Evaluation of paratransit performance as public transport in Medan City

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Abstract. Although bus comfort is a crucial indicator of service quality, existing studies tend to focus on passenger load factor and headway. This study examines the performance of paratransit in Medan city by using those criteria. The analysis is conducted using survey passengers onboard expressed as a percent of available seats and number of fleets required to operate a transport route for a given interval. The result showed there is significant gap in paratransit load factor from government regulation, and average headways of paratransit still fulfilling the level of services except for 2 operators which is National and Mars. Government intervention is needed to increase the service’s reliability of public transport.

1. Introduction
Medan as the capital of North Sumatra Province has a function as a center for social, economic and government activities. The population of Medan city approximately was 2,247,425 inhabitants with an increasing growth rate around 0.81%. Medan municipality total area was 265.10 km², so the population density reached 8,478 people/km² [1]. Currently, in Medan city, the real problem is rapid increase in urban population, per capita income, increase passenger demand and private vehicle ownership (9.8%) along with inadequate existing transport infrastructures (0.7%) this indicates that the use of public transportation is declining. The public transport operation in Medan governs by the private paratransit mode.

Public transportation is a platform to ensure people’s mobility in an area, particularly the ones who have no access to motorized mode. In cities and megacities of developing countries, the need for mobility is increasing which is in-line with the growth of the cities themselves [2, 3]. In time and space prism perspective, public transport services will provide more opportunities for people to visit various activity locations in order to fulfill their needs and desires in time and space dimensions [4,5,6]. In the case of Medan city, the first requirement to fulfill the citizens’ mobility with sufficient capacity and quality is constrained by the government’s limitation to meet it. Then the real contribution of paratransit becomes significant. Paratransit is used extensively in almost all cities in Indonesia. Paratransit is a public mode for passengers with a fixed route, but without a fixed schedule, and follows one route within...
the city’s network [7]. Also, in Medan City, public transportation is dominated by city transportation as paratransit, represents the spectrum of mini busses [8].

Currently, in Medan, the real problem is the increasing amount of private vehicle ownership, which offers greater movement flexibility and poor service quality of public transit, causing the use of public transportation is declining. The performance of paratransit is still not optimal, far from ideal conditions, lack of integrated routes, individual fleet ownership, with quality under the standard of public transportation services.

The disorganized of routes by the government seems to be another crucial issue. Amount of paratransit routes, and the number of fleets not based on the demand (exceed the demand), and along with decreasing of the demand, this causes unfair competition among operators and result deteriorate the services of paratransit. Therefore, this study aims to describe the performance of paratransit in Medan city by using headway and load factor criteria.

2. Evolution of public transport in Medan City

In Medan, public transport services are different from in developed countries that the services look like paratransit [9]. No fixed headway is found in the service, where the public transport drivers can change their route spontaneously without local government’s permission triggered by the demand. The public transport services are dominated by non-motorized (Becak) and motorized paratransit modes. Those systems have developed spontaneously in response to local conditions with minimal intervention of the local government.

Historically, in the early ‘60s the public transport service consisted was dominated by the unmotorized public transport mode (the three-wheeled pedicab). Then, in the decade of 70’s the motorized public transport came into operation in Medan city, especially the minibus [10]. Big bus was operated by a government-own company (PT. DAMRI) and it is that served a limited route only. Early in 2015, Medan supported by National Government developed the Bus Rapid Transit (BRT) system, by only providing 2 routes connecting the city center.

Since the paratransit operation plays a significant role in providing public transport services in Medan [11], the authors used the term paratransit in this article referring to transport services owned and operated by individual private participations.

As mentioned previously, the public transport quality of service in Medan city was evaluated from 2 various aspects such as headway, and Load factor. The study of load factor and headway was conducted on the by onboard survey with the number of routes that still operated. In order to evaluate the transit availability in Medan, the route service and number of fleets for Medan was also considered.

2.1. Routes and number of fleets paratransit

In paratransit operation, the regulating mechanism is set up by local authorities. The role of government (performed by the related bureau at the city or municipal level with some coordination with the city or municipal authorities in charge) is to issue permission to operate on the selected designated route and to decide the number of fleets on each designated route.

According to routes issued by the government, there are 109 routes, with a total of 6700 units registered to operate. From data collection show that the number of routes that are still operating far reduced (+ 60 routes) with numbers of paratransit that are still operating in 2019 is smaller than the numbers registered, which are 3,335 units.
From figure 1, we can see the paratransit routes operating in Medan, many overlapping routes. The shortest and the longest route length in Medan are 8 km and 40 km. The numbers of fleets in each route has a variety from 15 up to 200 vehicles.

2.2. Load factor
Load Factor is the percentage of a vehicle’s total capacity that is actually occupied. The value of the load factor is highlighted as a direct measure of paratransit performance measured. From a capacity perspective, the allowed passenger load on a bus (set by policy) constrains the number of people that a given number of minibusses can carry. Load Passengers is a measure of as a percent of available seats (12 passenger seats) calculated by.

\[
\text{Load Factor} = \frac{\text{Average Load}}{\text{Capacity}} \times 100\%
\]

The study of load factor was conducted in 60 paratransit lines in Medan city, with total fleets are 3,335 vehicles. The load factor can be obtained by conducting a boarding-alighting survey. From figure 1, it can be seen that the load factor value for paratransit is 20-51%. This shows the low-level productivity of the transportation services in Medan.
2.3. Headway

The headways considered in order to evaluate the transit availability in Medan. The fixed-headway feature reduces the flexibility of the operation to facilitate the fluctuations of demand within a given time period but provides more certainty of the public transport service to passengers. To ensure a high load of public transport service, the paratransit is scheduled with not fixed or flexible headways. The headway of paratransit was determined by using Table 1 [12]. The average headway of the paratransit in a certain period can be obtained using the following equation [5]. Average headways calculation results are shown in Table 2:

\[
H = \frac{60 \times C \times Lf}{P}
\]  

(2)

Where C is the capacity of paratransit, Lf is the load factor and P is the number passenger.

| LOS | Average Headway (min) | Vehicle/h | Comments |
|-----|-----------------------|-----------|----------|
| A   | < 10                  | > 6       | Passengers do not need schedules |
| B   | 10 – 14               | 5 – 6     | Frequent service, passengers consult schedules |
| C   | 15 – 20               | 3 – 4     | Maximum desirable time to wait if bus/train missed |
| D   | 21 – 30               | 2         | Service unattractive for choice riders |
| E   | 31 – 60               | 1         | Service available during the hour |
| F   | > 60                  | < 1       | Service unattractive for all riders |

From table 2, it can be seen that the range of average headway paratransit is 1-16 minutes. Based on table 2, only 2 routes provide LOS “B” and LOS “C”. The government regulates the ideal headway is around 5-10 minutes.

3. Conclusion

The analysis of paratransit performances in Medan has been conducted. Load factor and time headway are used to analyze the performance of public transport. The results show that load factor performance of the public transport service in Medan city is low or far below government standard. The time headway is determined as a function of vehicle capacity and peak point travel demand, calculated from vehicle capacity divided by the peak point demand (D). The result showed that average headways of paratransit still fulfilling the level of services except for 2 operators which is National and Mars.
Decreasing of paratransit’s occupancy in Medan, indicated because of its comfortability, safety, and punctuality. Government intervention is needed to improve the service’s reliability of public transport; besides push the demand from private car ownership.

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