Parking Utilization Analysis of Rail-based Park and Ride Facility Users

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Abstract:
The strategy towards encouraging the wider use of the public transport system needs to be relatively effective and accepted by the public at large. This study focused on a car park utilization which was undertaken in 2007 with the main objective of analyzing the utilization pattern of a fringe park and ride station in the Kuala Lumpur conurbation. A continuous 18-hour survey was carried out from 0530 to 2330 where the number plate, access and egress time of all vehicles were recorded. The findings revealed that there existed a relatively active accumulation pattern of the vehicles as well as a high percentage of long term parkers (beyond 8 hours). The survey further revealed a high occupancy rate of the facility among the users of the rail station. This warrants a higher provision of the facility and that the potential of the park and ride scheme is positive in the conurbation.

Keywords: Park-and-ride, utilization, duration

1. INTRODUCTION

The Kuala Lumpur Conurbation (KLC) is one large urban entity that centres on the Kuala Lumpur city centre hosting a complete range of urban functions. The geographic boundaries of the KLC are the districts of Gombak, Petaling, Klang, Kuala Langat, Sepang and the Hulu Langat while the Federal Territory of Kuala Lumpur occupies the centre of the conurbation (see Figure 1). Much of the economic activity within the KLC is taking place within the Klang Valley Region and is made up largely of contiguous urban residential development and supporting urban services. The fast development of KLC can be seen through its population growth which has risen from 3.37 million in 1991 to 4.21 million in the year 2000, representing 18.1% of the total population of Malaysia (Kuala Lumpur City Hall, 2005). The population is expected to rise to 7 million by the year 2020. The KLC covers a total area of about 4,000 square kilometres which is 40% larger than the size of the Klang Valley region of 2,843 square kilometres (Kuala Lumpur City Hall, 2005).
Figure 1 The geographic region of the study area of Kuala Lumpur Conurbation and the KTM Komuter rail route

Figure 2 Shah Alam KTM Komuter Park and Ride Station
With reference to infrastructural development, a major part of the national gateways and transportation nodes lie within this conurbation namely the Kuala Lumpur International Airport (KLIA), the nation’s biggest and busiest port namely Port Klang as well as the KL Sentral Station (KLSS). The KLSS acts as the national multimodal transportation hub that links the major transportation nodes of the country namely the KTM Komuter Sentul-Port Klang and the Rawang-Seremban rail commuter sectors, its intercity rail services, the urban light rail public transport system as well as the KL monorail system. The KLC is the most industrialised and economically the fastest growing conurbation in the country. Its economic significance lies in its contribution of 47.0% to the GDP in the year 2000, which makes it the biggest contributor to the nation’s GDP compared to other regions. Like many major urban areas of the developing countries, the city of Kuala Lumpur in particular, also experiences the process of urbanization. There experienced a relatively high availability of job opportunities of 59% in the city (46.9% in 1980) compared to 41% in the remainder of the KLC and 40% for the country as a whole for the year 2000. As can be seen, the employment to population ratio of 41% for Kuala Lumpur and its conurbation is slightly higher than the national ratio of 40% while lower than that of the city of Kuala Lumpur. The tertiary sector recorded a high rate of 70.8% of its population works (Kuala Lumpur City Hall, 2005).

With house prices and rental charges trending upward throughout the Kuala Lumpur Federal Territory, the city experienced a movement of people to the suburbs and the nearby outlying towns, who are faced with the undesirable option of commuting daily for work into the city. These suburbs and the nearby towns include that of, among others, the small-sized city of Shah Alam which is located 30km south-east of the city of Kuala Lumpur. The negative development of the city real estate sector had been one of the push factors for the out-migration of the residents while the relative availability of affordable houses has indeed been one of the pull factors of these suburban areas. While it is a challenge for the Kuala Lumpur City Hall to provide reasonable and affordable housing needs for the urbanites, such challenge is however lesser for its neighbouring Selangor, which has a population density of 664 persons per square kilometre. It was reported that the median price of a house in Kuala Lumpur stood at RM304,741 at the end of 2004 – almost twice the national average of RM156,808 (Ying, 2005).

### Table 1  KTM Komuter Ridership and Revenue

<table>
<thead>
<tr>
<th>Year</th>
<th>Ridership (mil.)</th>
<th>% increase</th>
<th>Revenue (RM mil.)</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995(from Aug.)</td>
<td>2.8</td>
<td>-</td>
<td>5.0</td>
<td>-</td>
</tr>
<tr>
<td>1996</td>
<td>11.1</td>
<td>+ 8.3</td>
<td>23.7</td>
<td>+18.7</td>
</tr>
<tr>
<td>1997</td>
<td>16.5</td>
<td>+ 5.4</td>
<td>37.6</td>
<td>+13.9</td>
</tr>
<tr>
<td>1998</td>
<td>20.8</td>
<td>+ 4.3</td>
<td>41.6</td>
<td>+ 4.0</td>
</tr>
<tr>
<td>1999</td>
<td>16.5</td>
<td>- 4.3</td>
<td>38.0</td>
<td>- 3.6</td>
</tr>
<tr>
<td>2000</td>
<td>19.4</td>
<td>+ 2.9</td>
<td>39.2</td>
<td>+ 1.2</td>
</tr>
<tr>
<td>2001</td>
<td>20.9</td>
<td>+ 1.5</td>
<td>45.8</td>
<td>+ 6.6</td>
</tr>
<tr>
<td>2002</td>
<td>22.5</td>
<td>+ 1.6</td>
<td>50.3</td>
<td>+ 4.5</td>
</tr>
<tr>
<td>2003</td>
<td>24.6</td>
<td>+ 2.1</td>
<td>59.1</td>
<td>+ 8.8</td>
</tr>
<tr>
<td>2004</td>
<td>27.4</td>
<td>+ 2.8</td>
<td>66.1</td>
<td>+ 7.0</td>
</tr>
<tr>
<td>2005</td>
<td>30.9</td>
<td>+ 3.5</td>
<td>73.8</td>
<td>+ 7.7</td>
</tr>
</tbody>
</table>

Source: Jamilah & Amin, 2007
The spatial mismatch of the employment city centre and the residential areas of the suburbs thus gave rise to the need for a well linked transport system that can provide affordable quality accessibility for the suburban residents to the city centre. This transportation needs includes the double tracking electrification system of the commuter rail and its park and ride facilities operated by KTM Komuter Sdn. Bhd. The basic concept of the park and ride scheme is that it should be able to reduce the number of presence of the private vehicles in the city centre with the shift of the travel pattern from driving into the city with private vehicles to instead using the rail as the main haul to the final destination. Table 1 illustrates the growth in the demand of the commuter services which sees a continuous increase in its demand.

Apart from the lack of affordable houses, the city residents are also plagued with issues relating to transportation problems. Problems relating to the increase in traffic congestion are indeed an issue that arise as a result of rapid motorization in Kuala Lumpur city (Jamilah & Amin, 2007). These issues further give rise to the need to study the extent of the demand and provision of the transport facilities and infrastructure of the suburban areas. Such example of facilities and infrastructure that are of importance towards fulfilling the transportation needs of the suburban residents is the park and ride facilities including that of the Shah Alam park and ride station (Figure 2).

2. SURVEY OBJECTIVES

With the increase in the patronage of the commuter services, there is indeed a need to gauge an insight into the extent of the provision as well as the demand of the park and ride facilities. The output of the analysis would be able to assist the planners and the rail operator in determining the need increase to increase the provision of the facilities and thereby further encouraging the use of the public transport system. This survey accordingly seeks to achieve the following objectives:

i. to determine the accumulation pattern of the park and ride facility of the Shah Alam station
ii. to determine the duration pattern of the parkers of the station in terms of short term parkers (less than 5 hours) and long term parkers (more than 8 hours)
iii. to evaluate the overall occupancy rate of each of the park and ride facility
iv. to provide a general conclusion on the parking utilization pattern of the parkers of the park and ride facility of a small sized city station.

3. STATION BACKGROUND

This research was carried out with the purpose of generating a pattern in terms of the daily workday parking demand of the users of the rail-based park and ride facility of the Shah Alam commuter station that is spatially located outside or the fringe of the city. The Shah Alam station is one of the biggest station (in terms of capacity) on the Sentul-Port Klang sector. Location wise, its surrounding area is dominated by residential areas and partly by light industrial areas. Facilities wise, Shah Alam station nevertheless lacks even the basic security amenity much needed by most of its parkers namely fence. This has led to reported cases of vandalism and even theft on vehicles that are left parked over a relatively long period. It has been reported that the incidents normally took place after midnight, targeting vehicles that are parked overnight. Apart from fencing, the station also lacks other forms of convenience and comfort such as fans.
Operationally, its park and ride facility is rather relatively conventional. It lacks the basic technology of allowing the entry of vehicles by automatic gate / barrier. Rather, the issuance of parking ticket is done manually by two parking attendants who would issue the ticket upon the arrival and consequently the parking of the vehicle by the parkers. The parking attendant's duty is from 6.00 am to 6.00 pm only. Before and beyond this time, any parkers would have the privilege of parking their vehicle free of charge. With the station designed like a 'T-shape' manner, the parking attendants would stand at the centre point of the station and would have to actually observe left and right side of the stations whether a particular vehicle that arrives at the station, would park his vehicle or merely a pick-up and drop-off (PDO) vehicle. The attendants would have to pay particular attention to the entry of vehicles on both sides of the station. Upon parking their vehicles and upon arrival at the entrance of the station platform, the attendants would manually write out the receipt and issue it to the parker, in return for a parking fee of RM2/entry. Devoid of covered parking and shelter, this manual process of ticket issuance and collection by the parking attendants however proves too much particularly during rainy days when it is observed that they found difficulty in differentiating between parkers and non-parkers. This thus affects the day's parking collection. The situation is even particularly worse when, at times, only one parking attendant is on duty. KTMB has installed the automatic gate/barrier prior to the opening of the station. However, the presence of a high electricity supply cable/structure only less than 50 metre from the installed gate was found to have a relatively dangerous effect on the use of the gate since there have been possible cases of short-circuit through the power supply cable. This led to the withdrawal of the use of the automatic gate by KTMB. In spite of the above shortcomings that the station users have to face, its relatively high utilization on weekday however warrants future expansion to accommodate the expected increase in the demand for the use of the facilities. Being the nearest station to the city centre, its average terminal-to-terminal travel time is 45 minutes.

4. METHODOLOGY

4.1 Survey Design

This car-park utilization survey was able to provide some information on the extent of the demand and supply of the park and ride facility. For the purpose of this study, supply here refers to the sum (capacity) of all the parking with the exception of spill over while demand is equal to the sum of all parking including the spill over. The case of spill over here relates to both the on-site spill over as well as the off-site spill over. It is indeed important to gauge the demand and supply of the park and ride facility because from these surveys, apart from being able to understand better the travel behaviour of the park and ride users, planning for future parking needs can also be implemented. The output shall be able to assist present and future planners to have a better understanding of not just the user behaviour of the park and ride facility itself but also on the supply provision side. This would lead towards a more feasible, economical and viable infrastructure investment thereby minimising economic, financial and also environmental wastage.

Terminology wise, the term demand here relates to the propensity of people to make trips. However, in the context of park and ride facility here, demand refers to the estimated number of vehicles that will require parking spaces at staging areas to transfer trip makers to higher occupancy modes, in this case, to rail (Drake, 1994). The parking demand here is analysed by means of its parking utilization indices namely accumulation, duration and rate of occupancy of the facility itself. Accumulation relates to the number of vehicles parked at a given time
(Papacostas & Prevedouros, 2001) while duration explains the total hours of the vehicles being parked at the facility and is divided into short-term parking, mid-term parking and long-term parking (ibid; Bolger et al., 1992). Short term parking here is defined as those parking duration of less than 5 hours while long-term parking refers to those exceeding 8 hours. Occupancy however refers to the number of spaces occupied divided by the total spaces available and is calculated on an overall basis in percentage form (Papacostas & Prevedouros, 2001).

4.2 Survey method

Similar to other trip generation study, parking studies like this car-park utilization study, gave focus to peak-hour traffic since it is perhaps the single most important quantity to be derived from. From a traffic capacity standpoint, this value is indeed important since it can give an indication whether the existing infrastructure are functionally obsolete (Henry et al., 1999). Like any other parking utilization surveys, time period use for the data collection was therefore of utmost importance (METRO, 1992). In line with other parking surveys, this survey was a continuous 18-hour observation from 0530 morning to 2330 in the evening.

Research of commuter passenger rail facilities have indicated that peak periods normally occur in the morning (am period) and late afternoon (pm period) of a working day. This actually corresponds with the commuters making trip to work, generally between the hours of 6 am to 8am. For the late afternoon peak, corresponding to commuters returning from work, the peak hours generally occur between 5pm to 7pm.

Taking that into account, traffic counts were taken on one working day in April 2007 at the Shah Alam station. The factor of capacity is also taken into account so that there is an even mixture of ‘ample and ‘tight’ parking situations relative to other stations. Initial pilot survey also indicated the need to provide extra spaces at this station due to its relatively high demand.

4.3 Data capture considerations

The traffic flow patterns around the station were to be surveyed first in order to gauge the possible flow pattern of the potential traffic/vehicles access to the stations and egress from the stations. The second step was to determine the vantage points from where the traffic counts could be taken. The selected vantage points were able to provide relatively sufficient views of the approaches to and the egress from the station, including the station parking garage. To make counts at both places simultaneously, an assistant was therefore necessary to perform the traffic counts. The recording was done on a formatted sheet of paper that had three main columns namely the number plate of the vehicles, the access time and the egress time. Additional information relating to the traffic pattern of the pick-up and drop-off passengers (as part of the park and ride inventory and referred to the PDOs), was also recorded simultaneously. It was recorded using slash symbol under the column labelled as PDO, together with the car plate number as well as the access and egress time.

4.4 Assumptions

For the purpose of a more practical approach data collection manner, several assumptions were made when conducting the car-park utilization survey. They were:
i  this traffic count in the survey only considered vehicular trips (i.e. trips made by private vehicles)

ii  vehicles parked at the station were for the purposes associated with using or supporting the station as a public transport facility. There were however small eating shops in the station (newsstand as well). Based on observations, the total number was a relatively small percentage of the total occupied capacity. They were however included in the counting as they were considered occupiers (parkers) of the available parking spaces of the station.

iii  based on observations also, there would be a relatively very small percentage of parkers that use the parking spaces for the purpose of car-pooling. They were however included in the counting as they were considered occupiers (parkers) of the available parking spaces of the station.

iv  the observers were capable of counting and recording all vehicles plate number and do not miss any vehicular movement that access to and egress from the stations.

5. ANALYSIS

Figure 3 illustrates the extent of the use of the Shah Alam park and ride facility on a typical weekday. From 5.30am to 2.30pm, the number of incoming vehicles exceeded the number of out-vehicles. This is expected since this period coincided with the morning rush hour. The 5.30am to 6.30am hour saw the most number of incoming vehicles (total 113) but significant vehicle accumulation only began from 6.30am onwards. This batch of parkers was highly likely employed in the private (or non-government) sector where offices began operation from nine in the morning. Majority of the parkers parked their vehicles during the 6.30 – 7.30 am stretch (total 38) and began to reduce significantly from the 1030 hour. With the morning rush

Figure 3
Hourly Traffic Flow of Vehicles at Shah Alam Park and Ride Facility (weekday)
hour, there seem to be a symmetric pattern with the evening rush hour whereby the out-vehicles dominated the in-vehicles from 2.30 pm onwards (Figure 4). Parkers began to leave the station with the most departure at the 5.30-6.30 pm stretch (152 vehicles).
Figure 5 clearly indicates that there existed relatively high pick-up and drop-off (referred as PDOs hereafter) (or kiss and ride) from the 3.30 – 8.30 pm stretch, again reflecting the evening rush hour of those from work-related trips. Cumulative accumulation of vehicles saw the highest by mid-day with 108 vehicles. With a capacity of 142 spaces, this clearly indicates that there existed no cases of over-utilization of parking spaces. Overall, there existed relatively low vehicle accumulation from mid-day (displayed by the close cumulative in-vehicle and cumulative out-vehicle lines) and alsoa very active PDOs scenario. In terms of the traffic flow pattern of the study areas, Shah Alam station saw its highest weekday accumulation at 11.30 am only. The station show symmetrical morning and evening peak hour parallel to that of compulsory trip maker pattern. The Shah Alam station clearly had a relatively high PDO traffic.

In terms of duration pattern, 55.6% of the park and ride users of Shah Alam station were long term parkers with a minimum parking duration of 8 hours. A total of 22.2% of the total parkers were equally short term (minimum of 5 hours) and mid term parkers (5 to 8 hours duration) (see Figure 6).

In terms of occupancy rate, the station showed a relatively good high occupancy rate exceeding 50 percent, with a rate of 95.1 percent. Even though the station recorded more than 50 % occupancy rate, it however exceeded the ideal occupancy rate of 85% to 95 percent (Papacostas & Prevedouros, 2001). This is because when the utilization of the capacity exceeds 95%, it becomes very difficult to find an empty parking space and thus may deter potential parkers to use the facility.
In terms of the overall parking duration pattern of the study areas, more than 80% of total parkers of Shah Alam parked more than 12 hours. Combining the occupancy rate with that of the duration of the station, it is clear that majority of the parkers are genuine long term parkers with occupancy rate exceeding 80% makes the park and ride facilities worthy of investment by its operator.

6. DISCUSSIONS AND IMPLICATIONS

In terms of its weekday accumulation pattern and its hourly traffic flow, the weekday pattern for the Shah Alam station displayed a symmetrical pattern typical to that of a morning and evening peak hour. This is expected since it is expected that more than half of the total respondents for the station were on work trip.

The station displayed a typical weekday duration pattern whereby majority (55.6%) of their park and ride users were long term parkers (8 hours or more). This finding is consistent with that of Niblett and Palmer (1993) as well as that of Pickett and Perrett (1986). In the case of Niblett and Palmer (1993), 92% of the British Rail Network South East (NSE) parked their cars for at least 12 hours while in the case of Pickett and Perrett (1986), 60% of the park and ride users of the Tyne and Metro stations parked for over 4 hours (defined as long term parkers). The findings perhaps indicate that majority of the users were employed in the private sector due to the relatively long parking duration. While it is common practice among most government employees to have an end to the day’s work at between 4.30pm -5.00pm, the private sector employees mostly work overtime, way beyond the normal 5.00pm time. The aspects of security and safety may still however need to be observed at the station. Thus, it is therefore understandable if most Shah Alam users were rather reluctant in leaving their private vehicles for relatively longer hours than necessary at the open, unfenced, unguarded station. Personal observations of cases of vandalism and reported cases of theft may have probably further enhanced their reservations towards leaving their vehicles for longer periods at the station.

Shah Alam terminal station experienced a relatively high of occupancy rate (95.1%). In terms of the function of a terminal station in encouraging the use of public transport, this finding is consistent with that of the findings of the Niblett & Palmer (1993) and Rathborne (2003) whereby it noted that in order to encourage the use of public transport, suburban park and ride lots should be built at stations that are at least 30km from the city centre. As far as the occupancy rates are concerned, the above findings seem relatively higher than that of the findings of Niblett and Palmer (1993) whereby the occupancy rate of the NSE rail station car parks from 1986 to 1990 were between 79 percent and 88 percent. A slightly higher occupancy rate was however seen in the work of Bolger (1992) whereby its nine park and ride stations in Calgary, Canada recorded a level of between 80 percent and 100 percent while the stations at West Midlands recorded an average occupancy rate of 80% (Smith, 1993). Taking the 85% - 95% (instead of 100%) of the available parking capacity as the ideal occupancy rate (Papacostas & Prevedouros, 2001) for the park and ride lot as well as the duration of parking (majority being long term parkers), the above findings certainly point towards an expanding market for its future use. The high demand for its use can perhaps be linked to the reasons for the use of the facility.
7. CONCLUSION

The utilization patterns of the rail-based park and ride station of a small-sized city of Shah Alam in terms of accumulation, duration and occupancy rate certainly indicates that there are good potential towards increasing the use of the park and ride facility. This indeed warrants an increase in the provision of the station parking facility. The rapid development in its surrounding region together with the fast urban sprawl of the Kuala Lumpur conurbation requires planners as well as the rail operator itself to seriously consider the future plans of the park and ride scheme of the area. The increase in the use of the facility will definitely, in the long term, assist in achieving the nation’s goal towards encouraging the wider use of the public transport system. This will in turn ultimately allow the realisation of the nation’s desire towards a more sustainable form of transport system.

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