www.cafetinnova.org

Indexed in
Scopus Compendex and Geobase Elsevier,
Geo-Ref Information Services-USA, List B of Scientific Journals, Poland, Directory of Research Journals

ISSN 0974-5904, Volume 09, No. 03

International Journal of Earth Sciences and Engineering

June 2016, P.P.229-234

The Performance of the Accessibility to BRT Stop: A Case Study on Transpadang Metro Bus

BAMBANG ISTIJONO[1], BAYU MARTANTO ADJI[1], TAUFIKA OPHIYANDRI[1], JOVI SATRIOS[2] AND YOSRITZAL[1]

[1]GriTrans, Civil Engineering, Faculty of Engineering, Andalas University,West of Sumatera, Indonesia
[2]Department of Transportation of Padang City, West of Sumatera, Indonesia
***Email:** bistijono1452@ahoo.co.id; bayumartantoadji@ymail.com; ophyandri@ft.unand.ac.id; yosritzal@ft.unand.ac.id*

Abstract: In this study were conducted the assessment of the accessibility performance to mass transit facilities before and after BRT (Trans Padang Metro Bus) operated. This study focuses on the accessibility of the bus transit stops in an urban area, a case study in Padang City, West of Sumatra, Indonesia. A total of 600 questionnaires were analyzed, multivariate analysesis were used. Regarding the performance, parameters which were observed namely; 'the access distance', 'the protection from the weather', 'the time delays', 'the convenient to access the bus stops facility', 'the protection from traffic accidents', 'the road pavement condition', 'the facilities for the disability' and 'the safety from crimes'. As the result, the performance of 'protection from the weather', 'the protection from other traffic', 'the facilities for the disability', 'the safety from crimes' increased. While, the performance of 'the access distance', 'the time delays', 'the convenient to access the bus stops facility', 'the road pavement condition' decreased.

Keywords: *transit system performance, accessibility, access distance, Transpadang Metro Bus, BRT.*

1. Introduction

The rapid growth of urbanization in developing countries has often been accompanied with the increasing of urban travel needs. As the economic activity levels increased, private vehicle ownnership incrased, the quantity and the travel distance of the trips made also increased, (Roza et al., 2013). Especially private car, the dependency for this means of transportation is very high, Dickinson et al, (2003) stated theat tThe uses of private car as a means of transportation in urban city is widely utilized, the majority travelling for work trip purposes uses this mode of transportation. The flexibility, time saving, comfort and safety concerned are among the advantages of private cars. Hagman (2003), he argued that the important advantage of private car use is the flexibility of accessibility and time, that means that if they use a private vehicle, there will be more convenient for people to go to anywhere at any time they desire without having to wait for public transport at the bus stop. Safety and comfort are also one of the advantages of using private vehicles. The other advantage that private car is more preferable for people is the convenience to bring their belongings along with them (Cullinane et al, 2003). Transportation planners must concern this condition because in transportation planning, there are two basic objectives: to provide sufficient mobility to access jobs, goods, and services and to provide mobility which have the minimum negative environmental impact trip (Salon and Aligula, 2012).

There must be an extensive effort to decrease the dependence of private car. One of the policies that are often suggested to attract people to leave away their private car is by improving the public transport policy (Cullinane, 2002). Bergstrom and Magnusson in 2003 argued that the number of cars in traffic could be decreased, especially in urban regions, by promoting active transportation (public transport, cycling and walking) as a means of travel. Many research attempted have been devoted into seeking how to promote active transport modes as part of a transportation system, e.g. Gatersleben and Appleton (2007), Wardman et al. (2007) and Akar and Clifton (2009). Encouraging public transport used, car ownership and usage hold seem to be the solution of transportation issues in urban cities.

Padang City is the largest city on the west Coast of Sumatra Island once the capital of the province of West Sumatra, Indonesia. The city has an area of 694.96 km² which is bordered by the geography of the sea but has a hilly terrain which height reaches 1,853 mdpl (Figure 1). Based on the data in Padang in Numbers in 2013, a number Padang City population is 871,534.

Wide negative effects of car as a transportation mode, namely ; traffic congestion, pollution, road accidents, and the lack of space for road and parking facilities were the problems that must be faced in Padang City. It caused by the depency of private car and unsufficient of public transportation servis. Padang city covered a regular bus and "Angkot" (a public transport which has the capacity 12 passengers) as

public public transportation. To increase the service, transportation authority provide a new public transportation system, namely Trans Padang Metro Bus (BRT).

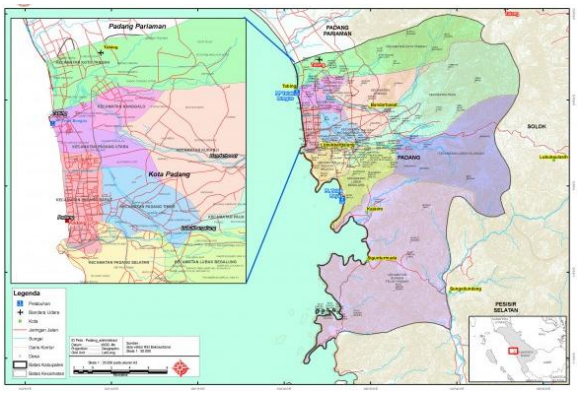

Figure 1 *Map of Padang City*

Government planned five corridors for Trans Padang Metro Bus (Figure 2), namely "LubukBuaya– Pasar Raya", "Indarung - Pasar Raya", "TelukBayur- Air Pacah", "TelukBayur - Pasar Raya" and "BIM (International Airport) – Teluk Bayur". The operation of this system has been planned since 2007, but continues to be delayed by various factors.

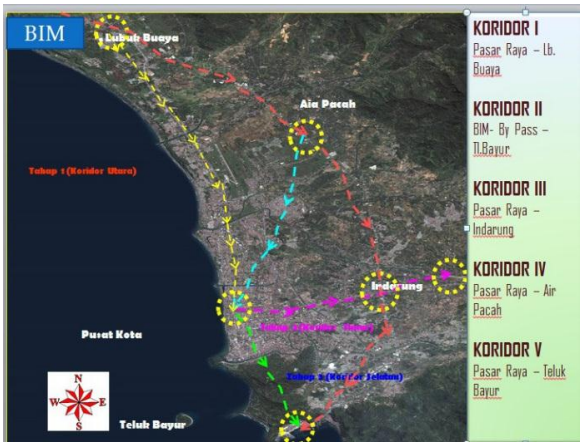

Figure 2 *The planned corridors of Trans Padang*

Fist corridor operated in january 2014, corridor is "LubukBuaya - Pasar Raya". The Length of the route is 20.6 km. The average travel time is 1 hour and 25 minutes. BRT Trans PADANG Metro Bus scheduled departure begins early in the morning at 06.00 am till 20.00 pm, every day at a ticket tariff of IDR 3,500 (USD 0.29) for general users and IDR 1,500 (USD 0.12) for students. The capacity of the bus is 20 passenger's seats and 20 standing passengers. This system operates 10 buses. There are 66 stops along the corridor 1 "LubukBuaya - Pasar Raya" (Figure 3).

Figure 4 shows one of the bus stop facility alng the corriodor of Trans Padang Merto Bus which is equipped with road markings, traffic signs, protection from the weather and the seats for the users who are waiting for the bus.

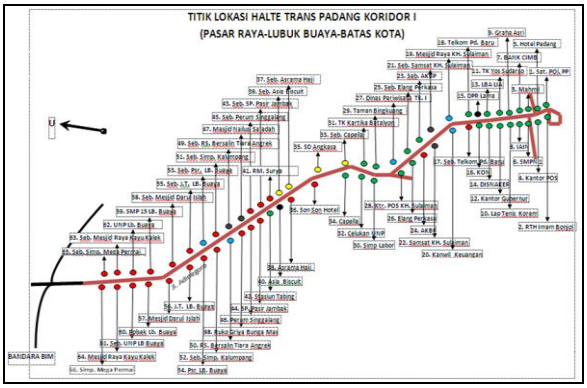

Figure 3 *Fist corridor of Trans Padang Metro Bus (Lubuk Buaya-Pasar Raya)*

Figure 4 *Trans Padang Metro Bus Stop facility*

Before BRT operates within Padang city, public transport systems operate with a stop based on user requests (Flag stop). With this system the user could stop the public transport anywhere, even at the street junction. Public transport operator could load and unload at any place. It is very disturbing the other traffic flow, due to the old bus did not have an exclusive line. It is also very dangerous because public transport will be stopped suddenly when the driver saw there were passengers on the edge of the road who wants to use public transport or any passengers getting off. To overcome these problems, the government operates the Trans Padang Metro Bus (BRT) to replace the old system. The operation of public transport becomes "Set stop". BRT only stop at bus stops and operates on the left side of the road. The were advantages and disavantages after Trans Padang Metro Bus operated., mainly accesibility to bus stop facility. This research attemted to find out the performance the accesibility.

2. Survey Results

Field surveys were undertaken in this study. A set of questionnaire was prepared and distributed to the respondents in along the Trans Padang route. The questionnaire covers public transit users. However, in this study the sample size is 600. Table 1 summarizes the socio-demographic data of respondents. The data consists of Trans Padang users. The percentages of females are higher than males. The survey recorded 59.3% females and 40.7% males in the study.

Table 1: *The socio-economic characteristic of the sample*

Characteristics	Statistic
Gender	Male (40.7%), Female (59.3%)
Age	0-15(13.3%), 15-25(50.0%), 25-50 (20%), > 50 (16.7%)
Occupation	Student (64.0%), employee (16.0%), self-employee (17.7%), housewife (3.3%), unemployed (3.0%)
Income	< USD 82.6 (50%), USD 82.6-165.1 (23.3), USD 165.1-412.8 (14.0%), > 412.8(12.7%)
Marriage status	Married (28.7%), not married (71.3%)
Private vehicle ownership	Private car (8.7%), walking (54.7%), Ojek (21.0%), private car (15.0%), Angkot (15.6%)

As the result in Table 1, majority of public transit users are respondents aged between 15-25 years old (most of which are student). The consistent pattern does not occur between respondent's ages towards the usage of mass transit for commuting. The highest numbers of public transit users are students, followed self-employee (17.7%). The view of public transit users is from low income group was explored in this research. Based on income level, the highest public transit user respondent earned an income less than 82.6 USD (50%), this result is in accordance with Sanchez in 2002, and his research also stated the relevance of low income and public transit users. He also indicated that this phenomenon can be considered for land public transit authority in decision-making of public transit system and policy such as the subsidies travel cost expenses for the public transit users. The majority of mass transit users walked to bus stops (54.7%), a total of 21 % of respondent used "Ojek", "Ojek" is the public transport by using the motorcycle. The operation of the "Ojek" is equal to a taxi. Respondent also used "Angkot" in accessing public transit (15.5%). "Angkot is defined as the public transport which has 12 capacity of passenger.

3. Result of the Study

As mentioned before, this study investigates the performance of the accessibility to Transpadang Metro bus stops. There are eight parameters were observed namely; 'the access distance', 'the protection from the weather', 'the travel time', 'the convenient to access the bus stops facility', 'the protection from traffic accidents', 'the road pavement condition', 'the facilities for the disability' and 'the safety from crimes'.

Regarding the assessment, there were 1 until 5 scales of performance assessment namely, "1" denoted 'extremely not satisfied', "2" denoted 'not importance", "3" denoted 'moderately satisfied', "4" denoted 'satisfied', "5" denoted 'extremely satisfied'. The assessment was conducted on the condition before and after Trans Padang operated.

Figure 5 *The comparison of the interior and exterior the previous bus (left) with BRT (right)*

3.1 The Travel Time and the Interior Condition of the Bus

The operation of Trans Padang was actually not make the travel time were shorter than the initial bus. The travel time average of the earlier bus is 65 minutes. Compared to BRT travel time average is 1 hour and 25 minutes. This happens because the former bus driver operates city bus with high speed. The city bus has 60 km/hour of maximum speed, while BRT has only 45 km/hour. The operation of BRT is more to provide the comfort and save of mass transportation. In figure 5 shows the comparison of the interior and exterior of the previous bus and. In addition, the operation of the BRT is intended to make the public transport stop at stops bus only. In order to obtain that purpose, this BRT had a physical barrier, which is has the entrance door higher than the previous bus, i.e 80 cm. To adjust the height of the entrance door, the bus stops infrastructure also made higher.

3.2 Access Distance

Transit used is associated with walking behavior and the result of TOD initiatives (Lachapelle and Noland, 2012). They also It was suggested that transit systems often cover the major central business district (CBD) with the high of walking activity. The transit system as a part of TOD must provide a good access to infrastructures for walking and pedestrian infrastructure. Public transit should provide the feeder service to serve the transit users who resides outside the acceptable walking distance area. Lachapelle and Noland, 2012 suggested that the catchment area of transit station (bus service) in business area is should be 500 meters. While Krygsman et al. (2004); Ben-Akiva and Morikawa (2002), the walking distance to access a subway system, light rail, or express bus service is 800–1000 m.

Moreover, the others other researches highlighting on access distance to public transit are well documented;

296 meters in Chicago (Levinson, 1974); 369 meters in Toronto (Schoppert and Herald, 1978); 523 meters in New York (Seneviratne, 1985); 512 meters in West Germany, Hamburg (Koushki, 1988); 859 meters in Saudi Arabia, Riyadh (Koushki, 1993); (400 meters in Indonesia (Soegijoko and Horthy, 1991); 263-493 meters in Hongkong (Lam et al., 1995) and 910 meters in Mumbai, India (Rastogi and Rao, 2003).

In this study, the public transport user is also given the question regarding the perception of distance access after BRT was operated. As the result is, a total of 28.3 % from 600 respondents stated that the access distance increased, 15% of respondents stated the access distance decreased and 56.7 % mentioned there were not any changes of the access distance.

Table 2 presents the trip distances from the respondent's residence to the nearest bus stop before and after Transpadang Metro Bus operated. In this table, the data of bus users indicated that, before Transpadang Metro Bus operated, the highest range of access distance is < 200 meters (48.08%), followed by between 500 – 1000 meters (30.0%), 200 – 500 meters (17.0%) and more than 1000 meters (5.0 %). After Transpadang Metro Bus operated, the respondents with the access distance < 200 meters and 200 – 500 meters decreased to 24.0 % and 15.67%. while the respondents with the access distance 500-1000 meters and > 1000 meters increased to 52.83 % and 7.50%.

Table 2 *The access distance to bus stop before and after BRT operated*

Access distance (m)	Before	After
	Percentage	Percentage
< 200	48.00%	24.00%
200-500	17.00%	15.67%
500-1000	30.00%	52.83%
> 1000	5.00%	7.50%

Regarding the performance of the access disteance to the bus stop before and after BRT operated, before Transpadang Metro Bus operated, respondents stated that the average performance was 3.34 STDEV 0.88, while after Transpadang Metro bus operated the average performance decreased to 2.71 STDEV 0.80. At 0.05 level of significant, the decline of the performance was significant (p value = 0.13).

3.3 The Protection from the Weather along the Access Route

Regarding the protection from the weather in accessing bus stops, it is defined as protection from the hot weather and the rain along the route of access. Padang City is a tropical area, which has a high rainfall intensity and has the high enough of the temperature. The range of the air temperature is between 23 ° C - 32 ° C, during the day and 22 ° C - 28 ° C, at night. The humidity ranged between 78 % - 81 %. The intensity of rainfall in Padang City reached an average of 405.58 mm per month, which has an average of 17 days of rain days per month. It could be an obstacle in encouraging people to use of public mass transit. In this study conducted an assessment of performance regarding 'the protection from the weather' before and after the BRT operated.

Multivariate test was conducted to observe the performance. As the result, after Transpadang Metro bus operated, the performance increased, (Average performance = 2.36, STDEV 1.05 to 3.75, STDEV 1.03), a significant increasing of the performance occurred at the level of 0.05 significant (p value = 0.18).

3.4 The Travel Time to Access Bus Stop

The travel time to access the bus have the correlation with the access distance. Table 3 shows the increasing of travel time to access the bus stop after transpadang Metro bus operated. In the table, after BRT operated, at all of access distance range, the travel time increased. The highest increasing of travel time is for the range of the access distance 500-1000 meters, namely 3.78 minutes.

Table 3 *The travel time to access the bus stop after transpadang Metro bus operated*

Access distance (meters)	The increasing of travel time (minutes)
< 200	1.20
200-500	2.60
500-1000	3.78
> 1000	2.21

With regards to this performance of the travel time, after BRT operated, the performance of this parameter also decline, (Average Assessment = 3.20, STDEV 0.91 to 2.81, STDEV 0.89), the decline was significant at 0.05 level (p value = 0.07).

3.5 The Convenient to Access the Bus Stops facility

As mentioned before, one of the purposes of the new bus system is the bus only stop at the bus stop (set stop). Physical constrain was assigned to obtain the purpose. If the old bus the high of the entrance door from road surface is only about 30 cm, while the entrance door of bus Trans Padang, the high is 80 cm. The infrastructure bus stops should be built based on the high of bus entrance door. This condition influence the convenient in accessing BRT. The respondents were asked regarding the performance of this parameter after BRT operated.

As a result, the performance of this parameter also decline (Average Assessment = 3.03, STDEV 0.79 to 2.84, STDEV 0.35), the decline was significant at 0.05 level (p value = 0.095).

3.6 The Protection from Other Traffic

In Padang City, The people concern with regards to the lack of pedestrian facilities, pedestrians should

move in an area, which mixed with other traffic flows. The risk of accidents in accessing the bus stop will always be threatened. It can also be a barrier in encouraging using mass transit in Padang City. In this study was also carried out observations about the risk of accidents before and after BRT operated. As the result of the user, the performance of this parameter increased (Average Assessment = 2.03, STDEV 0 .67 to 3.04, STDEV 0.99), the increasing was significant at 0.05 level (p value = 0.25).

3.7 Road Pavement Condition

As mentioned before, in accessing bus stops, the majority of mass transit users were walking. The condition of road pavement along the route must be concerned. The respondents were asking regarding the condition of pavement road along the route. As the result is the performance of this parameter also decline (Average Assessment = 3.03, STDEV 1.019 to 2.84, STDEV 0.94), the decline was significant at 0.05 level (p value = 0.087).

3.8 The Facilities for the Disability

In public transportation it must be concerned regarding the lack of facilities for the disability. In this study the investigation of facilities for persons with Disabilities. As the result is the performance of this parameter increased (Average Assessment = 1.13, STDEV 0.41 to 2.74, STDEV 0.72), the increasing was significant at 0.05 level (p value = 0.17).

3.9 The Safety from the Crimes during the Trip

Regarding this parameter, the performance also increased (Average Assessment = 1.53, STDEV 0.31 to 2.14, STDEV 0.54), the increasing was significant at 0.05 level (p value = 0.25).

4. Conclusion

Compared to the previous public transit, the BRT operation does not reduce the travel time of public transport users. The results obtained, the travel time is 20 minutes longer compared to the bus earlier. But as a new public transit system, BRT is more secure, because it only stops at the bus stop only (Set Stop). BRT operates only on the left side of the road, which do not interfere with the flow of other traffic. In visual, there is an increasing of the interior quality compared to the previous bus.

As the result, the performance of ‘protection from the weather’, ‘the protection from other traffic’, ‘the facilities for the disability’, ‘the safety from crimes during the trip’ increased. While, the performance of ‘the access distance’, ‘the travel time to access bus stop ’, ‘the convenient to access the bus stops facility’, ‘the road pavement condition’ decreased.

In improving the public transportaion service, accessibility to the bus stop is an essential paramater. The results of this research should be concerned by the authorities in order to increase the performance of the public transport service.

5. Acknowledgements

The authors would like to acknowledge the Faculty of Engineering, Andalas University, Padang West of Sumatera, *Indonesia*, for the funding of this research and publication.

References

[1] Roza, A., Ibrahim, N.I., Adji, B,M,, Karim, M,R., Study On Parking Characteristic: Case Study In Petaling Jaya City Council (MBPJ), Malaysia, Journal of Society for Transportation and Traffic Studies (JSTS), Vol.4 No.1, 2013.

[2] Dickinson, J.E., Kingham, S., Copsey, S., Pearlman, D., Employer travel plans, cycling and gender: will travel plan measures improve the outlook for cycling to work in the UK?, Transportation Research Part D 8, pp. 53–67, 2003.

[3] Hagman, O., Mobilizing meanings of mobility: car user’s constructions of the goods and bads of car use, Transportation Research Part D 8, pp. 1–9, 2003.

[4] Cullinane, S., Cullinane, K. Car dependence in a public transport dominated city: evidence from Hong Kong. Transportation Research Part D 8: pp.129–138, 2003.

[5] Salon, D., Aligula, E.M., Urban travel in Nairobi, .Kenya: analysis, insights, and opportunities, *Journal of Transport Geography 22*, pp.65-76, 2012.

[6] Cullinane, S., The relationship between car ownership and public transport provision: acse study of Hong Kong. *Transport Policy 9*, pp. 29–39, 2002.

[7] Bergstrom, A., Magnusson, R, Potential of transferring car trips to bicycle during winter. *Transportation Research Part A 37*, pp. 649–666, 2003.

[8] Gatersleben, B., Appleton, K., Contemplating cycling to work: Attitudes and perceptions in different stages of change. *Transportation Research Part A 41*, pp. 302–312, 2007.

[9] Wardman M, Tight M, Page, M. 2007. Factors influencing the propensity to cycle to work, Transportation Research Part A 41: 339–350.

[10] Akar, G., Clifton, K., The influence of individual perceptions and bicycle infrastructure on the decision to bike. *Transportation Research Record 2140*, pp. 165–172, 2009.

[11] Lachapelle, U., Noland, R.B., Does the commute mode affect the frequency of walking behavior? The public transit link, *Transport Policy 21*, pp. 26-36, 2012

[12] Krygsman, S., Dijst, M,, Arentze, T., Multimodal public transport: ananalysis of travel time elements and the inter connectivity ratio. *Transport Policy 11*, pp. 265–275, 2004.

[13] Ben-Akiva, M., Benjamin, J,, Lauprete, G,, Polydoropolou, A., 1996. Impact of advanced public transportation systems on travel by dial-a-ride, *Transportation Research Record 1557*, pp. 73–79, 1996.

[14] Levinson, H.S., Planning and pedestrian environment. *Proc., Seminar on Bicycle/Pedestrian Planning and Design, ASCE, Reston, Va*., pp. 37–75, 1974.

[15] Schoppert, D. W., Herald, W.S., Pedestrian range as related to transit stations and their immediate surroundings.'' *ITE J 48*, pp. 13–18, 1978.

[16] Seneviratne, P.N., Acceptable walking distances in central areas.'' J. *Transp. Eng., 111(4)*, pp. 365–376, 1985.

[17] Koushki, P.A., Walking characteristics in Central Riyadh, Saudi Arabia. *J. Transp. Eng., 114(6)*, pp. 735–744, 1988.

[18] Koushki, P.A., Ali, S.Y., Pedestrian characteristics and the promotion of walking in Kuwait City Center. *Transp. Res. Rec. 1396, Transportation Research Board, Washington, D.C*., pp. 30–33, 1993.

[19] Soegijoko, S.T.B., Horth,y S.I., Role of nonmotorized transport modes in Indonesian cities, *Transp. Res. Rec. 1294, Transportation Research Board, Washington, D.C.*, pp. 16–25, 1991

[20] Lam, W.H.K., Morrall, J. F., Ho, H., Pedestrian flow characteristics in Hong Kong, *Transp. Res. Rec. 1487, Transportation Research Board, Washington, D.C*, pp. 56–61, 1995.

[21] Rastogi, R., Rao, K.V.K., Travel Characteristics of Commuters Accessing Transit: Case Study. *Journal of Transportation Engineering 6*, pp. 684–694, 2003.