Analysis of Modal Shift to Support MRT-Based Urban Transportation in Jakarta

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Abstract. As a metropolitan city with large population, Jakarta requires adequate public transportation system for its alternative solution to support the activities of people. Mass Rapid Transit (MRT) is a public transportation system that goes in high mobility rate to transfer or carry passengers in large number without entry barriers This paper study about prospective passengers of Jakarta’s MRT, their interest to shift in commuting choices into MRT, willingness to shift (WTS), and willingness to pay (WTP). The research used stated preference with direct surveyes to customer. The analysis of modal shift (WTS and WTP) was conducted by parameters of urban transport: affordability, availability, accessibility, and acceptability. The result is most of respondents are willing to shift to MRT because of its faster, more comfortable, no traffic jam, more safe, cheaper, and other, and they even willing to pay additional fare from their current mode. And people who unwilling to shift to MRT due to the distance of the nearest stations is too far.

1. Introduction
Special region of Jakarta or Daerah Khusus Ibukota Jakarta (DKI Jakarta) is a capital city of Indonesia. Jakarta is a metropolitan city and the only city in Indonesia that has government status equals to province level. The population of Jakarta is differnt between day time and night time. At day time, population is a combination, from Jakarta itself and people who works in Jakarta from four satelite cities surrounding Jakarta: Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) [1]. This condition hamper congestion during peak hours, road traffic accident, insufficient parking lots, etc [2]. To support the needs of people in commuting, Jakarta needs adequate adequate public transportation system as an alternative solution to commute around the area.

The government of DKI Jakarta recently has initiated the newest Mass Rapid Transit (MRT)-based public transportation as the answer to the growing needs of fast and instant commuting demands. Jakarta’s MRT had been planned since 1985 and built under two phases: phase one started operating in March 24, 2019 and phase two is forecasted to operate in 2024 [3]. This type of public transportation aims to absorb passengers from the South to the city centre, expands from Lebak Bulus to Bundaran HI. A MRT train can carry up to 1,950 passengers on each trip, assuming the level of passengers is at the highest rate (crush load).

The paper will study about prospective passengers of Jakarta’s MRT, their interest to shift in commuting choices into MRT, willingness to shift, and willingness to pay. Section 2 gives explanation...
literature study of mass transportation, willingness to shift and willingness to pay. Section 3 explains about data collection. Section 4 analyze results and discussion, while Section 5 gives conclusion.

2. Literature Study

2.1. Mass Rapid Transportation

Transportation is the movement of things on trip from place of origin to place of destination. Origin can be defined as home, hence the trip is called as home base trip, towards a particular destination [4]. Mass transportation is generally defined as public commuting facility that can transfer people in large number from one place to another. This type of transportation aims to provide time, price, and similar cost efficiency. Mass transportation usually has predetermined price set by the company owner or the government. The role of public transportation is highly needed by most of people to fulfil their mobility needs [5].

Mass Rapid Transit (MRT) is a public transportation system that goes in high mobility rate to transfer or carry passengers in large number without entry barriers. Mass Rapid Transit consists of several types, such as heavy rail transit, light rail transit, and bus rapid transit [6]. In Jakarta, the first phase of MRT consist of 16 kilometres of train tracks with total of 13 stations have been built on this first corridor, expanding from Lebak Bulus (depot location) to Bundaran Hotel Indonesia [3].

According to [7], the parameters of urban transport are affordabillity, avaibillity, accesibility, and acceptabillity. Affordability refers to the extent to which the financial cost of journeys puts an individual or household in the position of having to make sacrifices to travel, or to the extent to which they can afford to travel when they want to. Availability refers to route possibilities, timings and frequency. Accesibility describes the ease with which all passenger can use public transport. It also include ease of finding out about travel possibilities, i.e. the information function. Acceptability is another important quality of public transport, either because of the transport, on the standards of the treveller.

2.2. Willingness to Shift

Willingness to Shift (WTS) is a decision-making process by the passengers or customers to identify the number of prospective passengers that are willing to choose the provided transportations based on users’ preferences [5] [8]. Mode shift happens when a particular mode has more comparative advantages than other modes. Factors that can determine one has more comparative advantage than others are reasoning factors, such as current choice of mode, distance from station, and respondent’s profile [9][10]. The analysis of willingness or unwillingness to shift into different modes are determined by these reasoning factors.

2.3. Willingness to Pay

Willingness to Pay (WTP) is a customer’s willingness to issue reward for obtained services. In transportation issues, WTP is determined by various factors, including quality, utility, and income rate [11]. We can also determine WTP based on respondents’ demography to find customers’ willingness to pay for MRT service, based on the following determinants: occupation, current choice of transportation, travel cost, and travel time [12]. Furthermore, the determinants will be applied on this study to discover our findings based on respondents’ profile.

3. Research Methodology

In a framework of measuring willingness to pay, there are two major ways: revealed preference and stated preference (see Figure 1) [13].This study is using stated preference with direct surveys to customer.

Analysis of WTS and WTP was conducted by parameters of urban transport: affordabillity, avaibillity, accesibility, and acceptabillity. Each element of parameters consist of indicators that
derived into question items in questionnaire. Analysis structure of dimension-element-indicator is shown at Table 1.

### Table 1. Analysis structure

| Dimensi | Elemen | Indicator |
|---------|--------|-----------|
| WTS and WTP | A. Affordability | A1. Respondent’s Profile |
|          |        | A2. Income rate |
|          |        | A3. Average cost of trip |
|          | B. Availability | B. Current choice of mode |
|          | C. Accessibility | C1. Distance to destination |
|          |        | C2. Travel time (hour) |
|          | D. Acceptability | D1. Willingness for mode shift |
|          |        | D2. Reasons to shift |
|          |        | D3. Average distance from home to station |
|          |        | D4. Increase in fees based on travel time (WTP) |

Data collection was done by spreading questionnaires online that require the respondents to pick or respond stated preference questions (SP) by random sampling method. We successfully gathered 91 respondents to be analyzed by statistic descriptive technique.

### 4. Result and Discussion

#### 4.1. Affordability

The occupation of respondent can be seen in Figure 2. From total respondents, the occupation they have are student/college student (49%), employee (31%), entrepreneur (7%), government employee (5%), and other (8%).

#### Figure 2. Occupation

The income rate of respondent can be seen in Figure 3. From total respondents, the income rate are less than 2.5 million rupiahs (48%), have 2.5 – 5 millions rupiahs (26%) and more than 5 million rupiahs (26%).
4.2. Availability
Current mode of transport of respondent can be seen in Figure 5. From total respondents, the current mode of transport are motorbike (42%), app-based transportation (20%), private car (10%), Transjakarta (8%), MRT (5%), Angkot (5%), KRL (5%) and others (5%).

4.3. Accessibility
The distance from home to destination of respondent can be seen in Figure 6. From total respondents, the distance from home to destination are less than 5km (21%), 5km - 10km (24%), 10km – 15km (18%), more than 5km (37%).
The travel time of respondent can be seen in Figure 7. From total respondents, the travel time from home to destination are less than 0.5 hour (34%), 0.5-1 hour (31%), 1-1.5 hours (21%) and more than 1.5 hours (14%).

4.4. Acceptability
4.4.1. Willingness to Shift (WTS)
Willingness to shift of respondent from their current mode of transport to MRT can be seen in Figure 8. From total respondents, 17% of respondents are already used MRT, 41% of respondents are willing to shift to MRT, while 42% of respondents are not willing to shift to MRT because the distance to the nearest station is too far from house or destination.

Some people still want to shift to MRT eventhough the nearest station from their home are more than 5km (54%) (See Figure 10). Meanwhile, the reasons why people are willing to shift to MRT are faster (46%), more comfortable (16%), no traffic jam (18%), more safe (9%), cheaper (7%), and others (see Figure 9).
The result is most of respondents are willing to shift to MRT because of its faster, more comfortable, no traffic jam, more safe, cheaper, and other, and they even willing to pay additional fare from their current mode. And people who unwilling to shift to MRT due to the distance of the nearest stations is too far.

4.4.2. Willingness to Pay (WTP)
The respondent who willing to shift to MRT have the average cost of trip using their current mode is about 14,281 rupiah per trip. While current fare of MRT is at the range of 3,000 – 14,000 rupiah per trip, which cheaper than their current mode about 1.5%. With this fare, most likely people will pay for this fare (only 4% of respondent still not willing to pay) (see Figure 11).

Analysis of willingness to pay additional fare in scenario of travel time reduction is shown at Table 2. At no time reduction, 51.9% respondents are willing to maintain their current fair (Rp14,218/trip). Meanwhile, 48.1% are willing to add fare, in which they want to shift to MRT not because of more
faster, but other reason such as comfortable. At 10-minutes reduction, 70.4% of respondents are willing to pay additional fare. At 20-minutes reduction, 74.1% of respondents are willing to pay additional fare even up to 100%. At 30-minutes reduction, 77.8% of respondents are willing to pay additional fare even more than 100%.

| Travel Time Reduction | Add 0% (Rp14,218) | Add 25% (Rp17,772) | Add 50% (Rp21,327) | Add 75% (Rp24,881) | Add 100% (Rp28,436) | More than 100% |
|------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|----------------|
| No time reduction      | 51.9%              | 29.6%              | 11.1%              | 5.6%               | 0.0%               | 1.9%           |
| 10 minutes reduction   | 29.6%              | 42.6%              | 24.1%              | 3.7%               | 0.0%               | 0.0%           |
| 20 minutes reduction   | 25.9%              | 20.4%              | 44.4%              | 7.4%               | 1.9%               | 0.0%           |
| 30 minutes reduction   | 22.2%              | 22.2%              | 29.6%              | 11.1%              | 11.1%              | 3.7%           |

5. Conclusion

Jakarta as a metropolitan city has a variety problem, this condition hamper congestion during peak hours, road traffic accident, etc so to support the needs of people in commuting that is Mass Rapid Transit (MRT)-based public transportation as the answer to the growing needs of fast and instant commuting demands. To purpose of this study find about prospective passengers of Jakarta’s MRT, their interest to shift in commuting choices into MRT, willingness to shift, and willingness to pay for the mode.

The respondent who willing to shift to MRT have the average cost of trip using their current mode is about Rp 14,281/ trip. While current fare of MRT is at the range of 3,000 – 14,000 rupiah per trip, which cheaper than their current mode about 1.5%. With this fare, most likely people will pay for this fare they even willing to pay additional fare from their current mode until 100% with conditions faster than the current mode.

most of respondents are willingness to shift MRT because of its faster, more comfortable, no traffic jam, more safe, cheaper, and other with the fact that nears MRT station is more than 5km from home (54%). And people who unwilling to shift to MRT due to the distance of the nearest stations is too far so they prefer to use the current mode.

6. References

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