

MODAL CHOICE ANALYSIS OF ELECTRIC RAILWAY TRAIN AND PRIVATE VEHICLE FOR TRAVELERS IN MANGGA DUA WITH STATED PREFERENCE METHOD


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ARTICLE INFO	ABSTRACT
<p>Published: January 17th, 2023</p> <p>Keywords: Mode Choice, Transportation Mode, Validity, Reliability, Stated Preference</p> <p>This work is licensed under CC BY-SA 4.0 </p>	<p>Transportation activity is a vital need for urban economic development. Mangga Dua, as a shopping center area and many other commercial points, has been supported by various modes of public transportation, one of which is the Electric Rail Train (KRL). The Bekasi area and its surroundings are a supporter of the transportation and agglomeration of Jakarta. Every day, many Bekasi people use the KRL for mobility activities to various areas covered by the KRL, including Mangga Dua. Even so, many private vehicle users still depend on road infrastructure which causes traffic congestion problems for Jakarta – Bekasi mobility. However, the fact that the Cikarang - Kampung Bandan KRL route is always busy indicates that KRL is still a solution for Bekasi - Jakarta transportation problem that many people choose. This research is intended to determine what factors influence the choice of KRL mode and what factors influence the choice of that mode. The method used is stated preference by collecting primary data using questionnaires from respondents who commute using Cikarang – Kampung Bandan Line. Data processing and analysis were carried out with the help of SPSS software version 16.0. The data processing and analysis results show that the factors influencing the choice of KRL mode are cost-effectiveness, safety, and convenience. Congestion and ease of access are the most influential factors afterward, and the effectiveness of travel time is the last order factor out of 5 factors in the most influential hypothesis. With the result that 71% of respondents chose KRL over motorbikes, it was concluded that KRL as a rail-based mode is a solution to the Jakarta - Bekasi transportation problem.</p>

INTRODUCTION

Urban mobility is characterized by traffic congestion, pollution, waste of time, noise, and numerous inefficiencies in capacity and space consumption at the scale necessary to enable the modern urban economy to function productively. Time is spent unproductively on the road, leading to higher operating costs, road maintenance costs, and driver/passenger fatigue. DKI Jakarta is one of the cities in the world where these signs can be found. Jakarta is considered one of the most congested cities in the world. The importance of transport as one of the primary needs of any modern society cannot be underestimated (Ceder, 2021); (Farda & Lubis, 2018); (Jakarta Traffic: TomTom Traffic Index, 2022); (Deka & Carnegie, 2021). The reason is that the community's economy is centered in DKI Jakarta as the capital. The people in the capital and those around the capital also meet their basic needs by carrying out daily transportation activities to and from the capital. The existence of this transportation need makes people encouraged to choose the mode they use.

Mangga Dua is a shopping district located in Central Jakarta, directly adjacent to Ancol,

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North Jakarta. Jalan Gajah Mada bounds this area on the west and Jalan Gunung Sahari on the east. In contrast, in the middle of this area are Jalan Pangeran Jayakarta and Jalan Mangga Dua Raya. This area is one of the 12 beach tourism points set by the DKI Jakarta Provincial Government to attract foreign tourists. With many shopping centers located in Mangga Dua, Mangga Dua is one of the largest shopping areas in Southeast Asia. The bustle of commercial buildings in Mangga Dua affects the high transportation activities of people from various regions in Jabodetabek who go to shopping centers, shophouses, and offices. Access to this area has been supported by many public transportation modes, including the Electric Rail Train, or KRL.

Bekasi is one of the supporting areas for transportation and urban agglomeration in Jabodetabek. This city is experiencing rapid growth, especially in the Cikarang area. Transportation in the Cikarang area still relies heavily on road infrastructure, especially toll roads. Seeing the road condition to Jakarta, which is always crowded, the rail-based mode is the most efficient solution. Many (Rahman, et al., 2020) people in the Bekasi City and Regency area use KRL to do activities every day in various areas covering the KRL route, including the Mangga Dua area. People who live in the Bekasi area and are active in the Mangga Dua area can choose the Cikarang - Kampung Bandan route. Considering the distance that is too ± 40 km with the route passing through several roads with a high current density level, and considering other factors such as travel costs, safety, and comfort, the community is encouraged to choose the KRL mode of transportation.

Even so, the high use of private vehicles (cars and motorbikes) that carry out movement activities from Bekasi City to DKI Jakarta is still a transportation problem that occurs on the Bekasi - Jakarta route (Hasiholan, Hariyani, & Ari, 2020). It indicates that the tendency of people to choose private vehicles as a mode of daily mobilization to the Jakarta area is still high. In 2019 KRL was the type of public transportation that got the most negative sentiment compared to other kinds of public transportation. However, the fact that the Cikarang - Kampung Bandan route KRL is still always crowded with passengers indicates that KRL, as a rail-based mode, is still a solution for transportation on the Bekasi - Jakarta route, which is widely chosen by the public. The existence of (Rachman, Nooraeni, & Yuliana, 2021) this study is intended to find out what factors make people choose KRL transportation modes compared to other methods of transportation and what factors are the most dominant among these factors, in a more specific scope, namely people who live in the Bekasi City & Regency area and its surroundings and daily activities in Mangga Dua who choose the KRL route Cikarang - Kampung Bandan (Cikarang Line), compared to people who live in the Bekasi City & Regency and surrounding areas and daily activities in Mangga Dua who choose to ride a motorbike.

LITERATURE REVIEW

Transportation is a tool to transport people, animals, and goods to their destinations. Alternatively, another sense of transportation is to move people, animals, or goods from their origin to their destination using tools that living beings or machines can use. Transportation is essential for the population's economic activity and daily life since it facilitates the movement of goods and people, thereby improving the economy. Public or public transportation is

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believed to be efficient because it can carry many passengers simultaneously. Development of public transportation has been developing since hundreds of years ago. Public transportation technology has developed from human-powered transportation, animal, and oil-fueled engines to now electric-powered ones. Public transport can be considered a sustainable way of traveling and is often encouraged by local governments (Yani & Amiruddin, 2021); (Hensher, 2019); (Fowler, 2019); (De Vos, Waygood, & Letarte, 2020).

Public transport is a critical factor for the functioning of urban systems. The development and improvement of public transport have a positive impact on the economy of the city and the country. Cities are a place of increasing global concentration that has the potential to lead to the increasing number of land transportation modes directly. Given these risks, it is essential to implement and develop electromobility in public transport in urban areas. High mobility makes urban roads crowded with motorists, and there are often long queues of vehicles. More people prefer private vehicles. The more congested the road will be by motorists. Therefore, public transportation in urban areas is generally more advanced in technology and has more fleets, diverse types, and integrated routes than in non-urban areas. It is intended so that urban travelers are more interested in choosing to use public transportation instead of private vehicles (Pamuła & Pamuła, 2020); (Alkharabsheh, Moslem, Oubahman, & Duleba, 2021); (Pietrzak & Pietrzak, 2021).

Travelers in choosing a mode are grouped into 2 (two): 1) Captive groups, namely the poor, people with disabilities, and other groups who only rely on public transportation services. 2) Choice Group is a traveler with access to a private vehicle and can choose the mode to do his mobility. The (Guerra, 2022) choice group can rate transportation services differently from the captive group (Fang, Xue, Cao, & Sun, 2021). Assessments from captive groups are used in the analysis of mode selection. The rapid rhythm of urban life causes urban people to value time, money, and comfort very much. In public transportation modes, be it buses, trains, or taxis. Travelers are not very interested in the route. The people of the capital will tend to choose a mode that can provide efficiency in time & cost, with the convenience of good service (Ceder, 2021).

Electric Rail Train or abbreviated as KRL, is a train that moves with an electric motor drive system. In Indonesia, electric trains are widely found in the Jabodetabek area and around the airport as commuter trains (Rifai & Fajriliani, 2020). KRL is a mode of transportation commonly used by the people of the capital and its surroundings. KRL is operating under the banner of PT. Kereta Commuter Indonesian (KCI) is a type of transportation that is large, fast, cheap, and efficient because it can carry many passengers and has its path so that it is not affected by traffic congestion on the highway. KCI began the modernization of Commuter Line transportation in 2011 by simplifying the existing line to five main roads, eliminating express commuter rail lines, implementing women's carriages, and renaming the economy-AC KRL to Commuter Line. The project will continue with the renovation, rearrangement, and sterilization of facilities and infrastructure, including trains and train stations, which will carry out. PT KAI (Persero) with the Government. These efforts are made to improve KRL services to support the daily mobility needs of the Jabodetabek community (Puri, Marzuqi, Chairuddin, & Sidjabat, 2020).

Stated preference is a survey method that measures people's preference for alternatives

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based on decision-making in situations of hypothetical choice. The Stated Preference method was first used for transport research by Davidson, J.D. in 1973 (Aizaki, Nakatani, & Sato, 2014). In the principle of transport (Hartini, Audina, Saptadi, & Pasha, 2022). Stated preference is used as a means of approach in the control of the transport system created by hypothesizing the travel situation, which refers to the approach using the respondent's opinion in the face of various alternative options. Another definition states that the indicated preference technique is a questionnaire technique by making an alternative hypothetical travel situation that is a combination of changes in service attributes of two modes, then tested on respondents by distributing questionnaires to find out the passenger's response to the experimental travel situation (Indriastuti, Purwanto, & Basuki, 2019). The stated preference method was chosen because it was rated the most suitable method for mode selection analysis research (Rifai, Putra, Isradi, Mufhidin, & Prasetijo, 2022).

Surveys as instruments in research with the stated preference method need to be tested for validity and reliability. Validity refers to the feasibility of the test as a measure of assessment. In this context, the survey of respondents as a testing instrument was tested for feasibility as an assessment measure for the selection of KRL and motorcycle modes for the people of Bekasi City and Regency who are active in the Mangga Dua Area so that the survey can be declared valid. In addition to being valid, the test instrument in the study must also be reliable, so a reliability test needs to be carried out. A reliability test is a test of accuracy, accuracy, or accuracy aimed at measuring instruments. A reliability test is performed to determine the extent to which a measuring instrument is reliable and consistent if the measurement is carried out twice or more in the same population as the same measuring instrument (Jin & Qi, 2018); (Rifai & Fajriliani, 2020).

METHOD

In this study, the *stated preference* method was used to determine the factors that made the people of Bekasi City & Regency choose the KRL mode by asking questions about respondents' opinions on the variables of convenience, cost, time, obstacles, safety, and comfort modes to respondents. Primary data collection in the form of survey data was carried out using questionnaires distributed using *google form* media. Data collection from respondents was carried out from November to December 2022. In addition, online questionnaires are distributed through social media to reach targeted respondents. In this study, the targeted respondents were people of productive age or labor force (aged 15 years and over) who are domiciled in Bekasi City or Regency and carry out daily activities in the Mangga Dua Area. Using Isaac and Michael's formula with a percentage of 10% error, out of the total population of the Bekasi City and Regency labor force of 3,497,829 residents, it was found that the number of respondents required was $N = 99,997$, rounded up to 100 random respondents. The data from these respondents were tested for validity and reliability to be recognized for their validity.

Respondents were asked for their opinions on the convenience, cost, time, obstacles, safety, and comfort of the modes they use daily by choosing 1 (one) of the 3 (three) answer options presented, where the answer options are attitude scales that have a score of 1 – 3. All respondents' answers to each question item were correlated and tested using the Pearson Correlation Formula. After the validity test, a reliability test was carried out using the

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Chronbach formula *alpha* method. Validity and reliability tests were conducted using the help of SPSS software version 16.0. After being tested that the survey is valid and reliable, the respondents' survey results were analyzed and looked at the relationship between the choice of public transportation mode (Y) with convenience (X1), cost (X2), travel time (X3), obstacles (X4), and safety and comfort (X5).

The research begins with a preliminary study of the fundamentals of fashion selection analysis research. Continued with the determination of the location of the study and the collection of the necessary data, in this study, the primary data is in the form of survey results of respondents' characteristics and mode selection, and secondary data is in the form of maps of location, population, and readings that support other primary data. After being collected, the data is checked to determine whether it meets the needs; if not, the data collection is carried out again, and if so, proceed to the following process. The following process is primary data processing: survey results obtained from respondents with the help of SPSS software, data analysis, and drawing conclusions and suggestions.

RESULTS AND DISCUSSION

Study Location Overview

Mangga Dua is the center of buying and selling electronic goods in Central Jakarta, DKI Jakarta. However, Mangga Dua is a central area for buying and selling goods and services from various fields, offices, shophouses, and other commercial and mixed-use development buildings. Located in Central Jakarta, which borders Ancol, North Jakarta, this area is strategic because many public transportations traverse it. Jalan Mangga Dua Raya is a road that is quite crowded with private vehicles during the hours of leaving and returning from work. Jalan Mangga Dua Raya is a 4 (four) lane 2 (two) way road separated by the road median, where the one rightmost lane in both directions is explicitly used for TransJakarta buses. The Transjakarta lane is traversed by the Transjakarta Bus, which passes through Corridor 5 (Kampung Melayu - Ancol) and Corridor 12 (Pluit - Tanjung Priok) (Corridor: Transjakarta, 2022). In addition to TransJakarta, public transportation that crosses Jalan Mangga Dua Raya is the microlite route M53 (Pulogadung - Kota), M39 (Pasar Senen - Kota), and Bajaj.

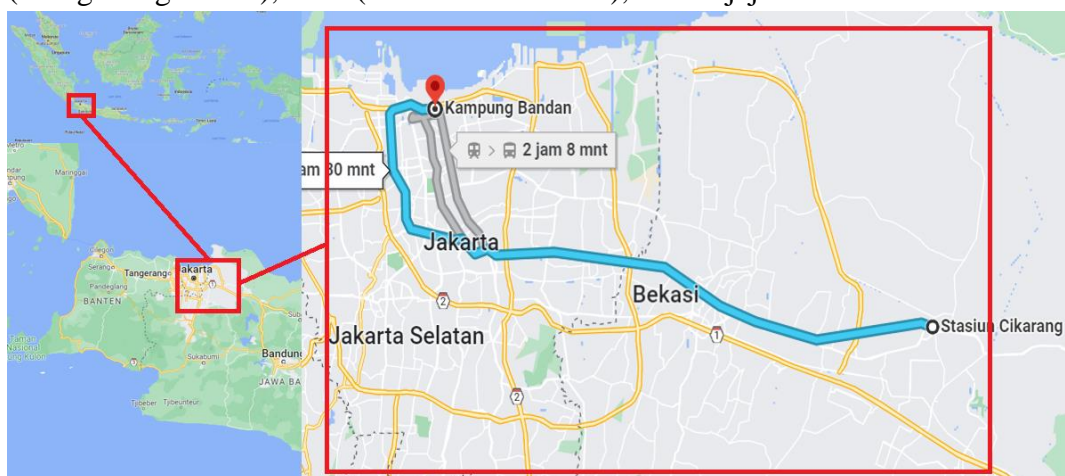


Figure 1. Study Location Map

In addition to these modes, the KRL crosses the Mangga Dua area, with Kampung Bandan station and Jayakarta station as the nearest access stations. Bekasi City and Regency,

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one of the capital's economic support areas, is one of the areas covering the KRL route, contributing much productive energy in Jakarta. Many people in the Bekasi City and Regency area use KRL to do activities every day in various areas covering the KRL route, including the Mangga Dua area. In addition, they can choose the Cikarang – Kampung Bandan (Cikarang Line) route for daily round trips. The location of the study is shown in Figure 1.

Primary Data Processing

The primary data in this study is survey data obtained from questionnaire answers distributed in November – December 2022 through Google Forms. This primary data must be tested for validity and reliability to be recognized for the survey validity. Validity and reliability tests are carried out with the help of SPSS software version 16.0.

Validity Test

In this study, the Corrected Item-Total Correlation Technique was used. *The resulting output* is said to be valid if the value of the Corrected Item-Total Correlation value is greater than the corresponding table R referring to Pearson Correlation. The Pearson value used is a 95% confidence level, or a 5% significance level, with 100 respondents, which is 0.195. The correlation test results are presented in Table 1. An item is valid if the Pearson Correlation value > 0.195 . Based on the results of data processing using SPSS, the variables Item 1, Item 2, Item 3, Item 4, and Item 5 meet the validity requirements, so it is said that 5 Items in the instrument are declared valid.

Table 1. Item-Total Statistics

	Pearson Correlation	R Table	Information
Item 1	0,383	0,195	VALID
Item 2	0,254	0,195	VALID
Item 3	0,266	0,195	VALID
Item 4	0,261	0,195	VALID
Item 5	0,344	0,195	VALID

Source: SPSS Processing Results

Reliability Test

In this study, the reliability test was carried out using the help of SPSS software version 16.0. A research instrument is declared reliable if the Cronbach Alpha value > 0.6 . The data processing results of respondents with SPSS are presented in Table 2. The data processing results of 100 respondents using SPSS gave an Alpha Cronbach value output of 0.689; Cronbach's Alpha Based on Standardized Items 0.690; and N of Items 5. Because the Alpha Cronbach value obtained ($0.689 > 0.6$), the research instrument can be declared reliable.

Table 2. Reliability Results Table

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items 5
0,689	0,690	5

Source: SPSS Processing Results

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Statistical Data Analysis

A summary of the characteristics of the respondents is presented in Table 3. Of the 100 respondents, 55 were female, while 45 were male. 90 people out of 100 people are workers, and the remaining 10 are students. Ten people from Bekasi City and Regency travel to Mangga Dua 1 time a week; 3 people two times; 6 people three times; 3 people four times; 58 people five times; 16 people six times; and four people 7 round trips 71 of them chose the KRL mode while 29 others chose motorcycles.

Table 3. Primary Data Summary

No	Variable	Choice	Percentage
1	Gender	Woman	55%
		Man	45%
2	Profession	Worker	90%
		Students	10%
3	Travel frequency in a week	1 time	10%
		2 times	3%
		3 times	6%
		4 times	3%
		5 times	58%
		6 times	16%
		7 times	4%
4	Mode Options	KRL	71%
		Motorbike	29%

Based on Table 3, the people of Bekasi City and Regency who travel to the Mangga Dua Area daily are primarily workers, with a percentage of 90%, and the others are student groups. 71% of respondents chose KRL mode as a mode of daily use, while another 29% chose motorcycles. Some factors cause people to choose the KRL mode in selecting this mode. These factors follow the values per variable sorted from the highest importance to the lowest value presented in Table 4.

Table 4. KRL Mode Assessment

Variable X	Items	Value
1	Travel cost-effectiveness	197
2	Safety and comfort of modes	197
3	Obstacles	196
4	Easy access to KRL station	196
5	The effectiveness of travel time	187

From Table 4, it can be concluded that cost-effectiveness, safety, and comfort are the most influential factors in choosing the KRL mode. Barriers and ease of access are the second most significant factors, and the effectiveness of travel time is the last of the five elements in

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the most influential hypothesis. The comparison of the average value between KRL and motorcycle modes is presented in Table 5. Based on the assessment results in Table 5, the overall average factor for the KRL mode is still more significant than that of motorcycles.

Table 5. Comparison of Average Values

Factor	Average value	
	KRL	Motorbike
Easy access to KRL station	2,761	1,670
Travel cost-effectiveness	2,775	1,966
The effectiveness of travel time	2,634	2,559
Obstacles	2,761	2,414
Safety and comfort of modes	2,775	2,067
		*Value Scale: 1-3

CONCLUSION

Based on the results of the analysis of the selection of KRL modes for the people of Bekasi City and Regency who have their daily activities in the Mangga Dua Area that have been carried out, it can be concluded that KRL as a rail-based public transportation mode is a mode of transportation used by most of the people of Bekasi City and Regency who have daily activities in the Mangga Dua Area. The results of processing and analysis of primary data in questionnaires showed that 71% of Bekasi – Mangga Dua travelers prefer to use the KRL mode instead of motorcycles. The most influential factor in choosing this mode is the factor of cost-effectiveness and safety, and comfort. Barrier and ease of access became the most significant factors afterward, and the effectiveness of travel time became the last of the five total elements in the most influential hypothesis. It can be concluded that KRL is a solution to transportation problems in the Bekasi City Area.

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