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Comparative Study of BRT and Multimodal Transportation in Makassar City and Rio de Jenairo City

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Abstract:- Multimodal transportation is aimed to support many modes and users, to reduce the use and the ownership of vehicle, and to promote the development of mixed use land. The development concept of the integrated multimodal transportation belonging to Makassar government's plans has not fully materialized. Various indicators include the limited types of public transport, the overlapping public transportation route services, the disproportionate amount of fleets to passengers, as well as the innapropriate terminal and stop points with the passenger lane points. Rio de Janeiro adopts a plan to improve public transportation options in the city and metropolitan area. The plan includes investments in expanding the subway system and constructing the separated busway system as well as the feeder transportation which will help the city to alleviate some urgent mobility issues and to prepare two major sport events: the World Cup 2014 and the Olympic 2016. This study is aimed to provide an overview related to the public transportation condition, especially in Bus Rapid Transit (BRT) and the supporting transportation in Makassar and Rio de Jenairo. Descriptive and comparative analysis methods are applied on the operational performance and the provision of facilities and infrastructure. In general, the operational performance of BRT Transoeste in Rio de Janeiro is in accordance with the minimum service standard, while BRT Transmamminasata in Makassar, still, shows many variables of operational performance that do not meet the minimum service standard.

Keywords:- *Multimodal-Transportation; Bus-Rapid-Transit; Multimodal, Makassar.*

I. INTRODUCTION

Each public transportation plan is designed without considering the impact on other public transportation services. In fact, in many cases in most metropolitan cities in developing countries, each public transportation is competing [1]. In constructing a popular multimodal transportation, an access from, and to, transit needs to be observed and considered. This can be utilized by considering the manufacture of bicycle or pedestrian paths on a transit service radius [2]. The "pull" strategy can be applied to improve the transit's attractiveness and quality. By intermodal integration, passengers manage to assume that a transit is a unity and a minimum-disruption service for trip [3].

There are two sides, considered in planning multimodal, that determine a multimodal network sustainability, the demand and the supply. Both have a different focus, yet keep in touch. The demand views from the user's perspective because it describes the market response, while the supply provides the provider's viewpoint, which illustrates that service level can be seen from the system. The calculation of the performance of the service has a lot of interest and kind as for the planning, design and policy analysis [4]. Bus Rapid Transit (BRT) is generally defined as a fast transportation mode that can unify a quality of rail transit (LRT) and a bus flexibility [5]. Meanwhile, reference [6] defines the Bus Rapid Transit, in a more simple and easier way, as a fast and flexible transportation mode that combines lanes, elements of Intelligent Transportation System (ITS), station or bus stop, vehicles, and service into an integrated system with a strong image and a good identity.

II. LITERATURE REVIEW

A. Operational Performance

The indicators of operational performance of public transportation in term of effectiveness include density, travel time, waiting time, average speed, headway and frequency. Meanwhile, the operational performance of public transportation in term of efficiency cover utilization, operational capacity, load factor and age vehicle. This study conducts public transportation operational performance indicators with effective and efficient approach seen from the load factor, travel time and headway [7]; [8]; [9].

B. Multimodal Public Transportation

The concept of multimodal public transportation consists of six, namely:

- Connecting Mode; defined as a connecting before, and after, main mode being used [10]. Access mode is described as a used mode from house to public transportation stop (busstop/ station/ terminal) such as pedestrian, bicycle, car or motorcycle, and taxi.

However, the after mode or "egress mode" is defined as a mode use from the stop (bus-stop / station / terminal) to the destination.

- Main Mode; usually used in the longest and most time-consuming trip of the other modes. It is been a lot of research and development of the main mode, on the development of public transit, the schedule synchronization between mode with another, [11].
- Multimodal network (Multimodal Network, Main Route, Feeder Route); [12] The main characteristics of multimodal network involve a network connected among types (modes) and a level difference or network. The highest level is the network for high speed and limited access while the lowest level includes for a short distance, lack of access to higher network, low speed, the higher network density.
- Transfer Point; a modal shift facilitie is also highly important to attract private transportation passengers that can integrate with public transportation.
- Transition Mode With Different Network (Intermodal Transfer Point); Intermodal Transfer Point is a point of connection between the two types of modes of two different tissue types. Reference [13] had evaluated the theory of building architecture development of intermodal transfer (Intermodal Transfer Point). The result showed an architectural design concept of multimodal system that was integrated, combined, flexible and providing multilayer network.
- Regulation; Reference [14] presents two policy models, experiential and conventional. Moreover, the policy-making should be prepared before planning, deployment, management, action and reaction. In fact, the policy is reversely ordered.designations.

III. METHOD

Comparative analysis or differential test is a form of variable analysis (data) to determine the differences between two groups of data (variable) or more. Comparative analysis or differential test is known as significance tests. There are two types of comparison, in-between-sample comparison and sample k comparison (a comparison among more than two samples). In addition, each model of comparative sample is divided into two types, namely correlated sample and uncorrelated sample [15].

In the previous studies, the researchers had identified characteristic, operational performance and service performance of each public transportion in Makassar. Furthermore, based on the issues identified, the researchers tried to create a planning scenario to resolve the problems. The comparison was conducted by comparing the existing condition, the result planning scenario, and the existing condition in BRT of Rio de Jenairo. The variables compared were operational performance and facility/ infrastructure variables.

Operational performance variable comprised of sub variables of waiting time, travel time, frequency, headway (time between), speed, operating hour, corridor length, and passenger using the feeder. However, facility and infrastructure variable had sub variables of bus line, average distance between stops, number of stops, specification of large and small stops, information board of schedule and arrival, bicycle facility and pedestrian facility.

The data of characteristic, operational performance and service performance were obtained from the result of primary survey and direct observation in the field, while the data of BRT Transoeste performance of Rio de Jenairo were obtained by literature studies and reports from Secretary of Transportation, Rio de Janeiro and ITDP (Institute of Transportation and Development Policy)

IV. DISCUSSION

Based on the result of primary survey, the time given by the operator to serve the passengers was 30 seconds for minimum or 60 seconds for maximum in each stop, depending on the number of the passengers. The time was considered enough to raise-and-lower the passengers properly and quickly, and was in accordance with the time standard of transfer.

Related to the modes used, it was divided into mode used before BRT (from departure to stop) and mode used after BRT (from stop to destination). The data of mode usage by BRT passengers was obtained based on the interview with BRT passengers.

Type of Mode	departure to stop (acces mode)	Percentage (%)	stop to destination (egress mode)	Percentage (%)
Pedestrian	154	77.39%	166	83.42%
Taxibike	17	8:54%	14	7:04%
Public transportation	8	4:02%	5	2:51%
Pedicab	9	4:52%	8	4:02%
Private	11	5:53%	6	3:02%
Total	199		199	

Table 1:- Use of Modes before and After BRT Transmamminasata

The survey of Transoeste passengers identified that the majority of users (85 percent) used regular bus to have the same trip before Transoeste, 7 percent took a van or kombis (informal-joint transportation), while 2 percent traveled by car or taxi. Only 1 percent traveled by bicycle or on foot. Fig 1. showed the mode used by people in Rio de Jenairo.

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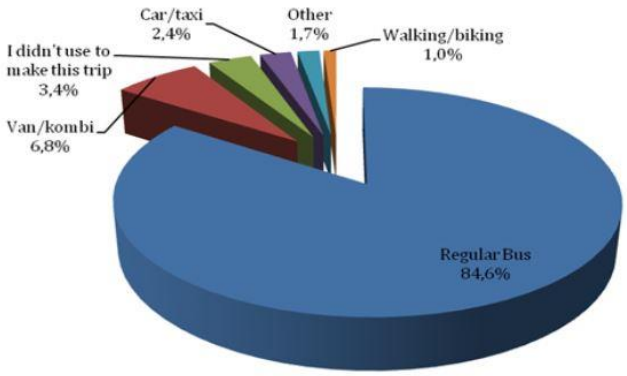

Fig 1:- Types of Transportation Mode Usage in Rio de Jenairo

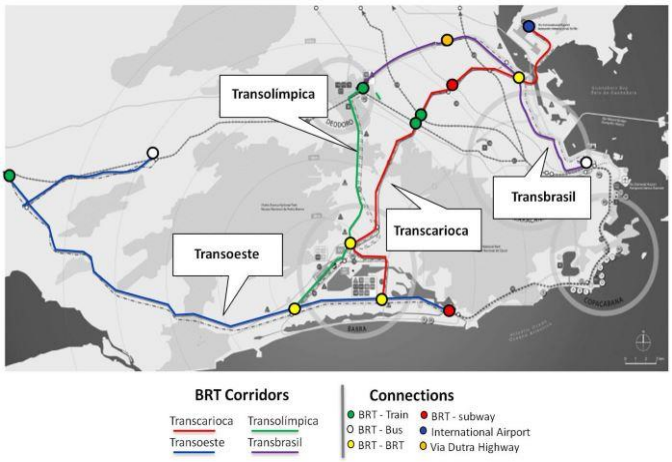

Fig 2:- Route of BRT Corridor and Connectivity in Rio de Jenairo

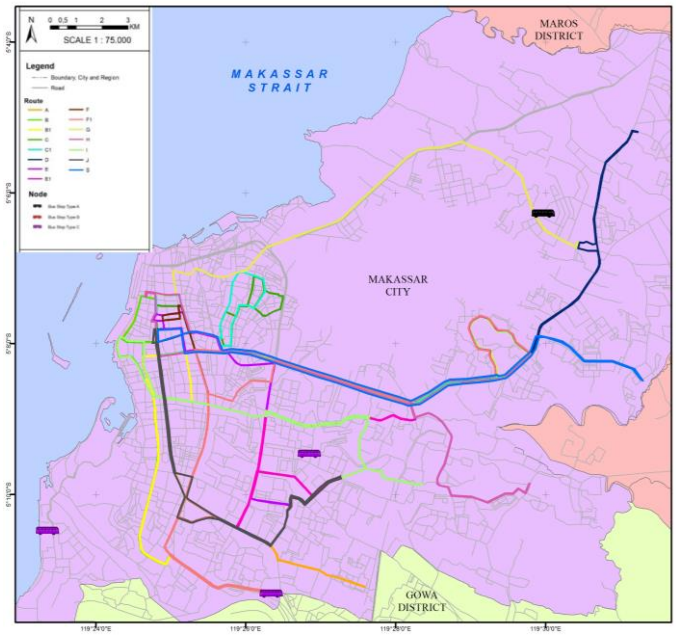

Fig 3:- Route of BRT Transmamminasata Corridor and Makassar Transportion Route

A. The Similarity Between Makassar and Rio

Indonesia and Brazil are categorized as developing countries and tropical climates because it is located at the equator. Having an average economic growth of 5% per year, followed by growth of high vehicle anyway. Makassar and Rio are ones of the metropolitan cities and ones of the five largest cities in their country with a population of approximately 2 million and 6 million, making it the center of economic growth and substantial business. The tropical climate in the two countries affects on public transportation

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planning which hot weather requires service providers should consider the issue of comfort in the vehicle and bus-stop or when the transfer process. The weather factor also becomes one of the factors inhibiting the public to walk, especially during the daytime.

The BRT Transmamminasata planning does not only serve the passengers in Makassar, but the metropolitan area (district) around Makassar such as Gowa, Maros, and Takalar. Similarly, for the BRT Transoeste in Rio serves commuters from the region around Rio. The BRT Transoeste began operations in 2012, while the BRT Transmaminasata was in 2014. Construction of two BRTs was motivated by the congestion that occurred in both cities due to the growth of private vehicle ownership and usage. The average speed of vehicles was only about 20 km / hour, if the provision of transportation was not done then the congestion would be worse in the subsequent years.

Before the BRT Transoeste and the BRT Transmamminasata, there had been public transportation operating in the form of public transportation in Makassar and minibus in Rio. After both BRTs operated, it was expected to be public or continued transportation. At first, both BRTs got a very good response from the public, viewed from the number of vehicles or fleets of BRT becoming insufficient to meet the passengers demand, especially in the rush hours, in the morning and afternoon.

B. The Difference Between Makassar and Rio

The comparison of operational performance between BRT TransMamminasata and BRT Trans Oeste was conducted as an effort to find out the similarities and the differences between the characteristics of the two regions. The significant differences could be seen on several operational performance variables of BRT Transmamminasata Makassar that did not meet the standard.

Variables	Existing	Plan	Transoeste
Operational performance			
Waiting time	17	5 and 10	4 and 8
Maximum travel time	60	73	84
Frequency	2	12 and 6	15
Headway	30	5 and 10	3 and 8
Speed	16.2	15	27.1
Operational hour	8:00 to 18:00	06:00 to 20:00	00:00 to 23:50
Corridor Length	27	27	38.6
Passengers using feeder	7%	7%	65%
Facilities and infrastructures			
Bus Line	Mix	Mix	Exclusive
Distance between Stop (meters)	450-1500	200-700	400-900
Average distance of Stop (meters)	844	485	638
Number of Stop	13	25	36
Great Stop Specification (meters)	10 x 2	10 x 1.5	10 x 60 (2 buildings)
Small Stop Specification (meters)	6 x 2		10 x 60
Bus Specification Information	None	None	Available
Route information	None	Available	Available
Schedule Information of Bus Operation and Arrival	None	Available	Available
Pedestrian Facility	Available	Available	Available
Bicycle Parking Facility	None	None	Available

Table 2:- The Difference between Makassar and Rio

The waiting time between BRT Trans Mamminasata showed 5 minutes during peak hours and 10 minutes at the usual hour, while Trans Oeste indicated 4 minutes during peak hours and 8 minutes at regular hours. The waiting time is the maximum time, while the frequency and the headway are nearly the same as the waiting time. A significant difference consisted of speed, operating hour and number of passengers using public or feeder transportation. Transoeste BRT's speed reached 27 km / hour, while the TransMamminasata's was only 15 km/ hour. This occurred because the Trans Oeste reached up outside of the city and served the commuters, therefore Trans Oeste should be faster to shorten the travel time.

In addition, other than speed, the different variable is operational time, the TransOeste operated 24 hours / 7 fulldays, while the Trans Mamminasata was 14 hours only. The last variables of the passengers using advanced transport (feeder) for the Trans Oeste was as much as 65% of passengers, while the Trans Mamminasata was just as much as 7%. For existing and plan condition, the Trans Mamminasata was still the same because of the unknown passengers switching from public transportation or private vehicle to the BRT if having the operational performance of plan results. Surely, if the plan results could work well, then there was a significant transition of passengers from private vehicle to public transportation, either the BRT Transmamminasata or public transportation.

V. CONCLUSION

There are several things concluded from the application of the concept of multimodal transportation in Rio de Jenairo. First, the main mode of transportation serves as a clear and feeders. The initial condition before the BRT transportation by bus to the small and medium size, then after the construction of exclusive lane BRT and bus transportation small- and medium are then used as a freight feeder or feeder transportation to the BRT lane. It takes a fairly long process, especially to reorder the route and time of arrival for each fleet. In addition, there exist small transportation as a mode of passengers for BRT, when viewed from the large scope of this BRT transportation can be a feeder for connecting to the MRT station and the airport.

In addition, including the transportation arrangements and the route, other things obtained are about policies in the development of transportation, especially for public transportation. Rio de Jenairo government heavily invests to build a public transportation such as subway (MRT), BRT and feeder transportation. Although the construction gets much help from the central government because of the development as well as the effort for the success of the Rio's 2014 Olympic, the policy of Makassar less focuses on tackle congestion and provision of public transportation. Makassar is currently focused on waste and sanitary. Regarding to the provision of public transportation, it still gets subsidies from the central government (the BRT Transmamminasata fleet is an assistance from the central government). Makassar Government manages to accelerate development, especially provision of transportation and accommodation, may also become host events of national and international that can attract a lot of people. As the construction of LRT in Palembang was built for their events National Sports Week (PON) and the Asian Games.

Construction of bicycle lanes and pedestrian shows as an effort to distract people from using private vehicles into using public transportation or nonmotorized vehicles. Bicycle and JPK have also become one of the supporting facilities of public transportation. Currently, Makassar Government has sought to revitalize the pedestrian in the main street and the center of activities in Makassar, whereas for the bike path has not been developed.

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