Comparison between Demand and Frequency in Malang Transit Operation System

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1. INTRODUCTION

Malang is the second largest city in East Java Province, Indonesia. It has an ancient history dating back to the Mataram Kingdom. The city population as of 2010 census was 820,243 (BPS, 2010).[1] Malang is located along Indonesian National Route 23, which connects it to Gempol and Kepanjen. Malang has a large intercity bus terminal, Arjosari, located in northern Malang. The primary means of public transportation is by blue microvan called *ANGKOT* (from ***ANG****kutan*=transportation and ***KOT****a*=city). The increasing population is not matched by the growth of transportation make some problems, like traffic congestion, accidents, and air pollution. The population growth is also increasing the rate of private vehicle ownership. The growth and development of the urban population affect the relationship between the magnitude of the population and the Angkot service, resulting in a lack of efficiency.

Therefore, this research compares the demand and the frequency in the Malang transit operation system in order to identify mismatches between the demand and the frequency to highlights potential areas for improvement. The aim of this paper to improve the level of service of Malang transit operation system.

2. OVERVIEW OF MALANG AND DATA

2.1. Angkot System in Malang

Fig.1 depicts the Angkot in Malang, which is the main source of urban transit. Angkot is a small van re-designed to accommodate more passengers. All back seats are removed and replaced by two long dark benches covered with foam. Normally, Angkot can carry 12 passengers, although sometimes it carries more. The fare is Rp. 3000 for the general public and Rp. 2000 for students. The role of government (performed by the municipal authorities in charge) is to issue permission to operate on the selected designated routes, and to decide the number of cars on each designated route. Angkots are owned and operated by individuals or multiple operators. There is no financial support or subsidy from the government, and the Angkot driver signs a contract to pay a fixed amount of money to the owner on daily basis. Recently, the urban transit system has faced great competition with motorcycles and private cars. The easy process of buying motorbikes and ease of use on roads through the leasing system enables many people to own a motorcycle, making urban transit in Malang less attractive.[2]

Fig. 1. Angkot in Malang

Fig. 2 shows the Angkot routes in Malang. In total, there are 25 lines, and the level of service of 16 of these lines, as indicated in the figure, was evaluated at the major intersections named “Jl. Mt. Haryono” and “Jl. Panglima Sudirman” (shown with a white circle).

2.2. Data of the Research

This research used a qualitative method. In order to gather information and data, this paper used a field survey conducted by the Ministry of Transportation Malang on weekdays in 2006 to identify the real conditions of Angkot in Malang. The survey was conducted from the viewpoint of “dynamic” and “static” aspects.

The dynamic survey included an onboard survey on every route. A surveyor recorded the number of boarding and

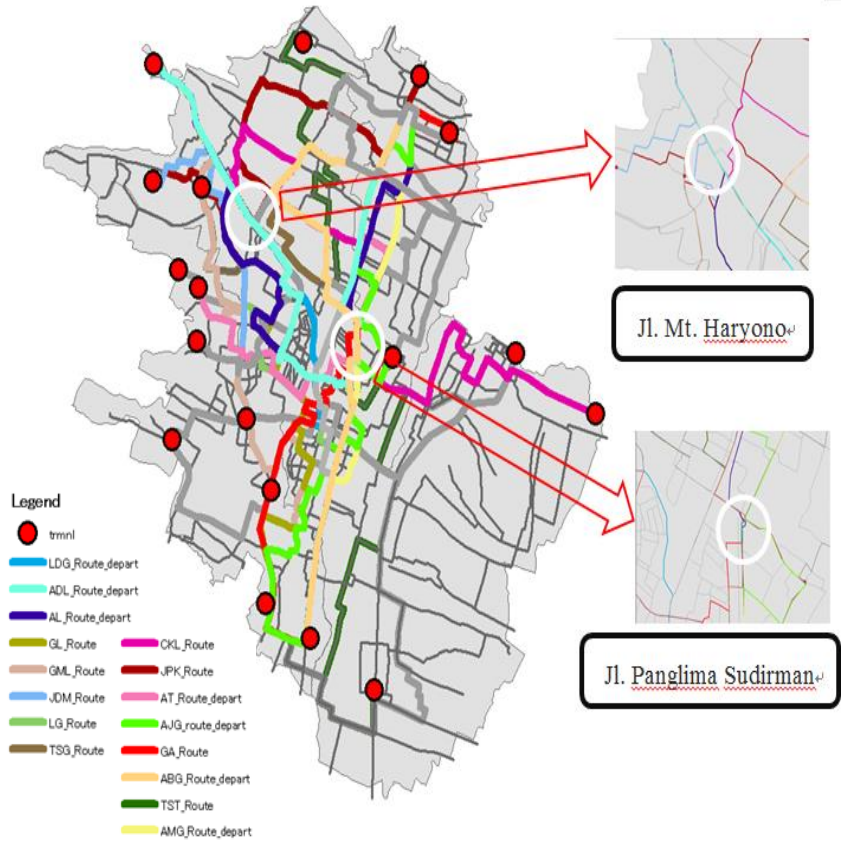

Fig. 2. Twenty five Angkot routes in Malang

alighting passengers as well as, travel time on each segment. The vehicles for the dynamic survey were randomly selected on weekdays from Monday thourgh Thursday, during the morning peak, daytime, and evening peak hours.

The static survey included a survey in one spot, calculating every Angkot that crossed the road in each direction. The purpose of this survey is to analyze performance of Angkot along every route to ensure that the number of vehicles operating is in accordance with the number permitted. The static survey was conducted on weekdays from Monday through Thursday, from 6:00 am to 9:00 pm, included peak times of 6:00 am to 8:00 am and 4:00 pm to 6:00 pm. These surveys generated data like, the frequency data at major road segments, and the load factor data, which is the number of passengers divided by the vehicle capacity.

3. URBAN TRANSIT IN MALANG

3.1. Angkot Performance in Malang

Fig. 2 shows the routes of Angkot in Malang, and **Table 1** summarizes of the static survey. The static data show frequency, headway, and load factor inside for 25 angkot routes in Malang. Note that frequency is the number of vehicles on the route passing through an area, with the unit "vehc/hour". **Table 2** summarizes of the dynamic survey. The dynamic data show Angkot performance, which show the ADL line including demand on Jl. P. Sudirman and Jl. MT. Haryono for comparison.

Table 1. Angkot Performance in Malang: Static data

Trajek Route	Frequency	Headway	Load Factor	Trajek Route	Frequency	Headway	Load Factor
	(veh./hour)	(minute)	(%)		(veh./hour)	(minute)	(%)
LDG	32.1	1.9	13.2	GM	43.2	1.4	29.0
ADL	31.9	1.9	33.5	ABB	11.5	5.2	36.7
AG	80.9	0.7	20.0	ASD	10.1	5.9	36.7
GML	12.2	4.9	35.2	AT	14.2	4.2	35.8
LG	39.1	1.5	31.3	MT	11.4	5.3	33.0
GL	18.8	3.2	46.7	MK	58.4	1.0	30.4
AL	30.8	2.0	40.6	TSG	7.7	7.8	20.7
CKL	24.6	2.4	39.1	JPK	7.7	7.8	33.0
AMG	64.7	0.9	39.9	JDM	9.5	6.3	7.9
ABG	28.6	2.1	27.9	MKS	3.3	18.4	38.2
AJG	24.4	2.5	7.3	MM	32.4	1.9	13.2
GA	58.4	1.0	37.6	TST	13.0	4.6	35.7
TGT	1.0	62.7	48.1				

Source : Ministry of Transportation in Malang City, 2006

Table 2. Angkot Performance in Malang: Dynamic data

ADL LINE	DEMAND (%)
ARJOSARI Terminal	41.7
JL. Simp. P. Seroso	41.7
JL. R. Intan	20.8
JL. A. Yani	41.7
JL. Let Jend S Parman	45.8
JL. Let Jend Sutoyo	41.7
JL. Wr. Supratman	45.8
JL. P. Sudirman	45.8
JL. Pattimura	50.0
JL. Trunojoyo	50.0
JL. Tugu	54.2
JL. Kahuripan	54.2
JL. Semeru	62.5
JL. Ijen	66.7
JL. Bandung	66.7
JL. Raya TlogoMas	41.7
JL. MT Haryono	41.7
JL. M Panjaitan	58.3
JL. Ijen	66.7
JL. Kertanegara	58.3
JL. Cokroaminoto	58.3
JL. Dr Cipto	58.3
LANDUNGSARI Terminal	25.0
MAX	66.7
MIN	20.8
MEDIAN	50.0

3.2. DISCUSSION

Table 3 shows the relationship between the demand and frequency of some road segments. Note that the road segments were selected from high/medium and low demand levels. (The location of the selected intersection is shown in **Fig. 2**). It is expected that a higher demand value will result in lower frequency. Indeed, the AL route's JL. Panglima Sudirman had an 87.5% demand value and 33.3% frequency value. However, the LDG route's JL. MT. Haryono had a 33.3% value and 28.4% frequency, which is higher than other road segments; this can cause a mismatch between the demand and frequency.

Table 3. Relationship between Demand and Frequency at the Major Intersection Segment

Route	Name of Segment	Demand	Frequency
LDG	JL. MT. Haryono	33.3	28.4
ADL	JL. MT. Haryono	41.7	34.5
AL	JL. MT. Haryono	54.2	33.3
GL	JL. MT. Haryono	20.8	16.6
GML	Jl.Mt Haryono Gg XII	37.5	11.2
JDM	JL. MT. Haryono	87.5	8.4
	Jl. MT. Haryono Gg X	95.8	8.4
LG	JL. MT. Haryono	16.7	34.6
TSG	JL. MT. Haryono	108.3	8.4
CKL	JL. MT. Haryono	29.2	21.8
JPK	JL. MT. Haryono	95.8	8.3
ADL	JL.Panglima Sudirman	45.8	34.5
AL	JL.Panglima Sudirman	87.5	33.3
AT	JL.Panglima Sudirman	95.8	15.3
AJG	JL.Panglima Sudirman	91.7	26.8
GA	JL.Panglima Sudirman	37.5	64.1
ABG	JL.Panglima Sudirman	83.3	33.6
TST	JL.Panglima Sudirman	16.7	14.3
AMG	JL.Panglima Sudirman	66.7	71.0

4. SUMMARY

This paper first overviewed the Angkot system in Malang, Indonesia. Then, for the sake of evaluating the efficiency of the Angkot system, the relationship between the demand and frequency of some road sections was compared. We confirmed a mismatch between the demand and frequency for some road segments. Future work should compare the demand and frequency for the entire network and identify measures to improve the Angkot system in Malang.

REFERENCES

[1] Central Bureau of Statistics (*Badan Pusat Statistik*) BPS, 2010.
[2] Malang Regency *(Kabupaten Malang)*. Website :
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