Mode choice analysis between LRT and car route Kebayoran Lama-Kelapa Gading

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Abstract. Jakarta starts to develop LRT, one of them is Route Kebayoran Lama-Kelapa Gading. To know the demand potential of LRT at those route by use the mode choice analysis between LRT and Car. Data Collection use stated preference method that will explain the comparison LRT utility with car utility. Variables that use for figuring the utility are travel time, travel cost and waiting time. Collecting data is done by using a questionnaire given to respondents and was accompanied by a surveyor, so if there are things that are not understood by the respondents can be explained by the surveyor. Data obtained from respondents used to obtain the information needed in order to meet the objectives of the study researchers. In this study, analysis of data using linear regression analysis using SPSS. The purpose of this analysis is to get the value of R2 to determine which model is the best among the various models of the analysis done. The best model regression analysis is the model that has the best fit of the statistic’s parameters. The best models are obtained by a process first tried various forms of independent variables to get the highest determination coefficient of linear equation function regression analysis. From the analysis has gotten F significant value is smaller than 0.05 for all variables which indicates that the value of the independent variable appreciable or significant or variable costs, travel time and waiting time significantly and simultaneously affect the public's willingness to use the LRT.

1. Background
Along with the increase in population and the number of activities in the city of Jakarta and surrounding cities in the Bodetabek area, transportation needs also increased. The increase in transportation needs was accompanied by an increase in the use of private vehicles. One mode of private vehicles that is widely used by residents in Jakarta is private car.

The high use of private cars causes a very high level of traffic congestion in almost every street in the city of Jakarta, especially during the morning and evening rush hours. To be able to reduce the level of traffic congestion, the government has implemented BRT (Bus Rapid Transit) which currently operates 12 corridors. In the next few years the MRT is planned to operate (Mass Rapid Transit) and LRT (Light Rail Transit).

Public transportation is expected to meet the transportation needs of people in the city of Jakarta and can streamline the movement so that it can reduce the traffic density on the road. It is planned that both types of public transport modes can transport passengers in large numbers and relatively faster.

Of the two types of public transport, the LRT is the latest type of public transportation that will be motorLRT in Jakarta will be effective which means that it will be in demand by road users in the city of Jakarta or the extent to which the LRT operation is acceptable to the public.
1.1. Formulation of the problem
How far is the competition for the use of LRT to use car by road users in the city of Jakarta and how is the condition of modal competition between LRT and car seen from the costs and services?

1.2. Purpose and objectives
The purpose of this writing is to find out:
• Knowing the potential demand from the LRT.
• Know the characteristics of car services.
• Knowing the characteristics of LRT services.
• Creating a modal selection model between LRT and Car

1.3. Scope of problem
Due to time and cost limitations, the authors give limitations on this thesis, namely:
• This research will only be conducted in the city of Jakarta
• Analysis based on secondary data and surveys using questionnaires to road users, especially car users.

1.4. Research approach
This research use survey data based on stated preference data. Responden preference is very important to figure how the private car user will move to LRT. The phenomenon of those figure is explained by the model.

2. Literature review
2.1. Transportation concept
The concept of transportation is based on the trip (origin) and destination (destination). In transportation, there are elements that are closely related to the concept of transportation itself [1]. These elements are as follows: Humans in need, Goods needed, Vehicles as tools / facilities, Roads and terminals as transportation infrastructure, Organization (transportation manager).
To realize the function and benefits of transportation, DKI Jakarta Provincial Government proposes the construction of LRT as a way to reduce congestion in Jakarta. The LRT will have seven routes with two of the seven routes promised by DKI Jakarta Provincial Government to be completed in 2018. The two routes are Kebayoran Lama - Kelapa Gading, and Kelapa Gading - Kemayoran - Pesing - Soekarno Hatta Airport.
LRT (Light Rail Transit) or better known as light rail is one of the passenger train systems that operate in urban areas where construction is light and can run with other traffic or in special trams or trams.
LRT is public transportation that operates on a special route. Usually the LRT has a minimum of three carriages that are designed to carry many passengers and are faster than buses.
LRT certainly has several advantages compared to other land transportation modes while the advantages are Development time is faster than HRT / MRT, Costs are relatively cheap compared to HRT / MRT, There is no need for a lot of land acquisition, Larger gradient, The bend radius is smaller, High technology, Relatively high speed, Environmentally friendly, There have been many examples
The advantages of LRT such as are Safer than a car trip, There are no emissions on the road., Can overcome steep gradients and sharp turns, loading capacity is quite high., can blend in with city traffic., no vertical, lateral or back / forward movement, avoid traffic congestion through segregation and priority, Can walk at high speed on a separate road and can pass through narrow roads., Level of boarding offers with easy access for everyone, including wheelchair users., Can increase to 12% elevation. LRT also has several disadvantages such as: Unable to reach remote areas,Costs are more expensive than BRT, Travel time is longer than MRT, High maintenance and operational costs.

2.2. Background LRT Jakarta
Based on DKI Jakarta Dishubtrans through public dialogue with DTKJ, the background of LRT development in Jakarta is:
1. The number of Jabodetabek trips reaches 25.7 million trips / day. 18.7 million (72.95%) is an internal journey of DKI Jakarta, 6.9 million (27.05%) is a trip from Bodetabek.
2. 27% of total trips in Jabodetabek use public transportation modes based on roads and railways (JUTPI).
3. Total public transport trips are only served approximately 2% of the total number of vehicles on the highway (SITRAMP II).
4. Anticipation of relatively high Car vehicle growth. The number of motorized vehicles in DKI Jakarta reached 7,979,833 units with an average growth of 8.12% per year.

Based on DKI Jakarta Dishubtrans through public dialogue with DTKJ (Jakarta, 16 September 2015) the objectives of LRT development include:
1. Increase the coverage of mass public transport system services in Jakarta.
2. Increase the capacity of the public transport system in Jakarta.
3. Improve the quality of service from the public transport system.
4. Improve coordination in the provision of public transport systems.
5. Integrate with other modes of transportation.

The LRT development is intended for the long term, with the intention of including:
- To achieve the 60% public transport share modality target, Jakarta must absolutely have high capacity mass transit (MRT / subway).
- Massive gliding LRT can damage the sights / beauty of the city or visual intrusion.
- LRT will be the MRT feeder.
- LRT is made on a surface (surface).
- Can use the busway lane (busway is replaced by LRT).
- LRT is part of the beauty of the city (tourist attraction).

There are 7 corridors LRT in Jakarta (plan)with total length 115,7 km and Line Kebayoran Lama – Kelapa Gading has length 21,6 km

2.3. Problem LRT Jakarta

To implement the LRT system in Indonesia requires a lot of careful consideration beforehand, including:
1. City Spatial Planning is needed, urban spatial planning is very important because it is related to the optimization of areas that need to be built and passed by LRT, related to demand and available land. In addition, planning is needed for the development of the LRT itself in the future. Development is carried out by adding lanes or changes from the lane itself so that it is expected to be even better for the LRT transportation system.

2. No small investment is needed, the cost per kilometer of the LRT is very high, with a cost per kilometre that is 5 times more expensive than BRT, a high development cost is needed, apart from the revenue obtained from the LRT itself. It is feared that high development costs and funds are obtained from loans at certain institutions, resulting in high tariffs and eventually quiet from LRT users.

3. Providing the best service, expensive investment costs if not supported by good service will be useless. For example, in Singapore, which has a timely and high frequency scheduling, it provides its own convenience for LRT users. The problem of public transport in Indonesia besides the LRT is the lack of timetable. Even for Heavy Train can often delay that takes hours. For public transport on the highway even worse because often in the regions do not prioritize scheduling for the operation of public transport it self.
4. Intermodal integration, the development of the LRT is expected to attract private vehicle users to public transport. Of course there must be pulling factors, including intermodal integration. Integration is very important to be built because high accessibility is expected to make it easier for users to use public transportation. Integration between terminals, or airports, is needed. You can imagine if there is no integration, as a user, you will feel uncomfortable, tired and various other complaints. Then integration is very important to be built.

3. Methodology

3.1. Modelling approach

Modeling of mode choice is done by means of discrete choice model [2] the different available alternatives in a discrete choice experiment are mutually exclusive and collectively exhaustive. Discrete model is based on selecting the alternatives that provides highest utility to the choice maker. Predicting the correct alternative for an individual is not always possible as many unobserved and situational variables come into play for decision making, thus the concept of random utility appeared [3]. Sometimes discrete choice was used for binary choice of travel mode and sometimes its use spreads to multi choice set as well as in other stages of forecasting process. The proceeds of this research shows in Figure 1 below:

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Survey Form Design
Pilot Survey Conducting and Revised Survey Form
Data Collecting
Data from Previous Study
Data Survey
Data Analysis
Develop the Model
Conclusion
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**Figure 1.** Research flowchart

3.2. Stated preference method

The survey method using a questionnaire aims to obtain a comparison of the quality of LRT services and the quality of service of car as illustrated by the modal selection model between the two modes. In this study, the method used for data collection is the Stated Preference method [4]. The researcher
gives a choice of statements that have been set to the respondent. The variables used in the statement are cost, travel time, and waiting time. This method is used because the LRT in Jakarta is not yet operational and is under construction.

Data collection was carried out using a questionnaire tool that was given to respondents and accompanied by a surveyor, so that if there were things that were not understood by the respondent it could be explained by the surveyor. Data obtained from respondents’ answers are used to obtain information needed by researchers to fulfill research objectives.

Questionnaire is a list of questions given to respondents to explore data in accordance with research problems. In survey research, the use of questionnaires is the most important thing for data collection in the field. The results of this questionnaire are to be quantified, compiled tables and analyzed statistically to draw conclusions from the study [5].

The main objective of the questionnaire is (a) to obtain information relevant to the problem and research objectives, and (b) to obtain information with reliable and high validity. Things that need to be considered by researchers in preparing the questionnaire, the questions compiled must be in accordance with the hypothesis and research objectives.

4. Data collection and analysis

4.1. Data Analysis Method

Data analysis method used in this study is by using the mode selection method with the type of binary difference model. This difference model describes modal competition based on the difference from the attributes possessed by the two models. The basis of the Difference Binary model is the utility of both competing modes. The utility of the mode is based on the service of each mode shown by its service attributes such as travel time, waiting time and tariff or costs incurred by modal users.

4.2. Choice Model

This analysis use linear regression model while dependent variable is users perception when have two choices of their trip moda that are LRT and Car. Independent variable are differences of waiting time, travel time and travel cost of both LRT and Car.

In this study, data analysis used linear regression analysis. The purpose of this analysis is to get constants, coefficients, R2 values to find out which model is the best among the various analysis models performed. The results of regression analysis using SPSS which is the best model. Based on the coefficient of consideration, the following best models are obtained :

\[ Y = -5.675 + 0.0156X_1 + 0.0185X_2 + 0.0001923X_3 \] \hspace{1cm} \text{………………… (1)}

\[ R^2 = 0.698 \]

Where :

\[ X_1 = \text{Differences of waiting time (CAR-LRT)} \]
\[ X_2 = \text{Differences of travel time (CAR-LRT)} \]
\[ X_3 = \text{Differences of travel cost (CAR-LRT)} \]
\[ Y = \text{Proportion of Choose LRT} \]

\[ Y = 0.845 - 0.0042X_1 - 0.00125X_2 - 0.0000585\ln{X_3} \] \hspace{1cm} \text{………………… (2)}

\[ R^2 = 0.692 \]

Where :

\[ X_1 = \text{Differences of waiting time (LRT-CAR)} \]
\[ X_2 = \text{Differences of travel time (LRT-CAR)} \]
X3 - Differences of travel cost (LRT-CAR)

Y - Proportion of Choose LRT

The best model is obtained by first trying various forms of independent variables to get the highest determination coefficient value from the linear equation function of the regression analysis. The results of regression analysis from various variations of the independent variable.

From the results (Car-LRT) of linear regression analysis the model is $R^2 = 69.8\%$ which means that the ability of the independent variable to predict the value of the dependent variable is 69.8%. The significant value of F is 0.000 less than 0.05 which indicates that the value of the independent variable is significant or significant enough or variable costs, travel time, and waiting time significantly and simultaneously affect the people's desire to use LRT.

From the results (LRT-Car) of linear regression analysis, the model is $R^2 = 69.2\%$ which means that the ability of independent variables in predicting the dependent variable value is 69.2%. The significant value of F is 0.000 less than 0.05 which indicates that the value of the independent variable is significant or significant enough or variable costs, travel time, and waiting time significantly and simultaneously affect the people's desire to use LRT.

5. Conclusion and recommendation
5.1. Conclusion
1. The linear regression method is adequate to modelling the mode choice between LRT and car
2. Among three variables that used for modelling the user choice preferences, the travel time is the most dominan variable.

5.2. Recomendation
Recommended to make the same at other areas or other corridors to see the variant that depend to the Corridors.

6. References
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