THE OPERATIONAL CHARACTERISTICS OF THE JAKARTA BUS RAPID TRANSIT SERVICES

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Abstract: In order to understand the operational characteristics of the Jakarta bus rapid transit (BRT) services, an observation was made on line 1 between Blok M and Kota. Three observation points were selected on Blok M terminal, Bank Indonesia stop and Kota terminal. Sufficient surveyors were assigned at each point to record the time of arrival/ departure of the bus and the number of passengers boarding and alighting. Headways, boarding/ alighting rates and travel speeds were calculated from the obtained data. The results confirm that no control on planned headways and boarding/ alighting times has been made due to lack of fixed time table of the bus service.

Key Words: bus rapid transit, headway, boarding/ alighting time

1. INTRODUCTION

Jakarta BRT service which incorrectly called as “busway” by Indonesian public have been providing service since 15 January 2004. At the time of the preparation of this paper three corridors (lines) have been in operation and an additional of four new corridors was about to start the services. According to the Decree of the Governor of Jakarta No.84/2004 which contains of Jakarta Macro Transport Pattern, there will be 15 lines of BRT services at the end of 2010. This paper is intended to provide brief description on the operational characteristics of the Jakarta BRT services on line 1 between Blok M and Kota.

2. OBJECTIVES

The objective of this research was to understand the operational characteristics of the Jakarta BRT services.

3. SCOPE AND LIMITATIONS

The observation was only conducted in the Jakarta BRT line 1 between Blok M and Kota on 3 hourly observations starting at 7.00, 16.30 and 20.00 on a single day in November 2006. Only three points were observed, i.e. Blok M terminal, Bank Indonesia stop and Kota terminal. Although the collected data allows the analysis of mean boarding/ alighting rate and travel speed, in this paper only analysis of mean headway and mean boarding/ alighting time will be reported.

4. LITERATURE REVIEW

The required scale of transport services depends on a city depends on the stage of development of the city. Small and traditional community lives in a relatively small area might only require walk as a mode of transport. As the community grows and the related area simultaneously grows a motorized vehicle might be required to shorten the travel time. To increase capacity the use of larger mode of transport such as bus should be initiated. Metropolitan area requires rapid transit for higher speed. For this purpose an exclusive lane is usually required longitudinally and/or transversely (Vuchic, 1981). Mass rapid transit (MRT) by means of underground or elevated railway system was believed to be the ultimate solution for metropolitan transport (Replogle, 2006). However, recently, some studies proved that bus rapid transit (BRT) provides competitive line capacity, requires lower costs (in terms of construction, operation and maintenance), gives less negative impact to environment, etc. (Replogle, 2006 and Schipper, 2006). However Morichi and Acahrya (2006) argued that for certain cities the demand might be much higher than the BRT capacity and suggested the MRT as the backbone with the support of the BRT as a feeder system as the solution.

Putranto (2004) found that worldwide, total MRT network length is significantly and negatively correlated with opening year of the first section. This means that total network length of MRT system that has been established longer is higher than total network length of MRT system that has just been established for a shorter period. This finding suggests that development of a comprehensive MRT system requires substantial period of time. Therefore BRT could be use as an intermediate option to be replaced by MRT at a later stage (Morichi and Acahrya, 2006). Zhang et al (2005) established a set of evaluation indexes including social economy factors, traffic function factors, environment effect factors and resources utilizing factor by taking managers, users and relatives as the subject of BRT scheme evaluation.

Line capacity is related to several characteristics such as the headway, boarding/ alighting time, number of boarding/ alighting passengers (boarding/ alighting rates), vehicle capacity, etc. The first three were analyzed in this paper.

5. METHODOLOGY OF DATA COLLECTION AND ANALYSIS

In order to understand the operational characteristics of the Jakarta bus rapid transit (BRT) services, an observation was made on line 1 between Blok M and Kota. Three observation points were selected on Blok M terminal, Bank Indonesia (BI) stop and Kota terminal. Three to four surveyors were assigned at each point to record the bus ID, time of arrival/ departure of the bus and the number of passengers boarding and alighting. At the terminals, arrival and departure platforms are separated and therefore passengers alight at the arrival platforms and board at the departure platforms. In the bus stops located between the terminals boarding and alighting is held a single platform. Therefore analysis of boarding/ alighting time was separated between the terminal case and the bus stop case. Three hourly observations starting at 7.00 (morning), 16.30 (afternoon) and 20.00 (evening) were made on a single day in November 2006. Travel speeds will not be presented in this paper due to limited speeds data (one hour observation for each time period resulted in limited number of buses that was be able to be traced in more than one point of observation).

Some t-tests for the difference of means of headways and boarding/ alighting times were made in order to evaluate the differences in the BRT operational characteristics between pairs of observation cases. Two methods to group the data were exercised, i.e. by period of observation, by routes and by combination of them. Obviously, the more the level of detail of the grouping, the less the number of sample on each group. The significant level considered in this paper was 0.05. It should be noted that number of sample is playing an important role in determining the minimum mean difference to be considered as statistically significant.

Additionally a Pearson Correlation analysis was also carried out between:

- boarding time and number of passengers boarding at the terminal
- alighting time and number of passengers alighting at the terminal
- boarding/ alighting time and number of passengers boarding/ alighting at the bus stop

A significant level (α) of 0.05 was also used to determine significant correlation coefficient (r).

6. DATA ANALYSIS RESULTS

Tables 1 to 5 summarize the results of mean difference of headways t-tests grouped by pairs of observation period, routes and combination of them.

Table 1 T-test for mean difference of headways grouped by observation period

Observation Period Start at	Mean Headway	Mean Difference with Headway from Observation Period that Start at	
		16.30	20.00
7.00	2’53”	18” (0.459)	3’59” (0.001)
16.30	2’35”	-	4’17” (0.001)
20.00	6’52”	-	-

*The numbers on the brackets show significant levels

Table 2 T-test for mean difference of headways grouped by route

Route	Mean Headway	Mean Difference with Headway from Route		
		BI-Blok M	Blok M-BI	BI-Kota
Kota-BI	2’39”	49” (0.139)	2’26”(0.006)	1’39” (0.001)
BI-BlokM	3’28”	-	1’36” (0.118)	50” (0.033)
Blok M-BI	5’5”	-	-	46” (0.434)
BI-Kota	4’18”	-	-	-

*The numbers on the brackets show significant levels

Table 3 T-test for mean difference of morning headways grouped by route

Route	Mean Headway	Mean Difference with Headway from Route		
		BI-Blok M	Blok M-BI	BI-Kota
Kota-BI	1’29”	1’22” (0.051)	3’52” (0.039)	2’17” (0.001)
BI-BlokM	2’51”	-	2’30” (0.190)	54” (0.238)
Blok M-BI	5’21	-	-	1’35” (0.377)
BI-Kota	3’46”	-	-	-

*The numbers on the brackets show significant level

Table 4 T-test for mean difference of afternoon headways grouped by route

Route	Mean Headway	Mean Difference with Headway from Route		
		BI-Blok M	Blok M-BI	BI-Kota
Kota-BI	1’41”	1’22” (0.001)	1’20”(0.099)	2’18” (0.001)
BI-BlokM	3’4”	-	1”(0.967)	56” (0.013)
Blok M-BI	3’2”	-	-	57” (0.229)
BI-Kota	4’0”	-	-	-

*The numbers on the brackets show significant level

Table 5 T-test for mean difference of evening headways grouped by route

Route	Mean Headway	Mean Difference with Headway from Route		
		BI-Blok M	Blok M-BI	BI-Kota
Kota-BI	10’8”	4’45” (0.029)	3’49” (0.085)	4’36” (0.034)
BI-BlokM	5’22”	-	56” (0.287)	9” (0.732)
Blok M-BI	6’18”	-	-	46” (0.445)
BI-Kota	5’32”	-	-	-

*The numbers on the brackets show significant level

It can be seen from Table 1 that mean difference of headway between morning and afternoon period was not statistically significant. Mean headway in the evening period was statistically significant different with either mean headway in the morning or afternoon period. This indicates that during off peak period (evening period) the number of buses operated was significantly decreased.

From Tables 2 to 5, we find that in general Kota-BI-Blok M direction of travel was having shorter mean headway than the opposite direction. This might be caused by limited observation hours. The BRT system is operated between 5.00 and 22.00.

Tables 6 to 8 summarize the results of the mean difference of boarding/ alighting times t-tests grouped by pairs of observation period.

Table 6 T-test for mean difference of terminal alighting time grouped by observation period

Observation Period Start at	Mean Alighting Time	Mean Difference with Alighting Time from Observation Period that Start at	
		16.30	20.00
7.00	48”	1” (0.901)	39” (0.001)
16.30	47”	-	38” (0.001)
20.00	9”	-	-

*The numbers on the brackets show significant levels

Table 7 T-test for mean difference of terminal boarding time grouped by observation period

Observation Period Start at	Mean Boarding Time	Mean Difference with Alighting Time from Observation Period that Start at	
		16.30	20.00
7.00	27”	2” (0.486)	13” (0.001)
16.30	25”	-	11” (0.001)
20.00	14”	-	-

*The numbers on the brackets show significant levels

Table 8 T-test for mean difference of bus stop boarding/ alighting time grouped by observation period

Observation Period Start at	Mean Boarding/ Alighting Time	Mean Difference with Alighting Time from Observation Period that Start at	
		16.30	20.00
7.00	14”	1” (0.236)	4” (0.001)
16.30	15”	-	6” (0.001)
20.00	9”	-	-

*The numbers on the brackets show significant levels

From Table 6, it can be seen that the mean difference of terminal alighting time between morning and afternoon period was not statistically significant. Mean terminal alighting time in the evening period was statistically significant different with either mean terminal alighting time in the morning or afternoon period. This correlates with the number of alighting passengers during different period of observations.

From Table 7, it can be seen that the mean difference of terminal boarding time between morning and afternoon period was not statistically significant. Mean terminal boarding time in the evening period was statistically significant different with either mean terminal boarding time in the morning or afternoon period. This correlates with the number of boarding passengers during different period of observations.

From Table 8, it can be seen that the mean difference of bus stop boarding/ alighting time between morning and afternoon period was not statistically significant. Mean bus stop boarding/ alighting time in the evening period was statistically significant different with either mean terminal alighting time in the morning or afternoon period. This correlates with the number of boarding/ alighting passengers during different period of observations.

Table 9 Correlation Analysis between boarding time/ alighting time and no. of passengers boarding/ alighting

Location	Correlation between	No. of Sampel	*r*	*α*	Significant at 0.05?
Terminal	boarding time and no. of passengers boarding	126	0.127	0.078	no
Terminal	alighting time and no. of passengers alighting	147	0.198	0.008	yes
Bus Stop	boarding/ alighting time and no. of passengers boarding/ alighting	100	0.118	0.120	no

From Table 9 it can be seen that boarding time/ alighting time were generally not correlated with number of passengers boarding/ alighting. It does not indicate that there was a standard time length of boarding/ alighting. The boarding/ alighting times were varied widely.

7. CONCLUSIONS

- Mean difference of headway between morning and afternoon period was not statistically significant. Mean headway in the evening period was statistically significant different with either mean headway in the morning or afternoon period.
- Mean difference of terminal alighting time between morning and afternoon period was not statistically significant. Mean terminal alighting time in the evening period was statistically significant different with either mean terminal alighting time in the morning or afternoon period.
- Mean difference of terminal boarding time between morning and afternoon period was not statistically significant. Mean terminal boarding time in the evening period was statistically significant different with either mean terminal boarding time in the morning or afternoon period.
- Mean difference of bus stop boarding/ alighting time between morning and afternoon period was not statistically significant. Mean bus stop boarding/ alighting time in the evening period was statistically significant different with either mean terminal alighting time in the morning or afternoon period.
- Boarding time/ alighting time were generally not correlated with no. of passengers boarding/ alighting. The results confirm that no control on planned headways and boarding/ alighting times has been made due to lack of fixed time table of the bus service.

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