Vehicle Operation Cost and Load Factor of Inter-City Micro-Bus Transit in Mamminasata Metropolitan Area

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Abstract: The objective of this paper is to describe the current vehicle operation cost (VOC) and load factor (LF) performance of the micro-bus transit (namely, Pete-pete) which has been operating as an inter-city public transport in Mamminasata Metropolitan Area (MMA) in South Sulawesi Province, Indonesia. The study focuses on the three origin-destination trips of the public transport in the area, i.e. Makassar-Maros route, Makassar-Sungguminasa route, and Makassar-Takalar route. The VOC survey for the transits uses interview method, while its analysis adopts Indonesia Ministry of Transportation. Meanwhile, the LF measurement is conducted by distance zone system as long as the transit's route. The analysis results show that the three routes have similar VOC categorized as highly cost. As well as, the three routes have low LF performance. The study results are useful in development of the public transportation management such as mode and route choice models in MMA for further studies.

Keywords: Vehicle Operation Cost, Load Factor, Micro-Bus Transit, Inter-City

1. INTRODUCTION

Nowadays, the activity-travel of individuals on urban area in Asian developing cities, such as Makassar City, Indonesia is increasing rapidly. The activity travel demand needs infrastructure supply such as various transportation modes and transportation networks. Regarding the activity-travel demand in Makassar City, the capital city of South Sulawesi Province, the current mode and infrastructure transportation supply is not adequate to serve the demand (Ramli & Hustim, 2003; Jusmin et al, 2003). This problem is supported by the increase of the activity-travel from and to its neighbor cities such as Maros, Gowa and Takalar (JICA Report, 2007). In order to overcome the transportation problem in the area, the government of Indonesia has made a regulation in order to develop the integrated land use transportation of the cities. In this regard, the four cities are called Mamminasata Metropolitan Area (Indonesia President, 2011). In cooperation with JICA, the government of South Sulawesi Province has already arranged a land use development plan of the MMA for the short, middle, and long terms (JICA Report, 2007).

The MMA plan also has provided a transportation system development plan as shown in Figure 1b in order to serve the activity-travel demand in the MMA, particularly inter-city travel among the cities in Mamminasata Area. However, the supporting programs in implementing the MMA's transportation plan are not provided yet, such as transition activities

program from the current public transportation to the public mass transportation, activities program in changing travel behavior of individual within MMA, etc. Regarding this, the MMA plan needs a supporting plan such as a development plan of the current transportation system in each city in the Mamminasata area. Therefore, an efficient and effective public transportation management for inter-city travel-activity in the MMA can be formed in the future.

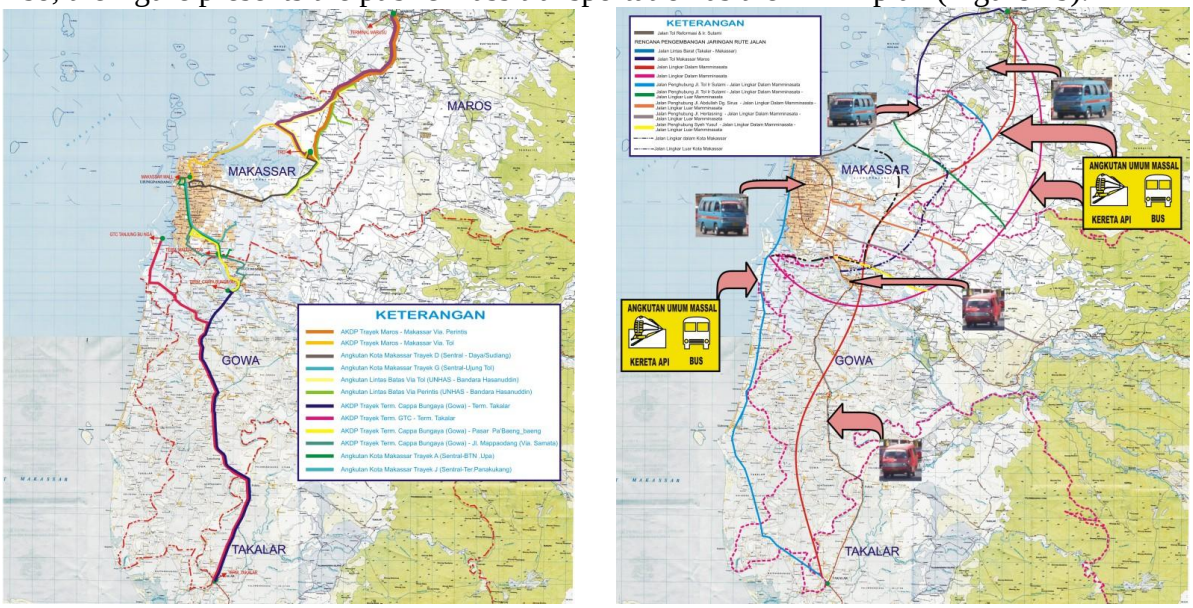
In order to contribute to the field, this paper attempts to describe the current vehicle operation cost (VOC) and load factor (LF) performance of the micro-bus transit (namely, Pete-Pete) which has been operating as inter-city public transportation in Mamminasata Metropolitan Area (MMA) in South Sulawesi Province, Indonesia. For this purpose, the study focuses to capture the three origin-destination trips of the public transportation in the MMA, i.e. Makassar-Maros route, Makassar-Sungguminasa route, and Makassar-Takalar route.

The rest of this paper is presented as follows. The next section presents the study methods then followed by a description of the VOC and LF performance of the current public transportation in the MMA. Finally, the paper provides a conclusion regarding the analysis results.

2. STUDY METHODS

2.1 The Study Location

Figure 1 shows the current public transportation network as the study location of this research. Also, the figure presents the public mass transportation as the MMA plan (Figure 1b).



a. The current public transport network (Ali & Ramli, 2007; Aly & Ramli, 2004)

b. The public transport network of MMA Plan (JICA, 2007)

Figure 1. The public transport network in Mamminasata Metropolitan Area

2.2 The Number of Micro-Bus Transit as Inter-City Public Transport in MMA

Table 1 shows the population number of the micro-bus transit operating as inter-city public transportation in Mamminasata area. Table 1 also shows that the number of micro-bus as inter-city public transportation on Makassar-Maros via Jl. Perintis route are 493 units, and 615

units registered and observed, respectively. For Makassar-Maros via Jl. Sutami/Tol, there are 387 units registered, and 417 units observed. On the track of Makassar-Gowa, there are 650 units bus observed. For Makassar-Takalar route, there are no available micro-bus registered, however, in actuality, a few seems to operate from Takalar. Therefore, this study attempts to capture their performances.

Table 1. Number of micro-bus transit in the MMA

Inter-city track in Mamminasata	Micro-Bus Number		Micro-bus Capacity
	Registred	Observed	
Makassar – Maros Via Perintis	493	615	11
Makassar – Maros Via Sutami/Tol	387	417	11
Makassar – Gowa	650	752	11
Makassar - Takalar	-	-	11

2.3 The Survey Method of Vehicle Operation Cost (VOC)

The VOC data is collected using an interview survey to the operators of the micro-bus transit in each route. The survey based on a questionnaire sheet involving questions about the items of vehicle operation cost such as direct cost (i.e. reduction cost, capital interest cost, bus crew cost, gasoline cost, tire cost, vehicle maintenance cost, terminal cost, ownership administrative cost, bus inspection cost, and insurance cost) and indirect cost.

2.4 Measurement Method of Load Factor

The load factor values of the micro-bus in the MMA are measured using a survey method which observes the loading-unloading process of the passengers along the micro-bus route. In this regard, the travel distance of the micro-bus is divided into some zone based on km-traveled. The zone dividing system of the three micro-bus routes operating in the MMA are presented in Table 2, Table 3, and Table 4 for Makassar-Maros route, Makassar-Gowa route, and Makassar-Takalar route, respectively.

Table 2. The zone dividing system of Makassar – Maros route

Route/Zone	Makassar-Maros (Round trip)	Distance (Km)
1	Terminal Marusu-Maccopa	2
2	Maccopa-Batang Ase	3
3	Batang Ase-Bulu-bulu	3
4	Bulu-bulu - Sudiang	3
5	Sudiang - Daya	3
6	Daya-Unhas Tamalanrea	5
7	Unhas Tamalanrea-Tello	2
8	Tello-Terminal Panaikang	3
Total of Travel Distance (Km)		15

3. RESULTS

3.1 The Vehicle Characteristics of the Micro-Bus Mode

Regarding the survey results, the vehicle characteristics such as producer, brand, and engine size capacity of the micro-bus mode operating as inter-city public transportation in the MMA

are presented in Table 5. Table 5 shows that the brand of the micro-bus operating in the MMA varies from Hijet, Zebra, T120SS, ST, and Carry. The producers or their industries are dominated by three biggest automotive industries from Japan, i.e. Daihatsu, Mitsubishi, and Suzuki. In addition, the engine size capacity of the micro-bus varies from 970 cc to 1500 cc.

Table 3. The zone dividing system of Makassar – Gowa routes

Route/Zone	Gowa-Makassar (Go)	Makassar-Gowa (Back)	Distance (Km)
0	Term. Cappa Bungaya	Karebosi	1
1	Terminal Baji Minasa	Gubernuran	1
2	Jl. KH. Wahid Hasyim	Kantor PLN	1
3	Kodim Sunggu Minasa	Mall Ratu Indah	1
4	Ruko Bulukumba Jaya	RS Labuang Baji	1
5	Term. Malengkeri	Jl. Veteran Selatan	1
6	Kampus Unismuh	Gedung Lestari 45	1
7	Kampus UIN	Kampus UIN	1
8	SD di Jl. A. Tonro	Kampus Unismuh	1
9	Jl. Kumala	Terminal Malengkeri	1
10	RS. Labuang Baji	Ruko Bulukumba Jaya	1
11	Mall Ratu Indah	Kodim Sunggu Minasa	1
12	Kantor PLN	Jl. KH. Wahid H	1
13	Gubernuran	Terminal Baji Minasa	1
14	Karebosi	Terminal Cappa Bungaya	1
Total of travel distance (Km)			15

Table 4. The zone dividing system of Makassar – Takalar routes

Route/Zone	Makassar-Taklar (Round trip)	Distance (Km)
1	Kota Takalar	3
2	Limbung	3
3	Palangga	2
4	Sungguminasa	1
5	Jl. St. Alauddin	7
6	Jl. Ratulangi	4
7	Karebosi	4
Total of travel distance (Km)		23 km

Table 5. The vehicle characteristics of the micro-bus mode

No.	Producer	Brand	Engine Size Capacity
1	Daihatsu	Hijet	1000 cc
2	Daihatsu	Zebra	1300 cc
3	Mitsubishi	T120SS	1000 cc
4	Mitsubishi	T120SS	1343 cc
5	Suzuki	ST	970 cc
6	Suzuki	Carry 1.0	1000 cc
7	Suzuki	Futura	1300 cc
8	Suzuki	Carry 1.5	1500 cc

3.2 Vehicle Operation Cost (VOC) of the Micro-Bus Transit

The VOC average of the micro-bus transit operating in Mamminasata Metropolitan Area (MMA) is shown in Table 6. Table 6 shows that the vehicle operation cost of the micro-bus of

Makassar-Maros route consists of 94.38 IDR/per-passenger-seat.km, 0.12 IDR/per-passenger-seat.km, and 94.50 IDR/per-passenger-seat.km for the direct cost, indirect cost, and total cost, respectively. Furthermore, the VOC of micro-bus of Makassar-Gowa route are 117.82 IDR/per-passenger-seat.km, 0.18 IDR/per-passenger-seat.km, and 118.01 IDR/per-passenger-seat.km for the direct cost, indirect cost, and total cost, respectively. Similarly, the VOC of micro-bus on Makassar-Takalar route for the three cost items are 115.30 IDR/per-passenger-seat.km, 0.18 IDR/per-passenger-seat.km, and 115.48 IDR/per-passenger-seat.km, respectively.

Comprehensively, the VOC of micro-bus for Makassar-Gowa and Makassar-Takalar routes are mostly similar. Meanwhile, the VOC of the Makssar-Maros route is lower than both routes.

Table 6. VOC averagely of the micro-bus transit

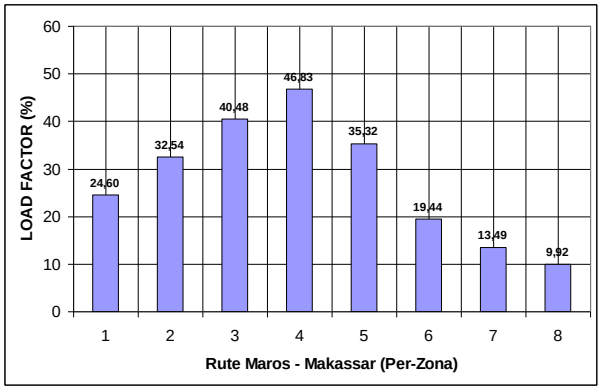
No.	VOC Items	VOC Average (IDR) of each route		
		Makassar - Maros	Makassar - Gowa	Takalar-Gowa
1.	Direct Cost	**94,38**	**117,82**	**115,30**
	a. Reduction Cost	16,82	8,95	8,95
	b. Capital Interest Cost	8,52	8,08	8,14
	c. Bus Crew Cost	12,98	12,98	12,98
	d. Gasoline Cost	42,83	50,76	50,76
	e. Tire Cost	2,25	6,49	6,49
	f. Vehicle Maintenance Cost	8,86	16,60	16,60
	g. Terminal Cost	1,12	1,53	1,53
	h. Ownership Administrative Cost	0,56	0,61	0,61
	i. Bus Inspection Cost	0,15	0,23	0,23
	j. Insurance Cost	0,31	1,59	1,59
2.	Indirect Cost	**0,12**	**0,18**	**0,18**
3.	Cost Total (pass-seat.km)	**94,50**	**118,01**	**115,48**

3.3 Load Factor (LF) Performance of the Micro-Bus Transit

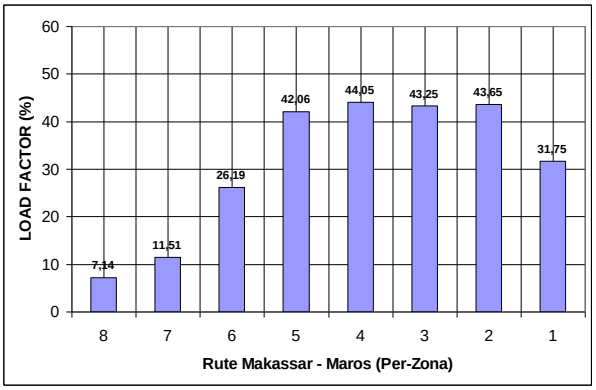
The load factor (LF) average of the micro-bus transit operating in Mamminasata Metropolitan Area (MMA) is shown in Figure 2 for the round trips of Makassar-Maros route, Makassar-Gowa route, and Makassar-Takalar route, respectively.

First, Figure 2a and Figure 2b show the load factor of the micro-bus of Makassar-Maros route for the round trips respectively. The Figures show that the highest LF average is 46.83% which occurred at zone-5 on Maros-Makassar route. The general phenomenon of the LF on the route is the LF at the zone-1 is 24.60% then increases until at zone-4. Next, the LF values decrease until 9.92% at zone-8. For Makassar-Maros route, the LF phenomenon is very small at the beginning zone (zone-8), 7.14% then the LF values increase more and more until zone-4 (LF values is 44.05%). Thus, at the two successive zones, the LF values are relatively stable, and then slightly decrease at the end of the route (zone-1) with value 31.76%.

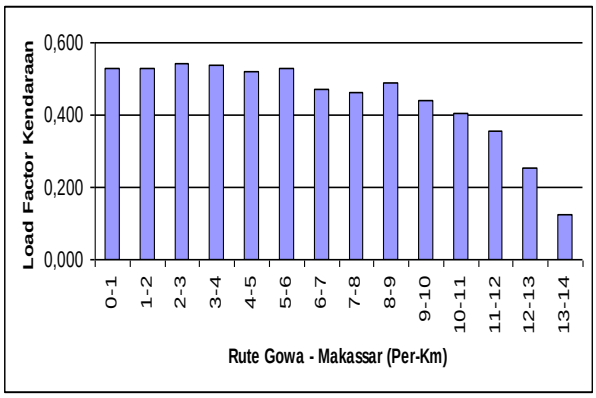
Furthermore, Figure 2c and Figure 2d show that the LF values of the micro-bus on Gowa-Makassar route are 0.50 – 0.55 at the first zone (Terminal Cappa Bungaya) until zone-5 and zone-6 (Terminal Malengkeri-Campus of Unismuh University). Then, the LF values decrease until the last zone (zone 13-14 or Karebosi Ground Park). In this zone, the LF value is 0,15. In this regard, the LF values begin to decrease drastically at zone 9-10 (Jl. Kumala-RS. Labuang Baji) and at zone 10-11 (RS. Labuang Baji-Mall Ratu Indah).



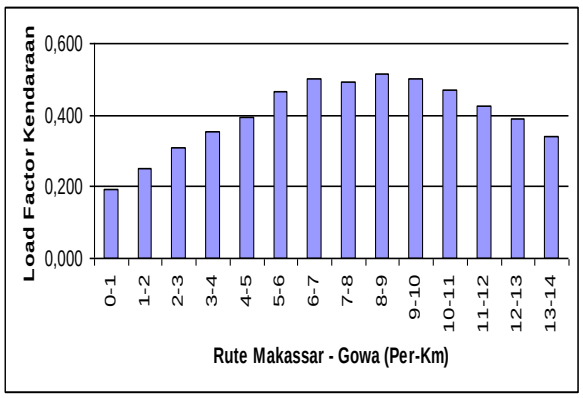
a. Maros – Makassar route



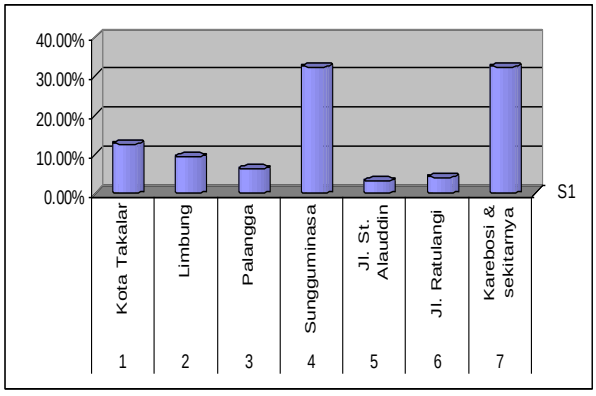
b. Makassar – Maros route



c. Gowa – Makassar route



d. Makassar – Gowa route



e. Makassar – Takalar route (Round trips)

Figure 2 The load factor performance of the micro-bus in the MMA

Finally, Figure 2e shows that the LF performances of the micro-bus on Makassar-Takalar route achieves the highest values only at zone-4 and zone-7 where the LF values are 30.0% in average. At the other zones, the LF values are only lower than 10%.

Overall, the LF values of micro-bus on Makassar-Gowa route are slightly higher than the LF values of micro-bus on Makassar-Maros route. However, the LF values of the micro-bus on Makassar-Takalar route are lower enough than both routes.

5. DISCUSSIONS AND CONCLUSIONS

Two important aspects, vehicle operation cost (VOC) and load factor (LF), in operation of the micro-bus transit system as inter-city public transport in Makassar Greater Area, namely

Maminasata Metropolitan Area (MMA) in Indonesia, have been elaborated. The study has attempted to capture performances of both indicators on the three operating routes that are available in the city, i.e. Makassar-Maros route, Makassar-Gowa route, and Makassar-Takalar route.

The VOC of micro-bus for Makassar-Gowa and Makassar-Takalar routes are mostly similar while the Makssar-Maros route has lower VOC than both routes. Further, the LF values of micro-bus on Makassar-Gowa route are slightly higher than the LF values on Makassar-Maros route while the LF values on Makassar-Takalar route are lower enough than both routes. Overall, all the routes have the VOC values which are categorized as highly cost. In other side, the three routes have low LF performances (the LFs are not more than 50%in average).

Briefly, we expect that the study results are useful in development of mode and route choice models, ability and willingness to pay model of individual in further studies toward the sustainable public transportation management in the MMA.

ACKNOWLEDGEMENT

We would like to express our thanks and appreciation to Indonesian Transportation Society, South Sulawesi Branch and Institute Survey on Transportation and Environment (ISTE) which supported us to access and utilized the survey data for the purpose of this paper. Without their cooperation, this paper would not be possible to be arranged. We also address highly appreciation and thanks to reviewers who had given correction of the early and short form of this paper in the 15th FSTPT National Symposium, Indonesia, 2012.

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