

Kingdom of Thailand

FY2018 Ex-Post Evaluation of Japanese ODA Loan

“Mass Transit System Project in Bangkok (Purple Line) (I) (II)”<sup>1</sup>

External Evaluator: Keishi Miyazaki, OPMAC Corporation

## **0. Summary**

The objectives of this project were to meet the increasing traffic demand and to mitigate traffic congestion in the Bangkok Metropolitan Region by constructing a new mass transit railway line (Purple Line: Bang Sue – Bang Yai Section), thereby contributing to urban economic development and environmental improvement such as in air pollution. This project was highly relevant to Thailand’s development plan and development needs, as well as to Japan’s ODA policy. Therefore, the relevance is high. As for efficiency, although the project cost was within the plan, the project period exceeded the plan. The outputs of this project were as planned. Therefore, its efficiency is fair. The operation and effect indicators of this project, such as operating rate, running distance and number of running trains, partially attained their target values. However, the actual values for ridership and income from passengers were far below the target values. The main reason for this was that although the demand forecast was projected based on the assumption that the entire stretch of the four mass transit lines planned at the time of appraisal would be in operation by the time that the Purple Line was completed, this was not the case. This project is considered to have met a growing transportation demand and to have alleviated traffic congestion in the Bangkok Metropolitan Region, including Nonthaburi Province, to a limited extent. On the other hand, the project had a positive impact on the promotion of regional development such as housing and commercial development in the areas along the Purple Line in Nonthaburi Province. No negative impact on the natural environment was observed, and land acquisition was appropriately executed in accordance with the related domestic laws and regulations of Thailand. Therefore, the effectiveness and impact of this project are fair. Meanwhile, as no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system, the sustainability of the project effect is high.

In light of the above, this project is evaluated to be satisfactory.

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<sup>1</sup> This ex-post evaluation is a joint evaluation between the Public Debt Management Office (PDMO) of the Ministry of Finance, the Government of Thailand and JICA.

## 1. Project Description



Project Location



The Purple Line

### 1.1 Background

The Bangkok Metropolitan Region, comprising of the Bangkok Metropolitan Administration (BMA) and its five surrounding provinces, accommodated a population of approximately 10.07 million people in 2008 and it was expected that this population would continuously increase in the future. The number of registered motor vehicles in the Bangkok Metropolitan Region rose by about 1.4 times in a 10-year period from 4.02 million in 1998 to 5.72 million in 2007. Along with the economic recovery of Thailand after the Asian Financial Crisis, industrial activity in urban areas was revitalized, and traffic congestion in the Bangkok Metropolitan Region worsened as the transportation system heavily relied on automobiles. Moreover, air pollution caused by gas emissions from motor vehicles was recognized as a critical environmental problem.

As a measure against such urban problems, the development of a mass transit system in the Bangkok Metropolitan Region was planned, and the Skytrain began operation in December 1999 and the MTR Blue Line, the construction of which was assisted by a Japanese ODA Loan, began operation in July 2004. However, both the Skytrain and the Blue Line operated only within the central district of Bangkok, and for only limited distances. Furthermore, the lack of connection to other transportation modes meant that 75% of users of public transportation relied on buses, and thus the response to the transportation demand was limited.

### 1.2 Project Outline

The objectives of this project were to meet the increasing traffic demand and to mitigate traffic congestion in the Bangkok Metropolitan Region by constructing a new mass transit railway line (Purple Line: Bang Sue – Bang Yai section), thereby contributing to urban economic development and environmental improvement such as in air pollution.

Loan Approved Amount/ Disbursed Amount	(I) 62,442 million yen / 62,442 million yen (II) 16,639 million yen / 16,639 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	(I) March 26, 2008 / March 31, 2008 (II) September 28, 2010 / September 28, 2010
Terms and Conditions	Interest Rate 1.4 % (0.01% for Consulting Service) Repayment Period 25 years (Grace Period 7 years) Conditions for Procurement General Untied
Borrower / Executing Agency	Mass Rapid Transit Authority of Thailand (MRTA) / MRTA
Project Completion	August 2016
Main Contractors (Over 1 billion yen)	<ul style="list-style-type: none"> <li>• Contract 1: JV Tokyu Construction Co., Ltd. (Japan) / Ch. Karnchang Public Company Limited (Thai)</li> <li>• Contract 2: Sino-Thai Engineering and Construction Public Co., Ltd. (Thai)</li> <li>• Contract 3: JV Ascon Construction Public Co., Ltd. (Thai) / Ruamnakorn Construction Co., Ltd. (Thai) / Power Line Engineering Public Co., Ltd. (Thai)</li> <li>• Contract 6: Italian-Thai Development Public Company Limited (Thai)</li> </ul>
Main Consultants (Over 100 million yen)	<ul style="list-style-type: none"> <li>• JV D2 Consult Ingenieure ZT-GMBH (Australia) / DB International GMBH (Germany) / Asian Engineering Consultants Corp., Ltd. (Thai) / Thai Engineering Consultants Co., Ltd. (Thai) / Chotichinda Mouchel Consultants Ltd. (Thai) / MAA Consultants Co., Ltd. (Thai) / PCBK International Co., Ltd. (Thai) / 1D2 Group Co., Ltd. (Thai) / Wishakorn Co., Ltd. (Thai) / Wisit Engineering Consultants Co., Ltd. (Thai) / Moh and Associates, Inc. (Taiwan)</li> </ul>
Related Studies (Feasibility Studies, etc.)	<ul style="list-style-type: none"> <li>• Feasibility Study for MRTA Purple Line Project, MRTA, Ministry of Transport (2006)</li> <li>• Special Assistance for Project Formation (SAPROF) for Mass Transit System Project in Bangkok, JBIC (2006)</li> </ul>
Related Projects or Programs	<p><u>JICA</u> [ODA Loan]</p> <ul style="list-style-type: none"> <li>• MRTA Initial System Project (Blue Line) (I) (II) (III) (IV) (V) (1996-2004)</li> <li>• Mass Transit System Project in Bangkok (Red Line) (I) (II) (III) (2008-present)</li> </ul> <p>[Technical Cooperation]</p> <ul style="list-style-type: none"> <li>• Training Program for the Mass Transport System Project in Bangkok (Purple Line and Red Line) (2011-2012)</li> <li>• The Study on Financial Frameworks in Mass Transit System Project in Thailand (Aug. 2010)</li> </ul>

	<p><u>World Bank</u></p> <ul style="list-style-type: none"> <li>• Country Development Partnerships (CDP) (2002-2007)</li> <li>• Strategic Urban Transport Policy Directions for Bangkok (2007-2010)</li> </ul> <p><u>Asian Development Bank</u></p> <ul style="list-style-type: none"> <li>• Promoting PPP in Bangkok Mass Rapid Transit and other infrastructure (2007)</li> <li>• Preparing the Bangkok Mass Rapid Transit Integrated Ticketing Project (2008-2009)</li> </ul>
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## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Keishi Miyazaki, OPMAC Corporation

### 2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: September 2018 – November 2019

Duration of the Field Study: January 7 – January 26, May 26 – June 1, 2019

### 2.3 Constraints during the Evaluation Study

Under the concession agreement with MRTA which is in charge of the development of the Purple Line as well as an owner of the Purple Line, the Bangkok Expressway and Metro Public Company Limited (BEM) is responsible for the operation and maintenance of the Purple Line. However, the data collected from BEM through questionnaires as well as interviews with the key BEM officials during the field study were limited. Instead, MRTA provided information and data on BEM. For this reason, the evaluation of the sustainability of the institutional, technical, and financial capacities of BEM was made based on information obtained through MRTA and from the BEM official website and annual reports.

## 3. Results of the Evaluation (Overall Rating: B<sup>2</sup>)

### 3.1 Relevance (Rating: ③<sup>3</sup>)

#### 3.1.1 Consistency with the Development Plan of Thailand

##### (1) Consistency with the National Development Plan

At the time of the appraisal of Phase I, *the 10th National Economic and Social Development Plan (2007-2011)* had set the enhancement of transport and logistics efficiency and environmental protection as one of the objectives. This included the development of a transport network through the advancement of each transport mode together with connecting roads, the

<sup>2</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>3</sup> ③: High, ②: Fair, ①: Low

promotion of effective transportation to reduce production costs, and the development of an efficient transport network between the Bangkok Metropolitan Region and its vicinities. The *Mass Transit System Investment Plan (2005-2012)* aimed at investment in the development of the seven lines in the Bangkok Metropolitan Region between 2005 and 2012. Based on this investment plan, the construction of three lines, such as the Purple Line between Bang Sue and Bang Yai section, the extension of the Blue Line from Bang Sue to Tha Phra and from Hua Lamphong to Bang Kae section, and the Red Line linking Phaya Thai, Bang Sue and Rangsit was approved by the Cabinet in August 2006.

Furthermore, at the time of the appraisal of Phase II, the *Mass Rapid Transit Master Plan in the Bangkok Metropolitan Region (M-MAP) (2010-2029)* designated eight primary routes, consisting of two commuter rail lines, an airport rail link, and five rapid transit lines (the Blue Line, the Purple Line, the Orange Line, the Dark Green Line and the Light Green Line), as well as five feeder bus lines. These routes, totaling 555.73 km, were to be constructed within a development period of twenty years, 2010-2029.

At the time of the ex-post evaluation, the *12th National Economic and Social Development Plan (2017-2021)* had 10 development strategies. The 7th strategy, the “Promotion of Infrastructure and Logistics,” indicated that the country should accelerate the construction of mass transit city rail projects in order to improve urban public transportation. The *2nd Mass Rapid Transit Master Plan in the Bangkok Metropolitan Region (M-MAP2) (targeting 2037)*, an update of *M-MAP (2010-2029)*, promotes a mass transit development project incorporating comprehensive policies such as improved accessibility to stations, integration with urban development and a higher quality of services, further aiming to support the transformation from the present car-oriented society to a public-transport oriented society. Meanwhile, the *Ministry of Transport’s Strategic Plan (2017-2021)* included strategies such as (i) expanding the coverage and accessibility of the transport service, (ii) improving mobility and connectivity in the transport system and (iii) developing a transport system for the disabled and the elderly as part of its public service obligation in its “Strategic Agenda 1: Development of Inclusive and Green Transport System.”

### 3.1.2 Consistency with the Development Needs of Thailand

At the time of the appraisal of Phase I, it was estimated that the population of the Bangkok Metropolitan Region and in the section along the railway targeted by this project would continuously increase. The section along the railway between Bang Sue station and the Chao Phraya River had an especially high population density, and even in Nonthaburi Province on the west side of the Chao Phraya River, although the population density was not quite so high, population growth had been around 14% for the five years since 2003. Thus, the population density was predicted to snowball, and the development of a highway network had been quickly

progressing including by the previous ODA Loans. Furthermore, it was projected that the areas around the terminal station (Bang Yai station) of the Purple Line would be developed as a commercial area under future urban development plans. Urban development in the wake of population explosion meant a vast number of cars and, as the Bangkok Metropolitan Region had adopted a traffic system heavily reliant on cars, aggravated traffic congestion. Additionally, air pollution from cars became a serious problem and efforts were necessary to reduce the environmental load.

While the population growth in Bangkok had leveled off at the time of the ex-post evaluation contradicting the estimation at the time of appraisal, the number of registered motor vehicles had risen as expected (Table 1). In Nonthaburi Province, both the population and the number of registered motor vehicles had been in an upward trend for the last six years.

Table 1: Population and Number of Registered Vehicles in Bangkok and Nonthaburi Province

Place	Item	2012	2013	2014	2015	2016	2017
Bangkok	Population	5,673,560	5,686,252 (0.22%)	5,692,284 (0.11%)	5,696,409 (0.07%)	5,686,646 (-0.17%)	5,682,415 (-0.07%)
	No. of registered vehicles	7,523,381	8,216,859 (9.22%)	8,651,172 (5.29%)	9,018,594 (4.25%)	9,363,588 (3.83%)	9,778,661 (4.43%)
Nonthaburi Province	Population	149,644	152,323 (1.79%)	155,106 (1.83%)	161,090 (3.86%)	165,544 (2.76%)	166,967 (0.86%)
	No. of registered vehicles	1,141,673	1,156,271 (1.28%)	1,173,870 (1.52%)	1,193,711 (1.69%)	1,211,924 (1.53%)	1,229,735 (1.47%)

Source: National Statistical Office of Thailand, Department of Land, Nonthaburi Province Statistical Office

Note: The figures in parentheses show the growth rate from the previous year.

Additionally, the *Bridge Master Plan 2031 of the Ministry of Transport*<sup>4</sup> predicted that the total volume of traffic crossing the Chao Phraya River would increase from 1.75 million PCU<sup>5</sup>/day in 2011 to 2.03 million PCU/day in 2021, and to 2.36 million PCU/day in 2031 regardless of the implementation of the master plan (Table 2). Thus, the necessity for reducing the volume of motor vehicles as well as the environmental load in the Bangkok Metropolitan Region over the Chao Phraya River remains confirmed.

Table 2: Traffic Volume crossing the Chao Phraya River

Item	2011	2021		2031	
	Baseline	Master Plan Not Conducted	Master Plan Conducted	Master Plan Not Conducted	Master Plan Conducted
Traffic Volume (PCU/day)	1,775,000	2,032,000	2,273,000	2,361,000	2,614,000

Source: Bridge Master Plan 2031, Ministry of Transport

<sup>4</sup> In this master plan, the construction of 10 new bridges is planned, in addition to the existing 22 bridges crossing the Chao Phraya River.

<sup>5</sup> PCU (Passenger Car Unit) represents the “number of vehicles in terms of passenger cars” calculated by converting vehicle units of different types (e.g., trucks, buses, motorcycles) into passenger car units and multiplying the latter by a certain coefficient.

### 3.1.3 Consistency with Japan’s ODA Policy

At the time of the appraisal, *Japan’s Economic Cooperation Program for the Kingdom of Thailand*, revised in May 2006, had the “Enhancement of Competitiveness for Sustainable Growth,” which included improvement in logistic efficiency, as one of its priority areas for assistance. Following the Program, JICA pursued a policy of boosting the facilitation of logistics in order to revitalize economic activities in industries stated in the “Trade Promotion Program.” Also, JICA promoted enhancement of the urban function and improvements in urban problems in the “Program for Improvement of Urban Environment.” Considering that this project aimed at mitigating the traffic congestion and improving the urban environment such as in air pollution in the Bangkok Metropolitan Region, the project was consistent with Japan’s ODA policy at the time of appraisal.

In light of the above, this project has been highly relevant to Thailand’s development plan and development needs, as well as Japan’s ODA policy. Therefore, its relevance is high.

## 3.2 Efficiency (Rating: ②)

### 3.2.1 Project Outputs

The project was executed mostly as planned (Table 3). The project was implemented under a Public Private Partnership (PPP) scheme contracted between MRTA and Bangkok Expressway and Metro Public Company Limited (BEM). The project components of civil works, depot works, track works and consulting services were financed by the Japanese ODA Loan, and other components such as the procurement of rolling stock and mechanical and electrical (M&E) works were implemented by BEM.

Table 3: Project Output (Plan/Actual)

Item	Plan <sup>(Note 1)</sup>	Actual
1. Civil Works <sup>(Note 2)</sup>	<ul style="list-style-type: none"> <li>• Elevated Structures from Ban Sue to Bang Yai: 23 km</li> <li>• 16 Stations</li> <li>• Transmission Structure at Bang Sue Station</li> <li>• 1 Bridge (Phra Nang Klao Bridge)</li> </ul>	<p>The total length: 24 km (Details of the Elevated Structures)</p> <ul style="list-style-type: none"> <li>• Purple Line: 23 km from Tao Poon Station to Khlong Bang Phai Station</li> <li>• Blue Line extension: 1 km from Tao Poon Station to Bang Sue Station</li> </ul>
2. Depot Works <sup>(Note 2)</sup>	<ul style="list-style-type: none"> <li>• 1 Depot in Bang Yai Station</li> <li>• 4 Park &amp; Ride Building (1 in Depot)</li> </ul>	Same as planned
3. Track Works <sup>(Note 2)</sup>	<ul style="list-style-type: none"> <li>• 46 km in main line</li> <li>• 18 km in Depot</li> </ul>	Same as planned
4. Procurement of Rolling Stock <sup>(Note 3)</sup>	72 cars	63 cars
5. Mechanical and Electrical (M&E) Works <sup>(Note 3)</sup>	<ul style="list-style-type: none"> <li>• Signal and Train Control</li> <li>• Communications</li> <li>• Automatic Fare Collection System</li> <li>• Platform Screen Doors</li> <li>• Depot Workshop Equipment</li> </ul>	Same as planned

Item	Plan (Note 1)	Actual
6. Consulting Services (Note 2)	<ul style="list-style-type: none"> <li>Project Design Review</li> <li>Project Management and Coordination</li> <li>Supervision for Civil Works and M&amp;E Works</li> <li>Assistance in selection of M&amp;E Works, Contractors and Operators</li> <li>Quality Assurance and Quality Control, etc.</li> </ul>	Same as planned
	<u>Work volume</u> - International expert: 1,103 M/M - Local expert: 3,245 M/M - Supporting staff: 1,944 M/M	<u>Work volume</u> - International expert: 558 M/M - Local expert: 2,743 M/M - Supporting staff: 11,083 M/M

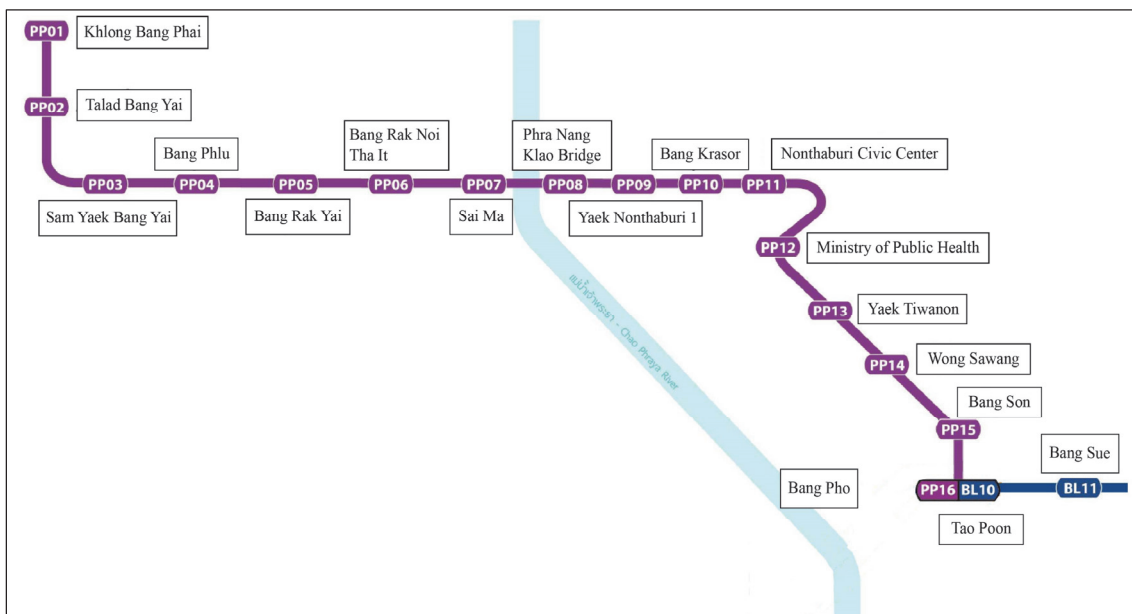
Source: JICA internal documents, MRTA

Note 1: This ex-post evaluation refers to the planned outputs of Phase II.

Note 2: Financed by the Japanese ODA Loan.

Note 3: Financed by the PPP.

A slight reduction (from 72 to 63) was seen in the number of procured train cars. According to MRTA, this was due to a modification in the passenger demand forecast for the Purple Line made during project implementation. There were also differences in the work volume of the consulting services. Due to changes in the demarcation and scope of the responsibilities of international experts, local experts and supporting staff during the project, the work of experts/staff was reallocated between each other. For example, it was initially planned that international experts would cover all the main consulting service tasks, but in the end their scope was limited only to supervision of M&E works. This reallocation was conducted within the plan. The above two changes did not in any way affect the quality of service or the realization of the project outputs.



Source: BEM

Figure 1: Route Map of the Purple Line



## Project Outputs



### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The actual project cost was 212,455 million yen against the planned cost of 212,536 million yen, which was within the plan (ratio against the plan: almost 100%) (Table 4). At the beginning of the project, the cost of M&E works for a 1 km section from Bang Sue Station to Tao Poon Station (an extension of the Blue Line) was included in the project cost, but during the project, these M&E works were officially transferred to the Blue Line extension project, and this cost was therefore completely taken out from the accounts of this project in MRTA. For this reason, this ex-post evaluation compares the modified plan with the actual project cost, subtracting the cost of the M&E works from the original plan.

Table 4: Project Cost (Plan/Actual)

Unit: Million Yen

Item	Original Plan (At Phase I Appraisal)	Modified Plan	Actual
1. Civil Works and Procurement			
a) Civil Works Section 1	39,252	39,252	43,932
b) Civil Works Section 2	36,025	36,025	40,791
c) Depot	13,819	13,819	15,443
d) M&E Works, Rolling Stock	35,310	35,310	45,931
e) M&E Works (Bang Sue-Tao Poon)	1,706	0	0
f) Track	8,934	8,934	10,083
g) Price Escalation	15,356	15,356	12,689
h) Physical Contingencies	7,327	7,32	0
Sub total	157,729	156,023	168,869
2. Consulting Services	5,283	5,283	4,590
3. Land Acquisition	25,920	25,920	24,854
4. Administration	9,447	9,447	1,116
5. VAT	3,241	3,241	5,441
6. Import TAX	3,182	3,182	0
7. Interest	8,561	8,561	7,330
8. Commitment Charge	879	879	255
Total	214,242	212,536	212,455

Source: JICA internal documents, MRTA

Note 1: The exchange rates used: 1 Baht = 2.75 Yen (February 2010) at the time of the appraisal and 1 Baht = 2.98 Yen (the average from 2008 to 2016) at the time of the ex-post evaluation.

Note 2: As the actual project cost was calculated based on the project cost provided in the PCR which was denominated in the local currency, some cost items do not necessarily match the actual disbursed costs in Japanese yen due to the exchange rates.

### 3.2.2.2 Project Period

The actual project period was 101 months (from March 2008 to August 2016) against a planned project period of 70 months (from March 2008 to August 2014), which exceeded the plan (ratio against the plan: 144%) (Table 5).

Table 5: Project Period (Plan/Actual)

Item	Plan <sup>Note 1</sup>	Actual
1. Signing of L/A	March 2008	March 2008
2. Land Acquisition and resettlement	Jan. 2007 – Aug. 2010 (44 months)	Dec. 2009 – Dec. 2010 (13 months)
3. Selection of Consultant	Jan. 2008 – Jan. 2010 (25 months)	Apr. 2009 – Mar. 2010 (12 months)
4. Consulting Services	Jan. 2010 – Aug. 2014 (65 months)	Apr. 2010 – Jan. 2015 (58 months)
5. M&E Works	Nov. 2010 – Aug. 2014 (46 months)	Feb. 2014 – Aug. 2016 (31 months)
6. Procurement of main contractors	Apr. 2008 – Dec. 2010 (33 months)	Apr. 2008 – Oct. 2012 (55 months)
- Selection of Contractor 1, 2 and 3	Apr. 2008 – Jan. 2010 (22 months)	Apr. – Feb. 2010 (23 months)
- Selection of Contractor 6	Apr. 2010 – Dec. 2010 (9 months)	Feb. 2010 – Oct. 2012 (33 months)
7. Civil Works	Dec. 2009 – Jan. 2014 (50 months)	Nov. 2009 – Nov. 2015 (73 months)
- Construction (Contractor 1, 2 and 3)	Dec. 2009 – Sep. 2013 (46 months)	Nov. 2009 – June 2015 (68 months)
- Construction (Contractor 6)	Jan. 2011 – Jan. 2014 (37 months)	Nov. 2012 – Sep. 2015 (35 months)
8. Warranty Periods	Jan. 2014 – Apr 2016 (28 months)	Aug. 2016 – July. 2018 (24 months)
9. Project Completion <sup>Note 2</sup>	August 2014	August 2016

Source: JICA internal documents, MRTA internal documents.

Note 1: This ex-post evaluation refers the planned project period of Phase II.

Note 2: The definition of project completion is the commencement of operation of the Purple Line.

Various factors for the 31 months delay were identified. Among these, internal factors are considered to have been the cause of most of the delays. For instance, the delay in the selection of main contractors retarded the commencement of civil works. Moreover, the selection of operators under the PPP scheme was delayed by 40 months. These factors caused the postponement of the start of M&E works and resulted in a delay of almost 2 years in project completion. Apart from these internal factors, external factors, such as the emergency decree for a coup in 2014, the occurrence of the flood disaster in 2011 which caused massive damage to the Chao Phraya River Basin, and a temporary lack of workers due to the 300 baht Minimum Wage Policy in 2012-2013,<sup>6</sup> also suspended the progress of this project. However, these influences were limited to several months.

### 3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

#### (1) Financial Internal Rate of Return (FIRR)

The FIRR was estimated as -2.78% for Phase I. No estimation had been made for Phase II at the time of appraisal. The preconditions for the calculation of FIRR are shown in Table 6. As the detailed information on the calculation of original FIRR was not available, the recalculation of FIRR was not able to carry out by this ex-post evaluation.

<sup>6</sup> Execution of the 300 Baht Minimum Wage Policy eliminated the wage difference between urban areas and rural areas, and migrant workers from rural areas returned home, temporally causing a shortage of labor for civil works.

Table 6: FIRR at the Time of the Appraisal of this Project

Item	Description
Financial Internal Rate of Return (FIRR)	-2.78%
Cost	Project Cost, Operation and Maintenance Cost
Benefits	Income from passengers, income from other resources
Project Life	30 years

Source: JICA internal documents

## (2) Economic Internal Rate of Return (EIRR)

The EIRR was estimated as 13.2% at the time of the Phase I appraisal and as 12.7% at the time of the Phase II appraisal. The preconditions for the calculation of the EIRR are shown in Table 7. The recalculation of EIRR was conducted at the time of the ex-post evaluation by redefining the project life starts from the signing of the loan agreement, and the result was -0.25%.<sup>7</sup> This was because the actual ridership was lower than the estimation, and also the period after project completion would be shorter in the project life and the benefits scaled down due to the prolonged project implementation period.

Table 7: EIRR at the Time of the Appraisal of this Project

Item	Description
Economic Internal Rate of Return (EIRR)	13.2% (at Phase I Appraisal) / 12.7% (at Phase II Appraisal)
Cost	Project Cost (except VAT), Operation and Maintenance Cost
Benefits	Effect of savings in running costs, effect of savings in running time
Project Life	30 years

Source: JICA internal documents

Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

## 3.3 Effectiveness and Impacts<sup>8</sup> (Rating: ②)

### 3.3.1 Effectiveness

#### 3.3.1.1 Quantitative Effects

Regarding the operation and effect indicators, the maximum speed achieved its target value. The degree of achievement of other indicators, such as operating rate, running distance, and number of running trains, ranged from 54% to 62% in 2018 which meant a partial achievement of the respective target values. However, the actual values for ridership and income from passengers in 2018 were far below the target values (Table 8).

<sup>7</sup> The recalculation of EIRR was made in the ex-post evaluation report on the MRTA Chalong Ratchadham Line Project (MRTA Purple Line, Bang Yai - Bang Sue Section) of the Mass Transit Authority of Thailand (MRTA) (2018) conducted by PDMO. This ex-post evaluation refers to the data and information used for the above EIRR recalculation.

<sup>8</sup> Sub-rating for Effectiveness is to be put with consideration of Impacts.

Table 8: Operation and Effect Indicator

Indicator	Baseline	Target	Actual		
	2008	2016	2016 (Note 1)	2017	2018 (Note 2)
		2 years after completion	Completion year	1 year after completion	2 years after completion
<b>Operation Indicator</b>					
a) Operating Rate (%/year)	—	92	57	57	57 (62%)
b) Running Distance (1,000 km/day)	—	31.7	16.8	16.8	16.8 (58%)
c) Number of running trains (runs/day)	—	246	134	134	134 (54%)
d) Volume of passenger transport (passenger-km/day)	—	1,816,546	N.A.	N.A.	N.A.
e) Ridership (No. of passengers/day) (Note3)	—	220,116	20,773	31,942	48,386 (24%)
f) Maximum Speed (km/hour)	—	80	80	80	80 (100%)
<b>Effect Indicator</b>					
g) Income from passengers (million baht/day) (Note 4)	—	6.49	0.46	0.52	0.99 (15%)

Source: Ex-Ante Evaluation (II), JICA internal documents, MRTA

Note 1: Duration of the 2016 data is from August to December.

Note 2: Duration of the 2018 data is from January to November.

Note 3: Ridership is added as a proxy indicator of the volume of passenger transport.

Note 4: The formula to calculate "Income from passengers" is the total annual income divided by the total operation days. It should be noted that as the Purple Line started operation from August 2016, the time-coverage for the income in 2016 was the 148 days from August to December that year.

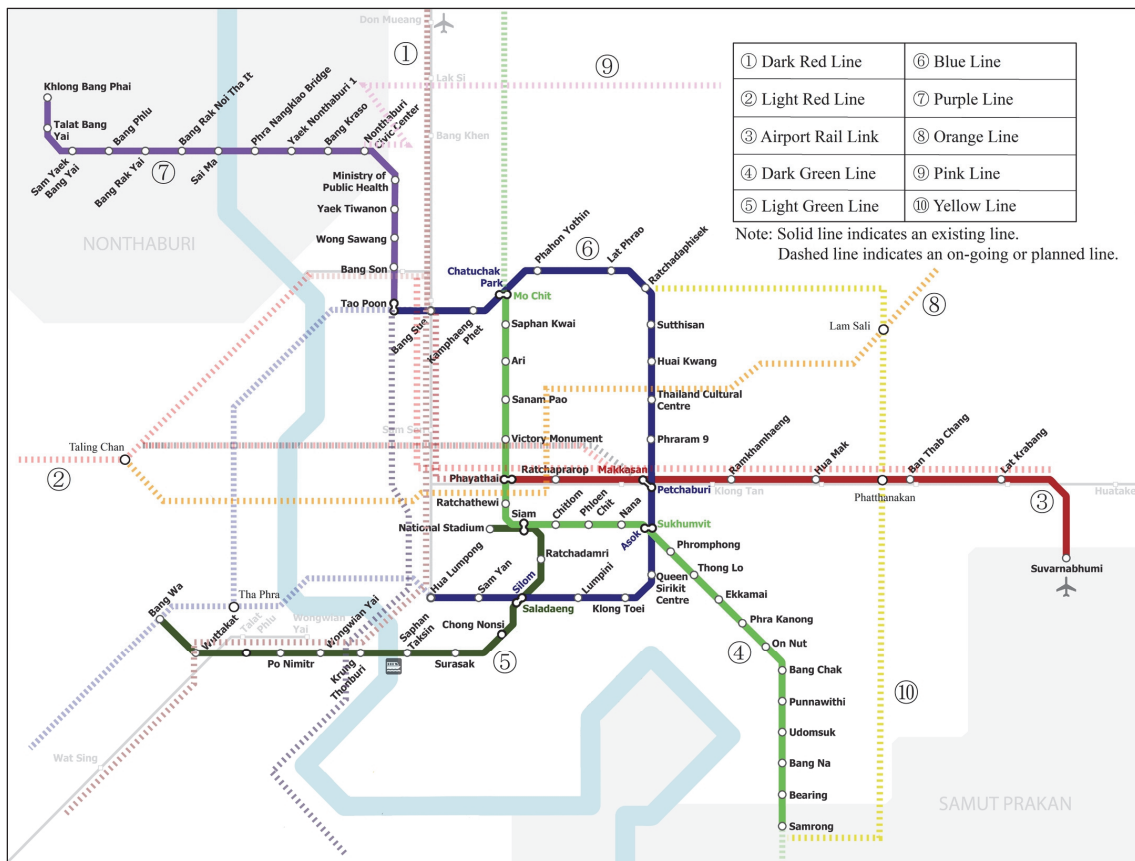
Note 5: The figures in brackets to the right of the 2018 actual values of indicators are the target achievement rate.

The underlying reason why some of the indicators were partially achieved or not achieved is the low ridership. Basically, the target figure for each indicator was created based on the estimated ridership at the stage of project formulation. This means that unless the estimated ridership was met, it was highly unlikely that the indicators would be achieved. The following factors behind why the actual ridership was substantially lower than the target were identified through the ex-post evaluation. First of all, the target total number of passengers was estimated assuming that the entire stretch of the planned four lines of the Bangkok Mass Transit System (MRT) (the Blue Line, the Red Line and the Dark Green Line) would be in operation by the completion of the Purple Line. At the time of the ex-post evaluation, some of the MRT line projects - the Red Line, the extension part of the Blue Line, and the extension part of the Dark Green Line - were still under construction. The ridership on each line tends to be affected by the extent of development of the entire mass transit system as well by connectivity. Secondly, although the target total number of passengers was estimated based on the population of the areas along the Purple Line in Bangkok and Nonthaburi Province, not all of the population were necessarily actual users of the Purple Line. According to interviews with officials of the Office of Transport and Traffic Policy and Planning (OTP) of the Ministry of Transport, potential demand should have been based on the number of potential users,<sup>9</sup> not on the population itself. As for the third reason, fares (ticket prices) for the Purple Line could be high.

<sup>9</sup> A number of potential users can be calculated by multiplying population by a reasonable rate considering a demand generated by the construction of an infrastructure.

Related agencies and local business owners reported in interviews that the fare was relatively higher compared to conventional means of transport such as buses and mini-vans. Finally, the feeder bus network between the Purple Line stations and residential areas was still underdeveloped.

Although MRTA and other related agencies have been trying to resolve some of the above problems, decisive resolutions have not yet been reached.



Source: prepared by the evaluator referring to the graph on Wikipedia

Figure 2: 10 Routes of Mass Rapid Transit Network

<Additional Indicators>

In addition to the operation and effect indicators set by the project, the ex-post evaluation examined the service quality of the operation of the Purple Line using the additional indicators shown in Table 9. They were set by MRTA in order to monitor the performance of BEM for their operation. All indicators, such as the number of trains in operation, the frequency of train operations and service delays, fully met their respective targets. Also, no serious accidents have happened so far. Therefore, it is considered that the service quality of the Purple Line has been maintained at a satisfactory level.

Table 9: Additional Indicators

Indicator	Baseline	Target	Actual		
	2008	2016	2016	2017	2018
		2 Years after completion	Completion year	1 year after completion	2 years after completion
<b>Number of trains in operation</b>					
a) Peak hours (No. of trains/hour)	—	12	12	12	12
b) Off-peak hours (No. of trains/hour)	—	8	8	8	8
c) Total no. of trains in operation (No. of trains in operation/day)	—	16 (Note)	16	16	16
<b>Frequency of train operation</b>					
a) Peak hours (minutes/one train in operation)	—	6	6	6	6
b) Off-peak hours (minutes/one train in operation)	—	9.33	9.30	9.30	9.30
<b>Service delays</b>					
a) Rate of delays of 2 minutes or more (%)	—	1.0	0.92	0.21	0.12

Source: JICA internal documents, MRTA.

Note: 12 for service and 4 for spare.

### 3.3.1.2 Qualitative Effects (Other Effects)

#### (1) To meet a growing transportation demand

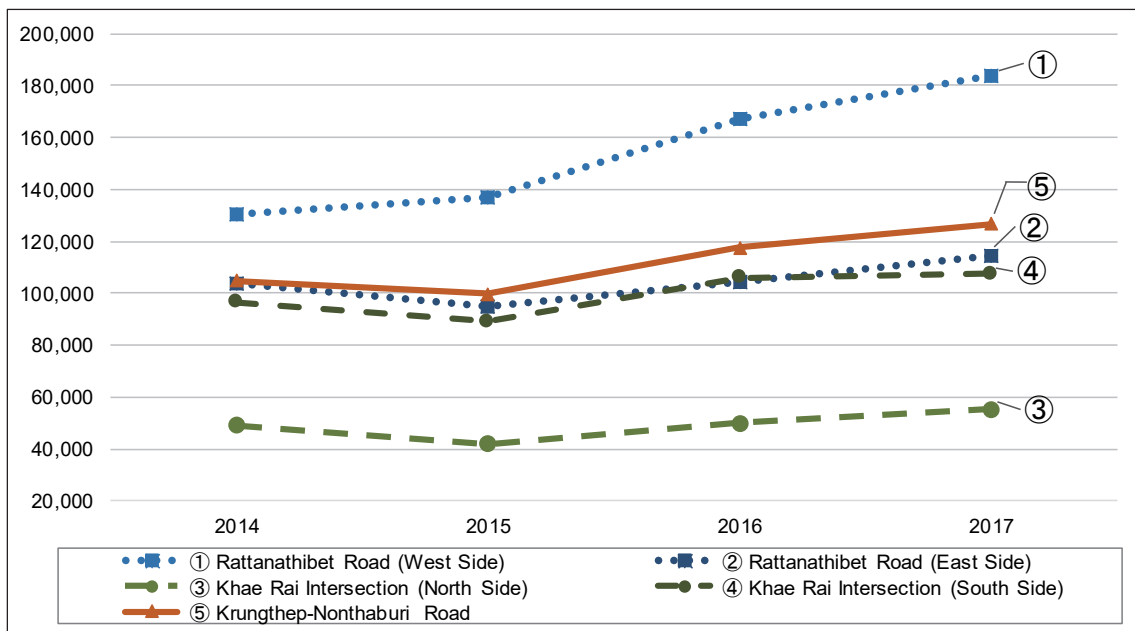
As mentioned in “3.1.2 Consistency with the Development Needs of Thailand,” the transportation demand in the Bangkok Metropolitan Region including Nonthaburi Province had grown. Taking into account the current situation that the ridership of the Purple Line is still not satisfactory and that the development of the mass transit system is still on-going, it can be concluded that the project effect of meeting a growing transportation demand was limited at the time of ex-post evaluation.

#### (2) Alleviation of traffic congestion

At the time of appraisal, it was estimated that the project would result in a reduction of approximately 5,600 vehicles per a day, based on the preliminary calculation in *the study for the evaluation of environmental improvement effects by the Japanese ODA Loan (2006)* prepared by JICA. In the ex-post evaluation, an attempt was made to recalculate the reduced number of vehicles utilizing the same calculation model. However, the above-mentioned JICA’s study report was not available. Therefore, this ex-post evaluation tried to verify to what extent the project contributed to alleviating traffic congestion in the surrounding areas of the Purple Line using other means.

This project constructed four Park & Rides (parking facilities) next to 4 stations such as Yaek Nonthaburi 1 station, Bang Rak Noi Tha It station, Sam Yaek Bang Yai station, and Khlong Bang Phai station. Data on usage of the Park & Rides provided by MRTA indicated that a total of 946 cars a day were parked in December 2018. Additionally, according to an interview with

the representatives of the Mini-Van Operators Club,<sup>10</sup> although they had had 31 mini-vans in operation in the area along the Purple Line, this was reduced to 24 mini-vans after the opening of the Purple Line. Considering this, it may be assumed that there had been a reduction of at least approximately 1,000 cars in use per day at the time of the ex-post evaluation. On the other hand, according to the traffic data on the major roads along the Purple Line (Figure 3), although the data covers only up to 2017, just one year after the opening of the Purple Line, traffic volume between 2016 and 2017 seems not to have been reduced.



Source: Department of Highway

Note 1: Rattathibet Road (West Side) is a 7 km road west of the Phra Nangklao Bridge over the Chao Phraya River.

Note 2: Rattathibet Road (East Side) is a 7.5 km road east of the Phra Nangklao Bridge over the Chao Phraya River.

Note 3: Khae Rai Intersection (North Side) means a 5.5 km road north of Khae Rai Intersection.

Note 4: Khae Rai Intersection (South Side) means a 3.6 km road south of Khae Rai Intersection and a 2.7 km road south-east of an intersection located 3.6 km south of Khae Rai Intersection.

Note 5: Krungthep-Nonthaburi Road means a 500 m road west of Yaek Tiwanon station and a 1 km road east of the station.

Figure 3: Traffic Data on the Roads along the Purple Line and its Location

Furthermore, in interviews with the Nonthaburi provincial government, the Bangkok Mass Transit Authority (BMTA),<sup>11</sup> and 10 local business owners in Nonthaburi Province, there were some reports that traffic congestion had improved thanks to the Purple Line. However, a majority of respondents said that it had not improved or had even become worse. The following reasons why the traffic situation is considered to have become worse were given: (i) real estate development, (ii) commercial development, and (iii) reduction in the number of lanes on the

<sup>10</sup> The Mini-Van Operators Club is a voluntary association with a membership of approximately 5,000 of mini-van operators (both corporate and individual). The target operation areas of the club members are three provinces near Bangkok city, Nonthaburi, Pathum Thani, and Samut Prakan.

<sup>11</sup> A public bus company under the Bangkok Metropolitan Administration (BMA).

main roads along the Purple Line because the elevated tracks of the Purple Line occupied two lanes in the center of the roads.

To sum up, although some progress in the modal shift from conventional transport means to railways has been observed in Nonthaburi Province since the opening of the Purple Line, the contribution of this project to the alleviation of traffic congestion in the target area was considered to have been limited at the time of the ex-post evaluation.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

##### (1) Development of the regional economy

###### a) Real estate development

The areas along the Purple Line in Nonthaburi Province used to be mainly farmland, but real estate development began just before the opening of the Purple Line. According to the Land Department of the Nonthaburi Provincial Government, 23-25 condominiums in total were constructed near Purple Line stations before and after the operation of the Purple Line. Furthermore, as the convenience of going to Bangkok city from Nonthaburi Province has improved due to the completion of the Purple Line, and because land and house prices in Nonthaburi Province are relatively cheap in comparison to Bangkok city, Bangkok city residents have gradually started to move to and live in Nonthaburi Province.<sup>12</sup>

###### b) Commercial development

In parallel with the construction of the Purple Line, a mega shopping mall named the Central Plaza Westgate was built and opened next to Talad Bang Yai station. It is the biggest shopping mall in the north-west part of the Bangkok Metropolitan Region, and at weekends it is bustling with many customers. In addition, some of the local business owners interviewed reported that the Purple Line has brought more customers to them.

There were some examples raised by local business owners near the Purple Line having indirectly had a negative impact on local businesses. For example, due to the opening of the Central Plaza Westgate, adjacent supermarkets apparently lost 25% of their customers and 10% of their revenues. Another stakeholder, the Mini-Vans Operators Club, mentioned that their customers had started to use the Purple Line instead of mini-vans, reducing their customers and revenues by around 50% compared to before the commencement of the Purple Line's operation.

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<sup>12</sup> On the other hand, there is a case found that the rapid development of condominiums and apartments in the area induced speculation on land and condominiums, leading to a hike in land prices and the cost of the estates. As a result, the price appears to have become unaffordable for local people, and this has also resulted in an oversupply of houses.



## (2) Improvement of the urban environment (air pollution)

As mentioned earlier, even though the traffic volume on the roads along and/or around the Purple Line continued to increase even after the opening of the Purple Line, approximately 1,000 cars in a day are parked at the Park & Rides constructed by the project, and the number of daily mini-van operations has dropped from 31 mini-vans to 24 mini-vans. Additionally, a customer satisfaction survey conducted by MRTA found that some of the passengers of the Purple Line use their cars and park them in Purple Line parking areas.

In summary, the Purple Line has likely contributed to improving the environment with the reduction of a daily amount of CO<sub>2</sub> emission equal to at least around the 1,000 cars that were traveling between Nonthaburi and Bangkok. However, the constantly increasing volume of traffic in the Bangkok Metropolitan Region may offset this positive effect.

### 3.3.2.2 Other Positive and Negative Impacts

#### (1) Impacts on the Natural Environment

This project was classified as Category A based on *the JBIC Guidelines for the Confirmation of Environmental and Social Consideration (April 2002)* as it fell into the railway sector and accompanied sensitive characteristics. The Environmental Impact Assessment (EIA) was made and approved by the National Environment Board (NEB) in January 2002 for the section between Bang Sue and Phra Nan Klao Bridge and in February 2007 for the section between Phra Nan Klao Bridge and Bang Yai. The areas to be targeted by the Project did not include areas such as national parks and their surrounding areas, and it was expected that an undesirable impact on the natural environment would be minimal.

During project implementation, an environmental quality monitoring report was submitted to MRTA by the contractors according to the approved EIA and the related Thai environmental laws. The consultants appointed by MRTA monitored whether or not the environmental parameters were within the environmental standards set in the EIA, and where necessary, environmental mitigation measures were taken during construction. The external evaluator of this ex-post evaluation reviewed the monitoring reports and confirmed that the environmental parameters basically met the environmental standards.

Even after project completion, environmental monitoring has continued to be carried out twice a year by the consultant employed by BEM using the same environmental standards set in the EIA, and its results are reported to MRTA. According to the latest environmental monitoring report (January to June 2018) available at the time of ex-post evaluation, some of the environmental parameters such as in noise level and the quality of surface water were observed to have been slightly exceeded due to external factors such as heavy traffic and wastewater produced by local residents. However, in general, no negative environmental impact in the surrounding area has been reported.

## (2) Resettlement and Land Acquisition

In the project, 38.9 ha of land was acquired, and 711 households were targeted for land acquisition. The compensation for the land acquisition to the target 711 households was undertaken according to the Resettlement Action Plan, in which only financial compensation was applied. Other programs, such as income restoration programs, were not provided. Items for compensation included land, buildings, agricultural products, moving costs, and loss of employment. This compensation was made in compliance with the related laws and regulations of Thailand such as the *Immovable Property Expropriation Act B.E.2530 (1987)*, the *Act on the provision of immovable property for mass transit activity B.E.2540*, and the *Compensation handbook of the Ministry of Transport*. According to MRTA, there have been no major problems associated with the compensation process.

After the land acquisition, a list was made of the information on the target residents including name, telephone number and previous address, and MRTA conducted some phone interviews to check their current status. According to MRTA, no unsettled cases was observed.

## (3) Measures for infectious diseases including HIV/AIDS

During the Project implementation, HIV/AIDS prevention programs, including HIV/AIDS training and surveys about workers' understanding of HIV/ AIDS, etc., were conducted in collaboration with local NGOs (Table 10).

Table 10: HIV/AIDS Prevention Program

Activity	Targets
HIV/AIDS training	All workers
Installment of condom boxes at worker houses	All workers
Installment of boards to educate about HIV/AIDS	All workers
Survey on workers' understanding of HIV/AIDS	20% of all workers

Source: MRTA

## (4) Consideration for Individuals with disabilities

The universal design was introduced into the Purple Line through the installation of detectable warning tiles, parking spaces, ramps, passenger elevators, disabled toilets, emergency call bells, signage, and platform screen doors according to the *Persons with Disabilities Empowerment Act, B.E. 2550 (2007)* and the *American Disability Act* as planned. During project implementation, MRTA invited members of organizations for the physically handicapped to the project site in order to confirm whether or not the designs met their needs. According to MRTA, the level of Universal Design introduced into the Purple Line is superior to that of the Blue Line, and they consider the Purple Line to be equipped with the most advanced facilities of universal design. Therefore, it is confirmed that the universal design introduced by this project met the international standards.

However, in an interview, the Association of the Physically Handicapped of Thailand, a local non-profit organization for supporting physically handicapped individuals in Nonthaburi

Province, pointed out the necessity for further improvement such as (i) the installation of an elevator at every exit of a station, (ii) the improvement of unpaved sidewalks and the removal of obstacles such as signboards near exits of stations,<sup>13</sup> and (iii) an increase in the number of temporary parking spaces in front of the exits of stations for boarding and alighting.<sup>14</sup>

#### Facilities with Universal Design introduced by the Project



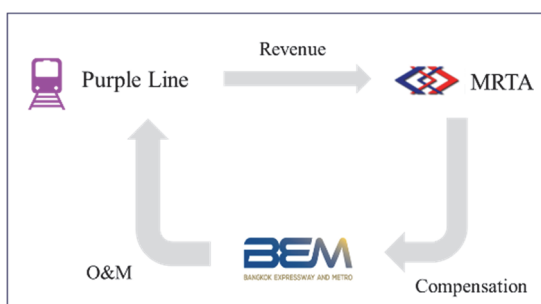
As stated above, this project has achieved its objectives to some extent. Therefore, the effectiveness and impacts of the project are fair.

### 3.4 Sustainability (Rating: ③)

#### 3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

##### PPP Gross Cost Scheme

The Purple Line adopts a PPP Gross Cost scheme, under which the operation and maintenance (O&M) are delegated to BEM under a 30 years concessional agreement with MRTA. In the agreement, the terms and conditions, including the contract period, the amount of remuneration for O&M, and the responsibilities of both BEM and MRTA are written, and MRTA's basic responsibility is to supervise the O&M



Source: The figure was created by the evaluator.

Figure 4: Concept of PPP Gross Cost Scheme for the Purple Line

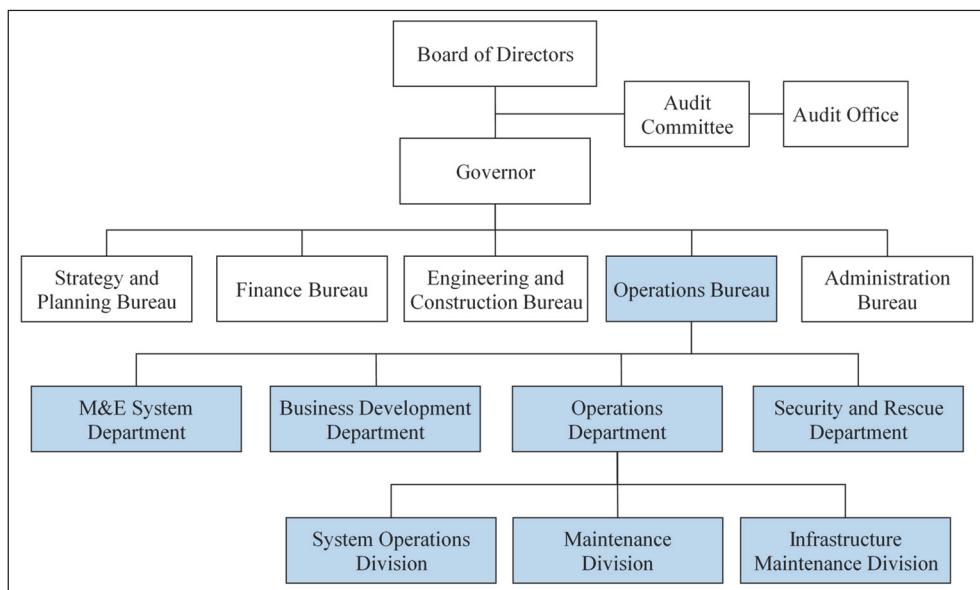
undertaken by BEM. Under the Gross Cost Scheme, all revenues from the Purple Line train fares come to MRTA, and MRTA pays BEM the remuneration for the O&M regardless of the amount of revenue from the Purple Line. Thus, the ridership risk (the risk of loss occurring when the actual number of riders is less than anticipated) on the Purple Line is to be taken by MRTA (Figure 4).

<sup>13</sup> In general, the scope of responsibility of MRTA is limited to station facilities up to the exit areas while the local government is responsible for the development and maintenance of sidewalks.

<sup>14</sup> MRTA was being indicted by the Association of the Physically Handicapped of Thailand for further improvement of station facilities to fulfill their needs.

<MRTA>

As a project owner and supervising agency of the Purple Line, MRTA regularly monitors and evaluates the performance of BEM by setting a number of key performance indicators such as train service availability, train service punctuality, graffiti removal and lighting. The Operation Department has 80 staff members and consists of (i) a System Operation Division, (ii) a Maintenance Division for train cars, (iii) an Infrastructure Maintenance Division for stations. MRTA is currently requesting that the Human Resource Department hires more recruits to make up for a lack of staff. The organigram of MRTA is shown in Figure 5.

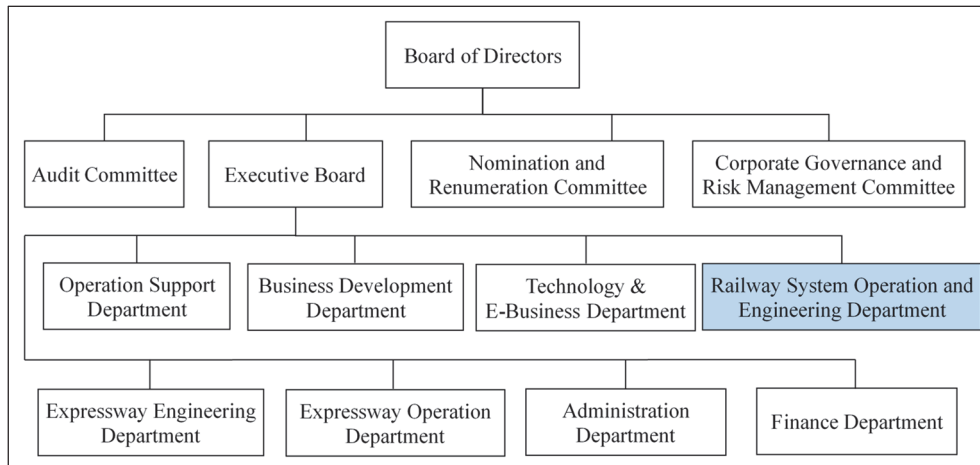


Source: MRTA

Figure 5: Organigram of MRTA

<BEM>

BEM takes responsibility for the O&M of the Purple Line and has experience in operating and maintaining a railway through the Blue Line. BEM was established in 2015 by the merger of the Bangkok Metro Public Company Limited and the Bangkok Expressway Public Company Limited. The businesses provide expressway and metro services, including commercial development relating to expressway systems and the metro. Nine hundred and eighteen staff are allocated to the Railway System Operation and Engineering Department. BEM also seems to be facing a lack of staff members, but have been recruiting engineers every month (250 engineers were being recruited as of 10th January 2019). It is planned that staff numbers will be brought up to a satisfactory level. The organigram of BEM is shown in Figure 6.



Source: BEM

Figure 6: Organigram of BEM

Although there seems a limitation in staff numbers in both MRTA and BEM, the Purple Line has been operated and maintained without major problems so far. MRTA and BEM have continuously endeavored to recruit more engineers and/or technicians. Therefore, no major problem has been observed in the institutional aspect of the operation and maintenance system.

### 3.4.2 Technical Aspect of Operation and Maintenance

#### <MRTA>

According to MRTA, of 80 staff allocated to the Operation Department, many are engineers or technicians with the academic background of a graduate of an university or a vocational training school. In addition, the engineers are obliged to receive regular training provided by BEM<sup>15</sup> as follows: (i) general safety (once a year), (ii) normal operations (once a year), and (iii) rules and regulations (twice a year). In parallel with this Project, the JICA technical cooperation “Training Program for the Mass Transport System Project in Bangkok (Purple Line and Red Line) (2011-2012)” was conducted with MRTA for the acquisition of the necessary knowledge and skills for appropriate O&M of the Purple Line. A member of MRTA staff who participated in the technical cooperation said that he was able to apply what he learned in the training to his work, and most of the participants still remain in MRTA.

#### <BEM>

Many of the BEM staff are engineers or technicians. BEM has experience in operating and maintaining a railway as they have operated the Blue Line since 2004. BEM has an in-house training center and provides training programs tailored for each type of job. These include

<sup>15</sup> The provision of training programs for MRTA employees is one of the responsibilities stipulated in the concessional contract.

training programs for station controllers (4 months), line/depot controllers (10 months), and engineering controllers (8 months). Each training program consists of approximately 40 modules covering basic and technical subjects for the respective fields.<sup>16</sup> In addition, BEM staff receive regular training provided with MRTA. Meanwhile, the maintenance of rolling stock, M&E systems, and other facilities at sites are subcontracted to private contractors, including the Japanese contractors who supplied the rolling stock and M&E systems. The technical levels of the maintenance contractors are satisfactory thanks to their experience.

No major issues have been observed in terms of the technical aspect of the O&M of the Purple Line.

### 3.4.3 Financial Aspect of Operation and Maintenance

<MRTA>

Under the PPP Gross Cost scheme, MRTA takes responsibility for the revenue from the Purple Line. Purple Line fares range from 14 to 42 baht for adults and half of these for children and the elderly, depending on distance. Table 11 shows the revenues and expenses of the Purple Line.

Table 11: Revenues and Expenses of the Purple Line

Unit: Million Baht				
Item	2015	2016	2017	2018
<b>Revenue</b>				
1. Revenue from concessions (fares, card issuing fees)	0.00	28.49	158.45	332.20
2. Revenue from commercial developments (Park & Rides, etc.)	0.00	1.53	21.75	29.94
<b>Total Revenue</b>	<b>0.00</b>	<b>30.02</b>	<b>180.20</b>	<b>362.14</b>
<b>Expense</b>				
1. Operating expenses for the Purple Line (except personnel expenses)	0.00	346.08	2,100.71	2,028.87
<b>Profit (Loss) for the year</b>	<b>0.00</b>	<b>(316.06)</b>	<b>(1,920.51)</b>	<b>(1,666.73)</b>

Source: MRTA

The revenues have not fully covered expenses, as ridership has remained far below target and income generation through commercial development at Purple Line stations has yet to progress satisfactorily. As ridership has gradually been increasing and as MRTA already plans to take measures to increase ridership such as a fare discount programs including monthly train passes for commuters, discount fares for the elderly, etc., it can be expected that the gap between revenues and expenses will gradually disappear as time passes.

Looking at the overall financial statements of MRTA, it can be seen that revenue has topped expenses since 2017, which in total covers the surplus expense of the Purple Line (Table 12). This implies that MRTA should be financially able to continue to operate and maintain the Purple Line in the future.

<sup>16</sup> No training is provided for chief controllers, as they already have previous experience as line/depot controllers is required.

Table 12: Profit and Loss Statement of MRTA

Unit: Million Baht

Item	2015	2016	2017	2018
<b>Revenue</b>				
1. Revenue from subsidies (for projects involving assets)	2,335.30	2,691.97	4,206.90	3,959.39
2. Revenue from subsidies (for operations)	2,196.85	2,291.97	4,861.01	4,687.74
3. Revenue from concessions	1,017.59	1,110.07	2,327.63	3,632.32
4. Revenue from commercial development	154.94	203.54	198.43	172.14
5. Revenue from non-current assets held for transfer	0.00	0.00	192.23	415.39
6. Gain on foreign exchange rates	(518.07)	(2952.24)	3,353.57	710.76
7. Share of profits from investments under equity methods	0.00	345.77	238.14	596.30
8. Other Revenue	50.86	87.42	57.49	79.66
<b>Total Revenue</b>	<b>5,237.47</b>	<b>3,778.50</b>	<b>15,435.40</b>	<b>14,253.70</b>
<b>Expense</b>				
1. Expenses related to personnel	539.17	625.71	681.69	699.57
2. Depreciation and amortization	1,915.82	2,227.32	4,797.22	5,862.39
3. Expenses from non-current assets held for transfer	0.00	0.00	192.31	415.45
4. Other expenses	329.74	386.27	408.77	346.56
5. Operating expenses for the Purple Line	0.00	346.08	2,100.71	2,028.87
6. Financial costs	1,741.37	1,808.06	2,540.93	2,360.09
7. Share of loss from investment under equity methods	83.29	0.00	0.00	0.00
<b>Total Expense</b>	<b>4,609.39</b>	<b>5,393.44</b>	<b>10,721.63</b>	<b>11,712.93</b>
<b>Profit (Loss) for the Year</b>	<b>628.08</b>	<b>(1,614.94)</b>	<b>4,713.77</b>	<b>2,540.77</b>

Source: MRTA

It should, however, be noted that MRTA has heavily relied on subsidies from the government. These subsidies accounted for around 59% and 61% of total revenue in 2017 and 2018, respectively. Considering that the revenue of the Purple Line itself may not outweigh the expenses for some time, the proportion of subsidy is not expected to decline rapidly. In other words, it cannot be said that the financial stability of MRTA is high. In order for MRTA to continue to operate and maintain the Purple Line in a stable way, government subsidies under a national railway policy will continue to be necessary. As mentioned above, as the target year of an important national railway policy, *M-MAP2*, is 2037, it can at least be expected that the government will continue to financially support MRTA for the mass rapid transit system, including the Purple Line, until then.

&lt;BEM&gt;

Under the PPP Gross Cost scheme, BEM is paid remuneration for the O&M of the Purple Line at around 2,000 million Baht a year, a total 57,208 million Baht for entire 30 years contract period, regardless of whether or not there is a surplus from the Purple Line. Table 13 indicates the profit and loss statement of BEM. The financial statement has been in the black for the last four years. BEM does not take any ridership risk, and sufficient remuneration for the O&M of the Purple Line is guaranteed for the next 24 years under the PPP Gross Cost scheme.

Table 13: Profit and Loss Statement of BEM

Unit: Million Baht

Item	2015	2016	2017	2018 (Note 1)
<b>Revenue</b>				
1. Revenue from expressway business	8,814.58	9,300.72	9,956.68	7,576.15
2. Revenue from rail business	2,373.56	3,230.06	4,520.90	3,562.42
3. Revenue from commercial development business	549.43	573.3	675.83	493.02
4. Other Revenue	1367.22	129.53	239.80	3,367.48
<b>Total Revenue</b>	<b>13,104.79</b>	<b>13,233.645</b>	<b>15,393.21</b>	<b>14,999.07</b>
<b>Expense</b>				
1. Cost of expressway business	1,383.12	1511.96	1,735.41	1,349.71
2. Cost of rail business	1,444.54	2,371.42	3,352.42	2,630.24
3. Cost of commercial development business	210.15	199.94	177.15	129.47
4. Amortization of rights to operate expressway sectors and compensation for site acquisition costs	3,422.56	3,470.88	3,694.86	2,828.42
5. Amortization of intangible assets under concession agreements of the MRT Blue Line Project	777.58	440.07	246.28	139.32
6. Selling expenses	79.25	92.54	95.25	74.78
7. Administrative expenses	893.99	892.09	1,048.99	808.66
<b>Total Expense</b>	<b>8,211.19</b>	<b>8,978.90</b>	<b>10,350.39</b>	<b>7,960.60</b>
1. Profit before share of profit from investments in associations, finance costs and income tax expenses	4,893.59	4,254.47	5,042.80	7,038.52
2. Profit before finance costs and income tax expenses	5,354.80	4,601.82	5,448.71	7,377.11
3. Profit before income tax expenses	3,422.25	3,175.79	3,837.95	5,933.42
<b>Profit (Loss) for the Year</b>	<b>2,701.01</b>	<b>2,612.86</b>	<b>3,142.35</b>	<b>4,842.48</b>

Source: BEM

Note 1: Duration of 2018 data is from the 1st quarter to the 3rd quarter.

Therefore, no major issues have been observed in terms of the financial aspect of the O&M of the Purple Line.

#### 3.4.4 Status of Operation and Maintenance

As mentioned above, maintenance of the facilities and equipment of the Purple Line, such as ticket machines, train cars and M&E systems, is undertaken by BEM on a daily basis. According to MRTA, a maintenance plan for maintenance and inspection is crafted every year, and BEM faithfully follows the plan. Also, on visits to project sites and facilities, it was observed that facilities and equipment have been kept clean and neat. As the budget for maintenance has been secured under the PPP Gross Cost scheme, this situation is expected to continue.

Therefore, no major issues have been observed in terms of the current status of the O&M of the Purple Line.

No major problems have been observed in the institutional/organizational, technical, financial aspects and current status of the operation and maintenance system. Therefore, sustainability of the project effects is high.



## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

The objectives of this project were to meet the increasing traffic demand and to mitigate traffic congestion in the Bangkok Metropolitan Region by constructing a new mass transit railway line (Purple Line: Bang Sue – Bang Yai Section), thereby contributing to urban economic development and environmental improvement such as in air pollution. This project was highly relevant to Thailand's development plan and development needs, as well as to Japan's ODA policy. Therefore, the relevance is high. As for efficiency, although the project cost was within the plan, the project period exceeded the plan. The outputs of this project were as planned. Therefore, its efficiency is fair. The operation and effect indicators of this project, such as operating rate, running distance and number of running trains, partially attained their target values. However, the actual values for ridership and income from passengers were far below the target values. The main reason for this was that although the demand forecast was projected based on the assumption that the entire stretch of the four mass transit lines planned at the time of appraisal would be in operation by the time that the Purple Line was completed, this was not the case. This project is considered to have met a growing transportation demand and to have alleviated traffic congestion in the Bangkok Metropolitan Region, including Nonthaburi Province, to a limited extent. On the other hand, the project had a positive impact on the promotion of regional development such as housing and commercial development in the areas along the Purple Line in Nonthaburi Province. No negative impact on the natural environment was observed, and land acquisition was appropriately executed in accordance with the related domestic laws and regulations of Thailand. Therefore, the effectiveness and impact of this project are fair. Meanwhile, as no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system, the sustainability of the project effect is high.

In light of the above, this project is evaluated to be satisfactory.

### 4.2 Recommendations

#### 4.2.1 Recommendations to the Executing Agency

##### (1) Promotion of Ridership

It is anticipated that the ridership of the Purple Line will increase substantially when the entire MRT system is developed and the accessibility to other MRT lines is improved. However, it is recommended that MRTA take initiatives to increase the ridership of the Purple Line, even in the current situation, as below:

- Introduction of a common ticket and a discount fare system: MRTA should consider introducing a common ticket with other MRT and transport means, a monthly/weekly commuter pass ticket, a discount fare for off-peak hours on weekdays, a weekend discount fare, a discount fare for senior citizens, etc.

- Commercial development of stations: at present no commercial services are provided at stations. Shops (e.g. kiosks) and services should be available inside and outside stations in order to improve the convenience of users.
- Development of a feeder bus network: MRTA should coordinate with local governments as well as local transporters to develop a local/feeder transport network between stations and residential areas.

## (2) Consideration for persons with disabilities

The Purple Line adopted the concept of universal design and introduced facilities for passengers with disabilities which met domestic and international standards. However, it was found that there is still a demand for improvement including the installation of an elevator at every exit of stations and improvement of unpaved sidewalks connecting exits. It is recommended that MRTA continue to communicate and exchange views and opinions with related organizations to improve services.

### 4.2.2 Recommendations to JICA

#### Promotion of Ridership

As mentioned above, MRTA has been trying to develop and launch promotional activities in order to stimulate the use of the Purple Line. These have included fare promotions, the introduction of a common ticketing system, commercial development and the development of a feeder bus network. As these activities are essential to increase ridership, it is recommended that JICA follows up with MRTA to ensure their smooth progress.

## 4.3 Lessons Learned

### (1) Importance of accessibility to stations

It was found that the underdeveloped feeder bus network between the Purple Line stations and residential areas was one of the constraints on promoting the use of the Purple Line. In fact, coordination on this issue had been made among the stakeholders, including MRTA and the local government. However, due to the bureaucratic culture of Thailand, the coordination mechanism has not been fully functional. MRTA currently has other railway projects under construction, the Yellow Line and the Pink Line. These two projects are likely to face the same problems as the Purple Line. In these similar types of on-going and future projects, JICA should emphasize the importance of accessibility to stations for passengers and support the executing agency in playing a leading role in coordination with stakeholders for necessary measures to be taken during the project implementation. This initiative will ultimately benefit the use of the MRT as well as promote the number of passengers.

(2) Consideration of a ridership estimation model responding to different scenarios

The actual ridership of the Purple Line in the target year was substantially below the target figure. One of the main reasons for this was that the target figure was estimated based on the optimistic assumption that the entire stretch of the planned Bangkok mass transit system (the Blue Line, the Purple Line, the Red Line, the Light Green Line, the Dark Green Line) would be in operation by 2011. The ridership on each route tends to be affected by the development of the entire MRT network as well as by connectivity to other MRT lines. Therefore, during a master plan study or a feasibility study, several demand forecasts for the Purple Line should have been examined based on different scenarios with the assumptions that other MRT lines, or a particular MRT line, would not be complete at the time of completion of the Purple Line. This would make it possible to more accurately grasp the project effects and conduct deeper factor analysis on the achievement or non-achievement of the target figures taking into account the change of assumption.

End

### Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
(1) Civil Works	<ul style="list-style-type: none"> <li>Elevated Structures from Ban Sue to Bang Yai: 23 km</li> <li>16 Stations</li> <li>Transmission Structure at Bang Sue St.</li> <li>1 Bridge (Phra Nang Klao Bridge)</li> </ul>	<p>The total length: 24 km (Details of the Elevated Structures)</p> <ul style="list-style-type: none"> <li>Purple Line: 23 km from Tao Poon Station to Khlong Bang Phai Station</li> <li>Blue Line extension: 1 km from Tao Poon Station to Bang Sue Station</li> </ul>
(2) Depot Works	<ul style="list-style-type: none"> <li>1 Depot</li> <li>4 Park &amp; Ride Building</li> </ul>	Same as planned
(3) Track Works	<ul style="list-style-type: none"> <li>46 km in main line</li> <li>18 km in Depot</li> </ul>	Same as planned
(4) Procurement of Rolling Stock	72 cars	63 cars
(5) M&E Works	<ul style="list-style-type: none"> <li>Signal and Train Control</li> <li>Communications</li> <li>Automatic Fare Collection System</li> <li>Platform Screen Doors</li> <li>Depot Workshop Equipment</li> </ul>	Same as planned
(6) Consulting Services	<ul style="list-style-type: none"> <li>Project Design Review</li> <li>Project Management and Coordination</li> <li>Supervision for Civil Works and M&amp;E Works</li> <li>Assistance in selection of M&amp;E Works, Contractors and Operators</li> <li>Quality Assurance and Quality Control, etc.</li> </ul> <p>&lt;Work Volume&gt;            - International experts: 1,103 M/M            - Local experts: 3,243 M/M            - Supporting staff: 1,944 M/M</p>	<p>Same as planned</p> <p>&lt;Work Volume&gt;            - International experts: 558 M/M            - Local experts: 2,743 M/M            - Supporting staff: 11,083 M/M</p>
2. Project Period	March 2008 – August 2014 (70 months)	March 2008 – August 2016 (101 months)
3. Project Cost		
Amount Paid in Foreign Currency	54,900 million yen	6,744 million yen
Amount Paid in Local Currency	159,340 million yen (57,942 million bat)	205,711 million yen (69,031 million bhatt)
Total	214,240 million yen	212,455 million yen
ODA Loan Portion	116,713 million yen	89,403 million yen
Exchange Rate	1 Baht = 2.75 yen (As of February 2010)	1 Baht = 2.98 yen (Average between 2008 and 2016)
4. Final Disbursement	(Phase I) June 2, 2015 / (Phase II) March 27, 2014	