Prediction of Traveling Behavior in Putrajaya, Malaysia

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Abstract: Putrajaya as a new federal administrative of Malaysia has led to a further increase in private car ownership and much higher land prices in the city centre. With jobs concentrated in the city centre, the commuting patterns of the trip makers tend to be that of morning/evening peak hours and this has led to congestion on some of the major highways leading into and out of the city. One possible way to reduce the use of cars is to replace commuter trips by car with other modes of transport, such as a combination of car and public transport called Park & Ride (P&R). The preliminary observation and survey has been carried out among of private car users in Putrajaya. The observations of P&R users show that only two percents parking lots were occupied from 320 parking lots were provided. A random of 50 respondents were interviewed. The findings were discussed about the reason why the car users are refused to use P&R facilities. Analyses about relation between factors such as bus frequency and parking fees at worksite have been made to answer research questions. Logistic regression has been used to analyse the factors that influence users to switch their trips mode to shift to P&R.

Key words: Congestion, park and ride, private car, putrajaya

INTRODUCTION

Putrajaya as a new federal administrative of Malaysia has led to a further increase in private car ownership and much higher land prices in the city centre. Combined with improvements in transport infrastructure connecting the suburbs and Putrajaya and relatively cheaper housing in the outskirts of Putrajaya, there exists a mismatch between residential and employment concentration. With jobs concentrated in the city centre, the commuting patterns of the trip makers tend to be that of morning/evening peak hours and this has led to congestion on some of the major highways leading into and out of the city.

One proposed solution related with traffic problems could be to replace long car trips with a combination of car and public transport, consisting of one short car trip and one longer trip by public transport (hereinafter called P&R). P&R could be an alternative for those having errands on the way or where the local bus is not frequent enough. P&R could be either used in less densely populated areas, where public transport is not profitable because of the lower demand, or it could be located closer to the city centre on the main routes where congestion starts. In the same time, the government tried to reducing the number of accident involved by private cars with introducing P&R scheme for car users.

P&R have been applied in many countries and cities as a means of transportation demand management and have achieved some results. P&R main purpose is to encourage the transfer of transportation mode, and to attract travelers shift from car users to bus passengers by providing good service.

Looked on objectively P&R seams to be a good alternative to the car however very few commuters use P&R. Then the question arises: how can frequently private car users are transferred to P&R?

Whether the P&R mode is chosen or not depends on many factors, such as the supply of public transport, the quality of the parking lot and parking conditions (Turnbull, 1995). Other factors influencing the choice are time and cost savings compared with driving a car for the whole trip. This supported by previous finding by Bos et al. (2004), the willingness of car drivers to use P&R increases if the travel time when using P&R is low. To offering low travel time by P&R, the introducing exclusive bus lane to the city and enabling efficient transfer at the P&R facility could produce this low travel time. Meanwhile, Hamid et al. (2008) concluded, there need to be cost savings as well as time savings in the use of the P&R scheme compared to other alternative mode of transportation.

Besides, Whitfield and Cooper (1998) stressed that in their finding, to maximize attractiveness, services should
be as efficient as using a private car (including interchange times), hence the need to consider service frequency and bus priority measures. Also a study in the UK found that 81% of potential bus users thought that a ‘turn up and go’ level of frequency (defined to be at least once every 10 min) was necessary to attract them to use the service (TAS, 2001). The objective of this study is to identify the factors affecting travelers’ choice of the P&R use. Two alternatives were considered, implementing the parking charges at work-site parking and increasing bus frequency departs from P&R station. In this study, a binary logit model structure was proposed and the use of the model was explained using a case study.

**Background of Study:** Putrajaya, which is situated 25 km south of the capital city of Malaysia (Kuala Lumpur), occupies a total area of 4,932 ha and is divided into 20 precincts. When fully developed in 2012, Putrajaya is expected to have a night-time population of 330,000 and provide 254,000 job opportunities (Putrajaya Corporation, 2011). The Putrajaya P&R station is located 5 km from the city of Putrajaya and is managed by Putrajaya Corporation (Parking Division). Located in the north east of the city and the station had its first commercial operation in September 2006. The station was providing 320 parking lots and the bus services served by Nadi Putra with a flat fare of 0.50 MYR (0.15 USD) per trip with interval time every 30 min. The rate for the use of its P&R facilities is free of charge. The duration of this service from 7.00 am to 7.00 pm for every day.

**The popularity of car:** The private car use is the second major mode of personal transport in Malaysia, because it is relatively affordable and reliable compared to other transport modes. As such, about 40% of the registered vehicles in this country are private cars. In addition, for the last decade or so, the number of registered private cars increased from 6.5 million in 2005 to 8.5 million in 2009 (Road Transport Department, 2011). The number of registered vehicles in Malaysia has shown in Fig. 1. With the society becoming more affluent and with the sales of locally-manufactured cars being at relatively affordable prices, the nation recorded a high increase in the ownership of private vehicles.

There are many reasons why people use car as a primary transport to make a travel. For example, it is a convenient and comfortable way to travel. Other than this, the driver and passengers can travel with their privacy, undisturbed and feel secure. Furthermore, car will make more easy door-to-door travel and car journey saves time. In addition, car also has cultural and symbolic values. Other reason make car is so popular and dominance in passengers transport is that the quality of car travel has considerably increased relative to public transport (Cameron et al., 2004).

**Public transport in Putrajaya:** In the local situation, although public transport development has always been characterized by the government's efforts to adapt to the needs of national development, the essence of public transportation development, as in other developing countries, has always needed to be improved to provide better services. However, the extent of the development for the improvement of public transportation is always questionable. Nor et al. (2006) were reported, the current modal in Putrajaya was dominated by private cars. The current modal split between public and private transport has shown in Fig. 2. There are currently 70 buses servicing the city, 15 of which are fitted with special lifters for disabled people. The Nadi Putra buses are running empty most of the time although they provide the connection between the major residential areas and the city centre.

**METHODOLOGY**

There were two methods used for data collection in this study. The first method is observational on P&R usage among car users in daily activity especially for working activity. The observation activity was carried out at Putrajaya P&R station at precinct one. A week of survey was carried out within 7.00 am until 3.00 pm. The second method, face-to-face approach was employed to each car driver and asked them to fill-up a self-administrated questionnaires form. Face-to-face interviews were used to complete the questionnaire for
The logistic regression was used to determine the odds that an event will or will not occur. In the present research (shift to P&R occurrence) was framed as a binary variable. That is, “1” was scored if a shift had occurred and “0” if no shift had occurred. The dependent variable is a logit, which is the natural log of the odds, that is:

\[
\log(\text{odds}) = \log \text{it}(P) = \ln \left( \frac{P}{1-P} \right) \quad (1)
\]

So a logit is a log of odds and odds are a function of \( P \), the probability of a 1. In logistic regression, was find:

\[
\logit(P) = \alpha + \beta X
\]

where,

\( P \): probability
\( \alpha \): constant
\( \beta \): coefficient of \( X \),

Then, convert the odds to a simple probability:

\[
\ln \left( \frac{P}{1-P} \right) = \alpha + \beta X \quad (3)
\]

\[
\frac{P}{1-P} = e^{\alpha + \beta X} \quad (4)
\]

\[
P = \frac{e^{\alpha + \beta X}}{1 - e^{\alpha + \beta X}} \quad (5)
\]

\[
P = \frac{1}{1 + e^{-(\alpha + \beta X)}} \quad (6)
\]

**RESULTS AND DISCUSSION**

The preliminary observations at Putrajaya P&R station show that only two percent parking lots are occupied and 98% of the parking lots at P&R station are not used from 320 parking lots were provided. Figure 3 represent the numbers of peoples were used P&R facilities in one week during observation. The maximum number of user on Wednesday with five peoples were used this facilities. It shows less than ten people were used this facility per day. This is because, a lot of parking space was providing at government offices area and the parking is free of charge. Nor et al. (2006) were reported, the main contributing to the domination of private transport as the preferred mode of travel in Putrajaya include the provision of a high quality road network with generous road space, the availability of ample parking spaces provided free of charge, and the generally modest cost of owning and operating private vehicles. In addition, poor public transport services further encourage the use of private vehicles.

Table 1 shows the frequency of the buses at P&R station was served by Nadi Putra. From the table below, the frequency of the buses between peak hour and after peak hour are same. The frequency for the buses between weekdays and weekend is same. The average interval time for almost all route are same within 30 min except for route 100 with the interval time during peak hour is 15 min and after peak hour is 20 min.

From 50 respondents were observed, only one respondent is P&R user and the rest were used private car to go their work place. Seventy-six percents of respondents age less than 40 and more than half (74%) of respondents are male. Meanwhile, more than 90% of respondents have completed their education with tertiary level (skill certification, diploma or degree level) and more than two-third of them (64%) work as semi...
The respondents were asked about the parking charges at worksite parking, all the respondent answering no parking charges were implemented. In this moment, no parking charges were imposed to the car users in Putrajaya CBD area. It found that, providing free of charge parking at worksite actually subsidizes car use in CBD area. The respondents were asked if a parking charge will implemented would shift them to use P&R. Parking fees of 1 MYR will be adequate to shift 75% from respondents to using P&R mode, while 99% the respondents will prefer to use P&R if the parking charge being 5 MYR (Fig. 5).

Table 2 shows the result for different parking cost and the probability of prediction p-values. Prediction (P) values for modeling results are derived from Eq. (6) which involves constant and coefficient values to verify the logistic prediction model for this study. By using the constant (α) and the coefficient (β) values, the model achieved the significant value (p) equal to 0.055 which is acceptable to be significant (p<0.10) as shown in Eq. (7). Thus, the result of logistic function has shown in Table 2 and Fig. 6. Therefore, with introduce parking charge will make car user pay more and will increasing their travel cost. According to Seik (1997), the parking charges in the CBD area has been substantial enough for car users to switch P&R. Seik (1997) also concluded that, 76% of the users cite cost saving as a main reason to switch P&R.

![Fig. 4: The average monthly income of the respondents](image1)

![Fig. 5: P&R switching percentages with increase in parking cost](image2)

![Fig. 6: P&R switching probability between survey and modeling result](image3)

![Fig. 7: P&R switching percentages with increase in bus frequency](image4)

<table>
<thead>
<tr>
<th>Parking charge</th>
<th>Survey Result (P)</th>
<th>Modeling Result (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MYR</td>
<td>0.74</td>
<td>0.748485904</td>
</tr>
<tr>
<td>2 MYR</td>
<td>0.88</td>
<td>0.865117319</td>
</tr>
<tr>
<td>3 MYR</td>
<td>0.96</td>
<td>0.932539306</td>
</tr>
<tr>
<td>4 MYR</td>
<td>0.98</td>
<td>0.967525060</td>
</tr>
<tr>
<td>5 MYR</td>
<td>1</td>
<td>0.984665231</td>
</tr>
</tbody>
</table>

\[
P = \frac{1}{1 + e^{-0.3226+0.7679 \text{Park Cost}}} \tag{7}
\]

Most of the people like the car because they can feel freely to do whatever they want. They can transfer from place to other place in safety way and it will takes a few times to transport without waste their time to waiting the bus/train to make a travel. In this study, the respondents were asked what the acceptable bus frequency was 15 min. If the bus frequency every 15 min, 75% of the respondent will switch to P&R. On the other hand, less people will switch to P&R if the bus frequency increases to every 30 min.

Table 3 shows the probability of prediction (P) for bus frequency departs from P&R station.
values for modeling results are derived from Eq. (6) which involves constant and coefficient values to verify the logistic prediction model in this study. By using the constant ($\alpha$) and the coefficient ($\beta$) values, the model achieved the significant value $p = 0.023$ which is acceptable to be significant ($p<0.05$) as shown in Eq. (8). Thus, the result of the prediction models has shown in Table 3 and Fig. 8. As a result, the longer waiting time for the buses is the one of the major factor why people refused to use P&R facilities. This reason was supported by Ying and Xiang (2009) on their study. According to the survey, Ying and Xiang (2009) concluded the travelers who will take P&R are willing to accept the bus frequency departs from P&R station within 10 min. Meanwhile, Lam et al. (2001) were reported the non-park-and-ride users stated that their primary reason for not using the facility is that they cannot save time. Reasonable arrangements for bus departure and reduce the waiting time of passengers can promote P&R.

$$P = \frac{1}{1 + e^{-(2.8567+0.2106\text{BusFreq})}} \quad (8)$$

CONCLUSION

In this paper, effectiveness of P&R facilities at Putrajaya area was studied. To switching private car users to P&R will be relative low unless if we can make park-on-site less attractive to cars users and less waiting time at P&R station or increasing bus frequency. Generally, the buses were served in Putrajaya P&R station has poor service frequency with an average of two per hour, even during the peak periods. It is concluded that the parking fee shall be an important factor in contributing to the success of P&R use. Increasing parking charges would cause a decrease in term of private cars travel into the CBD area. It is noticeable that a free parking provided at worksite one of the factor why P&R is unpopular among an employees in Putrajaya. This study also reveals that, the longer waiting time for the buses is the one of the major factor why people refused to use P&R facilities. Increasing the bus frequency from 30 min to 15-10 min will directly affect the use of the P&R facility.

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REFERENCES


