

Understanding People's Acceptance of Light Rail Transit in Bandung and Its Determinant Factors

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ABSTRACT

The aim of this research was to verify the readiness of Bandung people in accepting Light Rail Transit (LRT) as the new transport option. Through a survey questionnaire with various respondent backgrounds, the researchers applied statistical analysis using ANOVA to compare the acceptance between the group of gender, age, occupation, income, home location, mobility pattern, and current transport. As the extension, the research also explored the factor determining people's priority in choosing transport and showing attributes (comfort, security and safety, exclusivity, time travel, cost, flexibility, facility, and accessibility). The result reveals that there are no differences between-group comparisons in accepting LRT as the new transport. In analyzing the determinant factors, the result shows that passengers tend to value security and comfort for their daily activities in choosing public transportation. Meanwhile, the exclusivity and facility are considered undesirable for passengers in deciding to take public transportation for travel. LRT is considered as a mode transport that provides sustainable transportation value. The readiness of passenger and market environment to the sustainable transportation option is important to maintain the successful implementation of the LRT project in Bandung.

Keywords: people acceptance, Light Rail Transit (LRT), determinant factors

INTRODUCTION

Employee Transportation plays an important role in supporting people's daily activities as it is related to productivity and mobility (De Gruyter, Currie, & Rose, 2017). Therefore, an improvement in transportation has been made in many ways to ensure its sustainability (Di Pasquale, dos Santos, Leal, & Tozzi, 2016). The current trend in planning and investment of new modes of transport is focusing on technology advancement, design, and cost efficiency (Mattioli, Lucas, & Marsden, 2018; Owczarzak & Żak, 2015; Wiesenthal, Condeço-Melhorado, & Leduc, 2015). People are devoted to make an innovation in transportation with an optimized and efficient mindset. However, in public transport, which is mostly semi or non-profit, people tend to forget that the case is not only the advancement of technology and price (Owczarzak & Żak, 2015; Pojani & Stead, 2015). It also concerns the market readiness, which

includes people's acceptance of the new mode of transportation (Korczak & Kijewska, 2016). Thus, investing in a comprehensive transportation system like public transport will create greater access to mobility, business, and job opportunities for all citizens (Carteni, De Guglielmo, & Pascale, 2018; De Gruyter *et al.*, 2017).

A well-managed urban transportation system contributes to rapid economic growth in developing countries (Sharma & Newman, 2017). Public transport boosts economic growth by minimizing the overall transportation cost, controlling private car consumption, and encouraging savings (Carteni *et al.*, 2018; Pojani & Stead, 2015). On the other hand, urban sprawl has a significant effect on people's mobility and quality of life (Korczak & Kijewska, 2016).

The public transportation is as a measure to cope up with city congestion and growing in a city (Chowdhury & Ceder, 2016). To answer the sustainability of transportation issues, one of the

options is by creating mass transportation that can afford the need of people with economic and efficient consideration (Trindade *et al.*, 2017). The principal function of public transportation is to provide accessibility to all members of society, particularly for those with limited mobility choices (Cuthill, Cao, Liu, Gao, & Zhang, 2019; Gunaruwan & Jayasekera, 2015). The importance of mobility in sustainable transportation (infrastructure and service) has the value to the extent that they help society to achieve social, economic, and environmental goals, especially in considering the role of transportation in addressing poverty (Holden, Linnerud, & Banister, 2014). In addition, geographic isolation, which is measured by the length of commutation and travel time, is a significant factor in people's ability to leave poverty (Linnerud & Holden, 2016). Hence, the ability to serve high accessibility is the initial value of public transportation.

According to Hamenda (2018), the ride-sharing revolution and synthesis (the current case in the transit system) decline in service and performance, it cannot afford the growth of overpopulation. Thus, it makes people tired of using public transportation. (Hasselqvist, Hesselgren, & Bogdan, 2016). Hence, an approach to consumer behavior to improve transportation service is crucial to boost people's willingness to use public transportation (Oliveira, Bruen, Birrell, & Cain, 2019).

Several studies conducted have found that socio-demographic variables play a significant role in the demand for transportation (Cheng & Chen, 2015; Lee, Eom, You, Min, & Yang, 2015; Terayama & Odani, 2017). The indicators include gender, age (children, teenager, adult, and older), level of education, occupation or current status whether the person is employed or unemployed, and income (Clark, Chatterjee, & Melia, 2016; Şimşekoğlu, Nordfjærn, & Rundmo, 2015; Sundling *et al.*, 2016). Personal preference for transportation also has to be considered in mapping passengers' demand. The transportation selection includes activity that demanding daily commute, the person that travel (alone or with family), and efficiency in determining the choice of transport (Chowdhury & Ceder, 2016).

By considering factors in a service area that also influence passengers' preferences, punctuality of arriving and departing time from the transit area and efficiency of operation route also play a big part (Cheng & Chen, 2015). As a standard of service, safety, and security should also be considered as the determining factor (Oskarbski & Jamroz, 2015). A fast and reliable mode of transportation will make people consider to use public transportation (De Vos, Van Acker, & Witlox, 2014). The fact that Indonesia's public transport has a bad image regarding safety, security, and service becomes the reason people are not willing to use public transportation (Joewono & Kubota, 2007). A bad reputation from mass transport encourages people to use their private cars (Hasselqvist *et al.*, 2016). The intention in proposing public transportation, including

providing the infrastructure that people can walk and cycle, is the main point of sustainable transportation concept (Nasrudin, Rostam, & Noor, 2014).

Peer relations or social networks are also mentioned as one of the benefits of using public transport. People will blend with various types of people (De Gruyter *et al.*, 2017). In a heuristic study on car stickiness, the factors that determine people's likeness with the private car can be applied to public transportation. Thus, people can create comfortable mass transportation (Hasselqvist *et al.*, 2016). Some contextual change variables are mentioned by Clark *et al.* (2016). The factors encourage people to switch to public transportation such as low fare, government incentives, a well-built infrastructure, and efficiency in daily operation.

From the literature review described, the researchers identify eight attributes that most likely are related to measure perception towards rail-based transport taken from the study of De Vos *et al.* (2014), Joewono and Kubota (2007), Oskarbski and Jamroz (2015). It includes comfort, security and safety, exclusivity, reliability, cost or price preference, flexibility, facility, and accessibility of transportation mode.

Over these past years, the trend of private cars has proliferated in several cities in Indonesia. In Bandung, the expansion of the urban areas and rapid growth of the economy produces a significant increase in mobility needs and transportation demand. As the impact, high mobility also affects the rise in private vehicle percentage by 11% per year (Dinas Perhubungan Pemerintah Kota Bandung, 2016).

A survey conducted by Bandung Urban Mobility Project stated that the increase of population affected the increase of usage number of transportation, primarily private vehicles. Thus, it had an impact on the economy (a high cost of transportation due to traffic congestion), social aspect (damage in vehicle accidents), and environment (high consumption of fuel that caused pollution) (Sukarno, Matsumoto, & Susanti, 2016). Another forecast is that, by 2033, the average speed time in Bandung city will be 4,5 km per hour, with an average distance of 11,54 km/trip. It means that the average time people spend on the road for their daily trip will be 2,5 hours (Dinas Perhubungan Pemerintah Kota Bandung, 2016).

According to the data gathered by Dinas Perhubungan Pemerintah Kota Bandung (2016), the congestion will impact the economic sector with high monthly spending on transportation with average Rp436.000,00 per month. It is not ideal if people rely on the gross expenditure rate. The total loss because congestion will be Rp4,63 trillion per year. For the environment aspect, the consumption of fuel for motorized vehicles will reach 627 million liters per year. It contributes to 66,34% of gas emission/pollution in the city. In the social aspect, the transport accident reaches 22,37% per year. It is not only physical damage, but it also influences the quality of life of the citizens.

To face the current challenge in developing accessibility and mobility in Bandung, the regional government plans to support people's mobility with excellent infrastructure and several public transportation options. One of the projects that will be executed is a rail-based transportation system, called Light Rail Transit (LRT). LRT will be operated in the center of the city with five main lines to cater to the people's mobility demands (Dinas Perhubungan Pemerintah Kota Bandung, 2016).

Aligning with the sustainable transportation issue in developing countries, this research is conducted as a part of the LRT establishment in Bandung. LRT is not only an answer to counter urban sprawl in a big city like Bandung, but it is also an implementation of technology innovation that holds sustainability value in the economy, society, and environment (Sukarno *et al.*, 2016). By bringing out the sustainable transportation concept as an innovative system, there is a chance of lack of adaption or refusal to the new transportation from the people (Sanusi, Thayf, & Alamzah, 2017; Sharma & Newman, 2017). In order to succeed in the development of a new transportation system, public transportation should be perceived as a consumer-oriented market (Molander, 2018; Sanusi *et al.*, 2017). Hence, it is important to examine the market readiness of potential public transportation users. The information will increase the capability to understand the changing needs in terms of new system characteristics (Korczak & Kijewska, 2016). The purpose of this study is to investigate the market readiness of LRT in Bandung by identifying people's acceptance of the new transportation option. Thus, the specific objectives are to find the current travel behavior of people in the city and investigate people's acceptance of a new transportation option.

METHODS

The scope of this survey is Bandung, where LRT is planned to be operated with a population of 2.490.622 (Badan Pusat Statistik Bandung, n.d.). However, as the researchers identify people who have daily activity and require frequent mobility with productive age from 10-60 years, the total population is 1.898.247 people. Slovin equation with confidence level 90% is used in this analysis. It requires a minimum sample of 100 respondents. The population of this research encompasses people who live in Bandung. The sample is chosen using a random sampling method. Most of the data are collected via an on-site survey in the downtown area of Bandung, including Inter-city Bandung Station, Bus Rapid Transit (BRT) Station, Tegalega station, Braga Street, Balai Kota, and several commercial areas such as Pasar ABC, Paskal 23, and BEC. The survey was conducted from early February 2018 until the end of May 2018 and collected 163 samples.

To gather the information, the researchers

construct a structured survey questionnaire. It is distributed directly to the respondents using a hardcopy file. The survey questionnaire is divided into four sections. The first section is asking about respondents' profile as the independent variables in this research. The second section aims to investigate people's current travel behavior. It requires the respondents to inform their daily activities and mobility pattern. The third section asks respondents to rate a 10-point scale about their perception towards LRT (1= strongly disagree, and 10= strongly agree). In the fourth section, the respondents are asked to give rank to their priority in choosing a mode of transportation (1 is the first priority, and 8 shows less priority). The data collected are analyzed using SPSS Statistics for Mac version 23. Figure 1 explains the step-by-step performed in this study to analyze the data collection.

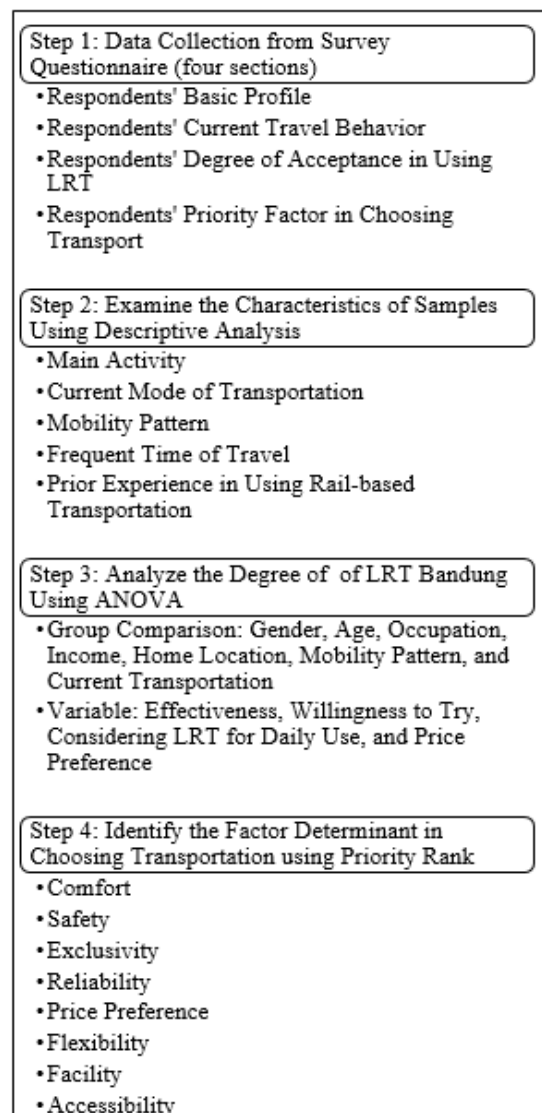


Figure 1 Research Methodology (Source: Author)

RESULTS AND DISCUSSIONS

To analyze the degree of acceptance, the researchers look at the respondents' profiles and characteristics gathered in this research. The total data collected are 163 with 11 missing data. From the remaining 152 data, 58% of the respondents are female. The majority of the respondent is in the range of 20-40 years old. It represents the productive age in Bandung (Badan Pusat Statistik Bandung, n.d.). As the survey is conducted in the center of the city, the data gathered shows that 74% of home location is around the town or Kota Bandung. The rest who is categorized lived in peripheral city are the respondents who live in Kabupaten Bandung, Kabupaten Bandung Barat, Kota Cimahi, and Kabupaten Sumedang. From most of the samples, their main activity in the city is related to their occupation as students (47%) and employees (36%). Last, in their monthly income, 59% is between Rp1.000.000,00-Rp5.000.000,00.

Table 1 The Characteristics of Samples and Current Travel Behavior

Description	Characteristic	Frequency	%
Main Activity in the City	School or College	8	5
	Shopping	63	42
	Rendezvous	8	5
	Tourism	11	7
	Working	16	11
Current Mode of Transportation	Passing	46	30
	Private Motorcycle	41	27
	Private Car	38	25
	Motorcycle Taxi	51	33
	Paratransit	18	12
	Taxi	0	0
Mobility Pattern	Damri Bus	4	3
	Daily Activity	40	26
	Commercial Activity	50	33
Frequent Time of Travel	Irregular Mobility	62	41
	00.00 - 07.00	3	2
	07.00 - 17.00	102	67
	17.00 - 21.00	8	5
Prior Experience Riding LRT	21.00 - 24.00	0	0
	07.00 - 17.00 to 17.00 - 21.00	39	26
	Yes	40	26
	No	112	74

(Source: Author's Data Collection)

To investigate people's current travel behavior, the researchers ask regarding the information on their main activity in the city where LRT is planned to be developed. Table 1 describes the characteristics of the sample and their current behavior. From the data collection, most of the respondents (41%) usually go to the town for shopping. Meanwhile, the other rests (30%) are only passing by or transiting to another destination.

Then, the motorcycle is the most favorite choice for people to travel around the city. About 34% of the respondents use a motorcycle taxi for traveling. Another 27% of the respondents ride their motorcycle. This survey also shows statistically that paratransit and Damri buses gain less interest from people (15%) from data.

From the respondents' activities in the city, the researchers cluster their mobility patterns into three types. This segmentation is adapted from the study of Oliveira *et al.* (2019), who clustered the type of traveler into commuting, business, and leisure. However, in this research, the clustering name and definition are adjusted with the situation of the respondents in Bandung.

The first one is the daily activity pattern that respondents regularly travel with a minimum of five times a week. About 26% of the respondents show that they have daily activities in the downtown area, such as going to work, school, or campus. These types of travelers have a similar frequent time of traveling every day. Most of them spend time in rush hours, 07.00-09.00 in the morning and 17.00-19.00 in the afternoon, and have an urgent need to reach the destination as fast as possible.

The second pattern detected is a commercial activity. About 33% of the respondents state that they usually visit a shopping market or doing business in a downtown area. These types of travelers do not have a similar frequent time of traveling and going to the city less than five times a week. Some of them state that they are traveling at the rush hour, but they already spare time for a long travel time. They do not have an urge to be in a hurry.

The third pattern is those who have irregular mobility in the city. It means that they do not have a specific agenda and schedule to visit the downtown area. These kinds of travelers fulfill 41% of the respondents with various reasoning for activity and frequent travel time. Their activities vary from accessing inter-city station, transiting to another destination, or visiting the tourist area. Thus, it makes their travel patterns in the downtown area hardly to be detected. With the current trend of using a motorcycle to travel, the researchers try to introduce LRT as new transportation in the city. About 74% of the respondents respond that they do not have any experience of riding LRT, but they acknowledge the existence of rail-based transportation in several megacities. Meanwhile, the rest 26% of respondents state that they have experience in riding rail-based transportation like LRT, MRT, or commuter in foreign

countries like Singapore, Thailand, Hongkong, Korea, Japan, Taiwan, and Europe countries.

From the survey, the researchers also gather the information that most of the people travel from 07.00 am to 21.00 pm. It can be suggested as the length of operation time of LRT. About half of the samples (62%) state that they travel around 07.00 am-17.00 pm for their daily activity. Thus, the circulation of operating rail-based system is expected to be concentrated during the day. Moreover, most of the people using transportation during the day should reach their destination on-time. It is represented by 26% of employees and students. Thus, the reliability of the LRT schedule should be taken into consideration.

After defining the characteristics of the samples, the researchers analyze the acceptance of LRT from the people in Bandung. The researchers conduct Analysis of Variance (ANOVA) to a variable of the effectiveness of LRT, willing to try the new transportation option, considering to change the current mode of transportation into LRT, and acceptance of price preference. ANOVA or group comparison is used to determine if the different criteria have a significant effect on accepting LRT. The assumption hypothesis works for group comparison is that there is no significant difference between groups in accepting

LRT (H0). Hence, the hypothesis will be rejected if the result shows that there significant difference between groups in accepting LRT (H1). A p-value $\leq 0,05$ is required for a significant effect on the comparisons (Hair, Black, Babin, & Anderson, 2013). The sig. value shows that all category values are smaller than 0,05 (p-value $\leq 0,05$).

From Table 2, the analysis of group comparisons (gender, age, occupation, income, home location, mobility pattern, and current transportation) shows significant results in accepting LRT. This result allows the researchers to accept the null hypothesis (H0) that there is no difference between groups in accepting LRT in Bandung.

The fact that most of the respondents are willing to accept the upcoming LRT in the city is different from the result of study from Clark *et al.* (2016), Şimşekoğlu *et al.* (2015), and Sundling *et al.*, (2016). These studies imply that different position in social and demographic group may result in different perception on seeing the use of transportation. The differences from previous study may happen because the respondents do not face the real situation which LRT is operated. Hence, the high degree of acceptance toward LRT is coming from people's willingness to adapt sustainable transportation system (Korczak & Kijewska, 2016).

Table 2 People's Acceptance toward LRT in Bandung

Group Comparison		Acceptance			
		Effectiveness	Willingness to Try	Considering LRT for Daily Use	Price Preference
Gender	Homogeneity	0,886	0,259	0,907	0,216
	F	2,702	0,711	0,121	0,010
	ANOVA	0,102	0,401	0,729	0,921
Age	Homogeneity	0,330	0,081	0,682	0,405
	F	0,030	0,122	0,463	0,592
	ANOVA	0,971	0,885	0,630	0,554
Occupation	Homogeneity	0,791	0,328	0,262	0,185
	F	2,282	2,288	0,889	2,155
	ANOVA	0,063	0,063	0,472	0,077
Income	Homogeneity	0,313	0,027	0,088	0,121
	F	0,804	0,950	1,247	1,417
	ANOVA	0,494	0,418	0,295	0,240
Home Location	Homogeneity	0,170	0,206	0,023	0,578
	F	2,010	1,401	1,838	0,634
	ANOVA	0,138	0,249	0,163	0,532
Mobility Pattern	Homogeneity	0,665	0,922	0,746	0,989
	F	0,070	0,529	0,674	0,364
	ANOVA	0,932	0,590	0,511	0,695
Current Transport	Homogeneity	0,680	0,169	0,421	0,695
	F	0,364	0,864	0,254	0,073
	ANOVA	0,834	0,487	0,907	0,990

(Source: Author's Data Collection)

From Table 2, people show an interest in trying LRT. They also assume that the price for one way ride is affordable between Rp8.000,00-Rp10.000,00. The result shows a positive perception of the effectiveness of LRT. People are aware of LRT as a sustainable transportation option that can manage traffic circulation and preserve the environment. It is statistically significant shown in the effectiveness. However, if the researchers compare to the willingness to try LRT with their consideration of changing current transport choices, there is a significantly different result. From the interview on the onsite survey, most of the people still doubt the reliability of public transportation due to its requirement of transiting and walking distance.

In analyzing factor determinant in using LRT Bandung, the researchers use statistic descriptive with mean calculation to the respondents' choice. The respondent is asked to rank their priority in choosing the mode of transportation with a score of 1 to 8 (1 is the first priority, 2 is the second priority, and 8 is the less priority). Thus, the low value of the mean score in the factor shows a higher priority of choice. Meanwhile, the high value of the mean score shows less priority of choice.

From the mean calculation in Table 3, the first choice for people in choosing transportation is comfort value. It is followed by safety and security from the first mile until they reach the destination.

The third value which points the reason people are unwilling to use public transport is reliability. People choose transportation based on the trip duration calculation from the transit area and travel time. Another reliability value is the accuracy schedule of transportation. It includes waiting time-in-transit area and travel time. In chronological order from 1 to 8, the researchers conclude that people prioritize comfort to safety, safety to the reliability, reliability to price preference, price preference to flexibility, flexibility to exclusivity, exclusivity to accessibility. The last is the facility.

These results are supported by the Joewono and Kubota (2007) and Oskarbski and Jamroz (2015). They agreed that comfort, safety, and reliability as the major determinant factors in choosing mode transport. However, they concluded that reliability and accessibility as the first priority from all of the factors. Meanwhile, in this research, people consider comfort as the first priority before reliability and accessibility. This result corresponds to Joewono and Kubota (2007) that highlighted Indonesian passenger loyalty to transportation agency based on their service quality. Hence, the combination of comfort, safety and reliability factors should be considered as an integrated part in service quality of the transport mode.

Table 3 The Factor Determinant in Choosing Mode of Transport

Degree of Priority	Rank	Mean	Description
Comfort	1	3,26	People choose transportation mode based on the comfort they can get during the trip.
Safety	2	3,55	People choose transportation mode based on the safety conduction and high security on the first mile to the last mile.
Reliability	3	3,82	People choose transportation mode based on the performance of transportation-related to the schedule.
Price Preference	4	4,18	People choose transportation mode based on the ticket price.
Flexibility	5	4,91	People choose transportation mode based on easiness in accessing transportation from their location.
Exclusivity	6	5,22	People choose transportation mode based on the prestige feeling of riding the vehicle.
Accessibility	7	5,22	People choose transportation mode based on the easiness to access transportation from their surrounding area.
Facility	8	5,83	People choose transportation mode based on the facility offered on the first mile to the last mile and the vehicle condition.

Notes: Means is derived from Ranking: 1= Highly Prior and 8= Less Prior

(Source: Author's Data Collection)

The trend of using a motorcycle to travel around the town also supports the reliability point as people's priority in choosing transportation (Hamenda, 2018). Furthermore, the phenomenon of a motorcycle taxi, which offers non-transit service, also makes people use it more than public transport.

Considering the data described, a question arises on why people prefer private transport than mass transport. Thus it is answered by Nasrudin *et al.* (2014). It states that one of the reasons people are not satisfied with the quality service of mass transportation by the government is mostly from the reliability value of transportation. To accelerate the performance of a new transportation system, an approach to the people as customers of mass transport is needed in projecting passengers' demand. Despite the trend of creating innovation in technology transportation, the government needs to bring people as the center of creating transportation service.

In accordance, a motorcycle taxi that uses a ride-sharing strategy has its advantage as complementary to public transportation options (De Vos *et al.*, 2014; Hamenda, 2018). Meanwhile, this transportation agency can provide comfort. It is the first rank of why people choose transportation. It is by integrating its service with transport network connectivity. This result is supported by Cheng and Chen (2015) on impact of accessibility, mobility and connectivity in people's willingness in using public transportation. From this research, it is identified that public transportation faces its problem due to limitation in the reachable area and schedule that cannot be customized.

CONCLUSIONS

This research aims to verify people's acceptance toward the upcoming mode of transportation, LRT. It is done by examining the characteristics of samples and their current travel behavior. The descriptive analysis operated in the variables obtains information about people's travel behavior in Bandung. Descriptive analysis can portray the characteristics of a particular group, situation, or individual. The socio-demographic approach is used in the analysis to describe the respondents' profile. It represents the people in Bandung. Completing the analysis of travel behavior, aside from socio-demographic information such as gender, age, occupation, income, and home location, the researchers also identify their main activity and mobility pattern. It is related to the purpose of travel and its relation with respondent status, frequent time of traveling, and current transportation.

The result of group comparison shows that there is no difference between groups in the category of gender, age, occupation, income, home location, mobility pattern, and current transportation in accepting LRT as the new mode of transport in Bandung. Thus, the result supports the conclusion that most of the respondents have a similar perception of the effectiveness of LRT and want to try new transportation. Moreover, the research also reveals

that respondents are considering to use LRT for their daily activities and accepting the price offered by the LRT agency.

From the factor determinant in choosing a mode of transportation, most of the passengers prioritize comfort, safety, and reliability. Hence, it is important to strengthen the competitiveness of the transportation from the comfort and safety in the new LRT in Bandung. Another emerging case of the development of LRT is the reliability factor of the transportation mode, especially in terms of punctual schedule. From the observation, the current condition of public transportation still cannot win over private vehicles and online-booking transportation. It causes less interest from people using mass transportation.

The result of this study has shown a similar perception among characteristics of transportation in the eye of passengers of the public transportation system. By analyzing the perception according to users' demography and travel behavior, the researchers can apply a different strategy for rail-based transportation to target a wider market. In terms of planning a new transportation system, the result can be used as a basis for the positioning mode of transportation in the market. Early adoption of capabilities based on the demand-perception can be set up as the competitive advantage of new transportation. The overall result of this study is expected to be a consideration for the government in designing a transportation system in Indonesia. The analysis of travel behavior can be useful for the transportation agency, especially in Bandung.

For future research, an elaboration about behavioral intention in using transportation with the qualitative method can be a good option. It can capture a deeper understanding of people's intention in using a specific mode of transportation. Future study is expected to explore more about the operation design of LRT in Bandung, which can meet passengers' demand. Then, it is expected to replace current travel behavior with LRT. It can also be seen as a business that it should maintain its sustainability. By analyzing passengers' demand, it is expected that the service and operation strategy are sustainable.

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