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by Sakti Adji Adisasmita Unhas

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Determination of Transit Service Accessibility Standard for Intercity Bus Passengers

Ashari Abdullah[1*], Ananto Yudono[1], Sakti Adji Adisasmita[2], Arifuddin Akil[1]
1 Architecture Engineering Department, Hasanuddin University
2 Civil Engineering Department, Hasanuddin University
**Corresponding Author, Email: ashari.arsitek@gmail.com*

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Abstract: Intercity bus terminals function as transit facilities that tend to be less effective. Intercity bus passengers prefer to transit outside the terminal. The connectivity factor is consideration of the passengers' needs (Abdullah et al., 2018), one of its indicators is accessibility to or from the transit location. At present, there is no standard for a convenient transit location distance for passengers from the place of origin or to a destination in the city. The criteria are compiled into the passenger transit level of service (LOS), as an effective tool to evaluate the quality of the location based on passengers' perceptions with the scales LOS A (Very Near), LOS B (Near), LOS C (Rather Close), LOS D (A Little Far), LOS E (Far) and, LOS F (Very Far). The research and case study were conducted in Makassar city. The data were obtained through questionnaires. Law Successive interval scaling and regression were used as the methods of analysis. The results of the research indicate that the transit distances expected by passengers were as follows: LOS A-B is<2 km and LOS C is 2,1-4 km , LOS D is 4,1-12 km, LOS E is 12,1-20 km and, LOS F is >20 km. Moreover, the distances of the transit location from roads were as follows: LOS A-B is < 100m, LOS C is 100-1000m, LOS D is 1001-2000 m, LOS E is 2001-2400m and LOS F is >2400 m.

1. INTRODUCTION

In Indonesia, the development of the intercity bus transportation service has improved, particularly in terms of bus facilities and convenience. This has also been caused by increased competition among bus operators however, the bus transportation service still has a problem related to passenger transit activity, particularly intercity transit. Based on the government's regulations concerning land transportation, public intercity transportation should pick up and drop off passengers in a terminal, from whence they can continue their journeys using a different mode of transport.

As we know, one of the functions of terminals for passengers is as a transit place from which they can continue their trips to their destinations. Based on pre-2016 data, Indonesia has 822 terminals of various types (Land Transportation In Figures, 2016). Although there are no data concerning the effectiveness of terminals, through observation, terminals tend to be quiet and have less transit activity. This can also be seen in relocated terminals, as intercity terminals create congestion and have limited capacity (Dimitriou, 1995). Relocation policies can reduce congestion at the former location and increase capacity at the new terminal, but new problems related to the passengers' reluctance to conduct transit activities at the terminals have arisen.

As transit facilities, terminals should minimise passengers' travel time and provide easy access to other modes of transportation in order for passengers to continue their trips to their destinations (Pitsiava-Latinopoulou & Iordanopoulos, 2012). Intercity bus terminals are considered to provide less satisfactory transit services for passengers. In this context, 'services' refers not only to aspects within the terminals such as terminal's facilities, but also to transit connectivity including public transportation support, access from roads, location, operator coordination with administrators, and availability and clarity of travel information (Abdullah et al., 2018). There is a tendency for intercity bus passengers to transit outside of the terminal because passengers prefer to transit in a place with better connectivity than the terminal has, even though this transit activity is considered illegal by the government of Indonesia. When carrying out transit activities, passengers usually do so in the representative pool of buses located in the city, and then use the bus or shuttle service to the terminal. However, transit activities at the bus pool in the city tend to cause congestion because the pool also functions as a base for buses. This pattern also results in inefficient travel for passengers since there is at least one change in the mode of transport.

In some countries, such as the United States (Klein, 2009), Great Britain (White & Robbins, 2012), Germany (Augustin et al., 2014) and France (Blayac & Bougette, 2017), operators are not obliged to use terminals as a place for passengers to transit, as passengers can transit from the curbside - this service is called 'bus curbside'. This policy results in the deregulation of transportation policies that provide some flexibility for operators to compete in terms of providing services to passengers. On one hand, curbside transit activities can provide the maximum service to intercity bus passengers but, on the other hand, the existence of transit activities causes congestion as a result of the inner-city bus pool.

2. LITERATURE REVIEW

There is still limited research related to intercity bus transit services; thus, the scope of this study is transit facilities that include not only intercity buses, but also transit facilities for other modes of transit such as terminals, stations, stops, interchanges and so on, while the indicators reviewed are access and accessibility. This selection was based on the issue of the ease of reaching transits locations, while connectivity pertains not only to the ease of reaching transit locations, but also to the ease of intercity bus connections. Wicaksono et al. (1997) studied the effects of terminal relocation on the utilisation of terminal buses. His findings were that the total amount of time spent by passengers affected intercity bus terminal passengers; the total time consisted of access time, transfer time and waiting time.

de Oña et al. (2016) studied passengers' behavioural intentions with regard to light rail transit(LRT); there were two indicators, namely the ease of using other transportation methods, such as buses and taxis, and the ease of LRT access from roads. This research only evaluated the factors affecting service quality and passenger satisfaction, and did not focus specifically on issues such as techniques for ensuring the ease of LRT access from roads. Iseki and Taylor (2010) used the indicator of ease of access to surrounding stations or stops, and the ease of finding stops/platforms, while Sedayu (2012) studied intercity bus terminal service and recommended a minimum service standard (SPM) related to terminals' locations, sites and accessibility to improve user satisfaction.

Wen, Lan, and Cheng (2005) studied any factors affecting passengers when using intercity bus terminals. In this research, a station's (terminal's) performance as a transit facility had the smallest effect on the quality of passenger service; however, the station performance indicators were only related to the condition of the station's facilities, cleanliness and information. Lin, Lee, and Jen (2008) studied the effects of efficiency of and deficiencies in service quality on repurchase intention; the research results indicated that deficiency in service quality had greater effects on passengers' intentions to reuse the service than did the efficiency of service quality, while the indicators related to the transit facility were appropriate and well-situated transit locations. The indicators used by Lin, Lee, and Jen (2008) are suitable for this research. Although Wen, Lan, and Cheng (2005) did not discuss the reviewed indicators, both studies used SEM as the analysis technique. Freitas (2013) studied the quality of intercity road transportation using an importance satisfaction analysis (ISA), which evaluated the criteria related to attendance, vehicles, routes, security, differential services and ticket fares. Freitas (2013) did not discuss the criteria of access or the accessibility of the transit facility. Arabi et al. (2015) studied determination of intercity bus terminal locations using AHP with GIS; there were some indicators pertaining to location access and accessibility, such as access to major streets and access to public transportation. Yatskiv et al. (2009) studied indicators of the quality of bus terminal services; the related indicators were accessibility for passengers and visitors at the terminals.

All the research mentioned above considered that the intercity bus transportation service only involved transit and intercity trips. However, only Wicaksono et al. (1997), Sedayu (2012), de Oña et al. (2016), Lin, Lee, and Jen (2008), Iseki and Taylor (2010), and Yatskiv et al. (2009) discussed the indicators related to access and accessibility. From the literature review, it can be seen that access / accessibility has only been assessed qualitatively, and that the topic has not been evaluated quantitatively; thus, the convenient distance for intercity bus passengers to transit has not been established.

Therefore, the first research question is: What is a convenient distance for intercity bus passengers to transit? The second is, what is considered to be a convenient distance between the transit locations and the main roads? This study aims to compile standard transit service distances for intercity bus passengers using a law of successive interval scaling analysis based on passengers' perceptions. In this study, the travel distance indicator will be used because the travel time has a flexible value depending on the conditions of passenger travel, while the distance is constant. This research is expected to contribute to giving consideration to a convenient distance of transit locations for intercity bus passengers to their origin / destination in the city.

3. RESEARCH METHOD

3.1 Case Study

This research was conducted in the city of Makassar, which has an area of 175.77 km^2 and a population of 1,469,601 (Badan Pusat Statistik (BPS), 2017).

Makassar is relatively round in shape. Makassar has grown and developed from the south to the north due to rapid city growth and land availability in the suburbs (Akil, A., 2017). The street pattern in Makassar is a grid; therefore, it offers high accessibility to reach locations (Akil, Arifuddin et al., 2014) . Currently, the public transportation services are the Bus Rapid Transit (BRT) and *pete-pete*. *Pete-pete* is a public transportation system that follows a route and is allowed to stop anywhere as long as there are no signs that prohibit it. BRT provides intercity transport to neighbouring cities such as Maminasata, whereas *pete-pete* is only in operation in Makassar itself. Most people in Makassar use private vehicles for daily trips. Makassar is representative of a city consisting ofover one million people in Indonesia.

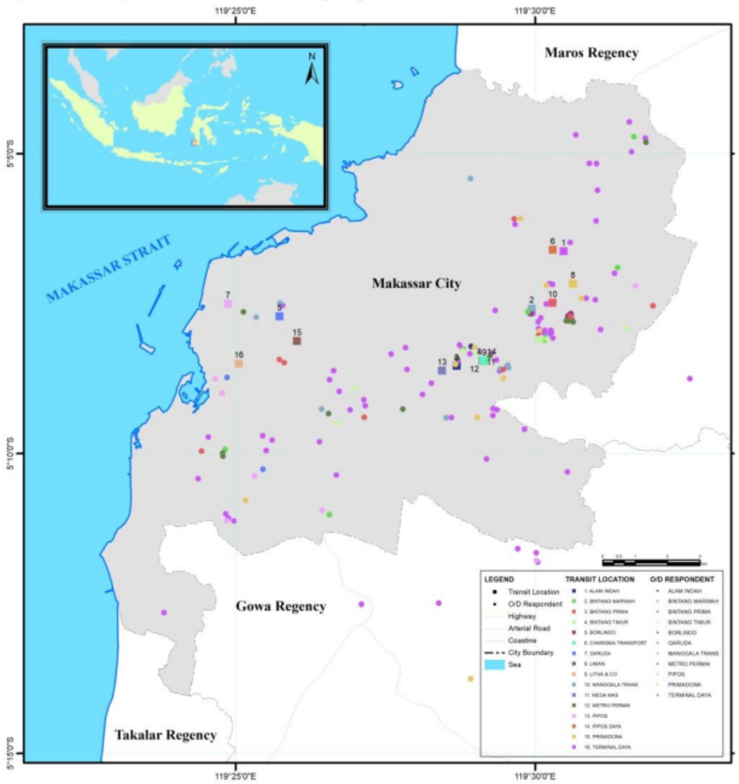

Figure 1. Map of spatial/positional relationships of origin/destination locations of respondents with transit locations in Makassar

The two items to be measured a relocation and ease of access from roads. Location measures the distance that passengers must travel from the origin/destination location to or from the transit location (terminal or pool). The origin/destination location in this research is passenger travel, most of which begins or ends at home and involves both public transportation and private vehicles to or from the transit location. Ease of access is related to the distance of the transit location from the main road; in this research, the main road is an arterial road**.** The research involved intercity bus passengers transiting via the Makassar Metro Terminal and the representative pool. Fifteen locations were used as the research objects, including one terminal and fourteen bus pools (see Figure 1). The measurement of the origin/destination location's distance from or to the transit location was obtained using Google

Earth. As Google Earth includes a number of travel distance options, this study adopted the shortest path value. The value of travel distance by passengers to the transit location can vary greatly depending on the passenger's location; thus, there was a group determination after the data collection to consider the variation in the distances collected. For the distance of the transit location from the main road (arterial road), the benchmark was the distance from the axis road to the front fence of transit location land (see Figure 2).The distance of the transit location from the road was less varied because some bus pools are the same distance from the road.

Figure 2. Example: Map of the distance of the transit location from the main road at Makassar Metro Terminal

3.2 Data Collection

This research was conducted over three months from March to May 2018. The data collection technique used was random sampling because the research population was not pre-determined. The criteria to select respondents were passengers who were in transit at the terminal or at the bus pool in the city. There were 150 distributed questionnaires, and any incomplete questionnaires were removed from the analysis. The measurement scale used was 1 = very far to 6 = very near.

3.3 Analysis Method

The analysis method used was the law of successive interval scaling. This method was developed by (Bock & Jones, 1968). Various researchers in this field have used this method, including Müller (1987), Müller and Gosling (1991), (Ndoh & Ashford, 1993), Correia and Wirasinghe (2005), (Correia, Wirasinghe, & de Barros, 2008a, 2008b), who studied airports, (Das & Pandit, 2015, 2016) who studied bus transit, Rashid and Pandit (2018) who studied household toilets in village settlements.

One of the uses of this technique is to compensate for the inconsistency of respondent assessments (Li et al., 2001) also called the Arrow paradox or the Arrow law (Arrow, 1951), which states that decision making about group order cannot be done based only on the assessment of each individual.

The law of successive interval scaling is based on a continuum and is divided into various categories. This technique essentially conducts a conversion from an ordinal scale to an interval scale. The arrangement of LOS order ranges from $+\infty$ to $-\infty$; a value of $-\infty$ means a bad/unacceptable LOS, while a value of $+\infty$ means excellence. In this research, LOS is divided into six categories. Each category has lower boundary and upper boundary values (see Figure 3). The calculation only uses the upper boundary value.

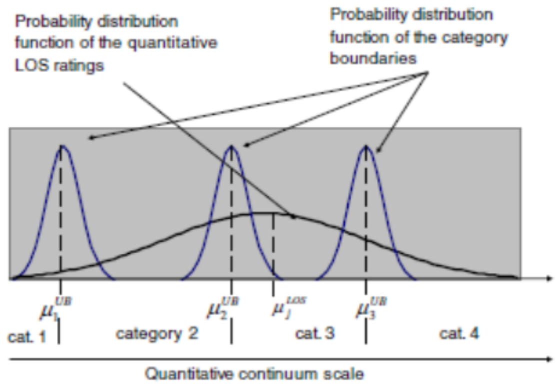

Figure 3. Illustration of the Successive Categories Method for all Passengers

When carrying out this calculation, the assumption was that samples were homogeneous and distributed normally. The steps in the analysis can be explained as follows:

1. Divide into groups j(j =1,2.... n) based on the specific interval as well as calculating the group mean
2. Calculate the answer frequency of f in k category for each group j (f_{jk})
3. Calculate the cumulative proportion P_{jk}

$$P_{jk} = \frac{f_{j(k-1)}+f_{jk}}{\Sigma f_j} \quad (1)$$

4. Transform P_{jk} data to normal distribution Y_{jk}
5. Calculate different intervals of normal distribution of $\underline{W}_{jk}$ for each category k

$$W_{jk} = y_{j(k+1)} - Y_{jk} \quad (2)$$

$$\underline{W}_k = \frac{1}{n}\sum_{k=1}^{n} W_{jk} \quad (3)$$

6. Calculate thenormal distribution of Y_{jk} in any category that did not exist previously

$$Y_{jk} = Y_{j(k+1)} - \underline{W}_k \quad (4)$$

7. Calculate the mean of the normal distribution of $\underline{\mu^{UB}_{-k}}$ for all groups in each category k

$$\mu^{UB}_{-k} = \frac{1}{n}\sum_{j=1}^{n} Y_{jk} \quad (5)$$

$$\mu^{UB}_{-k(n)} = \mu^{UB}_{-k} - \left(\frac{Y+Y_{j2}}{2}\right) \quad (6)$$

8. Conduct a simple linear regression analysis with $\mu^{UB}_{-k(n)}$ as the dependent variable and Y_{jk} as the independent variable to obtain μ^{LOS}_j. μ^{LOS}_j as the intercept value of j group.
9. Conduct a regression analysis with the mean of group j as the dependent variable and μ^{LOS}_j value as the independent variable. After evaluating the model's performance from the regression (R^2, F, Sig. 5%),this creates an equation to obtain the LOS limitation value based on the value of $\mu^{UB}_{-k(n)}$
10. Perform a conformity test or a chi-square (X^2) for the response proportion based on the observation of each category with the response proportion based on the model (Bock & Jones, 1968).

4. DISCUSSION

4.1 Respondents' Characteristics

Of the 150 questionnaires distributed, only 148 could be processed. In Table 1, it can be seen that intercity bus passengers were generally students or university students who were studying in Makassar with the aim of returning to their hometowns, which usually occurred during Idul Fitri Idul Adha, Christmas and the semester holidays. With regard to vehicles heading to transit locations, around 48% of the passengers used private vehicles; another option was on-line taxis, and 89.90% did not use public transport (*pete-pete*). Thus, very few intercity bus passengers used public transportation, probably due to the lack of public transport services in the city.

Table 1. Respondents' Characteristics

Attribute	Frequency	Percent
Gender:		
Male	65	43.9%
Female	83	56.1%
Age:		
17-25	105	70.9%
26-40	35	23.6%
41-65	7	4.7%
> 65	1	0.7%
Education:		
Primary School-Senior High School	59	39.9%
College Student	40	27.0%
Diploma	10	6.8%
Bachelor's Degree	27	18.2%
Master's Degree	7	4.7%
Doctoral Degree	-	-
Other	5	3.4%
Job:		
Entrepreneur	6	4.1%
Government employees	7	4.7%
Student	97	65.5%
Private employees	24	16.2%
Other	14	9.5%
Purpose of Travel:		
Go home	108	73%
Private	13	8.8%
Study	1	0.7%
Business	17	11.5%
Other	9	6.1%
Frequency of Travel Per Year:		
< 2 Round Trip	55	37.2%
3-5 Round Trip	65	43.9%
> 6 Round Trip	28	18.9%
Mode of Travel to Transit Location:		
Public transportation	15	10.1%
Taxi bike	12	8.1%
Private car	25	16.9%
Private motorcycle	46	31.1%
Taxi cab	13	8.8%
Other	37	25.0%

4.2 Location

For the analysis, the location parameter used was the distance that passengers travelled from the Origin/Destination (O/D) to the transit location. The passengers were divided into five groups in the range of 4km for each service level (Sl), except for the group 16-28 km due to the small number of respondents in the range of > 20 km (see Table 2). After calculating the cumulative proportions (P_{jk}), the results of these calculations were transformed into a normal distribution (Y_{jk}). In the information, there were some data (see the data in colour in Table 4) that could be obtained using the widths interval calculation (W_k) for each category based on the normal distribution data in Table 5.

Table 2. Number *of* responses (f_{jk}) against each rating category for each service group (Transit distance from origin or destination)

Sl	Range group (*j*) (km)	Avg. (km)	Rating Category (*k*) 1	2	3	4	5	6
1	0-3.9	2.5	1	2	13	10	18	1
2	4-7.9	5.4	1	7	20	5	13	-
3	8-11.9	10.5	3	9	16	-	2	-
4	12-15.9	14.3	4	8	-	1	-	-
5	16-28	18.7	4	5	4	1	-	-

Table 3. Cumulative proportion of responses (P_{jk}) at or below category *k* (Transit distance from origin or destination).

S	Avg. (km)	Rating Category (*k*) 1	2	3	4	5	6
1	2.5	0.02	0.07	0.36	0.58	0.98	1.00
2	5.4	0.02	0.17	0.61	0.72	1.00	1.00
3	10.5	0.10	0.40	0.93	0.93	1.00	1.00
4	14.3	0.31	0.92	0.92	1.00	1.00	1.00
5	18.7	0.29	0.64	0.93	1.00	1.00	1.00

Table 4. Normal deviation (Y_{jk}) corresponding to (P_{jk}) (Transit distance from origin or destination)

Sl	Avg.	Rating Category (*k*) 1	2	3	4	5	6
1	2.5	-2.01	-1.50	-0.37	0.20	2.01	3.49
2	5.4	-2.02	-0.94	0.28	0,58	2,39	3.49
3	10.5	-1.28	-0.25	1.50	1,50	3,31	3.49
4	14.3	-0.50	1.43	1.43	1,86	3,67	3.49
5	18.7	-0.57	0.37	1.47	1,90	3,71	3.49
	$\sum Y_{jk}$	-6.38	-0.90	4.30	6.03	15.10	
	μ_{-k}^{UB}	-1.28	-0.18	0.86	1.21	3.02	
		0.34	0.34	0.34	0.34	0.34	
	$\mu_{-k(n)}^{UB}$	-1.62	-0.52	0.52	0.87	2.68	

Table 5. Estimates of Interval Widths (*W*) for Each Service Level (Sl) and Rating Category Obtained from the Data in Table 4 for Sl

Sl	Rating Category (*k*) 1	2	3	4	5
1		-0.51	-1.13	-0.57	-1.81
2		-1.08	-1.21	-0.30	
3		-1.03	-1.75		
4		-1.93			
5		-0.93	-1.10		
Sums		-5.48	-5.20	-0.87	-1.81
Wk		-1.10	-1.30	-0.43	-1.81
Scale	0.00	-1.10	-2.40	-2.83	-4.64

Table 6. $\mu^{LOS}j$ values for each service group (j) (Transit distance from origin or destination)

Sl	Average	$\mu LOSj$
1	2.5	0.72
2	5.4	0.33
3	10.5	-0.47
4	14.3	-1.26
5	18.7	-0.98

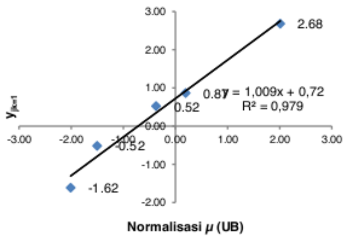

Figure 4. Linear relationship between $\mu^{UB}_{-k(n)}$ and yand Y_{jk} when j = 1

Based on the normal distribution data of $\mu^{UB}_{-k(n)}$, the data arrangement is linear, and is then related to the linear regression between$\mu^{UB}_{-k(n)}$and Y_{jk}, which will result in the $\mu^{LOS}j$ value and standard deviation of σj (Figure 4 shows the linear relationship between $\mu^{UB}k$ and Y_{jk} when j=1). Figure 4 shows the intercept value of 0.72 as the mean of the LOS rating from group j=1. In Table 6, it can be seen that the value of the service distance is inversely proportional to the mean of the LOS rating. This means that the positive perception of passengers will increase if the distance to the transit location decreases. However, the relationship among the data is not absolutely linear; therefore, the regression test based on curves has the greatest accuracy. In determining the regression model, it cannot only be determined by the high R^2 because, when using the equation, the results obtained are sometimes less rational; thus, the equation will not be used (Das & Pandit, 2015).

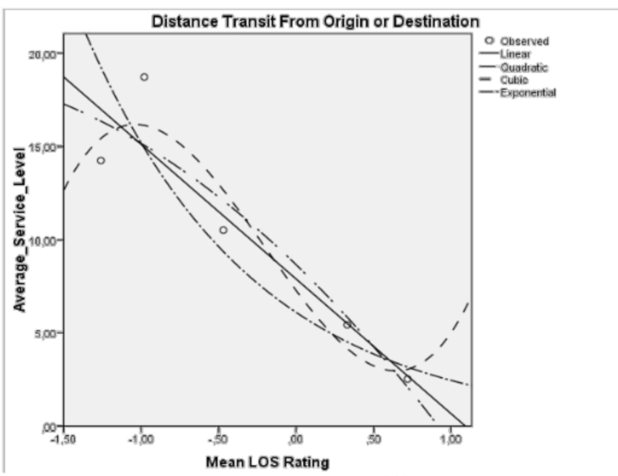

Figure 5. Curve estimation for the mean LOS rating $\mu^{LOS}j$ and the average service level for transit distance from origin or destination

Table 7. Upper boundary for each category (Transit distance from origin or destination)

Model Summary and Parameter Estimates

Dependent Variable: Transit Distance from Origin or Destination

Equation	Model Summary					Parameter Estimates			
	R^2	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	0.870	20.002	1	3	0.021	7.888	-7.229		
Quadratic	0.879	7.239	2	2	0.121	8.655	-8.037	-1.525	
Cubic	0.914	3.549	3	1	0.368	7.274	-11.138	3.312	5.564
Exponential	0.908	29.433	1	3	0.012	6.099	-0.913		

The independent variable is the mean LOS rating

In Table 7, it can be seen that, of the four models, R^2 values are cubic, exponential, quadratic and linear; however, the cubic and quadratic values are not significant, and the exponential value has a high R^2 value and good significance, but is less predictive than the linear value. Thus, an equation is used to connect the mean of the LOS rating $\mu^{LOS}{}_j$ and the mean of the service level to the distance from O/D to the transit location. The linear function is as follows:

$Y = 7.888x - 7.229$ ....(7)

Where Y= average service level and x= mean L^{LOS} rating, $\mu^{LOS}{}_j$.

The model's performance is measured via the total chi-square value (X^2) by calculating the mismatch between response proposals based on observations and the response proportion from the model. To determine the degree of freedom (df), it uses the formula of (n-1) x (m-3) (Bock & Jones, 1968), where n = the number of service groups and m = number of categories. The calculation result of X^2 is 6.714 with the degree of freedom = 12, and the table value is 21.03 with a significance of 5%; from this value, the arithmetic value X^2 is <X^2 table value, and the model can then be used to determine the LOS. Using the linear regression equation (7), LOS is calculated based on the intercept of each category $\mu^{UB}_{-k(n)}$(see Table 8). The preparation of the LOS scale is accomplished by rounding (Table 9).

Table 8. Upper boundary for each category (Distance transit from origin or destination)

Category (k)	Average	μ^{Los}
1	19.6	-1.62
2	11.7	-0.52
3	4.1	0.52
4	1.6	0.87
5	(11.5)	2.68

Table 9. LOS scale values for (Distance transit from origin or destination)

LOS category	LOS Scale Value (km
A/B (Very Near)	≤2
C (Rather Close)	2.1-4
D (Little Far)	4.1-12
E (Far)	12.1-20
F (Very Far)	> 20

From Table 9, it can be seen that the intercity bus passengers in Makassar assessed good or close transit distance as<2 km; Table 9 also shows that LOS A and LOS B are the same because LOS A is negative - this is an indication that passengers want a transit location that is close to the origin / destination. Passengers still feel relatively close at 2.1-4 km. The passengers felt that a distance of more than 4 km was less convenient or too far away. Currently, Makassar Metro Terminal is located 15 km from the city centre; therefore, it was categorised as being far. It was also revealed that the average passenger travelling between 4.1 and 10 km felt that the distance was quite far; therefore, passengers in the city centre felt quite far away, while the locations of the bus pools in the city are from 2-14 km away.

Based on the data concerning the travel distance, 32.4% of respondents travelled less than 4 km, while 67.6% of respondents travelled more than 4 km; therefore, the transit locations were still considered far away, particularly the intercity bus terminal. This differed from the bus pool that is located in the city; therefore, passengers' trips to the pool were shorter, but the passenger distance also tended to be within LOS C.

4.3 Distance to the Main Road

This analysis was only divided into three groups because the transit points were generally located within metres. The calculation of cumulative proportions (P_{jk}) is shown in Table 11, while the transformation to normal distribution (Y_{jk}) is shown in Table 12. The regression calculations are depicted in Table 15, and Table 14 shows the only exponential linear regression that has a complete summary model; thus, at this time, it is used as a linear regression for the LOS determination because it is more predictive and has a high R^2 value and a significance of below 5%, and because the value of X^2 = 3.16 is lower than is that of the chi-square table value 12.59. The equation model used is:

$Y = 533.821x - 1209.421$ ....(8)

Table 10. Number of responses (f_{jk}) against each rating category for each service group (Distance to main road)

Sl	Range group (j) (m)	Avg. (m)	Rating Category (k) 1	2	3	4	5	6
1	0-100	50	-	2	14	10	22	4
2	101-300	275	1	1	1	7	8	-
3	301-600	575	-	9	23	18	26	2

Table 11 Cumulative proportion of responses (P_{jk}) at or below category k (Distance to main road).

SI	Avg. (km)	Rating Category (k) 1	2	3	4	5	6
1	50	-	0.04	0.31	0.50	0.92	1.00
2	275	0.06	0.11	0.17	0.56	1.00	1.00
3	575	-	0.12	0.41	0.64	0.97	1.00

Table 12. Normal deviation (Y_{jk}) corresponding to (P_{jk}) (Distance to main road)

Sl	Avg.	Rating Category (k) 1	2	3	4	5	6
1	50	-2.14	-1.77	-0.50	0.00	1.43	3.49
2	275	-1.59	-1.22	-0.97	0.14	1.65	3.49
3	575	-1.57	-1.20	-0.23	0.36	1.95	3.49
	$\sum Y_{jk}$	-5.31	-4.19	-1.70	0.50	5.02	
	μ_{-k}^{UB}	-1.77	-1.40	-0.57	0.17	1.67	
		-0.20	-0.20	-0.20	-0.20	-0.20	
	$\mu_{-k(n)}^{UB}$	-1.57	-1.20	-0.37	0.37	1.87	

Table 13. Estimates of Interval Widths (W) for Each Service Level (Sl) and Rating Category Obtained from the Data in Table 12 for SI

Sl	Rating Category (k) 1	2	3	4	5
1		-1.27	-0.50	-1.43	
2	-0.37	-0.25	-1.11		-0.37
3		-0.97	-0.59	-1.59	
Sums	-0.37	-2.49	-2.20	-3.01	-0.37
W_k	-0.37	-0.83	-0.73	-1.51	-0.37
Scale	-0.37	-1.20	-1.94	-3.44	-0.37

Table 14. Upper boundary for each category (transit distance from origin or destination)

Model Summary and Parameter Estimates
Dependent Variable: Distance to Main Road

Equation	Model Summary R^2	F	df1	df2	Sig.	Parameter Estimates Constant	b1	b2	b3
Linear	0.996	240.887	1	1	0.041	533.821	-1209.421		
Quadratic	1.000	.	2	0	.	536.870	-980.701	-686.370	
Cubic	1.000	.	2	0	.	536.870	-980.701	-686.370	0.000
Exponential	0.868	6.592	1	1	0.236	562.712	-5.371		

The independent variable is the mean LOS rating

The LOS calculation results can be seen in Table 17. In the table, it can be seen that a convenient distance for passengers is below 100m from the main road for LOS A and B, while the distance of between 101-1000m is considered quite close; however, the passengers considered a distance of more than 1000m to be far. At the time of writing, the Makassar Metro Terminal was about 500 metres from the main road and 75 metres from the front fence of the transit location land; thus, it was considered to be quite close to the road.

Table 15. μ^{LOS}_j values for each service group (j) (Distance to main road)

Sl	Average	μ^{ub}_k
1	50	0.39
2	275	0.23
3	575	-0.04

Table 16. Upper boundary for each category (Distance to main road)

Category (k)	Average	μ^{Los}
1	2.413	-1.57
2	1.966	-1.20
3	970	-0.37
4	91	0.37
5	(1.717)	1.87

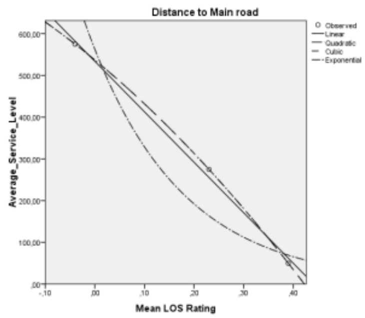

Figure 6. Curve estimation between mean LOS rating μ^{LOS}_j and average service level for distance to main road

Table 17. LOS scale values for distance to main road

LOS category	LOS Scale Value (Metres)
A/B (Very Near)	<100
C (Rather Close)	101-1000
D (Little Far)	1001-2000
E (Far)	2001-2400
F (Very Far)	> 2400

5. CONCLUSION

This study was conducted to determine the value of the LOS scale related to intercity passenger bus travel distance in transit and the ideal transit location from the main road based on passengers' perceptions using a law of successive interval scaling analysis. This research was conducted in Makassar with passengers whose destination city was served by Makassar Metro Terminal. With regard to determining the location of transit, Indonesia does not have a standard that can be used as an evaluation tool. Thus, the locations of intercity bus passenger transit facilities tend to be in the suburbs, as is the Makassar Metro Terminal. Based on the results of the LOS, a convenient distance for passengers of LOS A (very near) and B (close) was <2 km, while the LOS C (rather close)was a distance of 2.1 - 4 km, LOS D (a little far) was4.1-12 km, LOS E (far) was12.1-20 km and LOS F (very far) was>20 km . The distance of<4 km was considered to be less convenient for passengers. Most respondents were students aged 17-25 who preferred to transit within a distance of <2km; this was because the respondents travelled using private vehicles or non-route public transportation such as taxis, motorcycle taxis or on-line taxis; only a few used public transportation in the city (*pete-pete*).

Thus, if the transit distance is <2km, this could make passengers' trips in transit locations more efficient in terms of distance, travel time and cost. This is in line with the statement by Pitsiava-Latinopoulou and Iordanopoulos (2012) that transit facilities should minimise passengers' travel time and provide easy access to other modes of transportation.

The LOS for the distance of the transit location from the road to LOS A (very near) and LOS B (near) was ≤100 metres, while LOS C (rather close) ranged from 101-900 metres and distances greater than 1 km were considered far by the passengers. Although the distance of the transit location from the main road can be up to 1 km, the distance of the transit location from the main distance travelled, including the distance of passengers from their origin and destination to the transit location, must also be considered.

The law of successive interval scaling method can overcome the inconsistency in the respondents' answers, or the Arrow paradox, but it is still necessary to develop this in order for the mean LOS rating to remain in line with the group service value, to keep the mean LOS rating and group service values consistent.

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