The Area Coverage and People Walkability to Public Minivan Stop in Jembrana

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Abstract

Public minivans are now still available in Jembrana. However, it is undeniable that the number of private vehicles escalating and the nodes of transportation not properly functioning have led to a decrease in the use of public minivans. Therefore, it is essential to research the area coverage of passenger bags (the potential area of concentrated passengers) to determine the level of minivan scope based on people's walkability. The present research aims to figure out the factors and the distance that may influence people's walkability (as a ground to determine an area coverage). Some methods of analyzing the data, namely Structural Equation Modeling (SEM), were employed to find out potential factors. The factors became the basis of the analysis in which biner logistic regression was applied to determine the walking distance and the scenario to increase people's walkability. A circular buffer was implemented to decide public minivan stops in terms of passenger bags based on the walking-distance. The result of the research revealed that some factors influenced people to walk: distance, pedestrian facility including sidewalks, crossing facility, plantation along the pavement, and economy including work and wages. The walking distance was 109 meters. Finally, from the analysis of the walking distance using the area of the circle, it was found that the area coverage was 37.340,3 m².

Keywords: *Area coverage, walkability, factor, distance*

INTRODUCTION

A public minivan still becomes one of the transportation modes in Jembrana. However, the number of public minivan riders reduce significantly to 13.2%. Besides, some public minivan stops do not comply with prevailing laws. It indicates that the transportation nodes fail to meet the demand to reach more public minivan riders. To overcome the problem, determining an area coverage of public minivan stops is beneficial to know to what extent minivan stops reach their riders in Jembrana.

Area coverage is the basis and the primary focus for several countries to provide public transportation networks (Mulley et al., 2017). It is essential to avoid errors and inaccuracy in determining the area coverage as it may impact the decrease of the scope of service public minivan location (Burger, 2021). According to Andersen & Landex (2008), the area coverage of public minivan stops can be actuated based on people's walkability to the stops.

Zuo et al. (2018) argue that to find out people's walkability (V_1), it is essential to know some factors influencing people's walkability, such as walking distance (from home to target location) (V_2) (Kusuma et al., 2017); pedestrian facility (V_3), crossing facility(V_4) and plantation along the pavement (V_5) (Vichiensan & Nakamura, 2021); social condition including age (V_6) (Jaya et al., 2020; Daniels & Mulley, 2013; Sukor & Fisal, 2018) and gender (V_7) (Sukor & Fisal, 2018; Bunn & Wakenshaw, 2018; Kusuma et al., 2017). In addition, there is an economic factor, including work (V_8) (Daniels & Mulley, 2013), wage (V_9) (Jumsan et al., 2005; Soest et al., 2022), and vehicle ownership (V_{10}) (Daniels & Mulley, 2013; Sarker et al., 2020).

In general, the factors can diversly impact people's walkability to public minivan stops in some areas. As Jembrana has different area characteristics distinct from the other regencies in Bali, it may cause different people's walkability based on the potential factors that later influence area coverage of public minivan stops. The authors decide to further research people's walkability to public minivan stops by considering potential factors. Furthermore, it is important to analyze the walking distance as a base to decide the scope of area coverage.

LITERATURE REVIEW

Area coverage of public transportation stops is defined as the area around the stops along a route (Landex et al., 2006). Similarly, Jaya et al. (2020) defines area coverage as the area around bus stops and other public transport stops. According to Jumsan et al. (2005), the area around the public transportation route determined by the distance from an area to a transit location is generally called area coverage. Meanwhile, Sarker et al. (2020) describes area coverage as the average distance taken to the location of a bus stop. In short, the area coverage is an area or reachable region based on the stop location on a service route as a transfer and transit point of intermodal public transportation. Based on the definitions from some experts, it is known that the basis of area coverage can be seen towards transportation nodes. Based on The Indonesian Traffic and Public Transport Law No 22 of 2009, chapter 1 verse 5, it is stated that the transportation node is a spot location of transfer of both transmodal and intermodal. It includes a bus stop, bus station, port, airport, and railway station. In addition, government Law No.74 of 2014 concerning Road Transport and Minister Law No.15 of 2019 concerning The Exertion of People Transport and Public Motorized Vehicle in a Route emphasize that public minivans must pick up and drop off the passenger in a predetermined transportation node.

Nevertheless, to analyze the area coverage, it is important to know some factors that may influence it. Burger (2021) argues that area coverage is determined based on the walk length of the pedestrian walk. Normally, the area coverage also depends on walkability (the willingness of a pedestrian to walk) (Andersen & Landex, 2008). Jumsan et al. (2005) further explains that the service area coverage in a bus stop can be analyzed based on the distance a pedestrian can cover from their location to a bus stop.

As alluded to in the previous paragraph, walkability is the willingness of pedestrians to walk to a destination. It then further describes the pedestrian's willingness to the stop location to get to the nearest public transportation service (Basuki, 2014). Likewise, Afkara & Kusuma (2020) define the term 'walkability' as the distance one can cover to get public transportation service by accessing some nearest stop locations. Moreover, walkability can be defined as the willingness of

someone to walk from where they are to public transportation shelter (Jaya et al., 2020). From the three definitions, it is concluded that walkability is the willingness of a pedestrian to reach the nearest public transportation stops.

In some research, walkability can be influenced by some factors (Basuki, 2014). Later, such factors will be categorized into some walkability characteristics in a certain region that may differ from others. This is a base for knowing the problems in public transportation and seeking the best solution (Sari et al., 2021). Here are some factors that may influence walkability:

1. Distance

   Mulley et al. (2017) state that distance becomes the main consideration of one's decision on a public transportation route. Meanwhile, Daniels & Mulley (2013) argues that to achieve the target of good accessibility, much public transportation planning requires the analysis of walkability as a basic assumption. In a study by Noh et al. (2021), it was found that the desired-walking distance was 100 m in Penang, Malaysia. It was different from Jakarta; walking distance to the MRT station was 618 m (Afkara & Kusuma, 2020). In addition, a study from Basuki (2014) also revealed that walking distance to BRT was between 225 to 475 m. President Law No.55 of 2018, focusing on the Blueprint of Jakarta, Bogor, Depok, Tangerang, and Bekasi in the Year of 2018-2019, states that government must provide facilities for pedestrian and parking locations with a maximum distance of 500 m from the transportation node. The difference in the walking distance indicates the distance that an individual is willing to cover. Walking distance is described as the average distance that one can cover from where they are to a destination (Kusuma et al. (2017). Moreover, according to Afkara & Kusuma (2020), walking distance is the average distance traveled during the walk to the stop location at several points.

2. Pedestrian Facility

   In order to persuade people to be actively involved in public transportation, in England, the government makes some improvements in the accessibility to public transport (Daniels & Mulley, 2013). The provision of the pedestrian facility is crucial to accommodate people's mobility, specifically regarding walking activity (Wibowo et al., 2015). Law No 22 of 2009, focusing on Traffic and Road Transport, chapter 45, Verse 1, states that one required pedestrian facility is sidewalk/pavement. Therefore, to give pedestrians a safe feeling, convenience, and safety, a lane specifically made for pedestrians to give more room for both walking alone and in a group is needed (Wibowo et al., 2015). Apart from the lane, to enhance pedestrian safety, the government must create adequate and safe crossing facilities for pedestrians (Mulyadi, 2020). The facilities are, for instance, traffic signs, road markings, and pelican crossing. Furthermore, to attract public interest to walking the plantation should be done through the length of the pedestrian lane (Darmawan & Rahmi, 2021).

3. Social Condition

   The social condition affects one's willingness to walk to transportation services (Sukor & Fisal, 2018). There are some indicators of social factors, such as 'age' and 'gender'. According to Wolek et al. (2021), gender has become more predominant than other social indicators. Meanwhile, Sarker et al. (2020) argue that 'age' also impacts one's willingness to walk.

4. Economy Condition
   One's economic condition can be seen from several indicators, such as wages and types of work (Wolek et al., 2021) and vehicle ownership (Mulley et al., 2017). People with low economic levels will use 'cheap' transportation modes. On the contrary, well-being people and people with private vehicles are unwilling to use public transport for many reasons.

In this research, there are two variables such as dependent and independent variables. The dependent variable is the walkability to the public minivan service stop in Jembrana. Meanwhile, the independent variables are distance, pedestrian facility, social condition, economic condition, and other potential factors that may influence the dependent variable. Here are some indicators used in this research:

1. The 'Distance' variable consists of the distance indicators from home and target location to 'passenger bag'.
2. The 'Pedestrian Facility' variable consists of indicators such as pedestrian lane, pedestrian crossing facility, and plantation along the pavement to 'passenger bag.'
3. The 'Social Condition' variable consists of some indicators such as 'age' and 'gender'
4. The 'Economy Condition' variable consists of wages, work, and vehicle ownership.
5. 'Other variable' consists of indicators obtained from the open question.

The hypotheses are as follows:

H0: The factors do not significantly affect walkability

H1: Distance significantly affects walkability

H2: Pedestrian facility affects significantly walkability

H3: Social factor affects significantly to walkability

H4: Economy factor significantly affects walkability

RESEARCH METHOD

The research was conducted in public minivan stops which were also 'passenger bags'. In addition, the research carried out two surveys of the open question; they were (1) a survey about factors affecting walkability to 4 categories of the respondent (e.g., government, academics, public minivan riders, and other public) and (2) survey on 'passenger bag', which involved the citizens around the passenger bags and public minivan riders, to know the desired-distance that a pedestrian wants to cover from the origin location to minivan stops. To determine the ideal number of the research sample, the Slovin method and proportional technique were employed. The survey was carried out through a questionnaire.

The data from the survey were analyzed descriptively to get an illustration of the respondent. However, for deeper analysis, SEM (Structural Equation Modelling) was exerted to find out some factors swaying walkability to public minivan stops. According to Gusmiarti (2020), SEM is a multivariate analysis that aims to figure out the relation among variables, providing a more detailed analysis than any other technique. According to Islamia (2017), SEM has become an analysis technique normally used to test a model or research structure with higher complexity. There are some assumptions to understand before applying SEM, according to Gusmiarti (2020), they are as follows:

1. The Degree of Freedom (DF) should have a positive value to be used in the next analysis

2. The sample should be more than 200 samples with a scale from 5-10. It is multiplied by the number of parameters in both the questions and statements.
3. In SEM analysis, it is better to use interval data instead of ordinal or categorical data as it will cause the correlation coefficient smaller, especially when it deals with endogen variables

The logit biner analysis method was used to discover the distance to minivan stops that a pedestrian can cover. It was to know the walking-distance probability and to know how to increase walkability as well. Logistic regression is almost similar to linear regression, the distinction lies in using a dichotomy scale in the dependent variable. What means by dichotomy scale is the data scale 0 and 1 in the dependent variable (Anshori & Iswanti, 2017). There are some conditions in the use of logistic regression. They are as follows:

1. Independent variable does not need to convert to scale or interval
2. The dependent variable should be in terms of dichotomy or have two categories between 'yes' or 'no' or other options.
3. The category used in the dependent variable should be specific and discrete
4. The dependent variable does not need to have the same categories as other variable
5. Logistic Regression can select the relation in line with a probability of the variable

FINDINGS AND DISCUSSION

A. Factors affecting walkability

The first step to determining the area coverage in the public minivan stop was analyzing the factors swaying it. According to Wolek et al. (2021), factors that influence someone's walkability differ in each location based on its area condition and surrounding environment. Therefore, there were 35% of respondents from public society through an open-question survey. In this survey, five variables with each indicator and mostly selected additional variables were used.

The result of the survey was then analyzed with SEM. It was found that there were two additional variables such as health and affordable fare. The analysis went to several processes as SEM procedures comprising validity and reliability, model development, model identification, normality test, structural model test, and measurement model test and interpretation. In the process of validity and reliability, two additional variables were invalid. Thus, in the following analysis, they were not taken into account. Below is the result of the overall SEM test.

Table 1. Goodness Of Fit of The Relation among Variables and Indicators

No.	Goodness of Fit	Standard	Result	Description
1	*Chi-square*	The smaller, the better	15.063	Appropriate
2	CMIN/df	<2.0	1.255	Appropriate
3	*Probability*	>0.05	0.238	Appropriate
4	GFI	≥0.90	0.991	Appropriate

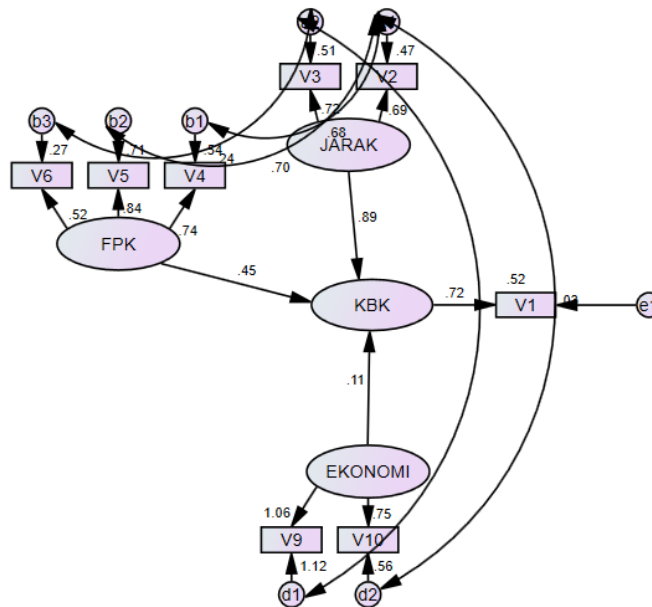| No.	*Goodness of Fit*	Standard	Result	Description
5	AGFI	≥0.90	0.972	Appropriate
6	TLI	≥0.90	0.996	Appropriate
7	NFI	≥0.90	0.991	Appropriate
8	RMSEA	≤0.08	0.025	Appropriate

Figure 1. The Relation between Variables and Research Indicators

It is seen from the table that some variables and indicators significantly affected the walkability, such as (1) 'distance' consisting of V_1 and V_2; (2) 'pedestrian facility' comprising V_3, V_4, and V_5; 'economy condition' including V_9 and V_{10}. The model was later measured by comparing it to Goodness of Fit to reach the fitted model.

Table 2. The Impacts of The Relation of Variables and Indicators

			Estimate	S.E.	C.R.	P	Label
KBK	<---	JARAK	.588	.075	7.872	***	par_5
KBK	<---	FPK	.266	.071	3.735	***	par_6
KBK	<---	EKONOMI	.041	.036	2.514	***	par_7
V_3	<---	JARAK	1.000				

			Estimate	S.E.	C.R.	P	Label
V_2	<---	JARAK	.950	.080	11.832	***	par_1
V_6	<---	FPK	1.000				
V_5	<---	FPK	1.186	.100	11.826	***	par_2
V_4	<---	FPK	1.026	.084	12.157	***	par_3
V_{10}	<---	EKONOMI	1.016	.480	2.119	***	par_4
V_9	<---	EKONOMI	1.000				
V_1	<---	KBK	1.000				

Based on Table 2, the significance level of CR value (based on Vogt (2015)) states that a high level of significancy can be seen from CR (Critical Ratio) of 0.05) which is 1.96. It means that the distance variable, pedestrian facility, and economic condition significantly impacted walkability in Jembrana. This became the distinguishing factor affecting walkability between Jembrana and other areas.

B. **Walking Distance**

At this stage of analysis, the survey on passenger bags was carried out. It was through distributing a questionnaire to public minivan riders. In the questionnaire, questions were designed grounded on variables affecting walkability. The target survey was public minivan riders from the dynamic survey of field-work-practice reports in Jembrana. In the end, 117 samples were taken in this study after measuring by the Solvin method. The result of the equation test for the logistic regression model can be seen in the following table as entrenched from the survey result of passenger bags with the dependent variable in terms of walkability and independent variables such as distance, pavement condition, crossing facility condition, plantation, wages, and work.

Table 3. Result of the Logistic Regression Model Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Distance	.072	.017	17.932	1	.000	1.075
	Pavement Condition	2.254	.616	13.389	1	.000	9.529
	Crossing Faciliy	.943	.535	5.102	1	.018	2.567
	Plantation	-.261	.603	6.187	1	.025	.770

Wages	-.001	.000	6.520	1	.011	.999
Work	.477	.877	2.971	1	.035	1.612
Constant	-9.065	1.992	20.702	1	.000	.000

a. Variable(s) entered on step 1: Distance, Pavement Condition, Crossing facility condition, Plantation, Wages, Work.

Here is the equation of logistic regression:

$$Y = -9.065 + 0.72 \times Distance + 2.254 \times Pavement\ condition + 0.943 \times Crossing\ facility\ condition - 0.261 \times Plantation - 0.001 \times Wages + 0.477 \times Work$$

The equation was later employed as a base to find out the walking distance and to seek a solution to enhance willingness to walk.
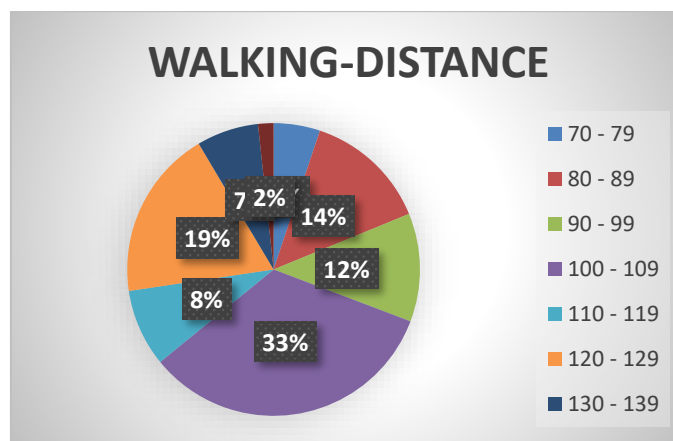

Figure 2. Walking-distance Recapitulation

Figure 2 shows that the highest frequency of walking-distance interval was at 100-109 m. Besides, the average walking distance was 102.692 meters with Mo 100 m. Therefore, data at 100-109 meters involving the Mean and Mo value was used to determine the desired walking distance. Later, it was analyzed with the logistic regression equation; in addition, regarding the wages indicator, the result of wages frequency distribution was used. The frequency range of wages of public minivan riders was Rp 1999.0823 – Rp 2399.0823. Nevertheless, the frequent scale dealing with pavement condition indicators, crossing facility, and plantation along the pavement was 0 to 1. Furthermore, the scale for work indicator was 1-5.

To find out the walking distance and the work scheme to increase walkability, Excel was applied to create a combination of 6 indicators. From the combination, there were 2000 couples. They were the basis of the logistic regression equation. Meanwhile, the result of the equation was computed in exponent with e=2.58. Here is the formula for the probability exponent of logistic regression.

$$P = \frac{e^{(\beta_0+\beta_1X_1+\cdots+\beta_nX_n)}}{1 + e^{(\beta_0+\beta_1X_1+\cdots+\beta_nX_n)}}$$

(4.1)

With,

β_0 = -9.065; β_1 = 0.720; β_2 = 2.254; β_3 = 0.943; β_4 = -0.261; β_5 = -0.001; β_6 = 0.477

From the formula, the probability of each combination could be known. To simplify the way of determining the combination with the highest probability, the combinations were input in Table 4.

The Table illustrates that the scenario to enhance walkability reached the highest probability at 0.903917 or 90%. The highest probability was at 109 m; therefore, it can be concluded that the walking distance from the origin location to the public minivan stop a pedestrian could cover was 109 m. This distance length was the basis for deciding the area coverage of the public minivan stop.

C. The area Coverage of Walking

A circular buffer with the help of Arc GIS apps was employed to determine the scope of the area coverage. This circular buffer method provided the vivid area coverage using the circle area formula based on a radius of walking distance. The computation of the circle area was as follows:

$$L = \frac{22}{7} x\ r^2$$

$$L = \frac{22}{7} x\ 109^2$$

$$L = 37.340,3\ m^2$$

Description:
r = radius of walking distance
L = circle area
The result revealed that the coverage of public minivan stops in Jembrana was 37.340,3 m². The area coverage can be illustrated on the map below:

Figure 3. The Map of Area Coverage of Public Minivan Stop in Jembrana

Table 4. Combination Probability of Effort to Enhance Walkability

	DISTRIBUTION TABLE				COMBINATION							
NO	INTERVAL		FREQ	DISTANCE	PAVEMENT CONDITION	CROSSING CONDITION	PLANTATION	WAGES	WORK	PROB		PERCENTAGE
1	0.021091	- 0.094909	329	105	0	1	0	2300	1	0.09445		9%
2	0.094909	- 0.168728	291	105	0	1	1	2300	3	0.16747		17%
3	0.168728	- 0.242546	221	101	0	1	1	2000	4	0.242285		24%
4	0.242546	- 0.316365	175	102	1	0	0	2300	2	0.31636		32%
5	0.316365	- 0.390183	150	105	0	1	0	2300	5	0.388863		39%
6	0.390183	- 0.464002	149	107	1	0	0	2000	2	0.46381		46%
7	0.464002	- 0.53782	135	101	1	1	0	2200	2	0.537368		54%
8	0.53782	- 0.611638	135	105	1	0	1	2400	5	0.610236		61%
9	0.611638	- 0.685457	135	107	1	1	1	2200	3	0.682204		68%
10	0.685457	- 0.759275	123	108	1	1	0	2100	3	0.763923		76%
11	0.759275	- 0.833094	101	109	1	1	1	2400	5	0.834109		83%
12	0.833094	- 0.906912	56	109	1	1	0	2000	5	0.903917		90%

CONCLUSION AND FURTHER RESEARCH

Based on the discussion result, here are some conclusions regarding area coverage of public minivan stops in Jembrana based on walkability, which are also the answers to research objectives:

1. The findings from the analysis indicated that the factors influencing walkability were walking distance, pedestrian facility including the pavement condition, pedestrian crossing facility, plantation along the pavement, and economy condition comprising wages and work
2. The findings show that the desired-walking distance was 109 m. In addition, the government should provide a public minivan stop 109 m from the potential passenger location to increase walkability. Furthermore, the government should provide good pavement conditions and a good pedestrian crossing facility targeting citizens with wages around Rp 2.000.000 and unemployed citizens.

From the finding of distance analysis, it was known that the desired walking distance was 109 m. Then, by applying the circular buffer method with the area of circle formulation to the analysis of area coverage, it was found that the area coverage of the public minivan stop in Jembrana was 37.340,3 m².

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