Research Article

Towards Sustainable Transport Integration: The Implementation of Bus Rapid Transit and Feeder Transport in Tangerang City

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Abstract.
This article presents a case study on policy implementation for a sustainable transportation system in Tangerang City, Indonesia. In an effort to tackle traffic congestion, reduce air pollution, and enhance public service quality, the Tangerang City Government launched a Bus Rapid Transit (BRT) system in 2016. Today, the system has expanded to four BRT corridors, supported by feeder transport services, aiming to achieve an integrated public transportation network. Based on literature review and field research, findings indicate that the BRT and feeder operations have improved the quality of public transport services in the city. Performance analysis highlights improvements in three main areas: 1) velocity, 2) roundtrip time, and 3) headway. However, frequency and load factor remain areas needing further development. Challenges to full integration include underutilized infrastructure, such as shelters and bus stop, a non-integrated ticketing system, and a limited number of BRT and feeder buses. Moving forward, key sustainability issues involve the need for enhanced human resource capacity, increased budget allocation, and improved service performance to support long-term transport integration.

Keywords: sustainable transport integration, bus rapid transit (BRT), governing sustainability

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1. INTRODUCTION

The city growth and its development cause an impact on the expansion of built-up areas, urban sprawl and transportation problems. There will also be an increase in travel demand to manage the movement of people and goods. This movement activity absolutely requires a facility and infrastructure in the field of transportation that is adequate in terms of quality and quantity. The connection between transportation and city growth fosters different issues. While rapid growth of an urban area is followed by the needs of accessibility such as mode of transport, on the other hand the city also experienced environmental issues.

Tangerang city as a part of Greater Jakarta Metropolitan Area has been facing devastated urban problems, one of which is transportation matter. The significant increase of population has caused high congestion as well as air pollution. Initially, transportation problems occur since there is a disproportion between the supply of transportation networking and its demand. Thus, aiming to achieve integrated connectivity which may support mode of transportation shifting, it is essential to have an integrated transportation system.

The geographical position of Tangerang where Soekarno Hatta International Airport administratively located, followed by rapid growth of the city has led the city become one of the strategic areas in enhancing economic activities in Jakarta Metropolitan area. Infrastructure provision such as sustainable transportation system becomes one of government strategic roles to provide public needs. It is also in line with spatial planning of the city released by the government of Tangerang City in 2018 that indicates a strategic role for managing sustainable transportation system which meets the need of society.

Transportation provision has always been an attractive case to be discussed. It is due to its function as public goods, meaning that everyone has similar accessibility in using various modes of transportation. To enhance the economics of scale, transportation accessibility in the city becomes a major issue for every government as well as other stakeholders. Local government should explore knowledge and practice to elevate public service quality.

In 2016 Tangerang Government initiated to operate one corridor of Bus Rapid Transit which connected eastern area to the city center. Currently the government expands BRT corridors into four (4) corridors, one of which connects to Trans Jakarta busway. Likewise, feeder transport is also developed by the government to escalate integrated public transportation. This study aims firstly to measure service performance analysis of integrated transportation system within Tangerang City. Secondly it aims to portray how the policy implementation regarding the operation of BRT and its feeder as an integrative and affordable applied for all levels of society.

2. THEORETICAL STUDY

Transportation is defined as a particular system consisting of facilities, flow of movement and controlling system that led movement of societies and goods efficiently in a specific

time(1). In a more focusing term of sustainable transportation, a similar perspective reveals from Black (2005) that mentioned sustainable transportation required equal sector's impacts within three paradigms of sustainable development: society, economy and environment(2). Meanwhile Litman depicted the necessity of integrating urban transport as a crucial aspect of sustainable transport goals to tackle problems in urban areas(3). Engaging those theoretical views, it is essential to observe modes of transportation which meet sustainable transportation criteria. Sustainable urban transport is a mode of transport basically used in a more density area to tackle environmental issues. Since there is also an important social justice and social equity issue, it "*needs proactive planning and action that go beyond what public administration has ventured to do up until now"*(4). Sustainable urban planning is a universal subject, confronting all urban areas of the world.

The implementation of transportation strategic is crucial both at managerial level as well as in the administration level, thus government policies have an important role. Krueger (1990) further explained that as a public institution, the government must achieve governance on a large scale, including in forming policy regulations and rules to provide basic services for the community(5). To deal with public service performance, a lot of governments commenced to address problems of traffic congestion, air pollution, and other externalities by implementing mass rapid transit such as BRT and feeder transport.

Bus Rapid Transit (BRT) system is a worldwide method capable of advancing the mobility of societies. It also consists of structured operations, interventions, busway improvement and upscaling lively neighborhood condition(6). Based on various studies, it is indicated that BRT systems have been developing significantly for the last two decades, notably in Global South. According to Hoffman (2008), BRT system is a form of transportation elements that have standards such as running ways, bus stops, shelters, vehicle types, smart systems, modes of tariff, modes of service, and branding(7) (8).

While there have been some considerable debates on the performance of bus transit model, BRT as a high-quality bus system might be categorized as comfortable as rail system. Bus transit is able to serve in a wider area and more flexible in dispersed land use of urban area (3). It does not require special facilities since it is operated on existing roadways so that the costs of capital can be controlled.

To measure public transport performance analysis, World Bank (1986) recommends five factors should be improved to reach a better-quality service: 1) velocity, 2) roundtrip

time 3) headway. 4) frequency and 5) load factor(9). In terms of velocity (speed), the standard released by World Bank is divided into two categories: 1) speed rate of 10-12 km/hour for less densities area, and 2) speed rate of 25 km/hour for the minimum standard, in regards of a more densely populated area. Indonesian government attempts to standardize similar elements of those performance analysis through decree of Ministry of Transportation released in 2002.

TABLE 1: Indicator of Performance Analysis.

Indicators	Standard of World Bank	Standard of Government of Indonesia
Velocity/speed	Max: 10 -12 km/hour Min: 25 km/hour	Average: 10 – 20 km/hour
Round Trip Time	Average: 1 – 1,5 hours Max: 2 – 3 hours	Average: 1 – 1,5 hours Max: 2 – 3 hours
Headway	Average: 5 – 10 minutes Max: 10 – 20 minutes	Average: 5 – 10 minutes Max: 10 – 20 minutes
Frequency	80% - 90%	
Load Factor	Passenger ratio: 70 %	Passenger ratio: 70 %

Source: World Bank (1986) and Ministry of Transportation (2002)

3. METHODS

The research framework for this study is literature studies. The first stage done in this research is to study the background in detail, to assess problem formulation, and to do literature review in obtaining the theoretical framework. Data collection methods gained from research journals, government rules and regulations, ministerial decrees, regional regulations and other reference sources related to the research and problems taken in this study. After finishing data collection, processing data analysis is used to portray the measurement of performance indicators.

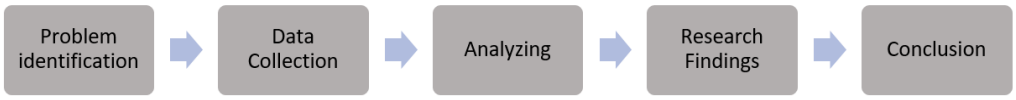

Figure 1: Method flowchart (*author*).

The data analyst method used in this study focused on five factors of public transport performance analysis from World bank(10). Both BRT system and feeder transport performance are measured during the year 2023(11). Importance Performance Analysis is also used to measure the prioritize of transportation service. The mechanism of this study is shown in the picture below. It started with problem identification to define the

issue and gain deeper understanding regarding scope of nature. The following step is data collection, a practical phase as an opportunity in gain relevant effects. The data collection is analyzed each performance indicator that it may ended with conclusion. Research findings portray each element gained from the analysis, ending with research conclusion.

4. RESULTS & DISCUSSION

Tangerang city is located next to the capital city of Indonesia, Jakarta, and is a part of Jakarta Metropolitan Area. The city is characterized by a high population number because of the high level of urbanization. Locating in a very strategic place and covered an area of 180 km2, Tangerang has been a home for about 2 million inhabitants, with population density of 10,925 km2 and a growth rate of 3.09%. It is an unavoidable fact that Tangerang has been facing various development challenges, especially in infrastructure sphere, transportation provision, congestion problem and urban housing provision

To overcome problems of transportation, in 2016 the government of Tangerang City initiated to improve transportation provision through the operation of BRT called *Bis Tayo*. Rather than using specific lanes, it operates in mixed traffic lanes. The government develops the system aiming to provide massed rapid transportation system which connected intercity main road so that it may integrate transportation system within the city.

BRT system in Tangerang City first operated in December 2016, provided for passengers in western part of Tangerang city to the city center (Gandasari Stadium-Poris Plawad Terminal). In 2018, the government expand the BRT route to another part of the city. To date, there are four (4) BRT corridors, one of which connects Tangerang as a buffer city to border of Jakarta, where the bus stop intersects with Trans Jakarta bus stop. Applying flat rate Rp. 2.000 for each trip.

Feeder transport also operates in Tangerang City to service passengers in smaller areas. It operates in collector street connecting residential area to main road. Different from BRT which has specific shelters, pick-up and drop-off system of feeder transport is anywhere along the road, including BRT Shelters. With capacity of 12 passengers, this type of transport operates simultaneously with conventional public transport. There are eight (8) units for each route and an additional vehicle as a backup.

Table 2: Number of BRT and Feeder Transport of Tangerang City in 2023.

No.	Type of Transport	Route Area	Number of vehicles	Additional Vehicle
1	BRT -1	Poris Plawad - Jatiuwung	9	1
2	BRT - 2	Cibodas – Poris Plawad	9	1
3	BRT - 3	Tangcity – CBD Ciledug	9	1
4	BRT - 4	Cadas – M1 Soetaa Airport	9	1
5	Feeder AP 1A	Mini Stadium Gandasari - Gajah Tunggal	8	1
6	Feeder AP 1B	Gajah Tunggal Intersection – KP.Ledug	8	1
7	Feeder AP 1C	Situ Bulakan Mutiara Pluit – Laris Maeket	8	1
8	Feeder AP 1D	Terminal Cimone – Jl.KH. Sholeh Ali	8	1
9	Feeder AP 1E	Perum. BTN Pasir Jaya – Mini Stadium Gandasari	8	1
10	Feeder AP 1F	Terminal Cimone – Kel. Koang Jaya	8	1
11	Feeder AP 1G	Terminal Cimone – Pajajaran Mini Stadium	8	1
12	Feeder AP 1H	Terminal Cimone – Pabuaran Stadium	8	1
13	Feeder AP 1I	Simpang Grendeng - Kavling Perkebunan	8	1

Source: Tangerang City Transportation Agency, 2022

4.1. Performance Analysis of BRT and Feeder Transport

Performance of feeder transport shows that out of five factors, there are three factors that meet the minimum standard namely velocity, round trip time and headway. Although not all routes gain positive performance, those three factors can be categorized as the positive trend of transportation service. Yet load factor and frequency indicate below standard performance.

While feeder transport indicates a low positive trend, BRT performance is quite deliberate. Of the performance analysis factors there are only velocity and round-trip time which meet the standard. Headway only shows improvement in one corridor, whereas load factor and frequency are still below standard.

Although research findings show insignificant improvement of transport service performance, the result of Importance Performance Analysis released indicates that level of service performance for integrated transport is adequate. Citizens appreciate the implementation of BRT and Feeder Transport. What might be improved are infrastructure facilities such as shelter, number of units, ticketing system and frequency.

TABLE 3: Performance of Feeder Transport in Tangerang City in 2023.

Feeder Transport ID	Velocity	Distance	RTT	LoadFactor	Headway	Frequency
	25km/hours		60-90 minutes	(70%) LF	15 minutes	Unit/hour 12
AP 1A	15,51	16,81	65	8	0:14	2
AP 1B	18,78	14,40	46	8	0:26	3
AP 1C	17,02	13,46	48	8	0:13	4
AP 1D	20,15	14,97	44	6	0:18	3
AP 1E	22,22	15,27	41	19	0:09	5
AP 1F	19,65	17,77	43	2	0:19	2
AP 1G	13,08	15,91	63	5	0:19	10
AP 1H	13,51	13,46	64	13	0:19	1
AP 1I	19,18	16,44	44	14	0:11	5
Average	**18**	**15**	**51**	**9**	**0:16**	**4**

Source: Transportation Agency of Tangerang City, 2023

TABLE 4: Performance Analysis of BRT in Tangerang City in 2023.

Feeder Transport ID	Velocity	Distance	Round-trip Time	LoadFactor	Headway	Frequency
	25km/hours		60-90 minutes	(70%) LF	15 minutes	Unit/hour 12
K1	23,50	30,30	77	13	0:17	3
K2	24,12	21,63	54	25	0:13	4
K3	20,29	26,81	79	57	0:23	3
K4	21,09	23,52	70	15	0:21	3
Average		**22**	**26**	**70**	**27**	**0:18**

Source: Transportation Agency of Tangerang City, 2023

5. CONCLUSION

The integration transportation system using BRT and feeder transport in Tangerang City has performed adequately to overcome congestion. Research findings portray Importance Performance Analysis is performed well. Although there is still an inadequate level of services mostly in frequency and load factor, the implementation of this integrated transportation system becomes a suitable policy implemented in Tangerang.

The operation of BRT and feeder transport in Tangerang City has upgraded the quality of public transportation services. Societies welcome the implementation of BRT and Feeder Transport. On the other hand, the integrated transportation services provided

are still not optimal due to the lack of utilities and infrastructure provision, such as bus stops, shelters and inefficient ticket management. The uneven distribution of feeder transport is also an obstacle.

In dealing with urban transportation problems, it is necessary to have an organized governance and operational system to meet the needs of the community. The inability to integrated public transportation will be a thoughtful constraint triggering transportation problems cannot be solved appropriately and properly, instead it tends to cause new complex and more complicated urban problems. Some key challenges for governing sustainability that might evolve in the future are the need of human resource capacity building, budget allocation expanding and performance enhancing for sustainable transport integration.

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