The Performance of BRT Trans Semarang Services to Achieve Sustainable Transportation

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Abstract. Semarang provides its many important activities and movements. This city already has BRT system for public transportation, expected to make a sustainable transportation system in Semarang city. However, there are several problems, especially in service performances. The existence of BRT has not been efficient to resolve the congestion problem in the city, indicated by the low BRT load factor level. Location of bus stops are not strategic and not easy to reach, dirty, cramped, have little seatings, do not have guards, do not have feeder mode from the housing area, and the bus arrival schedule is uncertain, causing people to use private vehicles in their daily life. The main purpose of this research is to assess the service performance of BRT Trans Semarang related to safety, comfort, and regularity to achieve sustainable transportation. Conditions of BRT service performance in regard to safety level, 78% of the provision is appropriate, and 22% is not appropriate. Based on comfort level, 70% of the supply is appropriate, and 30% is not suitable. As for the regularity level, 38% of the supply is appropriate, and 62% has not been matched from the total performance indicators of BRT services that require repairs and additions. Government, thus shall improve the regularity level to enhance the load factor of BRT Trans Semarang.

1. Introduction

Congestion becomes a problem in almost all cities, even in Indonesia. Lots of private vehicles, especially cars, are able to carry a maximum of two people. The more vehicles on the road, the higher congestion that occurs. The increasing of population and size of cities, causes people to travel in greater distances [1]. However, this does not make people prefer to travel by bus compared to private vehicles, eventhough cars and motorcycle have a higher risk on the road, excluding as sustainable means of transportation [2].

Higher population and size of cities indicated the demand to initiate better city planning by improving the accessibility of the city. Increasing mix land use and density of development are also a challenge for sustainable transportation. Land use planning and sustainable transportation are interelinked in facing sustainability issues [2]. TOD is expected as an alternative to stimulate people for shifting modes [3]. TODs can also reduce private vehicle use, and congestion in the. Cities with TOD system lead to density, population, employment opportunities on public transportation, and LOS of the current road road [4].
Many efforts have been made by the government to resolve this problem. One of them is implementation of the BRT system to reduce congestion and to support the goal of sustainable transportation.

BRT system is often preferred, because BRT has fast and efficient services compared to conventional buses, with cheaper rates, emphasizing to maintain security, comfort, and safety of users [5].

Bus Rapid Transit (BRT) becomes one of the popular transportation systems that serves as a more affordable travel alternative compared to trains [6]. BRT has features, such as having large capacity, low costs, and short implementation, which can be an alternative for big cities [7].

The performance of BRT services based on the Road-based Mass Transport Minimum Service Standard [12], is divided into:

A. Safety, consisting of bus stops, bus stop supporting facilities and bus cars
B. Convenience, consisting of bus stops, bus stop support facilities and bus cars
C. Regularity, consisting of waiting time, travel speed, stopping time at the bus stop, service information, bus arrival time information, stop in and out access, information regarding which bus stop that will be passed, accuracy and certainty of bus arrival and departure schedules, information on bus trip disruption, and payment system.

The government of Semarang City also implemented this BRT system to overcome the existing congestion. In 2017, the population in Semarang City was 1,753,092 people, with the length of roads in Semarang City reaching 2,785.28 kms, the number of motorcycles as many as 80% (± 1,252,346 units), private cars as many as 18% (± 33,523 units), and public transportation as many as 2% (± 3,824 units) [13]. This indicated that the high level of population growth accompanied by the increase in the number of motor vehicle ownership. The current condition of public transport, about 90% which is not feasible, still operates [8].

The large number of private vehicles has caused traffic congestion, for example in Jatingaleh, Kaligawe Road, Majapahit Road, Bubakan Roundabout, roads around Diponegoro Tembalang University campus, and Tugu Muda Roundabout and Simpang Lima area which is in Semarang Golden Triangle area. On the other hand, the existence of public transportation does not help much to reduce the volume of traffic density. The limitations of the Trans Semarang BRT route and the absence of a separate special lane for the Trans Semarang BRT lane causes the Trans Semarang BRT rate to be hampered by other vehicles passing in its lane. Thus, the Trans Semarang BRT which should carry the rapid concept cannot be fulfilled [14]. The load factor of BRT Trans Semarang in 2017 is 47.85%, under the Minimum of Standard Service and the service was not optimal [9].

The high number of requests for the Trans Semarang BRT was not matched by the number of available Trans Semarang BRT fleets. Especially during rush hour, many passengers have to wait a long time due to the lack of Trans Semarang BRT mode that serves, as well as the operating schedules that are not in accordance with fluctuations in user demand [8]. The headway of buses is between 20-25 minutes. Location of bus stop are not strategic and not easy to reach [9], dirty, cramped, have little seating, the uncertain bus arrival schedule [10], limited service coverage of the buses, and the absence of feeder modes [11].

The low price of BRT tickets has made Trans Semarang BRT operations demanding subsidies from the government [9]. The budget that must be spent by the Semarang Government in managing the Trans Semarang BRT was IDR 73 billion in 2016 [14]. However, the users feel that the current ticket prices and the services provided by the Trans Semarang BRT are considered quite expensive. Users are willing to pay more if there is an increase in the quality of services provided by the Trans Semarang BRT. Variables that affect user satisfaction are feeders and headways. Feeders are non-BRT public vehicles integrated with the Trans Semarang BRT route [9]. Headway is affected by the difference in travel time between buses and departure interval. Departure variables between buses are influenced by total fleet, affecting the total passenger seating capacity which influences the Trans Semarang BRT load factor [9].
2. Methods
This research utilizes descriptive quantitative method by observing the condition of BRT service performance in the Semarang city, compared to the minimum standard of providing BRT performance. The data that has been collected, then compiled based on each indicators of BRT service performance for each line, and compared to the Regulation of the Minister of Transportation no. 27 of 2015.

![Figure 1. Methodology of the Research Study](image)

3. Results and Discussions

3.1 Service Performance of BRT Trans Semarang

3.1.1 Safety
The assessment for BRT Trans Semarang service performance applies several safety indicators, for the bus stop, such as: lighting, security personnel, and security information. Meanwhile, for the buses themselves, the indicator consists of vehicle identity, driver identification, danger signal lights, lighting, security personnel, and window film.

| Indicators       | Existence | Lane 1 | Lane 2 | Lane 3 | Lane 4 | Lane 5 |
|------------------|-----------|--------|--------|--------|--------|--------|
| Bus stop         |           |        |        |        |        |        |
| Lighting         | ✓         | ✓      | ✓      | ✓      | ✓      | ✓      |
| Security personnel | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      |
| Security information | -      | -      | -      | -      | -      | -      |
| BRT fleet        |           |        |        |        |        |        |
| Vehicle identity | ✓         | ✓      | ✓      | ✓      | ✓      | ✓      |
| Driver identification | -      | -      | -      | -      | -      | -      |
| Danger signal light | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      |
| Lighting         | ✓         | ✓      | ✓      | ✓      | ✓      | ✓      |
| Security personnel | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      |
| Window film      | ✓         | ✓      | ✓      | ✓      | ✓      | ✓      |
Figure 2. One of the Conditions of BRT Trans Semarang Safety Indicators

Figure 3. Suitability of Safety Indicators

Based on the Regulation of the Minister of Transportation no. 27 of 2015 and from the safety indicators, the service performance for the BRT Trans Semarang supply indicated that, 78% of are suitable, and 22% are not suitable with the regulation.

3.1.2 Comfort

The assessment for BRT Trans Semarang service performance utilizes several comfort indicators for the bus stop, such as: lightings, temperature regulating facilities/air ventilation, floor area, and comfortable facilities for passengers’ entry and exit. Meanwhile, for the buses themselves, the indicators consist of lighting, transport capacity, room temperature control facilities, cleaning facilities, floor area, and smoke prohibition.
Table 2. Comfort Indicators Characteristic

| Indicators        | Lane 1 | Lane 2 | Lane 3 | Lane 4 | Lane 5 |
|-------------------|--------|--------|--------|--------|--------|
| **Bus stop**      |        |        |        |        |        |
| Lighting          | ✓      | ✓      | ✓      | ✓      | ✓      |
| Air ventilation   | -      | -      | -      | -      | -      |
| Floor area        | ✓      | ✓      | ✓      | ✓      | ✓      |
| Entry/Exit facilities | -   | -      | -      | -      | -      |
| **BRT fleet**     |        |        |        |        |        |
| Lighting          | ✓      | ✓      | ✓      | ✓      | ✓      |
| Transport capacity| ✓      | ✓      | ✓      | ✓      | ✓      |
| Temperature control| ✓    | ✓      | ✓      | ✓      | ✓      |
| Cleaning facilities| -    | -      | -      | -      | -      |
| Floor area        | ✓      | ✓      | ✓      | ✓      | ✓      |
| Smoke prohibition | ✓      | ✓      | ✓      | ✓      | ✓      |

Figure 4. One of the Conditions of BRT Trans Semarang Comfort Indicators
Based on the Regulation of the Minister of Transportation no. 27 of 2015 and from the comfort indicators, the service performance for the BRT Trans Semarang supply indicated that, 70% are suitable with the regulation, and 30% are not suitable with the regulation.

### 3.1.3 Regularity

The assessment for BRT Trans Semarang service performance applies several regularity indicators, where the indicators consist of travel time, travel speed, transit time at bus stop, service information, arrival time information, in and out access, transit information, certainty of schedule, travel disruption information, and payment system.

#### Table 3. Regularity Indicators Characteristic

| Indicators                    | Existence |
|-------------------------------|-----------|
|                              | Lane 1    | Lane 2    | Lane 3    | Lane 4    | Lane 5    |
| Travel time                  | √         | √         | √         | √         | √         |
| Travel speed                 | -         | -         | -         | -         | -         |
| Transit time                 | -         | -         | √         | √         | √         |
| Service information          | -         | -         | -         | -         | -         |
| Arrival time information     | -         | -         | -         | -         | -         |
| In and out access            | √         | √         | √         | √         | √         |
| Transit information          | -         | -         | -         | -         | -         |
| Certainty of schedule        | -         | -         | -         | -         | -         |
| Travel disruption information| -         | -         | -         | -         | -         |
| Payment system               | √         | √         | √         | √         | √         |

**Figure 5.** Suitability of Comfort Indicators

**Figure 6.** One of the Conditions of BRT Trans Semarang Regularity Indicators
Based on the Regulation of the Minister of Transportation no. 27 of 2015 and from the regularity indicators, the service performance for the BRT Trans Semarang supply indicated that, 38% are suitable with the regulation, and 62% are not suitable with the regulation.

4. Conclusion

The assessment is based on problems related to the operational performance of BRT Trans Semarang, and the analytic result related to each influential indicator. For safety indicators it showed that 78% are suitable with the regulation. For comfort indicators, the assessment showed that 70% are suitable. However, for the assessment based on regularity indicators, it showed that only 38% are suitable with the regulation. It means that most of the service performance of BRT Trans Semarang are suitable with regulation. Yet, this condition does not cause many people to change from using private transport to BRT. The low suitability on the regularity indicator becomes a major influence towards the service performance of BRT Trans Semarang.

In addition to the service performance of BRT which deals directly with bus stops or fleets, the certainty of information regarding schedules, transit information, travel disruptions, provides important indicators for the BRT users. If compared to other cities, such as Jakarta, BRT is one of the most popular public transportation alternatives because users can estimate their travel plans, by minimizing the risks that exist. This is due to the timeliness and clear information demanded by the user. By improving the service performance of BRT, it might improve the accessibility and the mobility of the city. The high level of accessibility and mobility becomes one measurement that the city has achieved sustainable transportation.

4.1 Recommendation

The service performance is related to the operational performance. Problem that occur in operational performance can reduce the quality of BRT Trans Semarang service performance. The main problem of BRT Trans Semarang is the low load factor, which can trigger the other problems. If the Government want to increase the load factor, they should consider to improve the main factors that have influence to the service performance. Based on the safety indicators, it is required to add security disturbance information stickers that contain telephone / SMS complaints, as well as to provide a driver's ID containing the driver's name and master number. Based on the comfort indicators, these are needs for additional temperature control facilities / air vents at the bus stop, an equalization of the height between the bus stop and the bus floor, and the addition of trash cans on the bus. Based on the regularity indicators, the recommendation consists of controlling the travel speed, adding service information that includes the name of the bus stop, arrival and departure schedules, routes and corridors, corridor movement, fares, service corridor route maps, and travel disruption information to determine the causes of late bus travel schedules.
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