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Invited Paper

Trans Semarang Bus Service Analysis for Monitoring and Passenger Information System

Mudjiastuti Handajani

Civil Engineering Department, Faculty of Engineering, Semarang University,

Soekarno Hatta Street, 50196 Semarang, Indonesia

hmudjiastuti@yahoo.co.id

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Abstract. Semarang Smart Transportation Program is creating city transportation system which is reliable, environmentally friendly, safe, comfortable, well-organized and modern management. Nowadays, Trans Semarang Bus always comes in uncertain times. The purpose of this study is to analyze Trans Semarang Bus performance which able to increase better city transportation system in the future especially in developing country such as Indonesia. Monitoring and Passenger Information System were able to inform buses departure and arrival in the real time. Research methodology in this study was qualitative and quantitative technique. The results of this study found the route length was 26.75 km; the average speed was 14 km/ hour; time calculation was 2.1 hours; the waiting time was 10 minutes, the headway was 20 minutes, the bus stop distance average was 300 meters. Many people in Semarang are expected on the buses to be on time. The data will be input into Monitoring System (MS) and Passenger Information System (PIS). MS and PIS will give accurate information to make a better city transportation system.

1. Introduction

Nowadays, Trans Semarang Bus public transportation has not been optimal since it is only serve 7% of total population [1]. Most of Semarang populations are prefer to use private vehicles (such as; motorcycles and cars) to do daily travel/activities which they think easier and faster. The strategy to improve the Urban Transportation System is by improving mass public transportation services. Thus, to make Trans Semarang Bus enthused by the people, the real time arrival and departure information should be provided. So that users can plan when to leave and when to arrive to their destination [2].

The program of City's Smart Transportation makes the city transportation system more reliable and environmentally friendly, safe, convenient, cheap, well organized, scheduled and makes management arrangement more modern [3]. Up to now, City Transportation System in Semarang has not used Passenger Information System yet. So, there is no information on arrival/ departure at the bus stop. The schedule/ the departure times are provided only at the terminal (final bus stop). Trans Bus in Semarang is on the roads alongside with other vehicles (mixed traffic); which causing traffic jams on the roads so often. Therefore, it is necessary to conduct analysis on the service/ performance of Trans Semarang Bus (route, speed, travel time, waiting time, headway and the distances amongst bus stops/ shelters).

The purpose of this study is to analyze the system of Trans Semarang Bus Corridor I and Corridor II, where the data will be used for monitoring system at Department of Transportation in Semarang and passenger information system at bus stop shelter. Besides beneficial to provide information on bus arrival/ departure in real time, it also helps to create a better city transportation system for developing countries, especially in Indonesia. So, it will attract Semarang citizen to use Trans Semarang Bus public transportation. Then it can reduce traffic jams on the roads and the volume of

vehicle/traffic on roads as well as reduce the consumption of fuel (BBM) [4], which comes from non-renewable fossils. This idea will create Smart Transportation which eventually leads to Smart City.

2. Literature Reference

States of the art of this study were taken from several previous studies, national journals and international journals. According to [5], the headway of Public Passenger Car (PPC) on Pandanaran street Semarang is just 30 seconds at peak hour; that indicates the large number of PPC. While at off peak hour, the headway is 10 minutes. The overlap routes between Trans Semarang Bus and Public Passenger Car (PPC) lead chaos and increase air pollution. Air pollution reduction can be done by replacing private vehicles with mass public transportation [6]. The higher the number of people served by mass Public Transportation in a city, the lower the fuel consumption (per five years) supports Smart Transportation [7].

Semarang Metropolitan City had 1.5 million populations in 2016. If the population density is high, it is best suggested to use mass public transportation. Population density and city transportation are the main keys to control fuel consumption [1]. Semarang's Type A Terminal of Mangkang has not been used optimally so far. This terminal should be able to serve an integrated urban transportation system (Interconnection Mode) better [8]. The use of Public Bus in some cities in Indonesia is still low. It can be seen from the model of transportation system and fuel relationship using Partial Least Square (PLS). It shows fuel consumption in a city gives only little effect on the number of bus (0.213), due to the very low number of public bus that serves people [4].

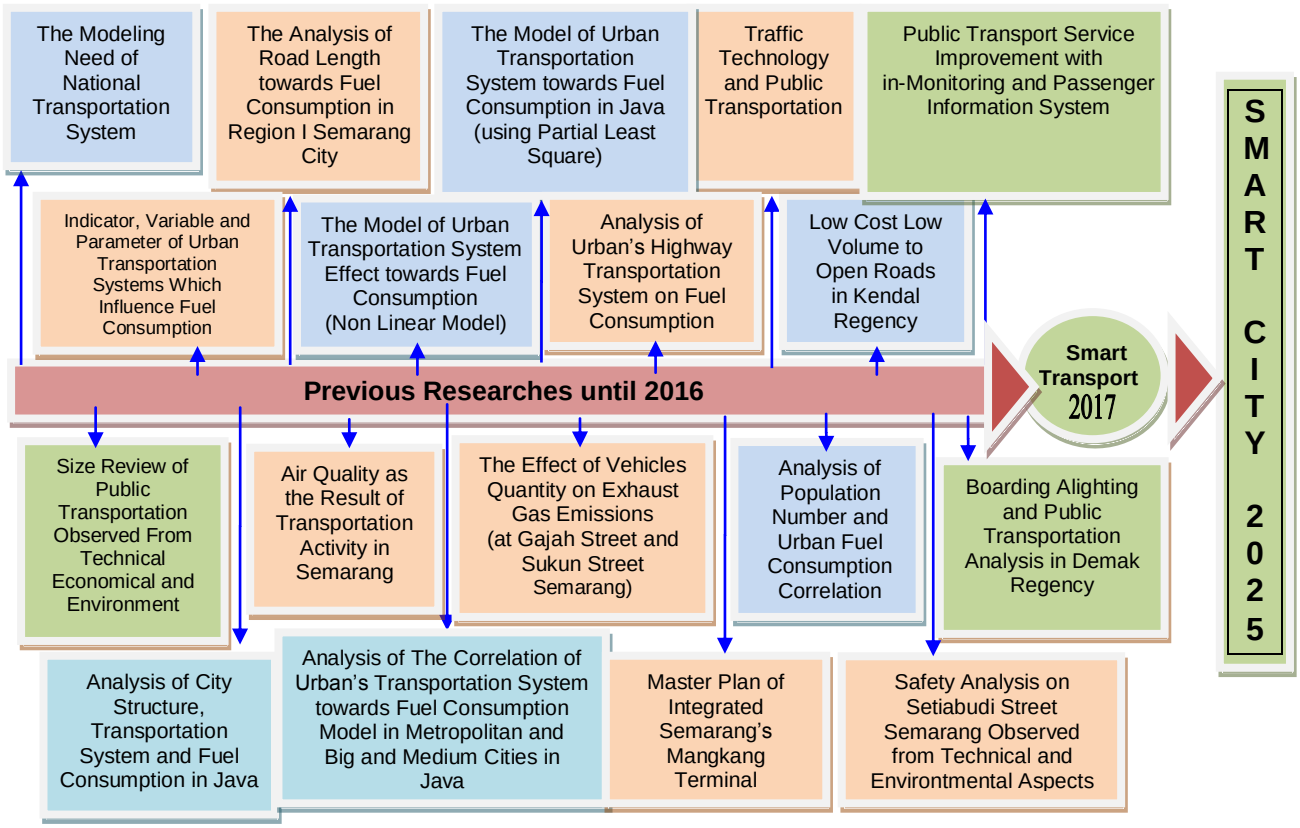

Fig.1. Fish bone diagram in the previous study

Monitoring system and passenger information system are designed as "stand alone" to display bus location in real time, equipped with mobile-phone network tracking to get bus location information to the central control unit. Monitoring method using web server to monitor bus in real time and

mobile application for passenger can work well if the land use are compact. Reducing fuel consumption can be done by transferring the use of private vehicles to reliable mass public transportation (eco-friendly, safe, comfortable, affordable, well organized and scheduled along with the modern management arrangement) [9]. Likewise, PPC routes need to be evaluated to avoid overlap [10].

This study will analyze the available Trans Bus work system. The data will be used for monitoring system and passenger information system in Semarang in the next research. The road map of this study is shown by fish bone diagram above (Fig. 1).

3. Research Methodology

The first stage was performing preparations, such as preparing survey equipments. Field survey was conducted to obtain primary data (Trans Semarang Bus route, speed, boarding alighting, headway, distance among bus stops, bus stops condition and questionnaires). Secondary data were taken from the Department of Transportation in Semarang (number of vehicles, schedules, coordinates, bus routes, number of stops, bus stops condition, and the type of bus). The next stage was compiling the data continued by analyzing Trans Semarang Bus service descriptively, qualitatively (Bus service questionnaire) and quantitatively (other data). Therefore it can be used to design further Monitoring System and Passenger Information System. The research flowchart can be seen in the following Fig. 2:

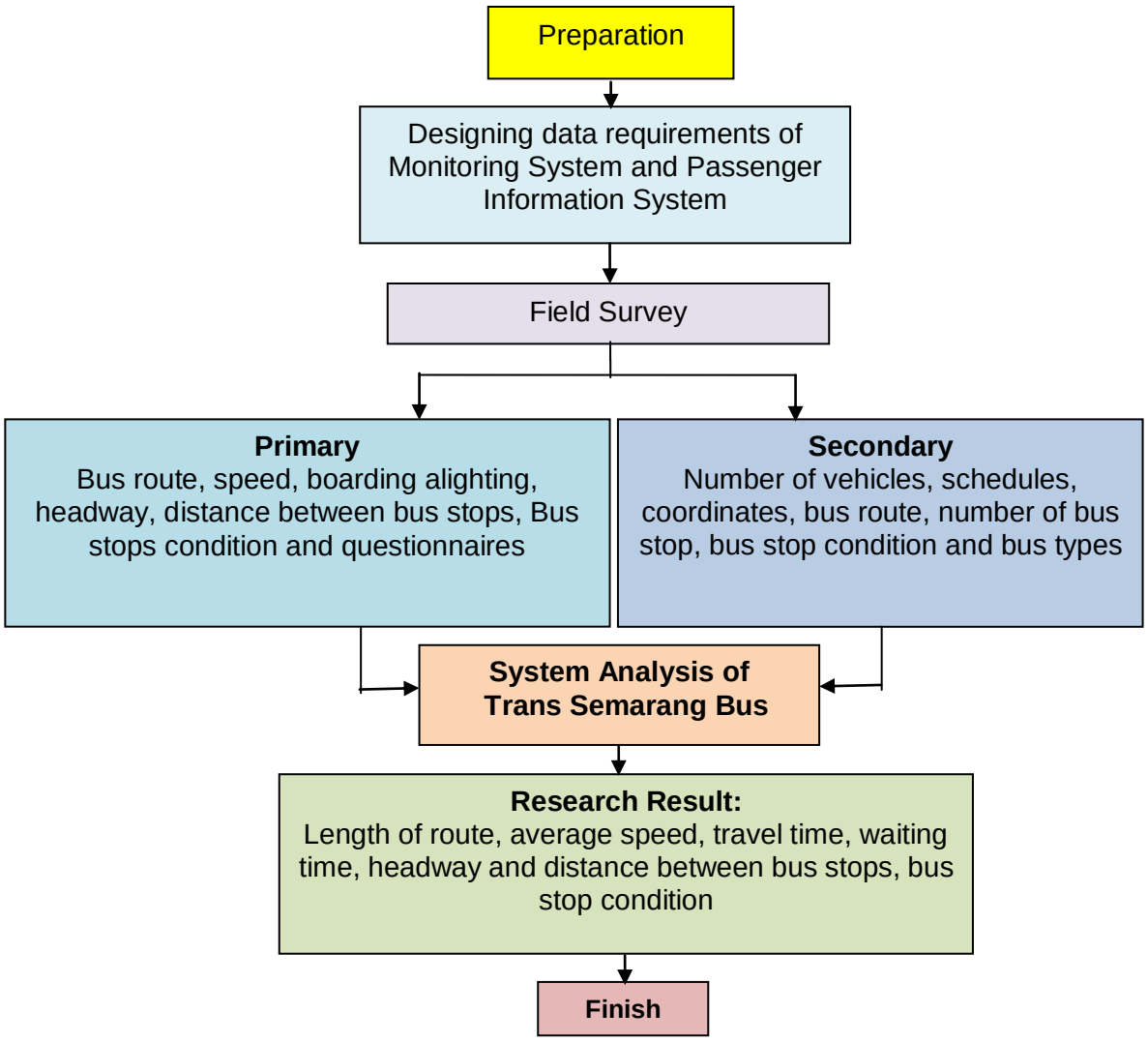

Fig. 2. Research flowchart

4. Research Result

During conducting this research, Bus Rapid Transit (BRT) operated in Semarang had 4 corridors. Corridor I (Mangkang-Penggaron) had a route of 26.75 km, so the whole route (round trip) reached 53.5 km, corridor II (Terboyo Terminal - Cisemut Terminal, Ungaran) had total route length of 49 km, corridor III (Tanjung Mas Port - Sisingamangaraja Street) had 55.8 km, Corridor IV (Tanjung Mas - Banyumanik via Bubakan) had 46 kilometers. Research Location in Corridor I and Corridor II of Bus Rapid Trans Semarang can be seen on Fig. 3.

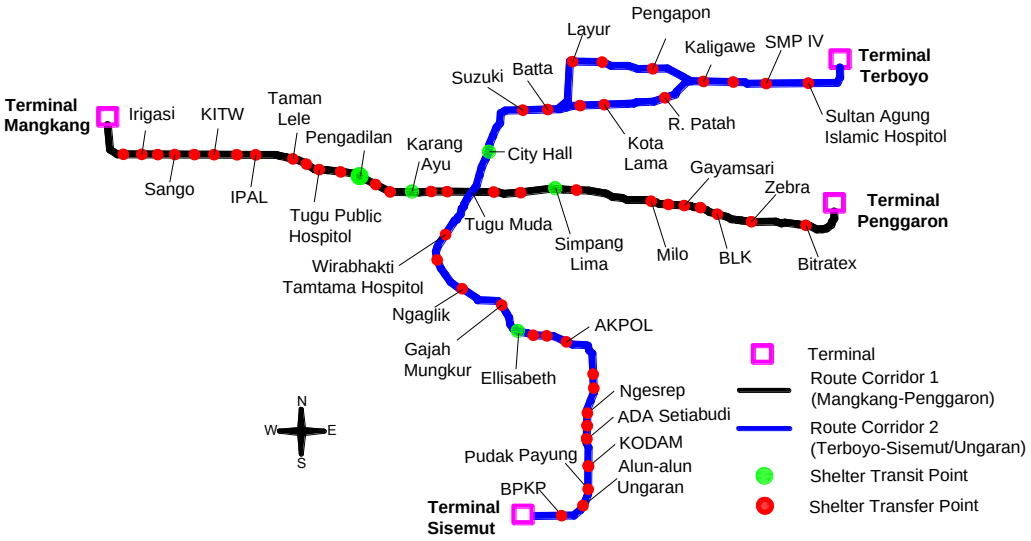

Fig. 3. BRT routes of Trans Semarang corridor I and II

The research results were as follows: the average travel time in the morning (at 06:15 to 09:10) a.m. was 2.916 hours; in daytime (at 10:45 a.m. to 12:10 p.m.) was 1.416 hours and in the afternoon (at 13:43 to 16:05) p.m. was 1.833 hours, so that the average travel time per day was 2.1 hours. The average speed was obtained by comparing the traveled distance and the required time to reach that distances. The traveled distance (Pedurungan-Mangkang route) in the morning, daytime and afternoon was 26.75 km. The speed in the morning, daytime and afternoon showed various results. In the morning, the travel time was 2.916 hours, the average speed was very slow that was 9 km/hour; in the daytime, with travel time of 1.416 hours, the average speed was quite high that was 19 km/hour; in the afternoon, the travel time reached 1.833 hours, vehicles moved a little bit slower at 15 km/hour. The average speed of vehicles /day was 14 km/hour.

According to data analysis, 46% people perceived that BRT waiting time was approximately 10 minutes, whereas 28% passengers said it was 5 minutes. 23% passengers agreed that the waiting time was around 15 minutes and 3% passengers stated it was more than 15 minutes. Some people (48%) perceived that BRT waiting time took approximately 10 minutes, whereas 12% passengers agreed it was 5 minutes. 34% passengers agreed that the waiting time was around 15 minutes and 6% passengers agreed it took more than 15 minutes. That's why, the average of BRT waiting time was 10 minutes. The average headway of BRT public transportation was double times of the waiting time. Therefore, the headway of BRT Semarang corridor I and corridor II was 20 minutes.

The distance of one bus stop to another one was around 100 meters to 300 meters (40%). The number of transportation change from BRT to other places was 2 times (57%). Number of public transport used toward the bus stop was 41% twice per day and the travel time was 42% at 7.00-8.00

a.m. The obtained data, such as; distance among the stops, vehicles headway, bus stop locations and bus locations,will be used for Monitoring System (MS) and Passengers Information System (PIS) of Bus Trans Semarang (Fig. 4).

The work principle of monitoring system is as follows: first, monitoring system is conducted in Department of Transportation Semarang viewed from the monitor inside the office. The server consists of web service and data base connected to Google map. Bus passenger member apps (by Android or I-phone) are connected to Google map. Passenger then registers on the system and service provider will provide bus position and information in real time (bus start and stop). Bus app operator will get the bus position by GPS and Android/I-Phone mobile phone. It is integrated and connected to Google map and direction service for calculating estimated time. Google map will send the information of BRT's location, so both the office and the passenger will be informed the position of the bus.

The existing headway of BRT was 22.46 minutes with the waiting time was more than 10 minutes and the load factor of the existing BRT was 44.73% [11]. With MS and PIS, passengers and Transportation Department will be informed bus location in real time. This system is expected to increase the load factor of over 70%, the maximum headway of 20 minutes and the waiting time of 5-10 minutes, based on the regulation of Transportation Department Directorate no.687/ 2002.

The system will give the real bus arrival and departure information. The availability of Monitoring System and Passenger Information System can help to design a better city transportation system for developing country such as Indonesia.

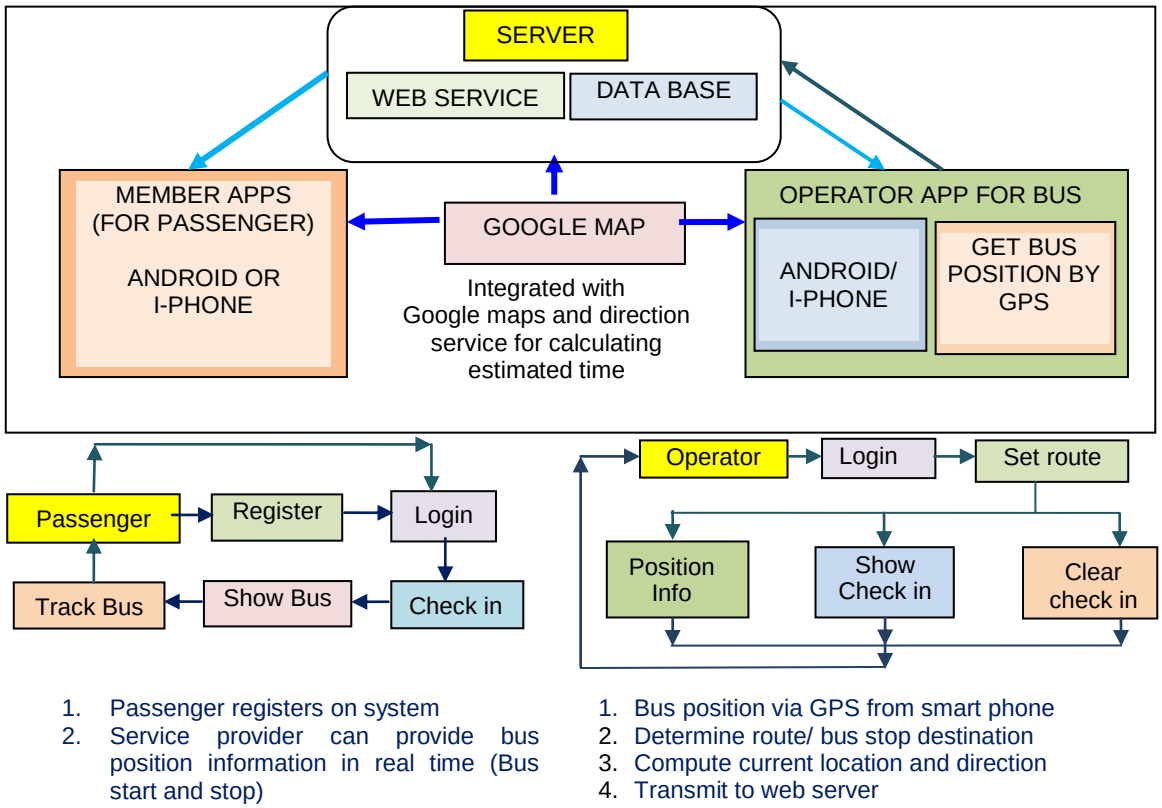

Fig. 4.The working plan of monitoring system and passenger information

5. Conclusion

According to the analysis result, the route of BRT (km), travel time (hours), average speed in a day (km/hour), waiting time, headway (minute), bus stop location, bus location and the obtained data

will be put into Monitoring System (MS) and Passenger Information System (PIS). The obtained data will be transferred to MS and PIS. They will give accurate information and finally as the result more passengers will use bus transportation. Besides, giving the real time of arrival/departure information will be helpful to design better city transportation in developing countries, especially Indonesia.

Acknowledgements

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