√ OPEN ACCESS

A Model of Passenger Demand on the Operation of LRT at Ngurah Rai Airport Corridor in Bali

Hermawati P[1*], Bahtiar[1]

[1]Bali State Polytechnic, Bukit Jimbaran Campus, Badung – Bali, Indonesia

Abstract		Original Research Article

In the planned of LRT procurement for the Kuta - Ngurah Rai Airport route, it is necessary to determine the potential travel demand and passenger characteristics, so that the government and the industry involved can plan their infrastructure and facilities needs appropriately. The results analysis show that passengers are included in the choice group, meaning that almost all have private vehicles but they have high motivation for the availability of safe, comfortable and on time public transportation. Potential Demand Analysis with Stated Preference shows the highest choice is LRT/ART of Airport-Kuta-Sanur route 66.50% of passengers, the second choice using private vehicles 22.10% of passengers. The potential demand model for LRT/ART users can be well explained by the individual passengers characteristics with a significance level of 84.807%, and the effect of all variables on the model is 54.3%. The characteristics of passenger trips can also explain the model with a significance level of 87.342%, and the effect of all variables on the model is 65.8%. With this model, it is hoped that the LRT / ART type mass transit system will be able to compete with private cars, taxis or online-based public transportation.

Keywords: LRT/ART users, Airport route, passenger, private vehicles, public transportation.

1. INTRODUCTION

Transportation is a derived demand due to economic, social, cultural and others. As an area or city grows, both in terms of economy and population, it will have an impact on increasing the use of transportation services, including the use of public transportation services for its movements. One of the transportation system facilities planning that is important to help solve transportation problems is mass public transport planning. Based on a study of the availability and needs of public transportation infrastructure and facilities (Hermawati *et al.*, 2020), it was found that the number of motorized vehicles in Bali in the last five years has increased by an average of 6.41% per year, or motor vehicle ownership in Bali has increased on average of 218,495 units per year, or an increase of 599 units per day, while the increase in road infrastructure is an average of 1.83% per year. That is indicating a clear imbalance between the provision of road infrastructure and the growth rate of vehicle ownership. The level of motorization in Bali is also quite high, namely 1.45 and 1.29 for Denpasar and Badung. For this reason, efforts must be made to overcome it by planning mass public transportation, road pricing, parking management and

traffic demand management efforts which are carried out simultaneously (Putri *et al.*, 2021).

Based on these conditions, it is time to look at the Sustainable Transport Modes planning program. A rail-based sustainable public transportation, which tends to be free from congestion is recommended, so that the resulting travel time is reduced with a large passenger carrying capacity (Putri *et al.*, 2021). As a solution, an alternative mode of public transportation that can accommodate many passengers has been developed, thereby reducing the use of private vehicles. The recommended form is the LRT (Light Rail Transit) type mass transit system. In connection with the LRT development plan on the Kuta - Ngurah Rai Airport route, it is necessary to conduct a study to determine the potential travel demand for potential passengers using this route and the factors that influence it, so that the government and the industry involved can plan infrastructure needs and ingredients exactly (Djie & Sumarno, 2020). In this study, the individual characteristics and travel characteristics of passengers on the route will be identified, the potential travel demand of potential passengers and a model of the

potential demand for travel of passengers and the factors that influence it in choosing the mode will be made. It is hoped that the mass transit system of the LRT (Light-Rail Rapid Transit) and ART (Autonomous-Rail Rapid Transit) types will be able to compete with private cars, taxis or online-based public transportation (O'Donnell *et al*., 2018).

In connection with the LRT development plan on the Kuta - Ngurah Rai Airport route, it is necessary to conduct a study to determine the potential travel demand for potential passengers using this route and the factors that influence it, so that the government and the industry involved can plan infrastructure needs and ingredients exactly. In this study, the individual characteristics and travel characteristics of passengers on the route will be identified, the potential travel demand of potential passengers and a model of the potential demand for travel of passengers and the factors that influence it in choosing the mode will be made. It is hoped that the mass transit system of the LRT (Light-Rail Rapid Transit) and ART (Autonomous-Rail Rapid Transit) types will be able to compete with private cars, taxis or online-based public transportation.

2. LITERATURE REVIEW
Demand Potential Modelling of LRT
LRT corridor Kuta - Ngurah Rai Airport is the planning part of the urban Sarbagita train. This first innovation in providing LRT in Bali is planned by building a shuttle train from the airport to the front of the Grand Tulip Hotel, on Sunset Road. This shuttle is planned to pass underground via Kuta with a length of approximately 5.4 km. In front of the Grand Tulip Hotel, it is planned to build a building that will be used as a city check-in area. This location will be connected directly to the ART light train prepared by PT KAI to serve the city to Sanur. According to the draft master plan, the LRT is planned to travel along the west side to Legian, Seminyak, Canggu, Badung government center, to Mengwi (Agustien *et al*., 2019). The research to be carried out is an innovation to further strengthen and refine the planning for the provision of the first rail-based mass public transportation for the public and tourists in Bali, by producing a potential travel demand model for the LRT / ART operation of the Kuta - Ngurah Rai route (Rahman *et al*., 2019).

Mass Public Transportation
Public transportation is a mode of transportation intended for many people, common interests, receiving shared services, has common directions and points, and is bound by route regulations and schedules (Sinaga *et al*., 2019). Travelers are obliged to adjust to these conditions if they choose to use public transportation. Public transportation operates on a certain schedule and route and can be boarded by anyone who is willing to pay a predetermined rate. Public transportation is divided into seven item, for example: online motorcycle, microbus, bus, train, river / sea ferry, airplane.

Mass transportation is a driving facilities that allows many people to move from one place to another and is able to provide time, place, and cost efficiency in various regions (Napitupulu *et al*., 2018). There are several types of mass transportation that are commonly used in cities, including Bus Rapid Transit, Heavy Rail Transit, Commuter Line, Monorail and Light Rail Transit.

Light Rail Transit (LRT)
LRT (light rail transit) is a passenger train system which usually operates in urban areas which have light construction and can travel with other traffic or on special routes. LRT is often called a tram. LRT is a mode of mass transportation that is part of the Mass Rapid Transit (MRT) with a smaller coverage (Baker & Lee, 2019). LRT has been implemented in various countries around the world and has undergone modernization, including automation so that it can be operated without a driver, can operate on special tracks, use a low floor LRT (about 30 cm heigh) to make it easier for passengers to get on and off (Sekasi & Martens, 2021).

Figure 1: The LRT rail is the same level with the highway (Barrett *et al*., 2019)

Potential Demand Analysis

The potential demand analysis was carried out to find out how many potential users of Light-Rail Rapid Transit (LRT) and it known as Autonomous-Rail Rapid Transit (ART) so that the planning can match the demand in Bali. This analysis uses an approach to the number of arrivals and departures of passengers at Ngurah Rai Airport in Bali and data from the distribution of questionnaires to potential passengers. Potential demand analysed is potential demand in year 2020. Based on the analysis, the characteristics and size of potential passengers using LRT / ART are obtained. Further analysis is carried out to compile a model of potential demand in the choice of mode to be developed based on individual and travel characteristics (Jin *et al.*, 2020). By modelling, it can also be seen the factors that influence passengers in choosing the LRT / ART mode in competing with other available public transportation modes as well as the expected LRT operational performance (Babatunde *et al.*, 2019).

Modelling

Models are a reflection and simplification of reality for specific purposes, such as providing explanation, understanding and forecasting. These models can be in the form of physical models, graphic models (maps and diagrams), statistical models and mathematical models. That can be explained in the physical, socio-economic and transportation models (Cahyono & Herijanto, 2015). In general, it can be said that the more similar a model is to the reality, the better the model is. Although it is a simplification, the model can be very complex, requires a lot of data and takes a long time to solve (Ortúzar & Willumsen, 2011).

3. RESEARCH METHODS

The target of this study is a potential demand model based on individual passenger characteristics and passenger travel characteristics in choosing the development of the LRT/ART mode to be operated on the route Kuta - Ngurah Rai Bali Airport.

Research Instruments and Variables

The main instrument in this research is a questionnaire form, which is designed to collect various data including individual characteristics and passenger travel characteristics and their assessment and choice of existing modes and the development of LRT / ART modes and the desired LRT operations. The questionnaire format refers to the questionnaire compiled in previous similar studies (Hermawati *et al.*, 2020). In the questionnaire, there are types of questions including the attributes of the answer choices.

Data Collection

Data collection in this study consisted of 2 (two) types of survey activities are as follows:

1. The first type of survey is the collection of primary data in the form of individual and socio-economic characteristics of LRT passengers, their travel characteristics and the LRT operational performance expected by passengers. The data collection through a questionnaire-based, either through direct interviews or online.

2. The second type of survey is to collect technical and operational data for the planned LRT on the Kuta - Ngurah Rai Airport route, from the Bali Provincial Transportation Office, PT KAI, and Planners as well as from previous studies.

Data Analysis and Modelling

The procedure for estimating the parameter values of a number of variables in the model and the probability of each variable were analysed using the SPSS program and were also described quantitatively and qualitatively.

In modelling the potential demand, the multiple linear regression analysis method is used, which is the most frequently used method (Derakhshan, 2015). Most of the transportation planning research uses linear regression analysis to examine potential demand and trip generation. Multiple linear regression technique is interesting for transportation analysis because it makes it easy to determine the degree of relationship between the dependent variable and the independent variable. The concept of multiple linear regression analysis states the relationship between one dependent variable and several independent variables. This mathematical model has the form:

$$Y = a + b_1X_1 + b_2X_2 + \ldots\ldots\ldots\ldots\ldots + b_nX_n$$

With:
Y = dependent variable (potential demand in choosing mode)
a = constanta
$b_1, b_2, \ldots., b_n$ = regression coefficient
$X_1, X_2, \ldots., X_n$ = independent variables (influencing factors)

4. RESULTS AND DISCUSSIONS

The opportunities for developing LRT/ART as one of the public transport modes services in Indonesia and in Bali can be well developed. ART is a medium capacity urban transport solution with a balance of capacity and cost. Mass public transportation technology is currently going towards electric vehicles. ART infrastructure development and operational costs are cheaper than other rail infrastructure and equivalent to developing BRT (Bus Rapid Transit). ART can be integrated and become part of existing transportation, and does not have to be a substitute for existing transportation. LRT/ART is a medium capacity urban transport solution with a balance between capacity and cost, short delivery times, low investment and also high adaptability (Ferbrache & Knowles, 2017).

Bali Railway Development Plan at Bali in Airport Corridors

There are two railway development plans in the Bali Ngurah Rai Airport corridor, namely (1)

Airport Urban Train Plan (Airport- Jineng Hotel – Sanur) and (2) Airport LRT / ART Plan (Airport - Central Parking). The urban train plan for the Airport route – Jineng Hotel - Sanur with a total length of 18 km. From this Jineng terminal, an airport shuttle LRT to check in center is planned, with the Jineng terminal - TOD Kuta - Domestic Terminal - International Terminal along 3.9 km, as shown in Figure 2. The type of train to be used and its technical specifications are shown in Figure 3.

Figure 2: LRT Shuttle Airport Route
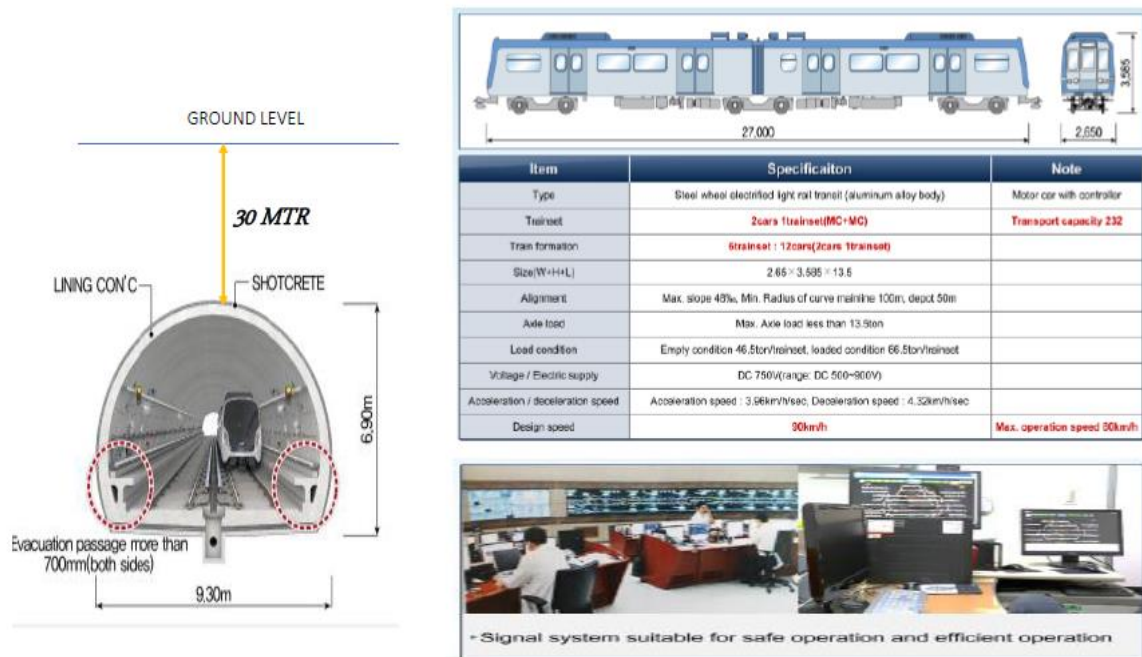(Jineng-TOD Kuta- Domestic Terminal- Internasional Terminal)

Figure 3: Technical Specification of ART/LRT in Bali

As an initial step in realizing the LRT / ART operation in Bali, it is planned to carry out an ART operational trial with the Jineng-Central Parkir-BLK route and there are also plans for a trial run up to Ngurah Rai Airport. The route used is rail sharing on the existing road.

Passenger Individual Characteristics

The characteristics of individual passengers using LRT/ART to and from Ngurah Rai Airport are reviewed based on gender, age, education, occupation, income and number of vehicles owned. These factors are reviewed according to the analysis conducted, which states that individual characteristics related to personal motivation in choosing the mode to be used are factors with the first ranking of interests that need to be analysed, which is considered more important than other factors.

Based on the characteristics of prospective passengers, they correlate with each other as an individual profile with their characteristics is adults, university educated, mostly as employees or entrepreneurs, having an income of 8-12 million rupiahs and on average own 2 - 3 units of cars and motorbikes. By looking at the individual profiles of passengers to and from the airport, it can be seen that they are included in the choice group, meaning they have private vehicles but are still enthusiastic about expecting safe, comfortable and on time of public transportation. In more detail, the individual characteristics of LRT / ART passengers to and from Ngurah Rai Airport can be seen in Table 1.

Table 1: Individual LRT/ART Passenger Characteristic at Airport Corridor

No.	Variable & Category		Result	
	Variable	**Category**	**Frequency**	**Percentage (%)**
1.	Gender	Male	96	70,60
		Female	40	29,40
2.	Age	< 15 years	1	0,75
		16 - 30 years	27	19,90
		31 - 45 years	18	13,20
		46 – 60 years	89	65,40
		> 60 years	1	0,75
3.	Education	SD	-	-
		SMP	-	-
		SMA	5	3,70
		S1/D4	44	32,40
		S2/S3	87	63,90
4.	Occupation	Student	18	13,20
		Government employees	73	53,70
		Private Employees	30	22,10
		Army/Police	-	-
		Entrepreneur	15	11,00
5	Family Income (million rupiahs)	< 4	17	12,60
		4 – 8	32	23.00
		8 – 12	33	24.40
		12 – 16	17	8,10
		16 – 20	11	1,50
		> 20	26	19,30
6.	Own vehicles (unit)	2	24	17,60
		2	34	25,00
		3	35	25,70
		4	27	19,90
		5	9	6.65
		6	7	5,15

Travel Characteristics of LRT / ART Passengers

The characteristics of passenger travel to be reviewed include the purpose of travel, frequency, number of group members, number of luggage, distance and travel time according to Table 2. The results of this study indicate that the purpose of travel to or from the airport is dominantly for the purpose of work, educational assignments and tourism purposes, with almost equal numbers of 24.10% to 27.90%. The frequency of trips to the airport is uncertain depending on their duties/needs about 28.70%, the most every 6 months 40.20%. Based on the number of group members, it can be seen that 40% they to go to the airport alone and 34.80% are two. The number of luggage carried, at most was one baggage about 73.30%. The travel distance to the airport from his house was less than 20 km with 52.20% and with a distance of 21 - 40 km is 39%. The most travel time to the airport is 31-60 minutes about 69.10%.

Table 2: Travel Characteristics of Passenger LRT / ART at Airport Corridor

No.	Variable & Category		Result	
	Variable	**Category**	**Frequency**	**Percentage (%)**
1.	Purpose of Travel	Bussines	12	8.80
		Education	38	27.90
		Working	37	27.20
		Tourist	32	24.10
		Social /Spiritual	12	8.80
		Festival/Competition	5	3,65
2.	Travel Frequency	Everyday	2	1,50
		1 – 3 kali/week	2	1,50
		1 x a month	8	6,10
		1 x 2 bulan	8	6,10
		1 x 3 bulan	21	15,90
		1 x 6 bulan	53	40,20
		Tidak tentu	42	28,70
3.	Travel Group number	1 person	54	40.00
		2 person	47	34.80
		3 person	15	11.10
		4 person	8	5,90
		5 person	5	3,70
		> 5 person	6	4,40
4.	Baggage number	1 pack	99	73.30
		2 pack	27	20,00
		3 pack	7	5,20
		4 pack	2	1,50
		No baggage	1	0,50
5	Travel Distance	< 20 km	71	52.20
		21 – 40 km	53	39.00
		41 – 60 km	5	3,70
		61 – 80 km	2	1,50
		81 – 100 km	4	2,90
		101 – 120 km	4	2,90
6.	Travel Times	< 30 minutes	26	19.10
		31-60 minutes	94	69.10
		61-90 minutes	7	5.10
		91-120 mins	3	2,20
		121-150mins	5	3,70
		Uncertain	1	0,70

Existing Travel Modes and Cost to the Airport
a. Travel Cost

The travel cost for passenger to the airport is currently around Rp.51,000 – Rp.100,000 per person about 40.40% and 25.70% of them paying travel costs Rp. 101,000 - Rp. 150,000 and uncertain is about 19.10%, because it depends on the travel distance and the choice of mode used. The profile of travel costs to Ngurah Rai Airport, Bali can be seen in Figure 4.
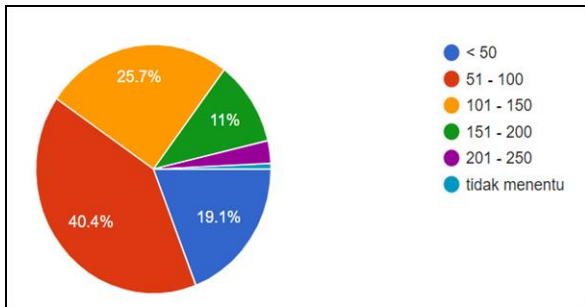

Figure 4: Travel Cost to Ngurah Rai Airport

b. Travel Modes

Various choices of modes that can be used by users to go to and from Ngurah Rai airport, Bali, both for passengers who are "captive user" and "choice user" there are various options, i.e using a bus, taxi, delivered by friend, family or a private car, car rental or online car or motorbike. Of the various options available, the most frequently used to go to the airport is by a private car, 51.5%, online car by 19.4% and using a motorbike 8.2%. On the way to and from the airport, it is preferable to use a car mode rather than a motorbike because it is closely related to carrying luggage. The choice of online mode is quite dominant, indicating the need to regulate its legal aspects because it has become a comfortable and efficient choice of society.

Potential Passengers Travel Demand

The potential passengers demand in each mode, whether it is for domestic, international flights or the number of passengers for the departure or arrival route, can be seen in Table 3.

Table 3: The Potential Passenger Travel Demand of All Modes Choices

No.	Potential Demand	LRT (Central Park)	LRT (Hotel Jineng)	Private Car	Taxi	Motor cycle	Number of Passenger (person)
1.	Modes Choices (Stated Preference)	17.60%	48.90%	22.10%	8.10%	3.30%	
2.	Total of Potential Demand	4,185,135	11,628,018	5,255,198	1,926,113	784,713	23,779,178
3.	Passenger for Domestic Flights	1,975,038	5,487,462	2,480,019	908,966	370,320	11,221,804
4.	Passenger for International Flights	2,210,098	6,140,556	2,775,180	1,017,147	414,393	12,557,374
5.	Passenger for Departure Route (Kuta -Airport)	2,139,441	5,944,243	2,686,457	984,629	401,145	12,155,916
6.	Passenger for Arrival Route (Airport – Kuta)	2,045,694	5,683,775	2,568,741	941,484	383,568	11,623,262

According to the planned operation of the LRT / ART mode for the Kuta - Ngurah Rai airport route, the respondent is given choices for all existing modes including the mode to be developed Rahman, H. Z *et al*., (2019), so the respondent is invited to choose and provide an opinion on the expected indicators on the development of the mode to be operated (stated preference). After analysing options by potential demand, the highest choice is LRT / ART with the route Hotel Jineng - Denpasar City - Sanur 48.90% (11.62 million) passengers, the second option is to use private vehicles totally 22.10 % (5.25 million) passengers and the third is using ART Central Parking route - Denpasar City (4.18 million) passengers.

Potential Demand Modelling

In this modelling analysis, a model will be made for the use of the LRT / ART mode for all passenger characteristics variables, both individual and their travel characteristics using Multiple Linear Regression Analysis. In detail, the independent variables to be analyzed include:

a. Individual characteristics (gender, age, education, occupation, income and number of vehicles owned) which are given symbols (X1, X2, X3, X4, X5 and X6)

b. Travel characteristics (purpose of travel, frequency of travel, number of group members, number of luggage, travel distance and travel time) which are given symbols (X11, X12, X13, X14, X15 and X16)

Modelling Based on Individual Characteristics

The results of parameter estimation in the modelling analysis are presented in Table 4. Access modes that can be selected include private cars, taxis, LRT Central Parking, LRT Jineng resort. A significant potential LRT demand model based on individual characteristic variables also can be seen in Table 4.

Table 4: Model of Potential Demand Based on Individual Characteristics

No.	Models	Constanta	Coefficient					
			X1	X2	X3	X4	X5	X6
1.	Private Car	-3,257	1,273	0,014	− 0,376	0,526	0,511	0,001
2.	Taxi	-0,020	0,118	- 0,137	− 0,986	0,388	0,672	- 0,122
3.	LRT Central	-2,292	1,415	- 0,163	0,493	- 0,132	0,258	0,100
4.	LRT Jineng	1,997	1,380	- 0,478	− 0,785	0,312	0,523	- 0,150

A significance analysis was carried out using the SPSS program, showing that the model built had a good significance between the dependent variable and the independent variable so that the potential demand model in choosing the mode access to Ngurah Rai Airport could be explained well by the individual characteristics variables of potential passengers who would use LRT, with a significance level of 84.733%. The effect of all individual characteristic variables (X1 - X6) on the choice of access mode is 57.9%,

Modelling Based on Travel Characteristics

A significant potential LRT demand model based on the travel characteristics variable can be seen in Table 5. The significance analysis using the SPSS program shows that the model built has a good significance between the dependent variable and the independent variable so that the potential demand model in choosing the mode of access to Ngurah Rai Airport can be explained well by the variables of potential passenger travel characteristics who will use LRT, with a significance level of 87.342%. The effect of all trip characteristic variables (X11 - X16) on the choice of access mode is 65.8%.

Table 5: Model of Potential Demand Based on Individual Characteristics

No.	Models	Constanta	Coefficient					
			X11	X12	X13	X14	X15	X16
1.	Private Car	-2,327	− 0,014	0,038	− 0,406	2,709	− 0,229	0,597
2.	Taxi	1,715	0,348	− 0,403	− 1,736	2,145	- 0,224	0,052
3.	LRT Central	0,194	0,088	− 0,392	- 0,304	2,049	− 0,562	0,955
4.	LRT Jineng	- 0,667	0,049	− 0,201	- 0,142	2,206	− 0,684	1,303

5. CONCLUSIONS

Referring to the results of the analysis obtained and discussed, the following conclusions from this study:

1. Based on individual characteristics of passengers, they are in the choice group, meaning that almost all have private vehicles but they expect the availability of safe, comfortable and on time public transportation to and from Ngurah Rai airport. The trip characteristics indicated that 74.80% of them departed to the airport one or two person in a car, with an average of 1-2 pieces of luggage. The average travel distance to the airport is 20 - 40 km with the most dominant travel time 31 - 60 minutes is 69.10%. So it can be assumed that the origin of the trip to the airport is from the Sarbagita area (Denpasar, Badung, Gianyar, Tabanan)

2. The total is 23,779,178 passengers who passed through Ngurah Rai airport, 51.12% were departures and 48.88% were arrivals. Demand Potential Analysis with Stated Preference shows that the highest choice is 48.90% (11.62 million) passengers on LRT/ART route the Jineng Hotel-Denpasar City-Sanur, the second choice is using a private vehicle 22.10% (5.25) million passengers and the third 17.60% (4.18 million) passengers using ART Central Parking route - Denpasar City.

3. The potential demand model for LRT / ART users on the route of Kuta - Ngurah Rai Airport can be well explained by the individual characteristics of passengers with a significance level of 84.733%, and the effect of all variables on the model is 57.9%, the form of the model is $Y_{ARTcentral\ park}$ = - 2.292 + 1,415 X1 - 0,163 X2 + 0,493 X3 - 0,132 X4 + 0,258 X5 + 0,100 X6 and $Y_{LRTjineng}$ = 1,997 + 1,380 X1 - 0,478 X2 - 0,785 X3 + 0,312 X4 + 0,523 X5 - 0,150 X6. (X1 = gender, X2 = age, X3 = education, X4 = occupation, X5 = income and X6 = number of vehicles owned)

4. The potential demand model for LRT / ART users on the route of Kuta - Ngurah Rai Airport can also be explained well by the characteristics of passenger trips with a significance level of 87.342%, and the effect of all variables on the model is 65.8%, the model format is $Y_{ARTcentral\ park}$ = 0.194+ 0.088 X11–0,392 X12-0,304 X13 + 2,049 X14 - 0,562 X15 + 0,955 X16 and $Y_{LRTjineng}$ = Y1 = - 0,667 + 0,049 X11 –0,201 X12-0,142 X13 + 2,206 X14–0,684 X15 + 1,303 X16 (X11 = purpose of travel, X12 = frequency of travel, X13 = number of groups, X14 = number of luggage, X15 = distance and X16 = travel time)

REFERENCES

- Agustien, M., Susanti, B., & Pahlevi, H. (2019). Modelling the Needs of Light Rail Transit (LRT) on Transit Oriented Development Area around LRT Stations in Palembang. *IOP Conference*

Series: Earth and Environmental Science. https://doi.org/10.1088/1755-1315/396/1/012022

- Babatunde, A., Tobi, A., Abigail, A., & Jimoh, A. (2019). Consumers potential demand analysis for local rice consumption in southwest, Nigeria. *International Journal of Mechanical Engineering and Technology*.

- Baker, D. M., & Lee, B. (2019). How Does Light Rail Transit (LRT) Impact Gentrification? Evidence from Fourteen US Urbanized Areas. *Journal of Planning Education and Research*. https://doi.org/10.1177/0739456X17713619

- Barrett, A. N., Fong, C. Y., Subramanian, A., Liu, W., Feng, Y., Choolani, M., Biswas, A., Rajapakse, J. C., & Bongso, A. (2019). Human Wharton's Jelly Mesenchymal Stem Cells Show Unique Gene Expression Compared with Bone Marrow Mesenchymal Stem Cells Using Single-Cell RNA-Sequencing. *Stem Cells and Development*. https://doi.org/10.1089/scd.2018.0132

- Cahyono, M. S. D., & Herijanto, W. (2015). Permodelan Tip Distribution Angkutan Barang Non Petikemas untuk Prediksi Volume perdagangan Dmestik di Pelabuhan Tanjung Perak Surabaya. *Institut Teknologi Sspeluh November ….*

- Derakhshan, A. (2015). *Mode Choice Behaviour of Intercity Travel for Visiting Friends and Relatives in Peninsular Malysia*. Universiti Teknologi Malaysia.

- Djie, T. N., & Sumarno, S. (2020). Evaluasi Teknis Rencana Jalur Light Rail Transit (LRT) Di Wilayah Bandung Raya. *REKA GEOMATIKA*. https://doi.org/10.26760/jrg.v2018i2.2262

- Ferbrache, F., & Knowles, R. D. (2017). City boosterism and place-making with light rail transit: A critical review of light rail impacts on city image and quality. *Geoforum*. https://doi.org/10.1016/j.geoforum.2017.01.013

- Hermawati, P., Aryawan, I. G. M. O., Sutapa, I. K., & Santiana, I. M. A. (2020). Kajian Permintaan Perjalanan Penumpang dalam Rangka Penyediaan Prasarana Sarana Transportasi Umum di Bali. *Jurnal Bali Membangun Bali*. https://doi.org/10.51172/jbmb.v1i3.139

- Jin, F., Yao, E., & An, K. (2020). Analysis of the potential demand for battery electric vehicle sharing: Mode share and spatiotemporal distribution. *Journal of Transport Geography*. https://doi.org/10.1016/j.jtrangeo.2019.102630

- Napitupulu, B., Ismiyati, I., & Handajani, M. (2018). Analysis of air pollution caused by mass transportation design changes. *MATEC Web of Conferences*. https://doi.org/10.1051/matecconf/201819504021

- O'Donnell, O., Kananura, R. M., Kiwanuka, S. N., Ekirapa-Kiracho, E., Waiswa, P., Hunter, B. M., Murray, S. F., Makacha, L., Makanga, P. T. P. T., Dube, Y. P., Bone, J., Munguambe, K., Katageri, G., Sharma, S., Vidler, M., Sevene, E., Ramadurg, U., Charantimath, U., Revankar, A., … Addai-Donkor, K. (2018). Qualitative study on maternal referrals in rural Tanzania: decision making and acceptance of referral advice. *BMC Pregnancy And Childbirth*.

- Ortúzar, J. de D., & Willumsen, L. G. (2011). Modelling Transport. In *Modelling Transport*. https://doi.org/10.1002/9781119993308

- Putri, A. B., Farda, M., Santosa, S. P., Dirgahayani, P., Suthanaya, P. A., Andani, I. G. A., Sutanto, H., Charky, L. R., & Nurjanah, N. (2021). Study of Public Transport Development in South Bali Districts: Potential Public Transport Mode. *International Journal of Sustainable Transportation Technology*. https://doi.org/10.31427/ijstt.2021.4.1.2

- Rahman, H. Z., Miraj, P., & Andreas, A. (2019). Exploring public-private partnership scheme in operation and maintenance stage of Railway Project. *Sustainability (Switzerland)*. https://doi.org/10.3390/su11226517

- Sekasi, J., & Martens, M. L. (2021). Assessing the contributions of urban light rail transit to the sustainable development of addis ababa. *Sustainability (Switzerland)*. https://doi.org/10.3390/su13105667

- Sinaga, S. M., Hamdi, M., Wasistiono, S., & Lukman, S. (2019). Model of Implementing Bus Rapid Transit (BRT) Mass Public Transport Policy in DKI Jakarta Province , Indonesia. *International Journal of Science and Society*.