Thailand

MRTA Initial System Project (Blue Line) I–V

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Field Survey: August 2007 – March 2008

1. Project Profile and Japan's ODA Loan

Map of the project area

Bangkok Subway (MRT Blue Line)

1.1 Background

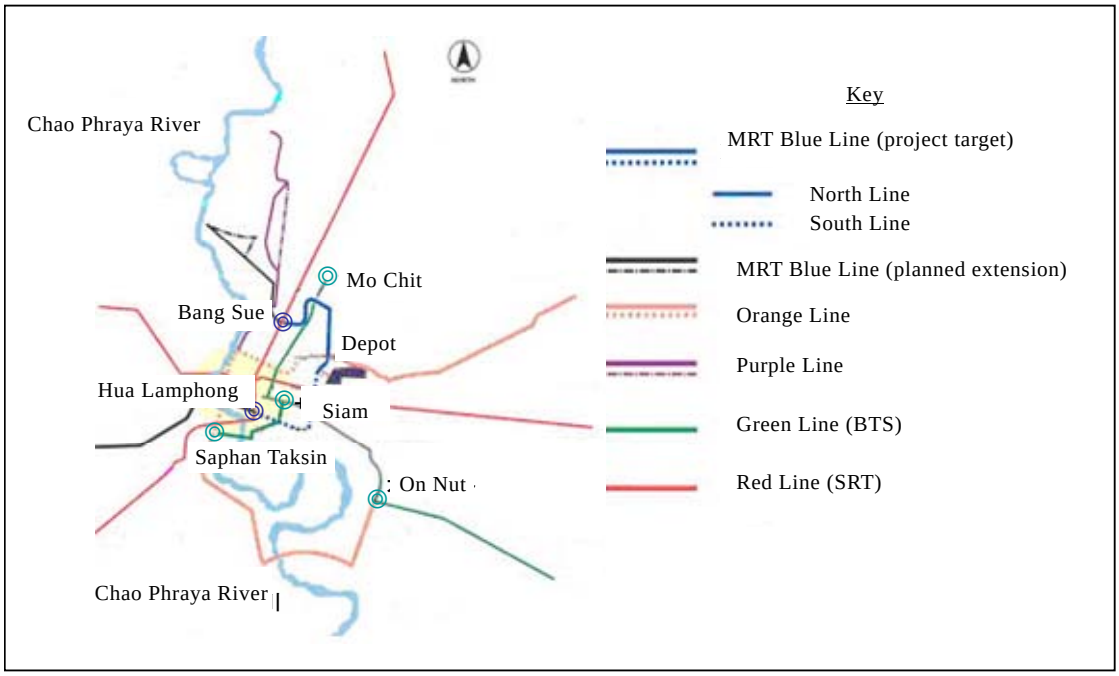
Accompanying the rapid economic development in Bangkok starting in the 1990s, regular traffic congestion and the associated air pollution became evident in the urban area. The Thai government drew up the Bangkok Mass Transit Master Plan (produced by the Office of the Commission for the Management of Road Traffic (OCMRT) and hereinafter referred to as the "master plan") in 1995 based on the 7th National Economic and Social Development Plan (1992–1996) for the purpose of developing a mass transit network and also for developing a network of ordinary roads and expressways to achieve steady economic growth, together with resolving the above-mentioned traffic congestion and air pollution. Furthermore, the development of the mass transit network proposed in the master plan is also specified in the subsequent 8th National Economic and Social Development Plan (1997–2000), and it is positioned as an extremely important national project in Thailand.

The plan for the Bangkok mass transit system, part of the master plan, involves the construction of five lines that will radiate out and join the Bangkok Metropolitan Area (BMA) with the Bangkok Metropolitan Region (BMR)[1] together with creating a network

[1] The Bangkok Metropolitan Region includes Bangkok, which is a special administrative area, and the surrounding five provinces of Samut Prakan, Pathum Thani, Samut Sakhon, Nakhon Pathom, and Nonthaburi.

in the BMA as shown in Figure 1. These five lines are the MRTA[2] System Blue Line (hereinafter referred to as the "MRT Blue Line"), MRTA System Orange Line, MRTA System Purple Line, BMA[3] System Green Line (hereinafter referred to as the "BTS"), and the SRT[4] System Red Line.

Figure 1: Bangkok Mass Transit Master Plan



Source: Produced by author based on a Mass Rapid Transit Authority pamphlet.

With regard to the development of the above-mentioned five rail lines, construction was begun first on the BTS and the Red Line by a public-private partnership (PPP) for the procurement of private capital, which used a private "special purpose company" (SPC) as the concessionaire. As in the case of the BTS and the Red Line, procurement through a PPP was originally studied for the MRT Blue Line, the development of which was planned concurrently with the above two lines. However, because the MRT Blue Line passes through central Bangkok, it was changed from an elevated rail to a subway, the first in Thailand, by a Cabinet decision in order to lighten the environmental impact. Together with this development, it was decided to implement the civil construction works using a Japanese ODA loan.

This ex-post evaluation is an evaluation of the MRT Blue Line construction project for which an ODA loan was granted in five phases following the above-mentioned background developments.

[2] MRTA (Mass Rapid Transit Authority)
[3] BMA (Bangkok Mass Transit Authority)
[4] SRT (State Railway of Thailand)

1.2 Objective

The objective of this project is to mitigate the traffic congestion in Bangkok which is ever-worsening by constructing a subway in central Bangkok as part of the development of a mass transit railway network in accordance with the 7th and 8th National Economic and Social Development Plans, thereby contributing to the smooth and efficient movement of people and improvement in environmental problems such as air pollution.

1.3 Borrower / Executing Agency

Borrower: Mass Rapid Transit Authority of Thailand (MRTA) (Guarantor: Thai government)

Executing Agency: Mass Rapid Transit Authority of Thailand (MRTA)

Furthermore, the borrower and executing agency for this project were changed from the Metropolitan Rapid Transit Authority (MRTA) to the Mass Rapid Transit Authority (MRTA) for the purpose of (1) improving the shortcomings arising from limitations in the law that established the former entity and (2) implementing the construction, service, and the operation and maintenance of the MRT Blue Line more flexibly and efficiently.

1.4 Outline of Loan Agreement

Loan Amount / Loan Disbursed Amount	Total: 222,426 million yen / 216,456 million yen Phase I : 26,586 million yen / 26,586 million yen Phase II: 32,659 million yen / 32,581 million yen Phase III: 23,343 million yen / 23,343 million yen Phase IV: 64,228 million yen / 64,156 million yen Phase V : 45,818 million yen / 39,999 million yen Local cost financing program for on-going projects: 29,792 million yen / 29,792 million yen
Exchange of Notes / Loan Agreement	Phase I : September 1996 / September 1996 Phase II: September 1997 / September 1997 Phase III: September 1998 / September 1998 Phase IV: September 1999 / September 1999 Phase V : September 2000 / September 2000 Local cost financing program for on-going projects: July 1997 / September 1997
Terms and Conditions - Interest Rate, Repayment Period (Grace Period)	Phase I: 2.7%, 25 years (7 years) Phase II: 2.7%, 25 years (7 years) Phase III: 0.75%, 40 years (10 years) Phase IV: 0.75%, 40 years (10 years) Phase V: 0.75%, 40 years (10 years) Local cost financing program for on-going

- Procurement	projects: 0.75 %, 40 years (10 years) General untied (Consulting service portion is partially untied)
Final Disbursement Date	Phase I: January 2002 Phase II: January 2003 Phase III: March 2004 Phase IV: January 2006 Phase V: March 2006 Local cost financing program for on-going projects: September 2001
Main Contractors (only contracts over 1 billion yen and concurred by JICA)	・ Italian-Thai Development Public Company Limited (Thailand), Obayashi Corporation (Japan), Nishimatsu Construction Co., Ltd. (Japan) ・ Kumagai Gumi Co. Ltd. (Japan), Bilifinger + Berger Bauaktien Gesellschaft (Germany), CH. Karnchang Public Company Limited (Thailand), Tokyu Construction (Japan) ・ Hazama Corporation (Japan), Siam Syntech Construction Public Co., Ltd. (Thailand), Mitsui & Co., Ltd. (Japan), Kajima Corporation (Japan), Maeda Corporation (Japan) ・ CH. Karnchang Public Company Limited (Thailand), SNC-Lavalin Inc. (Canada) ・ Worachak International Co., Ltd. (Thailand), Mitsubishi Corporation (Japan), Mitsubishi Electric Corporation (Japan) ・ Siam Syntech Construction Public Co., Ltd. (Thailand), Hazama Corporation (Japan), Mitsui & Co., Ltd. (Japan), Kajima Corporation (Japan), T.S.B. Trading Co., Ltd. (Thailand), Maeda Corporation (Japan)
Consulting Services (only contracts over 100 million yen)	Chotichinda Mouchel Consultants Limited (Thailand), MAA Consultants Co., Ltd. (Thailand), Mouchel Consulting Ltd. (UK), MVA Ltd. (UK), Transconsult Co., Ltd. (Thailand)
Feasibility Study (F/S), etc.	1994, F/S (Financial, Economic Viability and EIA, etc.) (by Thailand) 1995, M/P (Mass Rapid Transit System Master Plan) (by Thailand) 1995, SAPROF 1996, SAPI 1996, SAPROF (Phase II)

2. Evaluation Result (rating: B)

2.1 Relevance (rating: a)

This project is positioned as part of the development of a mass transit network for the purpose of relieving traffic congestion and reducing air pollution in the BMR, in accordance with the 7th and the 8th National Economic and Social Development Plans and the master plan. Furthermore, the project is highly consistent with national policy, such that the issues it addresses remain important topics at the time of this evaluation.

Among the five rail lines in the mass transit plan shown in Figure 1, at the time of this project appraisal, construction of the BTS and the Red Line was underway by a PPP for the procurement of private capital, using as concessionaries the Bangkok Mass Transit System Cooperation and the Hopewell Group. The condition of the facilities at the time of this ex-post evaluation is summarized as follows.

First, on the BTS, following the start of operations of the Sukhumvit Line (Mo Chit Station to Siam Station to On Nut Station) and the Silom Line (Siam Station to Saphan Taksin Station) in December 1999, civil works for construction to extend the Silom Line from Saphan Taksin Station were completed in March 2008, and civil works for construction to extend the Sukhumvit Line from On Nut Station are currently underway up to the border area of the BMA and Samut Prakan.

Construction of the Red Line was halted due to trouble with the contract with Hopewell. Otherwise, detailed study is underway for construction of the Purple Line. Furthermore, construction is underway on the Airport Link Line (Suvarnabhumi Airport to Makasan Station to BTS Phayathai Station) which will connect the new airport with central Bangkok.

In this way, compared to the master plan which was prepared at the time of the ex-ante evaluation (appraisal) (1996), there is an overall delay in the development process, as represented by the fact that only part of the BTS and the MRT Blue Line have been completed and construction was halted on the Red Line due to contractual issues. However, although some changes were added to the routes in the plan for the railway sector, overall it is judged that the development of the mass transit network is progressing in accordance with the national policy since the BTS was opened prior to the MRT Blue Line and, in addition to the MRT Blue Line which is the subject of this project, construction of the Purple Line is being studied.

As shown by the above, implementation of this project is consistent with the national plan, etc., and the relevance of project implementation is extremely high, both at the time of the appraisal and the time of the ex-post evaluation.

2.2 Efficiency (rating: b)

2.2.1 Output

In accordance with the master plan for the MRT Blue Line, this project was to construct 18 subway stations, 20 km of subway from Hua Lamphong Station to Bang Sue Station in Bangkok (south line: 9.4 km, 9 stations; north line: 10.7 km, 9 stations), and a 48-ha train depot. Together with this, peripheral equipment such as subway station escalators and elevators, etc., was to be constructed.

A comparison of the planned output and actual output of the project is summarized in Table 1.

As shown in Table 1, the project was implemented basically as originally planned in terms of the quantity of tunnels, stations, and facilities actually built, except for slight changes in the quantities of escalators and elevators.

Furthermore, whereas escalators and elevators were installed only in some stations on the BTS which was earlier constructed, escalators and elevators were installed in every station in this project, and door shields were installed on platforms, as shown in Figure 2. They were installed for energy-saving purposes and out of consideration for disabled or elderly persons from the standpoint of universal design as well as out of consideration for improved safety (see inserted column).

Table 1: Comparison of Output

Plan	Actual
South line (9.4 km, 9 stations) North line (10.7 km, 9 stations) Depot (48ha) Track (57,476 m) Escalators (239) / Elevators (71) Consulting services	South line (9.4 km, 9 stations) North line (10.7 km, 9 stations) Depot (48 ha) Track (57,476 m) Escalators (259) / Elevators(62) Consulting services

Figure 2: Door shields installed on platforms

Column: Introduction of Universal Design in the Bangkok Subway

In the project, the MRTA, acting as the executing agency, independently prepared barrier-free guidelines for content that was not adequately covered by Thai law and independently introduced considerations for disabled persons. These measures were favorably evaluated as good examples of ODA loan projects in terms of the "introduction of universal design (or consideration for disabled or elderly persons)" and were reported in a variety of materials, as shown in the example below.

Example: Handbook of the NGO Forum on Disability

"Initiatives in the Disabilities Sector from the Standpoint of Human Security − Current Status and Issues of International Cooperation" (p. 120, 126)

http://www.fasid.or.jp/chosa/kenkyu/ngo/index.html

2.2.2 Project period

A comparison of the planned and actual project periods is shown in Table 2.

Table 2: Comparison of Project Period

Item	Plan	Actual
Project management	March 1996 – October 2002	March 1996 – November 2002
Construction monitoring and supervision	October 1996 – January 2002	January 1998 – January 2003
Civil work	October 1996 – January 2002	October 1996 – April 2003
M&E system	April 1997 – October 2002	August 2000 – August 2004
Completion (start of operation)	October 2002	July 2004

As shown in Table 2, the planned project period at the time of the ex-ante evaluation (appraisal) was March 1996 to October 2002 (6 years, 8 months), but the actual project period was March 1996 to July 2004 (8 years, 5 months) (126% of the plan), representing a delay of 1 year and 9 months. Furthermore, the civil work of which MRTA was in charge was carried out basically during the planned time period, and the delay was primarily due to the time required for Cabinet approval of the concession contract with Bangkok Metro Public Company Limited (BMCL) which is the concessionaire for MRTA and the MRT Blue Line. MRTA submitted the results of negotiations with BMCL to the government in May 1998; however, it was not approved by the Cabinet until July 2000, and so there was a delay of 1 year and 10 months until the contract was signed. Moreover, because this was the first time for MRTA to arrange a concession contract and bidding for

operation and maintenance (hereinafter “O/M”), the following factors were discovered.

1) A concession contract/bidding committee was formed by persons in related bodies such as the Ministry of Finance and the Ministry of Transportation, but the committee lacked actual understanding of O/M itself.
2) Due to incompleteness of bidding documents for the concession contract, time was required for consultations with the bidder who was to become the concessionaire.
3) Because the concession contract/bidding was studied after the start of civil work, the bidding was not finished by the end of the civil work.

Furthermore, in the Project Completion Report (PCR) prepared by MRTA, the Asian currency crisis is also listed as one reason for the delay, but this ex-post evaluation was unable to ascertain any causal relationship.

2.2.3 Project cost

Table 3 shows a comparison of the planned and actual total project costs.

Table 3: Comparison of Project Cost

Plan	Actual
379,840 million yen (90,438 million baht) Foreign currency: 177,937 million yen (42,366 million baht) Local currency: 201,903 million yen (48,072 million baht) Exchange rate 1 baht = 4.20 yen	358,928 million yen (120,858 million baht) Foreign currency: 138,708 million yen (46,948 million baht) Local currency: 218,960 million yen (73,910 million baht) Average exchange rate: 1 baht = 2.97 yen

As shown in Table 3, the total project cost in the plan was 379,840 million yen (= 90,438 million baht), but the actual cost was less than the planned amount, at 358,928 million yen (120,858 million baht) (94% of the plan). However, breaking this down, the total project cost denominated in baht increased, but due to the impact of the exchange rate, the total project cost denominated in yen was slightly less than originally planned.

Given the above, the efficiency is evaluated as moderate because while the output and the project cost were basically as planned, the project period exceeded the plan by 26%.

2.3 Effectiveness (rating: a)

2.3.1 Operation and effect indicators (operating condition and number of users)

(1) Operating condition

Table 4 displays a comparison of the planned and actual operating conditions.

Table 4: Comparison of Operating Condition

<table>
<tr><th>Planned</th><th>Actual</th></tr>
<tr><td>1) Service time: 05:30–24:00
2) Number/frequency of trains operating
Number of trains operating: 266 trains/day
・ 22 trains/hour at peak times
・ 12 trains/hour at off-peak times
・ 14 trains/hour on average
Frequency of trains: 4.3 minutes on average
・ Every 2.7 minutes at peak times
・ Every 5 minutes at off-peak times

3) Capacity: 822 persons/train (3 cars)
4) Time required: approx. 35 minutes
5) Congestion: 45% (average)</td><td>1) Service time: 06:00–24:00
2) Number/frequency of trains operating
Weekdays (Monday–Friday)
<table>
<tr><th>Time</th><th>Number of trains operating</th><th>Frequency (min:sec)</th></tr>
<tr><td>06:00–09:00</td><td>16</td><td>04:24</td></tr>
<tr><td>09:00–16:30</td><td>14</td><td>05:00</td></tr>
<tr><td>16:30–19:30</td><td>16</td><td>04:24</td></tr>
<tr><td>19:30–21:00</td><td>14</td><td>05:00</td></tr>
<tr><td>21:00–24:00</td><td>10</td><td>07:00</td></tr>
</table>
・ Number of trains operating: 252 trains/day (average 14 trains/hour)

Weekends (Saturday and Sunday)
<table>
<tr><th>Time</th><th>Number of trains operating</th><th>Frequency (min:sec)</th></tr>
<tr><td>06:00–11:00</td><td>10</td><td>07:00</td></tr>
<tr><td>11:00–18:00</td><td>14</td><td>05:00</td></tr>
<tr><td>18:00–24:00</td><td>10</td><td>07:00</td></tr>
</table>
・ Number of trains operating: 208 trains/day (average 12 trains/hour)
・ Overall average number of trains operating: 13 trains/hour
3) Capacity: 900 persons/train (3 cars)
4) Time required: 30 minutes
5) Congestion: 54 % (2005), 53% (2006)
6) Service delays (actual)
・ Rate of delays 2 minutes or less: 1.08% average (management goal: 5.0%)
・ Rate of delays 5 minutes or less: 0.55% average (management goal: 2.0%)</td></tr>
</table>

Source: Prepared by the author based on the BMCL Annual Report 2006.

A comparison of the difference between the planned figures and the actual figures shown in Table 4 may be summarized as follows.

1) Whereas in the original plan the number and frequency of trains operating amounted to an average of 14 trains/hour running an average of every 4.3 minutes, the actual figures are slightly below those, at an average of 13 trains/hour running an average of every 6.5 minutes. However, the discrepancy is small.
2) The time required was less than planned, at 30 minutes rather than the planned 35

minutes.

3) The current delay in service of 2 to 5 minutes is even less than the target set at the implementation stage.

(2) Number of users

Tables 5 shows the original estimate of the number of users, and Table 6 shows the actual trend in the number of users following the start of operations.

Table 5: Original Estimate of the Number of Users

(Unit: persons/day)

BMCL Proposal	ITF Study[5]
430,000 (as of 2003)	246,000 (as of 2003)

Source: Interview at MRTA

Table 6: Actual Trend in the Number of Users following the Start of Operation

(Unit: person/days)

2004	2005		2006		2007	
Average	January–June	July–December	January–June	July–December	January–June	July–November
147,489	160,200	164,800	154,300	162,200	161,000	171,200

Source: BMCL Annual Report 2005, BMCL Annual Report 2006, and interview at MRTA

As shown by a comparison of the above planned and actual figures, the number of users in the original estimates varied widely between 240,000 to 430,000 persons/day, but the actual figures are lower. It is surmised that the difference is due to the fact that the project to extend the MRT Blue Line and other mass transit projects outlined in the master plan are not yet complete, as described in the PCR.

However, in addition to the fact that the actual number of users has been increasing from 100,000 persons/day when the train line initially opened to 150,000–170,000 persons/day, the number of users is expected to increase in the future, as indicated by the qualitative effects.

2.3.2 Internal rate of return

In this project, two types of internal rate of return were calculated at the time of the ex-ante evaluation. FIRR was calculated taking fare income from subway operation as the benefit, and EIRR was calculated taking as the benefits the effects of the reduction in travel expenses and travel time enjoyed by train users and the alleviation of traffic

[5] Result of study by ITF (Intermodal Transfer Facilities).

congestion through subway operation.

In contrast, the PCR did not calculate FIRR, and EIRR was calculated at 11.32%. Furthermore, the basis for the calculation of this figure is not specified. A comparison of figures at the time of the ex-ante evaluation and the ex-post evaluation (PCR figures) is shown in Table 7.

Table 7: Comparison of Internal Rates of Return

	Ex-ante Evaluation (at the time of Phase I appraisal)	Ex-post Evaluation (PCR figures)
FIRR (Financial Internal Rate of Return) Cost: Construction cost, consulting service expenses, cost of land acquisition, and operation and maintenance expenses Benefit: Fare income	6.88%	-
EIRR (Economic Internal Rate of Return) Cost: Construction cost, consulting service expenses, and operation and maintenance expenses Benefit: Reduction of travel expenses, reduction of travel time	11.19%	11.32%
Project Life	30 years	25 years

Because, as stated above, the actual number of users is lower than the forecast level thus reducing fare income, FIRR is lower than the level forecast at the time of the ex-ante evaluation (the time of the Phase I appraisal) and is surmised to be negative. Moreover, EIRR takes as benefits the “effects of reducing travel expenses” and “effects of reducing travel time.” It seems likely that benefits are also arising due to external factors (economic development, etc.), but they are difficult to measure. For this reason, even if EIRR were recalculated using the same premises as at the time of the ex-ante evaluation, it would be meaningless to compare the ex-ante and ex-post figures, and so the figures were not recalculated for this ex-post evaluation report.

2.3.3 Qualitative effects

Three items were studied as qualitative effects of the project, i.e., (1) the amelioration of traffic congestion, (2) the reduction of air pollution, and (3) the results of a questionnaire on user satisfaction.

2.3.3.1 Amelioration of traffic congestion

As a means of assessing the amelioration of traffic congestion in this ex-post evaluation, Table 8 shows the changes in average speed during 2003 to 2005.

Table 8: Change in Average Speed on Major Roads (2003–2005)

(Unit: km/hr)

Road Name	2003	2004	2005
Rama IV	18.25	19.45	20.27
Phayathai	11.92	11.31	12.43
Silom	10.30	10.43	11.57
Satun	10.03	11.72	11.30
Asok	15.42	15.38	14.68
Phetburi	21.45	21.15	21.29
Ratchadaphisek	29.01	29.56	29.43
Rama IX	27.53	29.68	38.17
Ladprao	18.24	21.57	21.49
Phahon Yothin	34.16	30.62	34.50

Source: Prepared by the author based on materials from the Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand.

As shown in Table 8, compared to 2003 prior to the opening of the subway, the average speed on major roads steadily rose during 2004 and 2005 following the opening of the subway. This trend is striking in the outlying areas of Rama IX, Ladprao, and Phahon Yothin.

Next, as shown in Table 9, the average daily traffic volume travelling in the direction of the subway line at intersections with major subway stations was stable or displaying a downward trend overall following the opening of the MRT Blue Line (2004–2006) compared to prior to the opening in 2003, except for Hua Lamphong, Sam Yam, and Kamphaengphet which are near the last stations on the line.

Table 9: Average Daily Traffic Volume Travelling in the Direction of MRT at Intersections with Major Subway Stations

(Unit: vehicles/day)

Intersection	2003	2004	2005	2006
Hua Lamphong	53,518	-	-	59,311
Sam Yam	-	64,474	-	65,490
Asok	44,424	37,312	41,477	-
Phetburi	39,254	34,226	38,024	-
Rama IX	67,850	69,744	56,674	-
Ladprao	55,942	55,671	-	53,430
Phahon Yothin	41,852	-	18,858	22,099
Kamphaengphet	22,322	-	27,841	31,111

Source: Prepared by the author based on materials from the Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand.

Looking at further details, during the off-peak time (9:00–16:00), there is an increase in traffic volume composed primarily of commercial vehicles, and the downward trend in traffic volume during the morning rush hour period (7:00–9:00) and evening rush hour period (16:00–19:00) shows a striking decrease compared to the average daily traffic volume. A decrease in traffic volume can be expected at the intersections of Hua Lamphong, Sam Yam, and Kamphaengphet, which are near the last stations on the line, if the MRT Blue Line is extended from the current last stations (Hua Lamphong Station and Bang Sue Station) because the average daily traffic volume at those locations is increasing.

2.3.3.2 Reduction of air pollution

With regard to air pollution, it may be assumed that the results of measurement of current air pollution in the BMA reflect the fact that traffic volume has been basically unchanged. As shown on Table 10, there is wide variation, and no clear effect due to the opening of the subway can be discerned.

Table 10: Results of Air Pollution Measurement in the BMA[6]

Year	CO (ppm) (8-hour average)	PM_{10} (μg /m^3) (24-hour average)
2003	1.0–2.0	65.4–108
2004	0.9–2.8	64.9–158.6
2005	0.8–5.5	65.7–100
2006	0.6–5.5	64.7–100.5
2007	0.9–1.5	61.8–106.8

Source: Prepared by the author based on materials from the Pollution Control Department,

[6] Definition of terms used:

1) SPM (Suspended Particulate Matter): Particles suspended in air with a particle diameter of 10μm or less (one-millionth of a meter).

2) PM_{10} (Particulate Matter): Particles suspended in air with an aerodynamic diameter of 10μm or less.

3) P_b: Lead. Used as an additive to gasoline. In recent years, unleaded gasoline has come into general usage.

4) CO: Carbon monoxide. CO is produced by incomplete combustion. Currently, automobiles, in which the degree of combustion fluctuates widely, are the main source of CO.

Explanation of figures in Table 10:

Figures in Table 10 show the range of actual levels measured periodically at measurement sites set up by the Pollution Control Department along major roads.

Explanation of figures in Table 11:

Figures in Table 11 are averages of actual levels measured periodically at measurement sites set up by the Pollution Control Department along major roads.

Reference figures: Japanese environmental standards, as follows.

1) SPM: The one-day average of hourly levels (24-hour average) is 0.10mg/m^3 or less. Moreover, the hourly level is 0.20mg/m^3 or less.

2) CO: The one-day average of hourly levels (24-hour average) is 10 ppm or less. Moreover, the 8-hour average of hourly levels is 20ppm or less.

3) PM_{10} and P_b: No standards.

Bangkok, Thailand.

However, an air pollution study on major roads confirmed that improvements occurred during 2003 to 2005, as shown on Table 11.

Table 11: Results of Air Pollution Measurement on Major Roads along the MRT Blue Line[6]

Road Name	Year	SPM (μg /m^3)	PM_{10} (μg /m^3)	P_b (μg /m^3)	CO (ppm)
Sukhumvit	2003	0.33	179.00	0.09	7.00
	2005	0.24	118.60	0.07	3.40
Rama IX	2003	0.15	81.40	0.06	2.20
	2005	0.14	66.20	0.05	1.90
Silom	2003	0.10	66.90	0.10	4.60
	2005	0.09	66.90	0.06	2.60
Phahon Yothin	2003	0.12	87.50	0.07	3.60
	2005	0.13	78.30	0.13	2.30

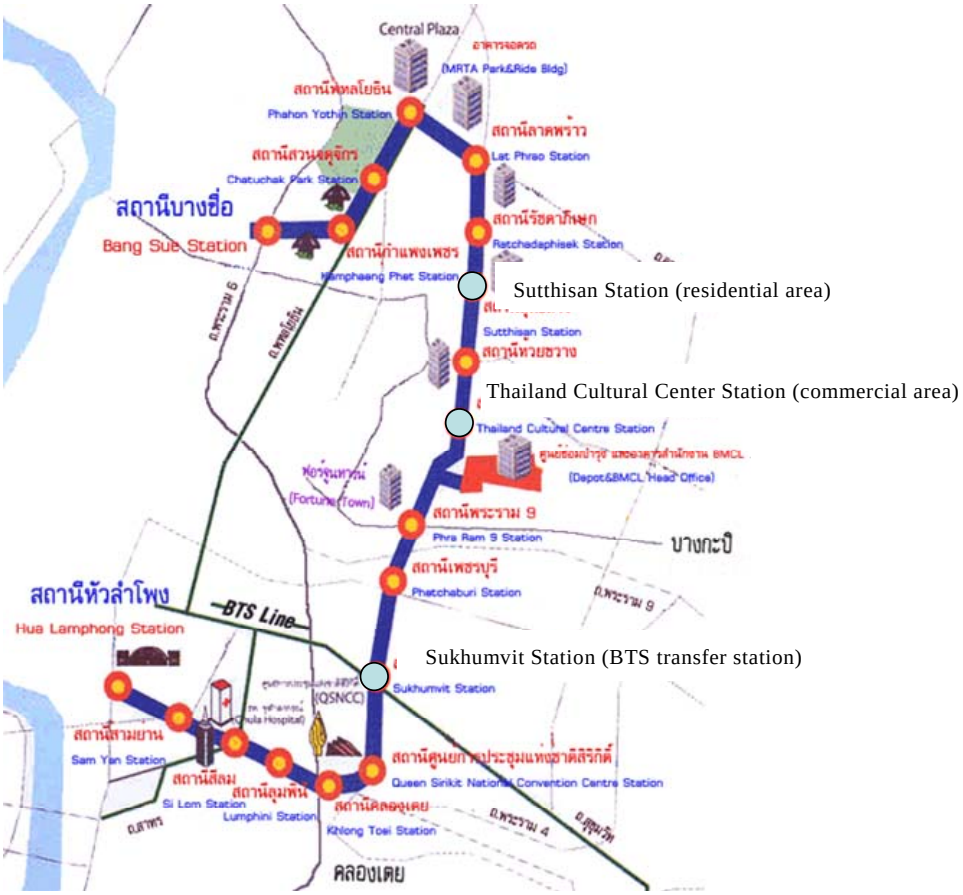
Source: Prepared by the author based on materials from the Pollution Control Department, Bangkok, Thailand.

From the above facts, an improvement in air pollution along the MRT Blue Line is recognized, but it is assumed that continued monitoring through measurement henceforth is necessary.

2.3.3.3 Results of the questionnaire concerning user satisfaction

A questionnaire survey concerning user satisfaction was conducted at three stations, the station for transfer to the BTS, a station in a commercial area, and a station in a residential area, as shown in Figure 3. The questionnaire survey was conducted during the subway operating hours of 7:00 to 19:00, and the number of interviews and the days on which they were conducted are shown in Table 12. The user sample for the questionnaire at each station was 500 persons.

Figure 3: Stations Where the Questionnaire was Conducted and Station Classification



Source: Prepared by the author based on a pamphlet from the Mass Rapid Transit Authority

Table 12: Outline of the Questionnaire Conducted at Three Stations
(Dates conducted and number of interviews)

Station Name	Classification	2007/12/01	2007/12/03	2007/12/05
Sukhumvit	BTS Transfer Station	9	12	7
Thailand Cultural Center	Commercial Area	10	12	7
Sutthisan Station	Residential Area	8	15	9

Source: Prepared by the author.

The question topics on the questionnaire are shown in Table 13.

Table 13: Question Topics in the Questionnaire (summary)

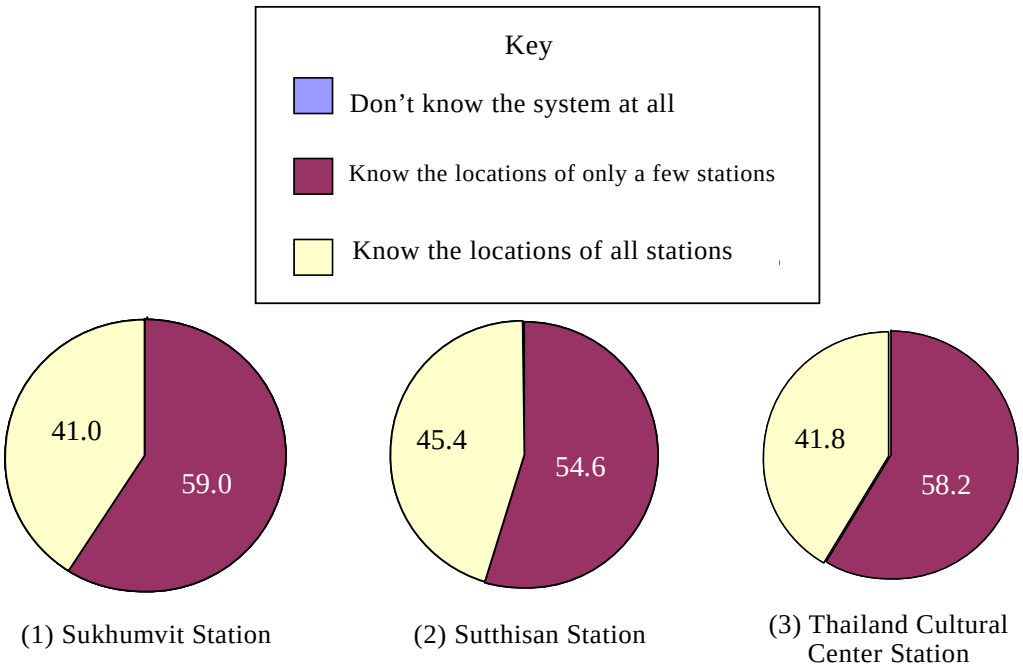
Questions 1–3	Knowledge of service area of MRT Blue Line
Question 4	Opinions concerning fares
Questions 5–10	Transportation facilities previously used
Question 11	Satisfaction with the MRT Blue Line system
Question 12	Opinions concerning improvement of transportation

Question 13	Knowledge and usage of the “Park & Ride” system
Questions 14–15	Contributions to land usage and land prices following the start of the subway service
Question 16	Requests to the MRT Blue Line

Source: Prepared by the author.

Figure 4 shows the questionnaire results concerning knowledge of the service area of the MRT Blue Line. As shown in the figure, since over 50% of users responded that they “know the locations of only a few stations,” it can be determined that knowledge of the MRT Blue Line and service area is not necessarily high at the current time.

Figure 4: Knowledge of the MRT Blue Line Service Area



Source: Prepared by the author.

As shown in Table 14, in response to the question concerning opinions on fares, 70% of users responded that the fares are appropriate, and so it may be judged that the current fares are accepted by users as being suitable.

Table 14: Opinions concerning Fares

Appropriate	High	Low
70.0%	30.0%	0.0%

Source: Prepared by the author.

As shown in Table 15, in response to the question concerning the transportation means used before the opening of the MRT Blue Line, over 50% used the bus, and when taxis and motorbikes are included, over 85% used transportation means powered by internal combustion engines before the opening of the MRT Blue Line. Given this, it may be assumed that the MRT Blue Line has been contributing qualitatively to the reduction of emissions that cause air pollution, such as CO_2 and SO_X, etc.

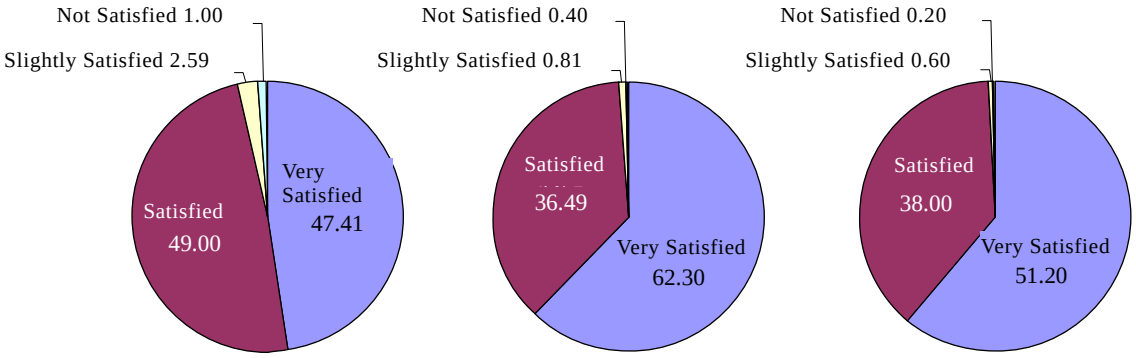
Table 15: Transportation Means Used before the Opening of the MRT Blue Line

Bus	Car	Taxi	BTS	Motorbike	Van	Walking	Boat
51.0%	14.2%	12.9%	8.6%	5.5%	3.7%	3.5%	0.7%

Source: Prepared by the author.

The results of the question concerning satisfaction with the MRT Blue Line, as displayed in Figure 5, show that nearly 100% of users gave a very favorable response to the development of the MRT Blue Line, saying that they are “very satisfied” or “satisfied.”

Figure 5: Satisfaction with the MRT Blue Line System



(1) Sukhumvit Station (2) Sutthisan Station (3) Thailand Cultural Center Station

Source: Prepared by the author.

Concerning the requests to the MRT Blue Line, the top five responses received are shown in Table 16. Over 60% of the users want the MRT Blue Line to be extended. Furthermore, the questionnaire results show that users want an increase in the number of trains and joint tickets/fares with the BTS and buses.

Table 16: Requests to the MRT Blue Line (top five)

Item	% of responses
Extension of subway network in the city of Bangkok	35.2%

Extension of subway network outside the city of Bangkok	33.1%
Reduction of fares	16.4%
Increase in the number of trains	9.4%
Joint tickets/fares with the BTS and buses	5.9%

Source: Prepared by the author.

Consequently according to the above results of the questionnaire, it may be said that the value and convenience of the MRT Blue Line is not necessarily appreciated because knowledge of the MRT Blue Line routes and service area is not very high even though three years have passed since it opened. Regarding this, it is expected that the number of users of the MRT Blue Line will increase henceforth because the actual number of users of BTS (400,000 persons/day in 2007) increased as people became aware of the existence (BTS route and service area) as well as the value and convenience (travel without traffic congestion) of the BTS over time following the opening of the line. Furthermore, because the users expressed a high degree of satisfaction with the current condition of the line, a larger increase in passengers can be expected if measures are taken to implement a project to extend the MRT Blue Line, increase the number of trains, and offer tickets/fares sold as a set for connecting with the BTS and buses as shown in the results of the questionnaire. Needless to say, development of other mass transit facilities is also indispensable for promoting an increase in the number of passengers.

2.4 Impact

2.4.1 Benefits to the target area and beneficiaries

2.4.1.1 Benefits related to operation

In this project, the following was assumed as benefits related to operation enjoyed by the target area and the beneficiaries.

(1) Improvement of bus routes (construction of a bus feeder system from MRT Blue Line stations)
(2) Development of Park & Ride facilities
(3) Introduction of joint ticket system for buses and the BTS, etc. (including fare discounts)

Among the above-mentioned items, for the improvement of bus routes with the objective of constructing a bus feeder system from MRT Blue Line stations, route changes had been made at the time of the ex-post evaluation in the below-mentioned 18 bus routes at 7 stations from among the total of 254 bus routes in Bangkok (Numbers 1 to 207 in Bangkok and Numbers 501 to 547 outside Bangkok), as shown in Table 17. Consultations are currently underway between BMTA (the bus operator organization) and MRTA concerning other bus routes.

Table 17: Bus Route Numbers following Route Changes

Station Name	Bus Route Number (BMTA)
Kamphaengphet	77, 145, 536
Ladprao	96, 179, 185, 503, 504, 516
Huai Khwang	12
Thailand Cultural Center	137, 517
Phetburi	11, 93, 206
Queen Sirikit National Convention Center	2, 25
Sam Yam	45

Source: Prepared by the author.

Park & Ride facilities were developed as follows.

1) Park & Ride facilities (2 locations; see Figure 6)
   - Ladprao (parking lot capacity: 2,400 vehicles)
   - Thailand Cultural Center (parking lot capacity: 180 vehicles)

Figure 6: Park & Ride Facilities

(a) Thailand Cultural Center Station

(b) Ladprao Station

2) Provision of parking lots[7]

Parking lots are provided at the following stations: Sam Yam, Sukhumvit, Phetburi, Thailand Cultural Center, Huai Khwang, Ratchadaphisek, and Kamphaengphet.

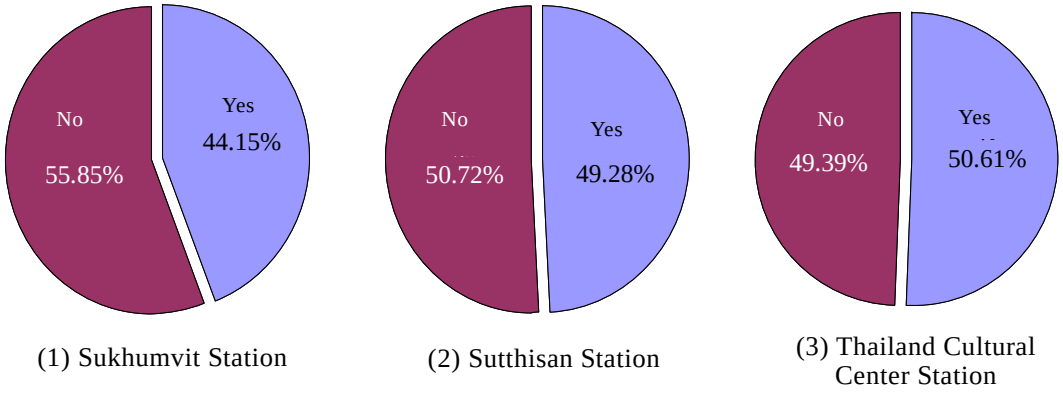
From among the question topics shown in Table 13, Figures 7 and 8 indicate the responses received concerning the usage of Park & Ride facilities. It was found that nearly 50% of passengers use the Park & Ride facilities one to two times per week at

[7] Definition of terms used:
Generally, parking lots that are available next to stations are included in Park & Ride facilities. However according to MRTA's definition, only the two large, roofed facilities at Ladprao Station and Thailand Cultural Center Station are Park & Ride facilities. MRTA differentiates these from the other parking lots without roofs.

minimum. Moreover, regarding usage of the Park & Ride facilities, the field survey confirmed through MRTA's usage records that nearly 100% of the total parking lot capacity is used.

At the time of the ex-post evaluation, an agreement had been reached between MRTA and BTS regarding the introduction of a joint ticket system for buses and the BTS, etc., (including a fare discount). It was confirmed that MRTA and BMTA (the bus operator organization) were consulting concerning the introduction of a joint ticket system for buses.

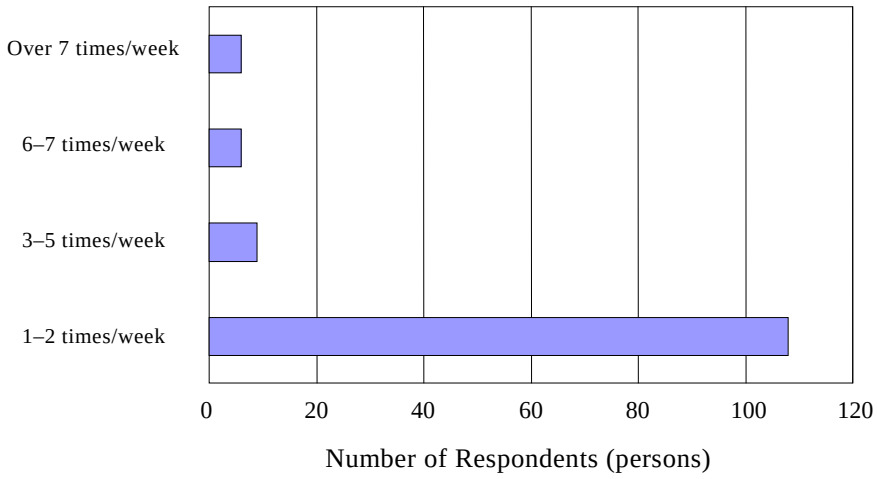
Figure 7: Experience Using Park & Ride Facilities



(1) Sukhumvit Station (2) Sutthisan Station (3) Thailand Cultural Center Station

Source: Prepared by the author.

Figure 8: Frequency of Usage of Park & Ride Facilities



Source: Prepared by the author.

Given the above results, the construction of a bus feeder system from MRT Blue Line stations and the introduction of a joint ticket system with buses (including discount fares)

are currently under discussion. Since, as seen in the requested items in the questionnaire results, these may be considered important items for promoting an increase in the number of users, it is desirable for discussion to continue between MRTA and other transportation facilities.

2.4.1.2 Changes in land usage

With regard to changes in land usage in the area along the MRT Blue Line, this report focused on four Influence Areas (Rama IV, Asok, Ratchadaphisek, and Ladprao) which are shown in Figure 9.

Moreover, Table 18 summarizes the shifts in land zoning between 1999 and 2006 in the four above-mentioned areas.

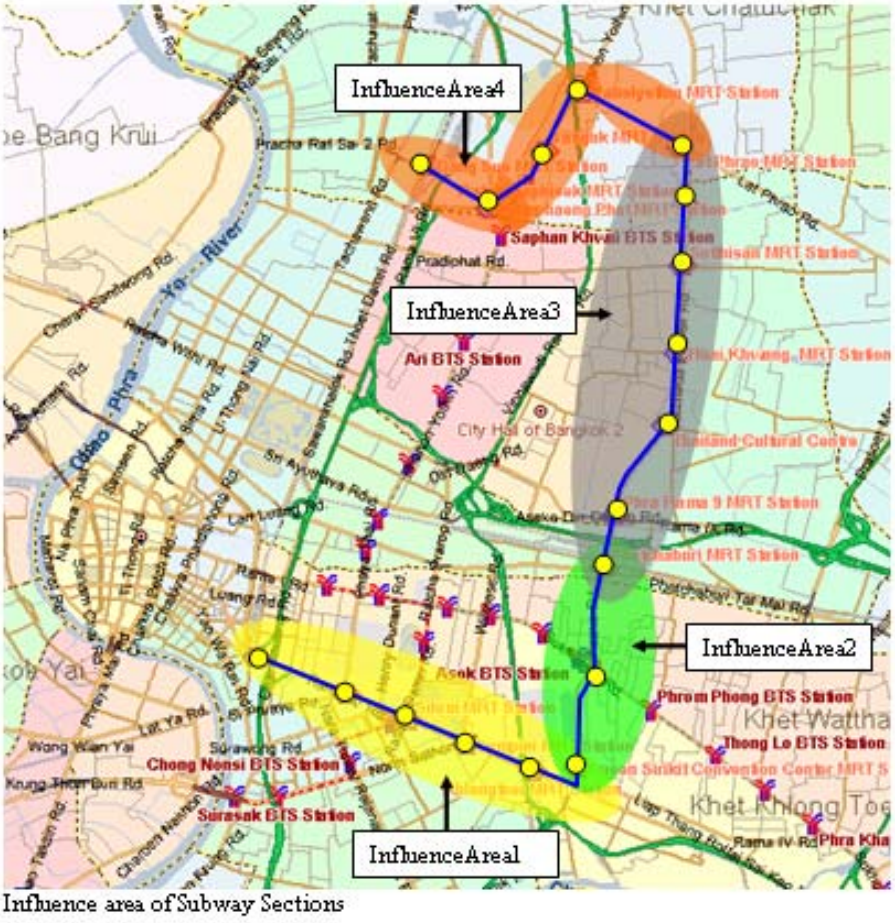
Table 18: Shifts in Land Zoning in Influence Areas

Area	1999	2006
Influence Area 1: Rama IV	- Commercial	- Commercial
Influence Area 2: Asok	- High-density residential - Commercial	- High-density residential - Commercial
Influence Area 3: Ratchadaphisek	- High-density residential - Medium-density residential	- High-density residential - Medium-density residential
Influence Area 4: Ladprao	- Medium-density residential	- High-density residential - Commercial

Source: Prepared by the author based on materials of the Treasury Department.

As shown in the table, there were no striking changes in land zoning because Rama IV, Asok, and Ratchadaphisek (Influence Areas 1 through 3) were already commercial or medium- or high-density residential areas prior to the start of operation of the MRT Blue Line. On the other hand, it can be seen that the Ladprao area, which is in the suburbs, developed from a medium-density residential area to a high-density residential area and commercial area.

Figure 9: Influence Areas where Changes in Land Zoning were Studied



Source: Prepared by the author based on a pamphlet from the Mass Rapid Transit Authority

Moreover, a study was added concerning the changes in land usage between 2001 and currently, in a 500-meter range around the three stations of Sukhumvit Station, Thailand Cultural Center Station, and Sutthisan Station. As a result, striking changes in land usage in each area were identified with (1) development from medium-rise commercial and residential facilities to high-rise buildings in the vicinity of Sukhumvit Station, (2) an increase in large-scale commercial facilities in the area surrounding Thailand Cultural Center Station, and (3) an increase in commercial and residential facilities around Sutthisan Station.

It is difficult to discuss these changes in land usage separate from the impact of steady economic growth during this period in Thailand, but it is probable that development of the MRT Blue Line was one factor propelling these changes.

2.4.1.3 Changes in land prices

The price of land in the area along the MRT Blue Line was in an upward trend prior to the opening of the MRT Blue Line, as shown in Table 19. Following the opening, the trend has continued. Moreover, there are striking increases in land prices in the suburbs (Ratchadaphisek – Rama IV, Ratchadaphisek – Sutthisan, Ladprao).

Table 19: Changes in Land Prices along the MRT Blue Line

(Unit: upper row, baht/m^2; lower row, rate of increase)

Area	2002	2003	2004	2005	2006
Rama IV – Hua Lamphong, Bonkai	76,250	78,750	81,500	85,000	90,000
	-	3.3%	3.2%	4.6%	5.9%
Ratchadaphisek – Queen Sirikit National Convention Center, Asok	63,125	65,000	68,750	71,250	72,500
	-	3.0%	5.8%	3.6%	1.8%
Ratchadaphisek – Rama IX, Sutthisan	52,500	55,000	58,750	61,250	62,500
	-	4.8%	6.8%	4.3%	2.0%
Ladprao	31,250	33,750	37,500	38,750	40,000
	-	8.0%	11.1%	3.3%	3.2%

Reference

Consumer Price Index (CPI)	100	101.6	104.2	108.8	113.7
(CPI = 100 in 2002)	-	1.6%	2.6%	4.4%	4.5%

Source: Prepared by the author based on materials of the Thai Appraisal Foundation.

The rise in land prices along the MRT Blue Line is interpreted as reflecting the impact of steady economic growth during the given period in Thailand, as with the above-mentioned changes in land usage. However, it may be assumed that some of the increase is due to the development of the MRT Blue Line given that the increase in land prices more or less exceeds the consumer price index which is shown in Table 19 for reference purposes.

2.4.2 Impact on the natural environment

The Thai government submitted the EIA report (prepared November 1993) for this project to the National Environmental Board (NEB) and received approval. Together with this, the Thai government prepared an action plan, and study of and measures for noise, vibration, dust, disposal of the earth removed by digging, and traffic congestion were implemented as indicated below.

In implementing this project, the MRTA placed the highest priority on mitigating environmental impact on the area surrounding the subway construction, made environmental measures a major issue in the evaluation of bidders, and prepared a detailed countermeasure plan for air pollution, dust, water pollution, and noise. Then, together with instructing the contractors to take measures in accordance with the

environmental countermeasure plan, MRTA took charge of the earth removed by digging and required the contractors to haul it to a designated location. Since claims from those neighboring the construction were minimized, this project is judged as having given adequate consideration to the natural environment during construction.

2.4.3 Resident relocation and land acquisition

In this project, 90% of the land acquisition was completed in the ex-ante evaluation stage (Phase I). In the appraisal document of Phase V, resident relocation of 1,059 households occurred mainly for land to construct subway station buildings. The document states that the resident relocation was conducted according to domestic Thai law without problem. In addition, according to an interview with the executing agency, resident relocation and land acquisition were implemented as originally planned and there were no particular problems.

In the above evaluation of effectiveness and impact, the number of users, which is the most easily understandable indicator for judging effectiveness, was lower than the forecast level. However as stated above, given that the number of users is expected to increase in the future and that the satisfaction of users is currently extremely high, the effectiveness and the impact are evaluated as being high.

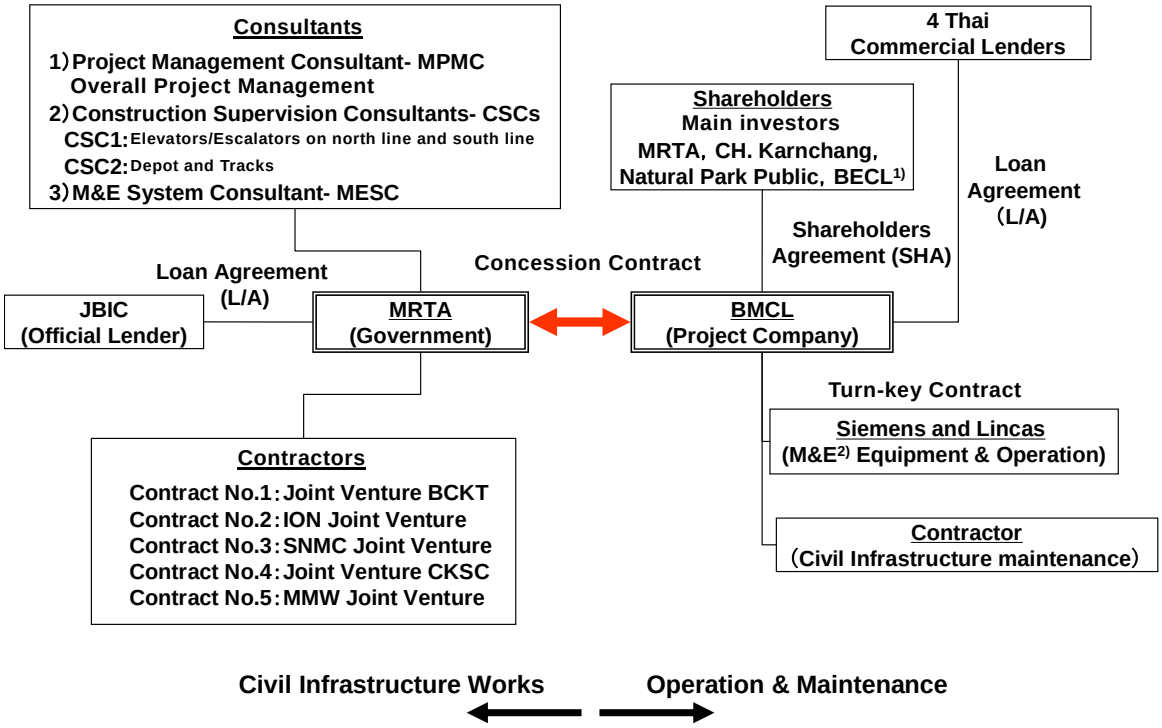
2.5 Sustainability (rating: b)

2.5.1 Executing agency

2.5.1.1 Operation and maintenance system

Figure 10 displays the O/M system chart for project construction as well as O/M. As shown in the figure, MRTA, which is the executing agency for this project, signed a loan agreement with the Japan Bank for International Cooperation (JBIC) and implemented the civil work (called “Civil Infrastructure Work” in the figure; hereinafter referred to as “civil infrastructure”). Moreover, the O/M was consigned to BMCL, which is a concessionaire of MRTA. BMCL signed a turn-key contract with Siemens and Lincas (hereinafter referred to as “Siemens”) for vehicles, communications, signal O/M, and education and training for its local staff, as a full set. BMCL implemented O/M of other civil infrastructure-related facilities.

Figure 10: Operation and Maintenance System Chart for Construction and Operation and Maintenance



Note 1: BECL stands for Bangkok Expressway Public Company Limited.
Note 2: M&E stands for Mechanic and Electricity.

It is clearly stated in the concession contract that MRTA is to participate in all O/M for the MRT Blue Line. The specific content is summarized as follows.

1) Following the signing of the concession contract, MRTA is to set up a Coordinating Committee, and the outline of the committee's activities is as follows.
   - Monitor and make recommendations concerning BMCL operations based on the contract
   - Report at least once every six months to a government agency concerning BMCL's operation and progress
     One representative of MRTA shall be a member of the BMCL Board of Directors
   - The same representative shall participate in meetings of the BMCL Board of Directors and consult with BMCL as MRTA's representative, together with examining documents
2) MRTA shall set up a Maintenance Department which shall continue to handle

technical issues related to systems which were handled by the former Engineering Department during construction. For example, the BMCL maintenance team conducts the inspection and repair of underground water springs according to the inspection manual and reports the results to the MRTA Maintenance Department.

2.5.1.2 Technical capacity

During the project, a comprehensive communication system and SCADA (Supervisory Control and Data Acquisition) were adopted as communications systems. As signal equipment, Automatic Train Control (ATC) (Automatic Train Operation (ATO) + Automatic Train Protection (ATP)), and Automatic Train Supervision (ATS) were adopted. Train operation orders are implemented by installing Centralized Train Control (CTC) at the depot, and other items are supervised by CTC. For O/M of trains, communications, and signals including the above, Siemens is implementing high-level O/M as the consignee. However, although the concession period is 25 years, currently the contract between Siemens and BMCL for O/M of M&E equipment is for 10 years. For this reason, in the future, BMCL, together with selecting and procuring equipment suited to the current system at its own expense, plans to carry out procurement for the future system and to train local personnel capable of O/M, just as is done by subway operation companies in Singapore and Hong Kong.

Meanwhile, BMCL's Maintenance Department is in charge of the maintenance and repair of civil infrastructure-related facilities. Specifically, track maintenance personnel carry out inspections and repairs of all subway tracks from after the time of the last train until the first train (1:00 a.m. to 5:00 a.m.). They primarily check for water springs in tunnels and stations, and there are no particular problems in the technical level of the personnel in charge.

2.5.1.3 Financial status

(1) Payment by BMCL to MRTA

Because BMCL was carrying out O/M based on the concession contract at the time of this evaluation, BMCL was the only object of financial analysis in this project.

As shown in Table 20, payments from BMCL to MRTA during the concession period may be generally divided into payments for fare income and payments for operating income from shops inside the stations and advertising, etc. Each of those may be further divided into fixed payments and payments linked to income.

Table 20: Payments from BMCL to MRTA during the Concession Period

1. Payments for Fare Income (VAT included)	2. Payments for Operating Income (VAT included)
1) Payment (fixed) Total 43,567 million baht (exempt for 1–10 years following start of operation, pay for 11–25 years after start of operation)	1) Annual payment (fixed) ・ Total 930 million baht ・ FY payment: 10 million baht (1–8 years following start of operation) ・ FY payment: 50 million baht (9–25 years following start of operation)
2) Annual payment (income-linked) ・ 1% of annual income (1–14 years following start of operation) ・ 2% of annual income (15 years following start of operation) ・ 5% of annual income (16–18 years following start of operation) ・ 15% of annual income (19–25 years following start of operation)	2) Annual payment (income-linked) ・ 7% of annual income (1–25 years following start of operation: fixed percentage over entire period)

Source: BMCL Annual Report 2005, BMCL Annual Report 2006, and results of interviews at MRTA.

As shown on the table, it is likely that operating income was below the forecast level as a result of the fact that knowledge of the MRT Blue Line route/service area was insufficient and its value and convenience were not necessarily appreciated when subway service initially began. It is also likely that payments were low when operation first began given that repayments were being made on the initial loan amount.

(2) Financial status of BMCL

Concerning the financial status of BMCL, although the fare income since the start of operation and the total income (including operating income) of BMCL are increasing as shown on Table 21, the amounts are less than initially expected. Moreover, because BMCL must also pay interest on the loan borrowed at the time it was founded in addition to the above-mentioned payments to MRTA, BMCL is in deficit.

Table 21: Trends in BMCL's Financial Status

(Unit: million baht)

	2004	2005	2006
Fare income	443	990	1,229
Total income	446	1,046	1,399
Income and expenditure	(957)	(1,716)	(1,669)

Source: BMCL Annual Report 2006 and results of interviews at MRTA

The main reason for the deficit is the fact that the number of users of the MRT Blue Line was significantly below the previously forecast level, as stated above. However, as shown in Table 22, another reason that may be mentioned is the fact that expenses accompanying subway operation exceed the fare income.

A generalization applicable to this case is that, compared to road development projects (toll roads, etc.), time is required to recover the investment in rail projects such as this one due to the fact that an initial investment is required in train cars and incidental facilities and that benefits are produced only after the development of a fairly large-scale railway or network. Given these special characteristics of rail projects, the operator needs to possess business know-how for maintaining the expenses accompanying rail service at a reasonable level. However, because this is the first time for BMCL and MRTA to operate a subway, although the current breakdown of detailed expenses three years after the start of operation is unclear, it may be conjectured that they are learning as they go and it is inconceivable that such know-how has been attained.

From this standpoint, it may be concluded that it is vital to form a plan to reduce expenses based on the actual results following the start of operation and to make efforts to increase the number of users.

Table 22: Trends in Fare Income and Expenses

(Unit: million baht)

	2004	2005	2006
	July–December	January–December	January–December
Income	443	990	1,229
Expenditure (business expenses, operating expenses)	674	1,417	1,445
Income/expenditure	0.66	0.70	0.85

Source: BMCL Annual Report 2005, BMCL Annual Report 2006, and results of interviews at MRTA

Given the above results, to the extent that net operating profit (including subsidies from the government) is negative, the financial status is not very safe in terms of indicators based on flow numerical values. For this reason, it is necessary to improve earnings quickly by analyzing the break-even point, reaching the target number of customers and producing a profit through further reducing expenses.

In addition, as mentioned in the BMCL Annual Report 2006, under the L/A between BMCL and commercial lenders which is shown in Figure 10, there are two companies, CH. Karnchang Public Company and Natural Park Public Company, which are required to

implement financial assistance. However, if the operating profit (including subsidies from the government) continues to be negative as is currently the case, a situation is possible in which public financial support becomes necessary to reduce payments to the main investor MRTA, because additional investment from commercial sources in the future would become difficult.

(3) Considerations related to the form of implementation of this project

Table 23 shows the advantages, including generalizations, of when a rail development project which is separated into top and bottom portions such as this project is implemented using concession contracts.

Table 23: Advantages to Implementation Using Concession Contracts

MRTA (public)	1) Initial investment amount (approximately 19 billion baht) can be reduced. 2) Efficient management can be anticipated by having it privately operated. 3) Reduction of future anticipated cash flow (demand risk) is decreased.
BMCL (private)	1) Taxes such as fixed asset tax are exempted. 2) By correctly understanding the risks, a suitable return can be enjoyed. 3) Efforts to cut operating expenses are directly linked to one's earning.

As shown on the table, dividing a rail project into top and bottom portions is, needless to say, rational and effective in terms of utilizing private-sector vitality. However, what should be considered in the ex-post evaluation of this project is that the financial status is deteriorating despite the fact that the project was implemented in top and bottom portions in Bangkok, which was judged to have the highest potential for return on investment in the Southeast Asia region, given its latent economic power and population. This indicates the importance of properly evaluating the uncertainty of business conditions at the early stage of the concession contract. This financial risk, which depends on the cash flow from fare income, is something that occurs whether operation is conducted by a public body or a private business, setting aside discussions on the efficiency of their respective management and operation. Consequently, management risk, which arises from inadequate management forecasts at the stage of the concession contract, entails the risk of business failure with private capital such as that of BMCL, and ultimately there is the same risk as in the conventional case of operation by a public body, namely that infusion of public funds will become necessary. Thus, in rail development projects using concession contracts, an indispensable factor is a detailed business analysis of the content of the concessionaire proposal by a public body.

Given this, it seems to be more realistic for the government to receive the contract for all of the civil works.

2.5.2 Operation and maintenance status

Looking at the current state of operation of the MRT Blue Line, it utilizes approximately 10,000 MWh/month of electric power for the operation of subway trains and incidental facilities. However according to an MRTA report, all of this electric power is supplied by a hydroelectric power plant, and so the environmental burden caused by CO_2 is limited to a low level. Moreover, the issue of crisis management in subway operation is generally considered to be important, and during visits to MRTA, it was confirmed that there are emergency train cars, firefighters, rescue teams, rescue equipment, and police dogs for emergencies.

Meanwhile, looking at the current state of maintenance and repair of the MRT Blue Line, it was confirmed that BMCL had 400 to 600 maintenance personnel (M&E system, civil infrastructure) and a budget of 634 million baht according to real figures in 2006.

From the above, it may be judged that there are no particular problems in the O/M status of this project.

Given the above-mentioned facts, it may be concluded that appropriate measures are being taken currently for O/M of the project, aside from the above-mentioned problems in the financial status. Therefore, the project is evaluated as having no problem overall in terms of sustainability.

3. Conclusion, Lessons Learned, and Recommendations

3.1 Conclusion

In view of the above, while the project does have issues in the area of efficiency arising from delays in the project period and in the area of sustainability arising from its financial status, it receives a high evaluation for relevance and effectiveness. Thus, the project can be given a high evaluation overall.

However, concerning the improvement of environmental problems such as air pollution which was an objective of this project, environmental effects were recognized only along the MRT Blue Line at the time of this evaluation due to external factors such as economic growth and the like, and no significant improvements were recognized overall. For this reason, it is surmised that in the future it is necessary to reduce traffic volume by increasing the number of subway users and to introduce new measures such as improvement of fuel efficiency typified by eco cars, as well as to continue observation.

3.2 Lessons Learned

There were two lessons learned in the ex-post evaluation of this project, and they concern the improvement of the bidding system for concession contracts and the

relevance of rail development projects using concession contracts, as discussed below.

1) Concerning improvement of the bidding system for concession contracts, defects in the bidding system for contracts were the main cause of the delay in the construction of this project. This arose from national risk in the form of a delay in the Cabinet decision to approve the concession contracts, and because study of the concession contracts was done in parallel with the civil infrastructure construction, the delay also affected the civil infrastructure. Consequently, it may be necessary to stipulate the detailed content of the concession contracts at the time of the start of the project.
2) When a rail development project separated into top and bottom portions like this project is implemented using concession contracts, an indispensable factor is a detailed business analysis of the content of the concessionaire proposal by a public body. In addition, when the initial investment expense for civil works for the subway is high as in this project, it may be difficult to recover all the invested capital through the expenses paid by the concessionaires alone, as in the BOT contract. Given this, it is probably more realistic for the government to receive the contract for all of the civil work.

3.3 Recommendations

Keeping in mind that there are aspects of future sustainability which cannot be clearly understood during the period of approximately three years following completion, the following points are presented as recommendations to MRTA, the executing agency of this project.

1) Following the end of the concession period (25 years), MRTA indicates that there is a possibility that it will conduct operation itself. If MRTA does not intend to conduct operation itself, there is no guarantee that BMCL or Siemens will continue to conduct operation. For this reason, it is necessary for MRTA to quickly acquire management know-how and knowledge of O/M methods, etc., and to start early on a study concerning the contracts following the end of the concession period.
2) It is necessary to confirm the method for handing over the facilities at the end of the concession period and to conduct monitoring of the O/M status in preparation for the handing over of the facilities.
3) It is necessary to take into consideration the changes in the amounts paid to MRTA, while monitoring the financial status of BMCL, etc., henceforth. It is also necessary to clarify the collateral transfer rights of the local lender which provided financing in the event that BMCL's business management deteriorates.

In addition, it is indispensable to implement MRTA extension projects and other mass

transit projects in order to increase the current income of the MRT Blue Line (fare income and operating income), or in other words, to promote the operating condition of BMCL and to boost the sustainability of this project. For this reason, it is considered to be indispensable for the Thai government to take measures to swiftly promote development of mass transit in accordance with the original master plan.

Comparison of Original and Actual Scope

Item	Planned	Actual
(1) Output	South line (9.4 km, 9 stations) North line (10.7 km, 9 stations) Depot (48 ha) Track (57,476 m) Escalators (239) Elevators (71) Consulting services	South line (9.4 km, 9 stations) North line (10.7 km, 9 stations) Depot (48 ha) Track (57,476 m) Escalators (259) Elevators (62) Consulting services
(2) Project Period	March 1996 – October 2002 (6 years, 8 months)	March 1996 – July 2004 (8 years, 5 months)
(3) Project Cost Foreign currency Local currency Total ODA loan portion Exchange rate	 177,937 million yen 201,903 million yen (48,072 million baht) 379,840 million yen 192,634 million yen 1 baht = 4.2 yen (as of September 1996)	 138,708 million yen 218,960 million yen (73,910 million baht) 358,928 million yen 186,664 million yen 1 baht = 2.97 yen (April 1997 – March 2006 average)