Commuters' travel behaviour and willingness to use park and ride in Tangerang city

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Abstract. The City of Tangerang has a substantial proportion of commuter trips of 31,1% or 423.000 trips/day to DKI Jakarta. Transjakarta is an integrated public transportation service from sub-urban areas to Jakarta and vice versa. Transjakarta is provided as mass public transportation to reduce private vehicle usage mainly to Jakarta, yet Transjakarta has not been effectively utilized and has not reached fairly significant number of passengers. Park&Ride (PnR) is a strategy to encourage transit ridership. This study aims to examine factors affecting the willingness of commuters to shift the automobile usage and to use the PnR facility. By using Cross Tabulation method, the result shows that the distance travelled has correlation significantly with willingness to use PnR. Characteristics of PnR facility have more influence than travel characteristics on willingness commuter to use PnR. Lesson learned on this study is improving on PnR conditions is needed to encourage commuter to use Transjakarta.

1. Introduction

Tangerang metropolitan city has experienced a rapid development in the last decade. The city functions to support Jabodetabek as the country's regional trade and service, industry, and education center. The majority of people who reside in Tangerang City are commuters who work in Jakarta. A commuter is a person whose primary activity occurs outside of the city where he lives and regularly makes a return trip every day. Only 23% of Jabodetabek commuters regularly use public transportation, whereas the remaining 77% still drive their private vehicles (cars and motorcycles).

In Jabodetabek, 47.5 million people move from place to place every day. This high level of mobility has caused citywide traffic. About 31.1% of commuters come from Tangerang City with a total of 423,000 trips to DKI Jakarta / day. The strategic location of Tangerang City which is near the State Capital of DKI Jakarta has rendered inter-city transportation highly influential to its local development. Transjakarta is an integrated public transportation service for commuting from sub-urban areas to Jakarta and vice versa. With Transjakarta reaching the sub-urban area, the people are expected to refrain from further use of private vehicles (cars and motorcycles) and revert to Transjakarta. Transjakarta operation in sub-urban area is one solution to overcome the ongoing congestion on Tangerang-Jakarta routes. The number of commuters in Tangerang City who use Transjakarta buses for their daily activities has only reached 1,029 people (0.15%).

One way to improve the role of mass public transport is implementing the concept of Park and Ride (PnR). Park and ride is one of the instruments in Transport Demand Management (TDM) which aims to shift the mode usage from lower-occupancy vehicles to higher-occupancy vehicle (HOV) [1]. PnR is

commonly defined as the act of parking at a custom-built car park and transferring to public transport to travel to one's destination [2]. According to Ginn (2009) park and ride has the benefit of supporting public transport with good interchange facilities [3]. Provision or development of park and ride in the suburban area will increase the productivity of public transport so that its use is more efficient. PnR is designed to facilitate the movement of commuters to use public transportation in urban areas with heavy traffic flow [4]. The purpose of PnR is to provide a public place for people in switching modes from private vehicle to public transportation. A study conducted in 2011 shows that mode shift to buses using the PnR facility alone made a significant congestion reduction to reach 16% in the journey time through the route in Southampton, United Kingdom [5]. In general, factors that can affecting the use of park and ride are characteristic of socio-economic, departure schedule and congestion level, access mode, and facilities provided [6].

This PnR concept was implemented under the local regulation of Tangerang City in accordance with Tangerang City's Local Spatial Plan for the Year 2012-2032. One of parking system strategies in Tangerang City is the provision of parking facilities with PnR concept for switching transportation at terminals and stations. The provision of PnR is currently located at Poris Plawad Terminal which is one of the departure points of Transjakarta in Tangerang City. The PnR is expected to encourage private vehicle users to park their private vehicles at the designated location and continue their commute downtown by Transjakarta. To optimize the park and ride facilities, it is necessary to study the factors affecting commuters to switch to the park and ride facility in order to support the mobility of Transjakarta buses in Tangerang City.

2. Study Area and Methods

2.1. Study Area
The park and ride facility in this study is located in the Poris Plawad Terminal, Tangerang City. The focus of the study area was chosen based on the sub district in Tangerang City included in the park and ride service radius. Based on several sources the park and ride literature, service radius can be represented by a parabolic curve with a service radius of 4 km [7].
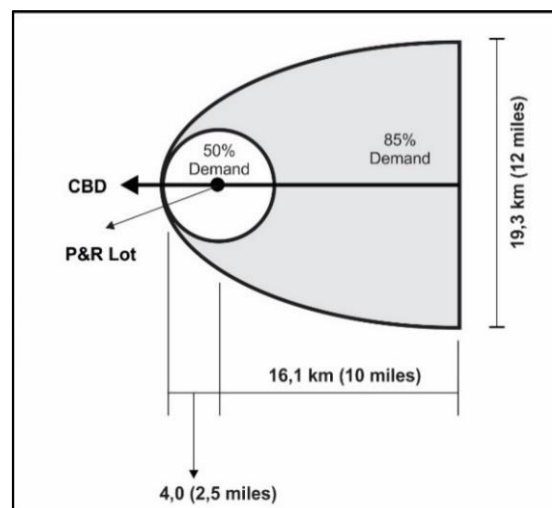

Figure 1. Service Area of Park and Ride Facility
Source: [7]

Using buffer analysis from the point of location of park and ride, there are 38 sub-districts included in the standard of park and ride service area in Terminal of Poris Plawad.

2.2. Data Collection Method
The primary data collection methods used in this research are field observation and questionnaires. Observation was conducted with identifying the characteristics of park and ride facility. Questionnaires were distributed to a number of respondents who were commuters in Tangerang City. Total of commuters in Tangerang City is approximately 283,779 people. Using an error of 8%, the number of samples taken is 141 respondents.

Sampling technique used in this research is simple random sampling technique. Randomly collected data was conducted on 38 sub-districts included in the standard of park and ride service area in Poris Plawad Terminal.

2.3. Analysis Method
The methods of analysis used in this study are Crosstab and Bivariate Correlation. Crosstab analysis is used in analysing the correlation between parking characteristics and commuter movement characteristics with the willingness of commuters to move using park and ride. Crosstab is a correlational analysis used to examine correlation between variables of nominal or ordinal categories. This variable is a variable with free category in one part and predictor category in other parts.

2.3.1. Determining Hypothesis
The hypothesis of this study:
- H0 : No relation between willingness to commute using park and ride with parking and travel behaviour characteristics
- H1 : There's a relation between willingness to commute using park and ride with parking and travel behaviour characteristics

2.3.2. Decision-making
Decision-making on crosstab analysis is made possible by comparing the chi-square value of the table and the resultant chi-square value. It can also be carried out by examining the significance value.
- If Chi-square Count < Chi-square Table, then H0 is acceptable
- If Chi-square Count > Chi-square Table, then H0 is rejected
  or
- If the sig value > 0.05, H0 is acceptable
- If the sig value < 0.05, H0 is rejected

After calculating the chi-square value and significance value, the strength of relationship between the independent variable and its predictor is determined using the value of the contingency coefficient [8].

Table 1. The Value of Contingency Coefficient

Size of Correlation	Interpretation
0 – 0,199	Very weak / no relationship
0,2 – 0,399	Weak relationship
0,4 – 0,599	Moderate relationship
0,6 – 0,799	Strong relationship
0,8 – 0,999	Very strong relationship

3. Results and Discussions

Some literature suggests that various factors may affect the use of park and ride facility. In summary, they are socio-economic characteristics, travel behavior and conditions of PnR facility. This study is aimed to examine how strong the commuters' travel behavior correlate with the willingness to use PnR facility. So, our study also linked willingness commuter to use PnR facility with factors of socio-economic characteristics and PnR facility characteristics. Using Cross Tabulation method, this study

resulted significance of correlation between willingness to commute using PnR facility with three factors as seen below.

Table 2. Crosstab Analysis on Sosio-economic Factors Against Willingness to Commute Using PnR

Variables	Pearson Chi Square	df	Significant Value	Remarks
Gender	0.023	1	0.879	According to chi-square test results, it can be concluded that the value of chi-square count (0.023) is lower than chi-square table (3.841) and the sig value (0.136) is higher than 0.05. Therefore, **H₀ is acceptable**. Thus, it can be concluded that gender does not affect the willingness of commuters to use PnR
Educational Status	2.598	2	0.273	According to chi-square test results, it can be concluded that the value of chi-square count (2.598) is lower than chi-square table (5.991) and the sig value (0.273) is higher than 0.05. Therefore, **H₀ is acceptable**. Thus, it can be concluded educational status does not affect the willingness of commuters to use PnR
Age			0.136	According to sig value, it can be concluded that the sig value (0.136) is higher than 0.05. Therefore, **H₀ is acceptable**. Thus, it can be concluded age does not affect the willingness of commuters to use PnR
Employment Status	2.996	3	0.392	According to chi-square test results, it can be concluded that the value of chi-square count (2.996) is lower than chi-square table (7.815) and the sig value (0.392) is higher than 0.05. Therefore. **H₀ is acceptable**. Thus, it can be concluded that employment status does not affect the willingness of commuters to use PnR
Income	4.419	4	0.352	According to chi-square test results, it can be concluded that the value of chi-square count (4.419) is lower than chi-square table (9.488) and the sig value (0.352) is higher than 0.05. Therefore, **H₀ is acceptable**. Thus, it can be concluded that income does not affect the willingness of commuters to use PnR

Factors of socio-economic of commuters have no correlation significantly with the willingness to use PnR based on Table 2. Commuters' socio-economic have no significant effect on their will to use PnR in Tangerang City. Furthermore, characteristics of commuters' travel behavior which correlate significantly with willingness to use PnR is only distance travelled. Commuters are willing to use PnR with a travel distance is not exceeding an average of 30 Kilometers.

Table 3. Crosstab Analysis on Travel Behavior Factors Against Willingness to Commute Using PnR

Variables	Pearson Chi Square	df	Significant Value	Remarks
Destination choices	4.387	4	0.356	According to chi-square test results, it can be concluded that the value of chi-square count (4.387) is lower than chi-square table (9.488) and the sig value (0.356) is higher than 0.05. Therefore, **H₀ is acceptable**. Thus, it can be concluded that destination choices does not affect the willingness of commuters to use PnR

Variables	Pearson Chi Square	df	Significant Value	Remarks
Activity	1.044	3	0.791	According to chi-square test results, it can be concluded that the value of chi-square count (1.044) is lower than chi-square table (7.815) and the sig value (0.791) is higher than 0.05. Therefore, H_0 **is acceptable**. Thus, it can be concluded that activity does not affect the willingness of commuters to use PnR. Activity types taken into consideration are work, school, and daily-shopping
Departure time	7.935	5	0.160	According to chi-square test results, it can be concluded that the value of chi-square count (7.935) is lower than chi-square table (11.070) and the sig value (0.160) is higher than 0.05. Therefore, H_0 **is acceptable**. Thus it can be concluded that departure time does not affect the willingness of commuters to use PnR
Distance			0.003	According to sig value it can be concluded that the sig value (0.003) is lower than 0.05. Therefore, H_0 **is rejected**. Thus, it can be concluded distance does affect the willingness of commuters to use PnR
Travel Cost			0.368	According to sig value, it can be concluded that the sig value (0.368) is higher than 0.05. Therefore, H_0 **is acceptable**. Thus, it can be concluded travel cost does not affect the willingness of commuters to use PnR
Travel time			0.659	According to sig value, it can be concluded that the sig value (0.659) is higher than 0.05. Therefore, H_0 **is acceptable**. Thus, it can be concluded travel time does not affect the willingness of commuters to use PnR

Based on factors of PnR characteristics, there are seven variables that are related to the willingness of the commuters to use PnR. These variables are availability of parking space, ease of obtaining parking, availability of pedestrian walkway in PnR, pedestrian walkway condition in PnR, security level, comfort level, and ease of obtaining mode access, as seen on Table 4 below.

PnR must be well designed and supervised in order to attract commuters for using it. The availability of parking space and ease of obtaining parking space are very much related to the time commuters spend to obtain parking space at PnR. The easier commuters can get their parking space, the faster the commute time will be. Pedestrian walkway is an important supporting facility for park and ride users to access the departure shelter. In the terminal area itself, the current parking is located inside the terminal, while the Transjakarta shelter is located in the front area of the terminal. The required adequate pedestrian facilities are needed by commuters to access Transjakarta shelter. Well-maintained pedestrian walkway in PnR will attract commuters to use PnR as it can increase the convenience level to its users.

PnR facilities must be equipped with good security system. Security against theft of motor vehicles or belongings inside the vehicle must be guaranteed to eliminate concerns among the commuters. PnR facilities are now equipped with security posts, security officers, and adequate lighting. However, the security level at the departure terminal must be improved by adding CCTV so as to provide more sense of security for its users. Furthermore, access mode in central area significantly affects the willingness to use PnR. Easier connectivity of public transport and pedestrians at the destination will influence commuters to commute using PnR. It affects the commuters travel time to complete the journey.

Table 4. Crosstab Analysis on PnR Characteristics Against Willingness to Commute Using PnR

Variables	Pearson Chi Square	df	Significant Value	Remarks
Availability of parking space	37.010	2	0.000	According to chi-square test results, it can be concluded that the value of chi-square count (37,010) is greater than chi-square table (5,991) and the sig value (0.000) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and the availability of parking space
Ease of obtaining parking	11.597	2	0.003	According to chi-square test results, it can be concluded that the value of chi-square count (11,597) is greater than chi-square table (5,991) and the sig value (0.003) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and the ease of obtaining parking.
Availability of pedestrian walkway in PnR	15.046	3	0.002	According to chi-square test results, it can be concluded that the value of chi-square count (15,046) is greater than chi-square table (7,815) and the sig value (0.002) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and the availability of pedestrian walkway in park and ride
pedestrian walkway condition in PnR	26.142	3	0.000	According to chi-square test results, it can be concluded that the value of chi-square count (26,142) is greater than chi-square table (7,815) and the sig value (0.000) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and pedestrian walkway condition in park and ride
Security level	12.700	2	0.002	According to chi-square test results, it can be concluded that the value of chi-square count (12,700) is greater than chi-square table (5,991) and the sig value (0.002) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and security level.
Comfort level	26.555	2	0.000	According to chi-square test results, it can be concluded that the value of chi-square count (26,555) is greater than chi-square table (5,991) and the sig value (0.000) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and comfort level
Public transportation services	5.544	3	0.136	According to chi-square test results, it can be concluded that the value of chi-square count (5.544) is lower than chi-square table (7.815) and the sig value (0.136) is higher than 0.05. Therefore, **H₀ is acceptable**. Thus, it can be concluded that public transport services does not

Variables	Pearson Chi Square	df	Significant Value	Remarks
				affect the willingness of commuters to use park and ride facilities
Ease of obtaining mode access	10.574	4	0.032	According to chi-square test results, it can be concluded that the value of chi-square count (10,574) is greater than chi-square table (9,488) and the sig value (0.032) is lower than 0.05. Therefore, **H₀ is rejected**. Thus, it can be concluded that a correlation exists between the willingness to commute using the park and ride facilities and the ease of obtaining mode access

Next, a contingency coefficient test was carried out to identify the strength of correlation between variables. Based on the analysis, out of 19 variables, eight are related to the willingness of the commuters to use PnR. These variables are availability of parking space, ease of obtaining parking, availability of pedestrian walkway in PnR, pedestrian walkway condition in PnR, security level, comfort level, ease of obtaining mode access, and distance travelled. Based on its correlation value, availability of parking space is the strongest compared to other variables, as seen on Table 5 below.

Table 5. The Strength of Correlation

Variables	Contingency Coefficient	Column B (t)
Availability of parking space	0.456	Moderate relationship
Ease of obtaining parking	0.276	Weak relationship
Availability of pedestrian walkway in PnR	0.311	Weak relationship
Pedestrian walkway condition in PnR	0.395	Weak relationship
Security level	0.287	Weak relationship
Comfort level	0.398	Weak relationship
Ease of obtaining mode access	0.264	Weak relationship
Distance	0.246	Weak relationship

Based on the results, improvement on PnR conditions in Poris Plawad Terminal, Tangerang City may encourage transit (Transjakarta) ridership from urban fringe area to city centre of Jakarta. In other cases, travel time and cost affect the probability of commuting by train to the centre of Jakarta by using the park and ride facility [9]. Other study also found that socio-economic factors (education level and private car ownership) and availability of parking in city centre of Bandung influenced the probability of shifting mode from motorcycle usage to train by using PnR facility [10]. It is interesting that the factors which affect the willingness of using the park and ride facility may differ according to the kind of transit mode to be used by commuters.

4. Conclusion

Based on the study results, it can be concluded that factors affect willingness to use PnR in Tangerang City are more related with PnR conditions than commuters' travel behaviour. Distance travelled have weak correlation with the willingness to use PnR, but availability of parking space have moderate correlation. Other variables related significantly with commuters' willingness are the ease of obtaining parking, the availability of pedestrian walkway, pedestrian walkway condition in PnR, the level of security, comfort, and the ease of obtaining supporting transport. Improving the conditions in PnR facility may increase the probability of shifting mode to Transjakarta in urban fringe area, specifically in Tangerang City.

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