

Sterilization of Bus Rapid Transit Special Lane Case Study : Transjakarta

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Abstract. Transjakarta (TJ) is Indonesian Bus Rapid Transit since 2004. One important element for a BRT system is to have a dedicated lane to ensure the bus can move quickly. However, in reality there are still many other vehicles that pass the special Transjakarta lane (TJ) and cause TJ bus trips to be hampered. The Minimum Service Standard (SPM) for the regularity indicator shows the headway at the level of 60% -70% of the target of 90%. This study aims to examine the effective methods of sterilizing TJ pathways so that they are expected to increase TJ's On Time Performance (OTP). Here the existing pathway sterilization methods and several other alternative methods are evaluated. The indicators used to evaluate are ease of use, speed of access, system reliability, flexibility and security. Evaluation is done using expert judgment. The results obtained from the three methods of sterilization (raids, manual portals with officers and automatic portals) statistically showed no difference between the three methods or the three methods showed the same performance / performance. However, based on in-depth interviews indicate that automatic portals and Electronic Traffic Law and Enforcement (ETLE) are still effective alternatives in the future.

Keywords: sterilization, bus rapid transit, transjakarta

1. Introduction

Bus Rapid Transit (BRT) Bus Rapid Transit (BRT) is a high-quality bus-based transit system which provides fast, convenient service and has a large carrying capacity [1]. Therefore BRT is often regarded as the right strategy to serve the transportation needs of the people in urban areas. So in 2004, Jakarta Regional Government operated a Transjakarta bus (TJ) which was a bus with a BRT system.

TJ was designed as a mode of mass transportation supporting the activities of the very crowded capital city of Indonesia. With the longest track in the world (251.2 km), and has 260 stops spread in 13 corridors [2]. One of the criteria for the BRT system is to have a special lane which is a vital element to ensure the bus can move quickly and not be hampered by congestion [3]. However, in reality there are still many other vehicles in Jakarta which have special TJ lanes which have caused TJ bus trips to be blocked [4]. Therefore, the BRT criteria for having a special lane still cannot be realized properly.

So it causes the arrival time between the bus (headway) to be late and exceed the reasonable limit. The headway indicator between buses according to Minimum Service Standards (SPM) is 7 minutes during rush hour, 10 minutes during long hours and 30 minutes for Night Transportation (AMARI). Whereas according to the achievement of SPM in 2018 the fulfillment of the headway indicator is still at the level of 60% - 70% of the target of achieving SPM which is 90%.

In previous studies, the direction of change and sterilization of the busway lane was considered as an alternative solution to reduce accident rates and curb traffic on the busway lane [5]. Other previous studies also discussed the design of an automatic portal control system for rfid-based busway lines using the fuzzy-pid method [6] and also the Active signal priority control method for bus rapid transit based on Vehicle Infrastructure Integration [7]. But no one has discussed the most effective method to overcome the sterilization of the busway lane.

Therefore, this study aims to examine the effective method of sterilizing TJ pathways so they are expected to increase TJ's On Time Performance (OTP).

2. Theoretical Basis

2.1 Urban Transport

Transportation is the transfer of people or goods from one place to another by using vehicles in road traffic space [8]. Transportation is closely related to the existence of a movement in the form of travel from origin to destination. As long as it can be in the form of a house, so the trip taken is called the home base trip, leading to the destination in the form of activities to be carried out, such as social activities (school, sports, family, etc.) and business activities (work, trade, etc.) [9]. According to Kanafani (1983), transportation is needed to support the interaction of social and economic activities which spread around it. The reasons which caused people travel unlimitedly such as goods and recreational needs [10].

Public transport options are the choice about the future of a city. The choice of Urban Transport Selection is very diverse and must be able to accommodate many people or commonly referred to as the Mass Rapid Transit concept. Mass Rapid Transit is also referred as a public transportation, which is a service for serving passenger transport usually with local coverage, which is available to anyone by paying a predetermined cost. This transportation usually operates on fixed special lines or potential public lines which are separate and used exclusively, according to the schedule set by routes or lines designed with certain stops. Examples of transportation with the Mass Rapid Transit concept are Bus Rapid Transit, heavy rail transit, Light Rail Transit. [3]

2.2 Bus Rapid Transit

Bus Rapid Transit is a public transportation which is very effective for urban transportation with high quality, high efficiency, low energy consumption and low costs compared to other transportation modes [11] [7] [12]. The concept of bus rapid transit (BRT) has spread throughout the world as a way for cities to improve public transport systems at a reasonable cost [13]. BRT has a very important role in efforts to reduce carbon emissions in transportation. Increased carbon emissions from the use of private vehicles could be stopped slowly by seeking humans to use public transportation every time they travel. BRT also has several elements such as special bus lanes which are generally in the median of the road, withdrawal of off-board rates, level boarding, bus priority at intersections, and other service quality elements (such as information technology and strong branding). The ability for buses from the bus rapid transit (BRT) system to travel smoothly along the lane in particular is very important [14].

Many cities in Asia implement this BRT system because it is considered to have many advantages compared to rail systems. The advantage is BRT system only requires a separator to separate public roads with special BRT lines while the rail system costs a lot to build railroads. In addition, BRT was chosen as public transportation because it was more flexible [15] [16].

2.3 Previous Researches

Based on data from DKI Jakarta Provincial Government, in 2012 accidents related to TransJakarta buses have increased significantly from the previous year. The accident occurred because of many other vehicles entering TransJakarta line. This shows the lack of awareness of motorists to comply with regulations and order traffic. Therefore, a solution is needed to reduce accidents. One solution is to maximize sterilization and contra flow programs. Sterilization is an attempt to generally sterilize motorists who enter TransJakarta lane. The referred contra flow is the direction of TransJakarta road in the opposite direction to the other road direction of the vehicle. This program aims to limit motorists and reduce the number of accidents which occur on TransJakarta lane [5].

Transjakarta or better known as busway is one of the mainstay public transportation modes in the capital city of Jakarta. The high number of accidents on the busway lane is caused by the disorder of motorized vehicle users who break through the special lane of Transjakarta bus. Sterilization of busway lane has been carried out such as raids, installation of MCB (Moving Concrete Block), and procurement of manual portals. In this study, we designed an automatic portal simulator to sterilize busway lane using the Fuzzy-PID control system. In this RFID-based system it is intended to differentiate vehicles which are allowed to cross the busway lane by comparing RFID cards detected with bus ID data in the database. The movement of the portal will be controlled by the Fuzzy-PID control when the HC-SR04 sensor detects the distance of the bus. Based on the test results obtained by the graph of system response using the Fuzzy-PID control method in the first parameter it is more linear and has a faster response time compared to other parameters [6].

2.4 Performance Evaluation

To evaluate the existing pathway sterilization performance methods and several other alternative methods using quality systems according to DeLone and McLean through several indicators as follows ease of use, access speed, system reliability, flexibility and security. Ease of use, namely the ease of use of the method to be implemented. Speed of access is how long it takes for each method to bring change. System reliability is the ability of the method to keep operating without interference. Flexibility means when the method has the ability to be implemented in all types of situations and conditions. Security methods are fulfilled if the method creates a sense of security towards the surrounding environment and human resources around it [17][18][19].

3. Transjakarta

Transjakarta is the first Bus Rapid Transit (BRT) transportation system in Southeast and South Asia with the longest track in the world (251.2 km) and has 243 BRT stations (previously called bus stops) spread in 13 corridors (lanes). TJ was developed in Jakarta since January 15, 2004. Commercial operations began on February 1, 2004. TransJakarta is a Public Private Partnership Program with the concept of efficiency and equality in the public transportation system, the Regional Government of DKI Jakarta Province. This system is part of the regional government policy in the Macro Transport Pattern in 2003 and it is regulated in the Governor's Decree Number 84/2004. In general, the policy covers the regional government system which is the two basic (backbone system) of urban development, namely (Murdiono 2006) [20]. TJ is an application of a system which has been implemented in Bogota, Colombia. Until now there are 13 corridors operating, namely corridor 1 (Blok M-Kota), Corridor 2 (Kota Harapan Indah-Harmoni), corridor 3 (Kalideres-Pasar baru), corridor 4 (Pulo Gadung-Dukuh Atas), corridor 5 (Ancol-Kampung Melayu), corridor 6 (Upper Hamlet 2- ragunan), corridor 7 (Kampung Melayu-Kampung Rambutan), korifor 8 (Lebak Bulus-Harmoni), corridor 9 (Pluit-Pinang Ranti), corridor 10 (Tanjung Priok -Cililitan), corridor 11 (Kampung Melayu-Mayor of East Jakarta), corridor 12 (Pluit-Tanjung Priok), corridor 13 (Puri Beta 2-Tandean) [2][21] .

Because implementing the BRT system, TJ must have a special line or priority lane. Priority lane or what is usually called a busway is a special road for vehicles designed to be used exclusively by buses. This pathway can be built on, above or underground and may be on a separate special lane or in a highway corridor. Transjakarta special lines must always be sterile from other vehicles. Sterilization is any process which an object, material or environment is made sterile. However, on the other hand, sterilization in the context of traffic conditions is to make the lane sterile to pass. This can be used to rearrange order in traffic so as to reduce the potential for accidents [5].

If the TJ special lane is sterile, the TJ On Time Performance (OTP) will go well. OTP and delay cannot be separated, because delay is the opposite of OTP. OTP is the timeliness which can be achieved by a flight, while the delay is explained in the Law of the Republic of Indonesia

Number 1 of 2009 concerning Aviation. Delays can be defined as the time difference between the scheduled departure or arrival time and the realization of the time of departure or arrival [22].

4. Data Collection and Analysis

Using quantitative and qualitative methods (mix methods). Data is obtained from the Department of Transportation (DISHUB), previous research, observation and also in-depth interviews. To measure data using expert judgment with 6 respondents who are experts in the field of transport associations (Institute for Transportation & Development Policy), Road Transport Traffic Coordinator (LLAJ), Head of corridor sterilization department (Transjakarta), Section head of transportation in route (DISHUB) and Coordinator of Road Safety Action Network (JaAkAman). The results of in-depth interviews with statistics analyzed. The results of observations are analyzed by qualitative explorations.

5. Results and Discussion

5.1 Causes that cause other vehicles to use a special Transjakarta lane

The thing which causes other vehicles to enter and use Transjakarta special lane is due to congestion on public road and the empty of the Transjakarta special lane, thus encouraging other vehicles to use Transjakarta special lane so the traffic jam can be reduced. The congestion can be influenced by several things, namely the density of vehicles during rush hour, the small number of road bodies caused by other infrastructure developments such as toll roads or Mass Rapid Transit (MRT) and Light Rapid Transit (LRT) projects which are mostly carried out in several points in Jakarta. Sometimes other vehicles using a special Transjakarta lane are not the driver's intentions, but rather the orders from the environmental police are intentional. The aim of the environmental police is not to manipulate traffic. This authority is called Discretion.

Police discretion is basically a police authority based on the principle of the general obligation of the police, namely a principle which gives authority to police officials to act or not act in their own judgment in the context of their general obligations. Usually, we often see this incident in several corridors. The regional police intentionally open and divert other vehicles to Transjakarta lane because of the extremely long traffic jam.

In addition to traffic congestion, the existence of intersections, improper placement of busway alignments and a lack of public knowledge about Transjakarta special lane also triggers the entry of other vehicles into Transjakarta special lane. Based on the results of interviews with researchers with experts in the field of Transportation or Road Transport Traffic (LLAJ), in essence Transjakarta still does not have its own roads such as trains or commuter lines. So Transjakarta and the police must be flexible to open their way when there is severe congestion. But if there is no congestion, the closure of a special TJ lane can be applied again. Especially on roads which have a small road body, the TJ must be willing to join other vehicles on the road, because there is no special TJ line on the small road body.

5.2 Policies which have been implemented by the Provincial Government (PemProv) and Transjakarta to carry out sterilization of special TJ lines

5.2.1 Raids by the Police who have collaborated with Transjakarta

For the purpose of safety and sterilization in the TJ special lane, Transjakarta has cooperated with the police chief. The result of the collaboration was the presence of special police forces which sheltered by Transjakarta with 100 police officers. One hundred police will maintain the safety of Transjakarta operation and also TJ special line sterilization every day with a schedule of two shifts in 13 Transjakarta corridors. However, the action of violators is only carried out when the hours are not crowded in the morning or afternoon, whereas during peak hours, the police do not take action against violators. The raid is expected to have a deterrent effect for offenders who use the TJ special lane. Many of the things which need to be

evaluated from the police raid are because personnel are limited so not all roads or shelters carry out raids, only certain points are placed by the police.

5.2.2 Using manual tools and Human Resources (HR)

The manual and Human Resources (HR) tool in question is by deploying several TransJakarta officers to open and close the manual portal at certain points. The installation of manual portals is carried out at the point of the lane with boundary concrete or commonly known as Movable Concrete Barrier (MCB), which is often an opportunity for other vehicles to enter and use the special Transjakarta lane. The manual portal clerk is scheduled for two shifts. The first shift is five in the morning until two in the afternoon and the second shift at two in the afternoon until eleven in the evening.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Razia is the same across categories of Indikator.	Independent-Samples Kruskal-Wallis Test	406,000	Retain the null hypothesis.
2	The distribution of Portal Manual dan SDM is the same across categories of Indikator.	Independent-Samples Kruskal-Wallis Test	406,000	Retain the null hypothesis.
3	The distribution of Portal Otomatis is the same across categories of Indikator.	Independent-Samples Kruskal-Wallis Test	406,000	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Razia	5	6,33	8,17	7,2660	,70585
Portal Manual dan SDM	5	6,67	7,40	7,0480	,26753
Portal Otomatis	5	6,83	8,33	7,7660	,65397
Valid N (listwise)	5				

Based on statistics there is no overall difference between the three solutions. The three solutions are equally good in terms of performance for Transjakarta special lane sterilization. Therefore, it is need to changes in attitudes and behavior of the community in traffic which are conscious and orderly towards the signs.

5.3 Solutions for the future to achieve a sterile Transjakarta special lane

To get a solution to replace the Transjakarta special lane sterilization policy, the researchers conducted interviews with various respondents who were experts in their fields such as transport associations representing the ITDP, head of department and coordinator of corridor sterilization from TJ, road transport coordinator (LLAJ), head of transportation people on routes representing the Transportation Agency (DISHUB) and the coordinator of the road safety action network representing Transjakarta users and transportation safety observers.

5.3.1 Use of automatic portals

In the modern era, everything requires increasingly sophisticated technology, so the manual portal which is now being implemented is considered too late. Then the manual portal needs to be upgraded with an automatic portal with sensors.

5.3.2 Add bus frequency

The addition of the frequency of these buses has been applied in Guangzhou, China and Africa. In China, we have dared to add buses to 350 busses per hour and hourly, so every 10 seconds the bus will pass. This will trigger the segregation and the lack of opportunities for private vehicles to enter the special BRT lane.

5.3.3 Expansion of bus stops to stations

To accommodate the increase in bus frequency per hour, it is necessary to improve infrastructure, because with the existing infrastructure, there are still banching buses, namely bus queues to drop and increase passengers. Therefore, repairs to infrastructure, especially shelters, need to be expanded, so the bus stops to become a station.

5.3.4 Consistent raids

The raid was considered more effective than the manual portal, because when opening and closing the manual portal it took quite a long time and the officers guarding the portal manual were very high risk.

5.3.5 Use of Automatic Portal and Electronic Traffic Law and Forcement (ETLE)

This solution has been planned by Transjakarta because it is considered very effective to sterilize TJ special lane. With the use of this sophisticated technology, it is expected which violators will be deterred so there is no possibility for other vehicles to enter and through TJ special lane. The use of this automatic portal is also considered to reduce operational costs because it can reduce human resources. But human resources are still needed, but not too much. These human resources are still needed to maintain the conditions during the operational implementation so that they remain safe and comfortable.

5.3.6 Increase law enforcement

Improve law enforcement consistently, namely firm, credible, transparent, indiscriminate and synergistic. In carrying out efforts to sterilize operators, regulators and police must work together.

5.3.7 Education and Advocacy

Educate by instilling the jargon "Do not imitate the wrong" and become a good example by not entering TJ lane. Advocacy happened at the level of peaceful action, sympathy and protecting public rights in safety. The most concrete solution is to urge law enforcers in every stakeholder to enforce the law consistently.

6. Conclusion and Future Research

The factor which makes TJ's trip hampered is because of the entry of other vehicles into TJ special lane due to congested roads. As a result, TJ headway exceeds the reasonable SPM limit. Therefore, an effective method is needed for TJ special lane sterilization efforts. The method of sterilization with the existing and several other alternative methods (raids, manual portals with officers and automatic portals). The results obtained from the three methods of sterilization (raids, manual portals with officers and automatic portals) statistically showed no difference between the three methods or the three methods showed the same performance / performance. The results of in-depth interviews found 7 solutions for TJ special lane sterilization efforts, namely automatic portals, additional bus frequencies, expansion of bus stops to stations, consistent raids, the use of automatic portals and Electronic Traffic Law and Enforcement (ETLE), law enforcement and education and advocacy. However, based on in-

depth interviews indicate which automatic portals and Electronic Traffic Law and Enforcement (ETLE) are still effective alternatives in the future because they use sophisticated technology.

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