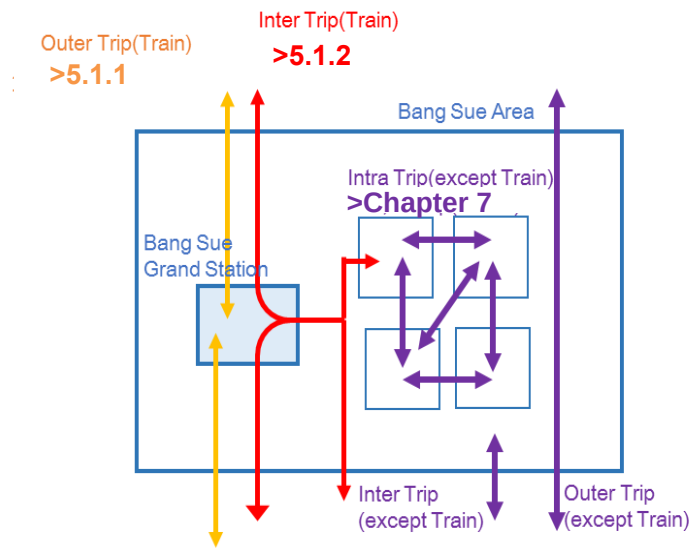


Chapter 5 Future Demand Forecast

5.1 Demand of Railway Passengers at State Railway of Thailand (SRT) Bang Sue Grand Station

The purpose of demand forecast of railway passengers is to estimate the volume of outer trip and inter trip by trains which go through Bang Sue Grand Station and Bang Sue Area. A framework of demand estimation is as shown in Figure 5.1.1.



Source: JST

Figure 5.1.1 Framework of Demand Estimation

5.1.1 Review of Existing Forecast

(1) Demand Forecast of Existing Railway

The future network of the Bangkok railway and the forecast of transport volume are described in Mass Rapid Transit Master Plan in Bangkok Metropolitan (M-MAP) by Office of Transport and Traffic Policy and Planning (OTP) as shown in Table 5.1.1. Some projects such as construction of new lines related to Bang Sue Grand Station and some extension projects of the existing lines are listed in M-MAP. However, not all projects make headway as initially planned.

This study will forecast railway passengers at Bang Sue Grand Station based on the basic data used in M-MAP.

Table 5.1.1 Master Plan in Bangkok Metropolitan Region

Master Plan	Total Distance (km)	Station	Coverage Area (km ²)	Coverage People (million people)	
Urgent Plan	236	145	370	3.3	Light Red Line: Bang Sue-Taling Chan (15 km) -under construction Light Red Line: Bang Sue-Phaya Thai-Makkasan (9 km) and Makkasan-Hua Mak (10 km) Dark Red Line: Bang Sue-Rang Sit-Thammasat (36.3 km) Dark Red Line: Bang Sue-Hua Lampong (6.5 km) Dark Green Line: Mochit-Saphan Mai (11.4 km) and Baring-Samut Prakarn (12.8 km)
					Purple Line: Bang Yai-Bang Sue (23 km) - under construction Blue Line: Bang Sue-Tha Pra (13 km) and Hua Lampong-Bang Kae (14 km)
First 10-year Plan (within 2019)	391	237	525	3.8	Light Red Line: Salaya-Taling Chan (14 km) Dark Red Line: Hua Lampong-Bang Bon (18 km) Airport Rail Link: Don Muang-Bang Sue-Phayathai (21.8 km) Dark Green Line: Saphan Mai-Khu Khot (7 km.) Light Green Line: National Stadium-Yos Sae (1 km) Purple Line: Bang Sue-Rat Burana (19.8 km) Orange Line: Taling Chan-Thailand Cultural Center-Bang Kapi-Min Buri (37.5 km)
Second 10-year Plan (within 2029)	509	312	680	5.13	Dark Red Line: Bang Bon-Mahachai (20 km) Light Red Line: Bang Bamru-Makkasan (10.5 km) Dark Green Line: Khu Khot-Lam Luk Ka (6.5 km.) and Samut Prakarn-Bang Pu (7 km) Blue Line: Bang Kae- Buddha Monthol Sai 4 (8 km) Yellow Line: Lad Phrao- Pattanakarn (12.6 km) and Pattanakarn-Sam Rong (17.8 km) Grey Line: Watcharapol-Rama IV-Rama IX Bridge (26 km) Light Blue Line: Din Dang-Sathorn (9.5 km) Airport Rail Link Extension

Source: M-MAP (Mass Rapid Transit Plan in Bangkok Metropolitan Region, June 2010)

The number of passengers at Bang Sue Grand Station was forecasted in 2016 by OTP. It includes generated/attracted trips from redevelopment area around Bang Sue Grand Station. The forecasted number is as shown in Table 5.1.2.

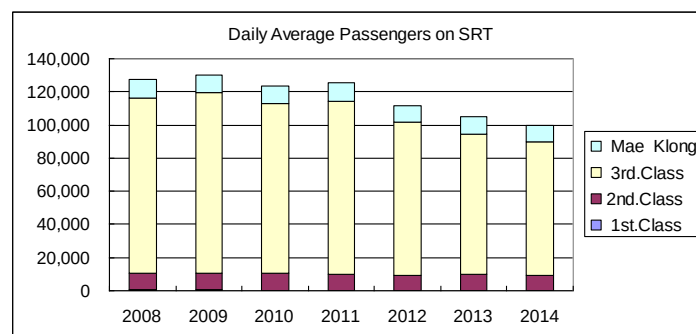
The number estimated by OTP should be reviewed and verified because the total number is as big as that of JR-Shinjuku Station (Japan), which is the biggest station in the world with 760,000 boarding passengers per day. Recently, the number of SRT railway passengers is decreasing and the number is about 100,000 per day as shown in Figure 5.1.2. Even though under the assumption that Bangkok has a half of the national population, it might be difficult to expect more than 50,000 passengers to use the existing railway except an urban mass rapid transit (UMRT) transportation network such as mass rapid transit (MRT) or Bangkok Mass Transit System (BTS) at the center of Bangkok.

Table 5.1.2 Railway Passengers Forecast by OTP

(Per day)	Year 2022		Year 2032		Year 2037	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Dark Red Line	105,600	106,100	185,200	185,100	217,100	218,000
Light Red Line	65,400	65,900	89,000	88,500	96,900	96,900
Long Distance Train	29,300	29,600	86,100	86,100	106,500	106,100
High-speed Rail	38,600	38,600	69,200	69,100	85,700	86,100
Airport Rail Link	30,700	30,800	48,400	48,600	60,300	60,100
Blue Line	56,700	56,500	121,500	121,300	145,400	144,600
Total	326,300	327,500	599,400	598,700	711,900	711,800

Note: Including traffic from the new redevelopment in Bang Sue Area.

Source: OTP



Note: Mae Klong is an independent, short distance route which is not connected with other routes.

Source: JST based on SRT

Figure 5.1.2 Daily Average Passengers on SRT in Thailand

(2) UMRT Passengers

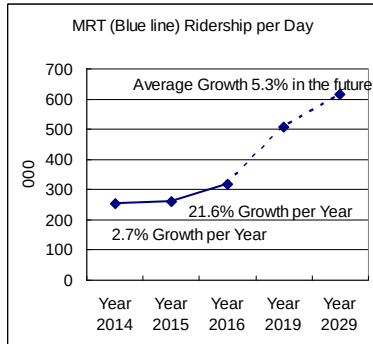
The Dark Red Line, Light Red Line, Airport Rail Link (ARL), MRT Blue Line, and BTS, they are described as UMRT. The annual growth rate of each line is as shown in Figure 5.1.3. According to Mass Rapid Transit Authority of Thailand (MRTA), the annual growth rate of MRT Blue Line is forecasted to be 5.3% in the future. According to Bangkok Mass Transit System Public Company Limited (BTSC), the actual growth rate of BTS is already 6.9% per year at present. According to SRT Electrified Train Co., Ltd. (SRTET), the average annual growth rate of ARL is 10.5%. These passengers' growth rates are higher than the population growth rate in Bangkok. It means that the usage of railway becomes more popular for those people living in and around Bangkok.

Figure 5.1.4 shows the comparison of MRT/BTS/subways extension and users in the world. The total extension and number of passengers of UMRT in Bangkok are still less compared with the other countries, since the UMRT network in Bangkok is still not dense. As shown in Figure 5.1.5, Sukhumvit Station of MRT and Siam Station of BTS have the largest passengers in each line. In the most recent year, the number of passengers in Siam Station, which is an interchange between two BTS lines, is approximately 112,600 and the number of passengers in Asok is 85,100. As the passengers of UMRT in Bangkok is increasing year by year, these numbers will higher in 2017.

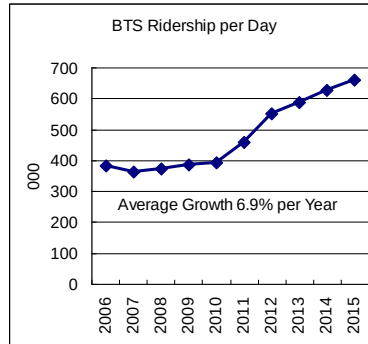
Although the number of railway passengers increases year by year, MRT and BTS have limit of their

carrying capacity. The capacity of one section is estimated to be about 300,000 for one line¹.

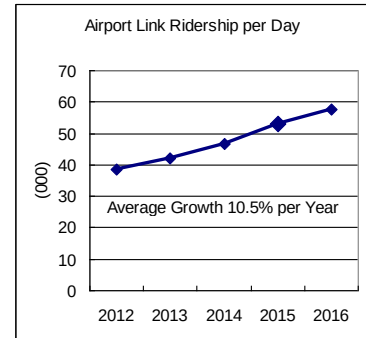
The distribution of the trip length of MRT is as shown in Figure 5.1.6. As the average trip length gets shorter, the number of passenger transshipment increases, and it increases the capacity of the entire line. Since Bangkok's average commuting distance exceed 6.0 km, the current use of railway is established in combination with other transport modes.



Source: MRT t

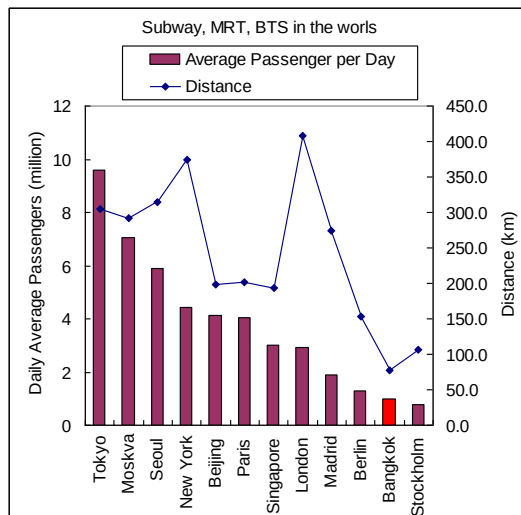


Source: SRT



Note: The number is the total of all stations
Source: JST based on SRT

Figure 5.1.3 Growth of Intra City Transportation Network



Source: Japan Subway Association

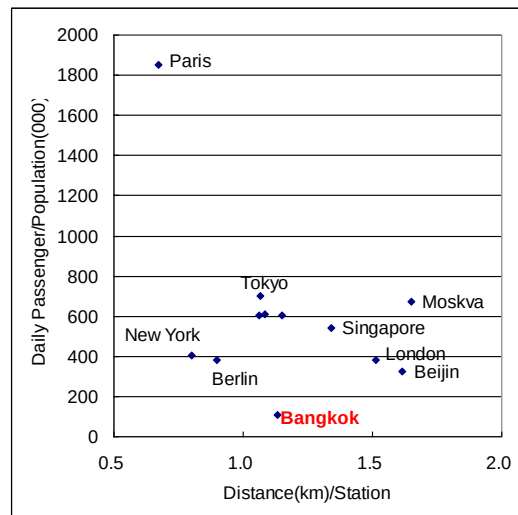
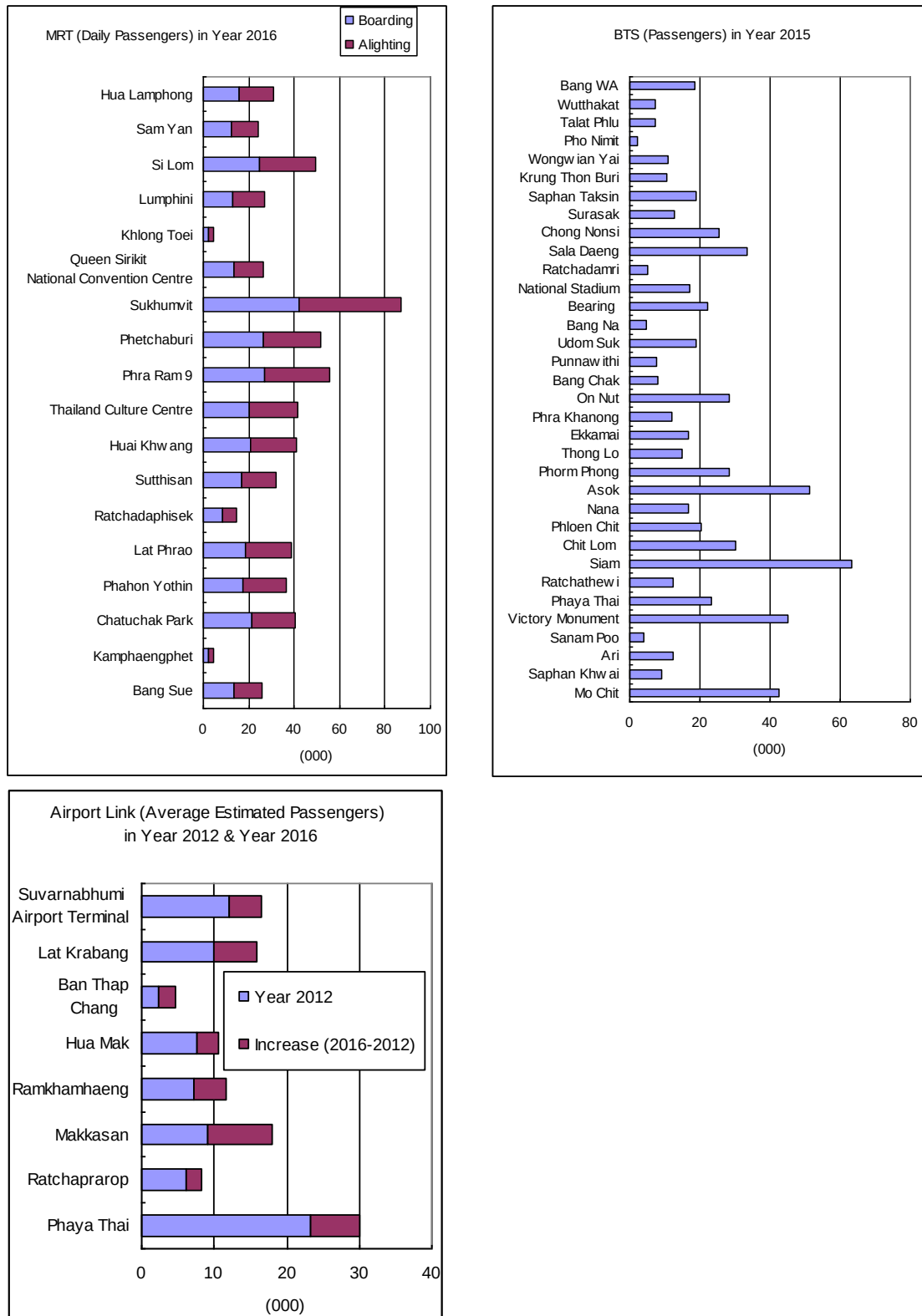


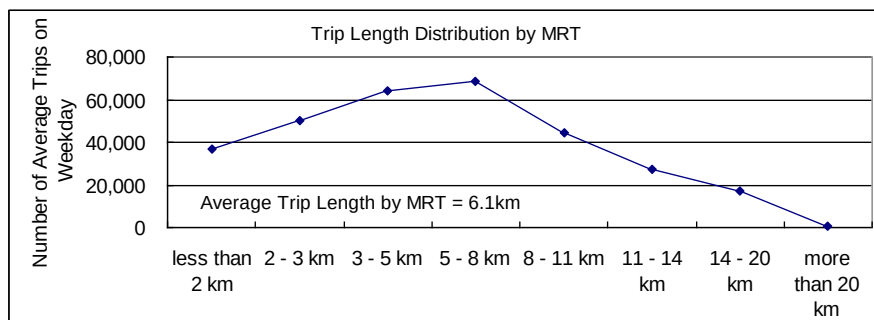
Figure 5.1.4 Comparison of MRT/BTS/Subways Extension and Users in the World

¹ (900 persons per train) x (every 5 minutes) x (14 hours) x (2 ways)



Source: JST based on MRT, BTS, SRT

Figure 5.1.5 Average Daily Passengers of MRT, BTS, and Airport Rail Link by Station



Source: JST based on MRT report

Figure 5.1.6 Trip Length Distribution by MRT Passengers

(3) Dark Red Line

Dark Red Line is expected to be used mainly for commuting. Approximately 80% of ridership is expected for commuting purpose. Passengers of Dark Red Line are forecasted by OTP and SRT as shown in Table 5.1.3. The numbers of passengers estimated by the two authorities are quite different from each other, because the number of passengers estimated by OTP includes generated passengers from Bang Sue Area redevelopment, while estimated number of passengers by SRT and JST do not.

The passenger estimation for Dark Red Line is as shown in Table 5.1.3. The conditions of the assumption are as follows:

- The baseline of the number of passengers: 23,717 (same as in year 2015 at Hua Lamphong Station)
- The growth rate: 6.9% (same as BTS)

In this survey, the modal share of railway is expected to increase up to 20% in the future, as instructed by the Government of Thailand.

Table 5.1.3 Dark Red Line Passenger Estimation

Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
OTP	Departure	105,600	139,847	185,200
	Arrival	106,100	140,140	185,100
SRT	Departure	14,033	17,740	21,353
	Arrival	37,161	46,978	56,545
JST	Departure/Arrival	37,878	52,919	73,934

Note: In this table, OTP's estimation includes the generated passengers from Bang Sue Area redevelopment while SRT and JST estimation do not.

Source: JST based on OTP, SRT

(4) Light Red Line

Light Red Line will start from Bang Sue Grand Station and heads to two destinations. One goes to Talin Chan and Salaya to the west, while the other goes to Hua Mak to the south. As of August 2017, the section between Bang Sue and Talin Chan is under construction, and the section is planned to commence its operation in 2020, the same period with Dark Red Line opening. The passenger capacity on one way per day is estimated to be 25,200.

The target passengers of Light Red Line in Bang Sue Grand Station in the future are firstly those who come from the west of Bang Sue Area, and secondly, are the additional induced passengers. There is a

possibility that they will get on SRT new lines. The present survey assumed that the new SRT passengers at Bang Sue Grand Station will grow at the same growth rate of MRT passengers. The potential of Light Red Line is as shown in Table 5.1.4., and the result of estimation is as shown in Table 5.1.5.

The conditions of the assumption are as follows:

- The baseline of the number of passengers: 25,200 (passenger capacity of one way per day)
- The growth rate: Same as the population growth rate and MRT passengers' growth rate

Table 5.1.4 Potential of Light Red Line

	Basic Line* (people/day)	Year 2022 (people/day)	Year 2027 (people/day)	Year 2032 (people/day)	Growth
Obvious demand	25,200	27,398	29,294	30,826	Growth by Population
Induced demand	25,200	32,564	42,081	54,379	Growth by MRT
*) By Bus & Morning Rail Operation					

Source: JST

Table 5.1.5 Light Red Line Passenger Estimation

Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
Forecast by OTP	Departure	65,400	77,200	89,000
	Arrival	65,900	77,200	88,500
Forecast by SRT	*) No report	—	—	—
Study Team	Departure/Arrival	59,963	71,375	85,205

Source: JST

(5) Long-distance Train

Although some trains survived after the opening of high-speed railway in Japan, some of them were abolished or transferred to the private sector because many passengers shifted from the old long-distance trains to the high-speed railway trains. Therefore, the forecast by SRT, which estimated that passengers of long-distance train will not increase, is comparatively reasonable. The present survey forecasted the number of passengers of long-distance train by using the growth rate of population in Bangkok under the condition that a half of the estimated passengers will shift to high-speed railway trains. The result is as shown in Table 5.1.6. The conditions of the assumption are as follows:

- The baseline of the number of passengers: Number of passengers in 2012, 2013, and 2014
- The growth rate: Population growth
- A half of the passengers of long-distance train will shift to other modes such as high-speed railway.

Table 5.1.6 Long-distance Train Passenger Estimation

Estimated by		Estimated Passengers (people/day)					
		Year 2012	Year 2013	Year 2014	Year 2022	Year 2027	Year 2032
OTP	Departure				29,300	40,486	86,100
	Arrival				29,600	40,776	86,100
SRT (including actual number of passengers)	Hua Lamphong	25,311	23,419	22,422			
	Bang Sue	910	960	916	24,646	24,646	24,646
JST	Departure/Arrival				13,398	14,325	15,074

Source: OTP, SRT, JST

(6) High-speed Train

There are five main routes of high-speed train decided by the Government of Thailand as shown in Table 5.1.7. Bang Sue Grand Station is planned as the terminal station. For the demand forecast of Bangkok-Chiang Mai route, the result of the “Preparatory Survey for the Bangkok-Chiang Mai High-speed Rail Development Project” supported by Japan International Cooperation Agency (JICA) is used as reference. On the other hand, feasibility studies on the other routes are not available. Therefore, the forecast for the other routes is estimated in proportion to the population.

Table 5.1.7 Demand Forecast of Planned High-speed Railways



Destination	Estimated Passengers (people/day)		
	2022	2027	2032
1 Chiang Mai		25,408	29,357
2 Ubon Ratchathani		18,242	21,077
3 Nong Khai		15,096	17,441
4 Padang Besar		2,353	2,718
5 Rayon		9,351	10,804

Source: JST based on the “Preparatory Survey for the Bangkok-Chiang Mai High-speed Rail Development Project” and population growth rate

OTP also has its own estimation. The comparison of the forecast for the five routes of high-speed trains by OTP and JST is as shown in Table 5.1.8. It should be noted that the number of passenger estimation by JST includes the departure and arrival of passengers.

Table 5.1.8 Comparison of Demand Forecast of Planned High-speed Railway by OTP and JST

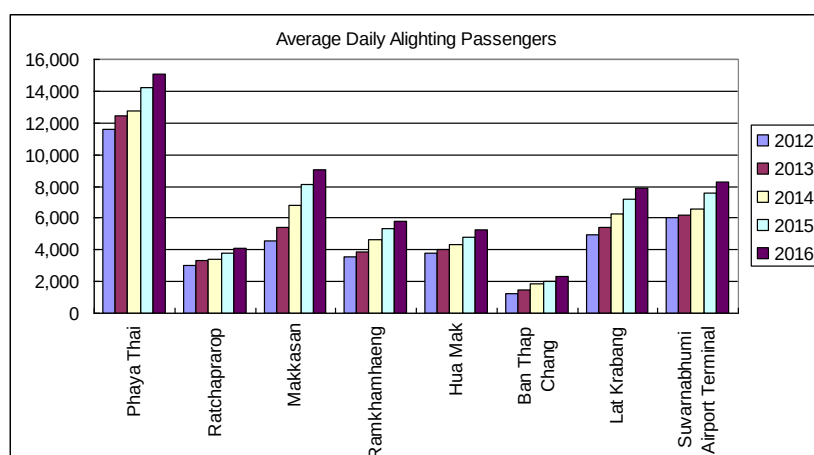
Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
OTP	Departure	38,600	53,900	69,200
	Arrival	38,600	53,850	69,100
SRT	Departure	-	-	-
	Arrival	-	-	-
JST	Departure+Arrival		70,449	81,397

Source: OTP, JST

(7) Airport Rail Link (ARL)

ARL is currently connected to the Suvarnabhumi International Airport and Phaya Thai Station. It connects to MRT Blue Line at Makkasan Station (Phetchaburi Station for MRT Blue Line) and BTS Sukhumvit Line at Phaya Thai Station. In the future, it will be extended to Bang Sue Grand Station.

The average daily alighting passengers on ARL by station are as shown in Figure 5.1.7. The numbers of passengers at Makkasan and Phaya Thai Stations are larger than at the ARL station at Suvarnabhumi International Airport. It shows that ARL is used not only as an airport line but also as UMRT for daily transfer.



Source: JST based on SRT

Figure 5.1.7 Average Daily Alighting Passengers at Airport Rail Link by Station

At the ARL station at Suvarnabhumi International Airport, more than 5% of flight passengers use ARL, as shown in Table 5.1.9.

Table 5.1.9 Share of ARL Users in Flight Passengers

(per year)	Airport Passenger (thousand people)		Alighting Passenger (thousand people)			
	Suvarna- bhumi	Don Muang	Suvarna- bhumi Airport Terminal	(Ratio) note	Phaya Thai	(Ratio) note
2015	52,902	30,304	2,759	5.2%	5,179	9.8%
2016	55,892	35,204	3,027	5.4%	5,491	9.8%

Note: (Alighting Passenger)/ (Airport Passenger at Suvarnabhumi International Airport)

Source: Department of Civil Aviation Thailand and SRT

The growth of flight passengers is generally in proportion to the growth of the gross domestic product (GDP). By considering the distance from the airports to Bang Sue Grand Station, about 10% of the flight passengers in Don Muang Airport and about 5% of flight passengers in Suvarnabhumi International Airport will be expected to use Bang Sue Grand Station.

Based on the share of the ARL users in flight passengers, the future demand of ARL is estimated as shown in Table 5.1.10. The assumption is; In the future of Year 2032 it is assumed the utilization share of Airport rail link in total number of airport passengers will be twice as 10% and 20% in Suvarnabhumi International Airport Terminal Station and Phaya Thai respectively, as the result of tourist promotions and integrated development surrounding Bang Sue Area.

Table 5.1.10 Airport Rail Link Passenger Estimation

Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
OTP	Departure	30,700	35,193	48,400
	Arrival	30,800	35,316	48,600
SRT	Departure		18,596	17,812
	Arrival		21,153	20,900
JST	Departure/Arrival		48,725	70,405

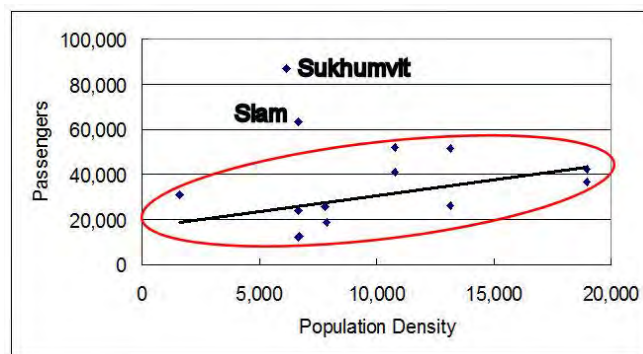
Source: OTP, SRT, JST

(8) MRT Blue Line

The demand of Blue Line is forecasted by OTP and SRT. By reviewing the data, it seems that most of Blue Line passengers considered transferring from MRT Bang Sue Station to Bang Sue Grand Station. However, some passengers from/to Blue Line consider using buses, taxis and walking by foot from MRT Bang Sue Station. Therefore, it is not appropriate to count all of Blue Line Bang Sue Station passengers as Bang Sue Grand Station users.

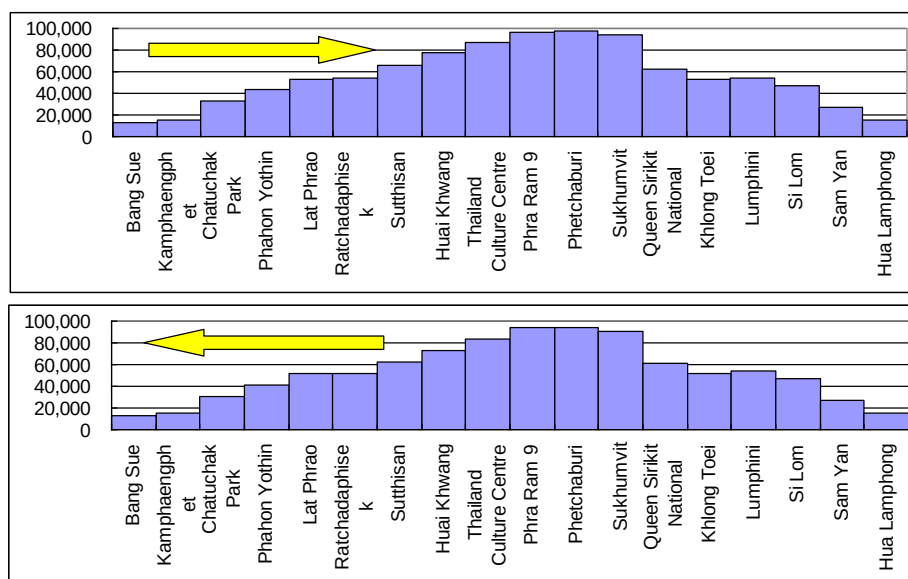
Generally, the number of passengers in each station is proportional to the density of population in the surrounding area as shown in Figure 5.1.8. Stations with special conditions, e.g., interchange stations such as Sukhumvit or Siam, and a station located at the center of the central business district (CBD) will attract more passengers. With this, MRT Bang Sue Station is not connected with other commuter lines at present.

However, in the future, Blue Line will become a loop line and will be connected to the Dark Red Line at MRT Bang Sue Station. MRT Bang Sue Station has the possibility to become one of the largest interchange points of the loop line in Bangkok. Figure 5.1.9 shows the number of passengers in Blue Line. Based on the trend of the number of passengers in each station, it could be claimed that MRT Bang Sue Station will have more passengers in the future.



Source: MRT, BTS, JST

Figure 5.1.8 Number of Passengers of Each Station and Population Density



Source: MRT

Figure 5.1.9 Average Daily Passengers on the Blue Line on Weekdays by Section and Direction in 2016

The result of the demand forecast for Blue Line is as shown in Table 5.1.11. In this table, the number estimated by JST means the total number of passengers in MRT Bang Sue Station while the estimated number of passengers by OTP and SRT means the number of transfer passengers from MRT Bang Sue Station to Bang Sue Grand Station.

Table 5.1.11 Demand Forecast of Passengers in MRT Bang Sue Station

Estimated by		Estimated Passengers (people/day)			
		Year 2016	Year 2022	Year 2027	Year 2032
OTP	Departure	-	56,700	89,100	121,500
	Arrival	-	56,500	88,900	121,300
SRT	To Red Line	-	7,017	8,870	10,676
	To Airport Rail Link	-	1,340	1,303	1,285
Study Team (Temporary)	Departure/Arrival	25,931	28,193	30,144	31,720

Source: OTP, SRT, JST

In the above number of passengers estimated by JST, passengers generated from/attracted to Bang Sue Area are not included. It only includes passengers from/to outside of MRT Bang Sue Station, as well as passengers who transfer to the other lines.

5.1.2 Railway Passengers in Bang Sue Area

(1) Forecast Framework

Table 5.1.12 shows the framework of the forecast. In order to forecast the railway passengers at Bang Sue Grand Station, the matrix should be filled in.

Generated/attracted trips in Bang Sue Area depend on the number of employees and residents. The employees and residents are determined by floor plan which will be planned based on property demand forecast. Examples of person trip data in Tokyo and Association of Southeast Asian Nations (ASEAN) cities are as shown in Figure 5.1.10, which shows that the generated/attracted trips are almost in proportion to the population of residents and employees.

The prediction method is a four-step estimation. Based on the real estate demand, the generated trips are estimated. The attracted trips are estimated based on the distribution of available transportation facilities. Then, the mode sharing rate is estimated, and finally, the traffic distribution and quantity are obtained.

(2) Number of Trips per Person per Day

Generally, the number of person trip per person per day is more than 2.0 trips for commuting in urban area. In Figure 5.1.10, Jakarta and Manila were surveyed in 2002 and 1996, respectively, and the target areas of survey contained rural areas. Therefore, the numbers of trips per day in these two cities are lower than 2.0. On the other hand, the data of Hanoi and Yangon are relatively new (in addition, the area of Hanoi in 2005 was narrower than now due to municipal integration in 2008), and the number of trips per day is over 2.0. From this viewpoint, the person trips in Bangkok, which is highly urbanized today, is considered to be more than 2.0 trips per person per day.

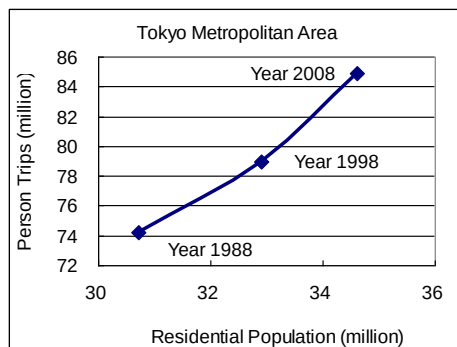
Commuting trips could be estimated based on the number of office workers; employees and customers

in the commercial area; and residents. The number of commuting trips in Bangkok is assumed at about 2.0 trips, and other trips beyond 2.0 should be assumed as a trip for other purposes. Except for people who have more than one working place, the purpose of the trips beyond 2.0 should be treated as business, social visit, shopping, etc. Share of purpose of trips in Bangkok and other cities in Asia is as shown in Figure 5.1.11, for reference.

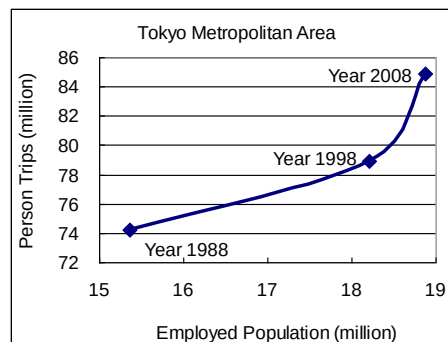
Table 5.1.12 Forecast Framework

			DESTINATION			
			SRT (1-5)	Redevelopment Zone (6-13)	City (14-15)	
ORIGIN	SRT	1 Dark Red Line	Transshipment passenger at Bang Sue Station	Passengers getting off from Bang Sue to redevelopment area	Passengers getting off to the other area	Total number of passengers getting off at Bang Sue
		2 Light Red Line				
		3 Long Distance Train				
		4 High-speed Rail				
		5 Airport Rail Link				
	Redevelopment Zone	6 Bus Terminal	Passengers getting on to Bang Sue from redevelopment area	Intra traffic in redevelopment area except for Bang Sue Station	Generated trips from redevelopment area by non-SRT way	Outflow trips from redevelopment area
		7 SRT Land				
		8 A1+A2				
		9 B				
		10 C				
		11 D (West)				
		12 D (East)				
		13 KM11				
City	14 Blue Line	Passengers getting on from the outside area	Attracted trips to redevelopment area by non-SRT way	*) Outside	*) Outside	
	15 BTS/Bus/Car/Taxi/sFoot					
	Total	Total number of passengers getting on at Bang Sue	Inflow trips to redevelopment area	*) Outside		

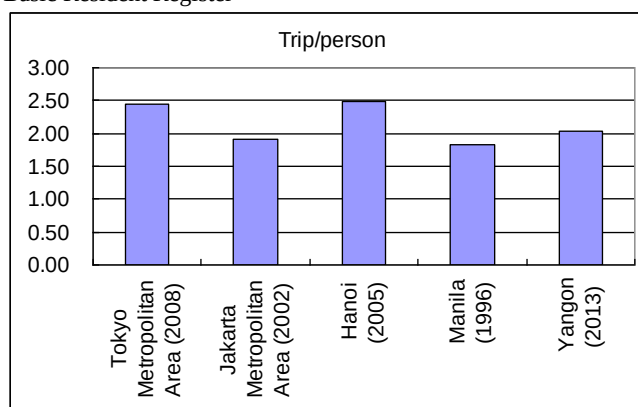
Source: JST



Source: Tokyo Metropolitan Area Person Trip Survey and Basic Resident Register

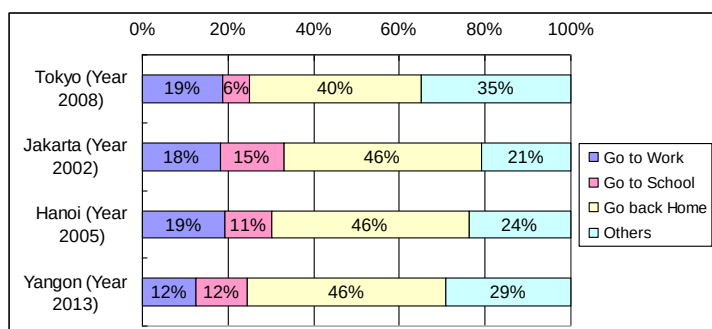


Source: Tokyo Metropolitan Area Person Trip Survey and Basic Census

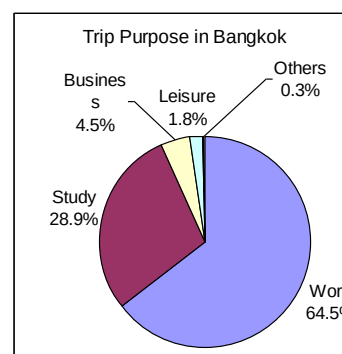


Source: Tokyo Metropolitan Area Person Trip Survey (2008), Jakarta STRADA JICA (2002), Hanoi HAIDEP JICA (2005), Manila MMUTIS JICA (1996), Yangon YUTRA JICA (2013)

Figure 5.1.10 Examples of Person Trips per Person per Day



Source: Tokyo Metropolitan Area Person Trip Survey (2008), Jakarta STRADA JICA (2002), Hanoi HAIDEP JICA (2005), Manila MMUTIS JICA (1996), Yangon YUTRA JICA (2013)



Source: Red Line Study

Figure 5.1.11 Share of Purpose of Trips in Bangkok and Other Cities in Asia

The character of Bang Sue Area is a business and commercial area and visitors come mainly for work, shopping or events. Therefore, extra trips other than basic 2.0 trips for commuting is assumed as shown in Table 5.1.13.

Table 5.1.13 Assumption of Extra (Non Commuter) Trips in Bang Sue Area

One Way (Generated/Attracted)	Inter Trips	Intra Trips
Office	1.3	0.1
Commercial	1.0	0.2
Resident	1.1	0.2
Hotel	1.2	0.1
Convention	1.0	0.2

Source: JST

(3) Estimated Modal Share

The modal share of train in Bang Sue Area is estimated to reach 40% in the future. It is assumed that the transfer rate between different lines will be 50%-65%. The transfer rate between different directions of long-distance train and high-speed railway is also assumed at 50%-65%.

After subtracting the number of passengers on long-distance train and high-speed railway from generated/attracted passengers in Bang Sue Area, passengers from the area are divided into other transport modes.

The inter city bus utilization rate is supposed to be 20% of those who come out from the station or who are in Bang Sue Area, and do not use the commuter trains. The rest are supposed to use other modes such as buses, cars, taxis, and so on. It should be considered that several transportation modes are required to access from zones in Bang Sue Area to Bang Sue Grand Station since some zones are located not within walking distance from Bang Sue Grand Station.

In Japan, the access area to a train station is usually planned within 150 m from a station. The passenger attraction rate of a station gradually decreases until the distance of 500 m, and for over 500 m, other access modes will be required. Considering the temperature and the climate in Bangkok, it would be appropriate to estimate that the maximum comfortable walking distance outside is maximum 500 m or rather less.

(4) Railway Passenger to Bang Sue Grand Station from Bang Sue Area (One Way)

Based on estimations above mentioned, generated trips in Bang Sue Area is estimated as shown in Table 5.1.14. For estimation, the Scenario 2, i.e. the case of integrated development which is explained in Chapter 6, and its planned floor area in Chapter 7 was applied as a condition of estimation.

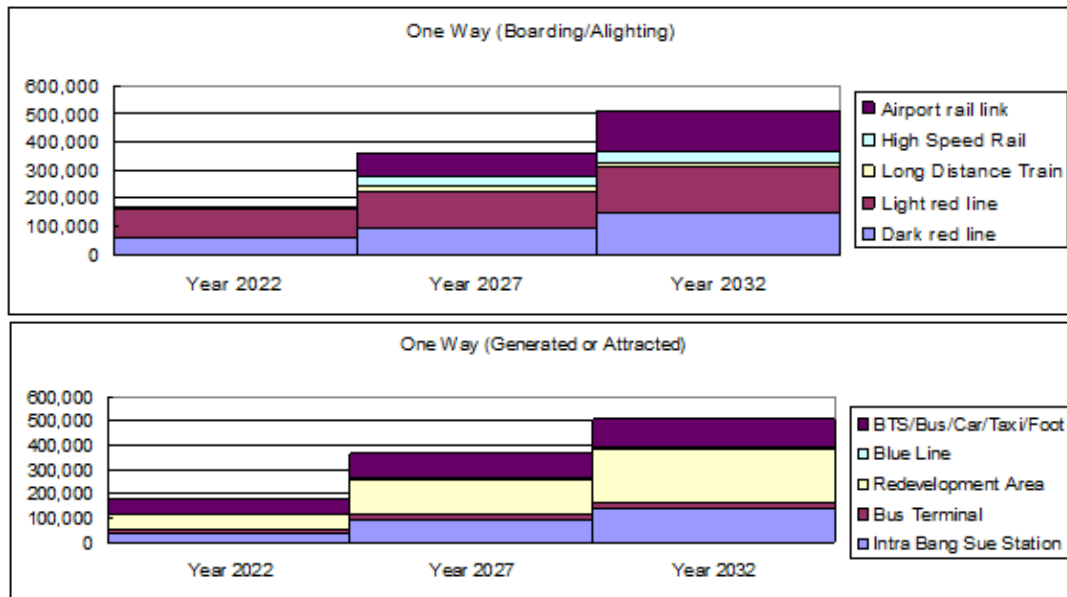
Table 5.1.14 Generated Trips in Bang Sue Area

Zone	Estimated Passengers (people/day)		
	Year 2022	Year 2027	Year 2032
SRT Land & F	113,600	233,800	233,800
A	17,500	17,500	17,500
B	0	0	97,600
C & I	0	49,800	67,400
D	4,500	4,500	117,400
H	0	0	36,300
KM11	0	54,000	54,000
Total	135,600	359,600	624,000
(Inter Trips)	116,100	305,300	529,900

Source: JST

(5) Forecasted Number of Passengers in Bang Sue Grand Station

Based on abovementioned analysis and assumptions, as the final result of forecasting, the number of railway passengers in Bang Sue Grand Station is estimated as shown in Figure 5.1.12. The number of passengers is almost at the same scale of Ueno Station including JR, Keisei, and subway (Ginza Line, Oedo Line, and Hibiya Line).



Source: JST

Figure 5.1.12 Passenger Estimation of Bang Sue Grand Station

Table 5.1.15 Passenger Estimation of Bang Sue Grand Station

One Way (Boarding or Alighting)	Year 2022	Year 2027	Year 2032
Dark Red Line	58,352	94,702	144,755
Light Red Line	101,989	132,421	169,598
Long-distance Train	13,389	14,303	14,954
High-speed Rail	0	35,170	40,374
Airport Rail Link (Red Line)	0	86,586	137,188
Total	173,730	363,182	506,870

From or To	Year 2022	Year 2027	Year 2032
Intra Bang Sue Station	37,395	92,839	136,836
Bus Terminal	13,365	24,141	27,540
Redevelopment Area	60,122	139,005	220,150
Blue Line	9,389	10,631	12,184
BTS/Bus/Car/Taxi/Foot	53,458	96,565	110,160
Total	173,730	363,182	506,870
Total (From Entrance of Bang Sue Grand Station)	136,334	270,343	370,034

Note: Passengers to Blue Line is not included in the table.

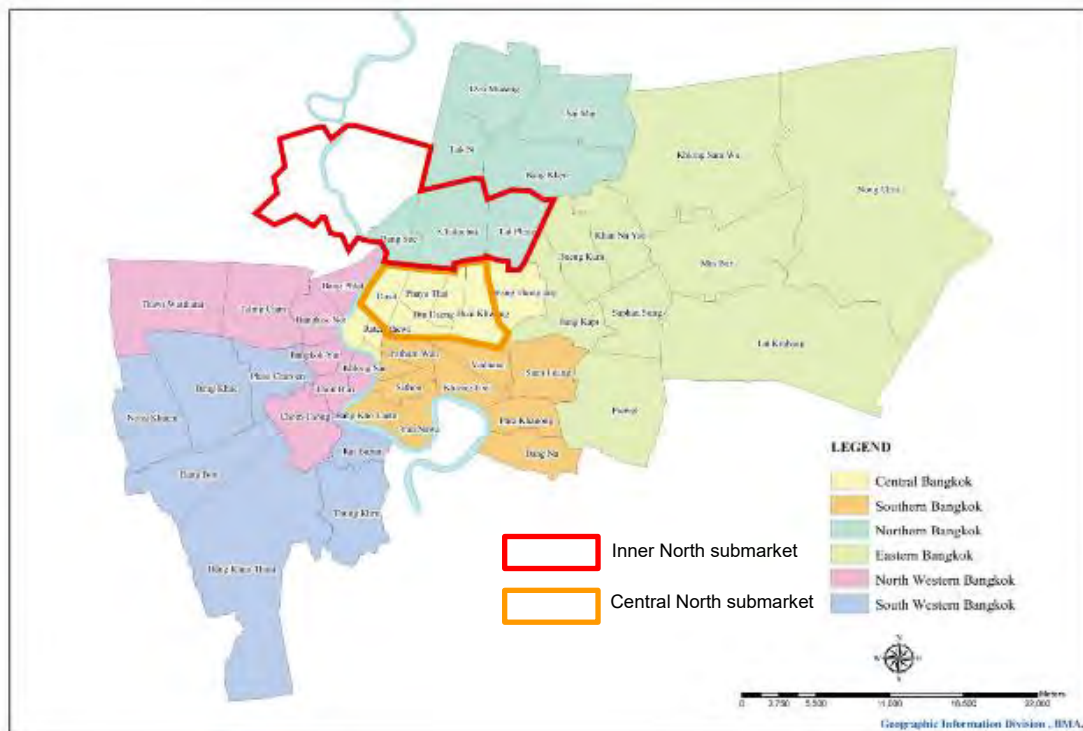
Source: JST

5.2 Property Demand in Bangkok and its Environs

The future property demand in Bang Sue Area is estimated based on the recent property market data which contains the property stock from 2006 to 2016, and the planned floor area from 2017 to 2021. It is assumed that the market demand is naturally covered by market supply; therefore, the estimated future supply will be considered as future demand.

5.2.1 Property Submarkets in Bangkok and its Environs

The area of Bangkok and its environs is divided into 12 submarkets as shown in Figure 5.2.1. Bang Sue Area is located at Chatuchak District in the Inner North submarket. Therefore, the estimation of the future supply will focus on the share of Inner North submarket and Chatuchak District in Bangkok and its environs. The share of Central North submarket, which is located just next to Bang Sue Area, will be given attention too.



Source: JST

Figure 5.2.1 Property Submarket in Bangkok and its Environs

Table 5.2.1 Districts and Counties in Each Submarket

Submarket	Districts
Central Bangkok	Bang Rak, Pathum Wan, Sathorn
Central East	Khlong Toey, Wattana
Central South	Bang Kho Laem, Yannawa
Rattanakosin	Phra Nakhon, Prom Pap Sattru Phai, Samphanthawong
Central North	Din Daeng, Dusit, Huay Kwang, Phaya Thai, Ratchathewei
Inner North	Bang Sue, Chatuchak, Lat Phrao, Muang Nonthaburi
Outer North	Bang Khen, Don Muang, Lak Si, Sai Mai, Pak Kret, Muang Pathum Thani, Khlong Luang, Thanyaburi, Nong Suea, Lat Lum Kaeo, Lam Luk Ka, Sam Khok
Inner West	Bang Phlat, Bangkok Noi, Bangkok Yai, Chom Thong, Khlong San, Pasi Charoen, Rat Burana, Taling Chan, Thonburi
Outer West	Bang Bon, Bang Khae, Bang Khun Thien, Nong Khaem, Thawi Wattana, Thung Khru, Phra Samut Chedi, Bang Kruai, Bang Yai, Bang Bua Thong, Sai Noi
South	Bang Na, Phra Kanong, Muang Samut Prakan, Phra Pradaeng
Inner East	Bang Kapi, Bung Kum, Khan Na Yao, Prawet, Saphan Sung, Suan Luang, Wang Thonglang
Outer East	Khlong Sam Wa, Lat Krabang, Min Buri, Nong Chok, Bang Bo, Bang Sao Thong, Bang Phli

Note: Bang Sue Area locates at Chatuchak district in INNER NORTH Sub-market
Source: Jones Lang LaSalle

5.2.2 Past Stocks and Planned Floor Area until 2021 in Bangkok and its Environs

The past stocks from 2006 to 2016 and the planned supplies until 2021 in Bangkok and its environs are as shown in Figure 5.2.2, Figure 5.2.3, Figure 5.2.4, and Figure 5.2.5. The data of hotel is only available from 2008.

(1) Office

The office floor stock of Bangkok and its environ is 7,375,975m² in 2006, and 8,626,664m² in 2016. Its planned floor area in 2021 will be 9,977,252 m². The growth rate of the stock in 15 years, from 2006 to 2021, will be approximately 135 %.

(2) Retail

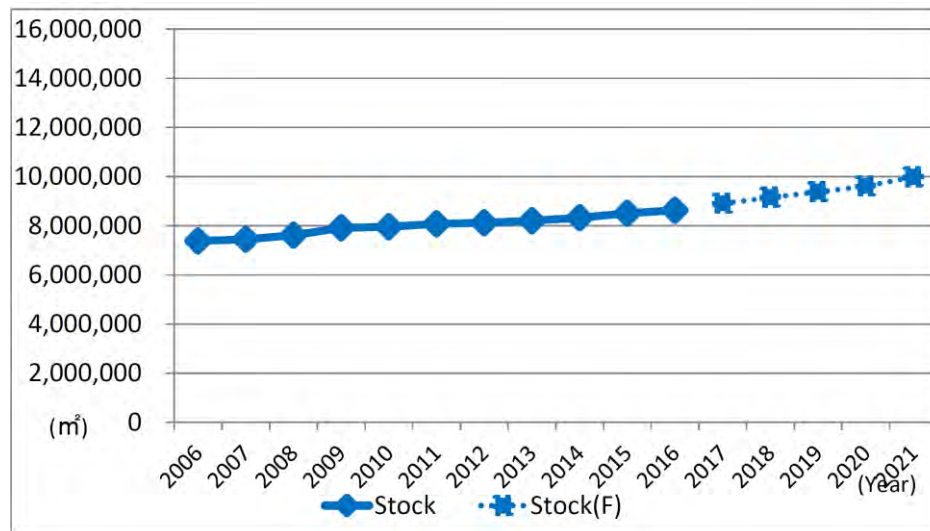
The retail floor stock of Bangkok and its environ are 7,293,476 m² in 2006 and 12,203,808 m² in 2016. The planned floor area in 2021 will be 14,992,162 m². The growth rate of the stock in 15 years, from 2006 to 2021, will be approximately 200%.

(3) Condominium

The condominium unit stocks of Bangkok and its environs are 54,836 units in 2006 and 444,882 units in 2016. The planned floor area in 2021 will be 584,061 units. The growth rate of the stock in 15 years, from 2006 to 2021, will be approximately 1,000%.

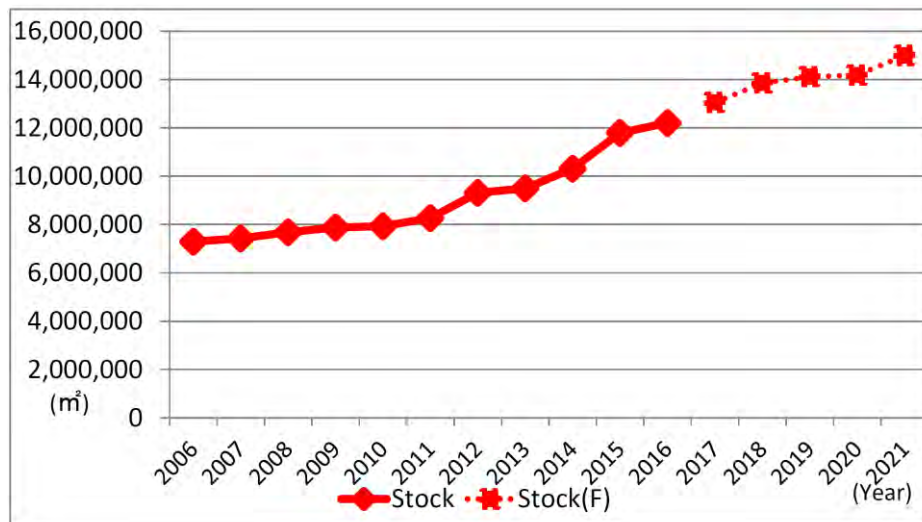
(4) Hotel

The hotel room stocks of Bangkok and its environs are 2,297 rooms in 2008 and 20,620 rooms in 2016. The planned stock in 2021 will be 27,753 rooms. The growth rate of the stock in 11 years, from 2008 to 2019, will be approximately 1,200%.



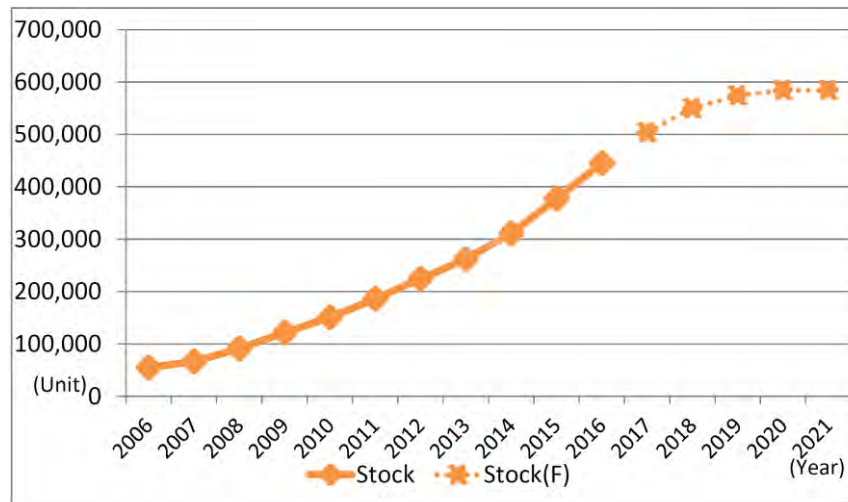
Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.2 Past Stocks and Planned Floor Area until 2021 in Bangkok and its Environs (Office)



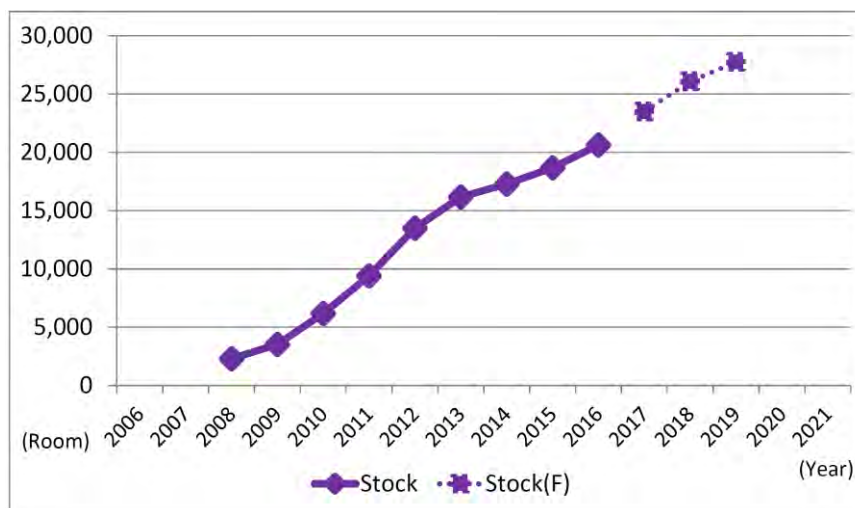
Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.3 Past Stocks and Planned Floor Area until 2021 in Bangkok and its Environs (Retail)



Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.4 Past Stocks and Planned Units until 2021 in Bangkok and its Environs (Condominium)



Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

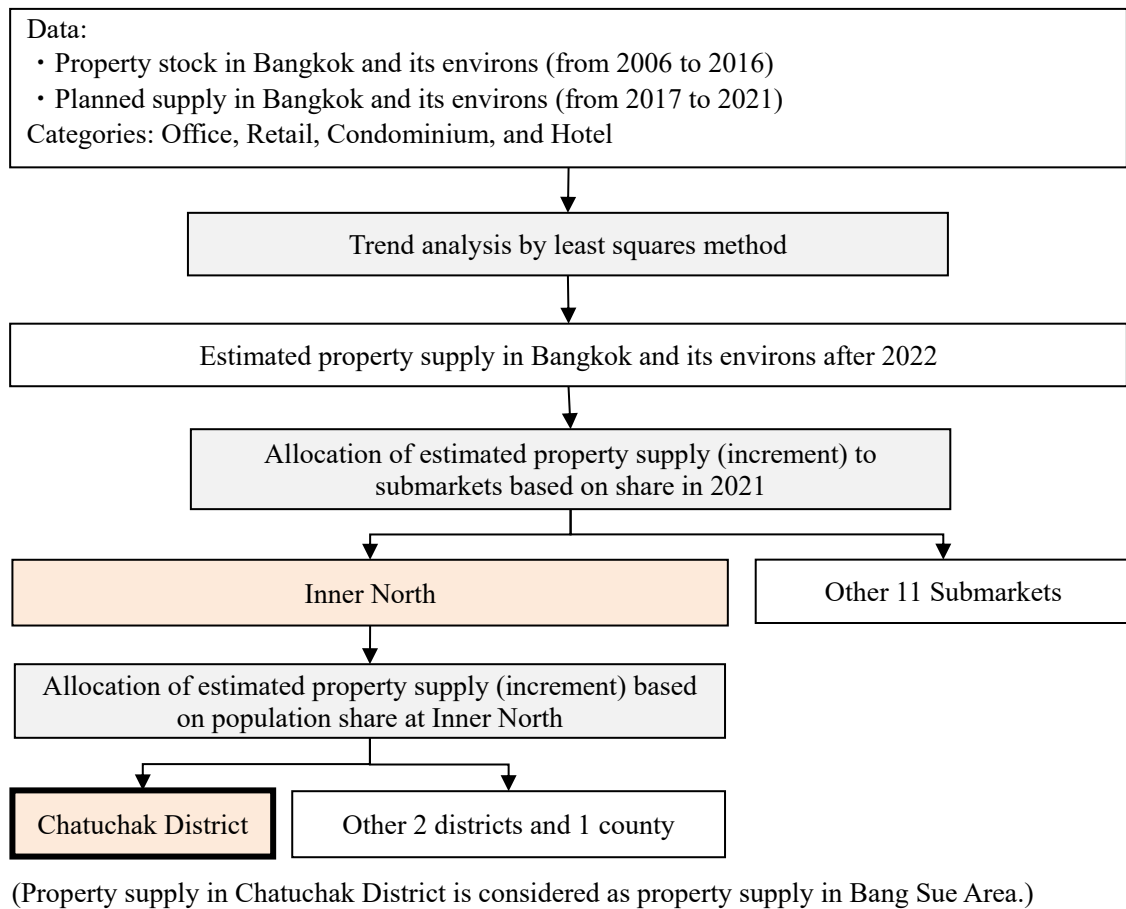
Figure 5.2.5 Past Stocks and Planned Rooms until 2021 in Bangkok and its Environs (Hotel)

5.2.3 Approach to Estimate Property Supply in Bang Sue Area after 2022

(1) Methodology and Process

The estimation of property supply in Bang Sue Area after 2022 follows the process as shown in Figure 5.2.6.

Firstly, the future property supply in Bangkok and its environs is estimated by least squares method based on the past trend and the planned floor supply. Secondly, the estimated supply in Bangkok and its environs is allocated to Inner North, based on the share of each submarket in 2021. Finally, the allocated supply of Inner North is allocated again to Chatuchak District based on the population share of three districts and one county at Inner North. The allocated future supply of Chatuchak District is considered as the future supply in Bang Sue Area.



Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.6 Process of Future Property Supply in Bang Sue Area

(2) Estimation of Future Property Supply in Bangkok and its Environs

The future property supply is estimated by least squares method based on the past trend and the planned floor supply. The least squares method formulas for office, retail, condominium, and hotel are shown below.

1) Office

- Data: The office floor stock from 2006 to 2016 and the planned office floor area from 2017 to 2021 in Bangkok and its environs².
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	$= a \times x + b$
	$= (a)159,210 \times \ln(x) + (b)7,093,958$
x : Years	r-squared : 0.9601

² Jones Lang LaSalle

2) Retail

- Data: The retail floor stock from 2011 to 2016 and the planned retail floor area from 2017 to 2021 in Bangkok and its environs³. Since there are different trends of supply from 2006 to 2010 and from 2011 to 2016, the data from 2011 to 2016 was selected as base data.
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	$= a \times x + b$
	$= (a) 7,101,361 \times \ln(x) + (b) 4,748,188$
x : Years	r-squared : 0.9806

3) Condominium

- Data: The condominium unit stock from 2006 to 2016 and the planned condominium units from 2017 to 2021 in Bangkok and its environs⁴.
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	$= a \times x + b$
	$= (a) 41,336 \times \ln(x) + (b) 33,460$
x : Years	r-squared : 0.9763

4) Hotel

- Data: The hotel room stock from 2008 to 2016 and the planned hotel rooms from 2017 to 2019 in Bangkok and its environs⁵.
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	$= a \times x + b$
	$= (a) 2,367 \times \ln(x) + (b) 4,707$
x : Years	r-squared : 0.9871

5) Estimated Result

The general trend of estimated property supply in Bangkok and its environs after 2022 is as shown in Figure 5.2.7 and Table 5.2.2.

³ Jones Lang LaSalle

⁴ Jones Lang LaSalle

⁵ Jones Lang LaSalle

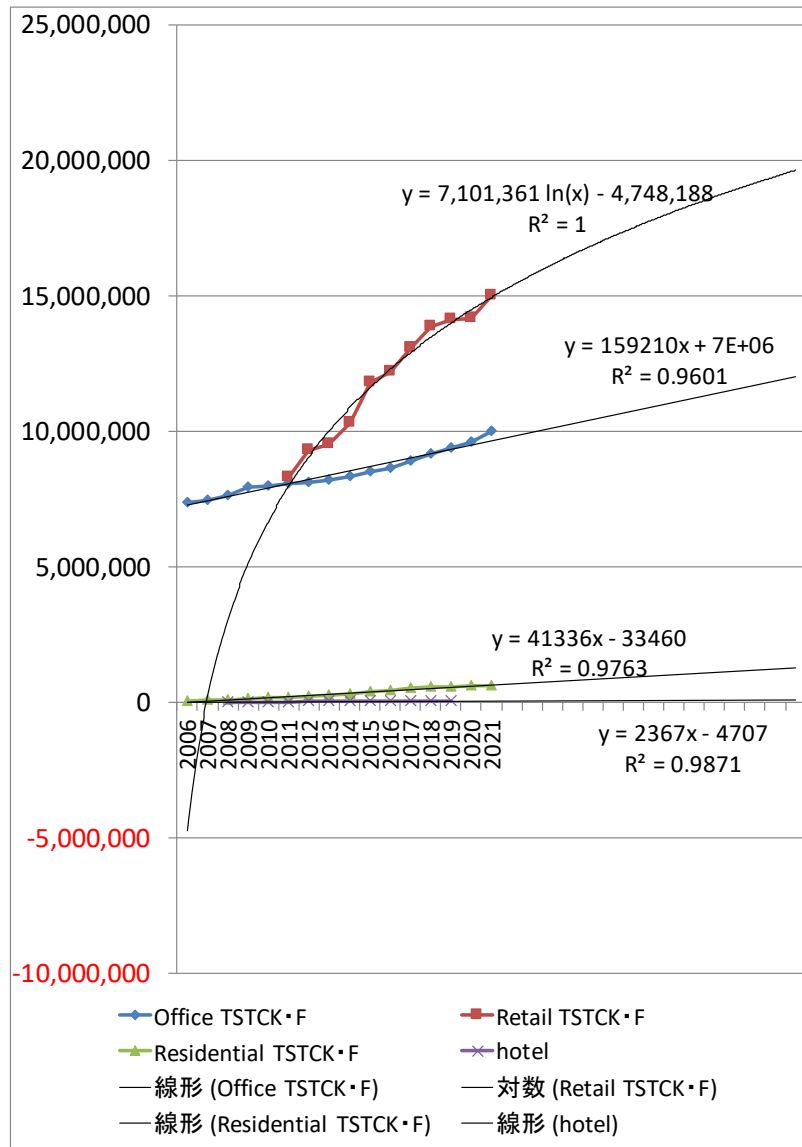


Figure 5.2.7 Past Record and Estimated Trend of Property Supply in Bangkok Property Market

Table 5.2.2 Estimated Property Stock in Bangkok and its Environs after 2022

	Office (m ²)	Retail (m ²)	Condominium (unit)	Hotel (room)
2021 (Planned figure)	9,977,252	14,992,162	584,061	45,000
2027 (Estimated figure)	11,392,628	18,656,739	1,082,612	59,202
2032 (Estimated figure)	12,188,678	19,863,254	1,289,292	71,037
2037 (Estimated figure)	12,984,728	19,863,254	1,495,972	82,872

Note: In this report, the estimated supply will be considered based on market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

5.2.4 Shares of Central North and Inner North Submarkets in Property Supply in Bangkok and its Environs

The shares of Central North and Inner North submarkets in the property supply in Bangkok and its environs are as shown in Table 5.2.3, Table 5.2.4, and Table 5.2.5. Data of the hotel room stock and plan in each submarket is not available.

The share of office grows from 2016 to 2021, both in Central North and Inner North. The growth in Central North, which is closer to CBD than Inner North, is outstanding.

Regarding retail, the share of Central North grows firmly, but the trend of Inner North is unclear.

Regarding condominium, comparing the shares in 2006 and 2021, the share of Central North declines. On the other hand, the share of Inner North grows significantly. In fact, along Phahon Yothin Road around Bang Sue Area at the Inner North, many condominiums under construction can be found, as of October 2017.

Table 5.2.3 Share of Property Supply in Bangkok and its Environs (Office)

	2006	2016	2021
Central North	20.6%	22.5%	24.6%
Inner North (including Bang Sue Area)	10.3%	10.9%	11.1%

Note: In this report, the estimated supply will be considered based on market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

Table 5.2.4 Share of Property Supply in Bangkok and its Environs (Retail)

	2006	2016	2021
Central North	6.9%	7.8%	9.4%
Inner North (including Bang Sue Area)	7.8%	10.1%	8.3%

Note: In this report, the estimated supply will be considered based on market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

Table 5.2.5 Share of Property Supply in Bangkok and its Environs (Condominium)

	2006	2016	2021
Central North	16.8%	15.2%	14.5%
Inner North (including Bang Sue Area)	5.5%	15.8%	17.1%

Note: In this report, the estimated supply will be considered based on market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

Upon these data, the shares in 2021 shown below are applied to allocate the estimated property supply to Inner North.

- 1) Office : 11.1%
- 2) Retail : 8.3%
- 3) Condominium : 17.1%
- 4) Hotel : 11.1% (Share of hotel is assumed the same as that of office)

5.2.5 Share of Chatuchak District in Property Supply at the Inner North

The population share among three districts and one county in Inner North is as shown in Table 5.2.6. It is hypothesized that the share of Chatuchak District in property supply in Inner North will be in parallel with the share of population. Therefore, the population share of Chatuchak District, which is 22.7%, is applied to allocate the estimated property supply to Chatuchak District.

Table 5.2.6 Share of Population at the Inner North

	Bang Sue	Chatuchak	Lat Phrao	Mueang Nonthaburi	Total
Population	126,136	158,130	121,000	332,388	405,266
Population Share	18.1%	22.7%	17.4%	41.8%	100.0%

Source: JST based on data of BMA for Bang Sue, Chatuchak, Lat Phrao, data of World Atlas for Mueang Nonthaburi

5.2.6 Property Supply in Chatuchak District after 2022 (Scenario 0 as a Basic Trend)

The property supply in Chatuchak District (original estimation) in 2027, 2032, and 2037 is as shown in Table 5.2.7.

In 2032, the estimated property supply figures are as follows:

- 1) Office: 55,704 m² (Net Floor Area)
- 2) Retail: 91,748 m² (Gross Floor Area)
- 3) Condominium: 27,367 units
- 4) Hotel: 656 rooms

Table 5.2.7 Property Stock and Increment in Chatuchak District after 2022

Office (NLA/m²)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase (m ²)	Chatuchak Increase (m ²)
2021	9,977,252	—		1,107,475		0
2027	11,392,628	1,415,376	1,415,376		157,107	35,652
2032	12,188,678	796,050	2,211,426		245,468	55,704
2037	12,984,728	796,050	3,007,476		333,830	75,756

Retail (GFA/m²)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase (m ²)	Chatuchak Increase (m ²)
2021	14,992,162	—		1,244,349		0
2027	18,656,739	3,664,577	3,664,577		304,160	69,023
2032	19,863,254	1,206,514	4,871,092		404,301	91,748
2037	20,894,244	1,030,990	5,902,082		489,873	111,167

Codominium (unit)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase (unit)	Chatuchak Increase (unit)
2021	584,061	—		99,874		0
2027	1,082,612	498,551	498,551		85,252	19,346
2032	1,289,292	206,680	705,231		120,595	27,367
2037	1,495,972	206,680	911,911		155,937	35,387

Hotel (room)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase (room)	Chatuchak Increase (room)
2021	45,000	—		4,995		0
2027	59,202	14,202	14,202		1,576	358
2032	71,037	11,835	26,037		2,890	656
2037	82,872	11,835	37,872		4,204	954

Note: In this report, the estimated supply will be considered based on market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

Chapter 6 Redevelopment Concept Paper and Scenario

6.1 Examination Fields and Progress

Essential urban development-related study fields were examined to elaborate a concept paper.

The examination fields and result are as shown in Table 6.1.1.

Table 6.1.1 Study Fields and Result

No.	Examination Field	Contents
1	Vision	• Manifestation of future urban development based on socioeconomic trend related to Bang Sue Area.
2	Basic policies	• Technical, financial, and organizational methods to realize the spatial development in the vision.
3	Spatial structure and formation of the area	• Whole concept of the methods for spatial development as shown in 1-3 of “Basic policies”.
4	Urban functions	• Urban functions needed in Bang Sue Area deriving from superior plans, market demand, and lessons learned from Japan.
5	Infrastructure to realize the urban functions	• Kinds and scale of infrastructure necessary for realizing the urban functions and floor supply.
6	Energy infrastructure	• Water, gas, electric power, cogeneration as well as common duct utility control system.
7	Road networking Route assignment plan	• Planning of an efficient and safe road network. • Analysis on traffic volume and inflow of people in terms of traffic capacity allowed in the area.
8	Area traffic management	• Area traffic management including BRT.
9	Preparedness against natural disasters/ BCP	• Basic policy for disaster preparedness including measures against flooding. • Content of BCP.
10	Accessibility to/ from Bang Sue Station	• Upgrading users’ comfort and area networking by providing skywalks, sky decks, an underground shopping area, elevators, escalators, etc.
11	Land use and related policies	• Land use planning analyzed in terms of urban functions, floor supply, infrastructure, road networking, and area traffic management. • Guidelines for management of land use and area designing.

Source: JST

6.2 Vision

Bangkok stood the first in the top 20 global destination cities by international overnight visitors in 2016, drawing away from other worldwide major cities like London, Paris, Dubai, New York, Singapore, Kuala Lumpur, Istanbul, Tokyo, etc. Nowadays, Bangkok is considered as one of the major hubs in terms of international movement of people. At the same time, the worldwide interurban competition is getting more and more severe in terms of attracting blue-chip companies, excellent human resources, international conventions, and inbound tourists from foreign countries. In this context, it is important to share a clear development vision widely among all stakeholders with a view of enhancing sustainable development and interurban competitiveness of Bangkok and Bang Sue Area with efficient public and private investments.

Both Thai and Japanese sides basically agreed to embrace the following as Bang Sue Area urban

redemption vision. The “Gateway to City of Angels” implies high specifications for redemption to realize a dynamic and attractive urban core, where people from all over the world get together for joy and creation.

Concept paper is as shown in Appendix 6-1.



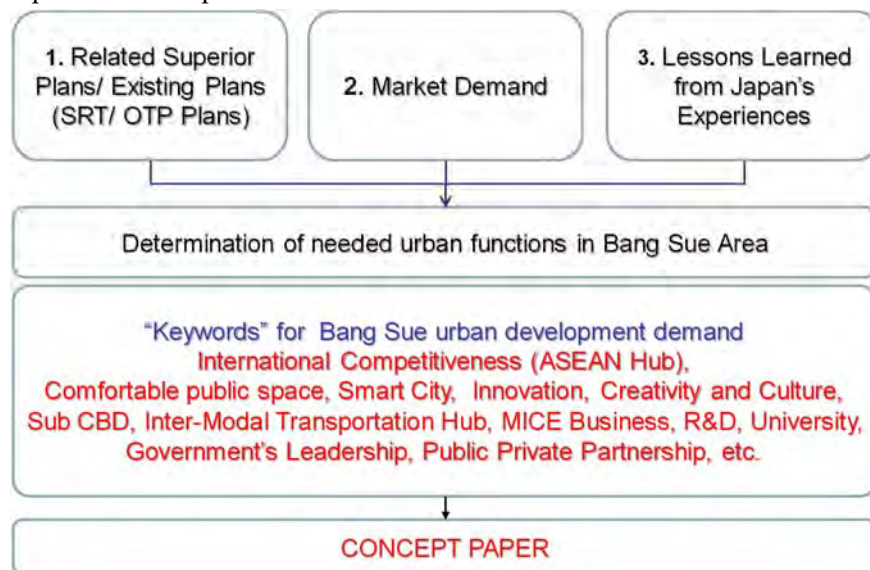
6.3 Development Concept Paper

6.3.1 Urban Functions Needed for Bang Sue Area

Urban functions needed for Bang Sue Area are derived as shown below.

(1) Points of View to Consider Urban Functions Needed for Bang Sue Area

Figure 6.3.1 represents three points of view to consider urban functions needed for Bang Sue Area.



Source: JST

Figure 6.3.1 Three Points of View to Consider Urban Functions Needed for Bang Sue Area

(2) Three Points of View

1) Related Superior Plans/ Existing Plans (SRT/ OTP Plans)

Urban functions required for Bang Sue Area in the superior plans are as shown in Table 6.3.1.

“Thailand 4.0” focuses on medical and wellness, digital IoT, and technological innovation, while socioeconomic plans focus on human resource development, economic competitiveness, and green

development. Thailand has a national policy for enhancing meetings, incentives, conferencing, exhibitions (MICE) in Bangkok by public-private partnership (PPP). The Mass Rapid Transit Master Plan in Bangkok Metropolitan Region (M-MAP) considers Bang Sue Area as one of the intermodal nodes in Bangkok. The Bangkok Comprehensive Plan defines the maximum Floor Area Ratio (FAR) in Bang Sue Area as 800%.

Thus, Bang Sue Area is designated as one of the largest urban development cores in Bangkok and the whole Thailand.

Table 6.3.1 Urban Functions Required for Bang Sue Area in the Superior Plans

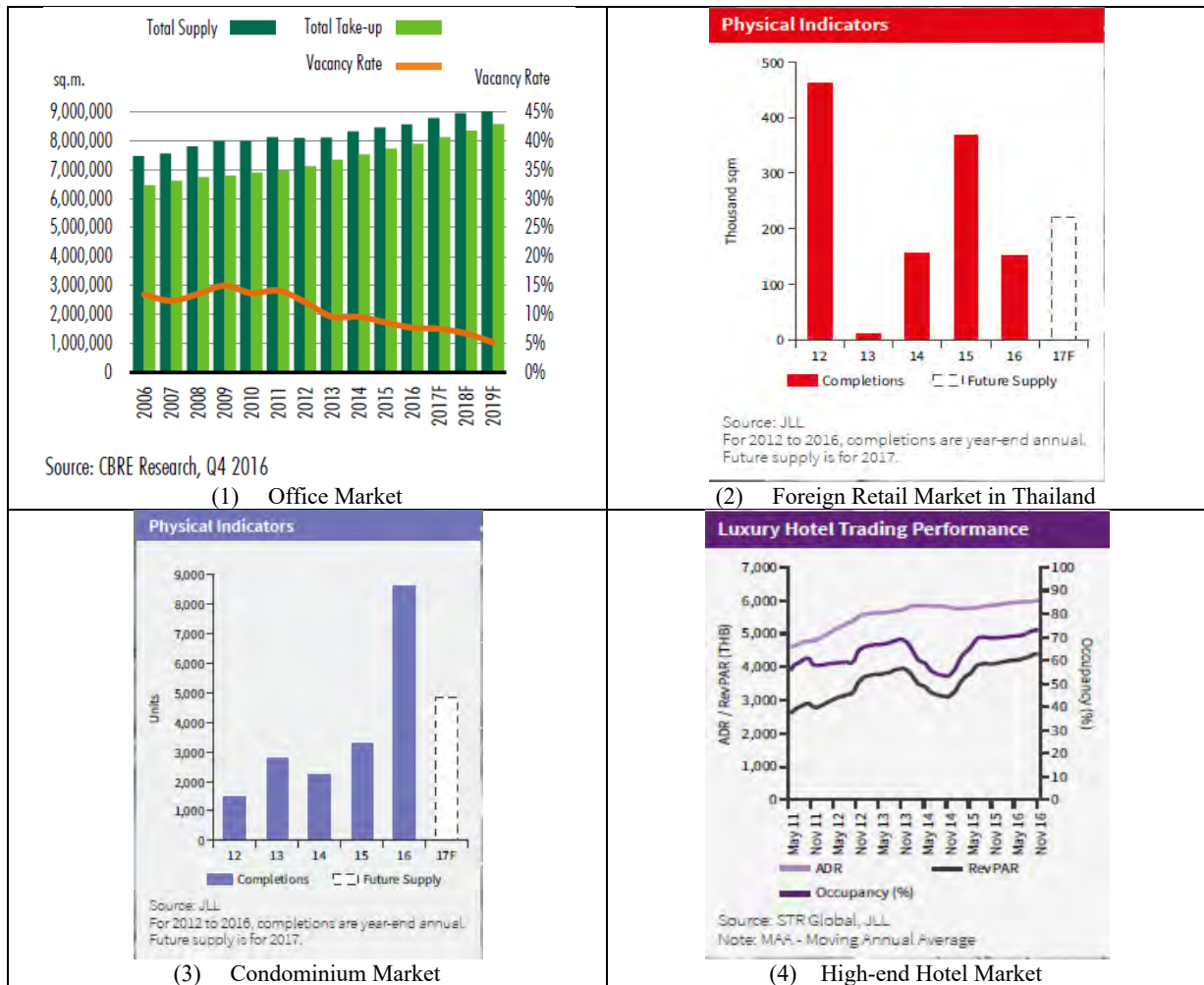
Category	Name of Plan	Keywords related or applicable to Bang Sue Area
Industrial	Thailand4.0	1. Medical, Wellness, 2. Digital IoT, 3. Innovation, Culture and high-valued service in five new categories - Keyword for innovation: Smart City, Low-carbon society, Medical Hub, etc.
Economic/Social	The 20-year national strategic plan	"Green Development" in six areas 1. Enhancing Human Resource, 2. Strengthen economy and competitiveness, 3. Green Development in six primary strategies
Economic/Social	The 12th Plan (2017~2021)	- Enhancing Human Resource, Green Development "Science Technology, Research and Innovation"
Other specific strategy	MICE Strategy	- Thai Government actively promotes MICE under collaboration of government and private sector. - Public Organization: Thailand Convention & Exhibition Bureau (TCEB) - Private sector (association): Thai Exhibition Association (TEA)
Transport	UR-MAP, M-MAP	Inter-Modal Nodes
Urban Planning	The Bangkok Comprehensive Plan (2013)	Bang Sue area : Commercial Zone, FAR 8:1 (sub CBD)

Source: JST

2) Market Demand

The recent market demand for office, condominium, and high-end hotel is generally up trending.

Recent property market demand in Bangkok is as shown in Figure 6.3.2. The floor area of foreign retail also has been increasing with some fluctuations for several years. Presently, Bangkok seems to have a steady property demand to some extent.



Resource: CBRE/ JLL HP

Figure 6.3.2 Recent Property Market Demand in Bangkok

3) Lessons Learned from Japanese Experiences

The Thai side has visited main cities in Japan, e.g., Yokohama, Saitama, Osaka, Nagoya, Fukuoka, etc., to learn lessons from existing developments. The tips for success in Bang Sue Area development are as shown in Table 6.3.2: Land Mark Tower (Yokohama), civic center with direct connection to the station (Saitama), sky decks/ incubation office/ knowledge center (Osaka), academic organizations (Nagoya), feeder bus terminal connected to the central railway station (Fukuoka).

Table 6.3.2 Tips for Success in Bang Sue Area Development

City and Area In Japan	Important Point of View	What we can propose for Bang Sue Area development?
1. YOKOHAMA Minato-mirai-21	➢ "Landmark Tower" ➢ Stepwise development	✓ A landmark high-rise with symbolic design (SRT Land)
2. SAITAMA Saitama City New Urban Core Area	➢ Government office buildings around the station	✓ MOT Governmental office building (Zone H)
3. OSAKA Ume-kita	➢ Practical flow line planning from/to Station ➢ Classy commercial space ➢ Comfortable walking space ➢ Permanent exhibition space ➢ Entrepreneur incubation office space ➢ Knowledge capital	✓ Commercial strategy/ Flow line from/to Station (Sky decks in Zone A and around Station) ✓ Permanent exhibition space for new high-tech products and incubation office space (Zone F/ SRT Land) ✓ R&D related facilities (Zone I)
4. NAGOYA Nagoya Station Area including Sasashima-Live-24	➢ AICHI University Nagoya Campus	✓ Academic institutes including universities (Zone I)
5. FUKUOKA Hakata Station Area	➢ Integrated and useful bus terminal with good access to commercial space ➢ Station plaza	✓ Integrated development of a feeder bus service terminal and commercial space (Zone A)

Source: JST

(3) Major Findings from the Points of View to Determine Needed Urban Functions in Bang Sue Area

The major findings from the Points of View to determine needed urban functions in Bang Sue Area are as shown in Table 6.3.3.

Table 6.3.3 Major Findings from the Points of View to Determine Needed Urban Functions in Bang Sue Area

Point of View	Major Findings in terms of Urban Development in Bang Sue Area	Urban Functions Needed for Bang Sue Area
1. Related Superior Plans/ Existing Plans (SRT/ OTP Plans)	☐ New urban core is needed maximizing the advantages of the best location as one of the main traffic nodes in Bangkok. ☐ Development policy for intellectual value-based industries. ☐ improvement in transport system	☐ Symbolic landmark tower building ☐ Entrepreneur incubation office ☐ R&D related facilities ☐ Medical, health & care related facilities ☐ New modal system development ☐ <i>Environmentally friendly & attractive development (including Smart City idea)</i> ☐ <i>Leadership in ASEAN Community</i>
2. Market Demand (in Bangkok)	☐ Property market is generally uptrending. ☐ Office/ Commercial/ Residential/ Hotel developments shall be the base of promising regular income for the landowner (SRT).	☐ Office/ Shopping center/ Condominium/ Hotel ☐ MICE related facilities (Arena/ Convention center/ Accommodations) ☐ <i>Appropriate development size</i>
3. Lessons Learned from Japan's Experiences	☐ Different urban functions which attract more and more people ☐ Access to/ from nearby stations ☐ Coordination between public and private/ PPP/ Stepwise development ☐ Environmentally and financially sustainable development	☐ Government office building ☐ Comfortable walking/ open space networking ☐ University/ Academic facilities ☐ Station plaza/ Sky plaza ☐ Integrated and useful bus terminal ☐ <i>PPP/ Public initiative/ Stepwise dev.</i>

**Italic font: Intangible functions*

Source: JST

(4) Urban Functions Needed in Bang Sue Area

The urban functions needed in Bang Sue Area derived from Table 6.3.3 are as shown in Table 6.3.4. The key functions are “Government Center”, “MICE Center” and “New Industry Incubation Center”. The collateral functions, which will be the main income source for the landowner, are office, commercial, residential, and hotel.

Table 6.3.4 Urban Functions Needed in Bang Sue Area

	Function 1	Function 2	Function 3
<u>Challenging points</u>	<u>Government hospitality for visitors/ comfortable and creative public space</u>	<u>Further diversification of visitors' purposes</u>	<u>Enhancement of R&D, Intellectual Industry</u>
<u>Key function</u>	<u>Government Center</u> • Gov. building • Museum	<u>MICE Center</u> • Arena/ Convention hall	<u>New Industry Incubation Center</u> • University • Incubation office spaces
<u>Expected effects</u>	• Ensure the ridership of new railways • Allow rapid infrastructure development	• Ensure the ridership of new railways • Make the best use of potential business chances	• Ensure the ridership of new railways • Initiate the country's industrial policy
<u>Collateral functions</u>	• Office • Commercial • Residential • Hotel		

Note: MICE=Meeting/Incentive Travel/Convention/Event
Source: JST

6.3.2 Development Concept Paper (Draft)

The essence of the draft “Development Concept Paper” is as shown in Table 6.3.5. The draft “Development Concept Paper” is as shown as Appendix 6-1.

Table 6.3.5 Essence of the Draft “Development Concept Paper”

No.	Essence	Contents
1	Objectives	• Year 2032, ten years later since Red Line’s inauguration, will be the target year of the present concept paper. • To clarify development concepts and actions among different stakeholders as common purposes. • To widely share, in the international community as well as inside the country, the development needs of CBD and the main roles of Bang Sue Area, which will be one of the main traffic terminals in Bangkok, emerging as a worldwide urban agglomeration.
2	Target Area	Bang Sue Grand Station and neighboring land
3	Vision	As shown in Section 6.2.
4	Basic Concept	<u>Concept 1:</u> To grow up to a centripetal urban core in Bangkok Metropolitan Area, which plays important roles in the international community. (1) To form an international and regional business and interaction center. (2) To ensure sustainability including safety and environmental friendliness. <u>Concept 2:</u> To create an eternally beloved new central district full of various attractiveness. (1) To create various attractions of urban life, from old to new, from a bustle of market places to ultramodern skyscrapers. (2) To create a comfortable walking space so that everyone would enjoy strolling along decks and paths in the area. <u>Concept 3:</u> To create a visitor-friendly traffic terminal area comfortable for everyone. (1) To create a world-class traffic terminal area comfortable for both Thai and foreign visitors. (2) To upgrade the user-friendliness in terms of transfer by creating public spaces. <u>Concept 4:</u> To stepwisely realize the conceptual plan by both public and private sectors. (1) To enhance all kinds of partnership between public-private and private-private, beside a strong initiative by the public, in order to properly realize the conceptual plan.

Source: JST

Urban functions to be assigned by zone are as shown in Table 6.3.6.

Table 6.3.6 Urban Functions to be Assigned by Zone

Zone		Urban Functions to be Assigned	Bang Sue Area Zones
Zone A	1	Office/ commercial/ hotel	
	2	Commercial	
Zone B	1,2	Residential, commercial, office	
	3,4	Commercial	
Zone C		Super arena or MICE facilities of the same kind	
Zone D	1	Hotel/ residential/ office/hospital (high-end constructions in expectation of the increase of foreign guests)	
	2	Residential/ commercial/ hotel/ office	
	3	Residential/ commercial/ hotel/	
	4	Residential/ office	
Zone E (SRT Land)	1,2	Office/ commercial (including a high-rise which will be one of the main landmarks of Bang Sue Area, Knowledge center and incubation office space) Civic center (future headquarters of MOT)/ residential	
	3	Residential	
Zone F	1	Commercial (retail shops to be constructed under skydecks around Bang Sue Grand Station)	
	2	Office /commercial (including amusement facility) /residential/ hotel	
Zone G (KM 11)		High-end residential (garden city with abundant greenery space)/ commercial/ office/ hospital/ school	
Zone H	1	Office/commercial/residential	
	2	Office/commercial/residential/hotel	
Zone I		Residential (high-rise condominiums)/ commercial	

Source: JST

6.4 Development Scenario

6.4.1 Development Scenario

There are two types of development, i.e.: Scenario 1 “Individual Development” and Scenario 2 “Integrated Development” as shown in Table 6.4.1 and Table 6.4.2.

Scenario 1 consists of individual development thoroughly by the private sector on an ad hoc basis, while Scenario 2 is a national project based on the country’s distinct policy for upgrading the whole value of Bang Sue Area with an integrated development to provide potential investors with maximum advantages.

Scenario 2 is based on the premise that Thai central government takes a strong initiative in the redevelopment in Bang Sue Area which is indispensable for ensuring an appropriate and effective positioning of urban functions described in Table 6.4.1 Table 6.3.1.

In the present report, it is Scenario 2 that is recommended in terms of effectiveness and sustainability

of the redevelopment.

Table 6.4.1 Comparison between “Integrated Development” and “Individual Development”

Development Framework/ Investment Condition		Scenario 1: Individual Development	Scenario 2: Integrated Development
Development Framework	M/P Positioning	M/P approved by SRT Board	M/P approved by Cabinet, designated as special development district
	M/P Contents	Primarily private development of office/retail/residential area, wherever feasible	Model case of TOD/Smart City with both public infrastructure and private development, orchestrated to maximize land value
	Implementation Structure	Implementation between SRT and Private	Implementation between Gov't, SRT and Private
	Coordination Process	Coordinate separately with each related agency	Establish “One Stop” window for accelerated coordination within special district
	Development Steps	Develop primarily based on availability of land	Step-wise development to maximize land value
Investment Condition	PPP Tender Process	Tender conditions and documents are developed top-down	Tender conditions and documents are developed interactively with inputs from private, so as to ensure bankability
	Leasehold Period	30 years	50 years (based on BMA special zone regulation)
	Government Support	Nothing specific	Tax incentives and longer grace period as part of special development district support

Expected Results

Usual private development. Profitability and economic effects are changed depending on developer's tendency.

Many bidders, A grade development, high profitability, significant economic benefit

Source: JST

Table 6.4.2 Key Consideration Points for Development Planning and Demand Forecast

Private/ Public	Floor use/ facilities	Scenario1: Individual Development	Scenario2: Integrated Development
Private Development Portion	Office	-Difficult to develop A grade skyscraper under 30 year leasehold condition. Suitable for back office demand, B grade, mid-low rise building.	-Possible to cultivate corporate HQ demand and develop A grade skyscraper. -However, balancing of office space supply is required. For example, ceiling supply set at 20% of total incremental supply forecast in North Bangkok area.
	Retail	-Limited to “flow-based” demand from terminal station pass-thru users. Primarily develop small-mid scale retail outlets to fulfill daily shopping needs.	-Both flow and stock (from office and residential dev) demand as catchment. Large scale retail development assuming destination shopping behavior.
	Hotel	-Business hotel to capture business trips from local cities, three star hotel.	-Capture international visitors, high grade, four to five star hotel.
	Condominium/House	-Difficult to justify landed house under 30year leasehold. Limited to apartments for short-term lease. Development area will need to be limited.	-Condominium and landed houses can be developed under 50year leasehold. Together with green network, prime residential district brand can be developed.
	MICE Facility	-MICE facilities are not feasible since it is difficult to develop as “destination” district.	-MICE facilities can be justified. However, size and function will need to take into account other competing MICE facilities in Bangkok.
Public Infrastructure Portion	Transport facilities (Inner zone roads, skywalk, park&ride, taxi bay, etc.)	-Limited gov't budget for inner zone transport. Private develops portions of transport facility, which may not be sufficient. As a result, transport convenience is sacrificed.	-Proactive development of transport facilities based on gov't budget and PPP availability payment scheme. Inner transport is extremely convenient and recognized as model case of TOD.
	Green and environment friendly network(park, green space, wind corridor, etc.)	-Coordination with city planning is delayed since this is SRT land solely developed by SRT. As a result, green network development is limited.	-Budgeting coordination with city planning is smooth, as this is cabinet approved special district. Ideal green network is developed, which will generate premium value for residential development and add to visitor demand generation.
	Basic utility (water treatment, electricity, gas), energy saving and other environment facilities	-Basic utility development requires coordination with multiple agencies, which could cause delay. Private is required to invest in own environment facilities, which sacrifices overall efficiency.	-“One stop” window allows coordinated planning and development of basic utilities. Budget/incentives for smart city related facilities are in place.

Source: JST

6.4.2 Adjustment of Demand Forecast for Scenario 2 (Integrated Development)

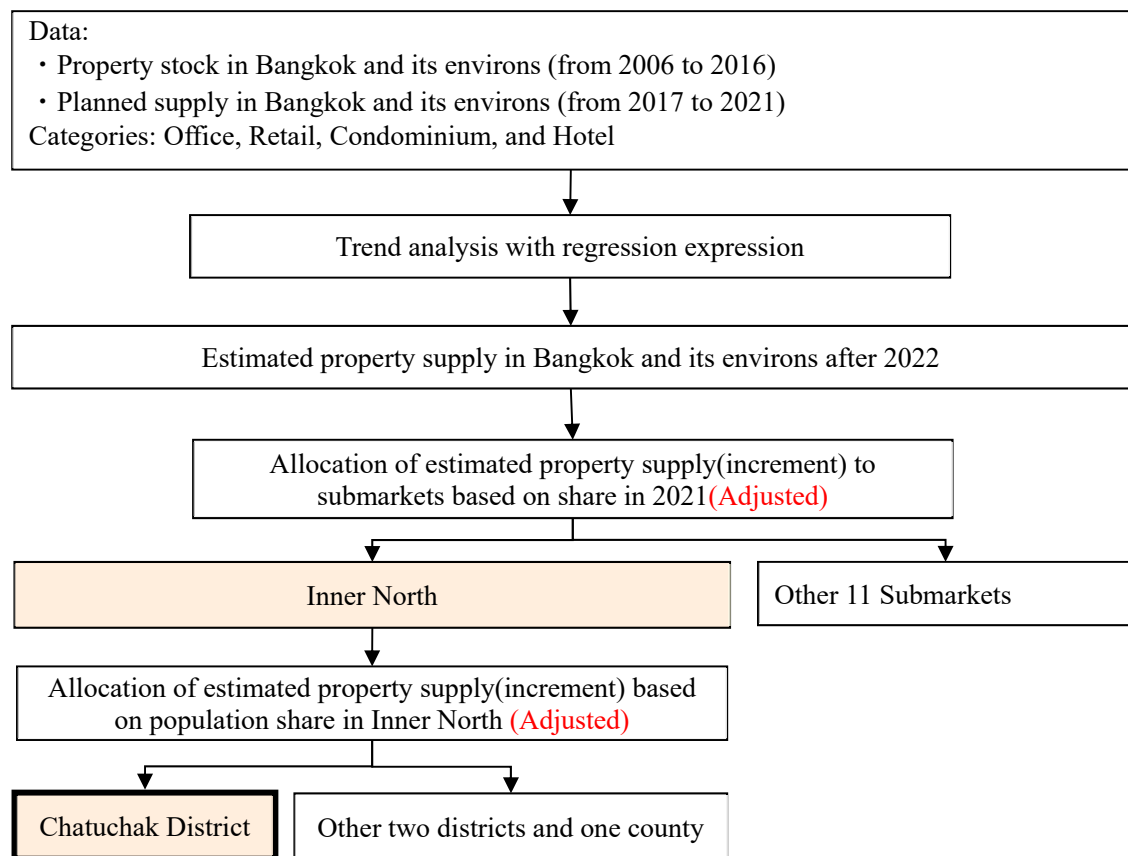
The property demand estimates after 2021 as shown in Section 5.2.4 are estimated by least squares method based on the past trend and the planned floor supply. Be that as it may, more demand will be expected with Scenario 2 (See Section 6.4.1), which is subject to maximizing the gross value added of the redevelopment through government initiative. Key points for development planning and demand forecast are considered in the present section.

(1) Methodology

With Scenario 2, it is considered that the additional value in Bang Sue Area would be maximized with the strong initiative of the Government of Thailand. Bang Sue Area would be more attractive and classy as newly developed urban core. In addition, there would be more demand of urban development around Bang Sue Area as transportation hub.

Therefore, in the present section, “shares of Inner North submarket in Bangkok and its environs” and “share of Chatuchak District in Inner North submarket” are adjusted for Scenario 2.

The process of estimation abovementioned and adjusted items is as shown in Figure 6.4.1.



(Property supply in Chatuchak District is considered as property supply in Bang Sue Area.)

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

Figure 6.4.1 Process of Future Property Supply in Bang Sue Area

(2) Estimation of Future Property Supply in Bangkok and its Environs

Estimated property supply in Bangkok and its environs after 2022 is as shown in Table 6.4.3.

Table 6.4.3 Estimated Property Stock and Increment in Bangkok and its Environs after 2022

	Office (m ²)	Retail (m ²)	Condominium(unit)	Hotel (room)
	(Total Stock)			
	(Total Supply after 2022)			
2021 (Planned figure)	9,977,252	14,992,162	584,061	45,000
2027 (Estimated figure)	11,392,628	18,656,739	1,082,612	59,202
	1,415,376	3,664,577	498,551	14,202
2032 (Estimated figure)	12,188,678	19,863,254	1,289,292	71,037
	2,211,426	4,871,092	705,231	26,037
2037 (Estimated figure)	12,984,728	20,894,244	1,495,972	82,872
	3,007,476	5,902,082	911,911	37,872

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

(3) Adjustment of Shares of Central North and Inner North Submarkets in Property Supply in Bangkok and its Environs

The future share of Inner North is adjusted based on its share in 2021 and share of Central North in 2021. Adjusted shares of property supply of Inner North submarket in Bangkok and its environs are as shown in Table 6.4.4. The foundation of adjusted shares is as shown below.

- 1) Office: Referring to 38%, the average share of Central North in increased floor area from 2007 to 2016. It was adjusted slightly lower than 38%, to consider it should be a long-term trend.
- 2) Retail: Referring to the average share of Central Bangkok (29%) and Inner North (21%) in increased net floor area from 2007 to 2016. The redevelopment of Bang Sue Area may bring more concentration of shopping malls to the Inner North; therefore 25% as in between of 29% and 21% was adopted.
- 3) Condominium: Simply referring to 18%, the average share of Central North in increased floor area from 2007 to 2016.
- 4) Hotel: As the submarket data is not available, it simply refers to the adjusted share of office (30%), as the trend of distribution of hotels generally has high correlation as with the offices.

Table 6.4.4 Adjustment of Shares of Property Supply of Inner North in Bangkok and its Environs

	Office (m ²)	Retail (m ²)	Condominium (unit)	Hotel (room)
Share of Inner North in 2021	11.1%	8.3%	17.1%	11.1%
Inner North Adjusted Share	30.0%	25.0%	18.0%	30.0%

Note: Share of hotel is assumed as the same as the office

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

(4) Share of Chatuchak District in Property Supply in Inner North

By considering having Bang Sue Area as a transportation hub within the district, shares of Chatuchak District are adjusted as shown in Table 6.4.5.

- 1) Office: 80%
- 2) Retail: 60%
- 3) Condominium: 25%
- 4) Hotel: 80%

Table 6.4.5 Adjusted Shares of Chatuchak District in Property Supply in Inner North

	Office (m ²)	Retail (m ²)	Condominium (unit)	Hotel (Room)
Share based on population share	22.7%	22.7%	22.7%	22.7%
Adjusted share	80.0%	60.0%	25.0%	80.0%

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

(5) Property Supply in Chatuchak District After 2022 (high-end estimation for Senario 2)

Property supply in Chatuchak District (high-end estimation for Senario 2) in 2027, 2032, and 2037 is as shown in Table 6.4.6. At the point of 2032, figures of estimated property supply are as follows:

- 1) Office: 530,742 m² (NFA)
- 2) Retail: 730,664 m² (GFA)
- 3) Condominium: 31,735 units
- 4) Hotel: 6,249 rooms

Table 6.4.6 Property Supply in Chatuchak District after 2022 (High-end Estimation)

Office(NLA/ m²)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(m ²)	Chatuchak Increment(m ²)
2021	9,977,252	—		1,107,475		
2027	11,392,628	1,415,376	1,415,376		424,613	339,690
2032	12,188,678	796,050	2,211,426		663,428	530,742
2037	12,984,728	796,050	3,007,476		902,243	721,794

Commercial(GFA/ m²)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(m ²)	Chatuchak Increment(m ²)
2021	14,992,162	—		1,244,349		
2027	18,656,739	3,664,577	3,664,577		916,144	549,687
2032	19,863,254	1,206,514	4,871,092		1,217,773	730,664
2037	20,894,244	1,030,990	5,902,082		1,475,520	885,312

Condominium(戸)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(unit)	Chatuchak Increment(unit)
2021	584,061	—		99,874		
2027	1,082,612	498,551	498,551		89,739	22,435
2032	1,289,292	206,680	705,231		126,942	31,735
2037	1,495,972	206,680	911,911		164,144	41,036

Hotel(部屋)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(room)	Chatuchak Increment(room)
2021	45,000	—		4,995		
2027	59,202	14,202	14,202		4,261	3,408
2032	71,037	11,835	26,037		7,811	6,249
2037	82,872	11,835	37,872		11,362	9,089

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

(6) Conversion from Property Supply (high-end estimation) to Gross Floor Area

Estimated property supply in Chatuchak District will be the basic information to study the floor volume and the layout in the stage of studying the “development plan”. Thus, estimated net floor area for office, units for condominium, and rooms for hotel will be converted to gross floor area.

The basic units for conversion to gross floor area are as shown in Table 6.4.7.

Table 6.4.7 Basic Units for Conversion to Gross Floor Area

Category	Average Floor Area / One Unit or Room	Rentable Area Rate
Office	—	60%
Condominium	80 m ² / unit	70%
Hotel	35 m ² /room	60%

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

Based on the basic units for conversion to gross floor area, future gross floor area in Chatuchak District in 2032 is estimated as shown in Table 6.4.8. To be balanced with the market demand, the total floor area will be developed step-by-step under the principle of stepwise development as shown in Section 6.4.3

Table 6.4.8 Future Gross Floor Area in Chatuchak District in 2032 (Scenario 2)

Category	Gross Floor Area	Share
1) Office	884,570 m ²	15.8%
2) Retail	730,664 m ²	13.0%
3) Condominium	3,626,902 m ²	64.7%
4) Hotel	364,518 m ²	6.5%
Total	5,606,654 m²	100.0%

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST, based on data provided by Jones Lang LaSalle

6.4.3 Estimated Demand for Scenario 1 (Individual Development)

Investment conditions for Scenario 1 consist of individual development having more disadvantages for private investors than Scenario 2 consisting of integrated development plan as shown in Table 6.4.1. Therefore, it will be expected that less development could be achieved in case of Scenario 1 compared with Scenario 2. As figures for reference, demand for Scenario 1 is estimated under the condition as shown in Table 6.4.9. The estimated gross floor areas are as shown in Table 6.4.10.

Table 6.4.9 Conditions for Adjustment of Shares in Each Scenario

Category	Adjustment of Inner North's Shares of Property Supply in Bangkok and its Environs			Adjustment of Chatuchak District's Shares of Property Supply in Inner North		
	Scenario 0	Scenario 1	Scenario 2	Scenario 0	Scenario 1	Scenario 2
1) Office	11.1%	25.0%	30.0%	22.7%	30.0%	80.0%
2) Retail	8.3%	Only within 400 m from the station	25.0%	22.7%	Only within 400 m from the station	60.0%
3) Condominium	17.1%		18.0%	22.7%	10%	25.0%
4) Hotel	11.1%		30.0%	22.7%	Only within 400 m from the station	80.0%

Note: In this report, estimated supply will be considered as market needs and demand.

Source: JST

Table 6.4.10 Future Gross Floor Area in Chatuchak District in 2032 (Scenario 1 and 2)

Category	Gross Floor Area (Scenario 1)	Gross Floor Area (Scenario 2)
1) Office	276,438 m ²	884,570 m ²
2) Retail	453,536 m ²	730,664 m ²
3) Condominium	420,482 m ²	3,626,902 m ²
4) Hotel	142,951 m ²	364,518 m ²
Total	1,293,407 m²	5,606,654 m²

Source: JST

6.4.4 Stepwise Development

(1) Development Preconditions

The development preconditions are described below.

- The present bus terminal in Zone C will be relocated in Old Mo Chit by 2023.
- Japanese side will propose development phasing and land use for the zones which are not mentioned in Thai side's existing plan.

1) Middle and long distance bus terminal

Middle and long-distance bus terminal is planned to be relocated. An adequate place was considered in terms of accessibility to Bang Sue Grand Station, center of Bangkok, commercial buildings nearby and construction easiness.

As shown in Table 6.4.11 Comparison Table for Medium and Long Distance Bus Terminal, parking space in front of Mo Chit Station (Old Mo Chit) can be considered as adequate relocation place. Main reason is that this place is close to Bang Sue Grand Station, Blue Line, and Green Line, thus, it has high accessibility to the center of Bangkok City. Secondly, Old Mo Chit is close to Chatuchak Weekend Market and Zone D that is possibly developed. Thirdly, Old Mo Chit is currently used as parking place; therefore, construction is easier than other candidates.

Furthermore, parking place in front of Mo Chit Station will be developed in high density. Bus platform and depot should be separated and depot should be moved to the dead space under the existing expressway. Some of the middle and long-distance buses already use the dead space as depot.

Table 6.4.11 Comparison Table for Medium and Long Distance Bus Terminal

	Items	Zone B	Zone C (Mo Chit 2)	Near Mo Chit Station, BTS Depot (Old Mo Chit)	Outside of Bang Sue Area Distant Place
1	Accessibility from Bang Sue Grand Station	○ 200 m from the station	△ Over 1 km from the station	○ Stop at the station	× Far from the station. If BT is close to the train station, passengers can access by train.
2	Comfortability using the access road from Bang Sue Grand Station	○ Underpass	○ Underpass	○ Skywalk	— Depends on the location
		△ Ground level walkway (partially cross with road)	○ Skywalk and ground level walkway		
3	Accessibility to the center of Bangkok (Accessibility to railway station)	△ Close to Blue Line and Red Line	× Disconnected by train	○ Close to two stations of Blue Line and Green Line	— Depends on the location
4	Accessibility to BMTA Bus Terminal (Terminal is planned between Zone A and B)	○ Close to BMTA Bus Terminal	× Far from BMTA Bus Terminal	△ Connects with Blue Line	— If BT is close to the train station, passengers can access by train
5	Accessibility to expressway	△ Connect if geometric design satisfied the necessary condition	× Difficult to connect with the expressway since several roads run complicated	× Disconnected with the expressway	— Depends on the location
6	Accessibility to commercial buildings	○ Easy access to commercial buildings around Bang Sue Grand Station	△ Access to commercial buildings in the north of Bang Sue Grand Station	○ Easy access to existing market and planned commercial buildings	— Depends on the location
7	Environment impact on bus terminal	△ Noise and vibration should be considered since railway facility is located nearby	○ No obstruction	○ No obstruction	— Depends on the location
8	Construction easiness	× Need to remove railway	△ Need to demolish the existing building or newly built building	○ No obstruction since it is currently used as parking space	— Depends on the location
9	Traffic congestion around the bus terminal	△	×	○	— Depends on the location
	Conclusion ※If several choices are presented in one item, adopt the better one	○ : 4 items △ : 4 items	○ : 2 items △ : 3 items	○ : 6 items △ : 2 items	No conclusion since most items depend on the location

Note:BT=Bus Terminal (Bus Platform)

Source: JST

(2) Development Phasing in the Thai Side's Existing Plan

The target year sectioning (short, middle, and long) that the Japanese side proposes is consistent with that of the Thai side. Table represents the development phasing of each zone according to the Thai side's existing plan.

Table 6.4.12 Development Phasing of Each Zone According to the Thai Side's Existing Plan

No.	Development Zone/ Facility	Short (-2022)	Middle (-2027)	Long (-2032)
1	Red Line/ Grand Station	Start-End	Operated	Operated
2	Airport Link	Start-End	Operated	Operated
3	Zone A	Start-End	Operated	Operated
4	Zone D	Start	End	Operated
5	Skywalk (A-D Intersection)	Start	End	Operated
6	Zone B	Start	Being constructed	End
7	Zone C	Start	Being constructed	End
8	KM11	Start	End	Operated
9	BKT (Old Mochit)	Start	End	Operated
10	BRT (Area Bus Service)	Start	End	Operated

Source: JST based on existing development schedule planned by Thai side (Start: Groundbreaking, End: Opening)

(3) Recommendable Stepwise Development

The stepwise development that is as shown in Table 6.4.13 is recommendable in terms of the following points of view: (a) inauguration of new urban mass transit railways, which are being constructed or will be constructed, (b) land status (availability, infrastructure including different types of utility), (c) market demand, and (d) financial arrangements.

Table 6.4.13 Recommendable Stepwise Development

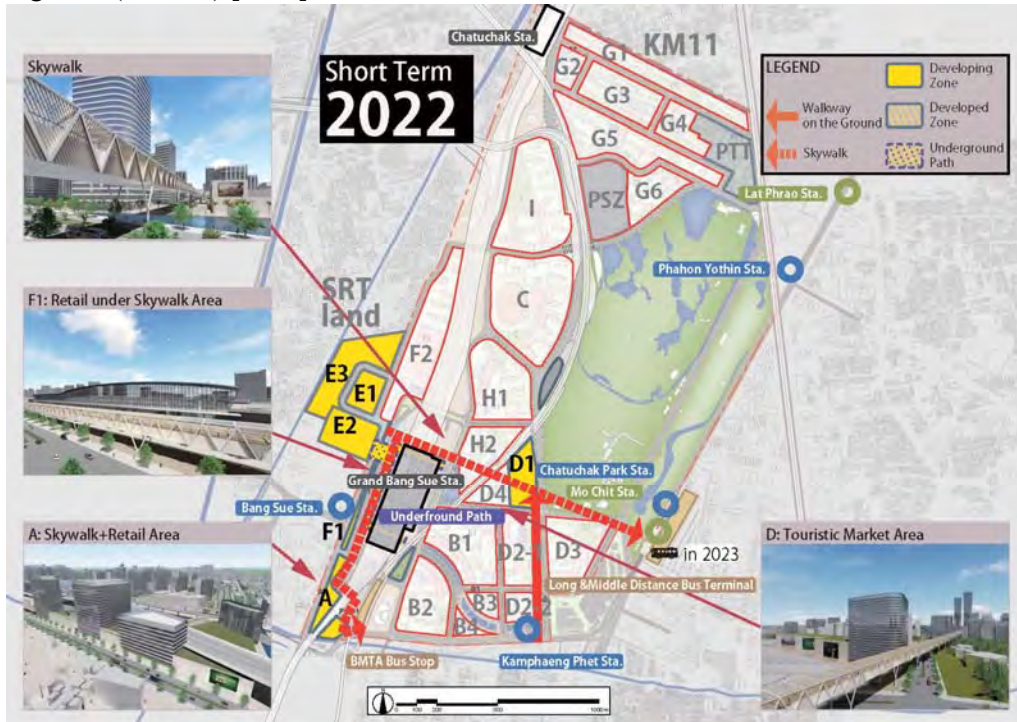
	短期・Short-term (~2022)	中期・Mid-term (~2027)	長期・Long-term (~2032)
Stepwise Development Concept	Establish key areas of the terminal station as the "core function" of development and create external links.	Expand office and commercial development in station surrounding area to strengthen "core function". Develop residential district and differentiating city function.	Obtain community feedback and further enhance integrated development
Concept1: To grow up to a centripetal urban core in BMA which plays an important role in the international community	Populate the station with zone A and Bang Sue Grand station ground/underground level commercial complex (for railway and inner city bus users). Establish international image with top class hotel (linked to station).	Develop advanced high-rise office complex, including land mark building (sky scraper). Commercial complex development to reach scale for shopping destination. (Zone F1, F2, SRT Land). Development of MICE related facilities and further strengthen attractiveness as visiting destination (Zone C).	University and Ministerial Building Complex development (Zone I, H).
Concept2: To create an eternally beloved new central district full of various attractiveness	Develop skywalk to connect Bang Sue Grand station with office, commercial complex and Mo Chit station. Create touristic market area (Zone D hotel, commercial, office) and strengthen links with Chatuchak Park.	Expand skywalk and ground walkway to connect multiple zones and create fun atmosphere for pedestrian. Develop green park and residential district (KM11).	Integrated development of area between Bang Sue station and Chatuchak (Zone B). (Note: This is only possible if current depot location is shifted to another place in the future)
Concept3: To create a visitor-friendly traffic terminal area comfortable for everyone	Station plaza, bus terminal (inner city), taxi bay, transit-friendly pathway and signage. Start shifting mid-long distance bus terminal from Zone C to old Mochit.	Escalator, membrane roof, underground air ventilation, barrier-free facility. New mid-long distance inter-city bus terminal completed in old Mochit.	Install traveller and promote access between zones. Operate shuttle bus within Bang Sue redevelopment area for visitor circulation.
Funding Perspective	Utilize concession fee discounts to generate public infra funds. Also, upfront fee payment or FAR bonus could be used to pool fund for the next phase	Advance public infra development using pool fund. Extract premium concession for F2, SRT Land and pool for next phase	Advance green park development and enhance the value of residential district. With land value increase, pool part of property tax for sustainable maintenance.

Source: JST

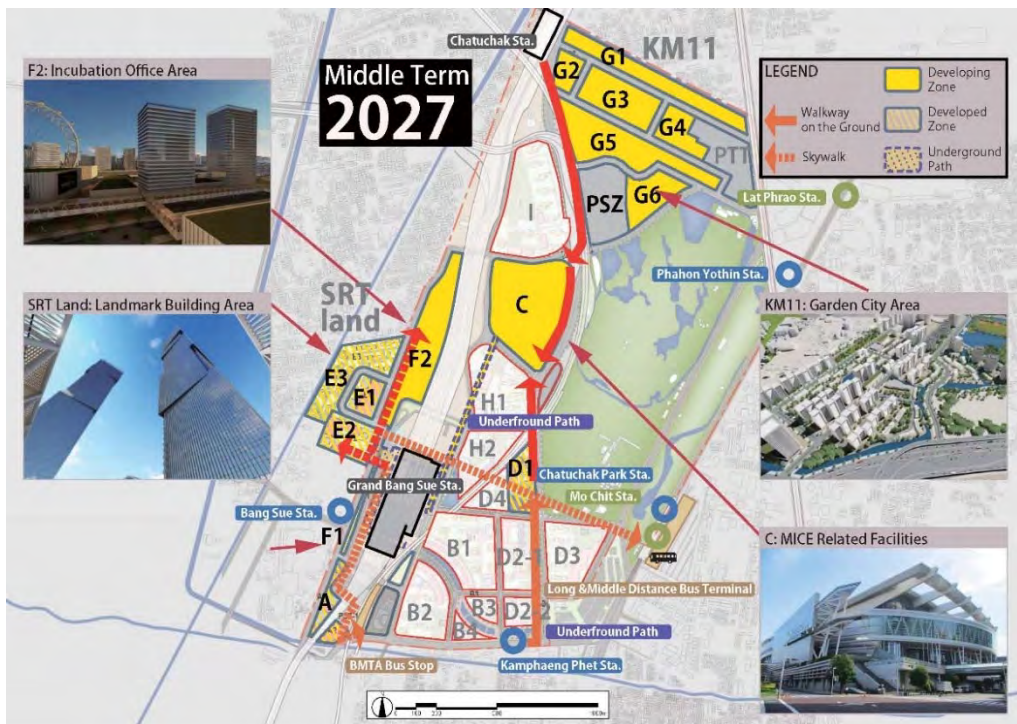
6.4.5 Stepwise Development by Zone

The recommendable stepwise development by zone is as shown in Figure 6.4.2.

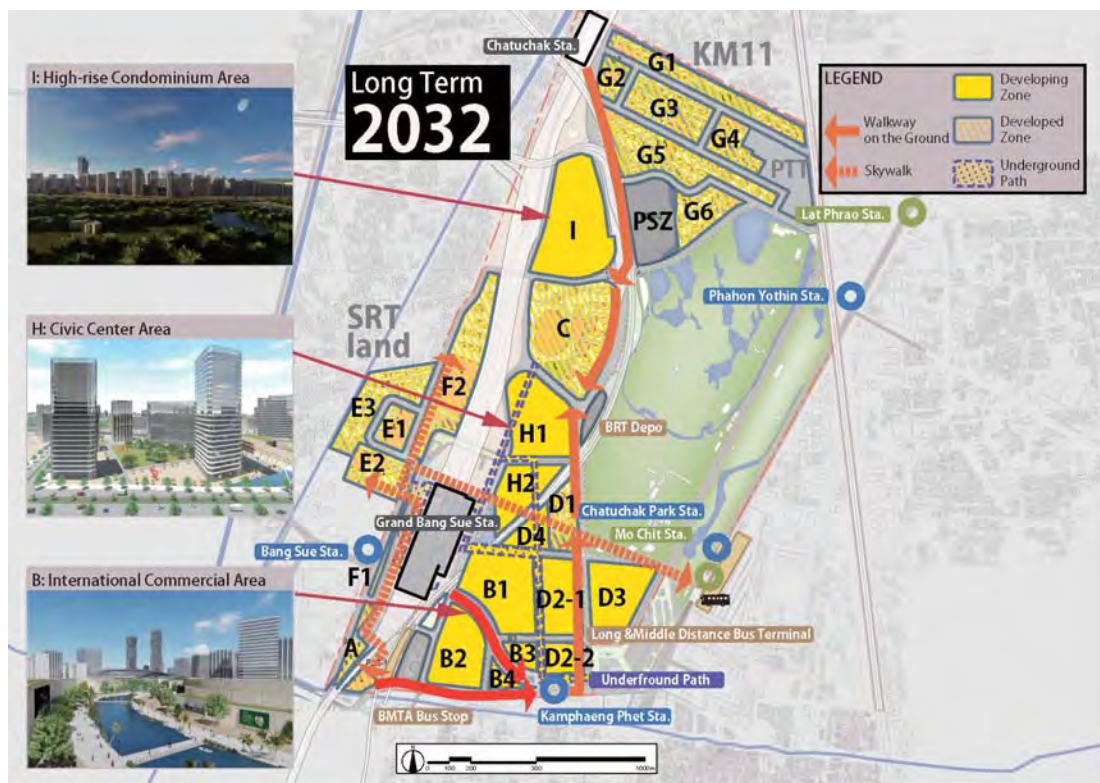
- Short term (Phase 1) [- 2022]: Zone A, Zone D1, Zone F1, SRT Land, underground shopping mall, and skywalks around Bang Sue Grand Station
- Middle term (Phase 2) [2027]: Zone C, Zone F2, KM 11, other skywalks, and sidewalks
- Long term (Phase 3) [2032]: Zone B, Zone D2/D3, Zone H, and Zone I



Short term (Phase 1) [- 2022]



Middle term (Phase 2) [- 2027]



Long term (Phase 3) [- 2032]

Source: JST

Figure 6.4.2 Stepwise Development by Zone

Table 6.4.14 Recommendable Stepwise Development by Zone

No.	Development Zone/ Facility	Short (-2022)	Middle (-2027)	Long (-2032)
1	Red Line/ Grand Station	Start-End	Operated	Operated
2	Airport Link	Start-End	Operated	Operated
3	Zone A	Start-End	Operated	Operated
4-1	Zone D1	Start	End	Operated
4-2	Zone D2/D3	-	-	Start
5	Skywalk (A-D Intersection)	Start	End	Operated
6-1	Zone B1,B2	-	-	Start-End
6-2	Zone B3,B4	-	-	Start
7	Zone C	-	Start-End	Operated
8	KM11(Zone G)	-	Start-End	Operated
9	BKT (Old Mochit)	Start	End	Operated
10	BRT (Area Bus Service)	-	Start-End	Operated
11-1	SRT Land (Zone E1,E3)	Start-End	Operated	Operated
11-2	SRT Land (Zone E2)	Start	End	Operated
12	Zone F	-	Start-End	Operated
13	Zone H	-	-	Start
14	Zone I	-	-	Start-End

Note: Colored cells were proposed by the Japanese side. Red printed cells are different from the Thai side's original ideas.

Note: Red Line, Grand Station, and Airport Link inauguration timing is consistent with that of Thai side's existing plan.

Source: JST (Start: Groundbreaking, End: Inauguration)

Chapter 7 Proposed Development Plan of Bang Sue Area

7.1 Basic Policies in the Development Plan

7.1.1 Basic Policies

In formulating a development plan (proposal) for the Bang Sue Area, with the objective of achieving the realization of the vision, the JICA Study Team (JST) made considerations based on various factors such as the content of the top-level plans, location-related conditions in the district, and socioeconomic trends. JST also referred to the contents of related plans that have been developed to date under organizations such as the State Railway of Thailand (SRT) and the Office of Transport and Traffic Policy and Plan (OTP) and introduce experience and know-how gained through past experiences of large-scale urban development projects in Japan. Basic policies for carrying out such considerations are shown in Table 7.1.1.

Table 7.1.1 Plan Formulation Policies

Policy	Matters for Care and Consideration
(1) To grow up to a centripetal urban core in Bangkok Metropolitan Area which plays important roles in the international community	- To elaborate an integrated master plan for successful redevelopment of the entire area. - To place core facilities including a landmark tower building, a smart city, etc. - To introduce attractive urban functions that boost development potential of the entire area.
(2) To create an eternally beloved new central district full of various attractiveness.	- To introduce the main facility to connect and organize each zones - To develop infrastructure and public spaces that make the entire area more attractive. - To prepare a guideline to promote a well-balanced area development. - Introduce upgraded infrastructure and facilities that will contribute to increasing the potential of the district. - Place (and guide people to) applications and functions that will increase the potential of the entire area. - Introduce guidelines for driving planned urban development.
(3) To create a visitor-friendly traffic terminal area comfortable for everyone.	- To ensure comfortable transfer between railway stations and other transport modes. - To construct pedestrian decks and plazas. - To introduce a feeder transport mode (ex. BRT) and make the best use of ITS in the area.
(4) To stepwisely realize the conceptual plan by both public and private sectors.	- To elaborate a stepwise implementation plan ensuring feasibility and viability. - Consider an appropriate division of labor to ensure a “win-win” To introduce vitality and resources of private sector. - To consider the best role-sharing system that ensure a win-win partnership for both public and private sectors.

Source: JST

7.2 Basic Plan

7.2.1 Basic Conditions for Plan Formulation

Before formulating a plan for the Bang Sue Area, the JST will summarize the main development bodies and division of cost burdens for each of the various city functions to be proposed in the development plan proposal. At the same time, the JST will outline the jurisdiction over these facilities to be transferred to the public bodies, and how these be maintained and managed in the future. These matters are outlined below.

(1) Envisaged Main Development Bodies and Division of Cost Burdens for City Infrastructure

As a general rule, the principal developers for supply and processing facilities (e.g., water supply and sewage processing) and other fundamental city infrastructure that are essential to city life should be the administrative bodies such as national and/or local government agencies, whose mission is to provide fundamental infrastructure for the citizens.

On the other hand, where urban development is being carried out on privately-owned land and utilizing various assets, there are some cases in which the rights of the owners stand to profit or otherwise benefit from the development bearing part of the development costs themselves.

In the case of the Bang Sue Area, all of the development land is owned by SRT, and so it can be envisaged that SRT will benefit from the development. Therefore, when developing roads, parks, supply and processing facilities and other city infrastructure, it is desirable for SRT to bear a certain portion of the cost burden, or to carry out the development in collaboration with the national government and/or local public bodies.

(2) Envisaged Maintenance, Management, and Transfer of Jurisdiction for City Infrastructure

Public land such as roads and parks are facilities that are made available for free public use. As such, it is desirable for these facilities to be maintained and managed by public bodies. As a general rule, the rights of ownership to the land on which the facilities are located are also typically transferred to the public bodies who are maintaining and managing them. However, in the preliminary meetings with SRT and Bangkok Metropolitan Area (BMA), JST saw many real examples in which existing facilities such as parks and roads in the district are being maintained and managed by BMA while the rights to the actual land itself remained with the ownership of SRT. For this reason, it is desirable for SRT and BMA to discuss and decide the issue on transfer of jurisdiction in the future.

7.2.2 Project Area

(1) Concepts on the Project Area

The project area is set to be the site owned by SRT. The boundary of the site is not clear, but it will be confirmed with SRT later. In the site, there are Bang Sue Grand Station, Chatuchak Park, and public roads (Figure 7.2.1). From the perspective of maintenance and management, it is expected that land for public roads would be transferred to the Bangkok government.



Source: JST

Figure 7.2.1 Project Area

(2) Settings of the Project Area

Areas before and after development are shown in Table 7.2.1

Table 7.2.1 Areas Before and After Development

	Usage	Area (ha)		Rate of Change
		Before	After	
Public spaces	Road	29	44.5	+53%
	Park, greenbelt	115	115	±0%
	River	1.5	1.5	±0%
	Subtotal	145.5	161	+11%
Residential area	Commercial and office	24	19.7	-18%
	Complex	0	98.8	—
	Residential	55	56	+2%
	Railway	198.6	94.3	-53%
	Expressway	11.8	11.8	±0%
	Other public facilities	18	11.1	-38%
	Subtotal	307.5	292	-5%
	Total	453	453	±0%

Source: JST

7.3 Concepts on Urban Infrastructure Development

In this section, plans such as fundamental urban infrastructure, environment and green network and transportation network are summarized. Infrastructure plan(Appendix 7-1) and facilities plan(Appendix 7-2) are attached as appendix.

7.3.1 Fundamental Urban Infrastructure

(1) Land Preparation Plan

As for flooding prevention, land height is 1 m above the height of road paving. In case of flooding, road surface can serve as emergency drains. Slope of land is planned to be at 0%. Land used for important facilities such as substations, water treatment plant, and wastewater treatment plant is 1.5 m above the height of road paving.

(2) Road Structural Plan

1) Road Alignment

Trunk roads of about 250 m wide will be constructed as zone boundaries. Existing road networks will be utilized and relocation of existing buildings will be minimized. In addition, as the land above the MRT is not allowed for buildings, it is planned for road construction. Zone C and Zone D will be separated by six-lane road, however, to ensure the integration of Bang Sue development, an underpass is planned for connections between two zones.

2) Typical Cross Section

Roads in the project area are planned with the following functions:

- Transport function (road ability, accessibility, and capacity)
- Space function (environment protection space, disaster prevention space, utility accommodation space, and urban landscape formation)

Typical cross section is planned as shown in Table 7.3.1.

Table 7.3.1 Typical Cross Section

Item	Width
Carriageway (two-lane/direction)	16 m(4 m x 4)
Central median strip	5 m
Sidewalk (utility zone)	14 m(7 m x 2)

Source: JST

(3) Storm Drainage Plan

Storm drainage plan is shown in Table 7.3.2.

Table 7.3.2 Overview of Storm Drainage Plan

Item	Contents
1) Plan area	170 ha
2) Storm water collection method	Separate system
3) Plan flow rate for storm drains	Flow rate of five-year flooding probability
4) Storm water retention pond	Capacity equivalent to ten-year flooding probability

Source: JST

The project area is generally flat. Storm water collection area is divided by trunk roads into four zones. At the end of each flow, there are retention ponds and drainage pumping station. Then, storm water is pumped from the station to existing rivers for discharge. The drains are constructed by concrete pipes or box culvert and installed on the road sides. Drains are planned to be continuous and connected to the pond in Chatuchak Park.

(4) Water Supply Plan

Demand forecast for water supply is shown in Table 7.3.3. In the table, $Q=53,000 \text{ m}^3/\text{day}$.

Table 7.3.3 Demand Forecast for Water Supply

Type	Water Unit (L/person/day)	Population	Demand (m^3/day)
Office	70	44,230	3,096
Commercial	70	292,280	20,460
Residential	200	126,942	25,388
Hotel	375	9,373	3,515
Total		483,605	52,459

Source: JST

Water supplied for Bang Sue is treated at Bang Khen Water Treatment Plant (WTP) (3.9 million m^3/day) owned by BMA and delivered from Phahon Yothin Pump Station. Water supplied for Bang Sue is planned to be connected to the existing water supply pipeline under trunk roads in more than four points. The high-density polyethylene (HDPE) is used for supply pipes. From the water demand of the district, it is proposed that two water tanks with pressure pumps should be installed to prevent decrease in water pressure. These water tanks also have important role in emergency situations such as power cut.

To accommodate increased demand for Bang Sue Area, it is planned to expand Bang Khen WTP and increase the supply pipeline from Bang Khen WTP to Bang Sue Area. Distribution pipeline is planned as loop system so that the area to be affected by water cut will be minimized when there is accident damaging the water pipe. In each zone, it is compulsory to install

a water receiving tank.

(5) Sewage Plan

Plan sewage volume is 80% of the water demand; and capacity of the wastewater treatment plant (WWTP) is $Q=53,000 \times 80\%=42,400 \text{ m}^3/\text{day}$.

The following is the sewage plan: Sewage collection area is divided into two blocks. The north block will discharge sewage to WWTP that will be constructed next to the existing Bang Sue WWTP. Sewage from the south block will be discharged to WWTP that will be constructed next to Block A. Plan sewage volume is 80% of water demand. Sewage system is separated system, thus, only wastewater will flow to WWTP. Sewage pipes are installed in utility space under sidewalks. Intermediate pump will be installed where the depth is more than 4 m. HDPE pipes will be used for sewage pipes. Manhole will be arranged in each 40 m and each zone will be connected to the nearest manhole. First stage treatment is not necessary in each zone. WWTP will be constructed in two locations.

(6) Power Supply Plan

1) Demand Forecast

Power peak load and power demand are predicted from power use unit and floor area. Power use unit is referred from the report of SRT in 2015 entitled “Study on Possibility of Commercial Area Development in Bang Sue Grand Station” and Guidebook on Plan-Design-Operation of City Gas Cogeneration by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan. The demand forecast is shown in Table 7.3.4 and Table 7.3.5.

Table 7.3.4 Power Load in Peak Time

Building Use	Power Consumption Rate [W/m ²]	Total Floor Area [m ²]	Peak Load [MW]
Office	62.500	884,600	55.3
Commercial	62.500	730,700	45.7
Hotel	34.375	364,500	12.5
Residence	30.000	3,626,900	109.8
Total	-	5,606,700	222.3

Source : The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan

Table 7.3.5 Power Demand Forecast

Building Use	Quantity of Power Consumption Rate [kWh/m ² · y]	Total Floor Area [m ²]	Peak Demand Amount [MWh/v]
Office	115	884,600	101,729
Commercial	284	730,700	207,519
Hotel	183	364,500	66,704
Residence	183	3,626,900	663,723
Total	-	5,606,700	1,039,674

Source : JST, Air-Conditioning and Sanitary Engineers of Japan

2) Policies on Developing Power Infrastructure

A transmission line is to be installed from the substation in the north of redeveloped area to the substation of the Red Line Project (220 kV/115 kV/24 kV). The other two 180 MVA substations (No.1 and No.2) will be constructed in the redeveloped area. From the perspective of infrastructure initial investment, the first one (Substation No.1) is proposed to be constructed near Zone A as it can be used in the initial development phase (Development Phase I). The required area is about 3,600 m² (60 m×60 m). The transmission line is 110 kV. From substation (220 kV/115 kV/24 kV) to Substation No.2, transmission line will be installed on the side of Red Line's tracks. The route of transmission line is shown in the basic plan drawings while specifications and main equipment with quantities are shown in Table 7.3.6.

3) Overall Specifications and Main Equipment

The transmission line substation is two-wire. The main equipment is shown in Table 7.3.6.

Table 7.3.6 Main Equipment and Quantity

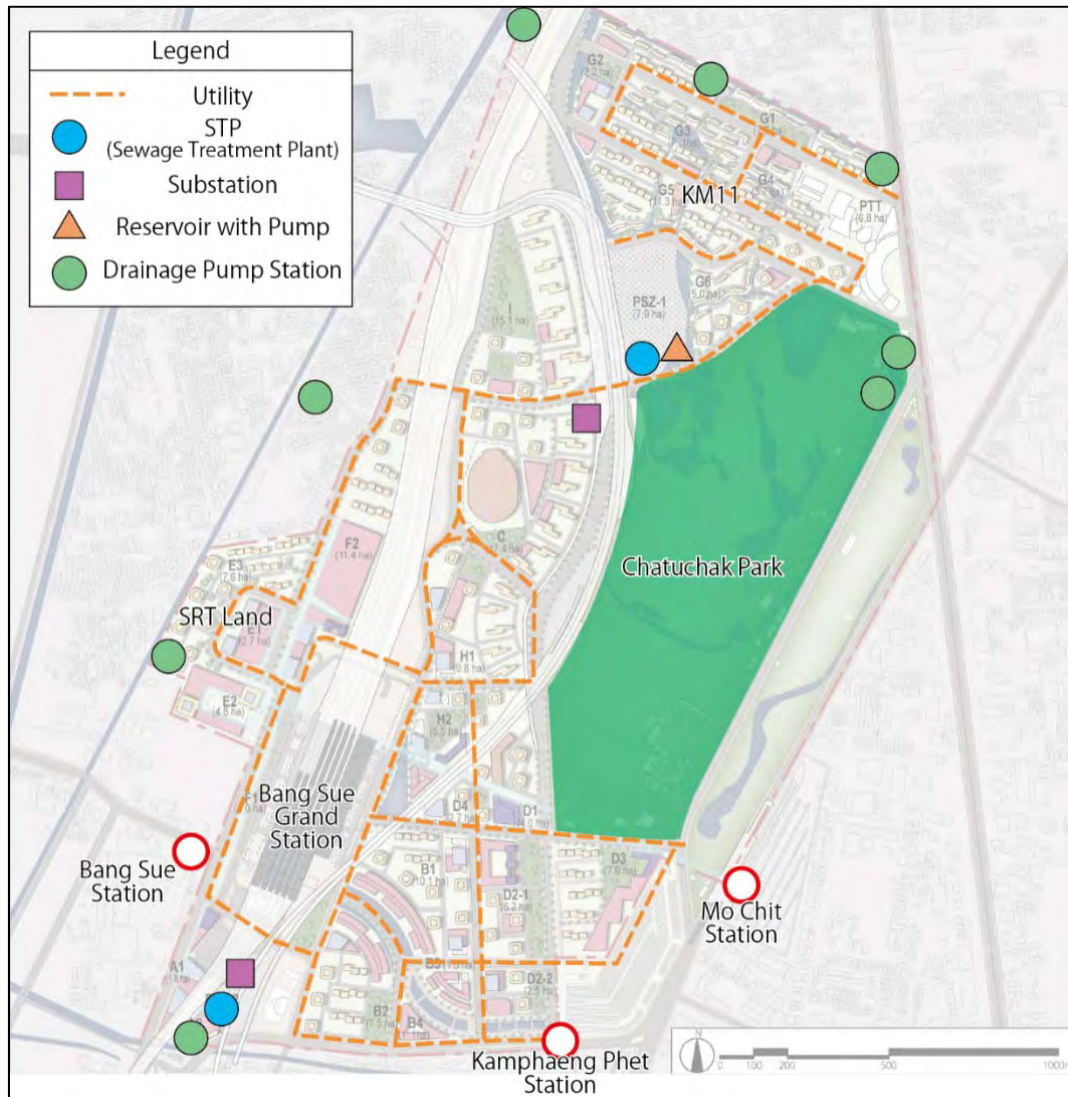
Items	Overview	Unit	Quantity
1. Substation	180 MVA (60 MVA×3)	location	2
2. Underground cable	Two-wire 110 kV	km	39
3. Pipeline	FEP, PV, etc.	set	1

4. Ring Main Unit	Switchgear, etc.	location	22
5. Accessories	Switch board, breaker, hand hole, etc.	Set	1

Source: JST

(7) Urban Infrastructure Plan

Placement of utilities, sewage and drainage pump, and reservoir pump is shown in Figure 7.3.1.



Source: JST

Figure 7.3.1 Urban Infrastructure Plan

(8) Communication Plan

1) Policies on Communication Plan

Besides the conventional voice communication, communication services that should be provided for end users in the future are multimedia communication services such as television meeting, IP TV, and data communication services such as large file transfer service. In the area of Bang Sue, there are three relay stations and communication cable that will be drawn in. The speed of existing relay station is 100 MB/s. The placement of substation is shown in Figure 7.3.2.



Source: JST

Figure 7.3.2 Relay Stations around Bang Sue Area

2) Overall Specifications and Main Equipment

Communication pipeline, optical fiber, and steel tower for antenna and other equipment are shown in Table 7.3.7.

Table 7.3.7 Main Equipment and Quantity

Items	Overview	Unit	Quantity
1. Communication line	Optical fiber	km	39
2. Pipeline	FEP、PV, etc.	set	1
3. Antenna tower	Independent steel tower	set	1
4. Station building	4 m x 4 m (reference)	set	1
5. Accessories	Hand hole etc.	set	1

Source: JST

(9) Energy Infrastructure (Cogeneration, District Cooling)

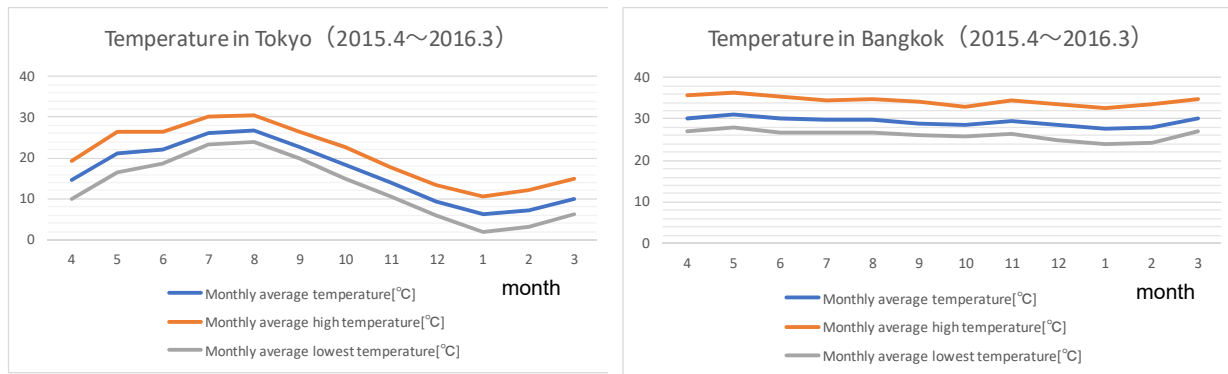
1) Overview of Cogeneration and District Cooling Facilities

Overview of the facilities is considered as follows:

(a) Characteristics of the Region and Possibility of Applying District Cooling

As shown in Figure 7.3.3, the weather in Bang Sue Area, or generally in Bangkok, has three seasons,

i.e., hot season, dry season, and rainy season. The average temperature is nearly 30 degrees C all year-round and the hottest month has an average temperature of about 35 degrees C. The difference of the hottest and coolest month is about 8.0 degrees C in Japan and 8.2 degrees C in Bangkok. In such conditions, the load for cooling is high all year-round and the demand period is expected to be longer than Japan as there is no middle period. Also, in some places such as in hotels where there is a demand for air-conditioning at night, there will be demand for cooling. From these situations, JST considers to apply smart city technologies to introduce an effective energy technology.



Source : Japan Meteorological Agency

Figure 7.3.3 Comparison of Temperature in Japan and Bangkok

(b) Consideration of Energy System

The JST considered energy supply method in Thailand as shown in Table 7.3.8. As infrastructure technologies have already been developed in commercial power supply, city gas, water supply and sewage, information communication, JST considers energy system from the perspective of optimization of regional energy use by district cooling and distributed energy. There are individual method and regional method of energy system. Individual method will equip packaged air-conditioner and independent heat source while regional method will equip regional heat source and utilize smart city technologies such as CEMS.

Table 7.3.8 Consideration of Energy System

	Individual Method	Individual and Regional Method	Regional Method
System characteristics	This is the conventional method. Recently, chiller efficiency (COP, IPLV, etc.) has been improved and able to be operated individually. Thus, it is easy to be introduced.	This is a balanced combination of district cooling and individual method for each area based on heat and power demand.	In dense urban areas where heat load density is high, introducing highly efficient cogeneration and heat sources may help increase energy efficiency, thanks to advanced operation management. However, in area with low heat load density, the ratio of benefit over cost is very small.
Initial cost	In building of medium size, cheap packaged air-conditioners are widely used.	Cogenerations and heat sources will be installed in machine rooms of large-sized buildings. They will be combined with cheap packaged air-conditioners to lower the cost.	It requires large-scale pipelines and energy center, thus, the cost is high.
	○	△	×
Running cost	As it can be operated individually, it is difficult to manage its operation. Thus, the running cost is rather high.	Central monitor and EMS will be installed in regions with high energy consumption while in medium and small-sized buildings, individual method will be used. By the combination, the running cost can be balanced.	With the operation management of central monitor and EMS, running cost can be cut down. However, the maintenance cost for pipelines to medium- and small-sized buildings will increase.
	△	○	△
Environmental friendliness and energy efficiency	As it can be operated individually, it is difficult to manage its operation. Thus, the energy use is rather high.	Central monitor and EMS will be installed in regions with high energy consumption while in medium and small-sized buildings, individual method will be used. By the combination, energy efficiency can be increased.	Running cost can be cut down thanks to advanced management by efficient equipment, central monitor, and EMS.
	△	△	○
Safety (disaster prevention, BCP)	Except for emergency cases, the operation is stopped in power cut.	If it is planned to cover the scope of emergency power sources and emergency capacity, it can both reduce the cost and function as disaster prevention and BCP measures.	As cogeneration can be utilized for emergency power sources while heat tank can be utilized for emergency water supply, this method is good for BCP. However, the cost is high.
	×	○	△
Sociality (to be popular as an advanced model for smart city)	As this is the conventional method, it is not considered as an advanced model for smart city	By introducing distributed energy, regional energy use can be optimized, and this method can be considered as an advanced model for smart city. In addition, it combines advantages of conventional method, thus, it may be popularized easily.	By introducing distributed energy, regional energy use can be optimized, and this method can be considered as an advanced model for smart city. However, as the cost is high, it may be difficult to be popularized.
	×	○	△
Recommendation	△	○	△

※Evaluation ○ : Good, △ : Normal, × : Poor

Source : JST

From the above results, it is proposed that for large-sized buildings and areas with high power and heat load density, regional energy will be supplied, while for medium- and small-sized buildings and areas with low load density, individual method will be applied.

(c) Methods of Supply and Installation Plan

There are three methods of supply in Japan for reference, i.e., heat supply project method, concentration plant method, and inter-building method. Energy center and route of district pipeline are considered based on the building's function, scale, heat demand, and arrangement. The location of energy center would be selected to be near the building with highest heat demand (use total floor area as a criterium) or in the center of a group of relatively big buildings.

In Bang Sue Area, land is divided into multiple blocks by railways and trunk roads. As for large-sized buildings, there will be relatively many high-rise buildings in each zone such as office buildings or commercial buildings. Currently, there is no example of district cooling in Thailand as well as related law. From these conditions, it is proposed that cogeneration and heat sources of district cooling will be installed in machine room of large-sized buildings or in energy plant and it will supply heat to surrounding area by concentration plant method. Electricity power is also supplied to surrounding area for private consumption. For low-rise buildings and buildings with low energy consumption density, individual heat sources and commercial power sources will be provided (Table 7.3.9).

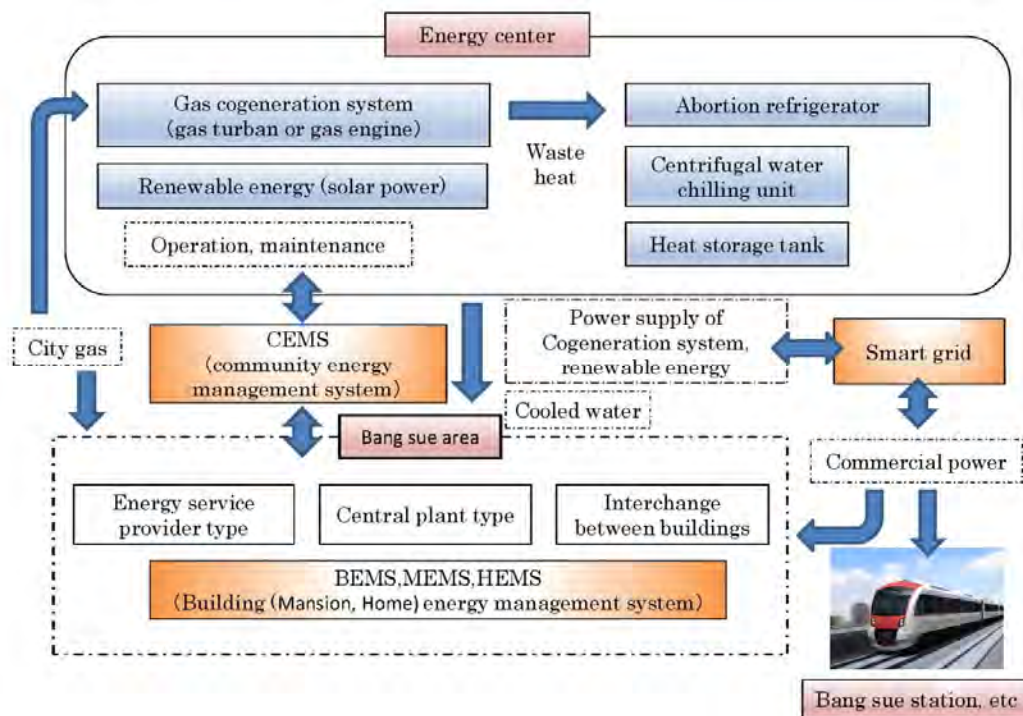
Table 7.3.9 Methods of Supply

Category	scale	Contract method	Supplier	Supply form
①Energy service provider type (Supplied from a large-scale energy plant to a wide supply area)	Large	Supply regulation based on heat supply business law	Energy service provider	Supply obligation based on thermal business law (supply provision is specified by supply provision).
②Central plant type (Supplied from an intensive energy plant into small and medium-sized specific areas)	Medium and small	Supplier-customer contract	Energy supplier based on contract	Supply obligation based on contract (constraint is less than ① Supply conditions are based on contract.
③Interchange between buildings type (Cooperation of neighboring building owners, energy interchange or shared use of energy)	small	Mutual contract between building owners	Owner of multiple buildings	You can negotiate by mutual agreement.

Source : JST

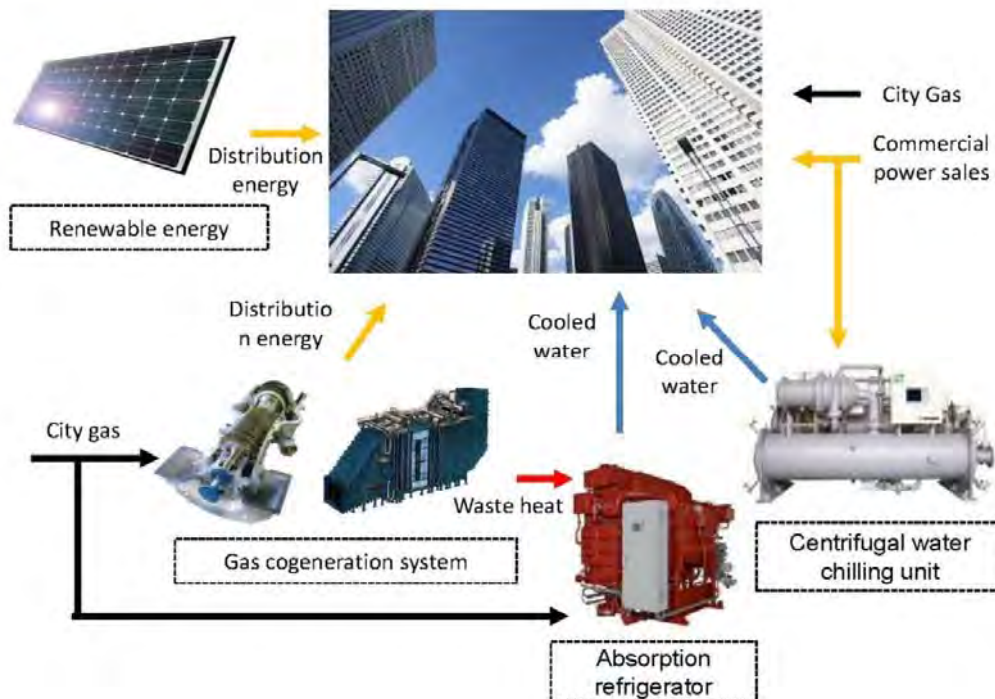
(d) System Image

The images of entire energy infrastructure and energy flow are shown in Figure 7.3.4 and Figure 7.3.5.



Source : JST

Figure 7.3.4 Images of Entire Energy Infrastructure



Source : JST

Figure 7.3.5 Image of Energy Flow

(e) Operation

To select the operation method, it is necessary to consider the ratio between heat and electricity use in facilities expected to be constructed in Bang Sue Area. As the fluctuation of temperature in a year is minimal, electricity will be mainly used and heat will be as supplement. Operation will be optimized by capacity sharing between absorption cooling machine and turbo cooling machine. Electricity will be generated by cogeneration as a base and commercial power supply will be controlled by grid. In addition, from the data on energy demand in each facility and the whole region, operation of cogeneration and heat sources will be optimized by CEMS and BEMS.

2) Estimated Capacities of Cogeneration and District Cooling Facilities

Estimated capacities of facilities are considered as follows:

(a) Conditions for Estimation

Electricity and heat load [W/m^2] during summer in Japan are revised by outdoor temperature (The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan). Assuming that the average temperatures during summer in Japan and Thailand are 30°C and 35°C , respectively, the revision ratio is $(35-30)/30 \times 100 = 17.8\%$. In addition, to supply for multiple buildings at the same time, a simultaneous usage ratio of 0.8 must be added.

Maximum load is calculated by electricity and heat load multiplied by aggregated floor area. The ratio between heat and electricity use is calculated from electricity and heat load. Capacity sharing among cogeneration, absorption cooling machine, and turbo cooling machine will be implemented. For buildings outside the target area of district energy supply, individual method will be used. Calculation of energy efficiency is shown in collection of materials.

(b) Main Equipment and District Pipeline

Reference specifications of main equipment and district pipeline are summarized as shown in Table 7.3.10.

Table 7.3.10 Reference Specifications and Functions

Equipment and Pipeline	Reference Specifications	Functions
Cogeneration	Type: Gas turbine (or gas engine) Emitted gas boiler Output : 15 MW~	Used as base operation. Supply for offices, commercial facilities and hotels, etc.
Absorption cooling machine	Type: hot water, vapor, genlink Cooling capacity: 80 USRT~	Used as base operation. Supply for offices, commercial facilities and hotels, etc.
Turbo cooling machine	Type: Inverter Cooling capacity: 150 USRT~	Response for load fluctuation due to outdoor temperature fluctuation in day time.
Cooling water heat storage tank	Type: RC constructed on-site Capacity: calculated from the number of people in emergency situations.	Fire fighting water and water supply in emergency (can be used for daily need with filtration equipment).
Solar power generation facilities	Type: roof-top or on the field Capacity: depends on the availability of vacant areas.	If the supply surpasses the household demand, electricity can be sold to others. In further discussion for adoption, it will also be considered as battery for emergency.
District pipeline	Material: SGP pipe Utility corridor: ready-made culvert	Insulation and corrosion protection based on site conditions.

Source : JST

(c) Estimated Results of Feasibility

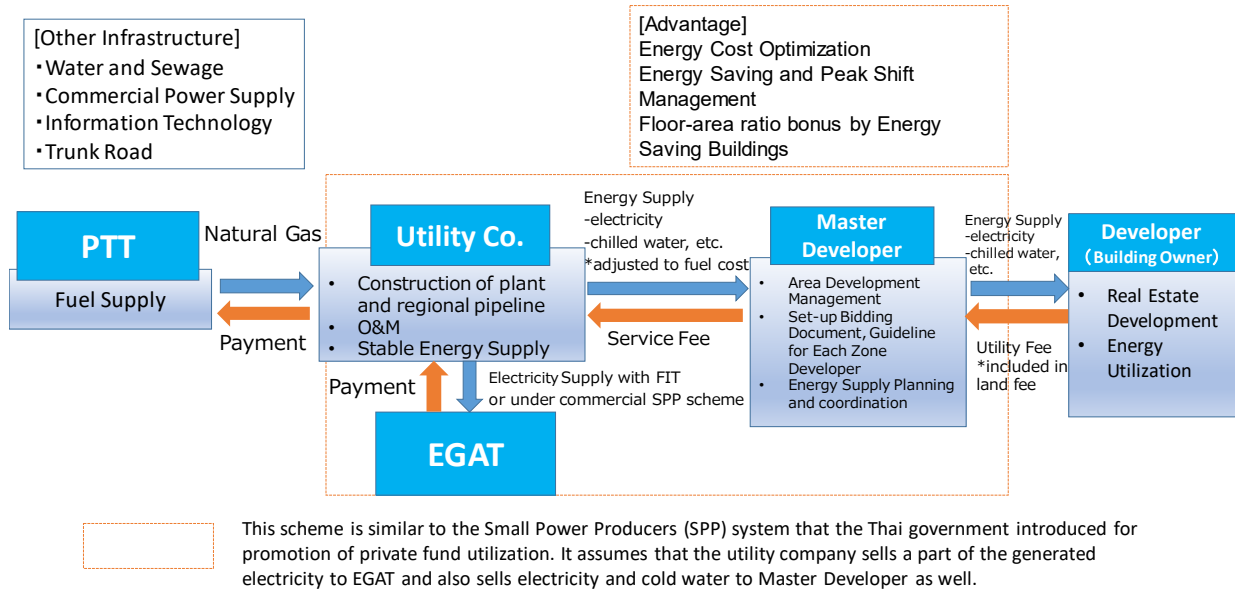
The JST estimated the efficiency of conventional system (electric cooling machine and commercial power source) and GCS-DC system. The results are compared as follows: For primary energy, about 6~8% was reduced and running cost was reduced by 13~18%. The estimation was made based on demand, which was also estimated from the floor area, unit electricity, and heat consumption. Therefore, the results may have some differences with the real situation of the system. However, it can be predicted that the benefit in operation is significant because demand for cooling in Thailand is high, the running period is long, and electricity price is high while gas price is low. From these results, it can be concluded that it is possible to introduce facilities with high cost effectiveness and environmental friendliness such as cogeneration and absorption cooling machine to supply energy in the district.

3) Business Model for Energy Supply

The business model for cogeneration and district cooling is summarized as follows (Figure 7.3.6):

- A) Supply method is concentration plant method.
- B) Operation management is a 24-hour 365-day monitoring system, which will be carried out by ESP of heat supply company.
- C) In Thailand, there is a feed-in tariff (FIT) policy which allows electricity generated by cogeneration to be sold. Therefore, the electricity is not only for use inside the district, but it can also be sold to gain income.
- D) For operating cogeneration and district cooling plant, spaces for chimney facilities are needed. These spaces can be rented from buildings by paying a rental fee. If pipelines are installed in utility corridors of the buildings, rental fee will also be paid.
- E) For cooling water supply building, there is no need for machine room, thus, it can be utilized as shop space for office buildings or commercial facilities.
- F) For cogeneration and district cooling, the energy supply company will carry out energy management to optimize district energy efficiency by CEMS and EMS. Demand response can be introduced, if necessary.
- G) The facilities introduced must have high levels of energy efficiency to realize the concept of smart city. It is necessary to establish a maintenance structure at the area. Furthermore, to reduce initial investment cost, cogeneration and auxiliary equipment should be procured from the same manufacturer or from a group of manufacturers.

Energy Supply Structure (example)



Source : JST

Figure 7.3.6 Business Model for Energy Infrastructure (example)

4) Renewable Energy

Solar radiation in Thailand is 1.5 times of that in Japan (reference from Solar GIS), thus, it is suitable to introduce solar power generation and use of solar heat. Solar power generation will give supply to park facilities or street lighting as part of environmental friendliness (Table 7.3.11).

Table 7.3.11 Overview of Equipment for Solar Power Generation

Items	Overview	Unit	Quantity
Solar power generation	Supply to park facilities or street lighting	MW	1
Battery	Capacity depends on the facility	set	1

Source : JST

(10) Energy Management (CEMS)

1) Energy Management System by Communication Infrastructure and Smart Grid

Energy management (CEMS, BEMS, MEMS) and smart-grid will be introduced. Energy management room of CEMS will be placed in SRT headquarters building to manage the whole zone independently. CEMS will help control energy data in facilities, cogeneration of energy center, and supply-demand of district cooling system. As developers in each zone introduce BEMS in offices, commercial buildings, and residential buildings, as well as introduce MEMS in condominiums, it would be possible to optimize energy use for each building.

2) Energy Management System

Specifications of energy management system are summarized as shown in Table 7.3.12. Equipment is referred from Yokomaha Smart City Project (YSCP).

Table 7.3.12 Specifications of Energy Management System

Equipment and Pipeline	Reference Specifications
CEMS, Integrated EMS	District EMS will install distributed power source, supply-demand adjustment facilities, and communications facilities and monitor from energy center. Target is to monitor distributed power sources such as cogeneration, district cooling, and solar power generators. With information sent by EMS in each area, energy consumption is made visible. The main functions of CEMS are as follows: (1) Demand and generation forecasting (2) Supply-demand plan (3) Controlling energy savings (4) Controlling voltage (5) Controlling generation (6) Demand response In addition, each EMS operator can cooperate with an energy service provider (ESP) that optimizes at the district level.
BEMS, FEMS, MEMS (Installed by architectural team)	Basic specifications are supposed to be in popular grade in Japan. However, the number of monitoring points must be in the range of optimization by CEMS. Also, EMS installed in each area must have the protocol that is interchangeable (BACnet, etc.). In each facility, a smart meter will be installed. Functions of EMS are as follows: (1) Measuring, monitoring, and controlling each equipment of the facilities. (2) Analysis tool based on visible energy consumption. (3) Support for optimal control based on energy efficiency evaluation (COP, etc.) of equipment and system. Each facility will have central monitoring devices to integrate with local control. Maintenance, including CEMS, will be managed by cooperation with ESP.

Source : JST

7.3.2 Environment and Green Network

(1) Measures against Floods (Disaster Prevention/BCP)

1) Measure with Retention Pond

As a measure against flood, 5% of developed land will be reserved for construction of retention pond. The pond must be capable for six hours of rainfall in peak with the probability of ten-year rainfall. Moreover, the pond inside Chatuchak Park can also be used as retention pond. Discharging waterway with a diameter of 5 m is under construction in the south of Bang Sue Area. It would significantly reduce the risk of flooding in Bang Sue Area.

2) Duplication of Power Sources by Commercial Power Source and Cogeneration

Duplication of power sources will ensure the reliability of power after disaster. For hospitals or headquarters of disaster response, cogeneration will also be used as emergency power source.

3) Elevation of Building Locations

Building locations can be evaluated by landfilling or raising floor. As the cost must be high, only power and air-conditioning facilities would be set on high floor depending on assumed water level.

4) Reduction of Flooding Damage

Power and air-conditioning facilities would be set on high floor. Cogeneration is placed in the machine room which must be flood resistant so that it can be used as emergency power source in

flooding period. For the outside wall, water-proof material will be used and drift-preventing fence will be installed, if necessary.

5) Flooding Measure

Waterstop and sandbag are being used for flood prevention in ventilation gate. Also, doors of underground rooms must be opened inward and evacuation route must be secured.

6) Issuance of Hazard Map

Issue the hazard map to confirm the risk of flooding damage in the redeveloped area.

7) Securing Headquarter of Disaster Response and Information Communication Facilities

Ensure a structure functioning in flooding time, which is responsible in first action and emergency response.

8) Plan of Designated Evacuation Site

The area, which will not be damaged by flooding in the redeveloped area, will be designated as evacuation site.

(2) Green Network

1) Basic Policy

With regard to Chatuchak Park as a large green core and builds green network to place green path, wind path, and trees in Bang Sue Area. It creates a comfortable and convenient movement space for the entire area(Figure 7.3.7).

2) Green, Water, and Wind Network

It obtains comfortable walking space and restrains an entire area of urban heat island by placing green shade of roadside trees and water space. For instance, for the green path making, roadside trees are planted along Kamphaen Phet Street, for the water path making, water spaces are placed on the ground above the subway, and for the wind path, roof is attached and small plants are planted on the skywalk.

3) Creating Open Spaces

In the parts where people gather from the train and other places, improving comfortableness and convenience by making a space where people can gather under the green shade.

4) Greening Buildings

By promoting green buildings in the initial development zones in Bang Sue Area, Green, which will be a future green core, is created. Especially, it is necessary to plant with greens for buildings (outside roof and wall of buildings) in Zones A, C, D, F, SRT Land, and KM11.



Source : JST

Figure 7.3.7 Green Network

(3) Landscape Creation

1) Basic Policy

To create a new Bang Sue landmark centered upon Bang Sue Grand Station considering the landscape of the entire area. (Figure 7.3.8)

2) Forming Landmark

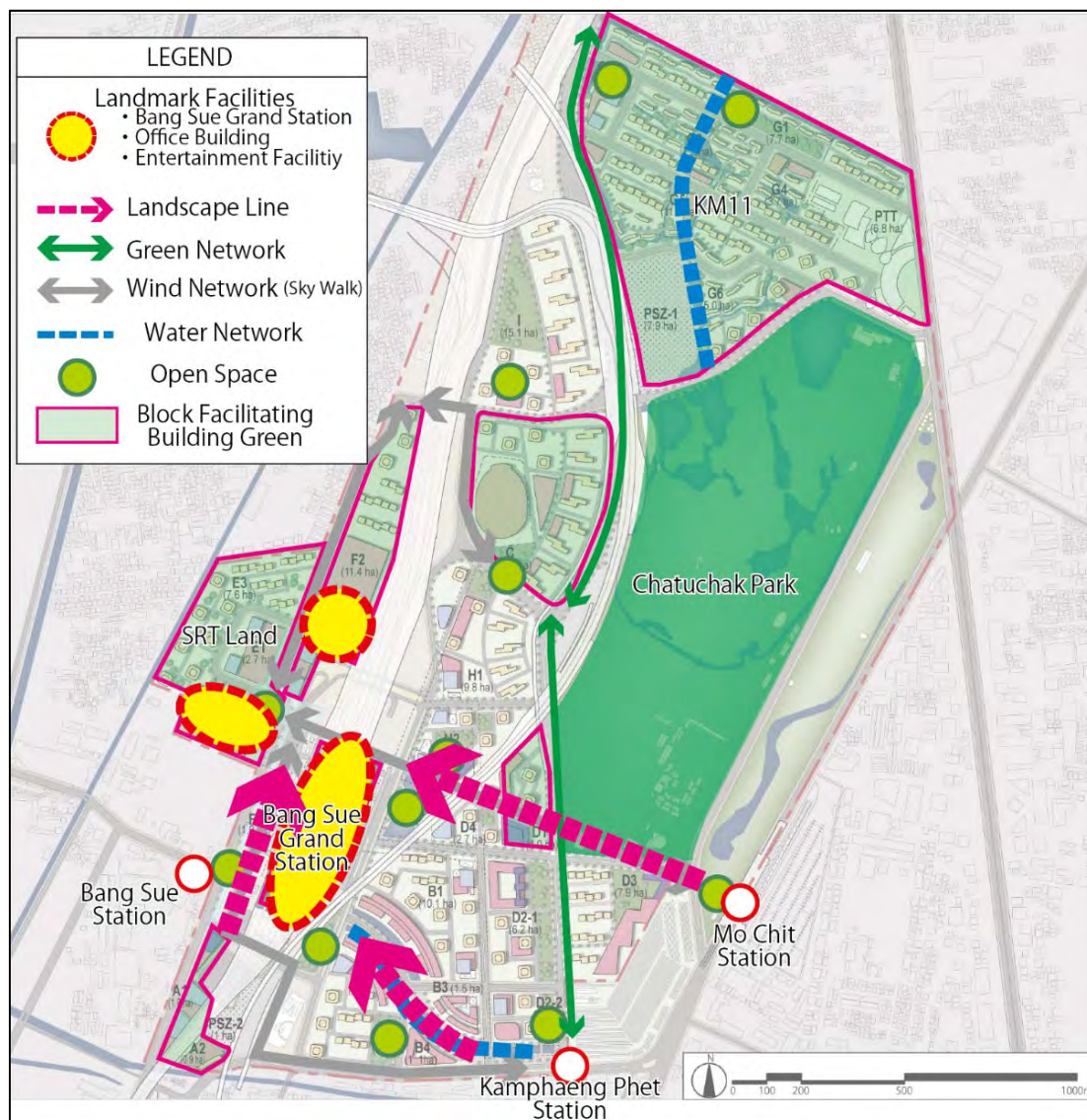
A peculiar landscape is created by building new landmark in Bang Sue Area. It is required to have retail and office buildings, which are high level and high volume, and entertainment facilities in SRT land and Sub Zone F2 that are adjacent to Bang Sue Grand Station.

3) Consideration for Building Color, Sign, and Advertisement

For the building color, attached sign and advertisement, in order to keep a beautiful landscape for the entire area, it considers good townscape creation, for instance, standardizes regular color range and shapes for buildings and needs consultation about concrete contents between the developer and local government.

4) Open Space and Walking Space

Create a landscape that is visually and physically appealing for pedestrians by doing setback for building and utilizing glass on the low floors of the retail and office buildings.



Source : JST

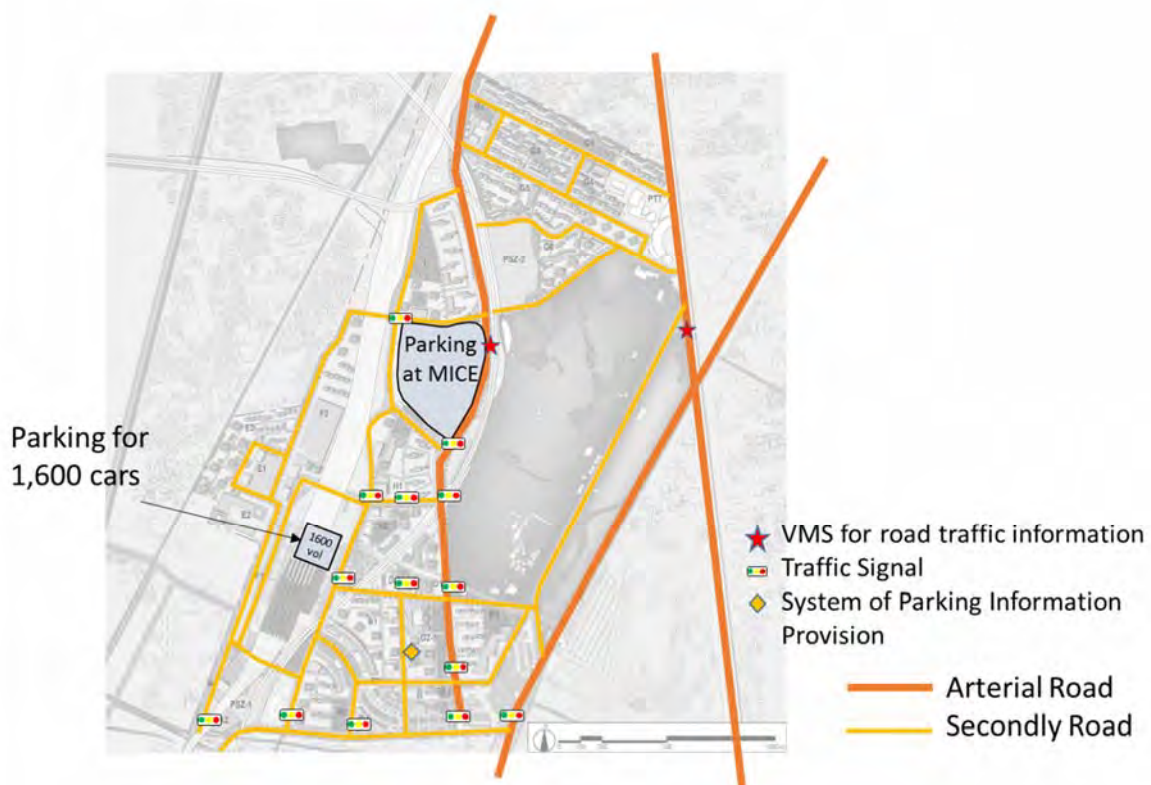
Figure 7.3.8 Landscape Creation

7.3.3 Transportation Network

(1) Road Planning

To reduce throughput traffic in Bang Sue District, in road planning, trunk roads are planned outside the district. Basically, roads inside the district are 2-lane/direction. Local roads are newly constructed or enlarged from the existing roads. In Red Line Project, there is also be a plan to construct roads in Bang Sue District. JST conducts road planning based on that plan.

As for the parking area, in the Red Line Project, there is a parking area of about 1,600 vehicles planned under Bang Sue Grand Station. Furthermore, in Bangkok, it is compulsory to secure a parking space for each building and the number of vehicles will be decided based on the building's functions and floor area.



Source: Study Team

Figure 7.3.9 Road Planning

(2) Sidewalk Planning

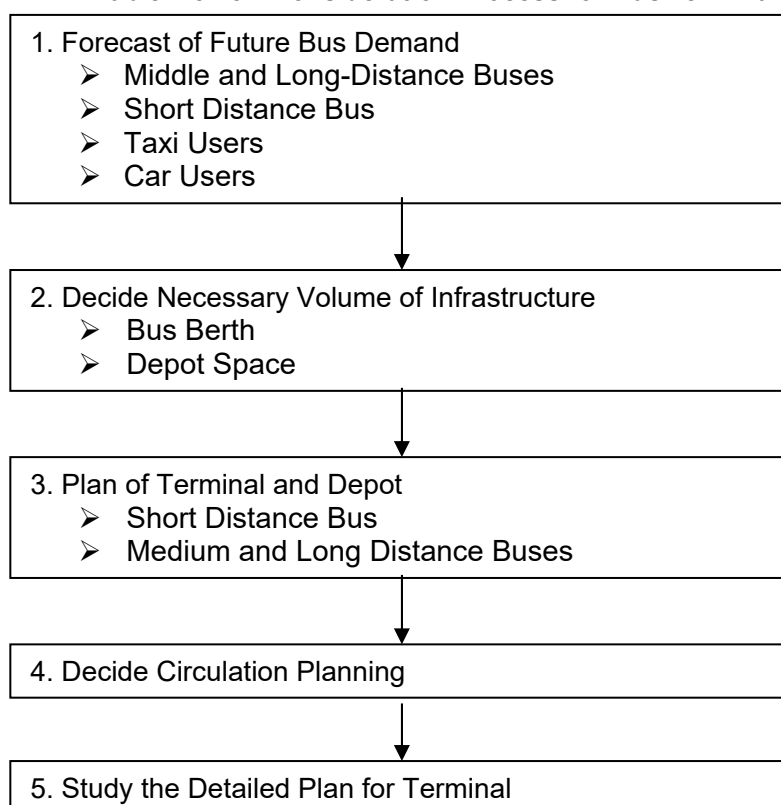
Sidewalk is planned along with road planning described in Section (1) above. In Bangkok, the separation between roadway and sidewalk is not clear in almost cases, however, as this is a transit-oriented development (TOD) project aiming to promote public transportation, the basic policy is to make the separation clear to provide a comfortable walking space for pedestrians. Sidewalks in Bang Sue District can be underground, on the ground or skywalk. On both sides of the road with a width of 7 m will be placed as ground sidewalk. Underground sidewalk and skywalk will be planned to ensure the accessibility to the facilities in the district. Details on underground sidewalks and skywalks will be described in Section 7.3.4.

(3) Public Transportation Planning

1) Middle and long distance buses, BMTA

Currently, middle and long distance buses, as well as BMTA are using Mo Chit 2 Terminal as platform and depot. However, there is a plan to relocate the terminal. To find an appropriate site for relocation, it is necessary to consider various factors as shown in Table 7.3.13. The number of bus demand in 2032 is forecasted. Also, it is noticed that in 2032, high speed railway will be opened, thus, number of passengers will choose high speed railway over middle and long distance buses. From the number of passengers estimated for middle and long distance buses, BMTA and taxis, areas of platforms and depots for these vehicles were calculated. From the calculation results, arrangement of facilities for each type will be planned as well as bus routes.

Table 7.3.13 Consideration Process for Bus Terminals



Source: JST

As there is no material available for bus demand forecast, the number of buses in 2032 is estimated from the population growth rate. Also, the interview with passengers using middle and long distance buses in Bang Sue District revealed that 78% of the passengers will transfer to high speed railway from buses and it showed that the users of high speed railway and middle and long distance buses are closed. As the number of middle and long distance bus passengers will decrease when high speed railway is ready, revision on bus demand forecast was made.

The number of berths for buses and taxis is calculated by using the formulas in the Guidebook for Station Plaza Planning.

Table 7.3.14 Formulas for Calculating Numbers of Berths for Buses and Taxis

Faciities	Estimation Fomula
On-board Berth	$\left\{ \frac{(\text{Number of Boarding Bus Passengers per Peak Hour})}{(\text{Average Number of Bus Passengers per Bus})} \times (\text{Bus Service Time}) \right\} 1/60$ Bus Service Time = Frequency of Bus Operation
Off-board Berth	$(\text{Number of Peak Alighting Bus Passenger per Peak Hour}) \times (\text{Average Alighting Time per Person}) / 60$
On-board Berth (Taxi)	$(\text{Number of Peak Boarding Taxi Passenger}) \times (\text{Average Boarding Time per Person}) / 60$
Off-board Berth (Taxi)	$(\text{Number of Peak Taxi Alighting Passenger}) \times (\text{Average Alighting Time per Person}) / 60$
Parking Space for Taxi	$\frac{(\text{Number of Waiting Passenger per Peak Hour})}{(\text{Average Number of Taxi Passengers per Taxi})}$
Boarding and Alighting Berth	$\frac{(\text{Car Users per Peak Hour})}{(\text{Average Number of Vehicle Passengers per Vehicle})}$

Source: Guidebook for Station Plaza Planning

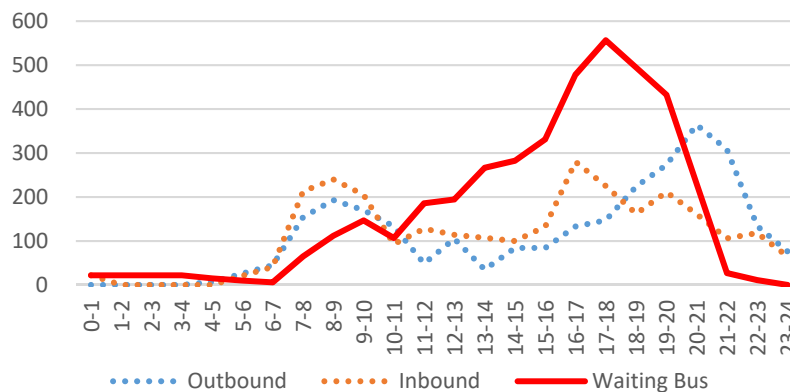
The results for middle and long-distance buses are shown in Table 7.3.15. In total, there will be 84 berths, which are reduced by more than 60% from the present number of 263 berths. The reason is that in the formula, the operation interval is set to be 10 minutes and thus, the number of buses using one berth is increased. At the current terminal, the operation interval is too long and the buses must wait for a long time at berths, thus, the total number of buses is small. Therefore, if the number of buses increases using one berth, it would be possible to increase the operational efficiency.

In the calculation of the depot area, the JST estimates are based on the number of waiting buses. The waiting buses are calculated by considering departing bus volume and arriving bus volume. As shown in Figure 7.3.10, Number of Waiting Bus Volume became maximum from 5:00 pm to 6:00 pm. The result is 33,026 m², which is only half of the present area of 71,980 m². The current depot is located under Sirat Expressway and inside Mo Chit 2 Terminal but there are multiple areas left unused, thus, only in peak hours, buses will be gathered in Old Mo Chit.

Table 7.3.15 Calculation Results of Facilities (Middle and Long Distance Buses)

Faciities	Spec of Facilities	Current Mo Chit 2
On-board Berth	(1) Outbound passenger volume per day : 42,159 vol/day (Total 83,146 vol/day) (2) Peak bus passenger volume: 5,607 vol/h ←(1)*0.133 Peak Ratio 13.3% (3) Average passenger volume per bus : 16.6 people/bus (4) Service interval : 10 min <u>Necessary berth = (2)/(3) × (4) × 1/60 = 56 berths</u>	263 Berths (long distance 130 berths 、 middle distance 133 berths)
Off-board Berth	(1) Inbound passenger volume per day : 40,987 vol/day (Total 83,146 vol/day) (2) Peak bus passenger volume: 5,082 vol/h ←(1)*0.124 Peak ratio 12.4% (3) Average off-board time : 0.333 minute Necessary berth = (2) × (3) / 60 = 28 berths	
Depot	Space per 1 bus : 59.4m ² ((13+5)*3.3 m) Bus peakvolume : 556 vol (Maximum waiting bus volume) 59.4×556 = 33,026 Necessary depot space : 33,026 m ²	71,980 m ² *Under Sirat Toll Way and Mo Chit 2

Source: JST



Source: JST

Figure 7.3.10 Time Variation on the Number of Waiting Bus Volume

Results of calculation done by BMTA is shown in Table 7.3.16. The current BMTA terminal is located near the current Mo Chit 2 Terminal; however, the future depot of BMTA terminal is also planned in the Red Line Project, which is under construction now. The results of depot are fit with the planning. Next to BMTA depot, there is a plan for a touristic bus terminal.

Table 7.3.16 Calculation Results of Facilities (BMTA)

Facilities	Spec of Facilities	Planning in Red Line Project
On- and off-board Berths	Total bus volume per day: 3,458 vol/d Peak bus volume per hour: 209 vol/h (Peak ratio 6%) Service interval: 10 min = Necessary berth : 35 berths	None
Depot	Necessary space per bus : 59.4m ² ((13+5)*3.3 m) Peak bus volume : 209 vol/h (Peak ratio 6%) = Necessary depot space : 12,456 m ²	1.4ha

Source: JST

Bus terminals and depots will be arranged based on calculation results above. Figure 7.3.11 indicates the bus route example in Japan.

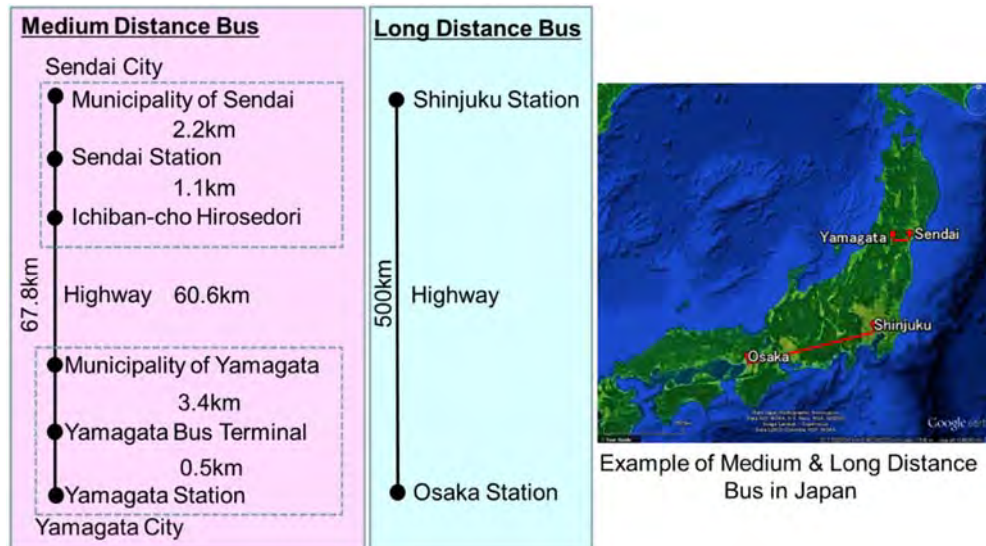
Basically, a distance of over 200 km from Bang Sue Grand Station is covered by high speed railway, while the distance within 200 km is covered by middle distance buses and commuter trains such as MRT, BTS, and BMTA. Terminal and depot for middle and long distance buses will be planned in Old Mo Chit. This is accordance with the planning proposed by OTP and SRT, in which the area will be opened from 2023 with taxi platform, BMTA platform, middle and long distance buses platform and commercial facilities. BMTA depot will be located in Bang Sue Grand Station as planned in the Red Line Project. However, the depot for BMTA is not planned clearly and it is recommended to locate it within walking distance from Bang Sue Grand Station.

The direct distance from Bang Sue Grand Station to Old Mo Chit is about 1.2 km. Although Old Mo Chit is next to MRT Mo Chit Station, it is important to provide access between Old Mo Chit and Bang Sue Grand Station, which is a railway connection point.

According to OTP, there will also be 50 berths for middle distance buses inside Bang Sue Grand

Station as shown in Table 7.3.11.

Those berths will be utilized for on-board berth for middle distance bus coming from Old Mo Chit. Besides Old Mo Chit, some of the buses would be arranged to stop at Bang Sue Grand Station. The number of berths is estimated at 30 berths. That number is calculated by dividing the number of on-board berth into middle and long distance buses.

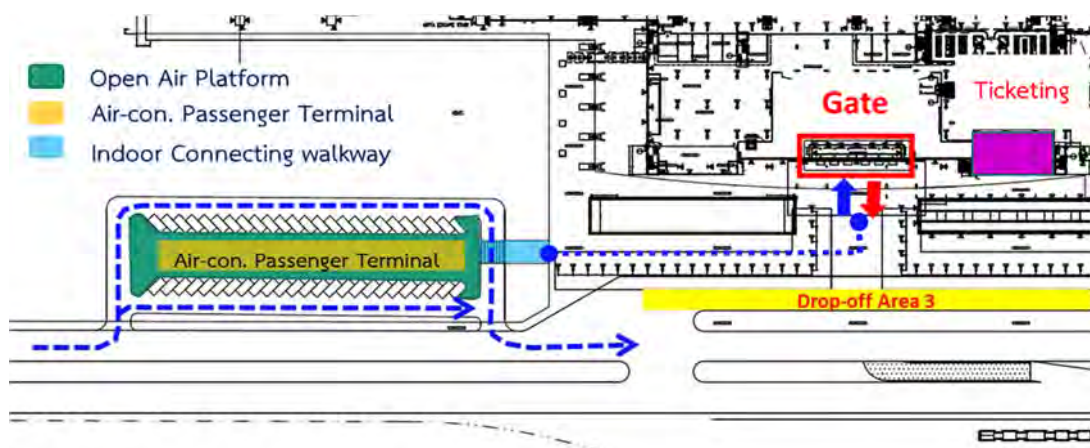


Source: JST

Figure 7.3.11 Example of Middle & Long Distance Bus Route in Japan

Similarly to middle & long distance bus, BMTA will mainly stop at Bang Sue Grand Station, but some of them would be arranged to stop at Old Mo Chit. Number of berth is estimated based on the percentage of passengers using Bang Sue Station for transshipment by highspeed railway or middle distance bus and passengers heading to a facility inside Bang Sue Area.

Above arrangement is shown in Table 7.3.17 and Table 7.3.12.



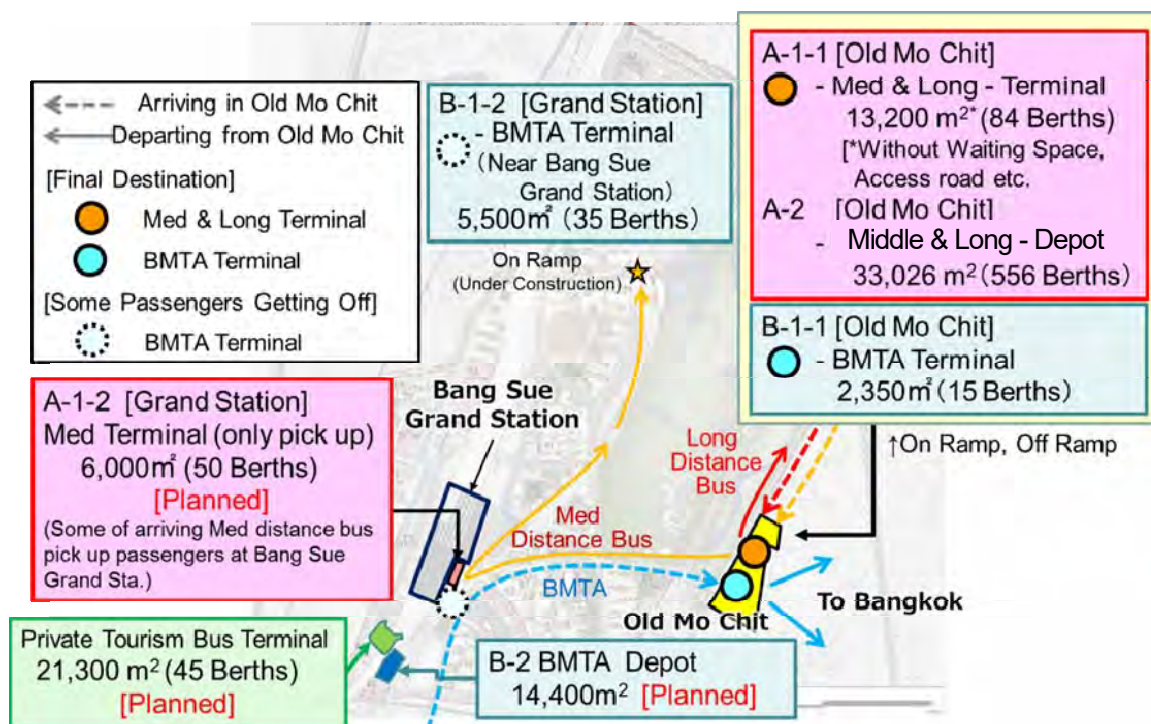
Source : OTP

Figure 7.3.12 Berths for Middle and Long Distance Buses in Bang Sue Grand Station

Table 7.3.17 Results of Facilities for Middle and Long Distance Buses and BMTA

	1.Terminal			2. Depot		
	Location	Volume		Location	Volume	
		Need	Existing /Planned		Need	Existing /Planned
A. Middle and Long Distance Buses	A-1-1 - Old Mo Chit	84 berths (On 56+ Off 28)	263 berths (Existing, Mo Chit 2)	A-2 - Old Mo Chit	33,026 m ² (556 berths)	71,980 m ² (Existing)
		Feasible (84<263)			Feasible (33,026 m ² <71,980 m ²)	
	A-1-2 - Bang Sue Grand Station* ¹	30 berths	50 berths			
		Feasible (30<50)				
B. BMTA	B-1-1 - Old Mo Chit	15 Berths* ²	No Plan	B-2 -Bang Sue Grand Station	12,456 m ² * ³	14,400 m ² [Planned] (Red Line PJT)
		Need a new plan			Feasible (12,456 m ² <14,400 m ²)	
	B-1-2 - Place within walking distance from Bang Sue Grand Station	35 berths	No Plan			
		Need a new plan				

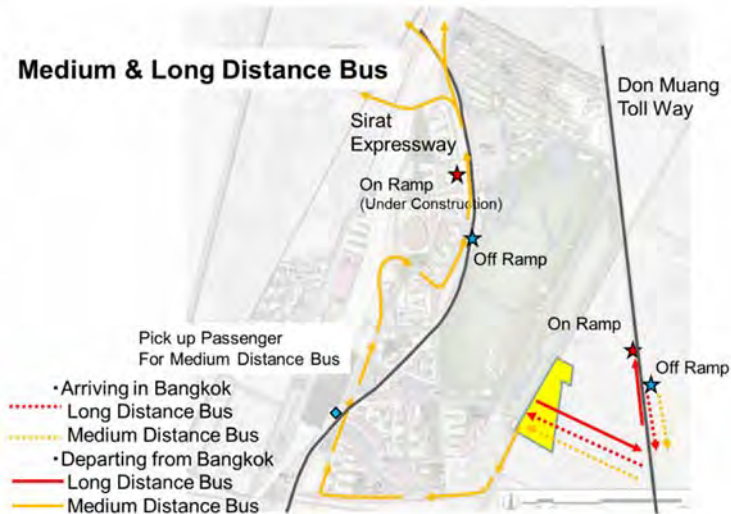
Source: JST



Source: JST

Figure 7.3.13 Arrangement of Bus Facilities

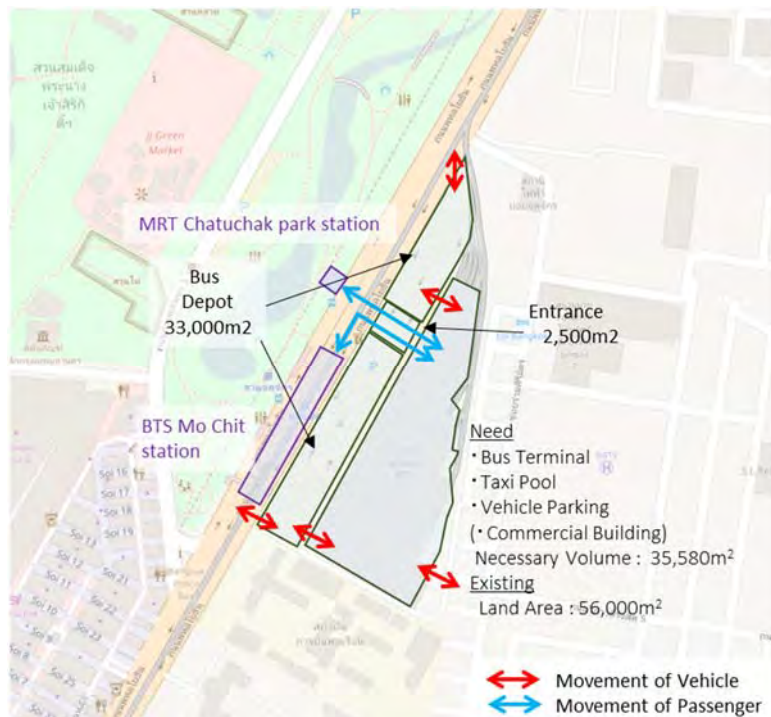
The routes of middle and long-distance buses are shown in Figure 7.3.14. These routes are the same with those proposed by OTP.



Source: JST

Figure 7.3.14 Routes of Middle and Long Distance Buses

Berths and depot of middle and long distance buses are arranged in Old Mo Chit. However, space for taxi and vehicle for pick up should be considered. The layout plan of these facilities is shown in Figure 7.3.15. This layout plan assumed that the existing BTS depot building will be revitalized. The building accommodates commercial space, bus terminal of BMTA, middle and long distance buses, taxi bay, and vehicle parking. In addition, the currently used parking space is assumed to be revitalized as depot for middle and long distance buses.



Source: JST

Figure 7.3.15 Layout Plan of Old Mo Chit Bus Terminal

In the current Mo Chit 2, ticket counters for buses are divided into booths and they occupy a lot of space. Also, the users are having difficulty in finding out the right booth to buy their tickets. Therefore, when transferring to Old Mo Chit, it is proposed that ticket counters are arranged into one window only.



Source: JST

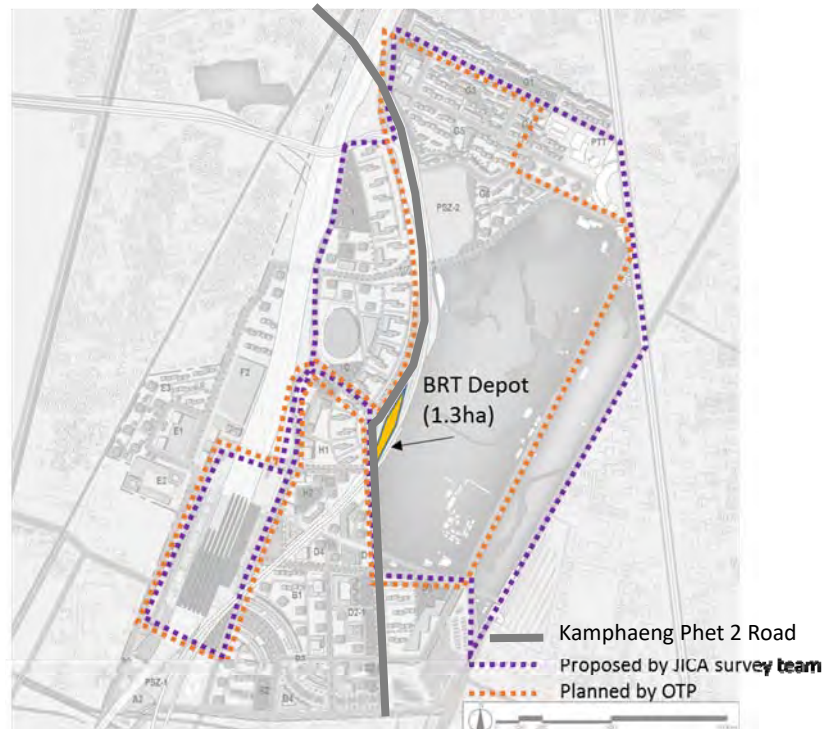
Figure 7.3.16 Reorganization of Ticket Counters (Left: Mo Chit 2; Right: Shinjuku Bus Terminal)

2) Circulating Buses in Bang Sue District

Circulating buses are already considered in the OTP survey. However, to avoid chronic congestion on Kamphaeng Phet 2 Road and increase the connection with Old Mo Chit, some of the routes are proposed to be changed as shown in Figure 7.3.17. Especially, for Kamphaeng Phet 2 Road, bus rapid transit (BRT) might affect the existing traffic flow. Therefore, route is planned except for Kamphaeng Phet 2 Road.

In BRT development, it is necessary to construct exclusive lanes, bus shelters, and depots. According to OTP, BRT is expected to be opened in 2022. However, based on the development scenario described above, in 2022, only the development of surrounding area of Bang Sue Grand Station will be reached and the increase in benefit from BRT development is limited. Therefore, the target year for operation is set at 2027. Until 2027, civil works and procurement of vehicles will be done by 2032, extra buses will be put into operation.

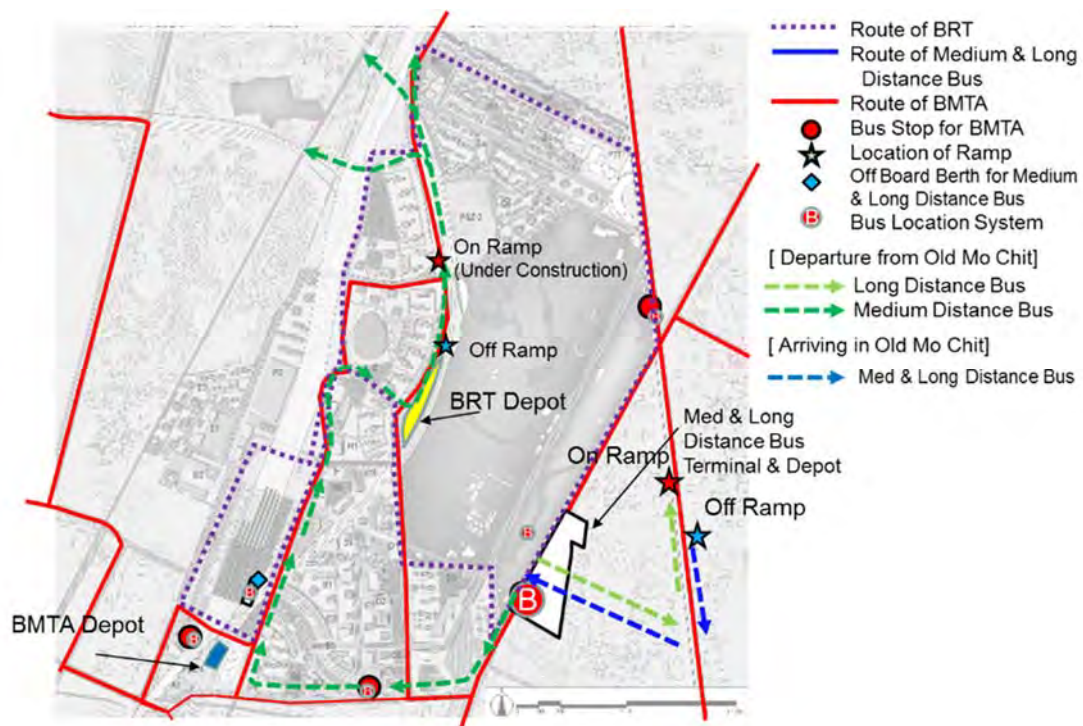
In short period, BRT is the possible mode of transport. If traffic demand will be increased, introducing monorail is one of the options.



Source: JST

Figure 7.3.17 Routes of Circulating Buses

Considerations for middle and long-distance buses, BMTA, and circulating buses are summarized in Figure 7.3.18. Berths and routes of BMTA are set to be the same as present. Routes and number of buses need to be considered later.



Source: JST

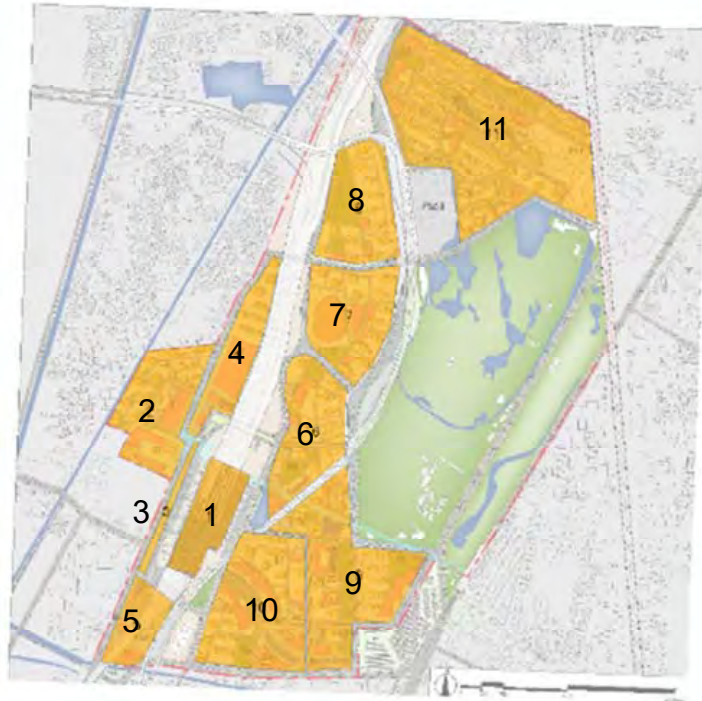
Figure 7.3.18 Public Transportation Planning

(4) Result of Traffic Demand Forecast

Based on road planning and public transportation planning, traffic flow in 2037 is forecasted. Forecast method is based on the four-step method using JICA STRADA. The objective is to judge the road plan and public transportation plan whether these satisfy the traffic demand or not.

1) Traffic Zone

Traffic zone shown in Figure 7.3.19 was adopted based on zoning category used in the development plan.



Source : JST

Figure 7.3.19 Traffic Zone in Bang Sue Area

2) Trip Distribution

Trip generation was estimated in Chapter 5. As presented in Chapter 5, the projection result depends on the number of visitors and residents in Bang Sue Area. The numbers of visitors and residents were projected from area of each planned landuse and unit of trips per area. trip distribution is estimated based on gravity model. The result is shown in Figure 7.3.20.

The biggest traffic demand appeared in Zone A – Bang Sue Grand Station.

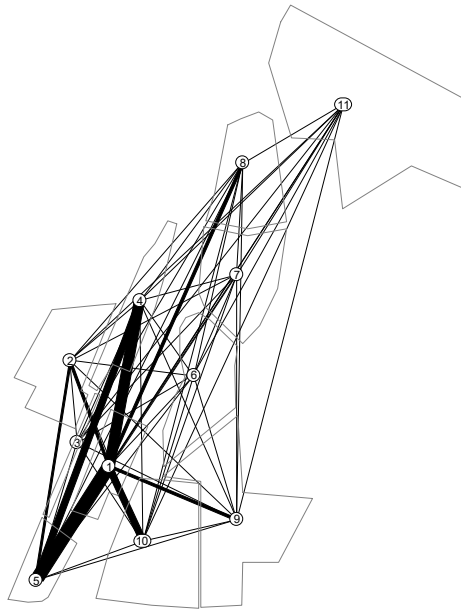
$$T_{ij} = a \frac{T_i T_j}{C_{ij}^b}$$

a, b = parameters

C_{ij} = Travel Cost (distance)

T_i = Total Number of Attracted Trips

T_j = Total Number of Generated Trips

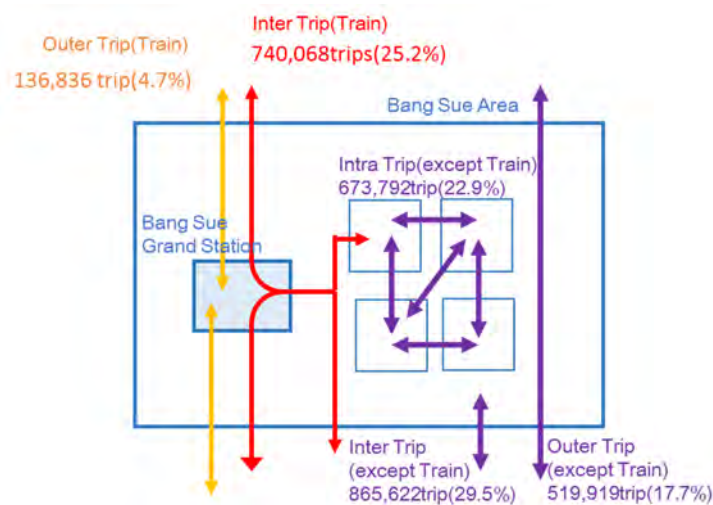


Source : JST

Figure 7.3.20 Desire Line for Inner Trip

On the other hand, trip generation inside Bang Sue Area is insufficient, since it is necessary to consider some vehicles just passing through the Bang Sue Area. Therefore, the demand forecast takes in consideration those passing through vehicles as well. To estimate the amount, the JICA Survey Team referred to the intersection count survey data taken by OTP at eight locations in Bang Sue Area. The JICA Survey Team regarded the survey data as passing through vehicles and calculated the future traffic volume by using population projection. Estimated trip number is indicated in the following figure.

Intra trip means trip generated and attracted inside Bang Sue Area. Inter trip means that origin or destination is inside Bang Sue Area and the other is outside Bang Sue Area. Outer trip means trip passing through Bang Sue Area.

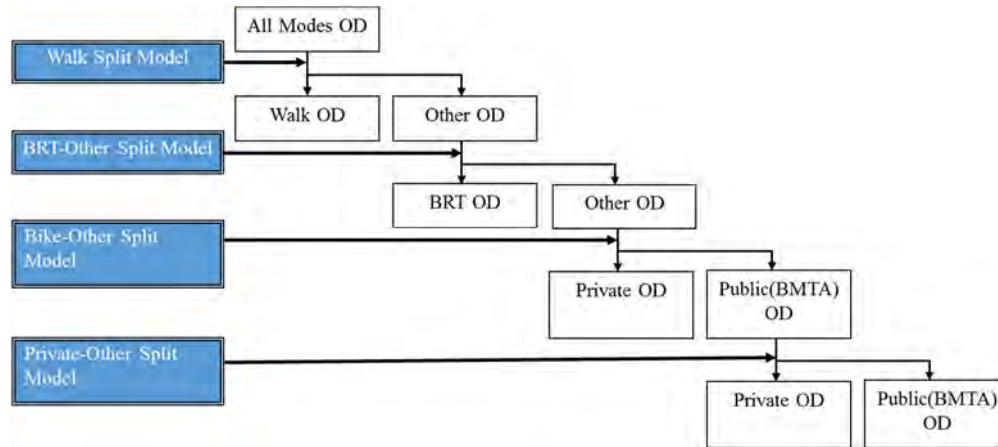


Source : JST

Figure 7.3.21 Trip Number in Bang Sue Area in 2032

3) Mode Choice

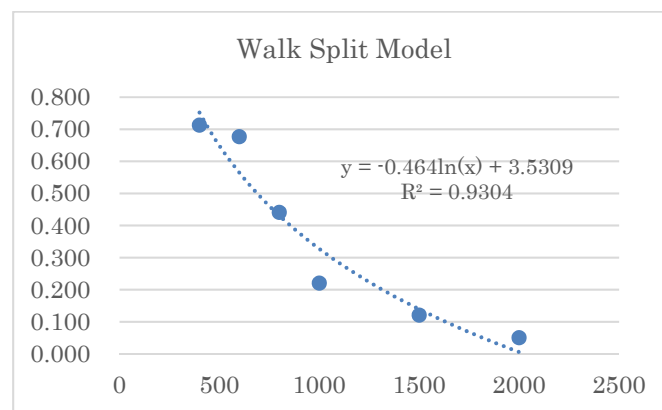
After the estimated trip distribution, modal split was assumed to each trip. Binary choice model is adopted to classify the trip mode. Modal share of train is basically assumed at 40% as shown in Chapter 5.



Source: JST

Figure 7.3.22 Estimation Flow of Traffic Modal Split

Modal share of walk was calculated from the interview survey result. Interview survey collected the maximum walking minutes. Walk split model is estimated as shown in Figure 7.3.23. As shown in the following figure, modal share of walk decreases as distance between origin and destination becomes long. Coefficient of determination is judged at 0.93, thus, the model describes the survey result.

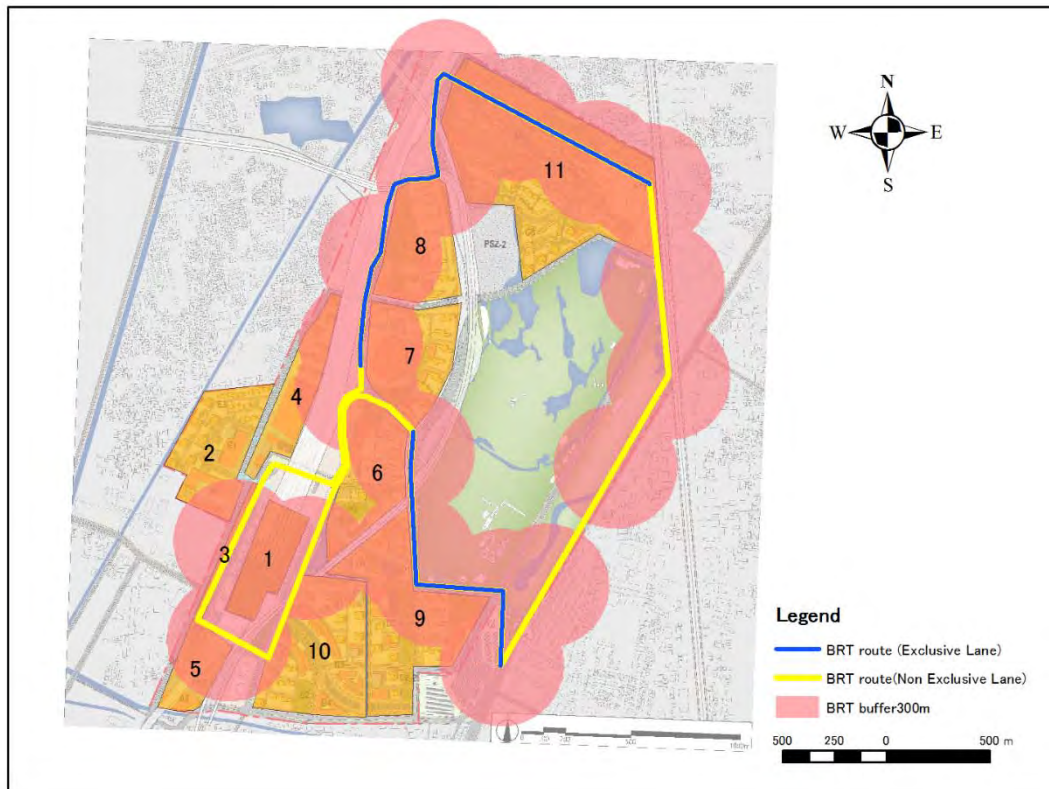


Source: JST

Figure 7.3.23 Walk Split Model

Modal share of BRT depends on the BRT fare, comfortability, and punctuality. However, detailed information of BRT is unclear. Accordingly, the JICA Survey Team assumed BRT station sphere and calculated an overlapping area of each zone and station sphere. In short, modal share is increased as overlapping area becomes bigger. As a result, BRT trip accounts for 26% of the total inner trip.

Number of BRT passengers are estimated 2,400 PPHPD as maximum. JICA survey team assume that the articulated bus are operated at interval of three minutes.



Source: JST

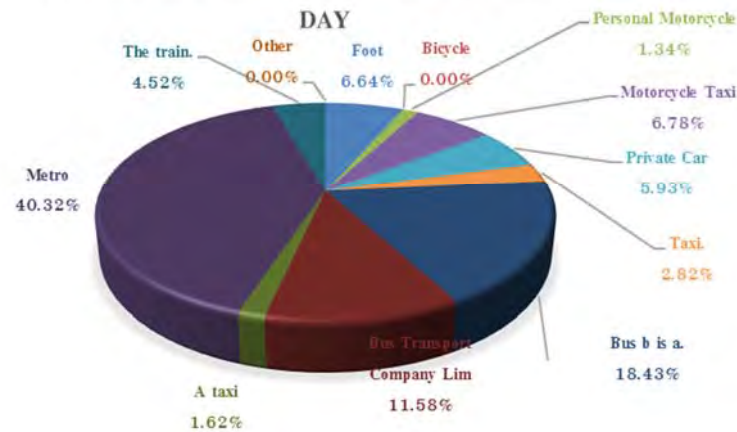
Figure 7.3.24 BRT Station Sphere

Finally, modal shares of automobile, motorcycle, and BMTA were estimated. OTP conducted origin-destination (OD) interview at the Bang Sue Area to grasp trip behavior. The JICA Survey Team assumed modal share based on the OD interview result. Figure 7.3.25 shows modal share of visitors to Bang Sue Area on weekdays.

As mentioned in Chapter 5, modal share of train accounts for 40%; therefore, 40% of inflow population will basically use public transportations such as bus, BRT or taxi when they move inside Bang Sue Area. Modal share of motorcycle is approximately 8% (personal motorcycle 1.34% + motorcycle taxi 6.78%) in Figure 7.3.25.

The reason is Bang Sue Area will be developed based on TOD concept. It means use of public transportation will be promoted, consequently, motorcycle ratio will be suppressed around Bang Sue Area. Therefore, modal share of motorcycle was not set beyond 8% in the future. However, passing through vehicle is not related to the TOD concept itself. Modal share of passing through is set separately.

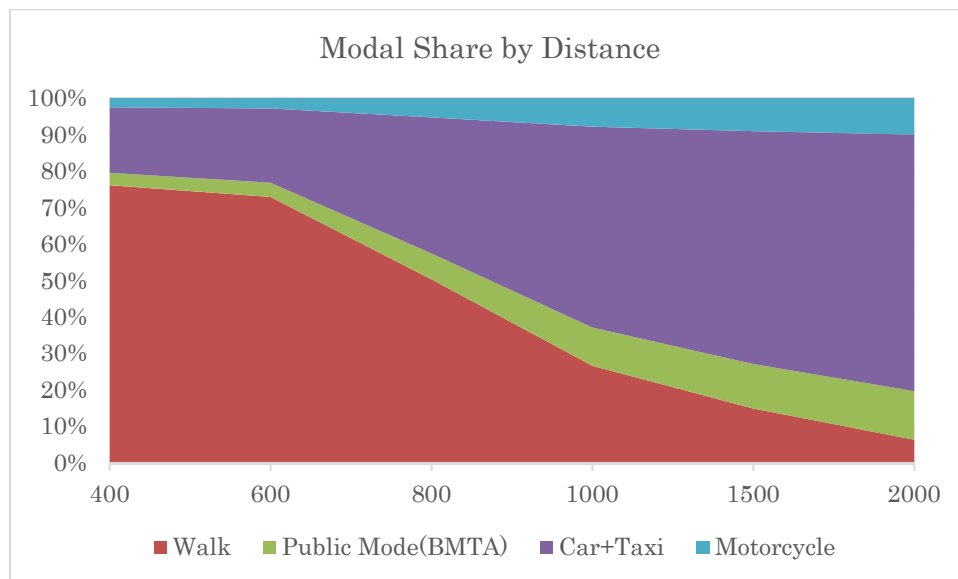
OVERVIEW OF THE TRIP TO THE AREA IN THE ORDINARY



Source: OTP

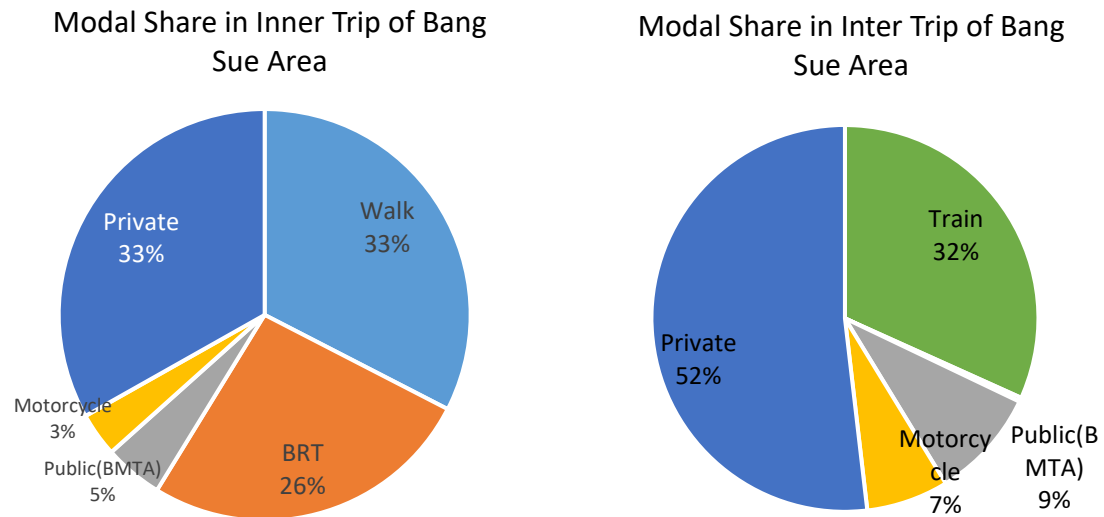
Figure 7.3.25 Modal Share by Transportation Mode by OTP Interview Survey

Considering the above conditions, modal share was analysed as below. Modal share varies according to the distance between origin and destination. As distance becomes farther, share of automobile and taxi becomes higher. Shares of BRT and train relied on the station sphere. Therefore, modal shares of BRT and train are omitted in the following figure.



Note: Shares of BRT and train relied on station sphere. Therefore, modal share of BRT and train are omitted in the figure.
Source: JST

Figure 7.3.26 Modal Share by Transportation Mode



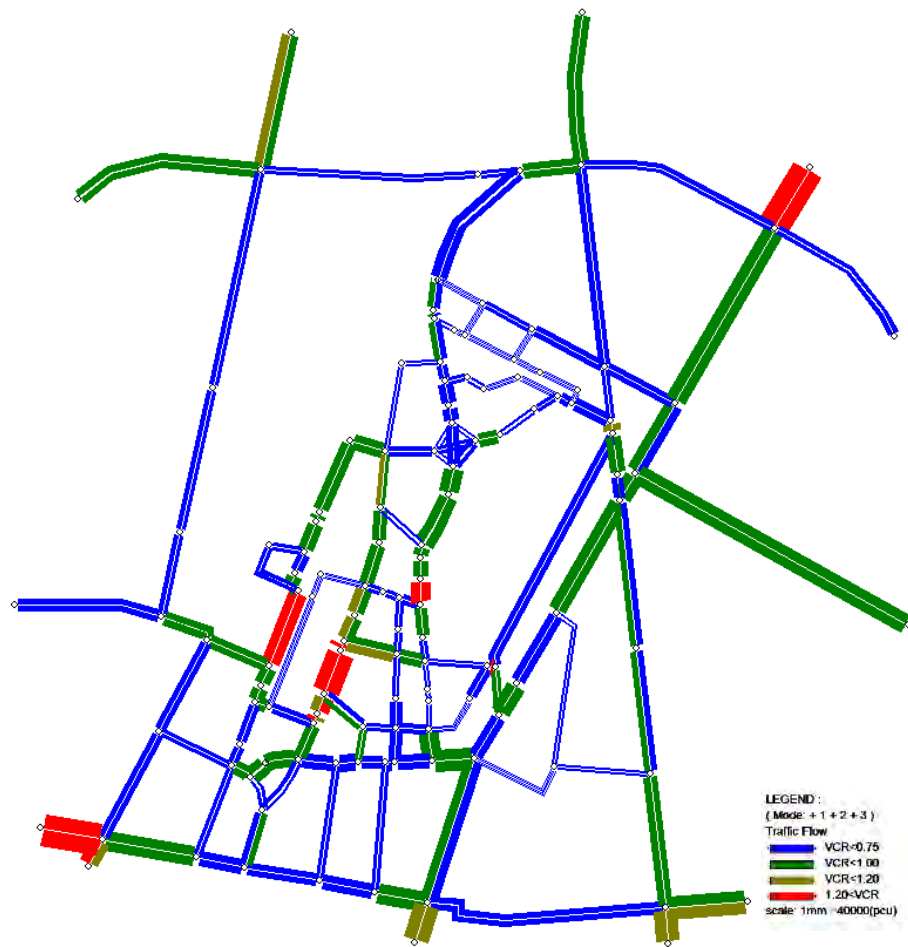
Source : JST

Figure 7.3.27 Modal Share (Left : Inner Trip, Right : Inter Trip)

4) Trip Assignment

All trips are sorted by transportation mode. After sorting all trips into each mode, trip assignment process was proceeded by user equilibrium assignment. The result is shown in Figure 7.3.28.

All roads do not exceed their road capacity. On the other hand, some roads around Bang Sue Grand Station exceed their road capacity. The reasons are the generated trips around Bang Sue Grand Station is huge, and supply of road infrastructure is not enough compare to traffic volume. The countermeasure is to increase the bus volume to decrease the number of private vehicles.



Source:JST

Figure 7.3.28 Result of Traffic Demand Forecast

Table 7.3.18 Trip Assignment Result

Year of Traffic Demand Forecast	Vehicle – km Total (PCU-km) ('000)	Vehicle-hours Total (PCU-Hour)	Average VCR*	Average Speed (km/h)
2032	2,837,767	66,604	0.62	42.6

Source:JST

7.3.4 Grade Up Facilities

(1) Sky Bridges

JST proposes to construct skywalks in the west of Bang Sue Grand Station in the south-north direction and in the east of the station in the east-west direction. The former will be constructed in 2022 while the latter will be constructed in 2027.

Sky bridges will be covered with roof to shelter pedestrians from sunlight. There will be mist spray on some locations to provide cool feelings.

(2) Underpass

The objective of constructing underpass is to ensure the accessibility from Bang Sue Grand Station to commercial facilities.

(3) ITS

ITS facilities that can be applied in Bang Sue Area could be variable message sign (VMS), signal coordination system, parking information system, bus location system, information provision system, and autonomous driving technologies. As VMS and parking information system are already applied in Bangkok, it would be possible to apply these facilities in Bang Sue. Bus location system will be installed in circulating bus stops and terminals of middle and long distance buses. Autonomous driving technology could be applied in circulating buses (Figure 7.3.29, Figure 7.3.30, and Figure 7.3.31).



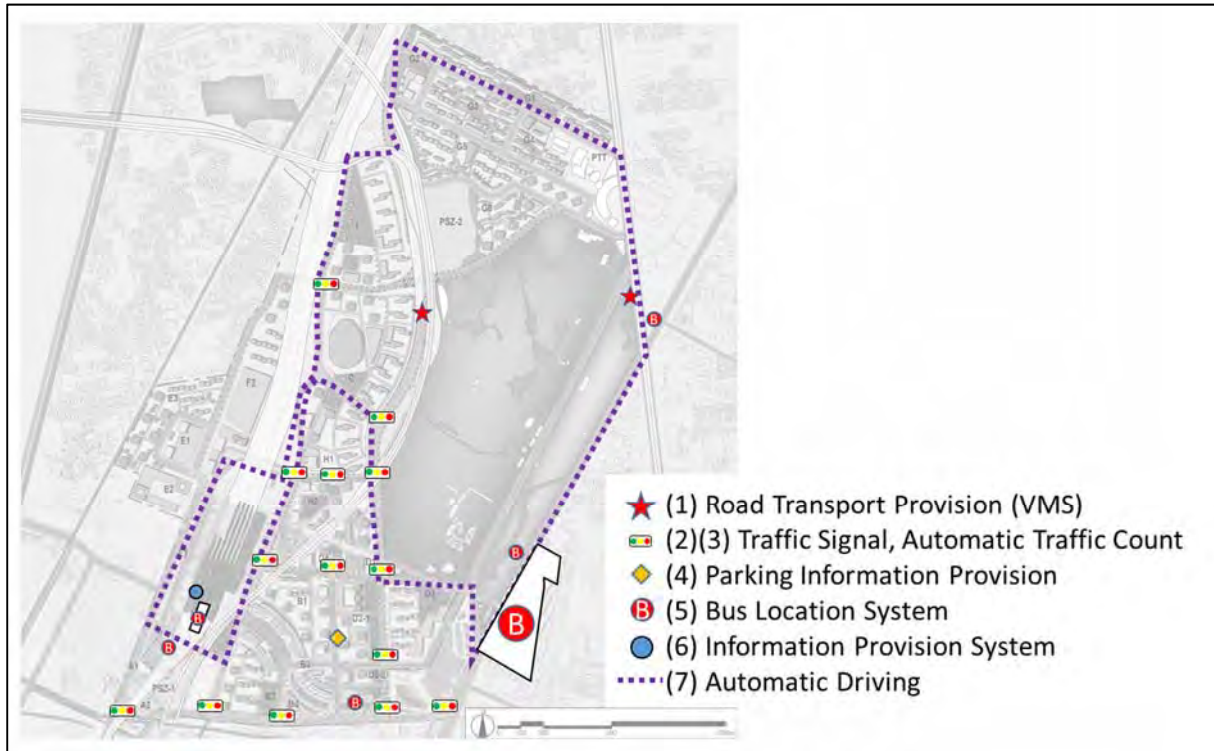
Source : JST

Figure 7.3.29 Parking Information System in Bangkok (Lumpini Park)



Source : JST

Figure 7.3.30 VMS in Bangkok (ChalermMaha Nakhon Expressway)



Source : JST

Figure 7.3.31 ITSPlan

(4) Data Center

1) Background for Activating Information Industry as Part of Smart City

Thailand 4.0 aims for economic growth in information industry by listing digital industry as one of the target groups of industry education. The target areas for digital industry regulated in the policy are Chiang Mai and Phu Khet. Bang Sue is not listed as a target area. However, it is listed as the target area for innovative industry promotion in the “smart up” program of the National Innovation Agency (NIA). Therefore, JST proposes to activate information industry as part of the smart city

To activate information industry, it is necessary to attract investors such as IT companies by providing reliable big data management, reducing initial investment cost, and high level of security. Data center may be one of the ways to realize the concept.

2) Performance of Data Center

Reference for performance of data center is shown in Table 7.3.19. It is necessary to consider construction cost and required specifications to decide the appropriate grade.

Table 7.3.19 Performance of Data Center (Reference)

Category	Description
Duplication of power system	The power will be supplied from two different substations by two systems. If incident occurs and one of the systems is stopped, power supply will be switched to the other automatically. As for the short period of switching, UPS will be used to maintain the power.
Duplication of main power facilities	There will be duplicated power system inside the center. Power sources for important equipment such as server room and air-conditioning system will be duplicated to provide usability and stability in 24-hour, 365 days.
Emergency power generation	Install emergency power generator to back up in case both main system and supplement system are cut. Also, expansion space for emergency power generator will be secured.
UPS	In case power cannot be supplied from outside, it will need a short period of time for emergency power generator to operate. In this period, UPS will be used. UPS is the back up device. As for emergency power generator, expansion space for UPS will be secured.
Measures against water leakage	In the design stage, measures against water leakage must be considered. Water leakage sensor, emergency drainage facility, and dike will be installed.
Measures against fire	Firefighting will use inert gas. Also, ultra sensitive smoke sensor which can detect cigarette smoke will be installed.
Measures against floods	Data center floor will be constructed higher than the sea level and important facilities will be placed on the first floor to prevent flood damage.
Management of temperature and humidity	Temperature and humidity inside the server room must be maintained constantly regardless of outdoor temperature or facility damages.
Prevention of static charge	To prevent damages from static charge, static-charge-proof floor is used.
Measures against electro-magnetic noises	Electricity line will be on the ceiling while communication line will be installed in cable racks under the floor. This will increase safety against electro-magnetic noises occurring in the electricity line.
Measures against crime	Besides the 24-hour 365-day monitoring, a strict process for entering/exiting (management by untouched card reader), camera recording, continuous presence of safeguards will be implemented to increase security.

Source : JST

3) Characteristics of Data Center

The characteristics of the data center are summarized as shown in Table 7.3.20 Characteristics of the Data Center. At present, as information industry is not developed enough, if the data center business is carried out by a private company, it would be difficult to join because the construction cost is high. Bang Sue Area development would need subsidies from the government as part of the special economic zone (SEZ).

Table 7.3.20 Characteristics of the Data Center

Merits	Demerits
➤ Facilities investment and personnel cost can be reduced. ➤ There is no need to open a server room in each company. ➤ Can be maintained with high level security. ➤ Can be operated continuously in 24-hour 365-day. ➤ Air-conditioning management, fire resistant, and earthquake resistance are considered thoroughly. BCP measures are implemented such as data back up. Risk for business can be reduced.	➤ High level facilities, duplication, back up, and BCP measures will be very costly. ➤ Energy consumption for maintenance would be high. ➤ It is not responsible for bankruptcy and unpredictable disaster. ➤ Procedures for entering server room are time consuming.

Source : JST

7.4 Land Use Planning

7.4.1 Basic Policies for Land Use Planning

JST will consider land use plans towards achieving the realization of the vision for the future for the Bang Sue Area based on the “Matters for Care and Consideration” outlined in the basic policies section.

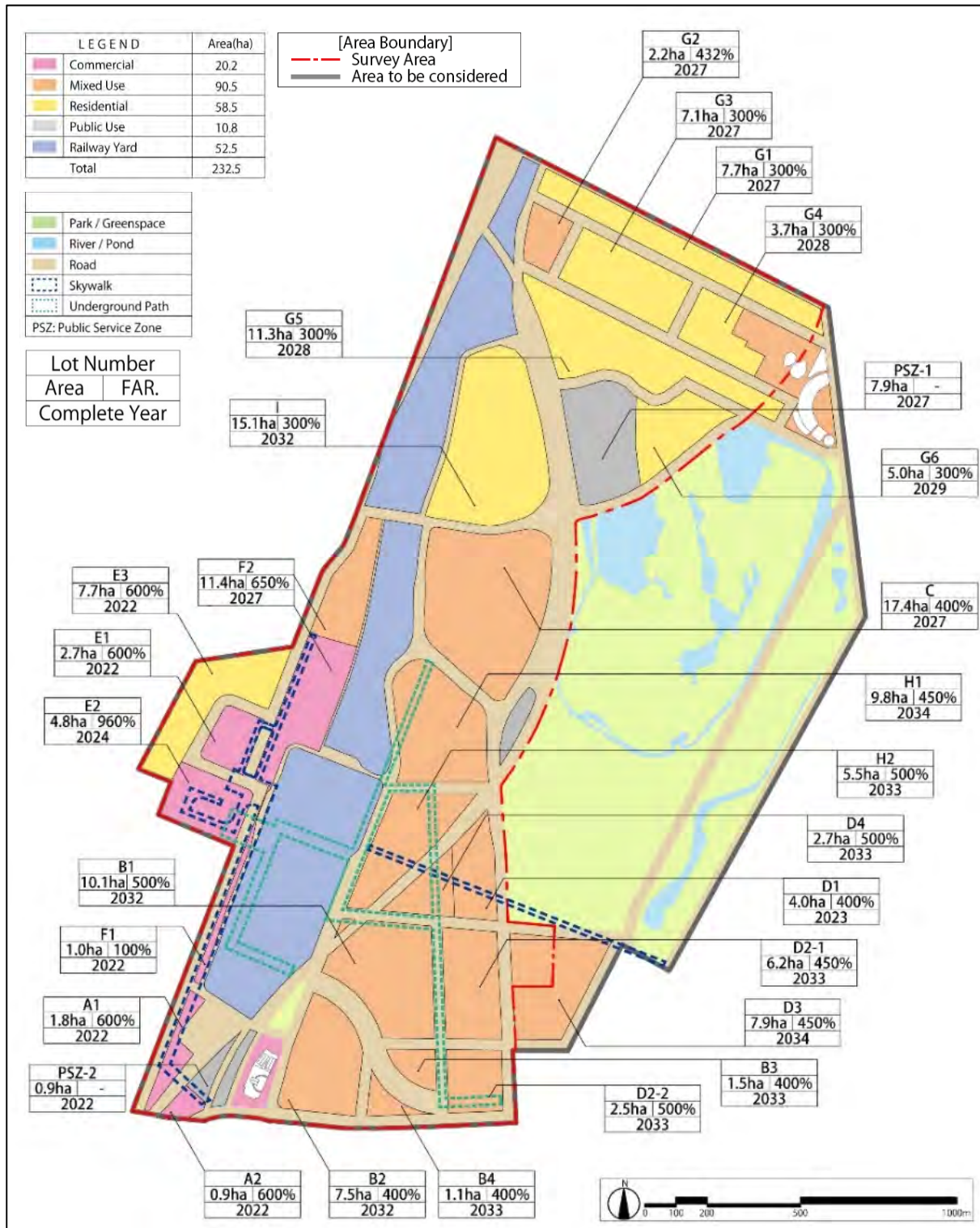
Land use will be divided into three distinct categories: (1) Commercial land (locations conducive to the development of commercial and business facilities of the kind that will form the central core of the city district), (2) Multi-purpose land (land for which the main application of use is for commercial and business purposes, but where residences will also be introduced for the purposes of creating liveliness—making the city feel busy and bustling—and ensuring a settled resident population), and (3) Residential land (with the aim of creating good quality residential zones in the Greater Bangkok area).

With regard to placement, commercial land will be located in the SRT land and areas surrounding Bang Sue Station, multi-purpose land will be located in the central part of the district that connects Bang Sue Station with Chatuchak Market, and residential land will be located in the western side of the SRT land (near to the border of the district), and in the northern part of the district.

7.4.2 Land Use Plan

Land use plan is shown in Figure 7.4.1. Proposed arrangement of future facilities based on the land use plan as shown in Figure 7.4.2. Based on the arrangement of future facilities, development images are as shown in Figure 7.4.3 and Figure 7.4.4.

These images including buildings and facilities are all for illustration, thus the contents will not be given conditions(Appendix 7-3).



Source : JST

Figure 7.4.1 Land Use Plan



Source : JST

Figure 7.4.2 Image of Future Development



Source : JST

Figure 7.4.3 Image Pers [Bang Sue Area]



Source : JST

Figure 7.4.4 Image Pers [Around Bang Sue Grand Station]

7.5 Volume Study

From the market research and interviews with real estate companies, JST calculates the floor area for office, commercial facilities, hotels, and residential buildings. Based on the land use plan, JST planned arrangement of buildings in each zone. Population forecast for each zone is shown in Table 7.5.1.

(1)Office

- 1) Floor area $\times$ 0.6 (Effective ratio)=Exclusive area
- 2) Exclusive area $\div$ 12 m²/ person=Number of people in the office

(2)Commercial facilities

- 1) Floor area $\times$ 0.5 (Effective ratio)=Tenant area
- 2) Tenant area $\times$ 0.8 person/m²=Number of customers

(3)Hotel

- 1) Floor area $\times$ 0.6 (Effective ratio) $\div$ 35 m²=Number of rooms
- 2) Number of rooms $\times$ 1.5person=Number of people

(4)Residential buildings

- 1) Floor area $\times$ 0.7 (Effective ratio) $\div$ 80 m²=Number of rooms
- 2) Number of rooms $\times$ 4 persons=Number of residents

Table 7.5.1 Volume Study

Land Use	Contents	Scale (m ² ,rooms, people)
(1) Office	Exclusive Area	530,760 m ²
	Number of People in the Office	44,230 people
(2) Commercial Facilities	Tenant Area	365,350 m ²
	Number of Customers	292,280 people
(3) Hotel	Number of Rooms	31,735 rooms
	Number of People	9,373 people
(4) Residential Facilities	Number of Rooms	6,249 rooms
	Number of Residents	126,942 people

Source : JST

7.6 Cost Estimate

(1) Basic Policies for Cost Estimate

Estimate with assumption on international contractors.

(2) Cost Estimate Items

Estimation is made for civil works and architecture works. Items included in the construction of the Red Line Bang Sue Station will be excluded. As land is owned by SRT, land use fee is excluded.

(3) Currency Unit

Use THB with conversion ratio of USD 1 = THB33.92 (July 13th, 2017)

(4) Estimate Time

July 2017

(5) Estimate Unit Price

Unit price is set based on the interview with related agencies in Thailand (MEA, BMA) and Thai consultants. The unit price for infrastructure is as shown in Table 7.6.1. The unit price for buildings is as shown in Table 7.6.2.

Table 7.6.1 Unit Price for Infrastructure

Large category	Middle category	Item	Unit	Unit Price (USD)
Basic Urban Infrastructure	Land reclamation	Earth fill	m ³	12
	Road	Road	m	1,800
		Road lighting	point	750
	Water supply	Filter plant	m ³	300
		Water tank	m ³	130
		Water pipe	m	200
	Sewage	Sewage pipe	m	200
		Manhole	point	1,000
		Sewage treatment plant	m ³	300
	Drainage	Drainage pipe	m	1,000
		Pumping station	point	1,000,000
	Electricity	Transmission line	m	3,000
		Substation	point	10,000,000
		Circuit breaker	point	50,000
		Distribution line (24kV)	m	200
	Communication	Duct	m	10
		Optical fiber cable	m	10
Transport Network	BRT	BRT station	set	15,869,960
		BRT car	car	473,200
	Underground passage	Underground passage	m ²	1,000
	Bas	Middle-Long distance bus terminal / Depot	m ²	500
	Parking	Underground parking	m ²	1,000
Green Network	Green space	Traffic light etc.	point	1,000,000
		Park	m ²	10
Smart Infrastructure	Co-generation system	Gas pipe	m	50
		Cooling pipe	m	50
		Gas co-generation system/ District cooling system	set	63,709,000
		Common duct	m	1,000
	CEMS	CEMS	set	34,058,000
Disaster Prevention	Solar power	太陽光発電装置	MW	1,820,000
	Regulation pond	調整池	ha	100,000
	Private power generation	Solar power generation facility	point	1,000,000
Upgrading Facility ¹	Underpass	Underpass	m ²	3,000
	Pedestrian road	Sky walk	m ²	500
	ITS	ITS	set	12,000,000
		Data center	m ²	3,800

Source : JST

¹ High value-added facilities for enhancing urban function and well-planned area development.

Table 7.6.2 Unit Price for Buildings

Large category	Item	Unit	Unit Price (USD)
Office	Office	m ²	1,500
Commercial Facilities	Commercial facilities	m ²	1,500
Residential Facilities	Condominium	m ²	1,500
Hotel	Hotel	m ²	1,500
Cultural Facilities	Arena	m ²	2,000
	Exhibition hall	m ²	500
	School, hospital	m ²	1,500
Public Offices	Government office /SRT head office	m ²	1,500

Source : JST

(6) Maintenance Cost

Referring to other examples, maintenance cost is assumed to be 2% of the total cost.

Details on cost estimate are shown in Table 7.6.3 and Table 7.6.4.

Table 7.6.3 Details on Cost Estimate for Bang Sue Area Redevelopment (Category)

Category	Small Category	Cost (USD 1,000)
Basic Urban Infrastructure	-	159,371
Transport Network	-	309,432
Green Network	-	6,100
Environment	-	103,127
Disaster Prevention	-	11,000
Upgrading Facilities	-	81,500
Buildings	Office	2,653,800
	Commercial Facilities	2,189,400
	Residential	10,880,700
	Hotel	1,093,500
	Cultural Facilities	550,000
	Public Offices	300,000
Total		18,337,930

Source : JST

Table 7.6.4 Details on Cost Estimate for Bang Sue Area Redevelopment (Detail)

		Category	Detail	Standard	Number		unit price (USD)	Total (USD)
					Total			
Basic Urban Infrastructure	1	Embankment		fill (average 1.0m)	1,400,000 m3		12	16,800,000
	2	Road		4Lane W= 35m	12,700 m		1,800	22,860,000
			Street lighting	per20m/both side	1,270 spot		750	952,500
	3	Water	Water plant	Q=60,000m3/day	60,000 m3		300	18,000,000
			Reservoir with Pump	V=10,000m3	10,000 m3		130	1,300,000
			water pipe	HDPE pipe (D=300)	25,400 m		200	5,080,000
	4	Sewer	sewer pipe	RC pipe (D=600)	25,400 m		200	5,080,000
			manhole	per 40m	635 spot		1,000	635,000
			Sewage treatment plant	Q=48,000m3/day	48,000 m3		300	14,400,000
	5	Drain	Drainage	Box Culvert (2mx2m)	25,400 m		1,000	25,400,000
			Pumping station	Q=1M3/s	4 spot		1,000,000	4,000,000
	6	Power	Transmission cable	110kV(2lines)	5,000 m		3,000	15,000,000
			Substation	180MVA(60MVAx3)110/	2 spot		10,000,000	20,000,000
			RMU(switch)		22 spot		50,000	1,100,000
			24kVcable		38,100 m		200	7,620,000
	7	Telecom	Cable conduit		76,200 m		10	762,000
			Optic fiber cable		38,100 m		10	381,000
			Sub Total					159,370,500
Transport Network	1	BRT	BRT station/Road Improvement		1 unit		15,869,960	15,869,960
	2	BRT	Vehicle		44 train		473,200	19,874,400
	4	Underground passage		20mx3m	63,600 m2		1,000	63,600,000
	5	Medium & Long distance	Bus Terminal/Bus Depot (Bang Sue Grand)		372,175 m2		500	186,087,500
	6	Underground parking	SRT land (Park&Ride)		10,000 m2		1,000	10,000,000
	7	Road facility	Traffic Signal etc	Traffic signal (Multi Color Graphic) . Traffic	14 spot		1,000,000	14,000,000
			Sub Total					309,431,860
Green Network	1	Green/Plantation	Park	5% of whole area	14 m2		10	6,100,000
			Sub Total					6,100,000
Environment	1	Co-generation	Gas pipe	D200	25,400 m		50	1,270,000
			Cooling pipe	D200	25,400 m		50	1,270,000
			GCS,DC		1 unit		63,709,000	63,709,000
			common duct		1,000 m		1,000	1,000,000
	2	CEMS			1 unit		34,058,000	34,058,000
	3	Solar power generation	common equipment	1.82millionUSD/MW	1 MW		1,820,000	1,820,000
			Sub Total					103,127,000
Disaster Prevention	1	Retention Pond			10 ha		100,000	1,000,000
	2	Generator		1MVA	10 spot		1,000,000	10,000,000
			Subtotal					11,000,000
Upgrading Facilities	1	Underpass	Intersection Underpass		3,000 m2		3,000	9,000,000
	2	Pedestrian Road	Skybridge	W=15m, L=3000m	45,000 m2		500	22,500,000
	3	ITS	bus location system, Parking information system, VMS		1 式		12,000,000	12,000,000
	4	Data center		3,800USD/m2	10,000 m2		3,800	38,000,000
			Sub Total					81,500,000
		Total						670,529,360

Data Collection Survey on Urban Redevelopment in Bang Sue Area
Final Report

	Category	Detail	Standard	Number		unit price (USD)	Total (USD)
				Total			
Buildings	Office			884,600	m2	1,500	2,653,800,000
	Commercial Facilities			729,800	m2	1,500	2,189,400,000
	Residential			3,626,900	m2	1,500	10,880,700,000
	Hotel			364,500	m2	1,500	1,093,500,000
	Cultural Facilities	Arena		50,000	m2	2,000	200,000,000
		Exhibition Center		50,000	m2	500	50,000,000
		Educational Facilities, Hospital		100,000	m2	1,500	300,000,000
	Public Offices	BMA/SRT		100,000	m2	1,500	300,000,000
				5,905,800			
	Total					Buildings	17,667,400,000
						Whole Total	18,337,929,360

Source : JST

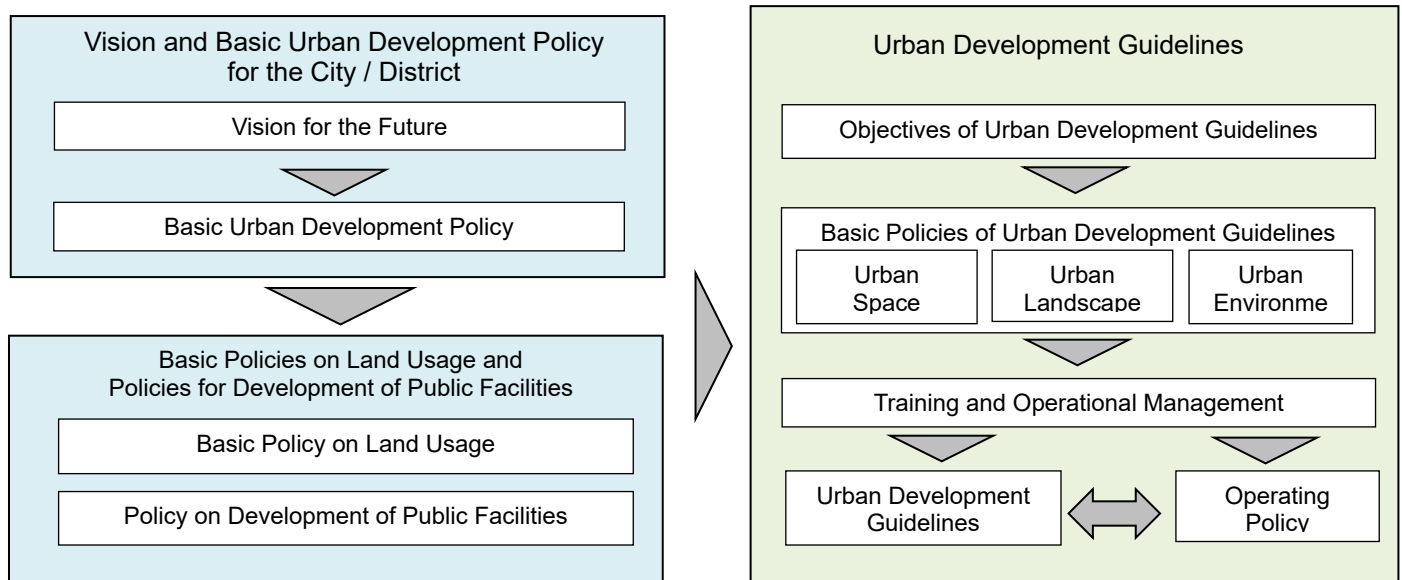
7.7 Guideline for Town Development

7.7.1 Objectives of Creating Urban Development Guidelines

(1) What are Urban Development Guidelines?

The urban development guidelines are guidelines that are formulated when carrying out urban development projects in a specific district. They essentially constitute a plan document, which maps out the urban space that is considered necessary in order to achieve the successful realization of the development; stipulates basic policies related to urban landscape and urban environment; cultivation and operation of the district towards the future; and sets forth guidelines and operating policies to guide the development in the desired direction based on the future vision and basic policies for what the developers aim to achieve through the development of the district, basic policies regarding land usage, and the development of public facilities, and the intentions of the developers (or development organization), local government bodies, and other relevant parties.

Flowchart for Creation of Urban Development Guidelines is shown in Figure 7.7.1.



Source: JST

Figure 7.7.1 Flowchart for Creation of Urban Development Guidelines

(2) Benefits of Introducing Urban Development Guidelines

Introducing urban development guidelines—along with the mechanisms for ensuring that not only the developers conducting development projects in the target district but also other business operators involved in land utilization and construction of facilities, etc., in the district reliably observe and adhere to the basic policies and guidelines set forth in the urban development guidelines—enables developers to guide the urban development in the desired direction (i.e., in line with the future vision and basic policies) over an extended period of time, even with the involvement of multiple organizations. It also makes it possible to achieve a high quality urban development that feels coherent and harmonious in terms of the look and feel of the district as a whole, including the shaping of the urban space, urban landscape, and urban environment.

Good management with urban development guideline will enhance the magnetism of the project, the value of property, and it support qualified investors to invest to the project.

7.7.2 Case Studies on Urban Development Guidelines in Japan

(1) Framework of Urban Development Guideline

An urban development guideline generally consists of land use policy, public facility development policy, policy for space management, land scape, and environmental consideration. Major contents of each policy are as shown in Table 7.7.1.

Table 7.7.1 Plan Formulation Policies

Component	Main Cotntents
Land Use Policy	• Positioning of the project area • Development concept, goal
Public Facility Development Policy	• Road, Park • Guiding board
Space management Policy	• Land zoning • Urban design for a good urban space
Land Scape Policy	• Architecture design, regulation on color • Lighting, planting, landscape planning
Environmental Consideration Policy	• Energy saving, Low carbon, recycling • Environmental concervation

Source: JST

(2) Minato Mirai 21 Central District (Figure 7.7.2 and Figure 7.7.3)

The Minato Mirai 21 (MM21) Central District of the city of Yokohama (in Kanagawa Prefecture) was developed primarily in old industrial sites, including the Mitsubishi Heavy Industries Yokohama shipyard and the Japanese National Railways classification yard for the Takashima Freight Line; with the objective of reducing the overconcentration of business in the central Tokyo by creating an economic hub in Kanagawa that would help lead the economy of the Greater Tokyo area. It is a large-scale urban development project in which the accumulation of corporate head offices, meeting, incentive tour, conference, exhibition (MICE), and hotel functions is progressing; a project that is truly representative of the Greater Tokyo area, and one which could be said to be very similar to that of the Bang Sue Area.

The MM21 Central District aims to become a “future city worthy of the 21st century,” and various progressive efforts are being advanced there, including the introduction of joint-use utility tunnels and district heating and cooling (DHC) systems and other initiatives geared toward creating a “smart city”. In order to create a dignified high-quality urban landscape in the district and maintain (and improve) the quality of the landscape, developers have created the Minato Mirai 21 Central District Urban Landscape Guidelines—a collection of landscape-related guidelines including landscape standards for the district’s symbolic main street (Minatormirai O-dori) and other areas—and are advancing their urban development efforts in accordance with those standards.

The guidelines stipulate three key policies: (1) the creation of a lively and energetic district accumulating a wealth of advanced city functions, (2) the shaping of an urban environment that is

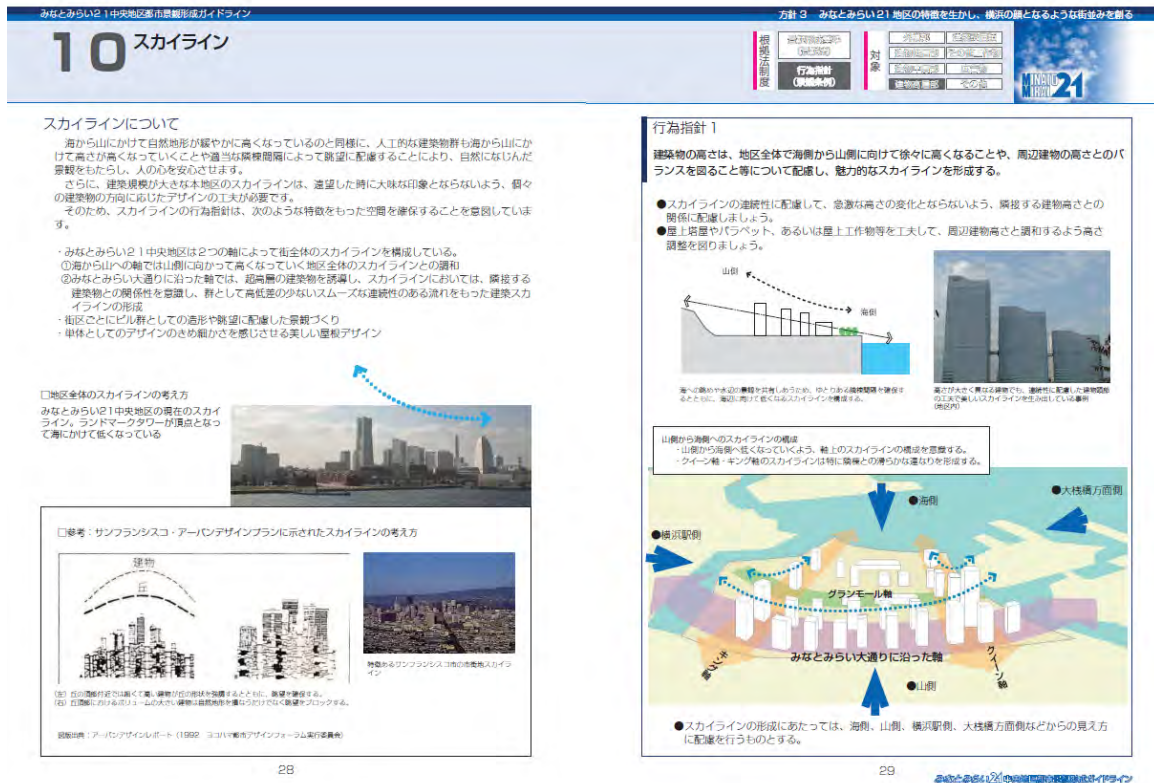
pleasant, comfortable, and people-friendly, and (3) the formation of a cityscape that will be the new “face” of the city of Yokohama and set forth strategies for the creation of an urban landscape focusing primarily on areas along three “urban axes” within the district and the single main street.

Specifically, the guidelines outline the expected action guidelines in relation to various aspects of development including “shaping a lively atmosphere on the lower floors of the buildings”, “creating walkway and plaza-type open spaces on private land”, “establishment of parking areas for cars and bicycles”, “use of color and lighting”, “building design and skylines”, “outdoor advertisements”, and “creating a lively and bustling atmosphere”.



Source: Urban Development Bureau, City of Yokohama

Figure 7.7.2 Creation of Walkway-type Open Spaces



Source: Urban Development Bureau, City of Yokohama

Figure 7.7.3 Skylines

(3) Toyosu 2 and 3-Chōme District (Figure 7.7.4, Figure 7.7.5)

The Toyosu 2 and 3-Chōme District projects are large-scale land use transformation projects the likes of which are rarely seen in Tokyo. It is a 50ha development centered on the site of the old Ishikawajima-Harima Heavy Industries Plant located in the Tokyo Rinkai (or “waterfront”) District. It is an urban development project that could be said to be very similar to that of the Bang Sue Area.

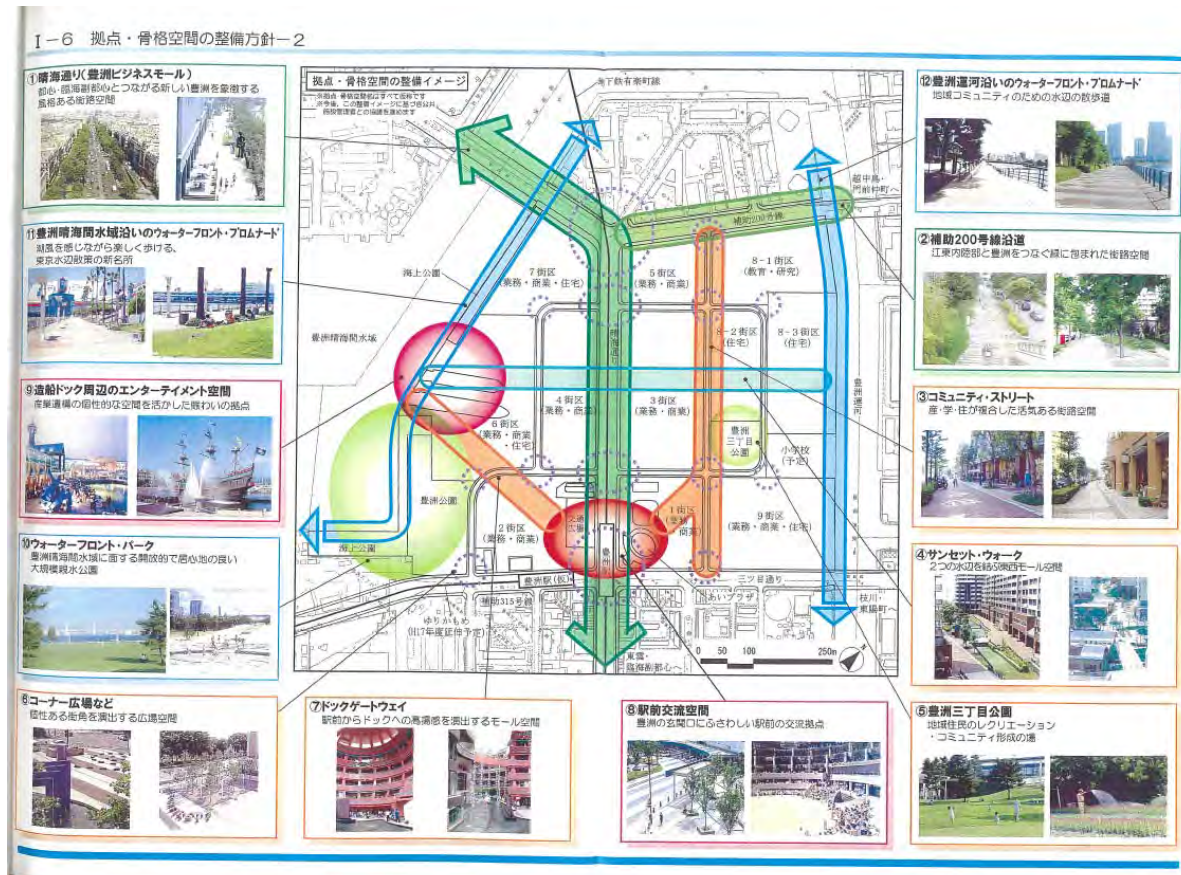
The Toyosu 2 and 3-Chōme projects seek to drive forward new urban development around the key concept of industry, based on the concept of a new industrial motherland; the background to this being location-related conditions such as the district’s close proximity to the Central Tokyo area, its convenience of access via subway trains and other public transportation, and its rich urban environment surrounded by the waters of Tokyo Bay. The developers have raised five urban development themes pertaining to the district (1) as an industrial hub, (2) as a city on the water, (3) as a living space, (4) as a center for various activities, and (5) as part of the wider environment; and have established guidelines setting targets for the creation of urban spaces in relation to each of these themes.

Specifically, the basic urban development policy that outlines the overall picture of the development sets forth policies relating to “networks and pedestrian spaces” and “open spaces such as plazas and parks,” while the basic policy for hubs and structural spaces outlines policies regarding the “creation of cityscapes” and “water, greenery, and light.”

The project’s Policy for the Development of Public Facilities stipulates basic policies for the local public bodies that construct, maintain, and develop city infrastructure in relation to features such as

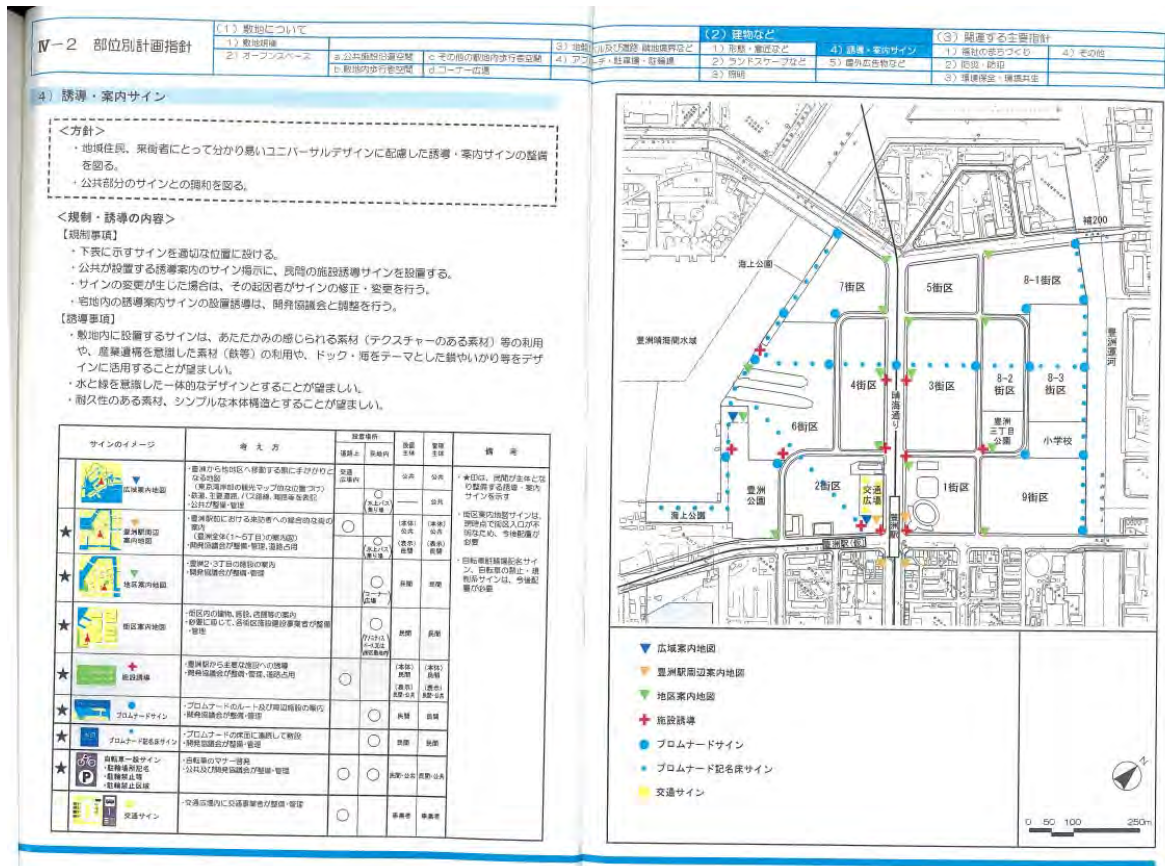
roads, parks, plazas, and promenades; and outlines landscaping, planting of plants and trees, and the use of lighting, etc. The project also has Premises Usage Plan Guidelines aimed at the business operators that develop individual blocks or zones within the district, which stipulate rules with regard to securing open spaces, walkways/passageways and plazas, plant and tree planting design and shaping, landscaping, guidance, informational signs, and outdoor advertisements in each zone.

The developers have also established an operational framework and operational workflow, etc., towards insuring the reliable operational implementation of these guidelines.



Source: Urban Renaissance Agency

Figure 7.7.4 Basic Policy for Hubs and Structural Spaces



Source: Urban Renaissance Agency

Figure 7.7.5 Guidelines for Guidance and Informational Signs

(4) Kamakura Fukasawa District (Figure 7.7.6, Figure 7.7.7)

The Kamakura Fukasawa District is a 32 ha large-scale land usage transformation project focused primarily on the site of an old JR Railway (a former Japanese National Railway Settlement Corporation site) located in the city of Fujisawa (in Kanagawa Prefecture), which again could be said to be very similar to that of the Bang Sue Area.

The district has set urban development targets for energetic urban development, safety and peace of mind, utilization of local resources, coexistence with the natural environment, and partnership between the public and private sectors, and is advancing its urban development efforts based on a future image of Fukasawa as a “healthy lifestyle hub.”

The project’s urban development guidelines contained an urban space formation policy, urban plan development policy, and urban environmental development policy based on the basic policies pertaining to the top level project plan itself, as well as land usage and public facility development. An operational policy has also been established with regard to the operational implementation of the guidelines, with a view of ensuring sustainable development of the district.

The urban development guidelines also provide an outline with regard to the development of distinctive roads (such as symbolic main roads in the district) and areas along those roads, and for the development of public spaces such as parks and street corner squares/plazas; along with matters for care and concern on spaces, landscapes, and environment that apply to all buildings and structures in the district.

5. まちづくりの指針

まちづくりガイドラインの基本方針に基づき、まちづくりの指針を定めます。まちづくりの指針は、以下の概要に示す項目ごとに、シートとして整理しました。シートでは、個別箇所の「つかいかた（活動や活用のイメージ）」、「つくりかた（どのようにつくっていくかの誘導）」、「未来へのつなぎかた（つくれたまちをより良いものにしていくための管理・運営方策）」をそれぞれ示し、想定される【対象】をかかわりが強いと思われる主体順に記載しています。



図 ー まちづくりの指針概要

Source: City of Fujisawa

Figure 7.7.6 Urban Development Guidelines

(3)都市環境の整備方針

地区周辺の自然環境との関係性やつながりに配慮しながら、環境への負荷の少ないまちづくりに取り組みます。また、未来においても、持続可能なまちであり続けるためには、自立したエネルギーや、人にも環境にもやさしい移動手段の確保ができるまちである必要があります。

こういった視点からも、以下のような環境配慮の取組みを行います。

1)都市緑化の推進と周辺の自然環境との調和

- ・地区周辺の斜面緑地と連携した都市緑化を推進し、緑をネットワークでつなぎます。
- ・大街区を中心に沿道緑化を誘導し、緑豊かなまち並み形成を図ります。
- ・建築物の壁面や屋上ならびに敷地内、まちかど等では積極的に緑化を図ります。
- ・緑化にあたっては郷土樹種を主体に行います。



(地域の自然環境とネットワークした緑化)

2)自然・風土に配慮した暑くなくいまいち

- ・地域の自然・風土に配慮した施設計画によって、ヒートアイランドの緩和を図ります。
- ・柏尾川や南西から吹く風を積極的に活用した風の道の形成に配慮し、夏季のヒートアイランド緩和と快適な歩行環境をつくり出します。
- ・緑化による緑陰、舗装材の工夫、風や雨水の活用等により地表面の温度抑制を図ります。



(緑陰による地表温度上昇の抑制)

3)建築物における環境への配慮

- ・エネルギー消費を極力小さくする建築物の建設誘導を図り、まちの低炭素化を図ります。商業施設、行政施設、大学は緑化市における環境配慮のモデルとなる建築物を誘導します。
- ・太陽光発電、太陽熱利用等再生可能エネルギーの活用、エネルギー利用の効率化を図るためマネジメントシステムの導入を図ります。



(自然エネルギーを活用した環境配慮建築)

4)公共交通を中心とした移動しやすいまち

- ・便利で快適な公共交通等の整備により、交通利便性が高く、環境の負荷の小さい公共交通や自転車・歩行等を中心とした、誰もが移動しやすいまちにします。



(公共交通機関を中心とした、環境負荷の小さな交通インフラの導入が全面的に進められている)



図 ー 都市環境づくりのイメージ

Source: City of Fujisawa

Figure 7.7.7 Illustrative Image for Development of Public Spaces

7.7.3 Desirable Guidelines for the Bang Sue Area

(1) Distinctive Features of the Bang Sue Area

The Bang Sue Area development is a leading TOD-type urban development project in Bangkok. The district has a number of appealing features that include spacious land, highly convenient transport access, attractive urban parks, and tourist hubs; and there are high hopes that by making fully effective use of these features, the district will play a major role in forming a multifunctional city area with high-level hub-like attributes that will bring new energy and vitality to Bangkok.

To achieve this, in carrying out the development of this district, it will be effective to formulate a basic urban development policy and grand-scale vision for the future of the district as a whole, and to create unified, district-wide development plans (such as land usage plans and public facilities development plans) based on a more advanced concept of planned “integrated development” that will enable the maximization of the city’s attractive features and added value; rather than the conventional style of “individual development” in which various business operators enter private-public partnership (PPP) bids as and when land becomes available for use and carry out development based on their own respective ideas, on an individual block-by-block or zone-by-zone basis.

Furthermore, in order to ensure proper realization of the plans relating to this integrated development under the Bang Sue Area development project, which will involve a diverse range of key entities and organizations including government agencies, SRT and private sector companies, it will be necessary to formulate a set of Bang Sue Area Urban Development Guidelines and to ensure reliable operation of these guidelines.

(2) Structure of the Bang Sue Area Urban Development Guidelines

The Bang Sue Area Urban Development Guideline aims to achieve a well planned, quality development and enhance magnetism of the project, the value of properties. Especially, it will mention on better management of public space, landscape and environment based on the feature of the area as transportation hub and having good parks. In addition, it will mention on implementation mechanism for the sustainable development of the whole area.

The following section is the proposed table of contents of the guidelines:

Bang Sue Area Urban Development Guidelines Table of Contents and Major Items to be Listed (Proposal)

■ Introduction

1. Urban Development Guidelines

(1) How Urban Development Guidelines are Regarded

(2) Purpose of Urban Development Guidelines

→ Lists of objectives that are aimed for in establishing and utilizing these guidelines

(3) Areas to Which the Urban Development Guidelines Apply

→ Lists of areas of the district, where it is expected that the guidelines will be utilized. As a general rule, the areas to which the guidelines will apply are equivalent to the entire project district

2. Urban Development of the Bang Sue Area

(1) How Bang Sue is Regarded Spatially and Socially

- Describes the top level plan and future concept, how the Bang Sue Area is regarded as part of Bangkok within the various plans, and what kind of possibilities and potential the district offers in terms of its location conditions and surrounding environment

(2) Vision for the Future

- Rather than how Bang Sue Area is regarded as described above, this section describes how the district should be in the future

(3) Basic Urban Development Policy

- Describes the direction that the development will take and policies towards achieving the realization of the vision for the future described in the above section

(4) Basic Policy on Land Usage

- Land Usage Plan

- Describes the way that land usage should be implemented and functions that should be introduced based on the vision for the future and the basic development policy

(5) Basic Policy on Development of Public Facilities

- Public Facilities Development Plan

- Upgrade Facilities Plan

- Describes the development of public facilities (e.g., roads, parks, plazas, supply and processing facilities) to be established and developed in the Bang Sue Area, and with regard to the introduction of upgraded facilities towards improving the beneficial effects of development

3. Basic Policies for these Urban Development Guidelines

(1) Basic Policy on Urban Space Formation

- Transportation network (public transport, cars, people, bus stations, transportation plazas, car parks, etc.)
- Green network (ecological corridors, ventilation paths for cooling breezes, parks, and green spaces)

- Describes (in pictorial and textual form) basic development policies and matters for attention regarding the development of transportation and “greenery” networks in the Bang Sue Area, towards the formation of urban spaces in the district

(2) Urban Landscape Development Policy

- Landscape formation (open spaces, height, design, use of color, greenery, etc.)

- Describes (in pictorial and textual form) basic development policies and matters for attention regarding the formation of landscapes, such as city infrastructure and various buildings/structures that will be developed in the Bang Sue Area, with the objective of developing and creating urban attractive landscapes in the district

(3) Urban Environment Development Policy

- Care and concern for the environment (improving energy efficiency, energy-saving, water percolation, and underground accumulation, etc.)
- Care and concern for disaster prevention and readiness

- Describes (in pictorial and textual form) basic development policies and matters for attention regarding care and concern for environmental issues, such as improving energy efficiency and energy saving measures, and initiatives regarding disaster prevention and readiness in the Bang Sue Area

4. Cultivation and Operation of the District

(1) Creation of Mechanisms for Sustainable Development

(2) Creation of Such Mechanisms

- Describes the way that organizations concerned with the management of the district should be, soft (i.e., non-hardware-based) mechanisms relating to such management, and matters pertaining to the creation of such mechanisms, etc.; for the purpose of facilitating attractive, energetic, and sustainable urban development in the Bang Sue Area, and carrying out continuous initiatives towards the future advancement of the district

5. Urban Development Guidelines

(1) City Infrastructure and Facilities Plan Guidelines

(2) Architectural Guidance Guidelines (for buildings and other structures)

(3) Low Carbon City Development Initiative Guidelines

(4) Safe and Secure Urban Development Initiative Guidelines

- Lays out specific rules and standards as guidelines to be observed and adhered to when advancing the formulation of specific plans, design, development and construction work, etc., in relation to matters set forth in the basic urban development policies in Section 3 above

6. Operation of Urban Development Guidelines

(1) Operational Framework

(2) Operational Methods

- Describes the organizations, frameworks, specific approvals, and licenses and the desired state of management in order to appropriately operate and implement the guidelines summarized so far, and achieve the actual realization of the urban development put forward in the vision for the future

(3) Future Initiatives Towards the Formulation of Urban Development Guidelines

In this survey, JST has made considerations (in Chapters 1 to 4) regarding basic matters in the content set forth in the proposed table of contents presented earlier. However, with regard to items 5. Urban Development Guidelines and 6. Operation of Urban Development Guidelines (which are detailed, technical guidelines) JST has chosen not to do so. Typically, the formulation of the content of these guidelines would entail a certain amount of time and labor after the formation of an expert committee including members of the development project organization(s), local public bodies, experts, and experienced academe. For this reason, JST has chosen not to carry out this step in the course of conducting this survey.

Moving forward, in laying out the urban development guidelines toward the determination of specific details of the urban development, it will be necessary to form a committee for the formulation of such guidelines, incorporating members from SRT, BMA, and experts in urban planning and urban development field, and so on, in order to advance concrete discussions with regard to the creation of such guidelines.

Chapter 8 Implementation Plan

8.1 Project Implementation Mechanism

In order to implement the Bang Sue Redevelopment Project, organizational and funding arrangements are essential. In this section, the project implementing organization and project funding mechanism are proposed.

8.1.1 Project Implementing Organization

(1) Overall implementation structure

The Bang Sue Redevelopment Project is a massive project both in terms of size and complexity. It involves many stakeholders at each of the development layers. As described before, in the JICA Study Team (JST) view, there are five layers of development:

Layer 1: Basic Public Infrastructure

Layer 2: Green Network and Environment Management

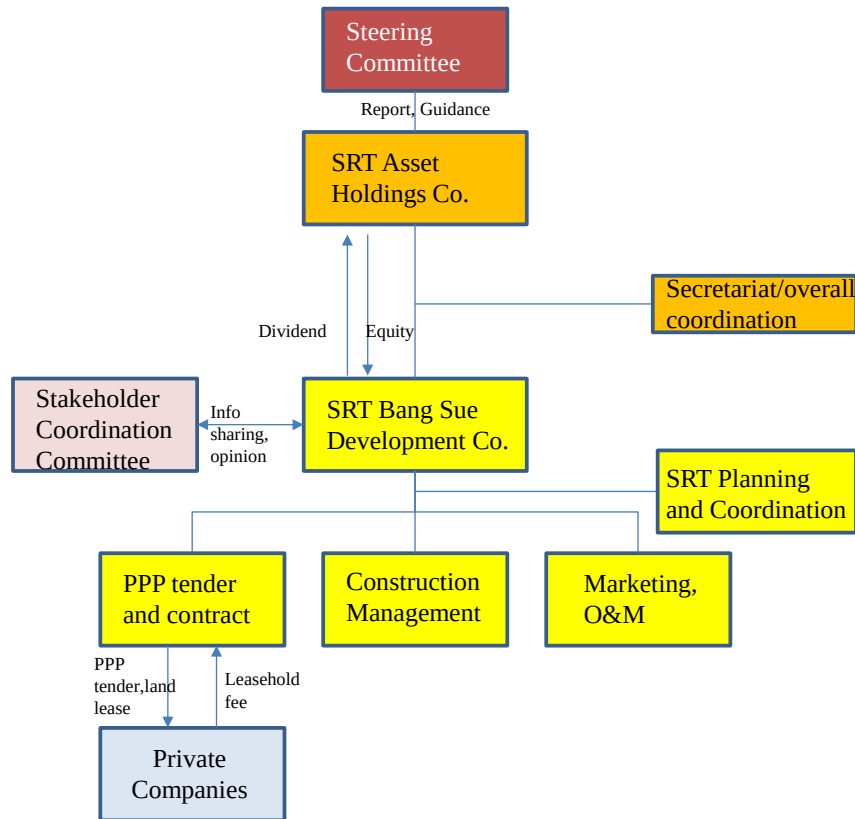
Layer 3: Transportation Network

Layer 4: Upgrade Facilities for Transit-oriented Development (TOD) and Smart City

Layer 5: Commercial and Magnetic Facilities

These development layers are all implemented on the State Railway of Thailand (SRT) land, which also add complexity. For example, trunk road (in Layer 1) is typically developed on top of the lands owned by the government. Trunk road development on SRT land requires a memorandum of understanding (MOU) between SRT and Bangkok Metropolitan Administration (BMA), to clarify the responsibility sharing of construction, and operation and maintenance (O&M). Such coordination between SRT and each government department require very strong coordination mechanism. Otherwise, the development will just take too much time and energy.

Therefore, government “top-down” implementation structure involving all key stakeholders is essential to successfully develop the Bang Sue area. JST’s suggested implementation structure is described below (Figure 8.1.1).



Source: JST

Figure 8.1.1 Project Implementation Organization

The key functions of this implementation structure are embedded in the following six key organizations:

1) Steering Committee

This committee supervises the overall project implementation from the viewpoint of city planning, transport planning, and state asset utilization. It needs a top-down decision-making authority to coordinate across different ministries and agencies. Hence, it should be chaired by the Vice Prime Minister. Key committee members include the National Economic Development Board (NEDB), Ministry of Finance (MOF)/ State Enterprise Policy Office (SEPO), Ministry of Transport (MOT)/ Office of Transport and Traffic Policy and Planning (OTP), Ministry of Energy, Ministry of Digital Economy, BMA, and SRT. A stakeholder chart is as shown in Figure 8.1.3.

2) SRT Asset Holding Company

This legal entity will be established to manage SRT's land asset as 100% subsidiary of SRT. It focuses on maximizing the value of SRT land. It manages all public-private partnership (PPP) contracts and provides transparent accounting on SRT land utilization status. For the Bang Sue Project, it monitors the progress of project implementation and reports to the steering committee to trigger actions for any bottlenecks required for the project.

3) Secretariat/Overall Coordination

JST suggests the project implementation secretariat and overall coordination function to be structured within the SRT Asset Holding Company. It will act as the secretariat for the steering committee to ensure

that all committee activity preparations and arrangements are well organized. Initial scope of coordination will be for the Bang Sue Project but could also expand to work on other land redevelopment project areas such as Makkasan and Maenam areas. In this way, coordination can be made between the Bang Sue Project and the development projects for Makkasan/Maenam. In the future, it could be provided with the authority to act as “one window” that will administrate all necessary permits required for the projects.

4) SRT Bang Sue Development Company

This legal entity will be established as a 100% subsidiary of the SRT Asset Holding Company. It is the driving force of the implementation of the Bang Sue Project. It leads the day-to-day activities of planning, marketing, tender, contract, construction management, and O&M. (This legal entity could be a special-purpose company (SPC) to utilize knowhow of a private company which has experience of integrated development. However, in this study, it is based on the premise that this legal entity will be established as a 100% subsidiary of the SRT Asset Holding Company.)

5) Planning and Project Coordination

This is the orchestrating function of implementation within the SRT Bang Sue Development Company. It integrates and manages all the project plans including the overall master plan (M/P) and zone-by-zone development plan. It acts to ensure that the project is implemented in accordance with the M/P and any other agreed guidelines.

6) Stakeholder Coordination Committee

This committee is formed and chaired by the SRT Bang Sue Development Company. It is a mechanism to receive input from project stakeholders on city design concept. Committee members could include academic group, neighbor land owners, existing and surrounding residents, shop owners, and transportation-related groups.

(2) Steering Committee and Working Group

The Steering Committee could have several working groups to provide means for technical level discussions by specific themes. In JST’s view, the following three working groups could be conceived:

1) TOD and Transportation Network Working Group

It discusses activities in relation to the enhancement of Bang Sue Area TOD and transportation network development.

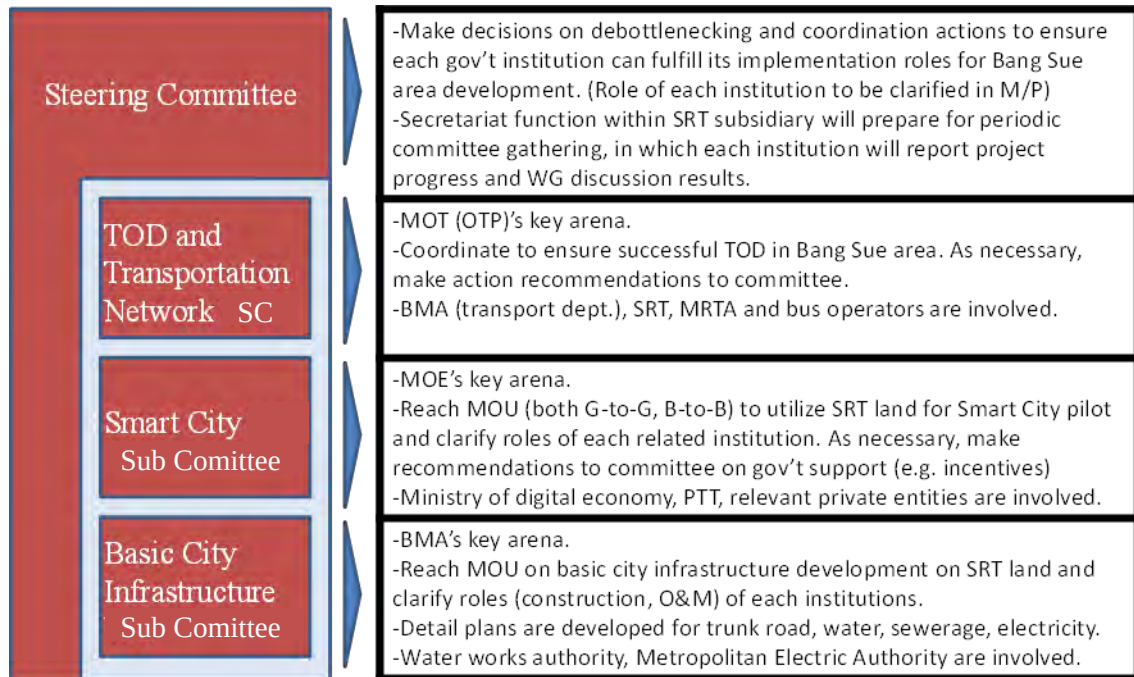
2) Smart City Working Group

It discusses the Bang Sue area as a pilot model for the implementation of the smart city concept.

3) Basic City Infrastructure Working Group

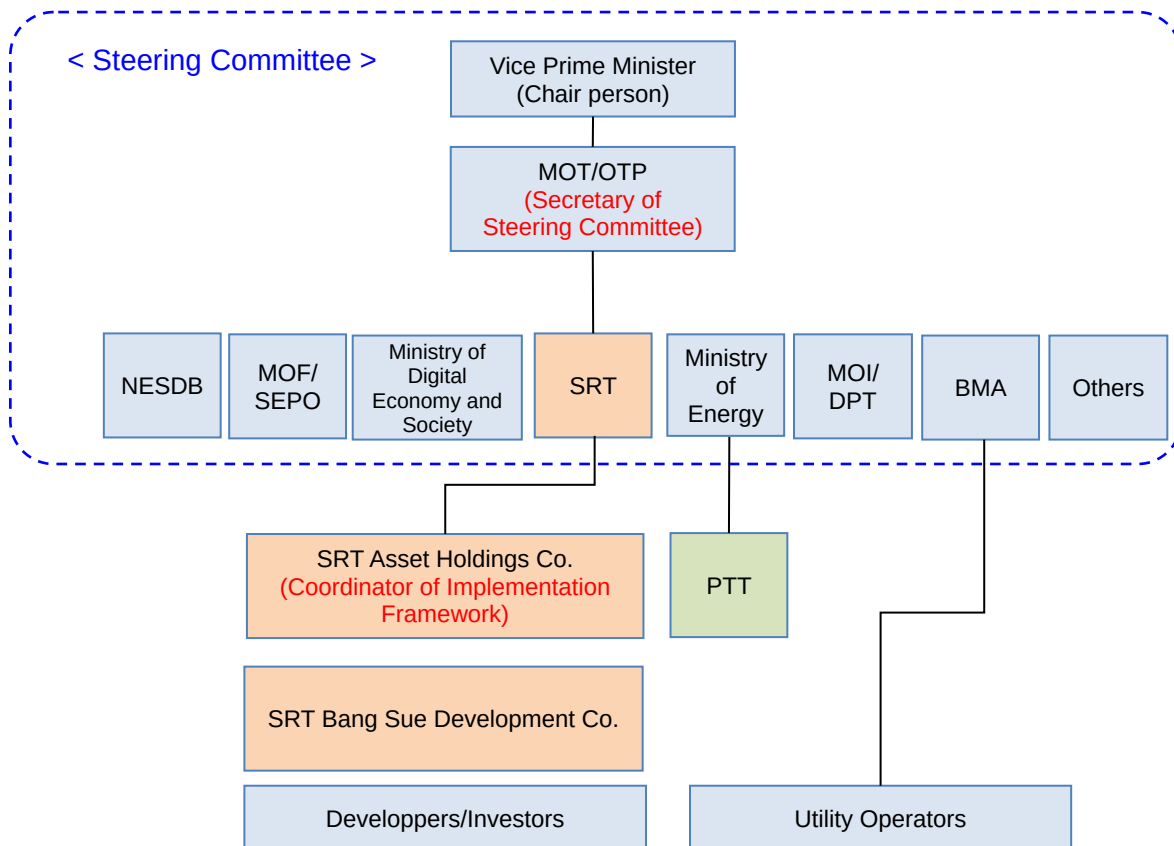
It coordinates cross-ministerial/agency plans and required MOU to accelerate basic city infrastructure development in Bang Sue.

Further details of the working group are described below (Figure 8.1.2).



Source: JST

Figure 8.1.2 Steering Committee and Working Groups



Source: JST

Figure 8.1.3 Stakeholder Chart

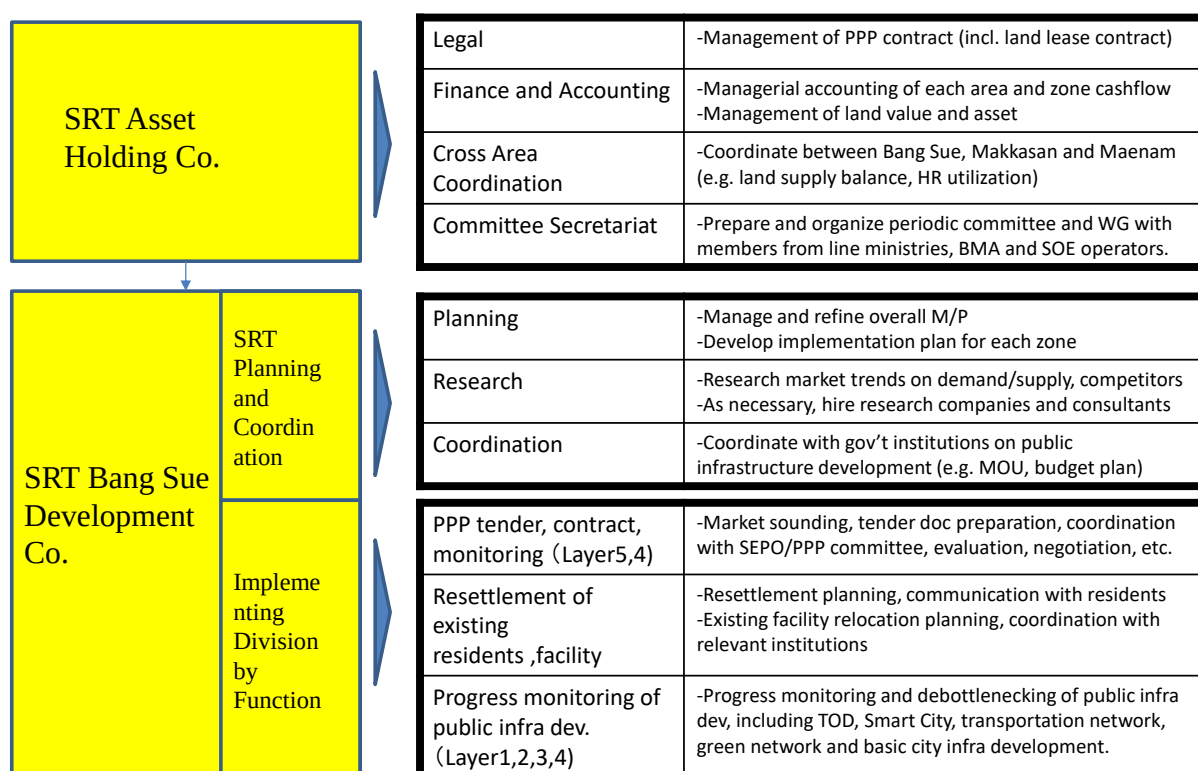
(3) Required Functions within SRT Subsidiary Organization

SRT subsidiary organizations will lead and orchestrate this massive project. It is extremely important to ensure that these organizations are equipped with the right functions and sufficient capacity. The key required functions of each subsidiary are the following:

Key Organizational Functions of SRT Asset Holding Company: This subsidiary entity provides transparency on how the land asset of SRT is being managed from legal and accounting aspects. In addition to legal, finance, and accounting functions, it also needs cross area coordination and steering committee secretariat functions.

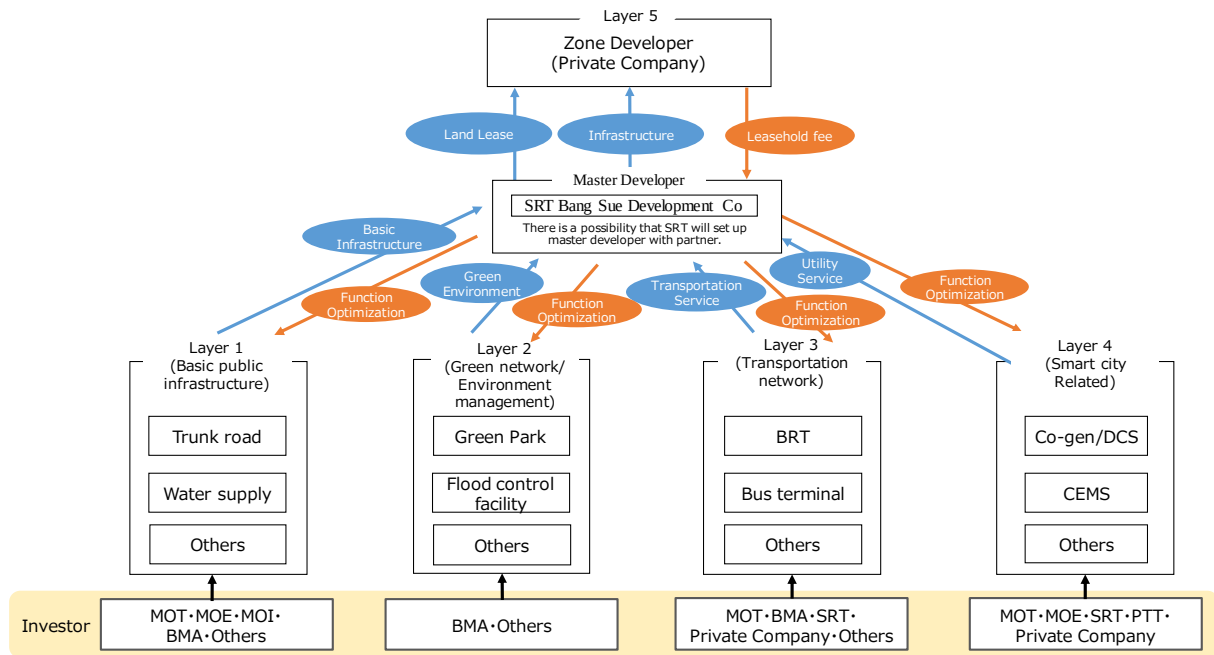
Key Organizational Functions of SRT Bang Sue Development Company: This subsidiary should have the essential business functions required to be the “Master Developer” and “Orchestrator” of this project. It should have planning, research, and coordination functions to ensure that the project is implemented and coordinated under robust plans. It should have implementing divisions by functions, which includes PPP tender and contracts, resettlement management, construction monitoring, and debottlenecking functions.

The details of the key functions are described below (Figure 8.1.4), and an image of overall project coordination led by SRT Bang Sue Development Company as a master developer is shown in Figure 8.1.5.



Source: JST

Figure 8.1.4 Required Functions within SRT Subsidiary Organization



Source: JST

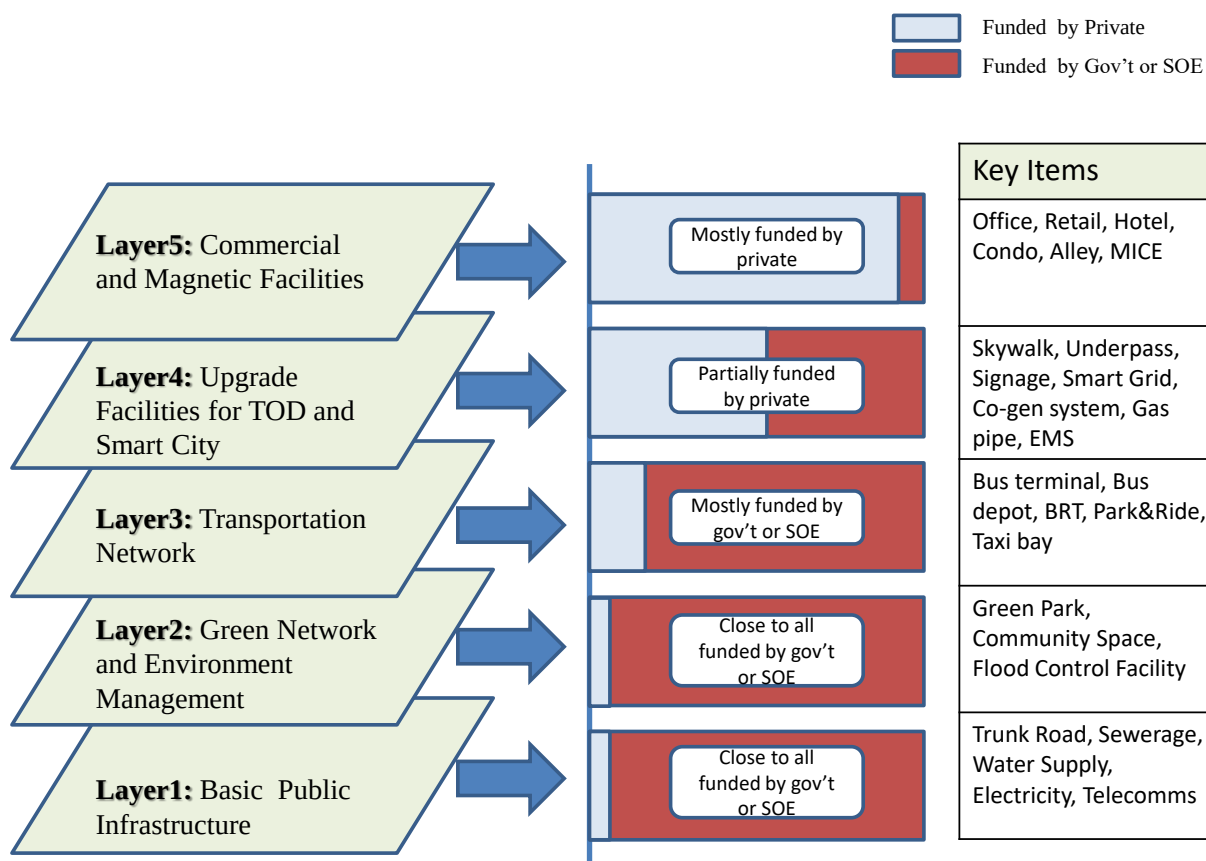
Figure 8.1.5 Image of overall project coordination led by SRT Bang Sue Development Co.

8.1.2 Funding Mechanism

(1) Funding Principles

Funding for this project will inevitably be a combination of private funding via PPP, government funding, and state-owned enterprise (SOE) funding. This is because the project is not merely about developing commercial facilities on top of the SRT land. As described before, the project has five layers of development. Each layer will have different funding characteristics.

The basic fund allocation principles are described in Figure 8.1.6.



Source: JST

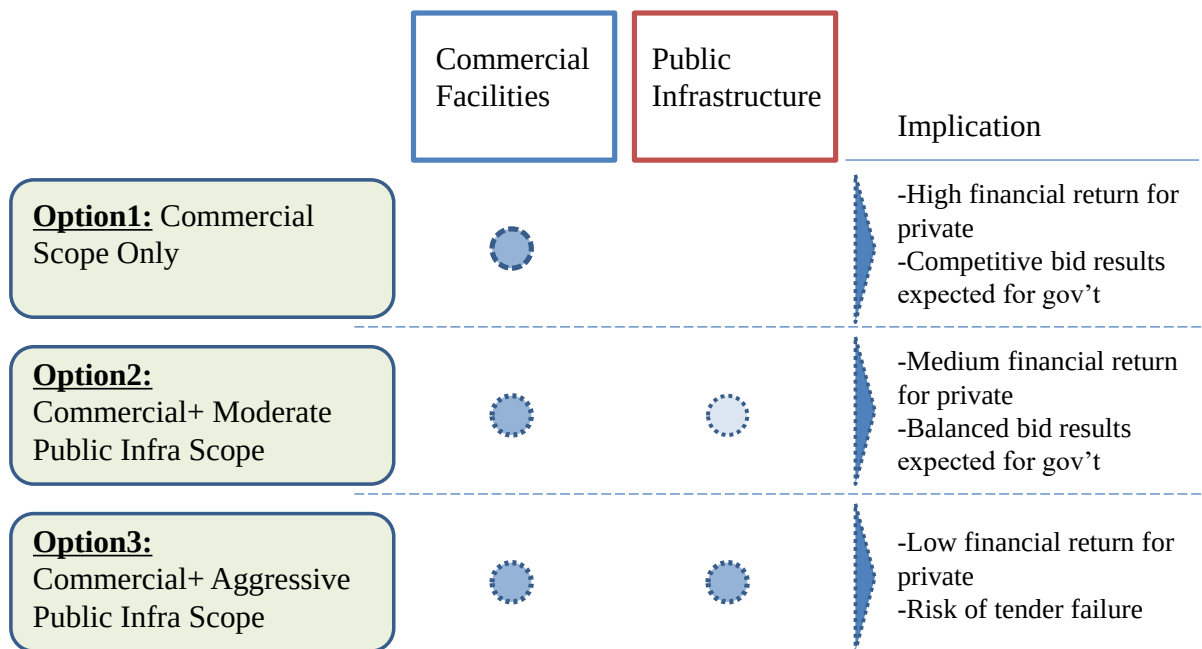
Figure 8.1.6 Basic Funding Allocation Principles

Layers below (layer 1, 2, 3) should mostly be funded either by government budget or SOE expenditures. This is because the nature of the bottom three layers is public infrastructure with broad public beneficiary. (Although, the possibility of private undertaking can not be completely denied.) Layer 4 (Upgrade Facilities for TOD and Smart City) will be a mix funding between private, government, and SOE. This is because part of the facilities could be bundled together within PPP tender scope. For example, skywalk connecting the station and commercial facilities could be funded by private because the commercial facility is the largest beneficiary under the TOD concept. Layer 5 will primarily be funded privately. There could be some room for incentives or subsidies from government to promote private investment.

Therefore, the scope of private funding could partially include public infrastructure in the form of PPP bundling. However, this should not be done too aggressively as it may dampen the private's appetite for investment. As described below in Figure 8.1.7, there are three options for private funding scope:

- Option 1: Commercial Scope only.
- Option 2: Commercial + Moderate Public Infrastructure Scope
- Option 3: Commercial + Aggressive Public Infrastructure Scope

Option 2 is most balanced and recommended. The exact level of PPP bundling should be determined thru interactive request for proposal process (RFP). In this process, potential bidders will have an opportunity to shape the PPP scope and enhances the success ratio of PPP tender.

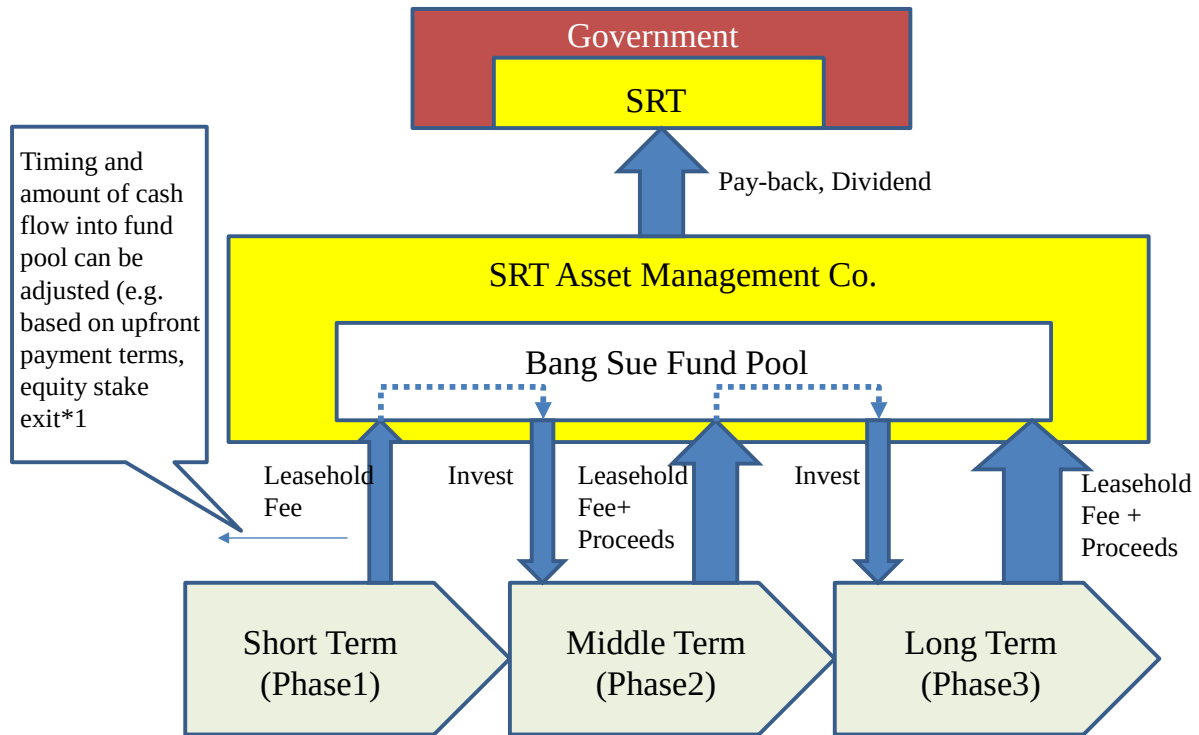


Source: JST

Figure 8.1.7 Scope of Private Funding

Successful PPP tender in the initial phase of project will be critically important. This is because early success will build momentum for enhancing the overall image of the project. Leasehold fee from phase 1 could be pooled to fund for the following phases of development. This “fund pool” concept is described below in Figure 8.1.8.

This pool fund could be developed inside the SRT Asset Management Company either in the form of separate managerial accounting or even in a separate bank account. Leasehold fee rights could partially be converted into private consortium’s shareholding so that SRT can also benefit from overall property value increase. The proceeds from shareholding could further be pooled for the following phase of development. This shareholding could be liquidated earlier once sufficient project cashflow from tenant is proven to be stable.



*1 SRT could convert leasehold rights into equity portion of SPC. Once SPC realizes stable operating cashflow, then, this could be sold to infrastructure fund (e.g. REIT)

Source: JST

Figure 8.1.8 Phased Usage of Fund Pool

(2) Funding Amount Requirements

Based on preliminary estimates, the overall funding requirements for this project is approximately THB 360 billion. In the order of size, Layer 5 (Commercial and Magnetic Facilities) requires THB 300 billion, Layer 3 (Transportation Network, mostly BRT funding requirement) requires THB 30 billion. Layer 4 (TOD and Smart City-related facilities) requires THB 20 billion. Layer 1 and Layer 2 requirements are not so large. This means that PPP funding for Layers 5 and 4 will have significant weight on the success for project funding.

Funding requirement by development step are the following: Short Term (Phase 1) THB 40 billion, Middle Term (Phase 2) THB 167 billion, and Long Term (Phase 3) THB 152 billion.

Please refer to Figure 8.1.9 for overall funding requirement. Detailed information is as shown in Appendix 8-1.

Overall (Billion Baht)		Short Term (Phase1)	Middle Term (Phase2)	Long Term (Phase3)	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	34.7	129.2	136.5	300.4
	MICE, others				
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	0.9	2.8	12.6	16.3
	Smart City facilities*3	0.7	1.7	1.1	3.5
Layer3: Transportation Network	Bus terminal/depot, BRT	0.9	30.6	0.0	31.5
	Park&Ride, Traffic signal				
Layer2: Green Network and Environment Management	Green Park	1.0	0.1	0.2	1.3
	Retention Pond				
	Back up generator				
Layer1: Basic Public Infrastructure	Embankment	1.9	2.3	1.3	5.4
	Trunk Road				
	Sewerage and Drainage				
	Water Supply				
	Electricity				
	Telecomms				
Total		40.1	166.7	151.5	358.4

*1 Accompanied with inner roads and parking

*2 Skywalk, Underground Passage, Travellator, Signage, Station Plaza, ITS

*3 CGS (Co-generation system), gas pipe, cooling pipe, solar power, CEMS (Community Energy Management System), data center

Source: JST

Figure 8.1.9 Overall Funding Requirement

In terms of funding allocation to organization, there are four organizational categories: Central Government, BMA, SOE operator, and a Private Company.

The details of funding allocation to organizations are described in Figure 8.1.10.

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo				PPP main scope
	Alley (Inner road)				PPP sub-scope
	MICE + others	Tourism related	Tourism related		Finance only, no demand risk
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*1	MOT	Traffic and Transport	SRT	PPP sub-scope
	Smart City facilities*2	MOE		PTT	PPP sub-scope
Layer3: Transportation Network	Bus terminal/depot, BRT	MOT	Traffic and Transport	BoKoSo, BMTA	
	Park&Ride, Traffic signal		Traffic and Transport	SRT	PPP sub-scope
Layer2: Green Network and Environment Management	Green Park		Environment		
	Retention Pond		Environment		
	Back up generator	MOE		EGAT	
Layer1: Basic Public Infrastructure	Embankment			SRT	
	Trunk Road	MOT	Public Works		
	Sewerage and Drainage		Sewer and Drain		
	Water Supply	Ministry of Interior		Water Works Authority	
	Electricity	MOE		Metropolitan Electric Authority	
	Telecomms	Ministry of Digital Economy			

Note: Business system between SOE operators and users (e.g. user payment mechanism of utilities to SOE operators) will need to be clarified within MOU.

Source: JST

Figure 8.1.10 Funding Allocation by Organization

Funding requirements for each of the organization categories are shown in Table 8.1.1:

Table 8.1.1 Funding Requirements for Each of the Organization Categories

Organization	Funding Requirements
Central Government	THB 46.3 billion
BMA	THB 3.3billion
SOE Operator	THB 9.5 billion
Private Company	THB 299.3 billion

Source: JST

The details of overall funding requirements by organizations are described in Figure 8.1.11.

Also, phase-by-phase funding requirements by organizations are described in Figure 8.1.12 (Short Term), Figure 8.1.13 (Middle Term), and Figure 8.1.14 (Long Term).

Data Collection Survey on Urban Redevelopment in Bang Sue Area
Final Report

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	285.9	285.9
	MICE, others	2.6	0.0	2.6	9.4	14.5
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	1.1	0.0	2.7	1.2	4.9
	Smart City facilities*3	0.7	0.1	0.0	2.8	3.5
Layer3: Transportation Network	Bus terminal/depot, BRT	42.1	0.0	0.0	0.0	42.1
	Park&Ride, Traffic signal	0.0	0.5	0.3	0.0	0.8
Layer2: Green Network and Environment Management	Green Park	0.0	0.2	0.0	0.0	0.2
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	1.0	0.0	1.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.6	0.0	0.6
	Trunk Road	0.0	0.8	0.0	0.0	0.8
	Sewerage and Drainage	0.0	1.7	0.0	0.0	1.7
	Water Supply	0.0	0.0	0.8	0.0	0.8
	Electricity	0.0	0.0	1.5	0.0	1.5
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		46.3	3.3	9.5	299.3	358.4

Source: JST

Figure 8.1.11 Overall Funding Requirements by Organization

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	34.7	34.7
	MICE, others	0.0	0.0	0.0	0.0	0.0
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	0.0	0.0	0.5	0.4	0.9
	Smart City facilities*3	0.0	0.0	0.0	0.7	0.7
Layer3: Transportation Network	Bus terminal/depot, BRT	0.3	0.0	0.0	0.0	0.3
	Park&Ride, Traffic signal	0.0	0.3	0.3	0.0	0.6
Layer2: Green Network and Environment Management	Green Park	0.0	0.0	0.0	0.0	0.0
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	1.0	0.0	1.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.0	0.0	0.0
	Trunk Road	0.0	0.1	0.0	0.0	0.1
	Sewerage and Drainage	0.0	0.5	0.0	0.0	0.5
	Water Supply	0.0	0.0	0.4	0.0	0.4
	Electricity	0.0	0.0	0.9	0.0	0.9
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		0.3	0.9	3.1	35.8	40.1

Source: JST

Figure 8.1.12 Short Term (Phase 1) Funding Requirements by Organization

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	114.7	114.7
	MICE, others	2.6	0.0	2.6	9.4	14.5
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	1.1	0.0	1.0	0.8	2.8
	Smart City facilities*3	0.6	0.0	0.0	1.1	1.7
Layer3: Transportation Network	Bus terminal/depot, BRT	30.4	0.0	0.0	0.0	30.4
	Park&Ride, Traffic signal	0.0	0.2	0.0	0.0	0.2
Layer2: Green Network and Environment Management	Green Park	0.0	0.1	0.0	0.0	0.1
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	0.0	0.0	0.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.2	0.0	0.2
	Trunk Road	0.0	0.4	0.0	0.0	0.4
	Sewerage and Drainage	0.0	0.8	0.0	0.0	0.8
	Water Supply	0.0	0.0	0.4	0.0	0.4
	Electricity	0.0	0.0	0.5	0.0	0.5
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		34.6	1.4	4.6	126.0	166.7

Source: JST

Figure 8.1.13 Middle Term (Phase 2) Funding Requirements by Organization

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	136.5	136.5
	MICE, others	0.0	0.0	0.0	0.0	0.0
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	11.4	0.0	1.2	0.0	12.6
	Smart City facilities*3	0.0	0.1	0.0	1.0	1.1
Layer3: Transportation Network	Bus terminal/depot, BRT	0.0	0.0	0.0	0.0	0.0
	Park&Ride, Traffic signal	0.0	0.0	0.0	0.0	0.0
Layer2: Green Network and Environment Management	Green Park	0.0	0.1	0.0	0.0	0.1
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	0.0	0.0	0.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.3	0.0	0.3
	Trunk Road	0.0	0.3	0.0	0.0	0.3
	Sewerage and Drainage	0.0	0.4	0.0	0.0	0.4
	Water Supply	0.0	0.0	0.1	0.0	0.1
	Electricity	0.0	0.0	0.1	0.0	0.1
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		11.4	1.0	1.7	137.5	151.5

Source: JST

Figure 8.1.14 Long Term (Phase 3) Funding Requirements by Organization

8.2 Financial Analysis

8.2.1 Objective and Approach

(1) Objective

The objective of financial analysis is to check financial feasibility and affordability of the project. That must be a critical factor for future success.

If the financial feasibility for private investor is not adequate enough to attract powerful private investors, tenders would fail or assumed the amount of lease fee, and tax revenue cannot be achieved. As a result, the project will fail.

In case that financial feasibility is adequate enough to attract private investors, tender would become competitive and powerful investor with financial power and know-how of urban development would be awarded. As a result, the project would be successful.

From a government point of view, it would be necessary to check the cost-benefit against the expense for project implementation.

(2) Scenario

There are two scenarios to be verified on this financial analysis: 1) Individual development and 2) Integrated development.

Individual development, i.e. Scenario-1 is a kind of “Without-Project scenario” where each zone would be developed separately only by the private investor without commitment from neither the government nor the integrated implementation scheme. As a consequence of Scenario-1, it is assumed that the land value increase of Bang Sue area would become insufficient to turn the project successful.

Integrated development, i.e. Scenario-2 is the major scenario where land value will increase more as a result of appropriate public involvement and commitment. It is aimed to reveal that both public players and private investors can enjoy more benefit in the Scenario-2 even if they have to bear more cost for public infrastructure developments.

(3) Player

It is assumed that there are four major players on the project:

- 1) Central Government (CG) including MOT, MOF, etc.
- 2) Bangkok Metropolitan Administration (BMA)
- 3) State-owned Enterprise (SOE) operators, including State Railway of Thailand (SRT) and Electricity Generating Authority of Thailand (EGAT), etc.
- 4) Private investor

Both CG and BMA obtain tax revenue as a benefit of the project. Instead, they would bear the cost of major infrastructure. SRT obtains land leasehold fee from private investors so that the land value increase is critical for the benefit. There is an option that lease fee revenue refluxes to the capital cost of infrastructure development in the next term. Private investors acquire development right instead of leasehold fee payment. They run their business on tenant marketing and facility operation with taking demand risk.

(4) Zone

According to the development plan, there are 25 sub-zones to be developed sequentially. It is assumed that there are some correction values regarding tenant occupancy, land value, and land lease area, because each sub-zone has variation factors such as the distance from railway station and area portion of profitable facility development, which have impact on land value and occupancy.

(5) Facility

According with the development plan, there are four profitable facility categories: 1) retail, 2) office, 3) residence, and 4) hotel. Based on the result of property marketing survey and market sounding, it is assumed that each type of facilities has different business model.

In the financial analysis, both retail and office apply tenant lease business. The developer builds the facility buildings and seeks tenants to move into the building. The developer covers the operational expense (OPEX) of the building and/or carry them onto the tenant lease fee.

The general business model of residence market is sales of condominiums. Service apartment business is only feasible in the central business district (CBD) area. It is noted that the residence in Bang Sue area must be sold with a condition of fixed-term leasehold because the land itself is constrained by leasehold agreement.

Hotel has a specific type of business model. It is assumed that developer bear the capital expense (CAPEX) for hotel building and sublease it to an operator so that the operator would bear OPEX.

(6) Infrastructure

Basic infrastructure cost would be borne by public players. On the other hand, it should be checked how much private investors could cover the infrastructure cost due to deduction of the public player's cost. The detailed analysis of this cost allocation of infrastructure development is described in Chapter 8.1.2

Based on the concept that OPEX of infrastructure would be covered by the service charge, OPEX for infrastructure is out of scope in the financial analysis.

(7) Revenue from the Development Project

Following figure illustrates share revenue of by business segments and their historical changes (expressed in 2017 fixed price).

As shown in the figure, since business model of residence market is sales of condominiums, revenue from residential will generate relatively early. Other than residential business, the project could expect stage revenue by sub-lease (hotel) and lease (retail and office).

Total revenue generated through out project period is estimated to be THB 2,602 billion, of which 45% is generated from retail business, and followed by office (28%), residential (14%) and hotel (13%).

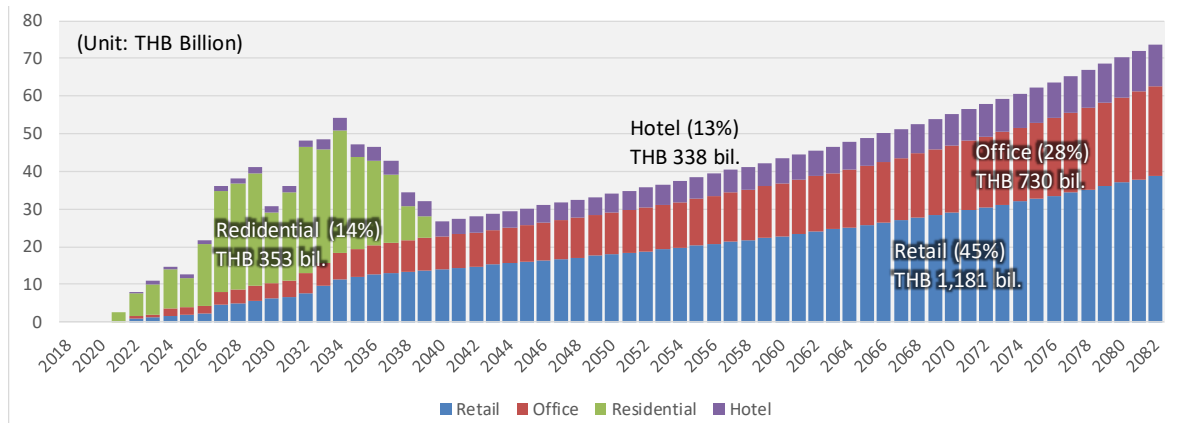


Figure 8.2.1 Share Revenue of the Development Project by Business Segments

8.2.2 Analysis Scheme

The following sketch in Figure 8.2.2 shows the financial analysis scheme:

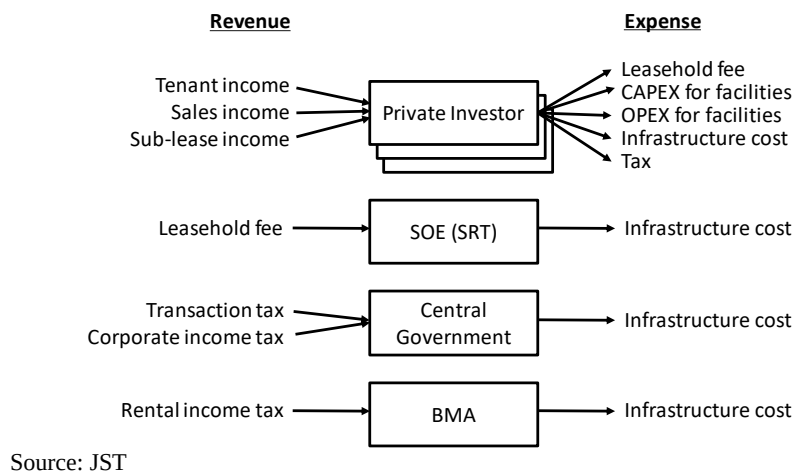


Figure 8.2.2 Financial Analysis Scheme

Private investors receive tenant income from retail and office tenancy, sales income from residence buyer, and sub-lease income from hotel operator. They have to pay land leasehold fee to SRT and tax to the government bodies, in addition to the CAPEX and OPEX for each facility. It would be required for private investors to bear some infrastructure cost within a reasonable range of amount.

SRT receives land leasehold fee from the private investors while the government bodies do taxes. They all should bear infrastructure development cost in order to achieve integrated development capturing increase in land value.

8.2.3 Precondition and Parameter

Table 8.2.1 shows major parameters of each scenario:

The following are the preconditions:

- In case of Scenario-1, facility grade becomes middle-class or 3-stars
- In case of Scenario-2, facility grade becomes high-class or 4/5 stars
- CAPEX of Scenario-2 becomes larger than the one of Scenario-1.
- OPEX stays the same in each scenario.

- Rentable / saleable floor area ratio is the total rentable / saleable area in a building divided by the area available for use.
- Rental income tax becomes revenue of BMA.
- Both transaction tax and corporate income tax become the revenue of the Central Government.

Table 8.2.1 Major Parameters

Parameter	Unit	Scenario-1	Scenario-2	Resource
Leasehold period	Years	30	50	Assumption by the JICA Study Team with reference of the Property Marketing Survey
Tenant lease price				Property Marketing Survey
Retail	[THB / net m ² / month]	750	1,500	
Office	[THB / net m ² / month]	486	623	
Sales price of residence	[THB / net m ²]	41,564	87,627	
Hotel sublease income	[THB / net m ² / month]	384.0	600.0	
Rentable / saleable floor area ratio				
Retail	%	50%		
Office	%	60%		
Residence	%	70%		
Hotel	%	60%		
CAPEX	[K THB / net m ²]	33	51	Estimation by the JICA Study Team
OPEX				Property Marketing Survey
Retail	[THB / net m ² / month]	300.0		
Office	[THB / net m ² / month]	150.0		
Residence	[THB / net m ² / month]	100.0		
Hotel	[THB / net m ² / month]	0.0		
Land value increase				
Year 2018-2032	%	4.0%	7.5%	Assumption by the JICA Study Team with reference of the Property Marketing Survey
Year 2033-2082	%	2.5%	5.0%	
Unit land price	[THB / gross m ²]	75.0		The report by TEAM Consulting Engineering and Management Co., Ltd
Lease price percentage	%	43.2%		Interviews
Upfront payment of land lease fee	%	40%		Interviews
Grace period of lease fee payment		3		Interviews
Payment period of lease fee	years	10		Interviews
Inflation	%	2.5%		Property Marketing Survey
Cost of debt		5.0%		Property Marketing Survey
Discount rate		5.0%		Set as same as cost of debt
Equity rate		30%		Property Marketing Survey
Loan grace period	years	3		Property Marketing Survey
Loan pay-back period	years	10		Property Marketing Survey

Parameter	Unit	Scenario-1	Scenario-2	Resource
Rental income tax		12.5%		Property Marketing Survey
Corporate income tax		20%		Property Marketing Survey
Transaction tax		5%		Property Marketing Survey

Source: JST, based on interviews and property marketing survey

The following Table 8.2.2 shows zone-specific preconditions of Scenario-2. Those values refer to the development plan.

It is noted that the Term 1 corresponds to Short Term (Phase 1) , Term 2 does Middle Term (Phase 2), and Term 3 does Long Term (Phase 3).

Table 8.2.2 Precondition of Each Zone Development

Sub-Zone	Term	COD ¹ Year	Land area Gross m ²	Scenario-1				Scenario-2			
				Retail	Office	Residence	Hotel	Retail	Office	Residence	Hotel
				Gross m ²	Gross m ²	Gross m ²	Gross m ²	Gross m ²	Gross m ²	Gross m ²	Gross m ²
A	1	2022	27,300	9,817	25,000	2,709	24,542	20,000	80,000	13,800	50,000
E1	1	2022	27,200	83,200	25,000	0	0	83,200	80,000	0	0
E3	1	2022	76,500	0	0	0	0	0	0	344,300	0
F1	1	2022	9,700	9,700	0	0	0	9,700	0	0	0
C	2	2027	39,500	0	0	0	0	30,000	0	493,200	0
D1	2	2023	174,400	0	0	0	0	0	0	45,500	73,000
E2	2	2024	48,300	50,000	62,500	85,480	0	50,000	200,000	213,700	0
F2	2	2027	113,900	55,641	37,375	38,315	25,680	195,000	119,600	335,700	90,000
G1	2	2027	77,200	1,639	0	22,115	0	5,000	0	168,700	0
G2	2	2027	21,900	6,000	20,313	0	0	6,000	65,000	0	0
G3	2	2027	70,900	1,721	0	21,268	0	5,000	0	154,500	0
G4	3	2028	37,300	0	0	0	0	5,000	0	79,000	0
G5	3	2028	113,400	542	0	10,851	0	5,000	0	250,100	0
G6	3	2029	50,100	0	0	0	0	5,000	0	107,700	0
B1	3	2032	100,600	38,410	25,000	98,789	0	40,000	80,000	257,200	0
B2	3	2032	74,800	16,885	12,500	34,761	0	30,000	40,000	154,400	0
B3	3	2033	14,800	44,400	0	0	0	44,400	0	0	0
B4	3	2033	10,800	32,400	0	0	0	32,400	0	0	0
D2-1	3	2033	62,400	31,442	0	22,869	21,748	60,000	0	109,100	41,500
D2-2	3	2034	25,000	20,000	9,375	17,480	0	20,000	30,000	43,700	0
D3	3	2034	78,500	46,930	0	45,334	46,930	60,000	0	144,900	60,000
D4	3	2033	26,500	0	10,938	6,600	0	0	35,000	64,300	0
H1	3	2034	97,600		25,000		0	10,000	80,000	239,400	0
H2	3	2033	55,300	4,810	23,438	13,911	24,051	10,000	75,000	72,300	50,000
I	3	2032	151,300	0	0	0	0	5,000	0	335,400	0

¹COD: Commercial Operation Date

Source: JST

The following Table 8.2.3 shows infrastructure preconditions, cost in each term, and assumed financial allocation:

Table 8.2.3 Infrastructure Cost and Allocation

Group	Item		Cost [THB in Million]			Allocation			
			Term 1	Term 2	Term 3	Private	SOE	CG.	BMA
Basic Infra	Embankment		41	246	287	0%	100%	0%	0%
	Road	Major road	110	348	318	0%	0%	0%	100%
		Street lighting	5	14	13	0%	0%	0%	100%
	Water	Water plant	306	306	0	0%	100%	0%	0%
		Reservoir	22	22	0	0%	100%	0%	0%
		Water pipe	24	77	71	0%	100%	0%	0%
	Sewer	Concrete pipe	24	77	71	0%	0%	0%	100%
		Manhole	3	10	9	0%	0%	0%	100%
		Sewage treatment plant	245	245	0	0%	0%	0%	100%
	Drain	Drainage	122	386	353	0%	0%	0%	100%
		Pumping station	68	68	0	0%	0%	0%	100%
	Power	Transmission cable	509	0	0	0%	100%	0%	0%
		Substation	339	339	0	0%	100%	0%	0%
		RMU (switch)	7	19	12	0%	100%	0%	0%
		24 kV cable	37	116	106	0%	100%	0%	0%
	Telecom	Cable conduit	4	12	11	0%	100%	0%	0%
		Optic fiber cable	2	6	5	0%	100%	0%	0%
Transport	BRT	Infrastructure/architect	0	538	0	0%	0%	100%	0%
		Vehicle/system	0	289	385	100%	0%	0%	0%
	Underground passage		122	814	1,220	1,220	50%	0%	0%
	Medium/long distance bus		271	6,041	0	0	25%	25%	0%
	Underground parking		339	0	0	0	50%	0%	0%
	Road facility		271	204	0	0	0%	0%	100%
Green	Green/plantation	Park	3	68	136	0%	0%	0%	100%
Smart City	Cogeneration	Gas pipe	6	19	18	0%	0%	100%	0%
		Cooling pipe	6	19	18	100%	0%	0%	0%
		GCS, DC	692	497	972	50%	50%	0%	0%
		Common duct	4	21	8	0%	0%	100%	0%
	CEMS		0	1,155	0	50%	50%	0%	0%
	Solar power generation		0	0	62	0%	0%	0%	100%
Disaster Prevention	Retention pond		3	12	19	0%	0%	0%	100%
	Generator		34	136	170	0%	100%	0%	0%
Grade-up	Underpass		0	305	0	0%	0%	50%	50%
	Pedestrian skybridge		763	0	0	40%	30%	0%	30%
	ITS		0	407	0	0%	0%	100%	0%
	Data center		0	1,289	0	50%	0%	50%	0%
MICE	Arena		0	3,400	0	80%	0%	10%	10%
	Exhibition center		0	850	0	80%	0%	10%	10%

	Education and medical center	0	5,100	0	80%	0%	10%	10%
SRT Office / Civic Center		0	5,100	0	20%	0%	15%	5%

Source: JST, cost allocation is based on interviews

8.2.4 Result

The output of the financial analysis is summarized in category of player, zone, and facility.

(1) Private Investor in Each Term

The following Table 8.2.4 shows the internal rate of return (IRR) of private investor in each zone.

Table 8.2.4 IRR of Private Investor

Zone	Term	COD* Year	Scenario-1		Scenario-2	
			FIRR	Equity IRR	FIRR	Equity IRR
A	1	2022	3.9%	3.5%	12.8%	15.1%
E1	1	2022	3.8%	3.4%	14.9%	18.0%
E3	1	2022	N/A	N/A	8.8%	19.8%
F1	1	2022	1.6%	0.7%	13.0%	15.1%
C	2	2027	N/A	N/A	10.3%	18.6%
D1	2	2023	N/A	N/A	11.4%	13.8%
E2	2	2024	2.6%	1.5%	12.2%	15.9%
F2	2	2027	2.2%	1.2%	14.0%	18.7%
G1	2	2027	-2.6%	-9.6%	8.5%	15.3%
G2	2	2027	2.6%	1.8%	12.3%	14.4%
G3	2	2027	-3.3%	-9.9%	8.6%	15.4%
G4	3	2028	N/A	N/A	10.8%	20.1%
G5	3	2028	-5.0%	-13.1%	9.4%	19.6%
G6	3	2029	N/A	N/A	11.3%	22.7%
B1	3	2032	1.4%	-0.6%	14.7%	24.4%
B2	3	2032	0.2%	-1.9%	14.6%	24.2%
B3	3	2033	4.6%	4.4%	18.4%	24.1%
B4	3	2033	4.6%	4.4%	18.4%	24.1%
D2-1	3	2033	3.4%	2.7%	17.1%	26.4%
D2-2	3	2034	3.1%	2.3%	16.0%	23.9%
D3	3	2034	4.3%	4.0%	17.6%	28.1%
D4	3	2033	0.1%	-1.6%	13.7%	22.7%
H1	3	2034	0.9%	-0.3%	15.4%	27.9%
H2	3	2033	3.6%	3.0%	14.1%	19.2%
I	3	2032	N/A	N/A	13.7%	30.7%

Source: JST

Not applicable (N/A) means there is no development plan in the zones. There is substantial difference between Scenario-1 and Scenario-2 where equity-IRR in Scenario-1 is less than 5% while

the equity IRR in Scenario-2 is over 15% in most zones.

One of the general suggestions on this result of Scenario-2 is that the latter developed zones of IRR become higher than the earlier ones. The reason behind is that the land value increase is set higher than the cost inflation and the difference between benefit and expense would become larger in later years.

Zones, where residence facility has high portion scores, have higher equity-IRR than zones without residence because the business model of residence is not rental but sales so that the revenue comes upper-front and the leverage becomes stronger.

Table 8.2.5 Facility IRR* in Short Term (Phase 1)

Zone	Retail	Office	Residence	Hotel
A	22.9%	15.1%	10.3%	16.9%
E1	22.9%	15.1%	N/A	N/A
E3	N/A	N/A	17.3%	N/A
F1	19.9%	N/A	N/A	N/A

*Both tax and leasehold fee are excluded in this IRR cashflow.

Source: JST

Table 8.2.5 shows IRR of each facility in Short Term developed zones. Office has the lowest IRR in lease business, which indicates that the office rental business generally gains low profit with relatively low risk.

(2) SOE

The following Table 8.2.6 shows the revenue of SOE:

Table 8.2.6 Revenue of SOE

	Year 2025	Year 2030	Year 2035
Revenue in Scenario-1 (Net Present Value) [THB in million]	422	1,030	528
Revenue in Scenario-2 (Net Present Value) [THB in million]	1,577	2,456	1,380

Source: JST

Land lease fee paid by private investors will be gained during year 2019-2044 under the condition that the grace period is three years and pay-back term is set at ten years. The revenue of SOE would become THB 2.5 billion per year in net present value while maximum infrastructure cost would become THB 1.2 billion per year so that the profit can reflux into the next phase investment.

(3) Central Government and BMA

In Scenario-2, there will be multiple Special Purpose Company (SPC) established within each zone. SPC is established by private developers. They will invest in developing office, hotel, condominium and mall. The following Table 8.2.7 shows the revenue of Central Government and BMA:

Table 8.2.7 Revenue of Central Government and BMA

		Year 2032	Year 2048	Year 2068
Tax Revenue of CG [THB in million]	Scenario-1	619	913	N/A
	Scenario-2	11,853	11,230	30,788
Tax Revenue of BMA [THB in million]	Scenario-1	388	995	N/A
	Scenario-2	2,701	8,719	23,134

Source: JST

Year 2032 is the last year of Long Term (Phase 3), years 2048 and 2068 are the final years of lease hold contract of Short Term (Phase 1) (beginning year is 2019) in each scenario (30 years in Scenario-1 and 50 years in Scenario-2). The tax revenue has substantial impact in Scenario-2.

On the other hand, in Scenario-1, the tax revenue is estimated only at 10% of Scenario-2. This is because the land value would have increased not enough for private investors to gain profit so that the tax revenue based on profitability would not have increased.

8.3 Economic Analysis

8.3.1 Objective and Approach

(1) Objective

Economic analysis aims to reveal the potential economic impact of the project. The impact is quantitatively calculated based on statistical data with some assumption. From economic point of view, important indicators are 1)"flow-based" population of station and surrounding facility users and 2) "stock-based" population (such as new residents or tenants) increase ratio. Also, increase in land price should be monitored. From user's point of view, we should monitor how users perceive the "convenience" and "comfort" level of using station and surrounding facilities.

(2) Approach

Effects of an urban redevelopment project could be measured by 1) increase in consumer spending, 2) economic linkage effects among construction, real estate, retail and service industries, 3) reduction in transit time, vehicle operating cost, CO2 emission and traffic accident resulting from modal shift, 4) increase in land utilization ratio, 5) rise in land price, 6) increase in public space, 7) employment creation, 8) daytime/ nighttime population increase etc.

Out of these effects, 1), 2), 3) and 5) could be measured by monetary value.

Taking data availability into consideration, this report estimated "1) increase in consumer spending" as economic benefit.

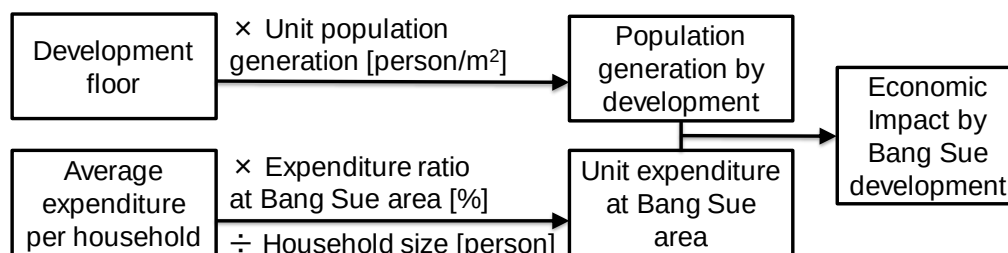
In this economic analysis, economic impact is estimated by the amount of consumer spending. The amount of consumer spending at the Bang Sue area is calculated by people generation and average consumer spending. Specifically, the following formula shows the basic idea of economic impact calculation:

$$\begin{aligned} &[\text{Economic impact of the project}] \\ &= [\text{Number of people generated by the project development}] \times [\text{Average consumer spending per person}] \end{aligned}$$

Following section explains the methodology and preconditions.

8.3.2 Analysis Scheme

The following Figure 8.3.1 shows the economic analysis scheme:



Source: JST

Figure 8.3.1 Economic Analysis Scheme

In order to evaluate the project impact, the number of population generation is calculated based on the difference between Scenario-2 and Scenario-1.

The average consumer spending per person refers to the data published by the Thailand National Statistical Office 2016.

8.3.3 Precondition and Parameter

The following Table 8.3.1 shows the population generation difference between Scenario-2 and Scenario-1.

Table 8.3.1 Population Generation Difference between Scenario-2 and Scenario-1

Zone	Retail [person]	Office [person]	Residence [person]	Hotel [person]
A	4,073	2,750	388	655
E1	0	0	1,593	1,877
E3	0	2,750	0	0
F1	12,000	0	17,262	0
C	0	6,875	4,488	0
D1	0	0	12,051	0
E2	0	0	0	0
F2	55,744	4,111	10,408	1,654
G1	1,345	0	5,130	0
G2	0	2,234	0	0
G3	1,312	0	4,663	0
G4	2,000	0	2,765	0
G5	1,783	0	8,374	0
G6	2,000	0	3,770	0
B1	636	2,750	5,544	0
B2	5,246	1,375	4,187	0
B3	0	0	0	0
B4	0	0	0	0
D2-1	11,423	0	3,018	508
D2-2	0	1,031	918	0
D3	5,228	0	3,485	336
D4	0	1,203	2,020	0
H1	4,000	2,750	8,379	0
H2	2,076	2,578	2,044	667
I	2,000	0	11,739	0

Source: JST

Unit expenditure per person is calculated by the average amount of monthly household expenditure multiplied by expenditure ratio at the Bang Sue area by facilities and divided by household size.

Average amount of monthly household expenditure refers to the National Statistical Office 2016. Household size is set at 3.2 persons/household referring to the National Statistical Office 2010. The expenditure ratio at the Bang Sue area by facilities is assumed by JST based on empirical data as shown in Table 8.3.2.

Table 8.3.2 Average Amount of Monthly Household Expenditure

Expenditure Item	Average Amount of Monthly Household Expenditure*	Retail	Office	Residence	Hotel
Food and beverages	8,498	5%	5%	20%	1%
Alcoholic beverages	177	5%	5%	20%	1%
Tobacco	94	5%	5%	20%	1%
Household operation	7,575	0%	0%	80%	0%
Apparel and footwear	787	5%	0%	10%	1%
Personal care	1,152	5%	5%	10%	1%
Medical and health care	544	5%	5%	10%	1%
Transport	7,092	5%	5%	50%	1%
Education	881	5%	0%	10%	0%
Recreation	482	5%	0%	10%	1%
Special ceremony	42	0%	0%	10%	0%
Total	27,325	985	878	11,749	188

Source: Average amount of monthly household expenditure refers to the National Statistical Office 2016, expenditure ratio is assumed by JST.

8.3.4 Result

The following Table 8.3.3 shows the result of economic impact by year:

Table 8.3.3 Economic Impact

	2022	2027	2032	2022 – 2082 Total
Economic Impact* [THB in Million]	582	2,806	4,473	297,193

* Economic price without inflation

Source: JST

It is estimated that the economic impact of consumer expenditure by the project development would become approximately THB 300 billion in 50 years.

8.4 Project Schedule

8.4.1 Project Implementation (Phased Development)

For the development of Bang Sue Area, the stepwise development that as shown in Chapter 6 is recommendable in terms of the following points of view: (a) inauguration of new urban mass transit railways, which are being constructed or will be constructed, (b) land status (availability, infrastructure

including different types of utility), (c) market demand, and (d) financial arrangements.

Specifically, a three-phase development program will be introduced from the perspective of promoting well-planned, integrated development of the overall area.

In the Short Term (Phase 1), urban infrastructure and residential land will be developed in the surroundings of Bang Sue Grand Station, mainly including the SRT's land, setting 2022 as the target year to coincide with the opening of Bang Sue Central Station. At the same time, development of a skydeck from Bang Sue Central Station to the surrounding district and Jatujak Station will also be planned.

In the Middle Term (Phase 2), re-development and development of relevant infrastructure will be planned in the F2 District north of Bang Sue Central Station, which is currently used as a depot, the C District in the central area, which is currently used as the bus center, and the KM11 District, where the residences of SRT staff are currently located, setting 2032 as the target year.

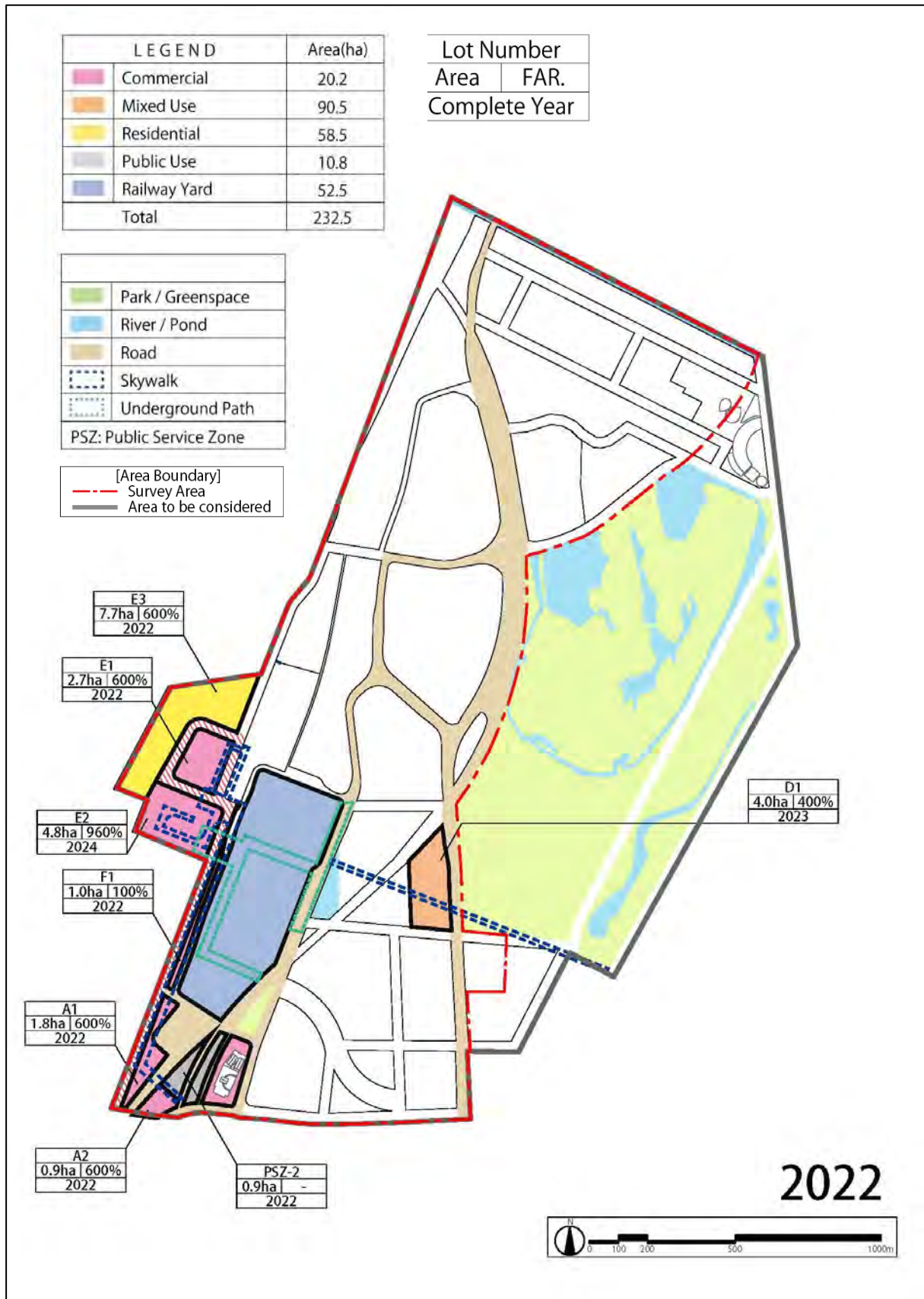
In Zone F2, as the railway incidental facilities exists, on the occasion of development in this zone, relocation of the facilities is necessary. SRT site near Chiang Rak Noi Station is considered as one of the candidate places. (Figure 8.4.1)



Source: JST

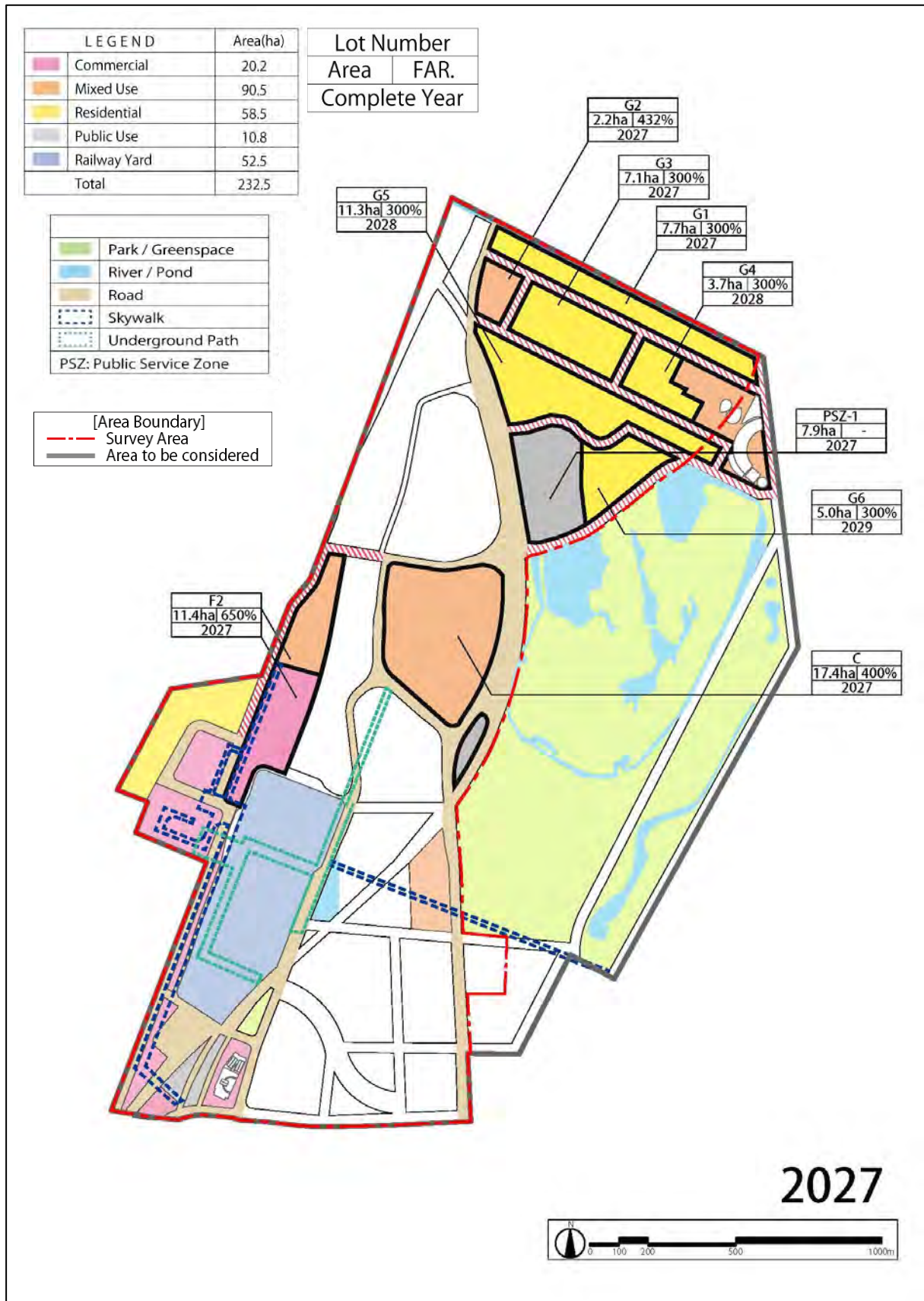
Figure 8.4.1 Relocation Candidate Site of Railway Incidental Facilities

In the Long Term (Phase 3), development of residential land and underground passageways will be planned mainly in B District in the south of the area, which is currently used as a depot, setting 2037 as the target year.



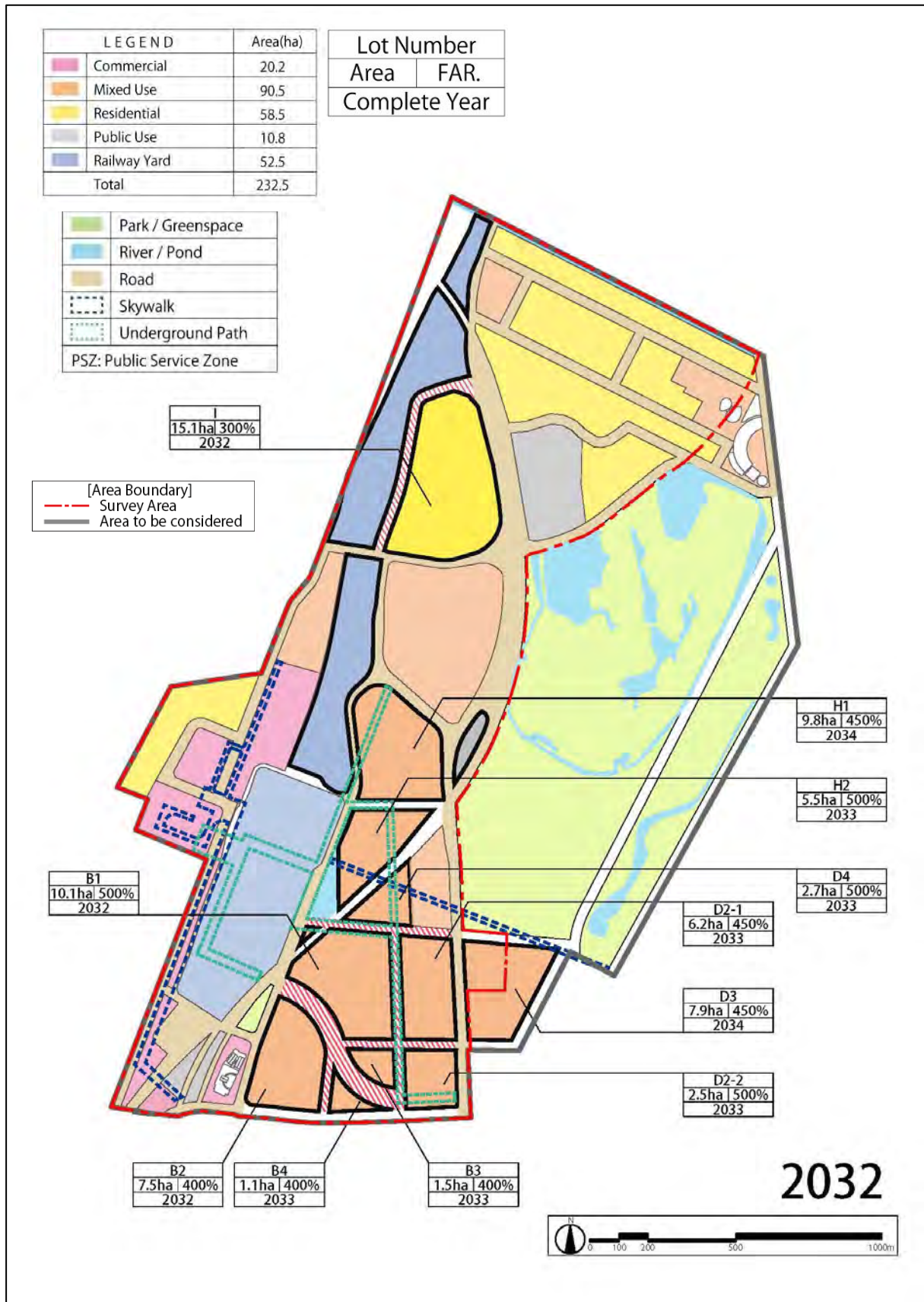
Source: JST

Figure 8.4.2 Project Stepwise Plan [Short Term (Phase 1)]



Source: JST

Figure 8.4.3 Project Stepwise Plan [Middle Term (Phase 2)]

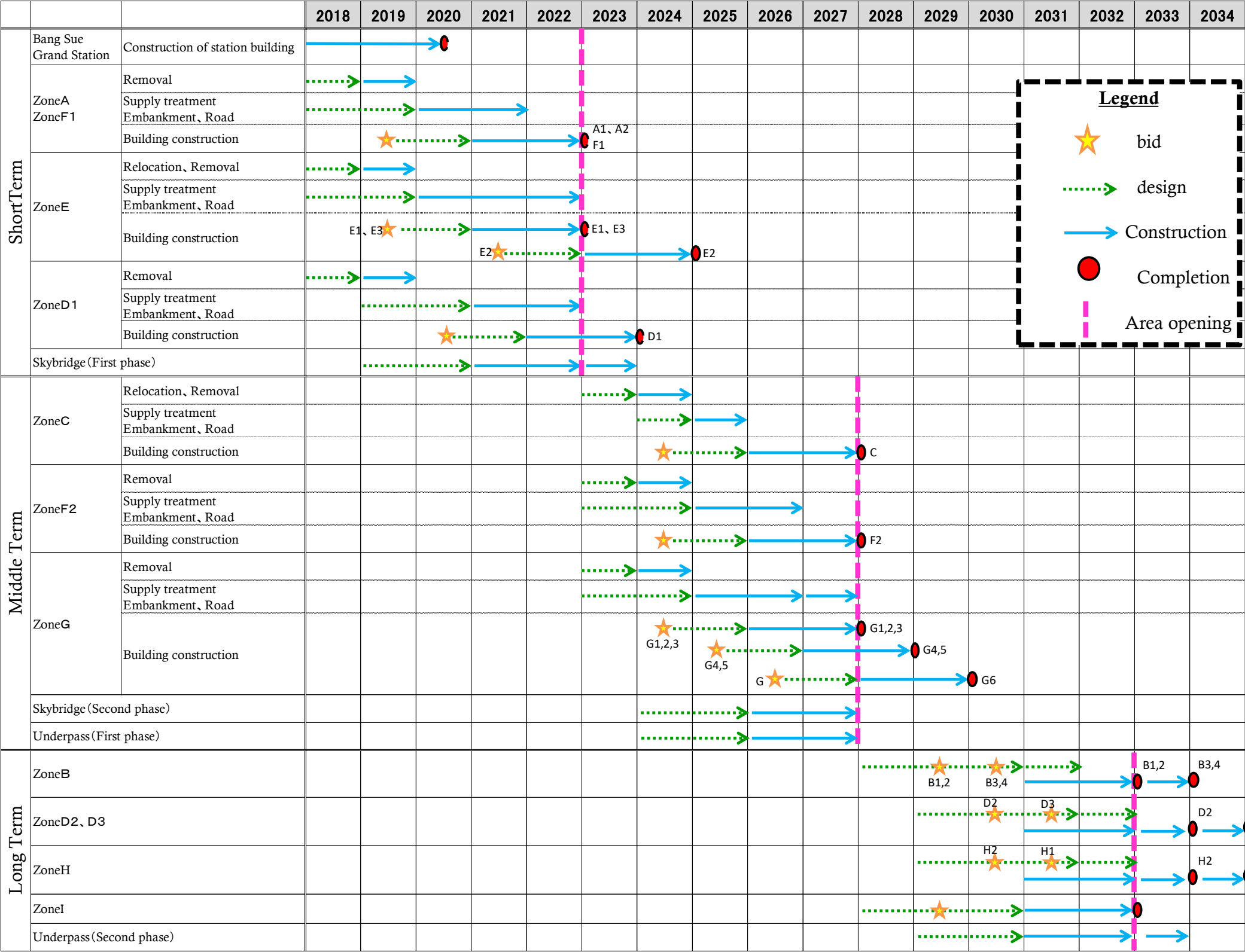


Source: JST

Figure 8.4.4 Project Stepwise Plan [Long Term (Phase 3)]

8.4.2 Project Schedule

Draft project schedule is shown in Figure 8.4.5.



Source: JST

Figure 8.4.5 Project Schedule

Chapter 9 Intention of Japanese Private Sector

9.1 Survey on the Intentions of Japanese Companies to Bang Sue Redevelopment Project

In order to implement Bang Sue Redevelopment Project, arrangement of organization and funding is critical. In this section, project implementation organization and project funding mechanism are proposed.

9.1.1 Briefing Seminar

A questionnaire survey was conducted to understand the intention of Japanese companies to participate into urban development-related business in Thailand and possibility of introducing qualified urban infrastructure. The survey was conducted to 1) the member companies of Japan Conference on Overseas Development of Eco-Cities (J-CODE), and 2) the member companies of division of Engineering Work and Construction, Japanese Chamber of Commerce, Bangkok. J-CODE is an association of private companies which have interest and intention to participate in urban development project in overseas countries especially in Souse east Asia. Briefing seminars were held to introduce the project of Bang Sue Redevelopment Project to member companies of those two organizations. The outline of the briefing seminar is as shown in Table 9.1.1.

Table 9.1.1 Outline of Briefing Seminar

Date	Target Organization	Process and Action
July 14 to 21, 2017	Japan Conference on Overseas Development of Eco-Cities	Briefing session by the JICA Survey Team Distribution of materials Collecting the questionnaire form by e-mail
August 3 to 10, 2017	Division of Engineering Work and Construction, Japanese Chamber of Commerce, Bangkok, Thailand	Briefing session by the Embassy of Japan Distribution of materials Collecting the questionnaire form by email

Source: JST

9.1.2 Questionnaire Survey

(1) Introducing the Project

Briefing sessions were held to introduce the basic information of the Bang Sue Redevelopment Project to member companies of those two organizations, i.e., the Japan Conference on Overseas Development of Eco-Cities (J-CODE) and the Division of Engineering Work and Construction, Japanese Chamber of Commerce (JCC), Bangkok, Thailand. The seminar for J-CODE was held on July 14, 2017, and the seminar for JCC was held on August 3, 2017.

(2) Questionnaire Survey

A questionnaire survey was conducted to the participants of the two briefing seminars. The purpose of the survey is to collect opinions from Japanese private companies to promote the project.

The outline of the questionnaire is as follows:

Question 1:
Types of interests on urban development project in Bang Sue Area
(Multiple Answer)

Question 2:
Opinion and suggestion on urban development in Bang Sue Area
(Free Answer)

Question 3:
Types of necessary materials and information to consider participation to the project of Bang Sue Area (Multiple Answer)

Question 4:
Expected support from the government (Japan and Thailand) to promote active participation of the private sector to the project (Free Answer)

Question 5:
Opinion, suggestion, and requirement of redevelopment in Bang Sue Area
(Free Answer)

Source: JST

Figure9.1.1 Outline of the Questionnaire

(3) Result of the Survey

Result of questionnaire survey is as follows:

1) Number of Answers

In total, 26 companies answered to the questionnaire survey. As a breakdown, there are eight manufacturing companies, five general construction contractors, three developers, two trading firms, two consulting firms, one retailer, and four other companies.

2) Summary of the Results and Analysis

Question 1: Interest of urban development project in Bang Sue Area (Multiple Answer), is as shown in Figure 9.1.2.

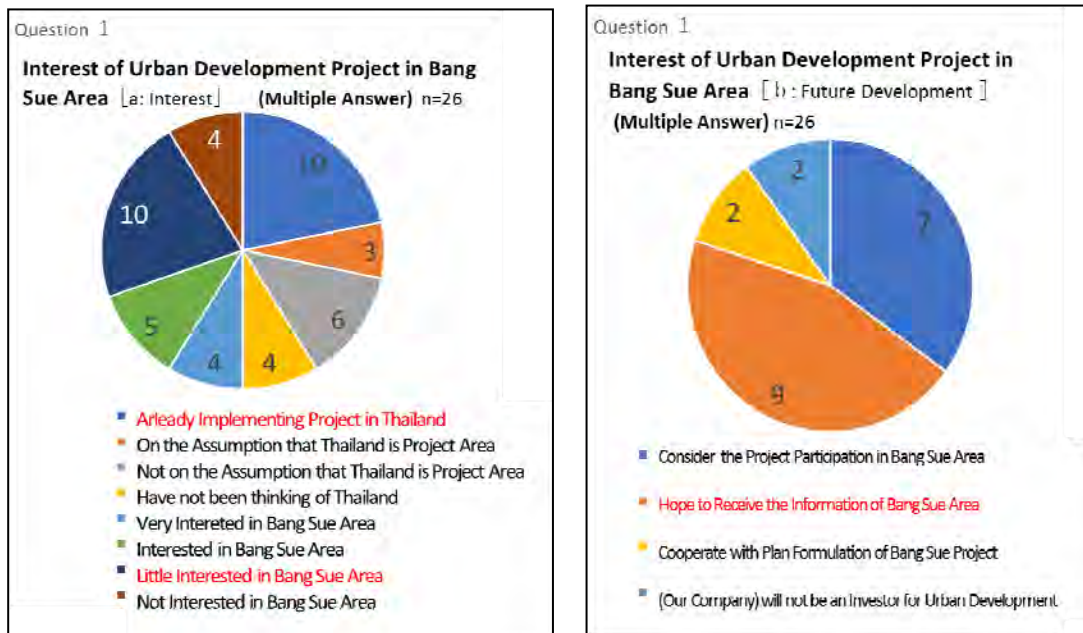
Question 2: Five companies requested further detailed information of the project.

Question 3: In terms of necessary information to consider business participation to the project, the most popular item is “Project schedule (14 companies)”, followed by “Infrastructure plan (10 companies)” and “Current situation of the site (9 companies)”, as shown in Figure 9.1.3.

Question 4: Some companies expect the government for “infrastructure development”, “tax benefits”, and “extension of land lease period (at least 50 years)”, as well as “devising a system to fair project selection”.

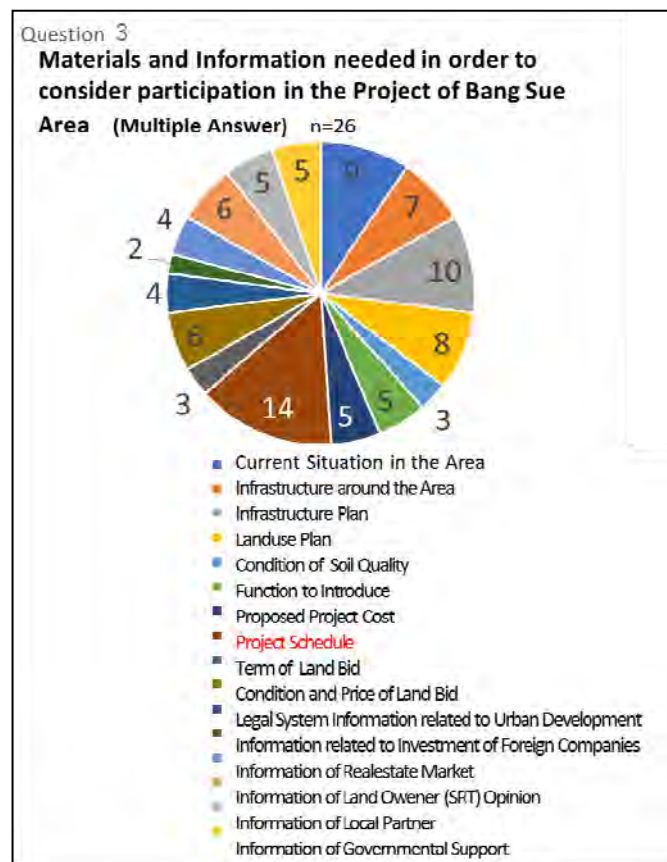
Question 5: Some companies expect “basic information on the area”, “information on the development plan”, and “governmental support in order to introduce the technology of Japanese

companies to the area”.



Source: JST

Figure 9.1.2 Result of Question 1



Source: JST

Figure 9.1.3 Result of Question 3

9.2 Understanding the Intentions of Japanese Companies through Interview Survey

9.2.1 Interview Survey

In addition to the questionnaire survey, interview survey was conducted in Tokyo, Japan. The survey mainly aims to understand primary impressions and conditions of developers on business participation in the Bang Sue Redevelopment Project.

(1) Interviewees

The interview was conducted to seven Japanese private companies, including developers, trading firms, and house builders. The interviewees are person in-charge of real estate project in overseas especially in the Association of Southeast Asian Nation (ASEAN) region.

(2) Questions

The major points of interview are as follows:

1. Business environment in Thailand for Japanese developers
2. Intention to participate in a business in Thailand
3. Impression of Bang Sue Area
4. Possible businesses in Bang Sue Area
5. Requirements/conditions for business participation in Bang Sue Area
6. Others

(3) Result

The major opinions and intentions of Japanese companies were learned through interviews as follows:

Table 9.2.1 Major Opinions from Japanese Private Companies

Category	Major Opinions
1. Business environment in Thailand for Japanese developers	- Thailand is an attractive market with stronger economy compared with other ASEAN countries. - For a Japanese company, Bangkok can be a regional base for business expansion in Asia, as well as Singapore. - On the other hand, land in good condition or attractive project in urban area is taken by local developers/investors which have strong network, connection, and political power. Japanese developers have small opportunity to participate in real estate business. - It is very difficult to obtain information of attractive projects. - Partnership with local partner is essential for Japanese developers/investors to implement land development business in Thailand. It is difficult for Japanese firms to purchase and develop the land on their own. - Thai firms seem not very active to do joint project with Japanese firm as they have enough financial and political ability to implement the project by themselves. - Japanese know how and technologies for urban development such as TOD are becoming acceptable and applicable as Bangkok develops urban railway system recently.
2. Intention to participate in business in Thailand	- Overall, many of the interviewees have positive attitude on the project. - Some firms have been involved in joint development projects in the city center of Bangkok with local partners (or partners from other Asian countries). - Some firms are conducting or have conducted a market research and survey for commencing business in Bangkok.

Category	Major Opinions
	- All interviewed firms are positive about doing business in Thailand (especially in Bangkok). - On the other hand, for some firms, project formulation is difficult, although they could implement a study for it.
3. Impression of Bang Sue area	- Most of the companies had heard about the area but not specific until the interview. - It is a great advantage of the project that the land is all owned by SRT and it does not need land acquisition and adjustment of ownership. - The area is appropriate for TOD and seems promising. - The area is a little distant from the city center of Bangkok, but it seems to have great potential as a residential area where people commute to the urban area by trains. - Development of the vacant lot will be of largescale, and information about the trends of existing markets in the surroundings is not clear. It makes difficult to look to the future market. Therefore, participating to the project from the first phase may be risky. It is suggested to check at the status of sales and other results from the first phase before making a judgment.
4. Possible businesses in Bang Sue Area	- Luxury serviced apartment targeting expatriates. - Condominiums targeting high-income person - Demand for office space is still unclear. - Commercial use could be promising. - Operation of MICE facilities is not suitable for Japanese firms.
5. Requirements / conditions for business participation in Bang Sue area	- Partnership with reliable local business partner is essential. - Local partner is expected to take care of licensing procedures and other necessary procedures. - It is ideal to have a partnership with local firms which have high interest in working with a Japanese firm and can accept Japanese technologies and experiences. - Land proceeds (rent fee, in this project) must be reasonable for business plan of Japanese firm. - In terms of bidding, design competition is preferable than price competition. - It is preferred that basic infrastructure (such as main roads and utilities) is developed by the government. - A 30-year lease period is too short. It would be a huge risk for private investors even if it could be renewed after 30 years. Fifty to 70-year lease period is an essential condition to participate in the project. - The amount of investment for single project is limited. Participation will be difficult if the size of one project is too large. - Basic information such as overall plan, project schedule, etc., will be necessary for internal discussion in the headquarters. - Clear prospects of support from the Japanese government will be a great help to consider business participation. It is preferred to have a system that allows Japanese firms to join the project without bidding, under special schemes such as Thailand-Japan joint model project.
6. Others	- It would be interesting to apply the concept of smart city, system that can be easily installed such as information technologies would be appropriate. - It is important to understand the expectation of the Government of Thailand, BMA and SRT toward Japanese private firms to avoid mismatch of the plan.

Source: JST

9.3 Promoting Quality Infrastructure

9.3.1 Intention of Japanese Private Sector

Results of the questionnaire and interview have revealed that many Japanese firms are highly interested in business participation to the project, with the advantages in the position of Bang Sue Area

in the superior plans, high traffic convenience, and the land of project area owned by one owner, the State Railway of Thailand (SRT).

On the other hand, regarding business participation to the project, few firms are ready to start consultation. Many firms preferred to start information research because many essential conditions such as lease period and other conditions of land lease and local partner are not clear yet.

Regarding “smart city” and other concepts, some Japanese firms expressed their positive intention to join the project from planning to operation phase. Supposedly that Japanese firms can begin to cooperate or participate from a relatively early phase, in terms of technical matters.

9.3.2 Policy for Promoting Quality Urban Infrastructure

The government of Japan has a policy to actively promote quality urban infrastructure with the aim of supporting Japanese private sector to join urban development projects and urban infrastructure development in overseas. In “Infrastructure Export Strategy”, the Government of Japan states that “On the condition of business model and business decision of private sector, the government will fully support private sector and promote introducing quality infrastructure to overseas under public-private cooperation.” “Wide-area infrastructure development” is mentioned as an approach. Specifically, it focuses on “Promoting area development project such as combination of transport infrastructure and surrounding area development”, “Problem-solving, urban management project including several sub-projects for transport management, urban development etc. to solve urban problems such as traffic congestion and so on”, and “Comprehensive urban development including environmental management and transit oriented development”¹.

Ministry of Land, Infrastructure, Transport and Tourism (MLIT) positions ASEAN as the most important area under their policy of international cooperation in infrastructure system. According to their policy for each country in ASEAN, the following contents are listed for Thailand; “Thailand is located at the center of Indochina, and it is a core country of Mekong region. They also consolidate their position as a factory of the world. They play a key role of ASEAN Economic Community (AEC) and for development of Mekong region. Many of Japanese private companies do their business in Thailand. For suitable development of Thailand, development of following sectors is crucial, such as, high value-added industry, development of transport infrastructure especially railways for productivity improvement, human resource development, development of institutions”².

Thus, the development of Bang Sue Area is a prospective project as a candidate of the policy of urban infrastructure promotion of the Government of Japan. As Japanese private sectors tend to watch a situation at the early stage of a project, the government should actively disseminate the information of this project. Moreover, it is recommended that the government supports Japanese private sector by market Japanese experience, knowhow and technologies related to urban development more actively.

¹ Infrastructure Export Strategy, <http://www.kantei.go.jp/jp/singi/keikyou/dai30/siryoku2.pdf>

² MLIT Action Plan for Infrastructure Development Promotion, <http://www.mlit.go.jp/common/001125098.pdf>

Chapter 10 Way Forward

10.1 Action Plan

Main actions to be taken at the very initial stage (until 2019) are as shown below.

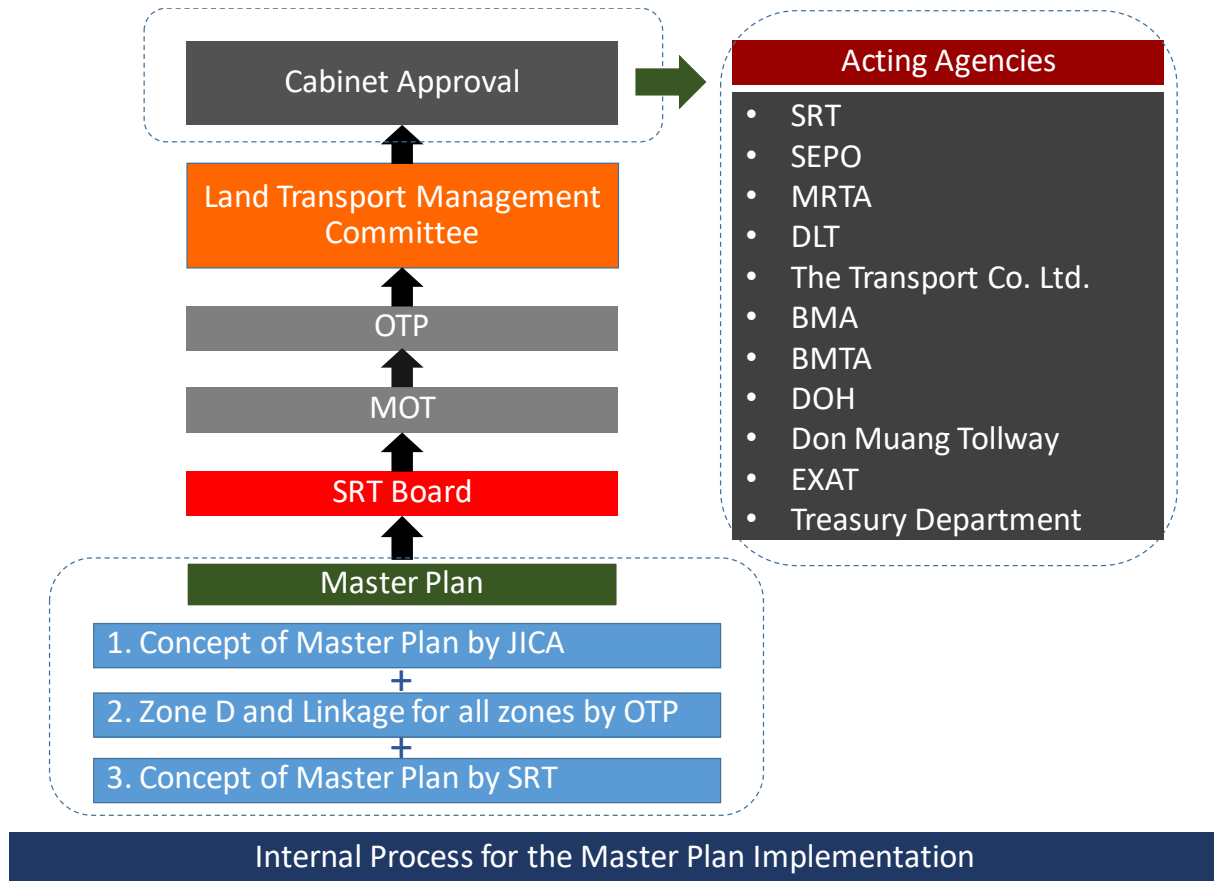
10.1.1 Actions to be Taken by Thai Government

Thai Government should take a series of comprehensive actions for smooth implementation of Bang Sue Area redevelopment as shown in Table 10.1.1. Thai internal process for Master Plan implementation is as shown in Figure 10.1.1.

Table 10.1.1 Actions to be Taken by Thai Government

Category	Action	Organizations in Charge	Related Organizations
1. M/P Finalization	(1) Feedback from stakeholders (It is recommended to make the best use of the movie, which was exclusively made for the present survey.)	OTP/SRT	MOT/ Ministry of Energy/ Ministry of Interior/ Ministry of Digital Economy/ BMA/ EGAT/ MWA/ MEA/ BoKoSo/ BMTA
	(2) Cabinet approval	Land Transport Management Committee/ OTP	SRT/ SEPO/ MRTA/ DLT/ BoKoSo/ BMA/ BMTA DOH/ Don Muang Tollway/ EXAT/ Treasury Dept
2. Steering Committee	(1) Members/ Roles	OTP/ SRT	MOT/ Ministry of Energy/ Ministry of Interior/ Ministry of Digital Economy/ BMA/ EGAT/ MWA/ MEA/ BoKoSo/ BMTA
	(2) Secretariat	SRT Subsidiary (SRT Property Co. for Asset Management)	SRT
	(3) Sub-committees for the following areas - Smart city - TOD and transport networking - Basic infrastructure - MICE	SRT/ OTP	MOT/ Ministry of Energy/ Ministry of Interior/ Ministry of Digital Economy/ BMA/ EGAT/ MWA/ MEA/ BoKoSo/ BMTA
3. Government Assistance	(1) Approval for a special zone including the followings. - Land lease period - Incentives for investors - One stop window	Land Transport Management Committee/ OTP	SRT/ SEPO/ MRTA/ DLT/ BoKoSo/ BMA/ BMTA DOH/ Don Muang Tollway/ EXAT/ Treasury Dept
	(2) Approval for the establishment of SRT subsidiaries (SRT Property Co. and SRT Bang Sue Development Co.)	OTP/SRT	MOT/ MOF
	(3) Coordination with PPP Committee	SRT/OTP	MOT/ SEPO
	(4) Finance planning	SRT/OTP	MOT/ MOF
	(5) Coordination regarding bus terminal/ depot planning	OTP/SRT	MOT/ BoKoSo/ BMTA

Source: JST



出典：OTP

Figure 10.1.1 Thai Internal Process for Master Plan Implementation

The temporary schedule for actions to be taken by Thai Government is as shown in Figure 10.1.2.

Category	Actions	2017	2018	2019
1. MP Finalization	(1) Feedback from Stakeholders			
	(2) Cabinet Approval			
2. Steering Committee	(1) Members/ Roles			
	(2) Secretariat			
	(3) Sub-committees			
3. Gov. Assistance	(1) Special Zone			
	(2) SRT Subsidiaries			
	(3) Coordination (PPP Committee)			
	(4) Finance Planning			
	(5) Bus Terminal/ Depot Planning			

Source: JST

Figure 10.1.2 Temporary Schedule for Actions to be Taken by Thai Government

10.1.2 Actions to be Taken by SRT

SRT should take a series of comprehensive actions, hand in hand with Thai Government, for smooth implementation of Bang Sue Area redevelopment as shown in Table 10.1.2.

Table 10.1.2 Actions to be Taken by SRT

Category	Action	Related Organizations
1. Establishment of Subsidiaries	(1) To clarify organizational functions, organizational structure, human resource, and daily work process	
	(2) To elaborate an internal regulation	
	(3) To recruit talent and provide training	
	(4) To coordinate Governmental Steering Committee	
2. Short Term Development (until 2022)	(1) A1/A2: Preparation and implementation - Market sounding - Tender documents - Discussion and coordination with PPP committee - Bidding/ Evaluation/ PPP Contract - Implementation supervision	PPP committee/ SEPO/ Private sector
	(2) E1/E3: Preparation and implementation - RAP (Resettlement Assistance Program) - Tender documents - Discussion and coordination with PPP committee - Bidding/ Evaluation/ PPP Contract - Implementation supervision	PPP committee/ SEPO/ Private sector
	(3) Bus terminals/ Depots	OTP/ BoKoSo/ BMTA
	(4) Skywalks/ Underground passages	BMA/ Private sector
3. Middle Term Development (until 2027)	(1) F1/F2: Preparation including the existing depot resettlement	PPP committee/ SEPO/ Private sector
	(2) E2: Preparation	PPP committee/ SEPO/ Private sector
	(3) C: Preparation including the existing bus terminal resettlement and MICE design	OTP/ BoKoSo/ BMTA/ PPP committee/ SEPO/ Private sector
	(4) G: Preparation	PPP committee/ SEPO/ Private sector
4. Smart City-related Planning/ Coordination through Sub-committee	(1) Planning	Smart City Sub-committee
	(2) Coordination	
5. TOD and Transport Networking-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	TOD and Transport Networking Sub-committee
6. Basic Infrastructure-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	Basic Infrastructure Sub-committee
7. MICE-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	MICE Sub-committee

Source: JST

The temporary schedule for actions to be taken by SRT is as shown in Figure 10.1.3.

Category	Actions	2017	2018	2019
1. Establishment of Subsidiaries	(1) To clarify organizational functions, organizational structure, human resource, and daily work process			
	(2) To elaborate an internal regulation			
	(3) To recruit talent and provide training			
	(4) To coordinate Governmental Steering Committee			
2. Short Term Development	(1) A1/A2: Preparation and Implementation (Market Sounding/ Tender Documents/ PPP Committee/ Bidding-Evaluation-Contract/ Implementation Supervision)			
	(2) E1/E3: Preparation and Implementation (Ditto)			
	(3) Bus Terminals/ Depots (Bokoso/ BMTA)			
	(4) Skywalks/ Underground Passages			
3. Preparation for Middle Term	(1) Zone F (including the existing depot resettlement), Zone E-2, Zone C (including Bus Terminal resettlement), Zone G			
4. Smart City-related Planning/ Coordination, Sub-committee*				
5. TOD/ Transport-related Planning/ Coordination, Sub-committee*				
6. Infrastructure-related Planning/ Coordination, Sub-committee*				
7. MICE-related Planning/ Coordination, Sub-committee*				

Source: JST

Figure 10.1.3 Temporary Schedule for Actions to be Taken by SRT

10.2 Main Considerations in Implementing Bang Sue Area Redevelopment

It is recommended that Thai stakeholders should consider all the points shown in Table 10.2.1 in implementing Bang Sue Area redevelopment, especially at initial stage.

Table 10.2.1 Main Consideration Points at Initial Stage for Thai Stakeholders

No.	Category (Topic)	Challenges	Consideration Points
1	Laws & Regulations (Special Zone)	Bang Sue Area may need a clear and explicit government policy for promoting and realizing a large-scaled integrated development	It is recommended that Thai government should discuss the designation of a special zone to Bang Sue Area by cabinet approval which includes prolongation of land lease period, promoting incentives for investors, and providing one window service. [Reference: Appendix 10-1: Act on Special Measures concerning Urban Regeneration]
2	Laws & Regulations (Land Lease Period)	Private sector prefers freehold to leasehold as for land arrangement. SRT land has its regulatory constraints: The leasehold period of Bang Sue Area is limited to 30 years, which may not attract private investors.	As mentioned above, it is desirable to designate Bang Sue Area as special development zone with benefits such as longer leasehold period (up to 99 years), tax incentives, longer grace period.
3	Laws & Regulations (Underground Space Development)	Few buildings are directly connected to the underground spaces at stations. In other words, convenience and land value have not been maximized yet. In the future, more buildings should be directly connected to underground spaces.	It is recommended to make clear rules regarding structure, maintenance, costs, etc. of joint spaces between underground space owner and the building owners. [Appendix 10-2] Underground Space Development
4	PPP Tender (PPP Tender Conditions)	Initial ramp-up period of Bang Sue Area redevelopment contains various business risks (e.g. tenant demand, interface with public infrastructure). It is required to prepare tender conditions that are attractive enough for private investors.	It is important to set up an interactive PPP tender process between public sector and private sector: 1) To obtain pre-proposals from potential bidders as part of PQ process, 2) To hold interactive opinion sharing sessions with each of short-listed bidders, 3) To refine RFP (Request for Proposal) documents to reflect private sector's opinions.
5	Investment Permits (One Stop Window)	Bang Sue Area redevelopment has multiple layers with many stakeholders. It is necessary to set up a convenient investment process so that potential investors should not annoyed by a complicated process which requires to obtain permits one-by-one from all stakeholders.	It is essential to establish one stop window for accelerated coordination to obtain necessary permits for each layer of redevelopment.
6	Implementation Organization	Bang Sue Area Redevelopment requires technical discussions which may be too detailed for senior level steering committee discussion.	It is needed to establish the following sub-committees. 1) Smart city 2) TOD and transport networking 3) Basic infrastructure

Source: JST