

Study on Mutual Influence between Park & Ride and Large Commercial Building in Bangkok

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1. INTRODUCTION

Most of the Asian cities are experiencing severe transport problems resulting from rapidly increasing vehicle ownership and usage. One of the reasons may be due to insufficient supply and inferior quality of public transportation. Of course public transport as an alternative to the private vehicle is generally less convenient than the use of a private vehicle, but it has the important advantages of being less polluting, more efficient in road spaces. Therefore, public transportation should be promoted instead of private car.

In Bangkok, Thai government plans to construct 12 mass rapid transit lines for solving serious traffic congestion. One of the new MRT line is Purple line. As MRT extension plan, Purple line starts to operate in 2016. In this line, the park & ride which is faced to large commercial building is constructed. Therefore, the mutual influence between large commercial building and park & ride interests transportation engineers.

There are many papers regarding utilization of park & ride. KHALID¹⁾ showed that the provision of adequate parking spaces at park and ride facility is very important and crucial for the success of the facility in Kuala Lumpur. On the other hand, Jose²⁾ mentioned that travel time from origin to station should be considered in order to determine location of park & ride. Thus, according to many study of utilization of Park & Ride, travel time and provision are evaluated for estimating demand of park & ride. However, it is assumed that the surroundings situation around park & ride also affects utilization of park & ride in reality. Especially, presence of large commercial building cannot be ignored in sight of promotion of park & ride and Mass Rapid Transportation use. There is no paper regarding mutual influence between park & ride and large commercial building. Therefore, in this study, large commercial building is focused on in sight of utilization promotion of park & ride.

The objective of this study is to reveal influence on promotion of Park & Ride use by large commercial building.

2 STUDY AREA

At present the transportation between Bangkok and Thonburi does not have the main rapid transit and high way

system, Therefore, Thonburi area, especially Rattanakibet road has traffic congestion at rush hour. In order to solve traffic congestion in this area, Thai government planned to construct Purple line. this line which start to operate in 2016 is located in west side of Bangkok and has a total distance of 23 km as shown in bellow figure.

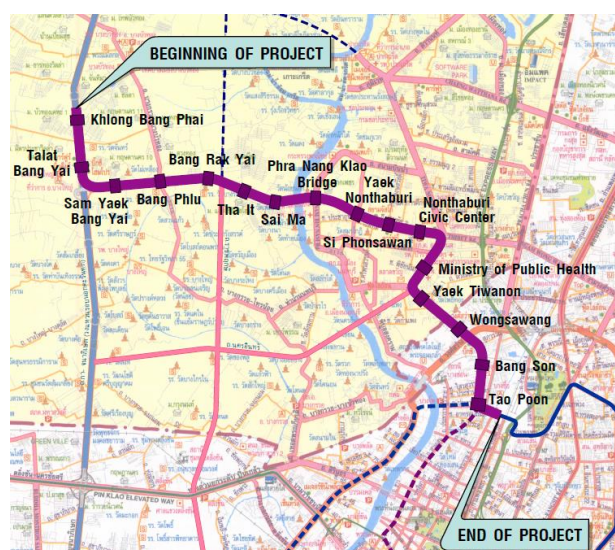


Fig 1 Study area at the Bangkok city

This line is also equipped with Park & Ride building at 4 locations. The capacity of park & ride at Kalong Bang Phai, Yark Yai, Tha It and Yark Nonthaburi 1 station are 1900, 1450, 1070 and 430 vehicle respectively. The parking fee for MRT passenger and non-MRT passenger is 15 and 80 Baht per 2 hours respectively. The monthly parking fee for is 1250 Baht per month.

The reason of choosing this line is that this line is equipped with Park & Ride building at 4 locations and large commercial building at 2 stations. Especially, Yaek Nonthaburi 1 station provides Park & Ride and is faced to large commercial building, Central Plaza Rattanakibet. After opening of Purple line, it is assumed that presence of the large commercial building influences promotion of Park & Ride use at Yaek Nonthaburi 1 station. Therefore, this station is suitable for evaluating mutual influence between Park & Ride and large commercial building as study area.

3. METHODOLOGIES

3.1. Questionnaire Survey

Questionnaire survey was conducted in west of Bangkok for 3 days from 17th to 19th in November 2014 for Thai. The questionnaire sheets were distributed at Central Plaza Rattana Thibet which is faced to Yark Nonthaburi 1 station in Purple line as shown in below figure.



Fig 2 Questionnaire area

The responders are required to answer the questions in a interview style in Thai. Thai students of Asian Institute of Technology(AIT), King Mongkut's University of Technology Thonburi and Chulalongkorn University helped with the interview. The questionnaire has two types. In one type, 4 questions about Park & Ride choice model were shown to respondents. On the other hand, in another type, 5 questions regarding it were presented. In total, 158 and 150 of people responded to the interview in questionnaire type A and B respectively. Then, 144 and 126 of samples were valid for analyzing respectively. Therefore, Valid Ratio of type A and B is 91.1 and 84% respectively.

Table 1 Outline of questionnaire survey

Target	Thai	
Method	Distributing by hand	
Type	Type A	Type B
Sample	158	150
Valid	144	126
Ratio	91.1%	84%

Type A : 4 questions in section 3

Type B : 5 questions in section 3

The questionnaire were classified into three sections, The first section asks totally 12 questions, the respondents' attribute and experience of using Park & Ride and large commercial building. The second section consists of

question about the recognition to transportation and large commercial building. In this section, respondents needed to choose appropriate answer. As for questions about perception, it is five-grade evaluation from "Strongly Disagree" to "Strongly Agree". The answers are analyzed by SEM (Structural Equation Modeling). there are totally 21 questions in this section. The third section is associated with the utilization choice of Park & Ride between suburbs of Bangkok and Center of Bangkok, expecting to analyze using disaggregate Binary logit model. Respondents are required choose either of using Park & Ride and MRT or not for various the stated preference situations on travel time, parking fee and presence of large commercial building.

3.2 Structural Equation Modeling (SEM)

Structural Equation Modeling (SEM) was applied to describe mutual influence between Park & Ride and large commercial building. SEM is one of the statistical methods to examine the relationship between cause and effect. In other words, SEM is a technique to identify the relationship between the latent variables that cannot be observed directly and the observed variables that can be measured by questionnaire survey and so on. SEM is widely used in engineering fields to examine the hypothesis associated with latent variables.

3.2.1 Hypothesis

In this study, it is assumed that presence of large commercial building influence promotion of park & ride utilization as hypothesis. Fig 3 shows model of park & ride. It is also assumed that the other factors such as satisfaction with MRT and quality of park & ride affect utilization of park and ride. Table 2 shows questions for SEM.

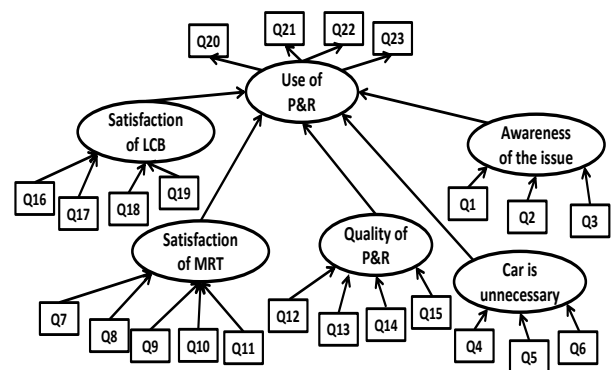


Fig 3 SEM of Park & Ride Utilization

Table 2 Variables in the model

LV	OV	Questions
AI	Q1	Traffic congestion is the serious problems in center of Bangkok.
	Q2	Using private cars pollute the environment.
	Q3	Using public transportation is good image.
CU	Q4	Private car is not a necessity in my life.
	Q5	Too much reliance on the private car is not a good thing to me.
	Q6	I want to use public transportation more than a private car.
SM	Q7	MRT fees is reasonable.
	Q8	Using MRT is good image.
	Q9	I am interested in using MRT.
	Q10	I feel satisfied with current MRT services.
	Q11	If MRT were more convenient, I would use MRT more.
FM	Q12	The installation of CCTV cameras needed for the Park and Ride.
	Q13	The distance between station and P&R should be near.
	Q14	Park & Ride requires the restroom.
	Q15	Park and Ride should provide parking roof for parking.
SL	Q16	The shopping mall has an advantage because you can buy everything you need.
	Q17	The Shopping mall has an advantage because there are many restaurants to serve you.
	Q18	The Shopping mall has an advantage because there are many fashion shops are available.
	Q19	The shopping mall has an advantage because you can buy fresh food for cooking by yourself.
UP	Q20	I want to use Park and Ride for commute in daily life.
	Q21	I want to use Park and Ride only when I am traveling on leisure activities.
	Q22	I want to recommend people close to me use Park and Ride.
	Q23	We should use the Park and Ride for positive impacts on the environment.
	Q24	I am interested to use Park and Ride.

LV : Latent Variables OV : Observed Variables

3.3 Park & Ride Choice model

The disaggregate binary logit model was applied to describe choice behavior model to use park & ride. It was assumed that there are two alternatives: using Park & Ride and not using park & ride. Using park & ride is specified by Eq.(1). The parking fee and travel time in MRT are used as explanatory variable. The 3 levels of parking fee is 25, 50 and 100 Baht. On the other hand, the 3 levels of travel time is 45, 60 and 90 minutes. Besides, presence of large shopping mall is used as dummy variable.

$$V = a_1 \times F + a_2 \times T + a_3 \times P + a_4 \quad (1)$$

where,

- V : utility function of Park & Ride
 F : Park & Ride fee
 T : travel time in MRT
 P : dummy variable of large commercial building
 a_1 : parameter of Park & Ride
 a_2 : parameter of travel time
 a_3 : parameter of dummy variable
 a_4 : constant of Park & ride

In this choice model, totally there are 9 questions. The questionnaire has two types. In one type, there are 4 questions regarding choice model. On the other hand, in another type, there are 5 questions about it. In Eq.(1), the question which shows park & ride with large commercial building was treated as $P = 1$, while the ones which shows park & ride without large commercial building was treated as $P = 0$.

4. Analytical Result

4.1 Questionnaire survey

Among the respondents, 56 percent are female. In terms of age, 46 percent are in range of 26-40 years old. Approximately, 70 percent of respondents own private car. Figure 4 shows means of main transportation for car holders and no car holders. 80 percent of car holders mainly use private car as means of transportation. On the other hand, 40 percent of no car holders mainly commute by Bus. Nearly one fifth of the respondents have used park & ride in MRT of Blue line. Figure 5 shows experience of Park & Ride at each station in blue line. 25 and 30 of respondents have used Park & Ride at Lat Phrao and Mo Chit station respectively. These park & ride is located outside of Bangkok. On the other hand, the others park & ride is in center of Bangkok. Therefore, it is assumed that the users at two stations used it in order to prevent traffic congestion in center of Bangkok.

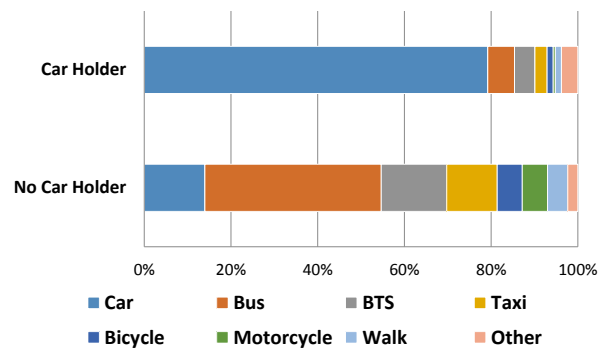


Fig 4 Means of main transportation

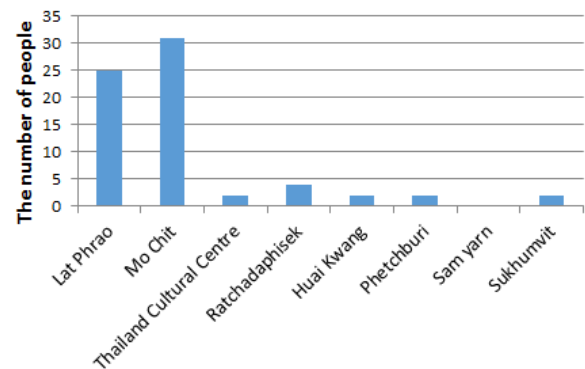


Fig 5 Experience of Park & Ride at each station

4.2. Analyses of Binary Logit model

In order to assess the effect of large commercial building in the modal choice, the Binary logit analysis was conducted for all respondents using the utility functions of Eq.(1). The regression coefficients were identified by free software R (Ver. 2.14.1). The dummy variables of large commercial building depend on whether or not the Park & Ride is faced to large commercial building.

4.2.1 Case of All Respondents

Table 2 shows the regression coefficients of the utility functions for all of respondents. The coefficients of parking fee, travel time, Park & Ride seem to be reasonable because the sign and t-value are large enough. On the other hand, coefficient of large commercial building dummy variable is not reasonable because that of t-value is less than 2.00. Therefore, this model is not acceptable.

Table 3 Regression coefficients for all respondents

	a1	a2	a3	a4
	parking fee	travel time	dummy variable of LCB	coefficient of P&R
parameter	-0.030	-0.045	0.241	4.041
t- value	-13.33	-8.18	1.78	10.70
sample	270			
likelihood ratio	0.161			
modified likelihood ratio	0.156			

4.2.2 Case of car holders

Targets was limited from all respondents to car holders. Table 3 shows the regression coefficients of the utility functions for car holders. All of parameters indicate reasonable signs and t-values of those parameters are large enough which means that they are significant. Besides, the likelihood ratio are large enough. Therefore, this model is considered to be statistically valid.

Table 4 Regression coefficients for car holders

	a1	a2	a3	a4
	Parking fee	Travel time	Dummy variable of LCB	Coefficient of P&R
Parameter	-0.031	-0.038	0.379	3.904
T- value	-12.16	-5.93	2.36	8.75
Sample	201			
Likelihood ratio	0.171			
Modified likelihood ratio	0.164			

Substituting the regression coefficients in Table 4 into the utility functions of Eq. (1), we can estimate the share of Park & Ride choice using the Binary logit model. Figure 6

shows share of Park & Ride choice with large commercial building and without it. Its horizontal axis represents park & ride fee. Travel time on MRT was set up 60 minutes in the figure.

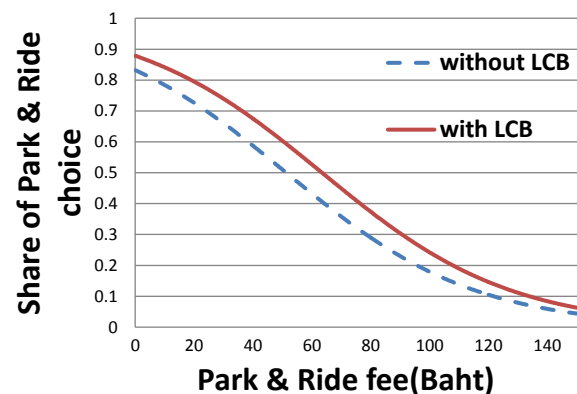


Fig 6 Share of Park & Ride with LCB or not

The share of Park & Ride choice is 0.60 with large commercial building while 0.51 without it as park & Ride fee is considered 50 Baht. The difference is enough large. It suggests that presence of Park & Ride influence the utilization of park & ride for Car holders.

5. CONCLUSION

In this study, presence of large commercial building influenced promotion of park & ride utilization for car holders by binary logit model. Moreover, it is shown that utilization of park & ride is affected by various factors such as Satisfaction with MRT and large commercial building.

6. REFERENCES

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