Chapter IV

Data Collection and Preliminary Analysis

This chapter discusses data collection of the mass transit study in three metropolitan areas, i.e. Bangkok, Thailand; Metro Manila, Philippines; and Sapporo, Japan. Data was collected by transit station. However, due to limited budget, time and other resources, only selected station areas were surveyed. Those station areas were selected based on previous studies and available data from local transport authorities. Although each area, especially Bangkok and Manila, was investigated using similar survey forms and method, the number of data available and observation obtained were different. Because of that and the different nature of those areas, data analysis carried out separately for each study area. However, many similarities are found from the result and insights for developing countries still can be drawn. The discussion begins with the description of general characteristics of the surveyed transit systems providing the overview of the study area. Data collection process then was discussed followed by data processing and summary. The results from preliminary data analysis and discussion conclude this chapter.

4.1 General Characteristics of Transit System under Investigation

4.1.1 Mass Transit Systems in South East Asia Region

The era of rail-based mass transit in South East Asia started when the Manila Light Rail Transit, known as LRT1, was opened to the public at May 1985. Then it was followed by Singapore with Singapore Mass Rapid Transit in 1987. Malaysia began operation of the Kuala Lumpur (KL) Putra LRT System at June 1999. Shortly afterward, Bangkok Mass Transit System (known as BTS or the Skytrain) followed suit December 1999. Currently, the four countries with rail transit system have the combined rail track length of 291.3 km with 267 stations. Note that Bangkok and Manila share only 14.8% and 15.7%, respectively of the regional total length. The summary of various forms and technologies of the transit systems are presented in Table 4.1.

Table 4.1 Mass Transit Lines in South East Asia

Line Name	Opened	Length (km)	No. of sta.	Separated	Fare** (¢ USD)
LRT1/Yellow Line	May 1985	15.0	18	fully elevated	23 - 29
LRT2/Purple Line/Megatren *	Apr 2003	13.8	11	mostly elevated	23 - 29
MRT3/Blue Line/Metrostart	Dec 1999	16.8	13	mostly elevated	15 - 29
Manila, Philippines[1]		**45.6**	**42**		
North-South Line (MRT)	1987	44.0	25	partly elevated	41 - 186
East-West Line (MRT)	Jul 1990	45.4	29	partly elevated	41 - 186
North-East Line (MRT)*	Jun 2003	20.0	16	fully underground	41 - 186
Bukit Panjang Line (LRT) *	1999	7.8	13	fully elevated	41 - 186
Sengkang Line (LRT) *	Jan 2003	10.7	15	fully elevated	41 - 186
Punggol Line (LRT) *	Jan 2005	10.3	15	fully elevated	41 - 186
Singapore[2]		**138.2**	**113**		
Kelana Jaya (prev. Putra LRT) *	Jun 1999	29.0	24	fully elevated	20 - 68
Ampang Line (prev. Star Line)	Sep 1998	15.0	18	fully elevated	20 - 68
Sri Petaling Line (prev. Star Line)	Sep 1998	11.8	18	fully elevated	20 - 68
KL Monorail	Aug 2003	8.6	11	fully elevated	32 - 68
Kuala Lumpur,Malaysia[3]		**64.4**	**71**		
Sukhumvit Line (BTS/Skytrain)	Dec 1999	16.8	17	fully elevated	29 - 114
Silom Line (BTS/Skytrain)	Dec 1999	6.3	6	fully elevated	29 - 114
Blue Line/MRT Line/Subway	Jul 2004	20.0	18	fully underground	34 - 89
Bangkok, Thailand[4]		**43.1**	**41**		
TOTAL		**291.3**	**267**		

* driverless system

** as of January 2006 (USD 1 ~ PHP 52 ~ SGD 1.6 ~ RM 3.5 ~ THB 35)

Source: [1]http://www.lrta.gov.ph, access date: March 2006;
[2]http://www.smrt.com.sg, access date: March 2006;
[3]http://www.monorail.com.my, access date: March 2006;
[4]http://www.bts.co.th, access date: March 2006

4.1.2 Bangkok's BTS and MRT Lines

Bangkok Metropolitan comprises fifty districts with the total area of 1,568.737 km squared and population of 5.6 millions inhabitants (Thai Office of Statistics census 2004). Bangkok has three different lines of mass transit system. Two lines are the elevated system, BTS (Bangkok Transit System), also known as the Skytrain and the other one is the underground system, MRT (Mass Rapid Transit). Bangkok mass transit line serve only eleven districts out of the metro area's 50 districts and that are about 20% of Bangkok Metropolitan population. BTS Company Limited, in its website, claims that total passengers from the first opening in December 1999 until mid of July 2007 are about 784.6 million passengers[Ψ]. This is equivalent to the daily

[Ψ] Bangkok Mass Transit Authority (http://www.bts.co.th/en/); accessed July 2007

passengers of 282,000. As for MRT line it was predicted to have daily passengers of 400,000 but the actual number is less than 200,000 passengers per day[ξ].

4.1.3 Manila's LRT and MRT Lines

Metro Manila comprises fourteen cities and three municipalities. Total area of Manila is 636 km2 with the population of almost 10 millions inhabitants (2000 census). Manila has three lines of mass rapid transit system that known as LRT (LRT1 and LRT2) and MRT, which are run by different operators. LRT 1, called as Yellow Line, is a fully elevated railway system. LRT2, called the Purple Line or Megatren, is the latest driverless mass transit system in Manila. LRT1 line is the oldest mass transit line while the LRT2 line is the newest line. Both of lines are operated by the Light Rail Transit Authority (LRTA), a government-owned and controlled corporation under the authority of the Department of Transportation and Communications (DOTC) as an attached agency.

MRT3 or Metrostar Express or Blue Line were began operation before LRT2 opened. The Philippine National Railway (PNR), named Orange Line is the conventional heavy train system that is operated as part of the overall transit system in Manila. The train connects Manila to other cities within the Luzon Island and is rarely used for commuting trip. The Manila mass transit system covers nine cities and one municipality, including the top three cities with highest population in Metro Manila, i.e. Caloocan City, Quezon City, and Manila City and that are about 71% of the Metro Manila area's population. The statistics provided by the authorities showed that LRT (LRT1 and LRT2) and MRT system have daily ridership of 380,000 and 400,000 passengers, respectively[ω].

4.1.4 Security Concerns and Safety Issues

For security and safety reasons, all lines in Bangkok and Manila mass transit authorities installed closed-circuit television (CCTV) in almost all their stations. This equipment can be used to monitor suspicious activities and to ensure safety and security in station areas and platforms. Frequent announcement reminding passengers to report any suspicious activities and not to leave their belongings unattended are

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[ξ] Mass Rapid Transit Authority, (http://www.mrta.co.th/eng/); accessed July 2007

[ω] Light Rail Transit Authority (http://www.lrta.gov.ph/) and Manila Metro Rail Transit System (http://www.mrt3.gov.ph/); accessed June 2006

made by line operators. Special transit security guard is employed by transit authorities as well.

The security precaution is also exercise for criminal and sexual harassments. For example, in Manila, all passengers with bags and other belongings must be go through security check before entering the station. In addition, the rule requiring separated waiting space for men and women is observed in most LRT1 stations.

Passenger safety comprises safety in station, on-board and in transferring. For the driverless system, the greater effort is needed to ensure safety. Commonly, as a minimal requirement, campaign posters on safety are placed visibly in all station platforms and inside the trains. Fire safety procedure and emergency routes are also publicly noticed clearly. Limited visibility of safety announcements are commonly found in LRT1 stations (Manila). However, some improvements on these are on going.

In all stations, a wide yellow line is drawn along the platform edges to keep passengers in safe distance from arriving and departing trains. Enforcement by transit polices or transit staffs are also performed. Platform screen doors are installed in all underground (MRT) stations in Bangkok but not yet in BTS (Bangkok) and Manila systems. These doors are not only to prevent accident caused by passengers falling into tracks but also to protect unauthorized area and for climate control.

4.1.5 Station Features and Amenities

Not all transit lines have passenger amenities in their stations. Public toilets are not provided in any stations in Bangkok or Manila. There are also limited numbers of chairs for waiting passengers. Some stations are directly connected or near shopping centers. In Bangkok, the operators of BTS utilize their station spaces as commercial area, i.e. selling food, book, product display, banks, and other advertisements. Commercial uses are present at certain MRT station but more in planned in the future. Although it is not under transit authority regulation, at least a convenience store such as 7-eleven is located near one of the gates at the almost all mass transit stations. Ticket vending machines or ticket windows are provided in sufficient number.

In Manila, at least one stall selling food and drinks is present in LRT/MRT stations. The number of stalls varies depending on station land use. Other services, such as stores selling mobile phone cards and other goods are usually located at the

street level outside the stations. Almost all stations of LRT1 have poor features. There are no ticket vending machine and limited ticket windows. Long queues for buying ticket always occur, especially during peak hours. There is also no ATM machines, public toilet, or public phones provided by transit authority. On the contrary, better features and amenities are set up in all LRT2 and MRT3 stations.

4.1.6 Access to Station

Not all stations in the study areas provided well design barrier-free path to access. BTS Line is a fully elevated railway track along main roads. Access gates were built on both of side road but limited elevator and escalator installed to reach station gates. On the other hand, escalator, elevator and ramp access for wheel chair are installed in all MRT stations. The Manila's LRT1 is not built with a good design-concept of transit accessibility. No escalators or elevators are installed virtually in all LRT1 stations. However, the other lines (LRT2 and MRT3) are built to have better access facilities.

There are many ways to reach station from home (access) and then to reach the destination from station (egress). Walking, transit and car are the common transportation modes to access transit station. Using motorcycle in Bangkok and Manila to access is rare and using bicycles is ever rarer. Poor pedestrian access route can be seen in almost all stations, thereby rendering walking to reach stations a difficult task. There are almost no parking facilities for park & ride all stations in Manila. Some stations in Bangkok provided parking space for park & ride.

Mass transit lines in Manila and Bangkok are not well integrated with the existing urban transit system, i.e. the bus system. There are too many overlapping bus routes. Along the mass transit corridors, bus becomes mass transit competitors rather than complementarities.

4.1.7 Comparative Benchmark: Sapporo Subway

Sapporo is the fifth-largest city in Japan and the capital of Hokkaido Prefecture with the density of 1,668 inhabitants per squares-kilometers (based on 2005 data, http://www.city.sapporo.jp/, accessed July 2007). Beside bus and taxi, there are railways, subway, and streetcars to serve as public transportation in the city area. The bus system serves various areas of the city and it is integrated with subways

and railway network. Long distance buses are also operated to connect the city with other areas in Hokkaido.

Japan Railways (JR), a government owned railway system in Japan, link Sapporo to other areas within the island and major cities around the country. The Sapporo Subway is mass transit system that is owned and operated by Sapporo City Government. There are three subway lines, namely Nanboku Line (Green Line, from Asabu to Makomanai, 14.3 km), Tozai Line (Orange Line, from Miyanosawa to Shin Sapporo, 20.1 km), and Toho Line (Blue Line, from Sakaemachi to Fukuzumi, 13.6 km). Sapporo Streetcar operates in a loop for downtown area and interchange with some subway stations.

Nanboku Line is the first line in Sapporo Subway that was opened in 1971 and fully operation in 1978. Tozai line was opened in 1976 and fully operation in 1999 while Toho Line started at 1988 and completely opened in 1994. From the year 1971 to 2003, Sapporo subway serves 500,000 passengers per day on average and the total of 70,000 km traveled[ฑ].

4.2 Data Collection and Summary

4.2.1 Interview Survey

The purpose of interview survey is to collect detailed information about commuter trips related to mass transit use and respondents' perceptions of the mass transit system, especially the access trip to reach transit station. The survey was carried out in the residential area surrounding station areas. Various methods of data collection were carried out depending on the local situation in the study area. For instance, in Bangkok, trained surveyors visited door to door respondents' house to interview commuters or those who did daily travel at the their residents. Graduate students of Civil Engineering Department of Chulalongkorn University also helped to collect data.

In Manila, the questionnaire was distributed on not only by door to door home interview survey, but also distributed to travelers in public areas such as mall and CBD areas. Students of Transportation Engineering Division of De La Salle University carried out the survey. To obtain a higher response rate, surveyors gave

[ฑ] Sapporo City Transportation Bureau, www.city.sapporo.jp/kensetsu/stn/eng; accessed October 2006

general description about the survey and the purpose of research and let them to fill out the questionnaires by themselves.

The mail-back survey method was applied for the study area of Sapporo Japan. With this method, there is no face-to-face interaction between surveyors and respondents. The questionnaires were distributed randomly to respondents' mail box in housing blocks near transit station. Respondents sent back the filled forms using business-reply mail that also included in the form. This method received lowest successful rate with less then 10% of respondents sending back the form.

Table 4.2 shows the data summary that was obtained from the interview survey. The second column in the table is the number of station area surveyed. Note that time limitation, not all stations can be surveyed. The third column shows the number of all observation while number of actual observation that can be used is in the bracket.

There are many reasons that some observations should be rejected. In Manila, for example, 21 of 1396 observations can not be used because of incomplete or missing data (6 observations), the destination beyond the study area, such as in other provinces (12), and only socio-economic data given (3).

Table 4.2 Summary of Data Obtained From Interview Survey

Study Area	Number of Station Area Surveyed	Raw Observation (Used)	Remark
Bangkok	14	344 (322)	Carried out on 7 BTS and 7 MRT stations
Manila	39	1396 (1375)	Carried out on 18 LRT1, 10 LRT2, and 11 MRT3 stations
Sapporo	5	190 (160)	Carried out on 4 subway and 1 commuter train station

The questionnaires in the interview survey were divided into several parts. In the first part, respondents were asked to describe their trips from home to their destination in detail (itinerary trip data). Every mode, including non-motorized mode was asked to be written down. Origin point, destination point, time elapsed and cost for the particular mode was asked to be report. There were two trip data asked, one is the trip details if using mass transit system and the other is the detail if using other mode for the same pair of origin-destination (home to destination). An example of an completed form for itinerary data is shown in Table 4.3.

Table 4.3 Typical Completed Form for Itinerary Data

Location/Segment		Transport mode / Others	Total Time Consumed (minutes)	Fare or Out of pocket cost (Baht)	Route of Public Transport (Sign Board)
From (Origin)	To (Destination)				
Home	Mo Chit BTS sta	Walking	7	0	
Mo Chit BTS sta	Siam BTS sta	BTS	11	35	
Siam BTS sta	Rama I road	Walking	4	0	
		Wait for bus	6	0	
Rama I road	Phayatai road	Bus	7	12	Bus No. 162
Phayatai road	Office	walking	3	0	
Total			38 minutes	47 Baht	

In the second part, respondents were asked about their perceptions of the mass transit system. For regular users, they were asked about how they reach the station, time and cost for doing so, and so on. The reason why they used the system was asked as well. Similarly, in this part, non-regular users were asked about their reason for not using the system.

Respondents' own characteristics were observed in the last part. The questions were applied for both types of respondents (regular and non-regular users). In the last section of this part, all respondents were asked to rate the factors that affected them to use or not use mass transit system regularly. More than twenty factors that were derived from literature were given to be rated.

To identify the data for each respondent, respondent identification number was introduced. The six digits number was used where the first three digits are indicated the station code and the last three digits are for respondent number. For instance, for Manila, the respondent number of 315190 means that is for the 190th respondent and his/her home is near the station with code of 315. Specifically, he/she is the 190th respondent for the Gil Puyat Station.

For Bangkok, an additional data set was taken from the research by Netipunya (2006), who carried out on-board interview survey at the same selected mass transit stations. In the survey, respondents were asked about how to get there (mode used to access station), time and cost to complete the access trip, his or her origin (i.e. home), and so on.

4.2.2 Station Investigation and On-board Interview

To understand the characteristics of stations, field investigation was carried out. The objective of the survey was to inventory all components of station that are related to access trip to that station. The survey was conducted in station areas and the

vicinity. In each station surveyed, recorded information includes station features and amenities, such as escalator and elevator provided, ramp for wheelchair or pushchair, number of ascending steps to reach station gate, number of ticket machine, chairs for waiting, public toilet, public phone, food and book stalls, and so on. The survey also collected information related to access mode to reach stations, such as parking facilities provided by the mass transit authorities, access from bus stop or drop off point, and so on. The walking distances from each facility were also recorded.

Due to the national security reason, the station survey in Manila could not be done. Station authority and police did not allow the researchers to do inventory around station area. At the period when the survey was conducted, the national security alert in Metro Manila was high. Full cautions were applied to all public facilities including mass transit system. Therefore, the investigation was carried out based on map, aerial photos, and information provided in website.

On-board Interview Survey provided an additional source of data for Bangkok and was conducted by Netipunya [43]. The survey was carried out at the same selected mass transit stations in Bangkok, i.e. seven BTS and seven MRT stations. The survey included a quick interview of passengers at station platforms to collect information related to access mode, access time and cost, and so on.

4.2.3 Summary of Respondents' Characteristics

General summary of socioeconomic data for the study area of Bangkok and Manila can be seen in Table 4.4 and Figure 4.1 through Figure 4.4. From Table 4.4, it can be seen that both in Bangkok and Manila, men and women respondents were sampled with similar proportion. Car ownership in Bangkok is somewhat higher than that in Manila, almost twice in proportion. Note that the proportion of those who do not own but have cars available for the trip as shown in the bracket.

Figure 4.1 shows the summary of education of respondents. The 'other' education level in the figure consists of technical school (2.7%), 2-years college degree (11.3%), and other (0.3%). Note that education system in Bangkok and Manila, especially after high school, is slightly different. In Manila, there are technical school and 2-years college degree after high school while in Bangkok there are only technical school and bachelor level (sometimes called a 4-years college degree in Manila).

Table 4.4 Summary of Socioeconomic Data

Socioeconomic Parameters	Prop.	Socioeconomic Parameters	Prop.
Bangkok (n = 322)		**Manila (n = 1375)**	
Gender: Men	42.9%	Gender: Men	52.8%
Women	57.1%	Women	47.2%
Age: n = 322; average: 38.6; std.dev. 13.7; min: 12; max: 73		Age: n = 1350; average: 25.8; std.dev. 8.9; min: 15; max: 72	
Marriage status: Single	61.2%	Marriage status: Single	76.9%
Married, has kid(s)	20.2%	Married, has kid(s)	14.8%
Widower/Separated	14.6%	Widower/Separated	5.2%
Married, no kid(s)	4.0%	Married, no kid(s)	3.1%
Have car (available for trip)	58.7% (82.0%)	Have car (available for trip)	30.4% (73.1%)
Have driver license	69.6%	Have driver license	40.3%

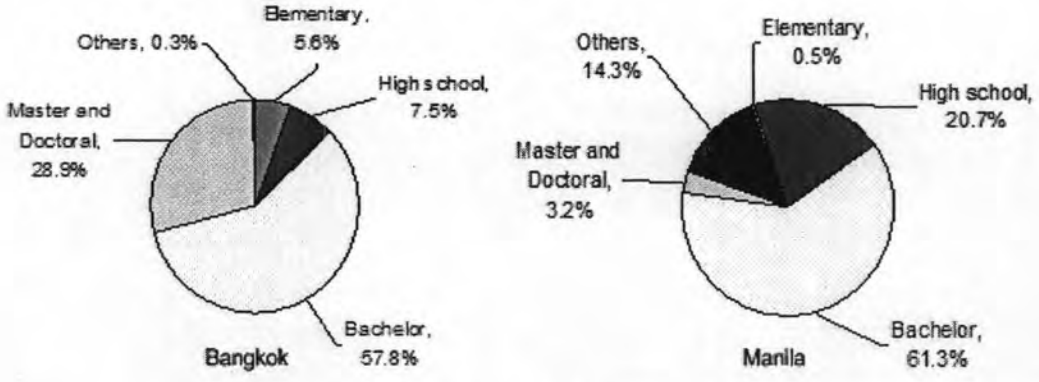


Figure 4.1 Summary of Education Level

Figure 4.2 shows the summary of employment status of respondents. The summary of household monthly income as reported by respondents is presented in Figure 4.3. Since the survey focus on commuter trips, the proportion of employee groups such as private employee, government employee, and business owner and student are high as seen in the table, especially for Manila.

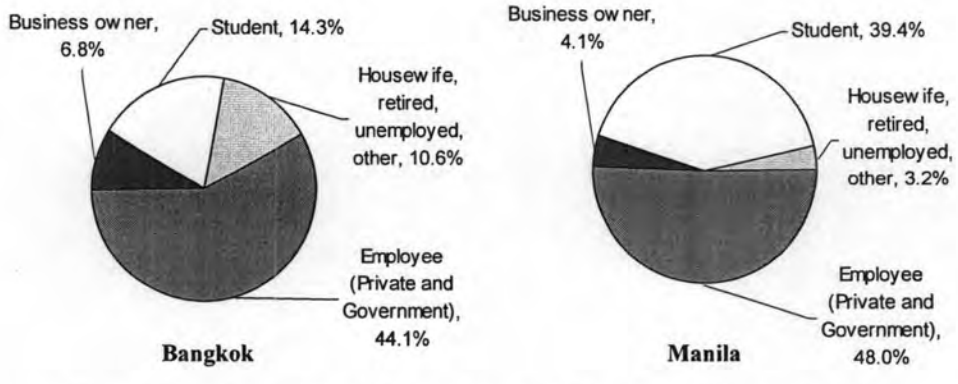
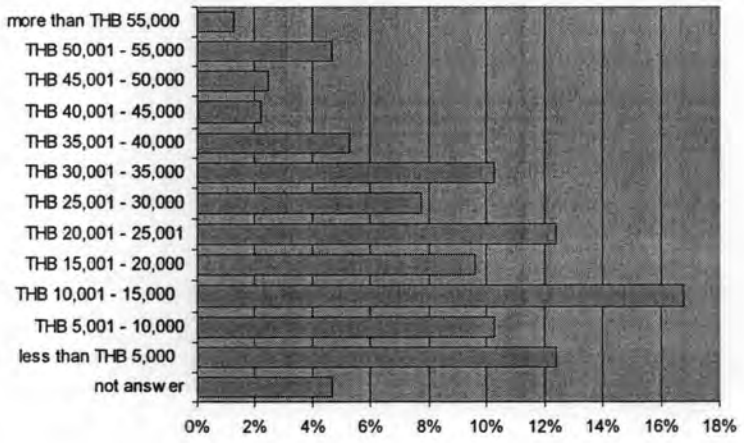
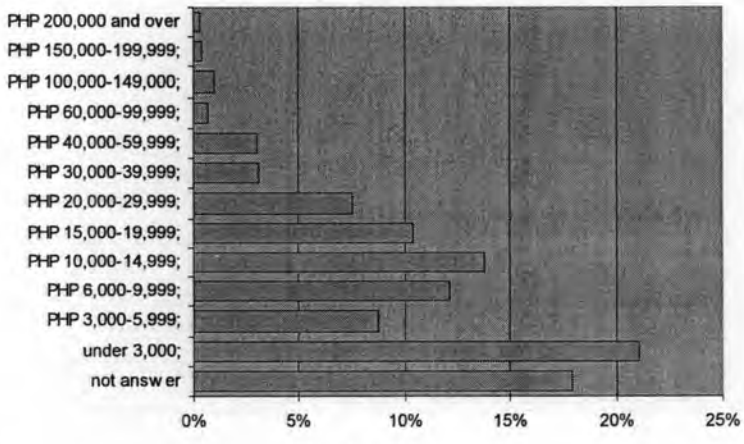


Figure 4.2 Summary of Employment Status of Respondents



Bangkok



Manila

Figure 4.3 Summary of Household Income

4.2.4 Characteristics of Bangkok's Station Areas

Land use characteristics in station area were obtained from field survey investigation. The area in radius of 1000 meters from station was defined as survey area. This distance is based on previous studies in Singapore that to access mass transit stations, about 90% of users are willing to walk less than 1,000 meters [8]. Figure 4.4 shows the summary of road density in the station coverage area. Since walking is main issue in this research, only roads that walking is possible to do were considered; expressways and roads in private area were excluded. In the figure, the first seven stations are BTS station while others are MRT.

Hua Lamphong is a station in the old downtown area where central rail station of Bangkok located. The main road in the station is denser than others. *Soi*, a narrow street with one or two lanes, network is more dominant in MRT line rather than BTS. Total road length for each station is 46.9 km on average. Curb sidewalks are provided

both sides in almost all main roads while almost no sidewalk available on *soi*. Therefore, pedestrians must be more careful to walk along *soi*.

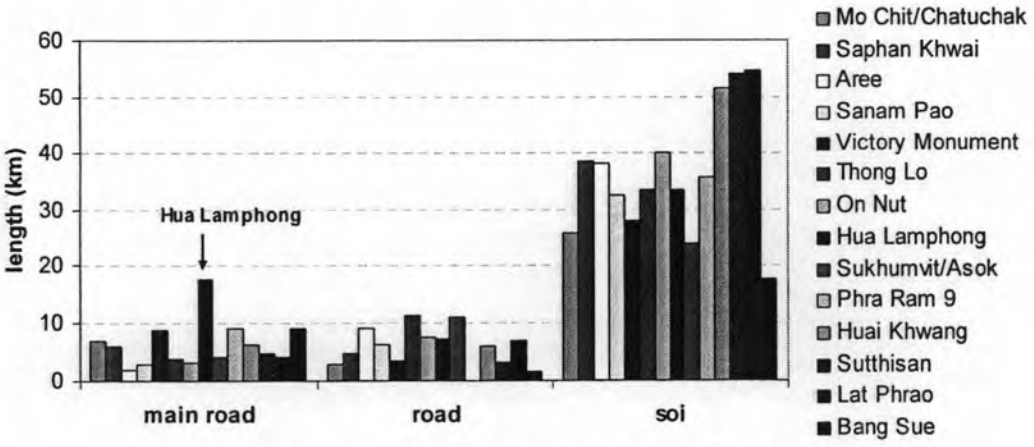


Figure 4.4 Road Length for Selected Stations

Figure 4.5 14 shows the summary of land use in station areas. The label public transport in the figure is for number of bus route and van stops in station area. Victory Monument station is a transit hub and there is a huge number of bus and van routes inside the area.

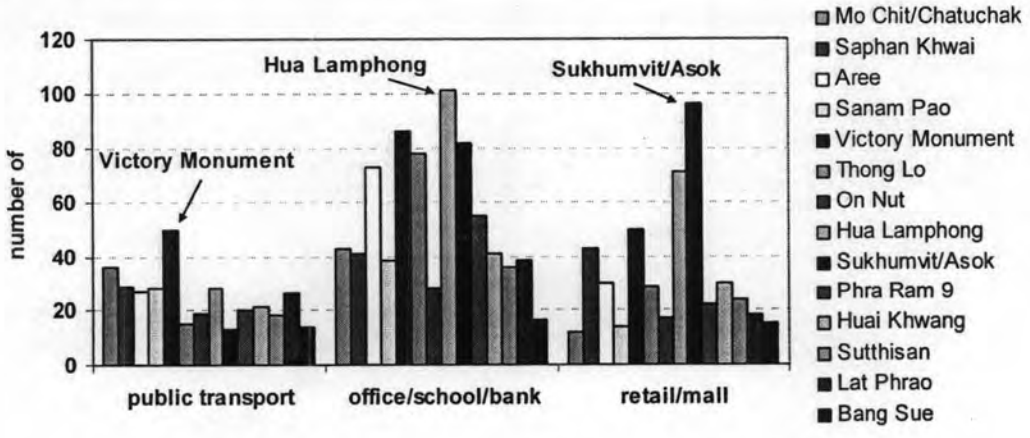


Figure 4.5 Land Use Characteristics for Selected Station Area

Office buildings, factory, company offices, bank, school, college and university are classified in the office/school/bank land use. Hua Lamphong, Victory Monument, and Sukhumvit/Asok have large number of this type of land use. Other types of land use such as market and shopping center, hotel, car rental and service, church, mosque, and temple, hospital, police station, post office, etc were classified into retail/mall category.

4.2.5 Characteristics of Manila's Station Areas

Summary of station land use for Manila can be seen in Figure 4.6 while almost all stations were surveyed. Characteristics of the main roads and minor roads are similar with those in Bangkok. However, some of the roads have only one side of sidewalk. Some minor roads exist in the station area but they could not be deemed as *soi* as in Bangkok. The total road length for each station is about 57.6 km on average, higher than Bangkok.

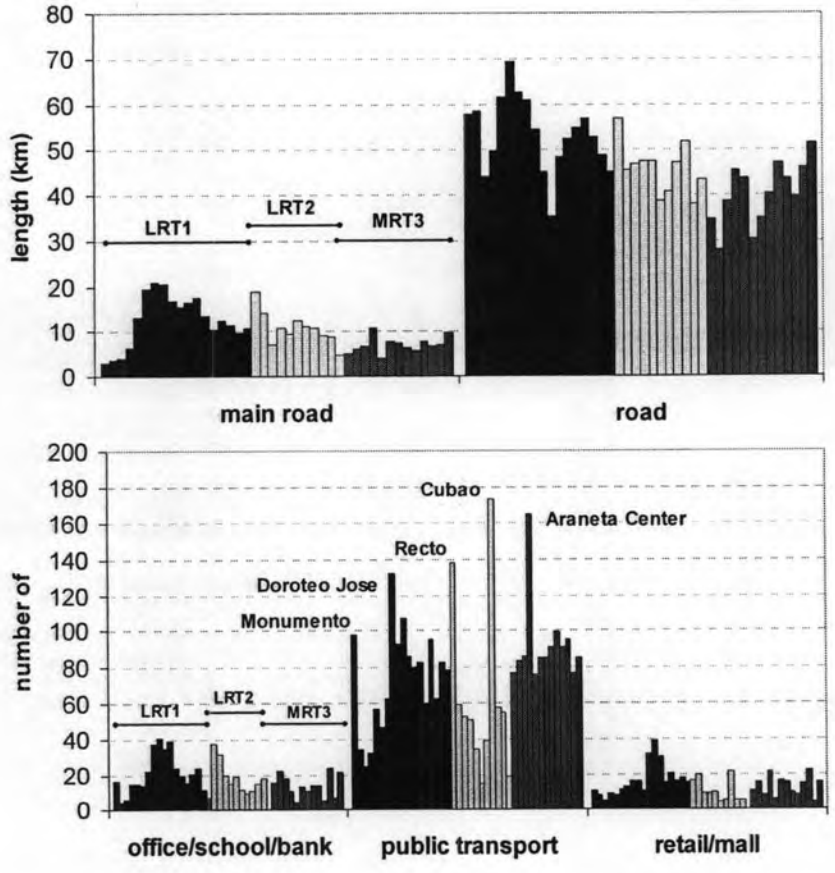


Figure 4.6 Total Road Length and Land Use for LRT/MRT Station

Recto and Doroteo Jose are interchange station while Monumento is the terminal station of LRT1. These stations are public transportation hub. Unlike Bangkok, there are many waiting points for *jeepney*, tricycle motor and *pedicap* (human powered bicycle) around the station. These numbers are counted as public transportation modes.

4.2.6 Station Features and Amenities

The summary of station access facilities can be seen in the Table 4.5 for both Bangkok and Manila. In Bangkok, at least one escalator is installed at every BTS

stations surveyed and almost all at MRT stations. Note that all BTS stations are elevated stations while MRT are underground stations.

At the time of survey, in Manila, no escalator and elevator installed in LRT1 stations while there are limited number in other lines. All LRT1 stations are elevated while the type of those of other lines varies among elevated, at-grade, and underground stations. Some escalators and elevators are built in commercial buildings that are connected to the mass transit stations. These facilities might be considered as station access facilities but the usage of them depends on working hours of the buildings that which shorter than mass transit service hour. Ramp facilities are a special access for wheelchair or pushchair that should be integrated with elevators. However, in some MRT3 stations, there are limited ramps installed.

Table 4.5 Station Access Facilities

Line	Number of Station Surveyed	Total Number of Gates	Total Number of Gates with Escalators	Total Number of Gates with elevators	Total Number of Ramp
BTS	7	28	13	5	5
MRT	7	24	22	13	13
Bangkok	**14**	**52**	**35**	**18**	**19**
LRT1	18	60	0	0	0
LRT2	10	27	3	10	10
MRT3	11	39	9	15	3
Manila	**39**	**126**	**12**	**25**	**11**

Table 4.6 shows the summary of transfer facilities for the study areas. As seen in the table, most of the station surveyed in both study areas provides access facilities with short walking distance. The number of gates in the station varies from 2 to 5 gates. In some stations, the purpose of taxi stands is not for taxi only but they are sometimes used as waiting point for vans.

Table 4.6 Summary of Transfer Facilities

Line	Total Gates	Car Park Facilities			Taxi Stand		Bus Stop/Drop off Point	
		No of Gates*	Total Cap.	Av. Dist.	No of Gates*	Total Cap.	No of Gates*	Av. Dist.
BTS	28	2	300	50.0	8	1.6	16	2.3
MRT	24	7	570	26.7	12	3.0	22	3.1
Bangkok	**52**	**9**	**870**	**30.0**	**20**	**2.2**	**38**	**2.7**
LRT1	60	3	440	38.4	49	64.9	49	72.8
LRT2	27	3	300	59.8	19	18.3	19	16.2
MRT3	39	1	30	7.8	29	56.1	29	111.8
Manila	**126**	**7**	**770**	**40.8**	**97**	**50.5**	**97**	**69.3**

* number of gate that have the facilities

The summary of station features can be seen in the Table 4.7. Unlike BTS stations, the book and food stores are not allowed in MRT stations. In the BTS line, there are 39 ticketing machines provided of 28 gates of the seven station surveyed. It could be said that on average about two and three machines were installed for two adjacent gates. On the contrary, manual ticketing system (ticket window) is more common than ticket machine in LRT1 stations. There are 72 ticket windows for 60 gates while there are only 49 machines.

Table 4.7 Summary of Station Features

Line	Station Surveyed	Total Gates	Ticket Windows	Ticket Machines	ATM	Public Phone	Book & Food Stores
BTS	7	28	15	39	14	50	50
MRT	7	24	12	30	28	57	0
Bangkok	**14**	**52**	**27**	**69**	**42**	**107**	**50**
LRT1	18	60	72	49	5	27	57
LRT2	10	27	12	70	5	10	43
MRT3	11	39	47	60	23	73	60
Manila	**39**	**126**	**131**	**125**	**25**	**100**	**10**

In the field investigation, some station amenities were valued by the number of 1 through 3 to reflect the situation. The value of 1 is for the worse and value of 3 is for the best. Table 4.8 shows the average rating of station amenities.

As can be seen in the table, among the station surveyed, BTS and MRT stations have similar amenities conditions such as trip information, the presence of station guards, the lack of chairs for waiting passengers, public toilet, and so on. Some BTS stations are more crowded than MRT.

In Manila, stations of LRT1 line, the oldest line in South East Asia, have the lowest value of amenities than stations in other lines. The stations have poor travel information and more dirty and poor condition of lighting. Based on average value, stations surveyed in Bangkok are slightly better than in Manila.

4.2.7 Notes on Station Characteristics and Facilities

In Bangkok, the survey results indicate that travel-related facilities, such as ticket windows and travel information booth, are sufficient in all stations surveyed. Passenger amenities, however, differ particularly between BTS and MRT stations. For instance, public phones and ATM are widely available at all stations while book stores and food stores are available only at BTS stations, but not MRT.

Table 4.8 Average Rating of Station Amenities

Line	Trip Information	Present of sta. guard	Chair for Waiting	Public Toilet	Crowded-ness	Clean-ness	Lighting
BTS	3.0	3.0	1.0	1.0	1.6	2.4	3.0
MRT	3.0	3.0	1.0	1.0	2.4	2.7	3.0
Bangkok	**3.0**	**3.0**	**1.0**	**1.0**	**2.0**	**2.6**	**3.0**
LRT1	1.0	2.1	1.2	1.2	1.4	1.3	1.3
LRT2	2.9	2.7	1.0	2.9	1.8	3.0	2.3
MRT3	1.9	2.2	2.0	2.8	1.4	2.0	2.0
Manila	**1.7**	**2.3**	**1.4**	**2.1**	**1.5**	**1.9**	**1.7**

Note *:
Information in station: 1-no; 2-yes, but not enough; 3-yes and enough
Present of station guard : 1-no; 2-yes, but not enough; 3-yes and enough
Chair for waiting: 1-no; 2-yes, but not enough; 3-yes and enough
Public toilet: 1-not provided; 2-yes, but not enough; 3-yes and enough
Crowdedness, especially in peak hour:1-too crowded; 3-not crowded
Cleanliness: 1-poor; 2-average; 3-good condition
Lighting: 1-poor; 2-average; 3-good condition

Access facilities of transit stations differ between transit systems. For example, escalators and elevators are provided more extensively at MRT stations, but are slightly lacking at BTS stations. In general, MRT stations tend to be better equipped to facilitate access trip than BTS stations. Since BTS and MRT are operated by different companies, their gates in interchange station serve independently, as show in the Figure 4.7. A passenger, who wants to continue from BTS to MRT or *vice versa*, needs to exit completely from BTS station area and then proceed to MRT station.

Figure 4.7 Transfer Situation between BTS and MRT Station

In the study area of Manila, there are a contrary condition between the oldest line (LRT1) and newest line (LRT2). Extra efforts needed for passenger to access

LRT1 stations than other lines. In terms of station amenities and physical station access condition, LRT2 has the highest potential to attract passenger while LRT1 is the poorest. However, in term of transit accessibility, there is not significant difference among those lines.

4.3 Trip Characteristics of Study Areas

4.3.1 General Trip Characteristics

Table 4.9 shows the average of total travel time and total travel cost to travel from home to desired destination use mass transit and not use mass transit, respectively. The non-mass transit mode comprises private car, bus, and van. The travel cost in the table is associated to out-of-pocket cost that respondents had to pay to fulfill his or her travel. Note that mass transit lines in Bangkok and Manila are built on dense traffic area and they are could be an alternative transit mode to travel in congested area.

Table 4.9 Total Travel Time and Cost for Using and Not Using Mass Transit

City	Sta. *	No of Obsv.	Average Total Travel Time (standard deviation), min.		Average Total Travel Cost (standard deviation)	
			using mass transit	NOT using mass transit	using mass transit	NOT using mass transit
Bangkok	14	322	43.6 (29.6)	53.8 (39.1)	THB 33.5 (17.7)	THB 11.9 (14.1)
Manila	39	1375	40.8 (18.4)	50.0 (27.2)	PHP 28.6 (16.4)	PHP 26.3 (18.6)
Sapporo	5	160	35.1 (17.1)	32.9 (23.0)	JPY 334.8 (242.3)	JPY 188.5 (253.1)

* number of station area surveyed. In Bangkok, 7 BTS stations and 7 MRT station were surveyed while in Manila almost all stations were surveyed. In Sapporo, only 5 subway stations were surveyed.
THB = Thailand Baht
PHP = Philippines Peso
JPY = Japanese Yen

As seen in the table, for the case of Bangkok and Manila, those who used mass transit experience shorter travel time than those who did not. The travel time advantages are 19% and 13% in Bangkok and Manila, respectively, while it was reported that in the case of European and North American cities, the advantages are about 20% - 50% [1]. Despite of local characteristics that differ among the cities, from the table, it could be seen that, on average, the total travel times in Bangkok and Manila are relatively higher than those in Sapporo, regardless of whether mass transit is used.

In both study areas, there is a significant difference on average of total travel cost between using and not using mass transit. There are overlaps between mass transit line and buses routes for several pairs of origin-destination. The fare for mass transit is particularly higher than bus or other fixed route transit for the same origin-destination pair. For instance, in Bangkok, the BTS fare from Siam Interchange station to Mo Chit station is THB 40 while the fare for a air-conditioned bus is only THB 13.

The similar system characteristic can be observed in Sapporo, which is an example of established mass transit systems. The average total travel cost for using mass transit is higher than not using mass transit. Based on interview results, it is found that the respondents preferred to take bicycle or walk as rather than using mass transit for shorter distance. Note that survey interview in Sapporo was carried out in the summer season. This situation could explain the reason of why the total cost of using is almost doubled with not using mass transit.

4.3.2 Characteristics of Mass Transit Trip

The general characteristics of mass transit trip in the study areas of Bangkok and Manila is summarized in Table 4.10. The main mode reported in the table is the mode that respondents usually used to travel daily.

Table 4.10 Summary of Mass Transit Trip Characteristics

General Trip Characteristic	Proportion of Respondents	
	Bangkok (n = 322)	Manila (n = 1375)
Main mode used:		
mass transit	45.3%	44.7%
car (drive or car share)	17.4%	9.0%
fixed route transit (bus and jeepney*)	32.0%	44.5%
for-hired transit (taxi)	2.5%	1.8%
others	2.8%	n.a.
Trip purpose: work	83.5%	56.1%
education	16.5%	36.5%
others	n.a.	7.4%
Frequency of transit use:		
never use (within a week)	28.4%	24.0%
occasional (only once a week)	12.9%	20.4%
frequent (2 -3 times a week)	22.4%	16.2%
regular (more than 3 times)	36.3%	39.4%
Mass transit line (as the origin station)	BTS: 58.7% MRT: 41.3%	LRT1: 43.6% LRT2: 28.9% MRT3: 27.5%

* *Jeepneey*is not exist in Bangkok

Since the survey was carried out within mass transit coverage areas, it is not surprising that the proportion of mass transit use is the highest. However, as can be

seen from the table, the frequency of mass transit use varies from very rare (never use) to everyday. Besides that, the proportion of fixed route transit is slightly higher in both cities. This finding could indicate the rivalry of mass transit and fixed route transit for the same origin-destination pairs.

Note that mode of van in Bangkok and Manila is slightly different. In Bangkok, van is a minibus that can carry 10 to 12 passengers. It mainly serves point-to-point trips and covers long distance routes, especially connecting between sub urban and CBD locations. In Manila, Asian Utility Vehicle (AUV) or Megataxi or known as *fx* is similar to Bangkok's van.

4.3.3 Transit use in Study Areas and Other Areas

In the evaluation of frequency of transit use, respondents whose trip was originated within station coverage area are grouped into never, occasional, frequent and regular users. The summary of frequency of mass transit use for the three study areas can be seen in Figure 4.8.

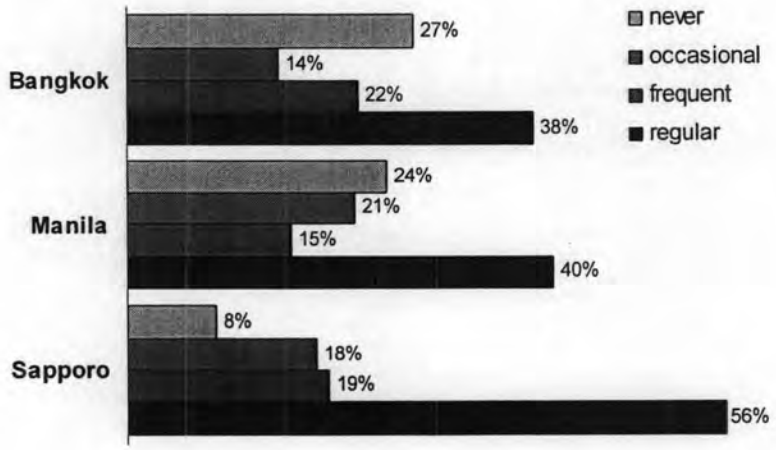


Figure 4.8 Frequency of Transit Use

It can be seen in the figure that in Bangkok and Manila the never and the occasional groups' share are 41% and 45%, respectively while in Sapporo, it is only 26%. On the other hand, there is higher proportion of regular users in Sapporo comparing to Bangkok and Manila, i.e. 56% against 38% and 40%, respectively. This finding indicates the higher proportion of infrequent users (never and occasional group) in Bangkok and Manila, and that encouraging these travelers to use mass transit more often will increase ridership significantly.

Table 4.11 illustrates the proportion of various modes for traveling from home to destination, e.g. office or school. As can be seen in the table, the proportion of car use in Bangkok and Manila is higher than in Sapporo. It might indicate that mass transit system is not attractive enough for car users. In the next section, it will be shown that travelers stated that they do not use transit because they own a car. Note that the 'other' mode for Sapporo data as shown in the table consists mainly of walking and bicycling.

Table 4.11 Proportion of Main Mode from Home to Destination

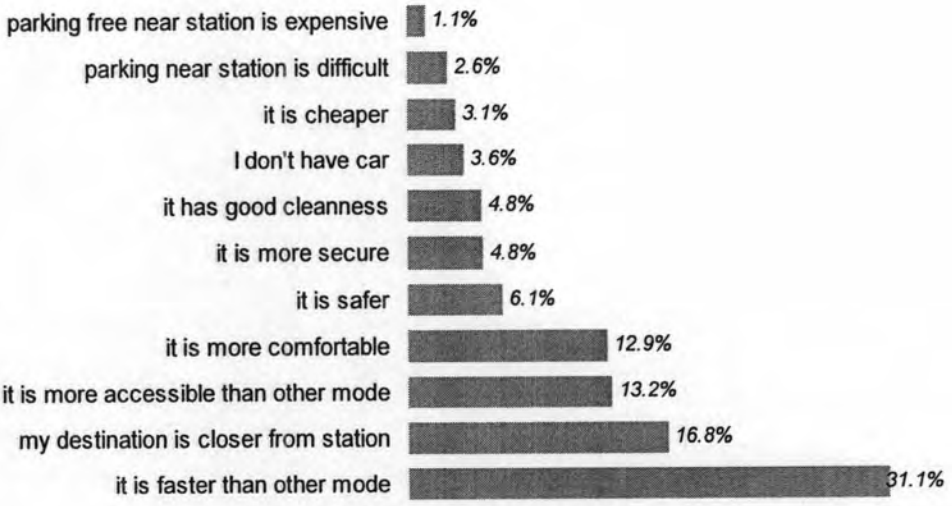
Study Area	No. of Observation	Mass Transit, %	Private Car, %	Fixed Route Transit, %	Flexible Route Transit, %	Other Mode, %
Bangkok	322	45.3	17.4	32.0	2.5	2.8
Manila	1375	44.7	9.0	40.5	5.8	n.a.
Sapporo	160	57.5	6.3	22.5	n.a.	13.8

Experiences from the established mass transit system, such as the Sapporo Subway, shows that the proportion of regular users is very high compared to others. It indicated that the Sapporo Subway is relatively successful in attracting travelers. On the other hand, mass transit systems in the study areas of Bangkok and Manila are less effective and suffer high proportion of infrequent transit users within their station coverage areas. The comparative analysis results reveal that the effective strategies to gain more transit ridership should be aimed at infrequent users group who live within transit coverage areas.

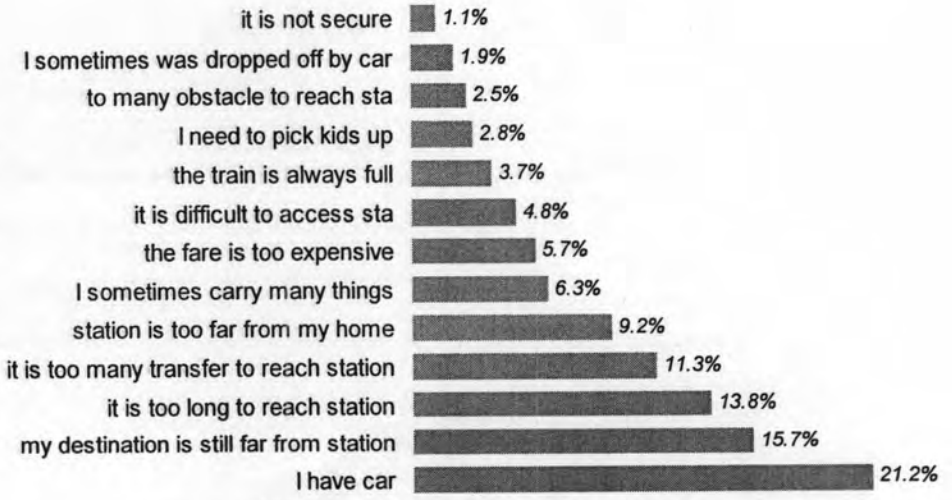
4.3.4 Attitudes Towards Mass Transit Use

From the results of interview survey, respondents who used mass transit regularly were asked to rank the list of the reasons of using the system while those who do not use transit regularly were asked to rank as well the list of reasons for not using transit. Number 1, 2, 3, and so on was used to describe the rank. The reason ranked 1 implies that it is the most important reason of using or not using the system. To obtain the clear distinction among ranks for each reason, rank was inversed, multiplied by associated number of respondents, and then summed. To show the important level among reasons, normalization was carried out. The highest percentage represents the most important reason, the second highest is the second most important

reason, and so on. Results for the study areas of Bangkok and Manila are shown in Figure 4.9 and Figure 4.10, respectively.



(a) Reasons of Use BTS and MRT

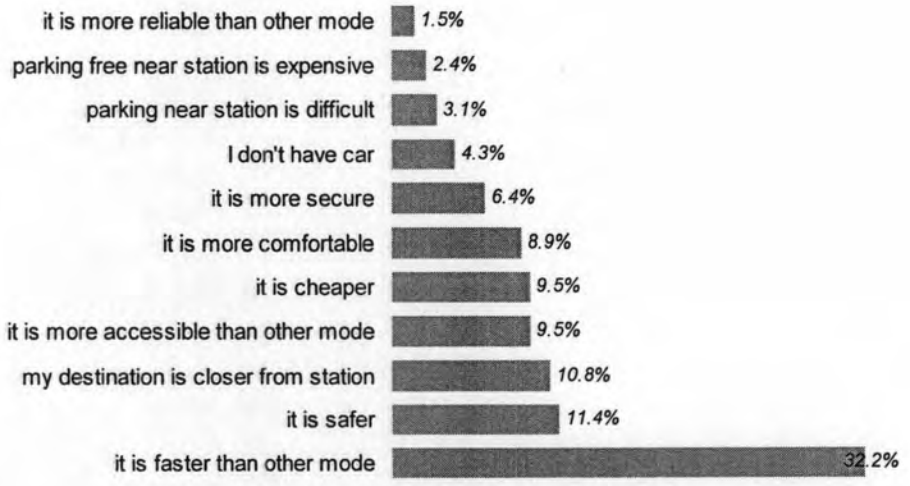


(b) Reasons of NOT Use BTS and MRT

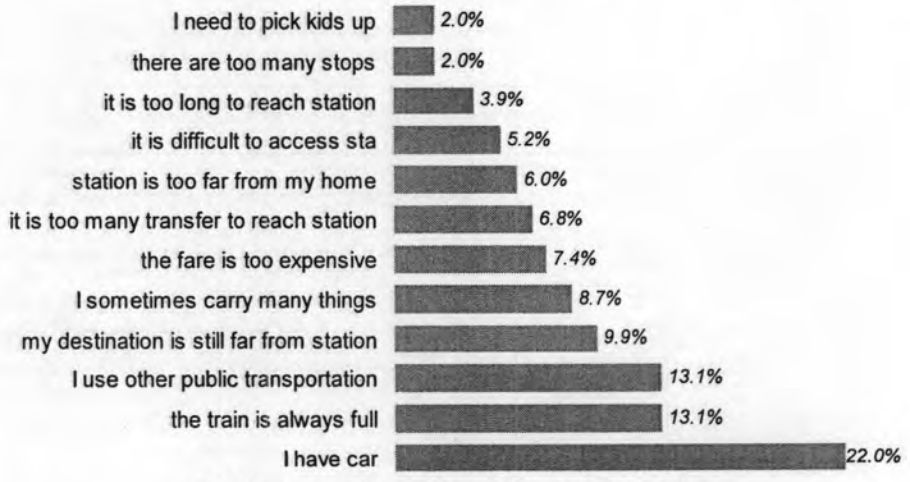
Figure 4.9 List of Reasons of Using or Not Using BTS and MRT

As shown in Figure 4.9, for the case of Bangkok, the main reason of using BTS and MRT is because the system is faster than the other modes. It agrees with previous discussion that BTS and MRT are more attractive in the term of time saving. On the other hand, car ownership is the main reason for not using mass transit. The second most important reason to use transit is because the destination (e.g. office or school) is close to station. This reason is similar to the second reason for not using mass transit, i.e. because the destination is far from the station. This finding is consistent with the basic concept of transit accessibility that good transit system is not

sufficient to attract travelers unless there are many relative advantages that can be gained by using mass transit.



(a) Reasons of Use LRT1, LRT2, MRT3



(b) Reasons of NOT Use LRT1, LRT2, MRT3

Figure 4.10 List of Reasons to Use LRT1, LRT2 and MRT3

Almost all BTS and MRT stations are located in dense area where traffic congestion always occurs. The reason of 'it is too long to reach station' might indicate that transit users who access by motorized mode have to spend longer time inside the access mode to reach mass transit station. The term of 'too many transfer' denotes the fact that transit users need to transfer between some access modes just to reach station. Note that reasons for not using mass transit can be deemed as critical factors to make mass transit more attractive. For instance, since having car is the main factor for not using mass transit, building more parking spaces near station could be a good strategy to attract more passengers with car availability.

Additionally, open questions related to suggestion for transit improvement were asked in the interview survey. Respondents gave many suggestions related to transit use and accessibility. In the case of Bangkok, the suggestions related to access to station are the foremost issues. Walking environment, presence of escalator and elevator, and number of access modes were the critical issues that respondents suggested for the transit improvement.

In the case of Manila, the main reasons for both of using and not using transit have similarity with Bangkok. For instance, the main reason for using mass transit is that because it is faster than other modes. Moreover, car ownership becomes the main reason of not using transit. Suggestions for transit improvements in the case of Manila are quite different from those in Bangkok. Suggestions related to transit service improvement are more dominant than improvement of access to station. These include requests for higher seat availability, better passenger flow management in station area, better ticketing system, more punctuality, and more comfort in station and inside the train. These findings could lead to effective improvement strategies and it indicates as well that the necessary improvements for Bangkok and Manila might be quite different.

4.3.5 Important Factors Affecting Mass Transit Use

It has been discussed earlier that within interview survey, respondents were asked to rate the importance level of factors that effect their behavior to use mass transit. The level importance 'not important', 'somewhat important', 'important', and 'very important' were used. Figure 4.11 shows the summary of the importance level for the case of Bangkok and Manila that were completed by 322 and 901 respondents, respectively. The bars that were shown in the figure represent the summation of the proportion of the level 'important' and 'very important' only. The factor by 'reasonable access distance', for instance, is rated 'important' and 'very important' 92% and 83% of respondents in the study areas of Bangkok and Manila, respectively.

The figure reflects respondents' perception of mass transit service. Respondents in Bangkok valued factors related to access to station higher than respondents in Manila. This can be seen in the last six bars in the figure. They are factors related to access distance, number of road crossings, presence of escalator or elevator, and the number of transit modes to access and egress. On the other hand, respondents in Manila valued factors related to station facilities more as shown by the

first three bars in the figure. They placed higher value on good ticketing system, less crowdedness and cleanliness in the station.

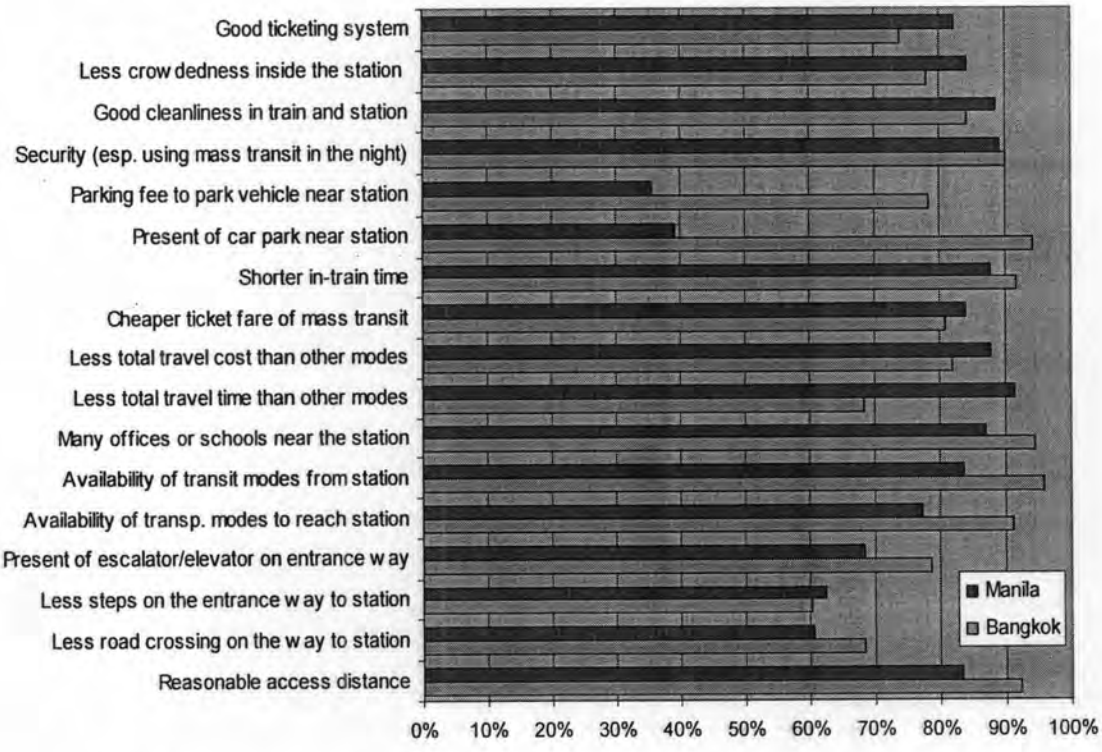


Figure 4.11 Important and Very Important Factors to Use Mass Transit

Moreover, many respondents in Bangkok considered parking garage near the station and its fee as 'important' or 'very important' while respondents in Manila did not do so. It could be understood since, based on data analysis results, car ownership in Bangkok is substantially higher than in Manila.

4.4 Characteristics of Access Trip

4.4.1 Access Mode Share

There are various access modes recorded in the data survey of the Bangkok and Manila study areas. Figure 4.12 shows the access mode recorded in study areas. Note that for Bangkok, the data of Netipunya [43] were used. Access mode of car comprises park and ride as well as drop off. In Bangkok, the access mode of *tuk-tuk* is a tricycle taxi while *songtaew* is covered pick-up truck and operates as *paratransit*. Motorcycle is classified as taxi because it is for-hired motorcycle.

In both study areas, walking is a dominant mode to access station. In Bangkok, the second dominant access mode is motorcycle taxi. Despite the safety issues, this

mode has highest maneuver ability in congested areas. It can take shorter route through narrow streets or even running on sidewalk to avoid traffic congestion. As discussed earlier, *jeepney* dominates public transportation in Metro Manila. So, it is not surprising that this mode becomes major mode to access mass transit station.

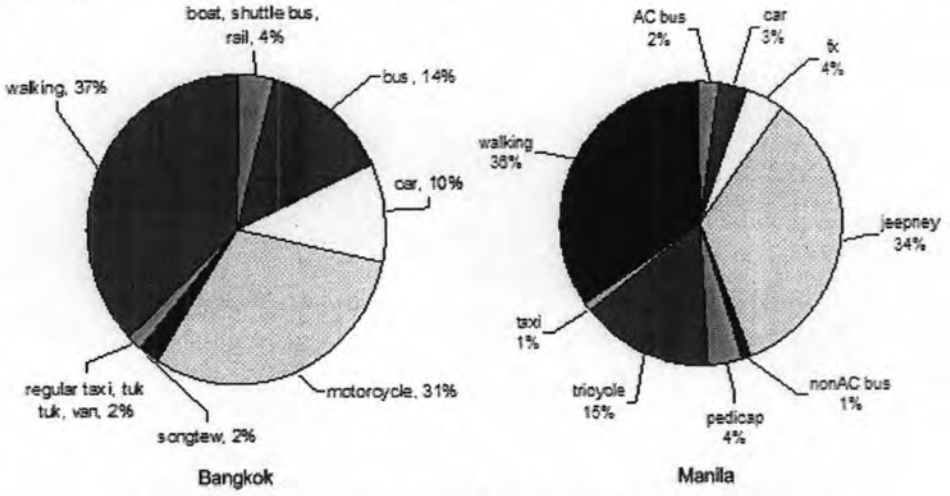


Figure 4.12 Access Mode Share for Study Areas

4.4.2 Access Distance

Figure 4.13 shows the distribution of walking distance to station in the study areas. Similar graphs from other studies are presented as well for comparison. It can be seen in the figure that the distribution of walking distance for tropical areas has similar trend while for non-tropical area, i.e. Sapporo, shows a slight drop. It was revealed as well that less than 10% of respondents walk longer than 1000 meters and none over than 2000 meters.

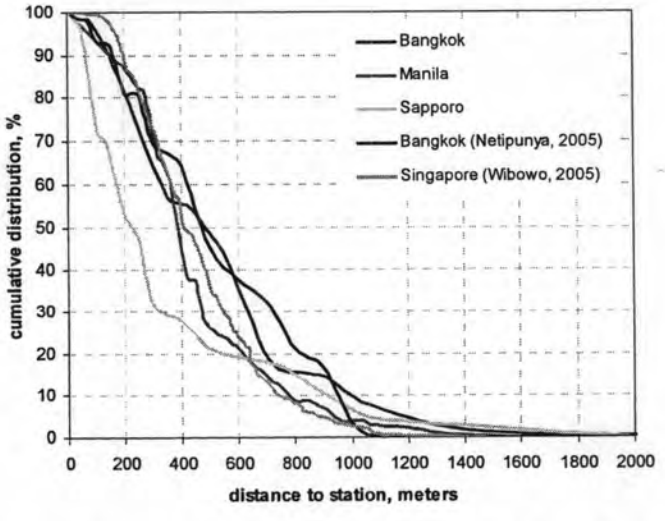


Figure 4.13 Walking Distance to Station in Various Study Areas

As mentioned in the literature, the proportion of walking to access station will decrease as the distance to station increases and, on the other hand, those of non-walking access modes increase. Figure 4.14 shows the relationship between various access mode and distance to station for Bangkok and Manila data. As shown in the figure, for Bangkok data, motorcycle taxi is preferable among others. The proportion of using car is relatively high in Manila although there are limited car parks provided in station areas. This finding might indicate high proportion of car sharing or drop off by car.

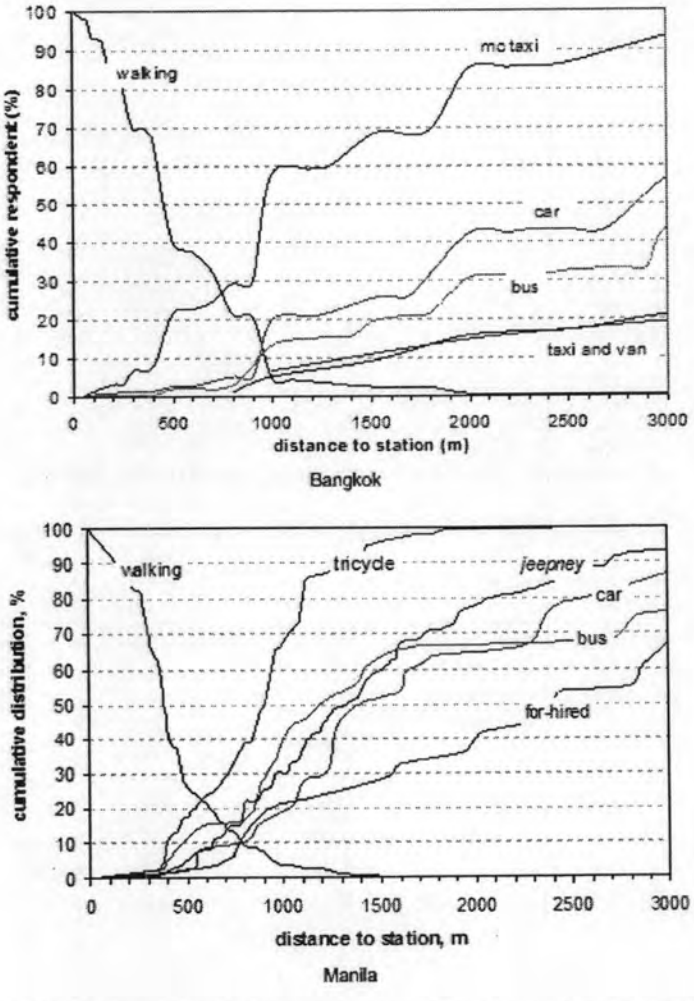


Figure 4.14 Relationship between Access Mode and Distance to Station