Analysing the Attractiveness of Park and Ride Facilities that Influences Travel Behaviour and Mode Shift

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ABSTRACT

Traffic congestion and pollution are problems in major urban areas due to the increased use of vehicles on the road. Reducing the number of private vehicles on the road requires a multifaceted approach, including providing efficient, reliable, and accessible public transport. Park and Ride (P&R) facilities support this approach by encouraging the public to use public transport by providing convenient parking facilities near transit hubs or major transportation routes. This paper aims to identify the determinants that influence the use of P&R facilities in considering various factors, including safety and security, availability, accessibility, and cost. 450 respondents were interviewed face to face using a structured questionnaire survey to user and non-user groups at three (3) major transit stations and their surrounding areas. The result has shown the attractiveness of P&R to the user group when it has good connectivity, easy to access, more parking spaces and within walkability distance from P&R and the platform. The feedback from the non-user groups indicated that P&R will be more attractive when the parking is free provided with assurance of the safety and security for customer and their vehicle, more information about P&R locations, clear road signage directions to P&R, and information about the cost and time saving when non user group shift mode from private to public transport.

Keywords: Mode Shift, Park and Ride, Public Transport, Private Transport, Travel Behaviour1**.**

INTRODUCTION

The increase in the use of cars has increased the impact on the environment, such as noise and gas emissions from vehicle exhaust. Physical aggression, obstruction, and congestion are other examples of this development. This problem has attracted the attention of politicians, urban planners, and academics in search of the best method to solve this problem.

Planning to shift car travel to other modes of transport, such as public transport, has been practiced in many cities. Some fundamental problems are evident in this context because many factors influence the mode of transport. One of the problems is that people believe there is no realistic alternative other than using the car

itself. The use of a car is considered economical for those who have a car. When a car is purchased, little consideration is given to maintenance costs and gasoline consumption. Therefore, the perception of using a car is usually economical compared to public transport. The car also has many advantages, such as high comfort and flexibility. The car is also considered to fulfill other needs such as status, prestige, and the feeling of being in control of one's journey. Therefore, public transport is difficult to compete and gain a place in the public's choice.

In many of the main cities, there is a public transport system built through several main routes that can be reached by using intermediate buses. To get to the station, one has to walk, cycle, take an intermediate bus or car, and so on. One may have an assignment on the way or a long wait at the station. The person may consider this a hindrance that makes him choose to use the car for the entire trip. One of the proposed solutions to some of the transport problems discussed is to replace car journeys with a combination of car and public transport, consisting of one short car journey and one longer journey with public transport (hereafter called Park & Ride).

Park & Ride can be an alternative for those with a business on the way or to go anywhere when local buses are less frequent. Park & Ride can be used either in less dense areas where public transport is not profitable due to low demand or is located closer to the city center on main routes where congestion started. However, looking at Park & Ride objectively as a good alternative, very few users use Park & Ride. Then the question arises: how to attract the attention of private vehicle users using Park & Ride?

Therefore, the overall aim of this paper is to:

1. understand more about factors influencing the choice of mode and
2. to find measures to attract car drivers to Park & Ride.

LITERATURE REVIEW

Car ownership is increasing, and more people continue using their cars later in life. In the survey by Rakuten Insight in July 2019 [17], 82.64% of respondents own a car in Malaysia. The car is the predominant transport and accounts for 80% of passenger journeys. Currently, most trips in Malaysia and cities worldwide are made using private cars. For example, the Klang Valley, Malaysia statistics showed that 6 million or 83% of the trips were made using private transport, and only 1.24 million or 17% were made by public transport [14]. The use of private transport in Malaysia is relatively high compared to other cities, such as London (10%), Singapore (36%), and Hong Kong (26%) [8]. However, using private cars causes serious problems, such as traffic accidents, congestion, global warming, and pollution [4].

Sustainable transport modes include car sharing, carpooling, cycling, parking, riding, and walking. Public transport has been proposed to overcome the serious problems caused by private transport [7]. Sustainable transport is a transport system that can provide economic, social, and environmental benefits. For instance, sustainable transport can give direct access to a transport system that individuals and society need and provide an efficient and affordable transport mode, thus supporting economic growth. It also minimizes waste and emissions, limits land use, and reduces pollution. Many researchers have published proposals for sustainable transport designs in the transport literature. [12] elucidated the implications of sustainable urban transport design in their study on the factors affecting travel mode choice in Australia. [8] explored the attitudes of bike-sharing system users in the hope of establishing ways to enhance users' intention to use this system. In addition, [2] and [22], investigated the possibilities of using hydrogen fuel for sustainable transport. [18] proposed an effective measure to improve the feasibility analysis system for sustainable transport in the Republic of Korea. Of the various forms of sustainable transport, one way to reduce commuters' dependence on private cars is through park-and-ride (P&R) facilities [9].

P&R is suitable for areas with a low population density where it is unproductive to use a public transport service due to low demand or on the main routes close to city centers where congestion starts [6]. The ability of P&R facilities to reduce the negative effect of dependence on private transport has attracted the attention of many researchers to investigate and propose strategies to improve the effectiveness of these facilities. [20], used the Decision Field Theory to study the P&R decision Behaviour in Beijing, China.

They provided helpful information enabling policymakers and authorities to formulate better plans and promote the use of P&R facilities. [13], carried out a study to explore the mode change Behaviour of P&R users in Melbourne, Australia, by using the multinomial logistic regression; the researchers reported that the travel time taken by public transport and the transfer time at P&R facilities are the primary factors influencing the use of P&R facilities. Similarly, [11], studied the driver's willingness to use P&R facilities in Nanjing, China. They found that the parking fees and higher congestion levels increase drivers' intention to use P&R facilities. [23], contended that encouraging people to use P&R facilities could help reduce road congestion and the adverse impacts of driving private vehicles, such as air and noise pollution and parking problems in CBD areas. Several European studies have been conducted [10].

[9], have concluded that P&R is an efficient means to reduce congestion. Several Asian countries, such as Singapore and Hong Kong, have been successful in dealing with traffic congestion using P&R. The P&R project in Singapore has been well-received by the public since the MRT-based project was first launched in 1990, and the number of commuters using the facilities continues to increase with each relaunching. This is due primarily to good publicity and attractive incentives [21]. [15] carried out an experimental study of the trial P&R project in Hong Kong involving the northern end of the current east rail line of the Kowloon–Canton Railway. They found that the response from the public is encouraging. Even though the world literature has reported many benefits of using P&R facilities [23], car drivers in Malaysia are still not persuaded to use the facilities. [5], [19], and [1] have demonstrated that the utilization rate of P&R facilities is relatively low. According to [3] and [5] this underutilization is due to several factors, such as the wrong location of the P&R lots, low-quality public transit, and high parking fees.

This paper aims to identify the determinants that influence the use of P&R facilities in considering various factors, including safety and security, availability, accessibility, and cost. The feedback was gathered from the two (2) groups of respondents, users, and non-users, that participated in this survey.

METHOD

Data Collection and Target Respondents

The primary data was collected via structured questionnaire surveys that were conducted using face-to-face methods. The survey location was at the selected transit station with P&Rs facilities, namely at Wangsa Maju, Taman Melati, and Gombak station, all situated along the same railway, Kelana Jaya line. These lots were chosen because P&R was built at Gombak Station, which included 1216 parking spaces to replace the old parking lots. However, the number of occupied rooms at the old parking lots still need to be fully utilized, and only 80% of 460 space were used even during weekdays. The P&R was entirely operated in Taman Melati and Wangsa Maju, and the rest of the users parked illegally along the road.

The target respondents were P&R users and non-users. The total number of respondents obtained area users = 240 and non-users = 210. A screening question will be asked first to obtain the right target groups. The respondents from the users' group were the ones who used the P&R facilities that were interviewed at the dedicated P&R areas, and the non-users' groups were those interviewed at shopping complexes and hypermarkets in the area where the users lived. The survey was designed to find reasons for using or not using P&R lots and to characterize the two target groups to understand certain factors influencing the choice of mode. Information was collected from users of these chosen P&R sites and frequent car drivers living in the surrounding area. The questionnaires were designed comprised of demographic profiles of respondents, elements of safety and security, availability, accessibility, and cost-related questions regarding the P&R.

Data Analysis

The following principal methodology was used to explore the research problem.

1. The Chi-square (x2) method compares the two groups of users and non-users.
2. Pearson Correlation tests the relationship between the choice of mode and background characteristics.

3. Open questions are categorized and analyzed qualitatively and subjectively. A few open questions have been coded and tested statistically using Pearson correlation.

RESULTS AND DISCUSSION

Comparison of Users and Non-Users

Chi-square was used to test whether there was a statistical difference between users and non-users. Comparisons of the two groups reveal that the background factors are much the same, and they were therefore not found to be significant at the 5% level. As per Table 1, the user groups comprise more families with young children, 82.1%, compared with 51.9% of non-users, and for older children, non-user groups comprise more percentage.

Table 1. Characteristics of users and non-users

No	Background Factors	Users	Non-Users
1	Number Of Respondents	240	210
2	Gender		
3	Men	45.7%	54.5%
4	Women	54.3%	45.5%
5	Average age	29yrs	34yrs
6	The average age when obtaining a driving license	21yrs	21yrs
7	The average age when starting to use a car more frequently	26yrs	23yrs
8	Average distance prepared to walk from parking to platform	264m	210m
9	Median distance prepared to walk from parking to platform	220m	200m

Between users and non-users, there was a significant difference regarding the age at which the respondent started to use a car more frequently ($\chi 2 = 1.769$, df = 1, $p = 0.000$, $p < 0.05$)). Non-users started to drive often at a younger age than users, as seen in Table 1.

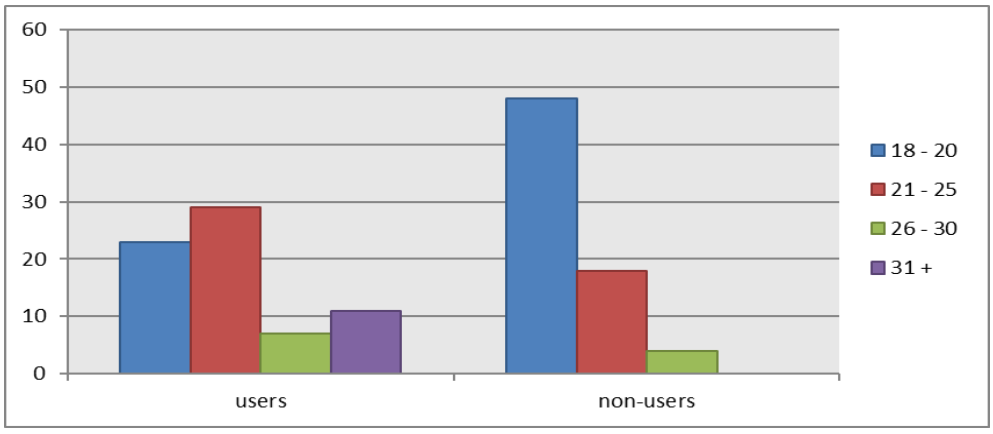

Fig 1: The age at which the respondent started using a car more frequently.

Fig. 1 shows that within the non-user group, those of 18 to 20 years old are the majority. As has been found in other studies, once a person has bought and started to use a car, it is more likely that the car will be used as the

primary mode. These results are supported by [16]. If a person starts to drive more frequently at a young age, it is more challenging to change to other travel modes. Some users have answered that they are prepared to walk from the parking place and the platform.

The Pearson Correlations analysis is done for the following factors:

1. Gender and age when obtaining a driving license.
2. Gender and age when starting to use a car more
3. frequently

However, the results show that both relations are not significant. The cross-tabulations between gender and age when obtaining a driving license were statistically insignificant ($p = 0.250$ vs. $p < 0.05$). Cross-tabulations between gender and the age at which a person starts to drive a car more frequently reveal a statistically not significant correlation ($p = 0.057$ vs. $p < 0.05$). Hence, it can be concluded that men and women start to drive a car more frequently at an earlier age and are likely to obtain their license at a younger age (18-19 years).

One interesting question is whether the grading differs between genders. The results show that women assign greater importance to the positive elements, apart from high frequency, which men rate more highly. Women also grade the negative factors more highly than men, apart from the walking distance between the parking place and the platform. Despite the different scores, the ranking of the elements is similar for gender. However, concerning ranking security, women have higher scores than men, and men have higher scores for a high frequency of public transport.

Attractiveness According To P&R Characteristics

Both users and non-users were asked to grade the characteristics of an attractive P&R on a scale of 1 to 5 (Likert Scale), and the mean values are provided in Table II. The result has shown that, in general, the ranking scores for users are highest compared to non-users, except for 'Parking is free'. The highest attractive factor obtained for users is the P&R link to the other public transport, e.g., buses, trains, and taxis, and for non-users is 'Parking is free'. One explanation could be that non-users are more sensitive to the budget.

Table 2: Attractiveness factors for users and non-users

No	Attractiveness factors	Users	Non-Users
1	Security for the car	4.26	3.93
2	Security for the people	4.24	4.07
3	High frequency of buses and trains	4.27	4.07
4	Parking is free	4.20	4.47
5	P&R links to the other public transport, e.g., buses, trains, and taxies	4.41	4.23
6	There are other services provided, e.g., shops	4.10	3.90

Table 3 shows the respondents' negative factors of P&R by mean values. As seen from the ranking list in Table 3, 'It is hard to find a parking space' given the highest score for both the Users and Non-Users groups.

Table 3: Negative Factors for Non-Users and Users

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No	Negative Factors	Users	Non-Users
1.	The distance from P&R to the platform is far	3.91	3.50
2	It is hard to find the P&R lot	4.10	3.60
3	It is hard to find parking space	4.23	4.07
4	The use of P&R results in five extra minutes of traveling time	3.43	3.40
5	It is not possible to see the bus or train from the parking place	3.66	3.20

Findings from Open Questions

Non-Users Feedback

When the non-users were asked about the existence of the new building P&R at Gombak Station LRT, nearly 60% of non-users said that they didn't know. Regarding using P&R, 96% of the non-users said they would consider using it, and 4% said they would use it if some conditions were fulfilled. Non-users also were asked what should be done to get more car users to use P&R; the lot should be safe for both people and vehicles. The ticket for public transport could be combined with the parking ticket. More comfortable trains and free parking are also mentioned. Many non-users would consider using P&R if it were faster and cheaper than taking the car. It should take less time with P&R than with a vehicle or cost less than the fuel cost for the same distance. Non-users repeatedly said that if it were cheaper and if they could save time, they would use it.

TV marketing or direct marketing about the distribution of the maps to people living in the area relatively close to a P&R lot are suggested. Some suggest a bonus system at the beginning to attract attention. Many of the interviewees stressed the importance of not being sure of getting a parking space. Non-users of P&R finally mention some more extraordinary measures such as congestion charges, banning cars in the city Centre, and raising the parking fees in the city. Non-users were also asked about so few users of P&R; they believe that people are lazy and that it is more convenient to drive to the destination. People need more knowledge and information about the public transport system and P&R. Some people need a car at work or have a free parking space at work. Regarding the road sign to the P&R and the problem of finding the way if you are new to the neighborhoods, some non-users said that they have yet to see the signs and need to know the existence of the P&R.

Users Interview Feedback

Users were asked about what made they start using P&R; many of them mentioned the fact that they began to park at the lot because they were dissatisfied with going by car and with the traffic congestion and were looking for a more convenient solution (71%), for the safety of the vehicle (15%), none availability/expensive parking fee at the final destination or workplace (10%). In comparison, 4% said they were unsure of the reason for parking. For the answers about what makes a good P&R lot, security for the people and car are mentioned by most users (85%). The users would also like more spaces at the lot and not far away from the platform. When asked about problems they find when using the P&R lot, not having enough parking spaces is the most common problem mentioned by users (77%). Another problem was security; the parking lot is far from the terminal. Users also asked about what they think should be done to get more car users to use P&R; here are some examples of measures mentioned by the users:

1. The P&R lot should be safe and have lights.
2. Free parking at the lot
3. Improve the facilities.
4. Better information and signage
5. Improve the public transport system.

Marketing should be done. This marketing could include comparing traveling costs between taking a car and using public transport. Several respondents mention free or subsidized parking places at work as an obstacle to using P&R. A more accessible payment system would be desirable at the P&R lots would be even better. It is also desirable to have signed with the next departure time of buses or trains. Other suggestions were better lighting, security for cars and people, and a guarantee of parking space at the lot.

Measures for Increasing the Use Of P&R

The following are the factors suggested by non-users.

1. More information about P&R locations with good marketing, publicity, and clear road signage direction to P&R.
2. Provide more safety and security measures for vehicles and customers.
3. Free parking fee at the P&R
4. Non-user requires information about the cost and timesaving shifting mode from private to public transport.

Followings are the factors suggested by users.

1. More parking spaces are provided to reduce lost time and carbon emissions.
2. Larger space for larger vehicles e.g., vans and SUVs
3. Short distance from P&R and platform, e.g., 300m
4. Better accessibility
5. Provided with Variables Message Signs (VMS) of arrival and departure information of public transport services at P&R e.g., bus, train.

The lot's most valued quality is security for individuals and vehicles. The security problem is mentioned several times throughout the questionnaires, indicating the factor's effect on making P&R attractive. Different kinds of shop service such as newspaper, magazine, food & beverage had the lowest priority. One explanation could be that it first has to be safe to park, and there has to be good public transport from the P&R lot. Once these conditions are fulfilled, there might be a demand for different services. The feedback from respondents has shown that 96% of non-users say they would consider using P&R, and 4% say they would use it if some conditions were fulfilled. 95% are prepared to use P&R several times a week, while 5% are prepared to use it once a week. The results indicate a high potential for using P&R among non-users.

Typical users can be described as follows:

1. They have younger children in the household than non-users.
2. Are older than non-users when they start to drive a car more frequently.
3. Assign a higher value than non-users to the fact that both buses and trains leave the lot.
4. The suggestions from the two target groups differ slightly. The users' ideas for increasing the use of P&R are more associated with improving the parking lot. The non-users suggest more general, wide-ranging solutions such as tolls, banning cars in the city Centre, and raising the parking fees in the city.

CONCLUSION

This study has described reasons for using or not using P&R and measures that could attract car drivers to use P&R. A purpose was also to see if there was any potential for increasing the use of P&R. This study has also been to characterize the two groups of users and non-users and to understand the extent to which certain factors influence the choice of using P&R. The results of this work provide an insight into the potential for increasing P&R. Some 96% of the non-users say they are prepared to use it at least once a week. Non-users

mentioned that the car's convenience is the main reason for driving, and other reasons are that they need a car at work or have free parking at work. As a recommendation, future research could explore two main areas how to make traveling by public transport or P&R easier with children and the effects of the measure on mode split. The location of the P&R lot is necessary. Some 28% of the users use P&R after leaving their children at daycare or school. There may be potential for using P&R if parents have more opportunity to park after leaving their children at daycare centers or, even better, if it were easier to travel with children on public transport. This could be a topic for further research, addressing how to make traveling by public transport or P&R easier with children. As the study indicates that better and more signs are essential, it would be interesting to determine the effect of better characters on the mode split. The impact of marketing on the mode split would also be interesting to study in more detail. Information about the cost of traveling by car and P&R should then be presented to car users.

More research is needed about how much users and non-users are willing to pay for different quality aspects at the lot. Valuation of quality factors such as security and walking distance between parking place and platform will be examined in a forthcoming study.

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