section					
4	Section Chief	Bachelor of Eng. or higher degree	Same as above	N/A	
5	Engineer	Bachelor of Eng. or higher degree	Same as above	N/A	
System Maintenance Division – Building and Permanent Way Maintenance Section					
	General Administrative Officer	Bachelor of Eng. or higher degree	Same as above	N/A	
4	Engineer (Civil)	Bachelor of Eng. or higher degree	Same as above	N/A	
5	Engineer (Electrical/ Mechanical)	Bachelor of Eng. or higher degree	Same as above	N/A	Open market

Source: MRTA

4.4 JOB MAPPING

Job mapping are summarized below:

E&M Department

		Name-Surename	Position	Level		Competency Level																					
Department	Division	Section				Core								Managerial						Functional				Technical			
						Ethics	Working as a team	Working according to standard for excellent	Focus on the need of customer	Ongoing Development	Innovation	Communication	Seek to know	Have a vision in operation	People Management Skill	Strategic and analytical thinking	Knowledge in the business	Solving Problem and Dicision Making	Leadership	Computer and Information Skill for Engineering	English knowledge for engineering	Knowledge in electrical and mechanical engineering	Knowledge in mechanical engineering for the facilities in the building	Knowledge in electrical engineering for the facilities in the building	Knowledge in electrical system engineering for MRT system engineering	Project Management for contoal MRT system operation	Corresspondece and documents control Skioll
						1.	2.	3.	4.	5.	6.	7.	8.	1.	2.	3.	4.	5.	6.	1.	2.	3.	1.	2.	3.	4.	5.
Electricam and			นายบดินทร์ บุรณอภิรักษ์กุล	Acting Director of Department/Director of Department	12	4	4	4	4	4	4	4	4	2	4	4	4	4	4	✓	4	4.	4.	4.	4.	4.	
Mechanical		Data and Documentation Section 2		Acting Chief of Section / Senior Chief of Section of Data and Documentation Section 2	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3	1.					4.
Engineerin				Acting Chief of Section / Senior Chief of Section of Data and Documentation Section 2	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3	1.					4.
				Acting Chief of Section / Senior Chief of Section of Data and Documentation Section 2	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3	1.					4.
				Acting Chief of Section of Data and Documentation Section 2	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3	1.					4.
				Senior Administration Officer	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4	1.					5.
				Senior Administration Officer	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4	1.					5.
				Senior General Administration Officer	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3	1.					4.
				General Administration Officer/employee	9	2	2	2	2	2	2	2	2							✓	3	1.					4.
				General Administration Officer/employee	8	2	2	2	2	2	2	2	2							✓	3	1.					3.
				General Administration Officer/employee	7	2	2	2	2	2	2	2	2							✓	2	1.					2.
				General Administration Officer/employee	6	2	2	2	2	2	2	2	2							✓	2	1.					2.
			นางสาวโอรินทร์ ชยาอนันตพัฒน์	General Administration Officer/employee	5	1	1	1	1	1	1	1	1							✓	1	1.					1.
				General Administration Officer/employee	4	1	1	1	1	1	1	1	1							✓	1	1.					1.
			นางสุพัตรา ต้มชลิบ	Aministration Officer /employee	5	1	1	1	1	1	1	1	1							✓	1	1.					1.
				Aministration Officer /employee	4	1	1	1	1	1	1	1	1							✓	1	1.					1.
				Aministration Officer /employee	3	1	1	1	1	1	1	1	1							✓	1	1.					1.
	M&E System Engineering Division			Acting Director of Division / Director of M&E System Engineering Division	11	4	4	4	4	4	4	4	4	2	3	3	3	3	3	✓	4.	4.			4.		
		M&E System Engineering Section		Acting Chief of Section/Senior Chief of ofM&E System Engineering Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.			3.		
				Acting Chief of Section/Chief of ofM&E System Engineering Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.			3.		
				Acting Chief of Section/Chief of ofM&E System Engineering Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.			3.		
				Acting Chief of ofM&E System Engineering Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.			3.		
				Senior Engineer of M&E System Engineering Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.			4.		
				Senior Engineer of M&E System Engineering Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.			4.		
				Senior Engineer of M&E System Engineering Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	4.			4.		
				Senior Engineer of M&E System Engineering Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	3.			3.		
				Engineer of M&E System Engineering Section	9	2	2	2	2	2	2	2	2							✓	3.	3.			3.		
				Engineer of M&E System Engineering Section	8	2	2	2	2	2	2	2	2							✓	3.	3.			3.		
				Engineer of M&E System Engineering Section	7	2	2	2	2	2	2	2	2							✓	2.	2.			2.		
				Engineer of M&E System Engineering Section	6	2	2	2	2	2	2	2	2							✓	2.	2.			2.		
				Engineer of M&E System Engineering Section	5	1	1	1	1	1	1	1	1							✓	2.	1.			1.		
				Engineer of M&E System Engineering Section	4	1	1	1	1	1	1	1	1							✓	2.	1.			1.		
		Train Control System Section		Acting Chief of Section/Senior Chief of ofTrain Control System Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	2.	3.			3.		
				Acting Chief of Section/Chief of ofTrain Control System Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.			3.		
				Acting Chief of Section/Chief of ofTrain Control System Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.			3.		
				Acting Chief of ofTrain Control System Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.			3.		
				Senior Engineer of Train Control System Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.			4.		
				Senior Engineer of Train Control System Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.			4.		
				Senior Engineer of Train Control System Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	4.			4.		
				Senior Engineer of Train Control System Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	3.			3.		
				Engineer of Train Control System Section	9	2	2	2	2	2	2	2	2							✓	3.	3.			3.		
				Engineer of Train Control System Section	8	2	2	2	2	2	2	2	2							✓	3.	3.			3.		
				Engineer of Train Control System Section	7	2	2	2	2	2	2	2	2							✓	2.	2.			2.		
				Engineer of Train Control System Section	6	2	2	2	2	2	2	2	2							✓	2.	2.			2.		
				Engineer of Train Control System Section	5	1	1	1	1	1	1	1	1							✓	2.	1.			1.		
				Engineer of Electrical and Mechanical Engineering Division	4	1	1	1	1	1	1	1	1							✓	2.	1.			1.		
	Electrical and Mechanical		นายธีระพล อคิสร	Acting Director of Division/Director of Electrical and Mechanical Engineering Division	11	4	4	4	4	4	4	4	4	2	3	3	3	3	3	✓	4.	4.	4.	4.			
	Engineering Division	Electrical Engineering Section		Acting Chief of Section/SeniorChief of of Electrical Engineering Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.		3.			
			นายชจร วรศิลป์ชัย	Acting Chief of Section/Chief of of Electrical Engineering Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.		3.			
				Acting Chief of Section/Chief of of Electrical Engineering Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.		3.			
				Acting Chief of Electrical Engineering Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.		3.			
				Senior Engineer of Electrical Engineering Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.		4.			
				Senior Engineer of Electrical Engineering Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.		4.			
				Senior Engineer of Electrical Engineering Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	4.		4.			
				Senior Engineer of Electrical Engineering Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	3.		3.			
				Engineer of Electrical Engineering Section	9	2	2	2	2	2	2	2	2							✓	3.	3.		3.			
				Engineer of Electrical Engineering Section	8	2	2	2	2	2	2	2	2							✓	3.	3.		3.			
			นางสาวพัชรัตนวดี ศศิสุวรรณ	Engineer of Electrical Engineering Section	7	2	2	2	2	2	2	2	2							✓	2.	2.		2.			
			นายลิขิต ชูทรัพย์	Engineer of Electrical Engineering Section	6	2	2	2	2	2	2	2	2							✓	2.	2.		2.			
			นายสุวิทย์ บัวเพชร	Engineer of Electrical Engineering Section	5	1	1	1	1	1	1	1	1							✓	2.	1.		1.			
			นายเกริกกฤต รุจิระธรรมง	Engineer of Electrical Engineering Section	4	1	1	1	1	1	1	1	1							✓	2.	1.		1.			
		Mechanical Engineering Section		Acting Chief of Section/Senior Chief of of Mechanicall Engineering Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	2.	3.	3.				
				Acting Chief of Section/Chief of of Mechanicall Engineering Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.	3.				
			นางระวีวรรณ พงศ์ศุภสมิทธิ์	Acting Chief of Section/Chief of of Mechanicall Engineering Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.	3.				
				Acting Chief of Mechanicall Engineering Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.	3.				
				Senior Engineer of Mechanicall Engineering Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.	4.				
				Senior Engineer of Mechanicall Engineering Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.	4.				
				Senior Engineer of Mechanicall Engineering Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	4.	4.				
				Senior Engineer of Mechanicall Engineering Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	3.	3.				

		Name-Surename	Position	Level	Competency Level																						
Department	Division	Section				Core								Managerial						Functional				Technical			
						Ethics	Working as a team	Working according to standard for excellent	Focus on the need of customer	Ongoing Development	Innovation	Communication	Seek to know	Have a vision in operation	People Management Skill	Strategic and analytical thinking	Knowledge in the business	Solving Problem and Dicision Making	Leadership	Computer and Information Skill for Engineering	English knowledge for engineering	knowledge in electrical and mechanical engineering	Knowledge in mechanical engineering for the facilities in the building	Knowledge in electrical engineering for the facilities in the building	Knowledge in electrical system engineering for MRT system engineering	Project Management for contoal MRT system operation	Coresspondece and documents control Skioll
				Engineer of Mechanicall Engineering Section	9	2	2	2	2	2	2	2	2							✓	3.	3.	3.				
				Engineer of Mechanicall Engineering Section	8	2	2	2	2	2	2	2	2							✓	3.	3.	3.				
			นายยุทธศักดิ์ ชื่นใจ	Engineer of Mechanicall Engineering Section	7	2	2	2	2	2	2	2	2							✓	2.	2.	2.				
				Engineer of Mechanicall Engineering Section	6	2	2	2	2	2	2	2	2							✓	2.	2.	2.				
				Engineer of Mechanicall Engineering Section	5	1	1	1	1	1	1	1	1							✓	2.	1.	1.				
			นางสาววิวรรณ อัศวสุขี	Engineer of Mechanicall Engineering Section	4	1	1	1	1	1	1	1	1							✓	2.	1.	1.				
	M&E System Supervisory			Acting Chief of Section/Chief of of M&E Project Management Section	11	4	4	4	4	4	4	4	4	2	3	3	3	3	3	✓	4.	4.				4.	
	Division	M&E Project Management Section		Acting Chief of Section/Senior Chief of of M&E Project Management Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.				3.	
				Acting Chief of Section/Chief of of M&E Project Management Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.				3.	
				Acting Chief of of M&E Project Management Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.				3.	
				Acting Chief of Section/Chief of M&E Project Management Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.				3.	
				Senior Engineer of M&E Project Management Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.				4.	
				Senior Engineer of M&E Project Management Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.				4.	
				Senior Engineer of M&E Project Management Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	4.				4.	
				Senior Engineer of M&E Project Management Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	3.				3.	
				Engineer of M&E Project Management Section	9	2	2	2	2	2	2	2	2							✓	3.	3.				3.	
				Engineer of M&E Project Management Section	8	2	2	2	2	2	2	2	2							✓	3.	3.				3.	
				Engineer of M&E Project Management Section	7	2	2	2	2	2	2	2	2							✓	2.	2.				2.	
				Engineer of M&E Project Management Section	6	2	2	2	2	2	2	2	2							✓	2.	2.				2.	
				Engineer of M&E Project Management Section	5	1	1	1	1	1	1	1	1							✓	2.	1.				1.	
				Engineer of M&E Project Management Section	4	1	1	1	1	1	1	1	1							✓	2.	1.				1.	
		Construction Management Section		Acting Chief of Section / Senior Chief of Construction Management Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	2.	3.				3.	
				Acting Chief of Section / Chief of Construction Management Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	3.				3.	
				Acting Chief of Section / Chief of Construction Management Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.				3.	
				Acting Chief of Construction Management Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	3.				3.	
				Senior Engineer of Construction Management Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.				4.	
				Senior Engineer of Construction Management Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	4.				4.	
				Senior Engineer of Construction Management Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	4.				4.	
				Senior Engineer of Construction Management Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	3.				3.	
				Engineer of Construction Management Section	9	2	2	2	2	2	2	2	2							✓	3.	3.				3.	
				Engineer of Construction Management Section	8	2	2	2	2	2	2	2	2							✓	3.	3.				3.	
				Engineer of Construction Management Section	7	2	2	2	2	2	2	2	2							✓	2.	2.				2.	
				Engineer of Construction Management Section	6	2	2	2	2	2	2	2	2							✓	2.	2.				2.	
				Engineer of Construction Management Section	5	1	1	1	1	1	1	1	1							✓	2.	1.				1.	
				Engineer of Construction Management Section	4	1	1	1	1	1	1	1	1							✓	2.	1.				1.	

Operation Department

Agnecies			Name-Surename	Position	Level	Competency Level																						
Department	Division	Section				Core								Managerial						Functional				Technical				
						Ethics	Working as a team	Working according to standard for excellent	Focus on the need of customer	Ongoing Development	Innovation	Communication	Seek to know	Have a vision in operation	People Management Skill	Strategic and analytical thinking	Knowledge in the business	Solving Problem and Dicision Making	Leadership	Computer and Information Skill for Engineering	Preparing the Official Letter	Rules, Regulation and law about the MRT operation	English knowledge for engineering	Technical Sense	Engineering knowledge about the MRT system	Engineering knowledgeabout the MRT system maintenance	Engineering knowledge about theMRT operation and service	Corespondence and document control Skill
						1.	2.	3.	4.	5.	6.	7.	8.	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	1.	2.	3.	4.	5.
Operation Department			นายสุชิน ศศิประภากุล	Acting Director of Department/Director of Department	12	4	4	4	4	4	4	4	4	2	4	4	4	4	4	✓	4.	✓	4	5.	5.	5.	4.	
				Senior Administration Officer (Administration)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	✓	4					5.
				Senior Administration Officer (Administration)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	5.	✓	4					5.
			นางสาวศศิลักษณ์ ลักษิตานนท์	Senior General Administration Officer /employee (Administration)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	3					4.
				General Administration Officer /employee (Administration)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3					4.
				General Administration Officer /employee (Administration)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3					3.
			นางสาวพัทน์ลิน ณ ระนอง	General Administration Officer /employee (Administration)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2					2.
				General Administration Officer /employee (Administration)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2					2.
			นางสาวประดับดวง ศัครุพ่าย	General Administration Officer /employee (Administration)	5	1	1	1	1	1	1	1	1							✓	1.	✓	1					1.
			นางสาวชลธิชา โรจนลิขิตกุล	General Administration Officer /employee (Administration)	5	1	1	1	1	1	1	1	1							✓	1.	✓	1					1.
				General Administration Officer /employee (Administration)	4	1	1	1	1	1	1	1	1							✓	1.	✓	1					1.
	System Operations Division			Acting Director of Division/Director of System Operations Division	11	4	4	4	4	4	4	4	4	2	3	3	3	3	3	✓	4.	✓	4.	4.	4.		3.	
			นายประสิทธิ์ เกลี้ยงเกิด	Acting Director of Division/Director of System Operations Division	10	4	4	4	4	4	4	4	4	2	3	3	3	3	3	✓	4.	✓	4.	4.	4.		3.	
		M.R.T. System Operations Supervisory Section 1		Acting Chief of Section/Senior Chief of M.R.T. System Operations Supervisory Section 1	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Acting Chief of Section/Chief of M.R.T. System Operations Supervisory Section 1	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
			นายณัฐภัทร์ อุณหคงคา	Acting Chief of Section/Chief of M.R.T. System Operations Supervisory Section 1	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Acting Chief of M.R.T. System Operations Supervisory Section 1	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Senior Engineer of M.R.T. System Operations Supervisory Section 1	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.		4.	
				Senior Engineer of M.R.T. System Operations Supervisory Section 1	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.		4.	
				Senior Engineer of M.R.T. System Operations Supervisory Section 1	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	4.	4.		3.	
				Senior Engineer of M.R.T. System Operations Supervisory Section 1	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	4.	3.	3.		2.	
				Engineer of M.R.T. System Operations Supervisory Section 1 /employee	9	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.		2.	
				Engineer of M.R.T. System Operations Supervisory Section 1 /employee	8	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.		2.	
				Engineer of M.R.T. System Operations Supervisory Section 1 /employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		2.	
			นายจักรพันธ์ อินทโชติ	Engineer of M.R.T. System Operations Supervisory Section 1 /employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		1.	
			นายปิยพงศ์ พรรณราย	Engineer of M.R.T. System Operations Supervisory Section 1 /employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		1.	
				Engineer of M.R.T. System Operations Supervisory Section 1 /employee	5	1	1	1	1	1	1	1	1							✓	1.	✓	1.	2.	1.		1.	
				Engineer of M.R.T. System Operations Supervisory Section 1 /employee	4	1	1	1	1	1	1	1	1							✓	1.	✓	1.	2.	1.		1.	
				Senior Administration Officer (Engineer)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior Administration Officer (Engineer)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				General Administration Officer /employee(Engineer)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee(Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee(Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee(Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		2.	
				General Administration Officer /employee(Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		1.	
				General Administration Officer /employee(Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				General Administration Officer /employee(Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				Administration Officer (Administration)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior Administration Officer(Engineer)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior General Administration Officer(Engineering Support)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee(Engineering Support)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee(Engineering Support)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee(Engineering Support)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		2.	
				General Administration Officer /employee(Engineering Support)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		1.	
				General Administration Officer /employee(Engineering Support)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				General Administration Officer /employee(Engineering Support)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
		M.R.T. System Operations Supervisory Section 2		Acting Chief of Section / Senior Chief of M.R.T. System Operations Supervisory Section 2	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Acting Chief of Section / Senior Chief of M.R.T. System Operations Supervisory Section 2	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Acting Chief of Section / Senior Chief of M.R.T. System Operations Supervisory Section 2	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Acting Chief of M.R.T. System Operations Supervisory Section 2	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Senior Engineering of M.R.T. System Operations Supervisory Section 2	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.		4.	
				Senior Engineering of M.R.T. System Operations Supervisory Section 2	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.		4.	
				Senior Engineering of M.R.T. System Operations Supervisory Section 2	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	4.	4.		3.	
				Senior Engineering of M.R.T. System Operations Supervisory Section 2	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	4.	3.	3.		2.	
				Engineering of M.R.T. System Operations Supervisory Section 2/employee	9	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.		2.	
				Engineering of M.R.T. System Operations Supervisory Section 2/employee	8	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.		2.	
				Engineering of M.R.T. System Operations Supervisory Section 2/employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		2.	
				Engineering of M.R.T. System Operations Supervisory Section 2/employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		1.	
				Engineering of M.R.T. System Operations Supervisory Section 2/employee	5	1	1	1	1	1	1	1	1							✓	1.	✓	1.	2.	1.		1.	
				Engineering of M.R.T. System Operations Supervisory Section 2/employee	4	1	1	1	1	1	1	1	1							✓	1.	✓	1.	2.	1.		1.	
				Senior Administration Officer (Engineer)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior Administration Officer (Engineer)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				General Administration Officer /employee (Engineer)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		2.	
				General Administration Officer /employee (Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		1.	
				General Administration Officer /employee (Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				General Administration Officer /employee (Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				Administration Officer(Engineering Support)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Administration Officer(Engineering Support)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior General Administration Officer (Engineer)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	

Agnecies			Name-Surename	Position	Level	Competency Level																						
Department	Division	Section				Core								Managerial						Functional				Technical				
						Ethics	Working as a team	Working according to standard for excellent	Focus on the need of customer	Ongoing Development	Innovation	Communication	Seek to know	Have a vision in operation	People Management Skill	Strategic and analytical thinking	Knowledge in the business	Solving Problem and Dicision Making	Leadership	Computer and Information Skill for Engineering	Preparing the Official Letter	Rules, Regulation and law about the MRT operation	English knowledge for engineering	Technical Sense	Engineering knowledge about the MRT system	Engineering knowledgeabout the MRT system maintenance	Engineering knowledge about theMRT operation and service	Corespondence and document control Skill
				General Administration Officer /employee (Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		2.	
				General Administration Officer /employee (Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		1.	
				General Administration Officer /employee (Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				General Administration Officer /employee (Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
		M.R.T. System Operations Standard and Technique Section		Chief of Section/Chief of M.R.T. System Operations Standard and Technique Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Chief of Section/Chief of M.R.T. System Operations Standard and Technique Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Chief of Section/Chief of M.R.T. System Operations Standard and Technique Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
			นายจเด็จ แดงแสงเทียน	Chief of M.R.T. System Operations Standard and Technique Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.		2.	
				Senior Engineer of M.R.T. System Operations Standard and Technique Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.		4.	
				Senior Engineer of M.R.T. System Operations Standard and Technique Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.		4.	
				Senior Engineer of M.R.T. System Operations Standard and Technique Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	4.	4.		3.	
				Senior Engineer of M.R.T. System Operations Standard and Technique Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	4.	3.	3.		2.	
				Engineer of M.R.T. System Operations Standard and Technique Section/employee	9	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.		2.	
				Engineer of M.R.T. System Operations Standard and Technique Section/employee	8	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.		2.	
			นายธนรัตน์ หงษ์พงษ์	Engineer of M.R.T. System Operations Standard and Technique Section/employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		2.	
			นายนิธินันท์ วิทูรแก้วศิริ	Engineer of M.R.T. System Operations Standard and Technique Section/employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.		1.	
				Engineer of M.R.T. System Operations Standard and Technique Section/employee	5	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.		1.	
				Engineer of M.R.T. System Operations Standard and Technique Section/employee	4	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.		1.	
				Senior Administration Officer (Engineer)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior Administration Officer (Engineer)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				General Administration Officer /employee (Engineer)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		2.	
				General Administration Officer /employee (Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		1.	
				General Administration Officer /employee (Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				General Administration Officer /employee (Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				Senior Administration Officer (Engineer)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				Senior Administration Officer (Engineering support)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.		3.	
				General Administration Officer /employee (Engineering Support)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineering Support)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineering Support)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.		2.	
				General Administration Officer /employee (Engineering Support)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		2.	
				General Administration Officer /employee (Engineering Support)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.		1.	
				General Administration Officer /employee (Engineering Support)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
				General Administration Officer /employee (Engineering Support)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.		1.	
	System Operations Division		นายภคพงศ์ ศิริกันทรมาศ	Acting Director of Division/ Director of M.R.T. System Maintenance Section	11	4	4	4	4	4	4	4	4	2	3	3	3	3	3	✓	4.	✓	4.	4.	4.	4.		
		M.R.T. System Maintenance Section		Acting Chief of Section/ Chief of M.R.T. System Maintenance Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
			นายวนัท สุจริตธรรมธร	M.R.T. System Maintenance Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				M.R.T. System Maintenance Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Chief of Section of M.R.T. System Maintenance Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Senior Engineer of M.R.T. System Maintenance Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.	5.		
				Senior Engineer of M.R.T. System Maintenance Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.	5.		
				Senior Engineer of M.R.T. System Maintenance Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	4.	4.	4.		
				Senior Engineer of M.R.T. System Maintenance Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	4.	3.	3.	3.		
				Engineer of M.R.T. System Maintenance Section/employee	9	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.	3.		
				Engineer of M.R.T. System Maintenance Section/employee	8	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.	3.		
			นายขวัญแก้ว รุจิรัตนมณี	Engineer of M.R.T. System Maintenance Section/employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.	2.		
				Engineer of M.R.T. System Maintenance Section/employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.	2.		
				Engineer of M.R.T. System Maintenance Section/employee	5	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.	1.		
				Engineer of M.R.T. System Maintenance Section/employee	4	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.	1.		
				Senior Administration Officer (Engineer)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	4.		
				Senior Administration Officer (Engineer)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	4.		
				General Administration Officer /employee (Engineer)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				General Administration Officer /employee (Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				Senior Administration Officer (Engineering Supprot)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	3.		
				Senior Administration Officer (Engineering Supprot)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	3.		
				General Administration Officer /employee (Engineering Support)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineering Support)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineering Support)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				General Administration Officer /employee (Engineering Support)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
		Building and Permanent Way Maintenance Section		Acting Chief Section/ Senior Chief of Building and Permanent Way Maintenance Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	2.	3.	3.	3.		
				Acting Chief Section/ Chief of Building and Permanent Way Maintenance Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		

Agnecies			Name-Surename	Position	Level	Competency Level																						
Department	Division	Section				Core								Managerial						Functional				Technical				
						Ethics	Working as a team	Working according to standard for excellent	Focus on the need of customer	Ongoing Development	Innovation	Communication	Seek to know	Have a vision in operation	People Management Skill	Strategic and analytical thinking	Knowledge in the business	Solving Problem and Dicision Making	Leadership	Computer and Information Skill for Engineering	Preparing the Official Letter	Rules, Regulation and law about the MRT operation	English knowledge for engineering	Technical Sense	Engineering knowledge about the MRT system	Engineering knowledgeabout the MRT system maintenance	Engineering knowledge about theMRT operation and service	Corespondence and document control Skill
			นายสถิต เจียรวิทยกิจ	Acting Chief Section/ Chief of Building and Permanent Way Maintenance Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Acting Chief of Building and Permanent Way Maintenance Section/ Chief of Building and Pe	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Senior Engineer of Building and Permanent Way Maintenance Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.	5.		
				Senior Engineer of Building and Permanent Way Maintenance Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.	5.		
				Senior Engineer of Building and Permanent Way Maintenance Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	4.	4.	4.		
				Senior Engineer of Building and Permanent Way Maintenance Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	4.	3.	3.	3.		
				Engineer of Building and Permanent Way Maintenance Section / employee	9	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.	3.		
				Engineer of Building and Permanent Way Maintenance Section / employee	8	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.	3.		
			นายทวี สันติธรารักษ์	Engineer of Building and Permanent Way Maintenance Section / employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.	2.		
			นายเอกชัย บุญมาลีตระกูล	Engineer of Building and Permanent Way Maintenance Section / employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.	2.		
				Engineer of Building and Permanent Way Maintenance Section / employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
			นายวิษณุ สัตยานุสนธิ์	Engineer of Building and Permanent Way Maintenance Section / employee	5	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.	1.		
				Engineer of Building and Permanent Way Maintenance Section / employee	4	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.	1.		
				Senior Administration Officer (Engineer)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	4.		
				Senior Administration Officer (Engineer)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	4.		
				Senior General Administration Officer (Engineer)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				General Administration Officer /employee (Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				Senior Administration Officer (Engineering Supprot)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	3.		
				Senior Administration Officer (Engineering Supprot)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	3.		
				General Administration Officer /employee (Engineering Support)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
			นายประกอบ ปิดถามัง	General Administration Officer /employee (Engineering Support)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineering Support)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineering Support)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				General Administration Officer /employee (Engineering Support)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
		Maintenance Standard and Technique Section		Acting Chief/Chief of Maintenance Standard and Technique Section	10	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
			นายสุพพัต พิพัฒนกุล	Acting Chief/Chief of Maintenance Standard and Technique Section	9	3	3	3	3	3	3	3	3	1	2	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Acting Chief/Chief of Maintenance Standard and Technique Section	8	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Acting Chief of Maintenance Standard and Technique Section	7	3	3	3	3	3	3	3	3	1	1	2	2	2	2	✓	3.	✓	3.	3.	3.	3.		
				Senior Enineering of Maintenance Standard and Technique Section	13	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.	5.		
				Senior Enineering of Maintenance Standard and Technique Section	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	5.	5.	5.		
				Senior Enineering of Maintenance Standard and Technique Section	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4.	4.	4.	4.		
				Senior Enineering of Maintenance Standard and Technique Section	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	4.	3.	3.	3.		
				Enineer of Maintenance Standard and Technique Section/ employee	9	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.	3.		
				Enineer of Maintenance Standard and Technique Section/ employee	8	2	2	2	2	2	2	2	2							✓	3.	✓	3.	3.	3.	3.		
				Enineer of Maintenance Standard and Technique Section/ employee	7	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.	2.		
			นายสุทธิพงศ์ อภัยรัตน์	Enineer of Maintenance Standard and Technique Section/ employee	6	2	2	2	2	2	2	2	2							✓	2.	✓	2.	2.	2.	2.		
				Enineer of Maintenance Standard and Technique Section/ employee	5	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.	1.		
				Enineer of Maintenance Standard and Technique Section/ employee	4	1	1	1	1	1	1	1	1							✓	2.	✓	1.	2.	1.	1.		
				Senior Administration Officer (Enginee)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	4.		
				Senior Administration Officer (Enginee)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	4.		
				Senior General Administration Officer (Engineering Support)	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineer)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineer)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineer)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				General Administration Officer /employee (Engineer)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				Senior Administration Officer (Engineering Supprot)	12	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	3.		
				Senior Administration Officer (Engineering Supprot)	11	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	4.	✓	4	4.	4.	3.		
				Senior General Administration Officer (Engineering Support) level 10	10	3	3	3	3	3	3	3	3	1		2	2	2	2	✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	9	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	8	2	2	2	2	2	2	2	2							✓	3.	✓	3	3.	3.	3.		
				General Administration Officer /employee (Engineering Support)	7	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineering Support)	6	2	2	2	2	2	2	2	2							✓	2.	✓	2	2.	2.	2.		
				General Administration Officer /employee (Engineering Support)	5	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		
				General Administration Officer /employee (Engineering Support)	4	1	1	1	1	1	1	1	1							✓	2.	✓	1	2.	1.	1.		

PS: General Administration Officer of the Operation Department divided 3 groups : 1.General Oeration Officer (Administration) 2.General Administration Officer (Engineering) and 3.General Administration Officer (Engineering Support)

4.5 TRAINING MODULES OF BLUE LINE ISP

Training modules of Blue Line Isp are summarized below:

Module	Date	Docs by	Trainer	Trainees	Training Purpose	Subject of Material /Handout
Module 7 – Familiarize with Railway Operation	Jan 06/ Jan 07	BMCL	BMCL	LC, DC, SC, TO, EC, MC	The participants will able to explain the component of Mass transit system	- Basic knowledge of Mass - Transit System - Depot operation plan - Glossary - Mode of operation - Reporting and organization of operation - System operation
Module 9 – Rulesbook	N/A	BMCL	BMCL	LC, DC, SC, TO, EC, MC	The participants will differentiate between rules, regulations and Operations Instructions, become aware of operational principles, codes of conduct, Safety Regulations for passengers and personnel, rules and regulations concerning the dangers arising from the third rail and other fundamental Regulations for the staff involved	- Maintenance and engineering work - Track possession management - Safety awareness - Emergency and accident response - General practices for train operation - Signal & interpretation
Module 12 – Operation Procedure Manual for CCR Staffs	Mar 03/ Nov 03	Siemens	BMCL	LC, DC, SC, TO, EC, MC	• The participants will perform the shift duties of CCR staff according to the regulations for Normal Operations after attending this module successfully. • The participants will perform the shift duties of CCR staff according to regulations for Operations in Normal, Degraded Mode and Emergency Preparedness for CCR staff after attending this module successfully. • The participants will perform the shift duties of CCR staff according to regulations for Operations in Normal,	- Normal train operation - Blue Line time schedule - Central Control Room (CCR) procedure - Depot operations - Maintenance activities exercise - Comprehensive test - M&E maintenance safety plan

Module	Date	Docs by	Trainer	Trainees	Training Purpose	Subject of Material /Handout
					Degraded Mode and Emergency Preparedness for CCR staff after attending this module successfully.	
Module 12 A	Nov 03	BMCL	BMCL	LC, DC, SC, TO, EC, MC	• Understanding the implementation in communication between station officer, including provides the information to ridership for both regular and emergency incident • The aim of this document is to describe operational procedures to be executed by the OCC staff. It is a basic precondition that all staff are well trained in the equipment at the particular workstations belonging to their position	- Normal operation - Communications - Exercise for approval to proceed - General technical background - Approval to proceed - CCR procedure
Module 12 B	Jun 03/ Jun 10	BMCL	BMCL	LC, DC, SC, TO, EC, MC	N/A	- Degraded operation - Maintenance works (General, telecom, rolling stock, track, signalling , power supply, stations, operational irreqularities, alternative program)
Module 12 C	Dec 03	BMCL	BMCL	LC, DC, SC, TO, EC, MC	N/A	- Training Basic Staffs for CCR operation
Module13 Communication Procedure	Nov 03	BMCL	BMCL	LC, DC, SC, TO, EC, MC	N/A	-station key instruction for communication in different circumstances
Module 16 Application of Manual Pont Locks & Cranking of Turnouts	Jan 03/ Jan 04	BMCL	BMCL	LC, DC, SC, TO	• Familiarize with turnout components • Enable to perform manual cranking of turnouts • Efficiently appoint the manual clamp lock to turnouts	-Application of Manual Point Locks & Cranking of Turnouts
Module 17 Application of the Short Circuit Device and	Jan 03/ Nov 03	SIEMENS	BMCL	LC, DC, SC, TO, EC, MC	• The participants will perform the application of the Short Circuiting Device in a correct manner as well as the correct usage of the voltage tester	-Application of Short Circuit Device and Usage of the Voltage Tester

Module	Date	Docs by	Trainer	Trainees	Training Purpose	Subject of Material /Handout
Usage of the Voltage Tester					under all safety related circumstances after attending this module successfully • The trainees can use Short Circuiting Device for protection in working at power line area The trainees can use Voltage Tester for testing the power supply line before the installation of Short Circuiting Device	
Module 20	Jan 05	BMCL	BMCL	LC, DC, SC, TO	N/A	Evacuation plan from Train & Station
Module 21	Jan 05	BMCL	BMCL	LC, DC, SC, TO, EC, MC	N/A	- Safety protection area, definition and practices - Safety in the Clearance Gauge
Module 25	Jan 05/ Jul 06	BMCL	BMCL	LC, DC, SC, EC, MC	N/A	- Maintenance works and co-ordination with operations - Document request for onsite operation - Internal memorandum
Module 27 Dissemination of information	Sep 03/ Jan 05	BMCL	BMCL	LC, DC, SC, TO, EC, MC	The participant will differentiate between the flow of information within the company and processing of controlled copies of manuals, as well as the investigation of incidents and accidents after attending this module successfully.	- Information Dissemination and Storage Methods - Information transfer in organization and collection
Module 28	Aug06/ Jan 07	BMCL	BMCL	LC, DC, SC, EC, MC	N/A	- Document request for onsite operation - Internal memorandum
Mod_29 Incident management		BMCL	BMCL	SC, EC, MC	N/A	- Incident and Accident Report - Bomb Threat Checklist - Classification of Incident - Determination of the On-Scene Commander for several types of incidents - Incident management process flow - Incident notification for CCR

Module	Date	Docs by	Trainer	Trainees	Training Purpose	Subject of Material /Handout
						- Items and Locations of Emergency & Rescue Equipment - Description and Possible Criteria - Manual of incident management - Incident Management / Liaison with Emergency Services (Third Parties)
Module 31	Jan 06/ Aug 06	BMCL	BMCL	LC, DC, SC, TO, EC, MC	• Staffs at the station practice the responds for the emergency incident • Remember for each role and responsibility when any incident occur • Responsive for the emergency immediately and accurately • Improving the confidence in respond the incident to the staff	- Exercise for basic respond plan for irregular incident
Mod_40 Station Ventilation and ECS system	Aug 03	BMCL	BMCL	LC, DC, SC, EC, MC	• Understanding for air condition controlling equipment incident • Understanding the mechanism of air condition controlling system • Capable of using air controlling system and responding to any signal accurately • Understanding and monitoring the working process of equipments from ECS/TVS Workstation	N/A
Mod_41 (Escalators & Elevators operating - Stations)	Sep-Oct 03	BMCL and SIEMENS	BMCL	LC, SC,EC	• The participants will comprehend the basic principle of lift, particularly for Machine room less Type. and escalator, especially in multi drive unit type. • The participants are able to do basic check and simple maintenance of lifts and escalators before	- Escalators EC and LC - examination (quiz) using to test the understand of participants after class - interfaces of lifts and escalators with the other systems, e.g. SCADA and Fire Alarm - specifications of lifts and escalators in MRTA project
Mod_42 (Tunnel Ventilation System)	Mar-Apr 03	BMCL	BMCL and SIEMENS	LC, SC,EC	• The participants will familiarize with the Tunnel Ventilation System for stations, intervention shaft and tunnel	- TVS workstation - daily report - Subject: KI's Module Report for TVS2:

Module	Date	Docs by	Trainer	Trainees	Training Purpose	Subject of Material /Handout
					• The participants will familiarize with the Tunnel Ventilation System for stations, intervention shaft and tunnel	Tunnel Ventilation System, TVS: Tunnel Ventilation System, PLC: Programmable Logical Control, LHD:Linear Heat Detection
Mod_43 (Fire Alarm & Fire Service System Operating - Stations)	N/A		BMCL	LC, SC,EC	• The participants will familiarize with the fire alarm and other extinguisher system	- Fire Alarm & Fire Services
Mod_44 (Electrical Services Equipment Operating - Stations)	Apr-Sep 03	•Mr. Prawit Impornruge e (BMCL Staff) •Mr. Anawat Puangpairoj (BMCL Staff: E&M Maintenanc e KI)	BMCL	LC, SC,EC	• The participants will familiarize with the Low Voltage Electrical System for stations, intervention shaft and tunnel • The participants will familiarize with the Low Voltage Electrical System for stations, intervention shaft and tunnel	- ACB manual - daily report - SCADA I-O RAM for Integrated Test - E&M Overview - staions(CCR Version) - electrical overview - Lighting Control System - Examination Sheet: Stations Electrical Services
Module 45 How to use telephone		BMCL	BMCL	LC,TO,SC,EC	N/A	- Telephone Operating Instruction - Euroset-TrainingManual
Module 46	N/A	BMCL	BMCL	LC,TO,SC,EC	N/A	- Radio System including Handheld Operating - HandPortTable
Module 47	N/A	BMCL	BMCL	LC, SC	N/A	- Operation Maintenance Training Manual for PA System - MRTA Project Training station
Module 48 (Platform Screen Door Operating)	N/A	BMCL	BMCL	LC, SC, TO	• To get acquainted with PSD system • To understand of how do the automatic & manual operations perform • To familiarize with PSD manual operating equipment • To enable the staff to handle the fault	- Training Videos - Mod48_test and solution - Platform screen door operation Manual

Module	Date	Docs by	Trainer	Trainees	Training Purpose	Subject of Material /Handout
					indication, faultfinding and response to that failure	
Module 51 (SCADA System Operating)	N/A	BMCL	BMCL	EC	N/A	- Training Material Module#51 (SCADA System Operating - Communication - System Configuration Description
Module 52	N/A	BMCL	BMCL	LC, EC	N/A	- VICOS Presentation
Module 54	N/A	BMCL	BMCL	LC, SC, EC	N/A	- Plumbing&Drainage

LC – Line Controller, **DC** – Depot Controller, **SC** – Station Controller, **TO** – Train Operator, **EC** – Engineering Controller, **MC** – Maintenance Controller

4.6 EXAMPLES OF TRAININGS IN RAILWAY SECTOR

Introductory review of training programs in overseas railway companies are presented below (This is a result of preliminary review and will be further studied subsequently).

British Railway, United Kingdom

Training Centers were established in divisions across the UK to cater for the "In-house" training of railway staff such as drivers, signalers, trackworks, O&M staff, safety training and certification etc on the particular rolling stock and systems employed in that division.

Some outsourced training such as Quality Auditing was allowed, but in general training was all "In-house". However, now all training is "out-sourced" by private contractors. These Contractors acquired the old BR Training Centers under privatization and established themselves as private companies. Training is mainly safety orientated as Licenses or certificates that allow staff to work on the track must be revalidated every 2 years.

Safety critical works such as signalling requires staff to have an Institute of Railway Signalling License (IRSE). To get a license one must be assessed on your day to day works and by formal assessment. This works is carried out partly in-house by Network Rail (formerly BR) and outsourced assessors.

This type of approach is not recommended for MRTA, but standards must be set and achieved under assessment by MRTA before they can allow staff to work on safety critical systems and equipment. Training of Operating staff should also be carried out. On the Purple Line an Operator training simulator is provided where trainee operators can be trained and assessed competent before talking up actual duties in the OCC. MRTA should have its own training organisation where staff (including new recruits) are systematically trained and assessed before being allowed to work on the railway. This system is adopted in all railway organisations I have worked for in my career including BR, MTRC Hong Kong, Taiwan HSR, LRTA Philippines to name a few.

Manila Line 2, Philippines

For LRTA Line 2 in manila, a structured training programme was submitted to the Employer's representative for approval. The Contractor supplied all teaching aids, books, etc and the training was a mixture of practical and theory training in the Philippines and abroad.

Candidates were assessed on a weekly basis to ensure they understood the training and achieved the level necessary to move on to the next level.

Mainly the trainees were LRTA Managers who would train future staff after the Contractor has left the project. This was especially true of Driver Supervisors where drivers are reassessed every 6 months for driving competency.

Delhi Metro and Other Metro Systems, India

With several cities in India (Bangalore, Hyderabad, Mumbai, Kochi and Kolkata) opting for metro railway lines simultaneously, the demand for qualified and trained human resources at various levels has taken a sharp ascent. This has also impacted the employment market with steep increase in compensation. Indian Railways and consulting establishments such as RITES and IRCON are the fountainheads of talent pool within India and they are unable to cope with the unprecedented demand. The inadequate 'critical mass' of human resources is one of the major constraints that is being witnessed by all new metro railway corporations. Metro companies in India are trying to address the issue using a combination of the following approaches.

- Hiring outstanding managerial talent from non-transport background and training them in metro rail operations.
- Hiring superannuated Indian Railway officials (this has its own limitations) and orienting them on modern rail management systems.
- Forging partnership with companies from abroad, which have substantial experience in metro railway management (or with DMRC) and providing 'hands on' training to the newly recruited professionals.

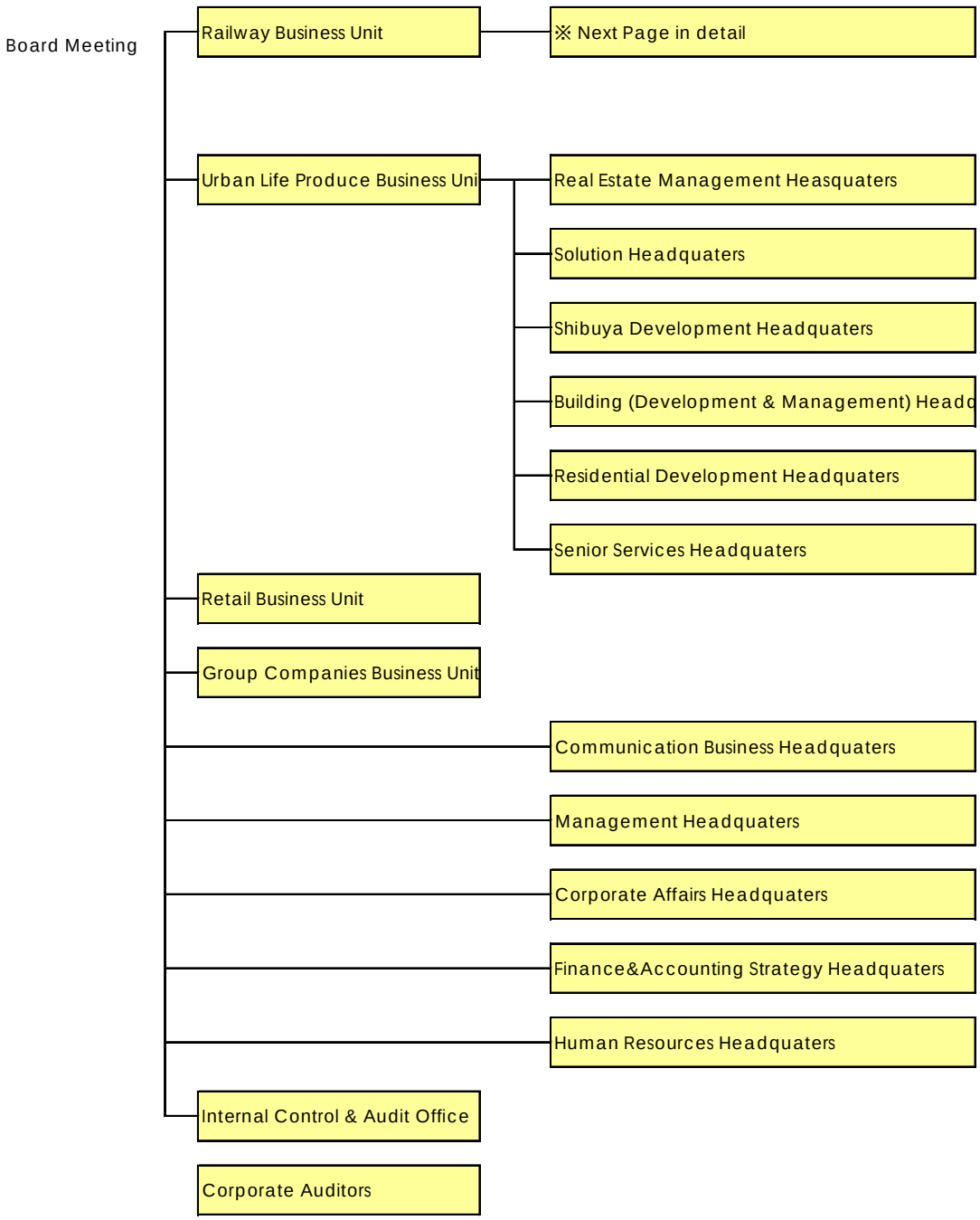
The training of professionals by the Indian Railways is organized at the following railway institutes.

- Railway Staff College, Vadodara
- Indian Railway Institute of Civil Engineering (IRICEN), Pune
- Indian Railway Institute of Mechanical and Electrical Engineering (IRIMEE), Jalampur
- Indian Railway Institute of Electrical Engineering (IREEN), Nashik
- Indian Railway Institute of Railway Signal and Communication Engineers (IRISET), Secunderabad
- Railway Industry Authority (RIA), UK
- Staff Training School, Neopara, N-S Metro, Kolkatta (especially for safety training)

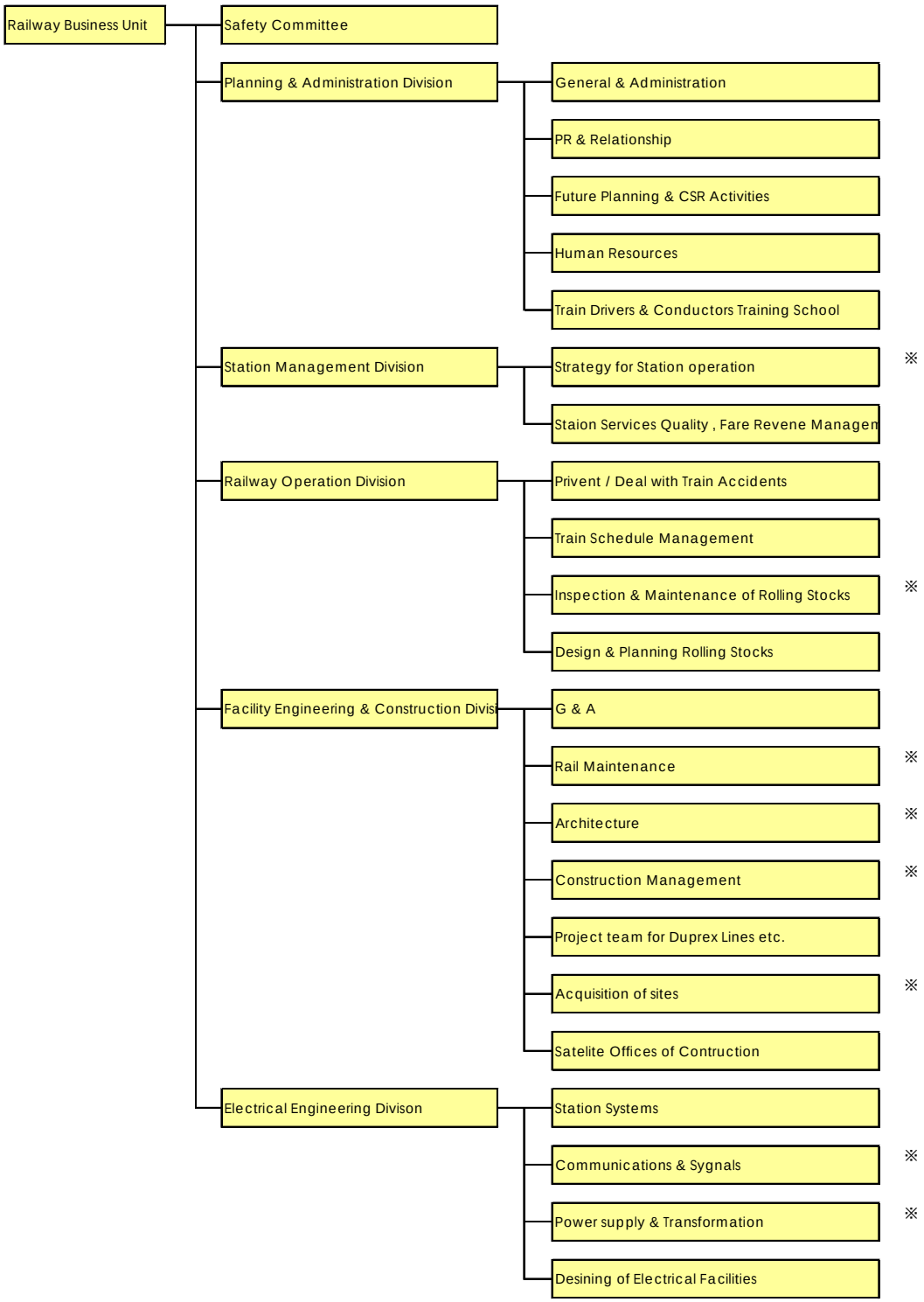
The facilities in these institutes also need to be leveraged to harness optimum benefit.

5.1 ORGANIZATION STRUCTURES OF TOKYU CORPORATION

The Organization Chart of Tokyu Corporation (1)

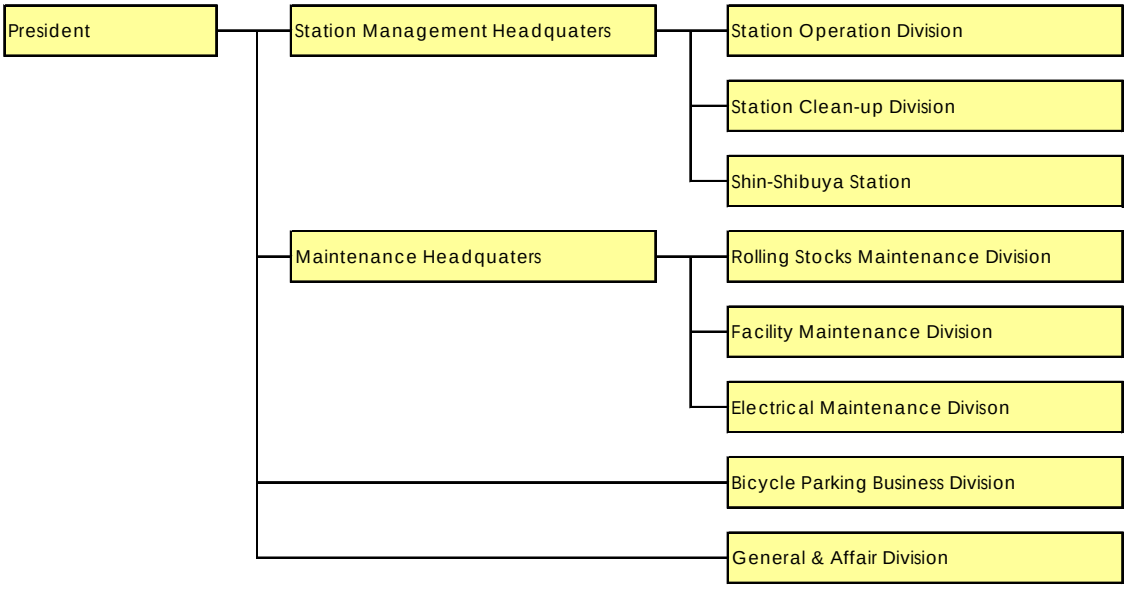


The Organization Chart of Tokyu Corporation (2)



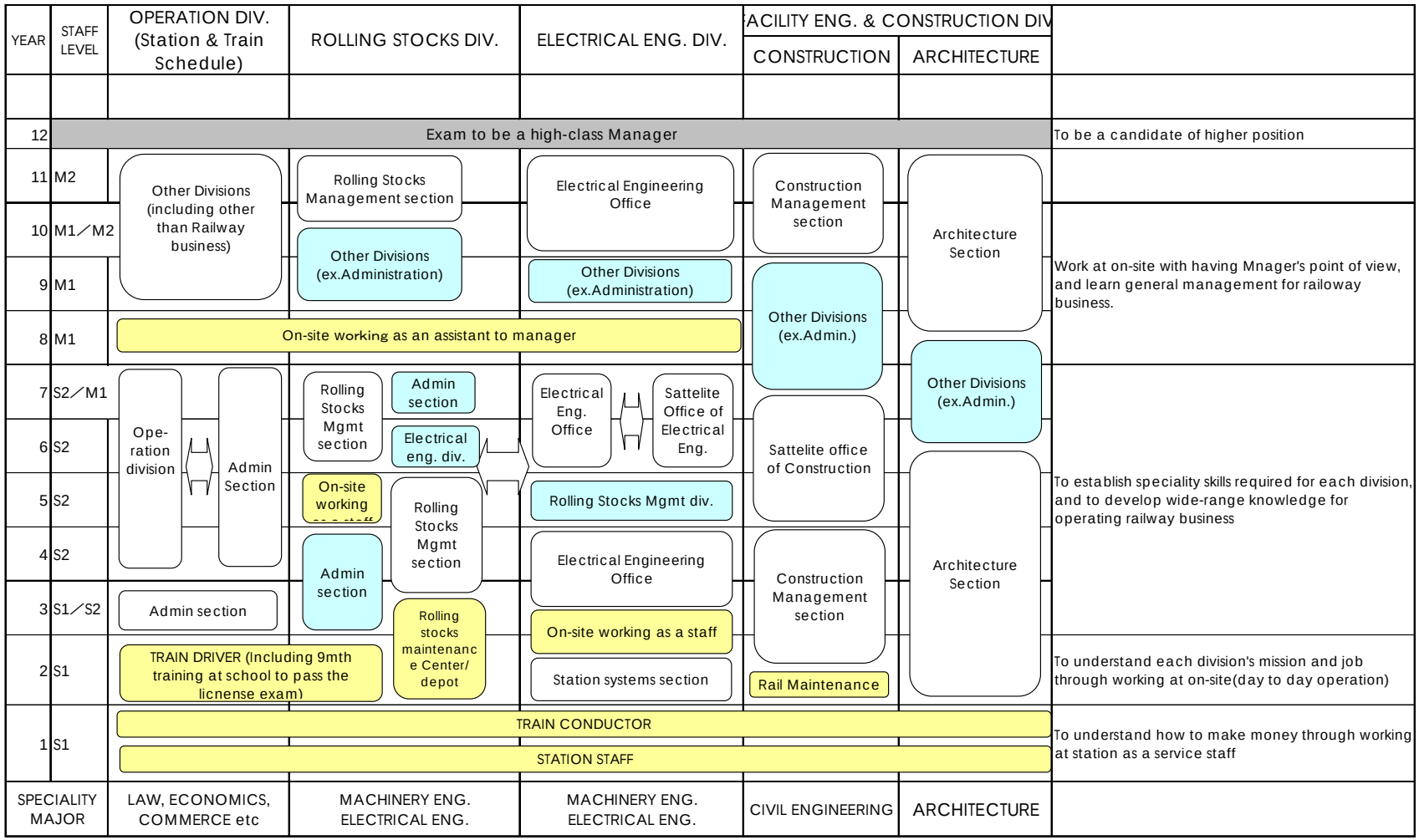
(※)・・・Partially outsourced to Tokyu Railway Service, Co.(100% Subsidiaries)

The Organization Chart of Tokyu Railway Services



Note: Tokyu Railway Services is 100% Subsidiary of Tokyu Corporation.

5.2 CAREER STREAMS AT TOKYU CORPORATION



※S1:Staff level1, S2:Staff level2, M1:Manager level1, M2:Manager level2 (To step up each levels, passing exam is required)

6.1 SWOT ANALYSIS OF MRTA

SWOT Analysis SWOT – Strengths, Weakness, Opportunities and Threat Analysis is a well established managerial tool to review institutional, project, tasks for their strategic validity. Both S (Strengths) and W (Weaknesses) deal with internal factors what, how and why an institution, project or tasks are strong or weak, whereas O (Opportunities) and W (Weaknesses) focus on external factors that may affect the institution, project or tasks.

SWOT Analysis of MRTA The following is a SWOT assessment of legal, institutional, operational aspects of MRTA as well as human capacity of MRTA management and staff in short. It also includes some future implications such as the cases on direct operations, non-railway businesses. Some tables focus on the HR issues such as staff capacity or evaluation and career stream.

(1) Legal Framework – MRTA Act

Strengths	• Strong and confirmed role given under the MRTA Act
Weaknesses	• Rigidity in interpreting MRTA's businesses and activities
Opportunities	• Ability given under the MRTA Act to conduct railway operations directly in a comprehensive manner
Threats	• Possible key decision making at government on the eventual changes

(2) Railway Lines – including future lines

Strengths	• Having most dense and widely covered lines
Weaknesses	• No plans of interfaces between the lines to enhance efficiency of operations and comfort for passengers
Opportunities	• Influence over other lines for further integrated services to passengers
Threats	• Possible political intervention to take MRTA's involvement away

(3) Railway Operations - Net Cost Concession Scheme

Strengths	• Easy management, all responsibilities on the concessionaire • Virtually no responsibilities on railway operations, thus no way to be held accountable
Weaknesses	• Indirect and remote supervision and control only • No possibility to build internal capacity • No internal technical and operational human resources and information
Opportunities	• Strong drive to get closer to Gross Cost Concession Scheme and beyond
Threats	• Overall responsibility as pubic transport coming on MRTA • Downward internal morale if Net Cost Scheme continues • Political intervention blocking allowing MRTA to take full control as an Operator

(4) Railway Operations - Gross Cost Concession Scheme

Strengths	• Closer to direct operations • Direct involvement to ridership and revenue flow • More rewarding job responsibilities allowing staff to gain valuable experience and knowledge
Weaknesses	• Still indirect supervision and control • Difficulties to build internal capacity • Political intervention blocking allowing MRTA to take full control as an Operator`
Opportunities	• Possible direct engagement on ridership increase measures on the regional / suburban development
Threats	• Key roles taken away on the regional / suburban development

(5) Railway Operations - Direct Operations (future)

Strengths	• Full understanding of railway operations • Direct Involvement to ridership and revenue flow • Direct feeling and touch with passengers and customers
Weaknesses	• Difficulties in managing stretched operations • Keeping staff once experience and knowledge gained due to low pay scales.
Opportunities	• Ability to offer other regional development stakeholders
Threats	• Possible operating right revoking or suspension by other railway operator • Staff once having gained experience and knowledge attracted away to join Railway operators such as BMCL or BTS for more money • No anti-poaching rules between railway authorities and operators.

(6) Core and Associated Railway Operations (future)

Strengths	• Direct access to all managerial, technical, administrative information on railway operations
Weaknesses	• Not high economic and financial returns expected
Opportunities	• Easy integration and incorporation to the overall policy and other associated, non-rail operations
Threats	• Reactive working environment under the pressure from other stakeholders

(7) Non-Rail Operations - Regional/Suburban Development (future)

Strengths	• More integrated ridership policy and strategy to be able to plan • Higher demand forecast and revenue plans to be established
Weaknesses	• Excessive demand and a short supplying capacity, if demand arisen sharply
Opportunities	• Stronger influence and assurance of MRTA's role
Threats	• Possible interventions by external stakeholders

Considering both direct and indirect intervention

(8) Institution / Internal Capacity and Ability (current)

Strengths	• Highly motivated management and staff • Strong wish to promote direct operations
Weaknesses	• Relatively short history • Having no experience in railway operations
Opportunities	• Planned new line projects
Threats	• Eventual take over by others or removal of the planned lines

(9) Managerial Level Capacity

Strengths	• Strong and highly qualified professionals
Weaknesses	• Having not much experience in railway businesses
Opportunities	• N.A.
Threats	• N.A.

(10) Technical Capacity

Strengths	• Highly qualified personnel
Weaknesses	• Not much opportunity to exercise technical knowledge and skills under "indirect" management and supervision • Under paid for their qualifications. • Can find positions in Private companies for more salary • Not much scope to use the qualifications they have gained in the application of their work. • Current job responsibilities not very rewarding in terms of goals achieved
Opportunities	• Purple Line project should allow the lucky candidates allowed to take part in the supervision and overseeing of the M&E Contractor during design, construction, testing & commissioning phases of the Works. • Set up teams for the future Purple Line PPP organisation and build ther teams up to gain maximum knowledge and experiences from the project, but not to hinder the projector delay it in anyway.
Threats	• Staff once having gained experience and knowledge attracted away to join Railway operators such as BMCL or BTS for more money • No anti-poaching rules between railway authorities and operators

(11) Administrative / Financial / Legal Capacity

Strengths	• Adequate and appropriate staffing
Weaknesses	• Not much internal-coordination
Opportunities	• N.A.
Threats	• N.A.

(12) HR Recruitment / Compensation Package

Strengths	• Attractive hiring conditions comparing with SRT • With the "new" type of business image of MRTA
Weaknesses	• Not too much attractive offers made vis-à-vis private sector companies • Mismatch between TOR and actual work • Too high expectation without good understanding of "indirect" nature of MRTA operations
Opportunities	• Further attractiveness added with new line projects coming up
Threats	• Higher turnover of staff, if mismatch of TOR and actual work continues

(13) HR Training – from MRTA HR viewpoint

Strengths	• Abundant training opportunities • Compensating mismatched TOR and actual work
Weaknesses	• Not well organized, planned • Rather fragmented in response to Dept / Staff needs • Difficulties in finding internal resource persons due to the Net Cost Scheme nature • Trainings rather personal objectives, and not institutional ones
Opportunities	• Higher retention of staff, if carefully organized to meet institutional need and responding to long-term career path requirements
Threats	• If not well organized, difficulties in maintaining staff through training

(14) HR Evaluation / Career Stream / Path – from MRTA HR viewpoint

Strengths	• Clear KPI to be introduced
Weaknesses	• Too much detailed KPI that may lead to subjective judgment by supervisors • Not clear career stream / path offered to staff • Virtually no regular job rotation
Opportunities	• More attraction to newcomers with KPI and other more transparent HR tools
Threats	• Fall out of HR system, if KPI and career path not well implemented

6.2 BASIC TRAINER COURSE IN BANGKOK

Basic Training Course

Sq. No.	Categories	Topic	Duartion (Day)	Cost (Ex. VAT)	Training Company	Web Site	Client
1	Program "Clic-BIZ Presentation & Personality Skills"	- Technical presentations in various presentation - Concept and importance for presentation - Self-analysis - Analysis of key issues and obstacles in the presentation - Develope the unique personality	9	USD9,000.00	Consulting and Bisiness Development Institute	www.stepplus.org	Uni-Thai Shipyard & Engineering Co., Ltd.
2	Self Leadership Development Program	- Goal setting : Target the Smart, Planning the Success, Dealing with obstacles - Self Awarenss : Learn techniques for reading other people, Techniques supplement the strengths and weaknesses of their own negative - Positive Attitude : The development of positive thinking, different perspective, to build confidence and courage - Leadership Style : The role, the difference between manager and leader - Self Motivation : Targeting, techniques of self-encouragement, dealing with disappointment - Emotional Intelligent : Management of their own ego, techniques to create humorous, creating a good atmosphere with people around you	1 1 1 1 1 1	NA	Deone International Co., Ltd.	www.deonetraining.com	Provincial Electricity Authority - HQ
3	Shaping Strategic and Performance Management	- Balanced Scorecard - KPIs : Principles to Practices - Action Plan Techniques	2 2 1	THB5,500.00 THB5,500.00 THB3,200.00	Thailand Productivity Institute	www.ftpi.or.th	Public Training Courses
4	Self Development for Professional	- Personal Productivity - Sparking Your Creative Thinking - Power up Your Positive Mind - Systemic Thinking - Problem Solving and Decision Making Techniques - Maximize Time and Priorities management - Communication with High Impact - Stress Management - EQ for Self Development	1 2 1 2 2 1 1 1 1	THB3,500.00 THB5,500.00 THB3,200.00 THB5,500.00 THB5,000.00 THB3,200.00 THB3,200.00 THB3,200.00 THB3,200.00	Thailand Productivity Institute	www.ftpi.or.th	Public Training Courses
5	Knowledge Management : KM	- Knowledge Management, Knowledge Economy, Creative Economy	1	THB3,500.00	Thailand Productivity Institute	www.ftpi.or.th	Public Training Courses
6	Power Pitches : Power Presentation	- How to pitch work - Define Situation - Design Presentation - Delivery Presentation - Transaction Analysis - Conduct Meeting Techniques - Using QA Pitch Work - Techniques of persuasion - How to pitch and off the job summary - The follow-up after work and pitch	2	NA	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	- Acer Computer - Amarin Printing and Publishing Co., Ltd.

Quality Control and Quality Audit Courses

Sq. No.	Categories	Topic	Duartion (Day)	Cost (Ex. VAT)	Training Company	Web Site	Client
1	ISO 9001 : 2008 Quality Management System	- Executive Overview - Awareness - Implementation and Requirements - Documentation - Internal Audit	1 1 2 1 2	NA	Quality Alliance (Thailand) Co., Ltd.	www.qatthailand.com	- ADC Design and Construction Co., Ltd. - PPS Concrete Co., Ltd.
2	ISO 9001 : 2008 Quality Management System	- Quality Awareness - Introduction and Implementation - Effective Internal Auditing - Excellent QMR	1 2 2 2	NA THB2,900.00 NA NA	NY Consultant & Training (Thailand) Co., Ltd.	www.ny-consult.com	Public Training Courses
3	ISO 9001 : 2008 Internal Quality Audit (IQA)	- Interpretation of ISO 9000 Series - Quality System Documentation Auduting - Audit Planning / Prepare - Audit Performance / Review	2	NA	SGS (Thailand) Limited	www.th.sgs.com	Public Training Courses
4	ISO 9000	- Internal Quality Audit	3	THB6,000.00	Thailand Productivity Institute	www.ftpi.or.th	Public Training Courses

Man Management Course (1)

Sq. No.	Categories	Topic	Duartion (Day)	Cost (Ex. VAT)	Training Company	Web Site	Client
1	The Heart of Coaching	- The Methods and systems of modern work processes coach basic - To understand the true meaning of art and blocked the work of modern coaches - To understand the integration between the three main roles of the supervisor (lead, manager and coach) - How to motivate behavior modification adjustment Metal Pine motto forms of learning - Assess their own performance in order to create actions plan job coach (Coaching action Plan) - Job coach process concepts etc.	2	THB16,000.00	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	Public Training Course
2	Act Coach : Effective Coaching	- Key Tasks and Responsibilties - Coaching Belief & Mindest - Coaching Analysis - Inner Work of the Coachee - Coaching Relationship - Coaching Competencies - Coaching Model - Personal Working Styles & Coaching Techniques	1	NA	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	- Amarin Printing and Publishing Co., Ltd. - Metro System Corporation Plc.
3	Deal With Different People	- Foundamental to the psychological types of people - Understanding of different people and working with people in each category - How to seek a type of each person - Techniques of different managements - Psychological management team consists of different people	1	NA	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	Thai Farmers Bank Ltd.
4	People Management & Working Plan	- Basic Principle : Understanding personality, Motivating, Learning, Understanding behavior modification, Effective Communication, Situational Leadership, Goal Setting, Planning and Prioritizing, Personal Objective Setting - SMART - People Management : Delegation and Empowerment, Follow up Setting and Plan for people development, Skill, Coaching, Supervisor's Techniques for Performance Evaluation - Giving and receiving feedback - How to deal with differnce people in 9 groups - Performance Ranking - Assessing and developing jib skills	1	THB4,800.00	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	Public Training Course
5	Convincing : Word Art and Phychology of Presentation	- Psychology in convincing : Psychology in persuading/convincing people, understanding nature of people, creating credibility, NLP techniques - Psychology in presentation : Rhetoric in convincing, essential of speaking and listening, Rhetoric in presentation and pursuation Art of pursuation in presentation, Rhetoric in presentation in difficult situation, Summary of using persuation principles for success	1	THB4,800.00	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	Public Training Course

Man Management Course (2)

6	Synergistic Teamwork : The Power of One	- Process to build and develop teams - Create a unified communication and trust within the team	1	NA	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	Bangkok Aviation Fuel Service Limited
7	Stratrgy Moves	- Analysis Strategy for the 6 Strategy Moves : Guerrilla attack, Isolation attack, Flanking attack, Frontal attack, Differentiated circle, Undifferentiated circle - Analysis of the eight strategic in the Strategy Moves : Signalling defense Creating barriers to entry, Global service, Counter attack, Pre-emptive strike, Blocking entry, Holding the ground, Withdrawing - When the strategic offensive, or better - 8 Rules of successful strategies	1	NA	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	Mercedes Benz
8	Managing to High Performance	- The administrative role in management performance - Theories and concepts of performance managemengt excellence - Setting goal and palnning - Phychological Management of the subordinates - Review Performance of subordinates and staff - Techniques to improve - Criteria to measure or performance - Long Term Performance Management - The development of leadership skills to create works	NA	NA	Strategic Business Development Center Co., Ltd.	www.sbdc.co.th	NA
9	Smart Coach	- Coaching principles : Coaching culture & Career management, Coaching Mentoring and Counselling - Basic Skill of coaching : Deep listening, dialogue, learning questions, heartfelt communication, feedback - Process and techniques : presentation, observation,session, relationship facilitate learning and result	2	THB9,000.00	Deone International Co., Ltd.	www.deonetraining.com	Public Training Courses
10	Coaching for Effective Manager	- Analysis Competency - Analysis of EQ - Drawing on the creativity of self and team to capitalize - Coaching the importance of leadership - Develop a positive attitude - Forms of learning and perception of subordinates - Learn Communication skills Think & speak - The benefits of using communication skills - Science and Art of Teaching - Tool Coaching - Create and design lesson plans - How to Coach Team : classification group sobordinates, assessing the strengths and to accelerate deveopment, prepare discussion to build mutual understanding, - Learning the 7 Key Commitments : Commitment to self, to people, to customer, to task, to organization, to family, to public	2	USD7,000.00	Deone International Co., Ltd.	www.deonetraining.com	Toyota

Man Management Course (3)

11	Feedback how to program the mind to subordinates	- The challenge of corporate business - Qualifications and effective leadership practices : foundation of sucessful leadership, leaders in the heart, feature and effective leadership practices, demonstration of skills, self assessment - Coaching : concept of teaching, style of teaching, teaching methods - To provide feedback comments to others (Giving Feedback) to improve : when should a Feedback, how to Feedback	1	NA	Consulting and Bisiness Development Institute	www.stepplus.org	Public Training Courses
12	People Management Essentials	- Intelligence Leadership	1	THB3,500.00	Thailand Productivity Institute	www.ftpi.or.th	Public Training Courses
		- Talent Engagement	1	THB3,200.00			
		- Conflict Management by Psychological Concept	1	THB3,200.00			
		- Motivates Emplyees Through Performance	1	THB3,200.00			
		- Superb Supervisor	1	THB3,200.00			
		- Performance Appraisal and Giving Feedback	1	THB3,200.00			
		- Assignment & Controlling Tricks and Tips	1	THB3,200.00			
		- Effective Job Instruction	2	THB4,500.00			
		- Job Method	2	THB4,500.00			
		- Job Relations	2	THB4,500.00			
13	Leadership Development	- Navigate your way to Higher Levels of Perfromance - How to Lead and Motivate your people	1	THB4,500.00	Deone International Co., Ltd.	www.deonetraining.com	- Biomin - Thai 2-way Frabric

6.3 SUGGESTED TRAINING COURCE MODULES

Course Modules in Sequence

(The sequence can be varied dependent on the discipline required)

Module 1: Rolling Stock, Duration 2 Weeks

Week 1:

- Design Concepts, including MRTA Structure gauge, Purple Line Track alignment, trackworks specifications for rail to wheel interfaces and Materials quality control and Safety Standards
- Operating Conditions
- Maintenance Conditions
- Environmental Conditions
- Design Requirements, i.e. Fire protection standards, materials and equipment etc
- Crashworthiness Standards
- Performance Requirements
- Ride Performance
- Bogie Performance
- Bogie Design and features
- Wheel Design
- Gear Box Design and Function
- Coupler Types and functions and features
- Glazing and safety standards
- Electrical Apparatus, Wiring and Components
- Door Controls
- Locks and Keys
- Safety Requirements
- RAMS Requirements
- Electromagnetic Compatibility Standards (EMC/EMI)
- Surge and Transients
- Labelling and Signage
- Technical and Construction Requirements
- Service Life
- Lifecycle Costs
- Refurbishment
- Train Control and Monitoring System (TCMS)
- Diagnostic and Fault Indication System
- Visit to Blue Line Depot and Rolling Stock Inspection
- Intermediate Course Examination

Week 2:

- Structural Construction
- Mechanical Considerations, including critical loading calculations, including fatigue assessments, calculation models, acceleration and braking loads, mechanisms etc.
- Interfaces with the signalling and communications systems.
- Construction Process
  1. Carbody Inspection (completion of iron works of carbody)
  2. Concealment Inspection (completion of wiring and piping **before** concealment)
  3. Completed Bogie Inspection
  4. Factory Inspection of Completed Rolling Stock
- Other Considerations: Factory and On-site testing procedures
- Shipping and delivery of Rolling Stock to Site.
- Static and Dynamic Setting Up and Testing on-site procedures
- Integrated Testing
- Trial Running
- Completed Course Examination and Student Assessment of Understanding Interview

Module 2: Signalling Systems, Duration 2 Weeks

Week 1:

- Basic Appreciation of the Signalling System Elements and Sub-systems architecture, including interfaces with Rolling Stock, Communications Systems, Power Systems and Platform Screen Doors
- Signalling Systems Performance requirements, i.e.90 Second Headway etc.
- Signalling Principles in detail
- Control Tables appreciation and understanding
- Interfaces Appreciation, Rolling Stock, Communications Systems, Power Systems, and Platform Screen Doors
- Visit to Blue Line Depot, OCC/CCR and Trackside Equipment site-visit
- Intermediate Course Examination

Week 2:

Level 1: Central Traffic Control system, features and functions including:

- Timetable Scheduler function
- Automatic Train Supervision system (ATS)
- Automatic Train Regulation function (ATR)
- Automatic Route Setting (ARS)
- Route Setting controls and screen displays
- Panoramic Display System
- Alarms and Fault Reporting
- Non-vital link to Computer Based Interlocking (CBI) and Wayside Equipment

- Playback and Training Room Equipment (PTR)
- Faulting & maintenance

Level 2: Computer based Interlocking and Wayside Equipment

- CBI & Technicians Maintenance Terminal and data transmission medium to Wayside Equipment
- Wayside & Depot Signals
- Wayside and depot Point Machines and Derailers (Trailable and non-trailable)
- Train Detection system
- EMI/EMC Understanding and Survey Techniques and Solutions/Safeguards
- Grounding and Bonding
- Stray Current protection System
- Faulting & maintenance

Level 3: Interfaces: Faulting and Maintenance

- Rolling Stock
- Communications Systems
- Power Systems
- Platform Screen Doors
- Other Considerations: Factory and On-site testing procedures and lifecycle costs.
- Installation of Signalling Systems on-site
- Setting Up and Stand Alone Testing procedures
- ATP Static and Dynamic Testing
- ATO Static and Dynamic Testing
- CTC to Wayside Testing
- Control Table and Signalling Principles Testing
- Integrated Testing
- Trial Running
- Completed Course Examination and Student Assessment of Understanding Interview.

Module 3: Communications Systems, Duration 2 Weeks

Week 1:

- Basic Appreciation of the Communications Systems, System Elements, features and functions and Sub-systems architecture, including interfaces with Rolling Stock, Signalling Systems, Power Systems, AFC System, SCADA and Civil Building Services, including:
  - Backbone Transmission Network
  - Master Clock
  - Telephone PABX (Digital and Analogue)

  - Train Radio (Digital TETRA)
  - CCTV
  - PA & PIDS
  - SCADA
  - AO&IT
  - CASS
  - CMMS & MMC Systems
  - Fault Reporting And Corrective Action System (FRACAS)

- EMI/EMC Understanding and Survey Techniques and Solutions/Safeguards
- Radio Survey (for positioning of)
- Thailand NTC Standards and International Standards
- Sub-Systems Performance requirements such as radio 99% coverage
- Visit to Blue Line Depot, OCC/CCR and Station Operations and Equipment Rooms
- Intermediate Course Examination

Week 2:

- Level 1: Central Traffic Control system, features and functions including:
  - Telephone Workstation
  - Radio Workstation
  - Public Address Workstation
  - Passenger Information Display Workstation
  - CCTV Control & Monitoring Workstation and projector System
  - SCADA Workstation
  - SCADA GUI Displays
  - Fault Logging/Alarms
  - Playback and Training Room Equipment Network Switching for Fall=back OCC
  - Faulting & maintenance
  - Lifecycle Costs

- Level 2: Station Equipment Room and Wayside Equipment
  - General Equipment Room layouts and equipment housings
  - BTN Network/LAN/WAN/Wi-Fi
  - Radio Base Station, Antennas, grounding and bonding
  - Telephone PABX (Digital & Analogue) and Types of Instruments (Telephones)
  - Faulting & maintenance

- Level 3: Interfaces: Faulting and Maintenance
  - Rolling Stock
  - Signalling Systems
  - Communications Systems
  - Power Systems

  - AFC System
  - Platform Screen Doors

- Other Considerations: Factory and On-site testing procedures.
- Installation of Communications Systems on-site
- Setting Up and Stand Alone Testing procedures
- Radio Coverage Testing, including use of Spectrum Analyser
- Transmission Network Performance Measuring/Testing
- Integrated Testing
- Trial Running
- Completed Course Examination and Student Assessment of Understanding Interview

Module 4: Power Systems, Duration 1 Week

Week 1:

- Basic Appreciation of the Power Systems, System Elements, features and functions and Sub-systems architecture, including MEA High Voltage arrangements, TSS & SSS Networks, system harmonics and their effects and the SCADA System, and interfaces with Rolling Stock, Signalling Systems, Communications Systems and Civil Building Services, including:
  - MEA Power Feeding arrangements appreciation
  - MEA Fault Levels
  - MEA SCADA
  - MEA Rules and Regulations
  - Bulk Sub Station Arrangement, including Transformers, GIS, NGR and Filter Plants, Protection devices and Metering.
  - Transformer Efficiency and Design of Protective Devices/Fuse Factoring
  - Station TSS, Including Transformers, Switching, Rectifiers and Protection Devices
  - Station SSS, Including Transformers, Switching, and Protection Devices
  - Cabling, Indoor/Outdoor types
  - Power Supplies, UPS and Battery Standby
  - Interfaces with Civil Building Services,
  - Interfaces with Trackworks “Conductor Rail” system, including “Stinger” system.
  - Earthing and Bonding
  - Safety Standards, including “Step-and-Touch, EMC/EMI, etc.
  - SCADA System, including BTN Interface, RTU’s and Electric Switching, Control and monitoring.
  - SCADA operating rules and regulations and safety lockout devices/systems.
  - Fault Reporting And Corrective Action System (FRACAS)

- Visit to Blue Line BSS, OCC/CCR SCADA Workstation and Displays and Station Operations Rooms SCADA/BMS Interface arrangements and typical station TSS/SSS Plant Rooms
- Other Considerations: Factory testing procedures
- Installation of Power and SCADA Systems on-site
- Power System Setting Up and Stand Alone Testing procedures
- SCADA System Setting Up and Stand Alone testing procedures
- Integrated Testing
- Trial Running
- Operation and Maintenance Procedures
- Completed Course Examination and Student Assessment of Understanding Interview

Module 5: AFC System, Duration 1 Week

Week 1:

- Basic Appreciation of the AFC System, System Elements, features and functions and Sub-systems architecture, including types of Fare Structures, Fare Promotion Options and Business Rules for Passes, Types of equipment and functions etc., and interfaces with the Communications Systems Data Networks and Civil Building Services, including:

  - AFC System structure and overview, including "Closed" and "Open" AFC systems
  - Fare Products
  - Common Ticketing requirements between MRTA Lines
  - Central Clearing House for common ticketing with other transportation authorities and systems, Government policies and studies.
  - Token Issuing Machines (TIM) features and functions and reporting to SC
  - Contactless Smart Token (CST) design and standards
  - Add Value Machine (AVM) features and functions and reporting to SC
  - Automatic Gates, Entrance/Exit/B-directional/Extra Wide/Mechanical Gate
  - Point Of Sales Terminal (POST) features and functions and reporting to SC
  - Contactless Smart Card (CSC) design and standards
  - Card Initialisation Device (CID)
  - Card Personalisation Device (CPD)
  - Portable Card Reading Device (CRD)
  - Remaining Value Checking Terminal (RVCT) features and functions
  - Station Computer (SC) features and functions and reporting to the CC
  - Park & Ride Ticketing Equipment, Facilities and Interfaces with SC
  - Central Computer (CC) features and functions
  - Central Computer Audit Reporting
  - How to investigate anomalies using the SC and CC Reports and Diagnostics

  - How to determine the required number of equipment for an AFC system in design
  - Ticket Office Layout and Cash Drawer arrangements.
  - Cash Handling Room and Cash counting machines, cash box trolleys etc.
  - Station TSS, Including Transformers, Switching, Rectifiers and Protection Devices
  - Station SSS, Including Transformers, Switching, and Protection Devices
  - Cabling types/wire-ways
  - Power Supplies, UPS and Battery Standby
  - Interfaces with Civil Building Services,
  - Earthing and Bonding
  - Safety Standards, including NFPA 130 and "Step-and-Touch etc.
  - Fault Reporting And Corrective Action System (FRACAS)

- Visit to Blue Line AFC Central Computer Control Room and AFC Audit Offices, Station Ticket Office and Cash Handling Rooms AFC/BMS Interface arrangements and typical station AFC Equipment Installation in the AFC Workshop.
- Other Considerations: Factory testing procedures
- Installation of AFC Systems on-site
- Setting Up and Stand Alone Testing procedures
- Integrated Testing
- Trial Running
- Operation and Maintenance Procedures
- Completed Course Examination and Student Assessment of Understanding Interview

Module 6: Depot Workshop Equipment (DWE), Duration 3 Days

Day 1 - 3:

- Basic Appreciation of the DWE Equipment Operation, features and functions, O&M Requirements and interfaces with the Communications Systems (if any) and Civil Depot Building Services, including:

  - Underfloor Trainset Lifting Line
  - Movable Jacking Systems, 10 and 15 Ton Capacity
  - Overhead Cranes
  - Trainwash Plant
  - Parts Washer and Bogie Wash Facility
  - Drying Oven
  - Sand Blasting Equipment
  - Painting Equipment
  - Brake and Compressor Test Equipment
  - Traction Motor Test Facility
  - Electronic Workshop

- Vehicle Coupler Test Stand
- Vehicle Door Test Stand
- Train Air Conditioning Module Repair
- Bogie Preload Stand
- Damper Test Stand
- Spring Test Stand
- Hi-Rail Maintenance Vehicle
- Flat Wagon
- Rail and/or Road Shunting Vehicle
- Rail Grinding & Reprofiling Machine
- Rail Defect Inspection Equipment
- Infrastructure Maintenance Vehicle
- Underfloor Wheel Lathe
- Hydraulic Wheel Press
- Welding and Cutting Equipment
- Repair Equipment
- Bearing Removal Equipment
- Bogie and Wheelset Workshop Equipment
- Trackwork Equipment and Hand Tools
- Wheel Centre Boring Machine
- Oil and Grease Disposal
- Lubricant Dispensers
- Waste Disposal
- Pallet Storage System
- Two Tier Shelving System
- Tool Storage System
- Battery Charger - Rolling Stock
- Inspection Platform (Scaffold)
- Forklift Trucks
- Bogie Turntables
- Re-railing and Rescue Equipment
- Axle Lathe
- Maintenance Platform
- Rail Mounted Ultrasonic Testing Vehicle
- Depot Test Track Safety Fencing
- Depot Yard Lighting
- Depot Workshop Underfloor Pit Lighting
- Cabling types/wire-ways
- Power Supplies
- Interfaces with Civil Building Services,
- Earthing and Bonding
- Safety Standards, including “Isolation of Power” in main Workshop
- Fault Reporting And Corrective Action System (FRACAS)

- Visit to the Blue Line Depot
- Other Considerations: Factory and On-site testing procedures.
- Setting Up and Stand Alone Testing procedures
- Integrated Testing
- Trial Running
- Operation and Maintenance Procedures
- Completed Course Examination

Module 7: Platform Screen Doors (PSD), Duration 2 Days

Day 1 - 2:

- Basic Appreciation of the PSD Equipment Operation, safety features and functions, O&M Requirements and interfaces with the Signalling System and Civil Station Building Services, including:
    - Basic Normal Operation
    - Degraded Operation
    - Safety Doors for Emergency Passenger Evacuation from a Train
    - Track Access Doors
    - PSD Control System
    - Power Supplies
    - Interface with Signalling System
    - Interface with Civil Station Building Services
    - Cabling types/wire-ways
    - Power Supplies
    - Interfaces with Civil Building Services,
    - Earthing and Bonding
    - Safety Standards, including “Isolation of Power” in main Workshop
    - Fault Reporting And Corrective Action System (FRACAS)

- Visit to Typical Blue Line Station Platform and PSD Control Equipment Room
- Other Considerations: Factory and On-site testing procedures.
- Installation of PSD System on-site
- Setting Up and Stand Alone Testing procedures
- Integrated Testing
- Trial Running
- Operation and Maintenance Procedures
- Completed Course Examination and Student Assessment of Understanding Interview