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ELECTRONIC ROAD PRICING 2 SYSTEM IMPLEMENTATION: CASE OF PROTOCOL STREETS IN JAKARTA, INDONESIA

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Abstract

This research analyzes the formulation of Electronic Road Pricing related to transportation policy to mitigate street jam. There are various concepts to improve the transportation services in Jakarta, Indonesia with the Electronic Road Pricing System as an alternative. This research uses transportation method is one analysis tool with Traffic Counting system. Suggests three findings, (1)The implementation of Electronic Road Pricing in Jakarta using Single Gantry is a solution in accordance with the road aesthetic, ease of installation and cost factors (including operational cost), (2) In formulating policies, the government should consider win-win solutions, pro-poor and enhance the added value of business sector, and (3) Electronic Road Pricing System will change Jakarta from F Level of Service to C Level of Service by converting the use

of private vehicles into the use of public transport. Results confirmed that: (1) Paid Road System 1 or ERP1, namely Dedicated Short Range Communication uses Gate and electronic equipment, digital communication, and cellular network, and (2) whereas Paid Road System 2 or ERP2, namely New Gen Electronic Road Pricing and Vehicle Positioning System uses Gate and electronic equipment, digital communication, and cellular network and supported by satellite aids.

Keywords: Electronic road pricing; level of service; single gantry; traffic counting; vehicle to capacity ratio

INTRODUCTION

The province of Jakarta, Indonesia has reached the traffic jam level where the speed of vehicles is just 10-20 km/hour, the V/C (Vehicle to Capacity) ratio has reached 0.85 and even higher. It means that Jakarta has become the most terrible city in Indonesia in term of traffic jam. Based on the data from Research & Development Center of Land Transportation and Train, the Ministry of Communication, Jakarta is the city with the highest level of traffic jam in Indonesia. Compared with other cities, the speed of a four-wheeled vehicle in Jakarta is only 10 to 20 km per hour on average. This is because there have been too many vehicles in Jakarta, and the volume has been overcapacity.

As a comparison, based on V/C measurement, Bogor as the supporting area for Jakarta, is the most jammed city in Indonesia, followed by Jakarta, Bandung, Surabaya, Depok, Bekasi, Tangerang and Semarang (almost all are located in the great area of Jabodetabek). For example, Pajajaran street in Bogor city has V/C value ranging from 0.4 to 0.74, which is approaching or beyond the ineligible threshold, because the proper threshold is under 0.5. The satisfaction measurement by Waze Index in 2016 entitled *Reveals Where in The World are the Best and Worst Places to be a Driver* determines Bogor city as the second worst place in the world to drive (Waze.com., 2016). Although Jakarta has many inner-city toll roads, it also starts to develop some public transportation. However, the number of drivers is increasing. Even added with other drivers from outside Jakarta, it has been calculated that the average speed kof vehicles in Jakarta is around 10 to 20 km per hours with the V/C ratio is 0.85. Some policies in transportation have been implemented in Jakarta, such as the 3-in-1 policy, Odd-Even policy, Mass Public Transportation Rejuvenation, however they have not been effective in improving the transportation Level of Service in Jakarta.

The other cause of traffic jam is that people in Jakarta prefer using private vehicles (cars and motorcycles) rather than the available public transportation. The number of Jakarta citizens now is more than 10 million people. According to the information from a transportation mass media, in New York city (USA), which also has more than 10 million citizens, around 70% of its citizens are willing to use public transportation (subway, overpass, public bus, and taxi). As a result, there are no terrible traffic jams in New York city. The same thing happens in Shanghai (China) which also has more than 10 million citizens. Most of Shanghai people prefer using public transportation (subway, overpass, public bus, and taxi). Therefore, the transportation in Shanghai city has no significant traffic jams.

To overcome congestion problems in Jakarta, a number of alternative suggestions can be made, such as restrictions on the use of private vehicles and motorbikes through the implementation of ERP (Electronic Road Pricing) system, rapid mass transportation (MRT) construction, Bus Rapid Transport (BRT) operation, activation of Integrated Border Bus Transportation and the establishment of Megapolitan Transportation Authority (Raharjo, 2012). According to a transportation expert in Jakarta, the road users do not obey the traffic regulations. This worsens the transportation performance in Jakarta. In order to improve the transportation services in Jakarta, there are several ways and policies, such as using ERP system, adding the modes of public transport, rejuvenating the existing fleets, Park and Ride policy, Car Pooling, and so on.

The plan to add the modes of public transport includes among others: MRT (Mass Rapid Transport, and Subway), LRT (Light Rapid Transport, Overpass), and TransJakarta Bus. There is an option to limit old and new vehicles. Related to human resources (drivers), it is necessary to enhance the drivers' competence beyond having a driving license. The policy that limits the number of old and new vehicles has not been fully implemented. The limitation of new vehicle ownership has not ever been implemented because it is feared to disrupt the investors in automotive business.

Many cities in automotive-producing countries experience terrible traffic jams, like Mexico City, St Pietersburgh (Russia), Mumbai (India), Rio de Janeiro (Brazilia), Bangkok (Thailand), and Jakarta (Indonesia). The number of registered motor vehicles (excluding for Army, Police, and Diplomatic Corp (CD) by the type and year of vehicle in 2015 (DKI Jakarta Provincial Statistics Agency, 2015) includes 13,989,590 Motorcycles, 3,469,168 Passenger Cars, 706,014 Load Cars, 363,483 Buses, 139,801 Special Vehicles, and totally 18,668,056 vehicles. The total number of Passenger Cars, Load Cars, and Buses is 4,538,665. One of the efforts to reduce the traffic jams in Jakarta is by implementing ERP.

In order to implement the second Electronic Road Pricing, institutional studies and regulations are needed for its effectiveness, because so far only technical studies that have been done. The scope of study includes: (1) Regulation and institutional analysis related to ERP in Jakarta, (2) Analysis on the area selection for ERP implementation in Jakarta, (3) Scenario arrangement for ERP implementation in Jakarta, (4) Establishment of government regulation and/or prohibition in the ERP area in Jakarta, (5) Analysis on the utilization of fund resulted from ERP charges in Jakarta, and (6) Need analysis for road traffic and transportation policy related to ERP in Jakarta.

Researches on ERP have been done by many researchers with the goals almost the same with its implementation plan in Jakarta, such as by (Menon & Guttikunda, 2010). Singapore, for example, with the ERP will charge the vehicles to pay for the traffic jam they make. In its implementation, the drivers will have to pay for the road, bridge and tunnel they pass through. Efforts made in Singapore to curb the increase in road vehicles using a sophisticated ERP system, with extensive management preparation, changes in speed on the road to ensure a higher lane and environment (Goh, 2002).

The aim is to reduce the use of vehicles during the peak hours, thus reducing the load of traffic jam. Research by (Agarwal & Koo, 2016), through ERP implementation which is considered expensive by road users, finds that as many as 12% to 20% road users move to bus transportation in the morning and around 10% in the evening. Another research result in England, ERP can influence demand, influence the degree of pollution, meets the road users' desire, and increase the income through the payment made by road users (Walker, 2011). The ERP tariff system or cost for traffic jam is successfully implemented in Metro Vancouver Canada (Arnold, 2013), whereas in Hong Kong it becomes an effective solution for long-term success. However, the government needs to take some strategies of public involvement to obtain public supports for ERP (Talukdar & Hassan, 2014).

The provincial government of Jakarta shows some alternative policies where, as the authority, it may choose the toll way scheme which is suitable for reducing traffic jams (Yudhistira, 2015). The introduction of ERP in Jakarta requires socialization for the majority of road users, which can gradually be used as an understanding of the scheme, thus getting a more acceptable public response. The study of ERP must provide insight for the Jakarta government in a more effective policy and aims to promote the implementation of ERP in Jakarta (Sugiarto, Miwa, Sato, & Morikawa, 2015).

ERP in India does not only reduce traffic jams but also eliminates the need for toll gates as well as provides an alternative source of income for Indian government (Bharathy, C. M., Subramaniam, T. P., Deepakraj & Swetha, 2016). Another study attempts to comprehend

commuter behavior in choosing routes based on ERP policy implementation on the Sudirman and Kuningan corridors (Rizki, Karsaman, Santoso, & Frazila, 2016). Another research is a prototype ERP system design based on the Raspberry Pi embedded system with RFID and image processing capabilities based on OpenALPR. The system works with the vehicle running under the gantry will be recorded by recording the plate image and reading the RFID tag (Tjandra, Nugroho, & Utomo, 2016).

The implementation of ERP is a solution for reducing the number of vehicles and making the owners of vehicles move to using public transport. This can not happen without the role of the governments of Bandung and other metropolitan cities in Indonesia and all related parties, including the academicians who review the implementation of ERP (Rizal, Maulina, Purnomo, & Febrian, 2017). The last research, ERP becomes a part of the Indonesian government's transportation strategy which includes good transportation planning, providing good road networks, and providing bus and train as a well integrated public mass transportation system (Rasetyono, 2017).

The aims of this study are: 1) to know and analyze the areas of ERP implementation, 2) to know and analyze the government's regulation and prohibition in the area where ERP is implemented, 3) to know and analyze the procedure/technique of implementing ERP, 4) to know and analyze the utilization of fund resulted from ERP, and 5) to know and analyze the formula of transportation policy related to ERP. This study focus on three traffic spots located around Senayan, Semanggi and the National Monument which pass Sudirman Street and Thamrin Street.

Legal Basis

Some regulations/legislations which become legal basis for executing and implementing a charged need management are; (1) Act No. 22 Year 2009 concerning Traffic and Road Transport, (2) Act No. 28 Year 2009 concerning Local Taxes and Local Retributions, (4) Government Regulation No. 32 Year 2011 concerning Management and Engineering, Impact Analysis as well as Traffic Need Management, (5) Government Regulation No. 55 Year 2012 concerning Vehicles.

Criteria for Traffic Need Management

The traffic limitation by charging private vehicles is one of the techniques in the Traffic Need Management. Based on the government regulation, the criteria for implementing Traffic Need Management can be described through: (1) comparison between the traffic volume of motor vehicles and the road capacity, (2) the availability of public transport network and services, and

(3) the quality of environment. Traffic Need Management is performed by limiting the traffic of personal vehicles in certain corridors or areas at certain time and on certain streets that includes: (a) passenger cars, (b) buses, and (c) freight cars with the maximum loading capacity of 3,500 (three thousand five hundred) kilograms.

The limitation of personal vehicle traffic is done if the street, area, or corridor meets the following criteria: (1) the ratio between the traffic volume of motor vehicles and the roada capacity on one of the street lanes is the same as or more than 0.7 (zero point seven), (2) only vehicles with average speed less than 30 km per hour can pass through in the peak hours, and (3) public transport network and services are available in the route which fulfills the minimum standard of services for the road, area, or corridor (Peraturan Pemerintah Republik Indonesia, 2011). In addition to fulfilling those criteria, the implementation of traffic limitation should also pay attention to the quality of environment. The limitation of personal vehicle traffic, as meant by Article 65 of the Government Regulation, can be done by limiting the vehicle traffic based on the number of passengers and the police number of the motor vehicles.

Traffic limitation cannot be implemented for national streets

The retribution for traffic control is a public service retribution. The resulted retribution for traffic control is used only for such activities as: (1) improvement of traffic performance, and (2) improvement of public transport services. Charging retribution for traffic control is done in accordance with the regulations/legislations, aiming that the local government; (1) limits on the main streets where the retribution will be applied, (2) provides the street where the limitation fulfilling minimum standard will be implemented, (3) installs, repairs, and maintains road equipment in certain areas, corridors, or streets which are directly related to the road users on streets and/or crossroads; and (4) provides the system and equipment necessary for implementing the limitation of personal vehicle and freight car traffic.

Paid Road System (Electronic Road Pricing/ERP)

Paid Road System or Electronic Road Pricing (ERP) is the implementation of electronic-based paid street applied on paid zone (Transport Department, 2017). Electronic Road Pricing is a policy that implements a paid road for every vehicle passing through it. ERP is aimed at reducing the jam on certain streets although in another street node it enhances another traffic jam (Bisnis Indonesia, 2010). The advantage of this system is that it makes easy payment process and enables the implementation of different tariffs in accordance with the condition of traffic jam and the types of vehicle.

The goal of Paid Road System is to regulate the traffic by implementing paid roads, and as a tax-based mechanism to get the government's property in the procurement of ERP system. Paid Road System with ERP1 or Dedicated Short Range Communication (DSRC) uses Gate and electronic equipment, digital communication, and cellular network. Paid Road System with ERP2 is a new generation of ERP, namely New Gen ERP or Vehicle Positioning System (VPS) taking the advantage of satellite and cellular network aids. Vehicles do not need to stop for accessing or being accessed by ERP equipment. ERP is also the implementation of a simple concept by using the cost of personal transportation for the road users and allocating the cost to the government in the form of local income (Santos, 2004).

Congestion pricing (charges for traffic jam) is one of economic instruments which aim to reduce the use of private vehicles. ERP is one of the terms for congestion pricing. With congestion pricing, private vehicle users will be charged if they pass through an area or corridor which is jammed in a certain period of time. The users of private vehicles finally should determine whether they will continue their trip through the area or corridor by paying an amount of money, find another route, find another destination, change the time while having a trip, cancel their trip, or move to another mode of transport permitted to pass through the area or corridor (Susantono, 2010). ERP as a traffic retribution for private vehicles can reduce the number of private vehicles which pass through certain streets with the density of their vehicles in a certain period of time or in the rush hours (Karyono, 2016).

METHOD

The research method used here is a mixed analysis method consisting of qualitative method and quantitative method. Primary data were collected through field observation on areas to be affected by ERP covering Sudirman Street and Thamrin Street. In addition, in depth interviewed was conducted from six agencies directly associated with the implementation of ERP. The agencies are Jakarta Transportation Council, Jakarta Transportation Service, Institute for Transportation and Development Policy, State Traffic Police, the Government of Jakarta Province, and City Planning Service.

The sample size used was only focused on total number of passenger cars passing Sudirman street towards the National Monument, cars passing Semanggi-Senayan street, cars passing Senayan-Semanggi street and cars passing Sudirman-Thamrin street. Field observation involved eight surveyors using Traffic Count device (TC). Counting time was divided into rush hours and non-rush hours in three parts of time, at (1) 10:00-11:40 AM, (2) 1:00 PM-2:40 PM and (3) 4:00 PM-7:30 PM, while conducting the observation on three zones: Senayan zone, Semanggi zone and the National Monument zone. The data will be collected by eight

surveyors at each two minute distance on the same day. The number of passenger cars through fast lanes and slow lanes in the three zones is summed and calculated by estimating what percentage of Vehicle to Capacity ratio (V/C) is, average number of passenger cars every 60 minutes at rush hour and non-rush hours.

The research indicators in this study are: (1) Types of regulation,(2) Relationship among regulations, (3) Harmonization of regulations, (4) Streets and crossroads, (5) Traffic, among others V/C ratio, (6) Government Regulation and Prohibition, (7) Traffic control system, (8) The technology used, (9) Investment, (10) Classification of vehicles that must pay, (11) Tariff establishment, (12) Fund utilization, and (13) Supporting policies. The methods of collecting data implemented here uses: (1) Library studies, (2) Collecting primary data through field observation in some road zones where the Paid Road System will be implemented, (3) Interview with officials from the institutions/organizations related to ERP implementation plan, and (4) Websites both domestic and overseas related to ERP implementation. Data analysis is carried out to get the description of ERP implementation based on the collected data during the research. The collected data comes from the stakeholders related to ERP implementation. Subsequently, the data related to the regulation and legislations concerning ERP implementation is collected as well.

ANALYSIS AND RESULTS

Procedure of Paid Road System/Electronic Road Pricing 1

Dedicated Short Range Communication has procedures as follows: (1) The sensor on the gate equipment (Gantry) or tower will send a signal out to OBU (On Board Unit) equipment or IVU (In Vehicle Unit) attached on the vehicle. The signal is received by OBU/IVU, (2) The vehicle enter the paid zone. After that, OBU/IVU starts to calculate the cost that should be paid, (3) OBU/IVU finishes the calculation when the vehicle leaves the paid zone, and (4) OBU/IVU reduces the amount of money deposit in the card (such as e-Money, Flazz, etc.). Subsequently, OBU/IVU sends the transaction to Central Computer System via cellular communication network. The local government of Jakarta makes a trial using gate (gantry) and OBU (On Board Unit) or IVU (In Vehicle Unit) equipment, like what has been installed on the vehicle in front of Farmer Statue in Menteng in the center of Jakarta city, Indonesia.

The Use of Next Gen ERP/ ERP2/ Vehicle Positioning System (VPS) Equipment

The Next Gen ERP/ERP2/Vehicle Positioning System (VPS) as ERP 2 uses a satellite with the following procedures: (1) OBU/IVU receives signal from satellite which accurately indicates the vehicle location, (2) When the vehicle enters the paid zone, OBU/IVU records the zone, time,

and category of vehicle, (3) When the vehicle leaves the zone, OBU/IVU starts to calculate the tariff, 94) OBU/IVU reduces the balance of money in the smart card, and subsequently sends the transaction to central computer system via cellular network, (5) the camera for Regulation Reinforcement installed on the road side takes the vehicle image, and the system will delete the image when the transaction is found successful, and (6) the picture of trespassers (those with incomplete transaction) is sent to the system in the data center.

Comparison of ERP Implementations in Some Countries

ERP can also be used as a part of sustainable and integrated transportation policies. It acts to suppress the demand while the other components of the policy determines the use of balanced land and improves the supply of infrastructure and public transport services. The role of ERP is to support such an initiative by freeing up the valuable space of road and thus reducing the need for road.

ERP level in Singapore is reviewed three-monthly. Changes are triggered by the speed of traffic prevailing along the street in RZ (retribution zone and freeway in every 30 minutes of interval. ERP level will be adjusted if the prevailing speed is out of the optimal range of 20 to 30 km per hour and 45 to 65 km per hour in RZ and toll way respectively. If the average speed prevailing in the part of toll way or selected road in RZ is under 45 km per hour or 20 km per hour, the ERP level will be raised. Likewise, when the speed is respectively more than 65 km per hour or 30 km per hour, the ERP level will decline. The speed for this level adjustment will be announced and such an ERP level adjustment has benefited the consumers. The point is that the driver's behaviour determines the ERP level (Transport Department, 2017).

A feasibility study in Hong Kong on ERP has ever been done with two choices, namely Dedicated Short-Range Communications (DSRC) System dan Vehicle Positioning System (VPS), selected for field evaluation. DSRC system is based on information exchange between the road-side reading and in vehicle unit (IVU) by using a low-power micro wave communication. This is similar to the operation of auto-toll system available in various toll facilities in Hong Kong (Transport Department, 2017)**.**

ERP in the UK has benefits for the British government, i.e.: (1) ERP effectively increases British government's income, since the demand for road trip is relatively inelastic, especially at rush hours in the afternoon, and (2) ERP can enhance the efficiency and social driving power for their externalities. Whereas the weaknesses of ERP in the UK are: (1) it disrupts the freedom of using public roads, (2) there may be a perception that ERP will increase the government's income and (3) it enhances the inequality in the UK which will give worse impact to other than those passing through ERP area (UK & Pettinger, 2007).

In Stockholm, Sweden, all the entrances and exits of such areas have unmanned control points. Payment is made in various ways in 14 days after the vehicle pass through a control point and the driver can not pay directly at that point. Single Gantry is implemented in 42 payment points in Gothenburg, and 560,000 vehicles pay the retribution everyday (in Stockholm there are around 350,000 vehicles everyday) (Transport Department, 2017).

Milan in Italy, like other cities in Europe such as London, Stockholm, and in Asia like Singapore, are the cities which implement ERP to improve the quality of air. More than half of people in Milan, the second biggest city in Italy after Rome, use private cars and motorcycles, contributing air pollution (Bertacche, 2008).

Public Consultation

The need for ERP depends on the public acceptance of the projected speed of vehicle and its effectiveness in reducing traffic jams compared with the other alternative efforts. Based on the research findings, the act of drastic restraint is not justifiable due to the reasons of traffic management before 2006. It is impossible to implement ERP without a public consensus on the objectives and principles of the proposal. There may be public resistance against ERP because of the reluctance to accept new initiatives and road users' anger with the new imposition of charges. A planned and tested program of public consultation to show how ERP works and to enable public suggestions for system objective development can enhance the awareness of ERP system as the measurement for alleviating traffic jams and building public understanding of its possibility for identification.

It is suggested that public consultation program starts to enhance public understanding of traffic jam problem and to encourage public discussion on the possibility of using restraints and alternative solutions, including ERP. People should be consulted specifically with the acceptable vehicle speed. Seeing the comparison of ERP implementation in some countries, for implementing ERP local government needs to anticipate several things that people will do: (1) Finding alternative routes to avoid the charge, (2) Using alternative transportation modes, (3) Changing the travel time to obtain lower charge or travelling at free period of time, (4) Travelling with friends or family members and make a joint payment, (5) Traveling to the park and ride facilities and continuing their travel using public transport, (6) Eliminating, postponing, or combining the ways of travelling, and (7) Paying the bill for travel as planned.

Based on the research, the driver's choice indicates that the transport users want routine changes. The most frequent response is that people change their time of driving or move to public transport. The survey in Hong Kong indicates that the gas emission in the paid area decreases up to 4%. The reduction of carbon monoxide is 4%, nitric oxide 2%, and solid

particles in the respiration is 0.4%. A study on voice pollution shows that the ERP scheme in the paid area indicates the decrease of noise.

ERP Implementation in Jakarta

The preparatory time or lead time for ERP implementation in Jakarta is predicted to take several years, for example six years like in Singapore (three years for tender and the other three years for installation). The preparatory time (lead time) like in Hong Kong needs five years to use DSRC which is more comprehensive in its implementation. The time for preparing the implementation is five years, one year for prequalification, demonstration and tender; 2.5 years for system design, construction of gantries, acceptance test, manufacturing and installation of in-vehicle units (manufacturing and installation of OBU or On Board Unit here is called IVU or In Vehicle Unit), 1.5 years for socialization to public and legislation process in the Provincial People's Representative Assembly. If it uses VPS by satellite, then the preparatory time (lead time) will be longer. This is what is called ERP2 or Next Gen ERP. The time will be longer since the product is not available in the market, and the time for IVU/OBU installation will be much longer. It is predicted to take six years of preparatory time (lead time) to implement ERP2 (VPS system). Here, one and half year is for socialzation to people and for legislation process.

The regulation shows: (1) which are the paid zones, this is determined after the camera on the gantry has detected the vehicles entering the paid zones (DSRC, Dedicated Short Range Communication), (2) the satellite detects the vehicles entering the paid zones (VPS), (3) what are the paid periods of time, data concerning period of time is determined by the database and can be exhibited on IVU/OBU, and (4) the billing based on the type of vehicle, which needs: (a) a camera which monitors and determines the type of vehicle entering the paid zone (DSRC), and (b) a satellite which monitors and determines the type of vehicle entering the paid zone (VPS).

All of them are then saved in In-Vehicle Units or On Board Units. If the IVU or OBU determines that a vehicle has entered the paid zone, then it will reduce the balance of its smart card which subsequently make a communication with the road-side equipment, and then with the server computer through a cellular network. If the smart card is successfully charged, then it does not need to record the vehicle identity or location, meaning that it protects the road user's privacy. Based on that description, to implement ERP in Jakarta, Single Gantry is the appropriate solution regarding some factors: road aesthetics, easiness of installation, costs (including operational cost). The necessary equipment to be installed on the Single Gantry are: (1) ANPR camera: to detect the vehicle's police number and to take the picture of violations, (2)

Laser Scanner; used to classify the vehicle, (3) DSRC Antenna; used to read OBU data, and (4) Lane Controller; used for supervision, verification, and data processing.

Establishment of Government Regulation for the Zone where ERP is Implemented

The international standard for ERP implementation in Jakarta is that it uses some regulations such as EN 13372 Road Transport and Traffic Telematics (RTTT): DSRC – Profiles for RTTT applications, and EN 15509 Road Transport and Traffic Telematics (RTTT): Electronic Fee Collection – Interoperability application profile for DSRC. Whereas the legal basis among others are: ERP in Act No. 22 Year 2009 concerning Traffic and Road Transportation, Opportunity for ERP in Act of PDRD No. 28 Year 2009, General Service Retribution or Retribution for the services provided by Local Government for the sake of public interest and benefit as well as can be enjoyed by personal individual or entity; (Article 1 General Requirements), and the Jakarta Provincial Government Regulation No. 25 Year 2017 concerning Traffic Control by Limiting the Number of Motor Vehicles through an Electronic Paid Road System. (DKI, 2016)

Some criteria for street, corridor or road traffic control area that limit motor vehicles through an electronic paid road system are as follows: (1) it must have two directions where each of them has lanes, (2) mass public transport network and services are available in the routes in accordance with the prevailing minimum standard of service and legislations, (3) it has a comparison between the traffic volume of motor vehicles and the road capacity in one of the directions equal or more than 0.9 in the peak hours, (4) it can only be passed through by the motor vehicles with average speed in the peak hours equals or less than 10 km/hour. Article 7 of the Jakarta Provincial Government Regulation mentions the streets, corridor or area that the electronic paid road system can be implemented, such as Sisingamangaraja street; Sudirman street; Husni Thamrin street; Medan Merdeka Barat street; Majapahit street; Gajah Mada street; Hayam Wuruk street; Gatot Subroto street; and Rasuna Said street. The motor vehicles permitted to pass through the street, corridor or area of elecronic paid road system are among others passenger cars, buses, freight catrs, public motor vehicle, official vehicles, ambulances or hearses and fire-extinguishing cars.

Prohibitions in ERP areas

Some prohibitions limiting the use of ERP include: Act No. 5 Year 1999 concerning the Prohibition of Monopoly and Unfair Business Competition, Article 8 paragraph 1) point c which regulates that the technology used in the ERP area uses DSRC at the frequency of 5.8 GHz. This prohibition causes the auction of ERP become discriminative and obstruct other businessmen with competitive technology from taking participation in the auction.

The Jakarta provincial government is suggested to provide, "Park and Ride" system, so that motorcycle riders can also move to public transportation in order to reduce the traffic jam. Motorcycle riders can park their motorcycle in a place and then continue their trip by taking public transportation. Motorcycles need a huge land for parking area. In the period of 2010-2014, the number of motorcycles increases. In 2010, the number is “only” 8.76 million units. In four years, it soars to become 13.08 million units. On average, it grows 10.54 percent per year.
Up to now, there has been data that shows the volume of motorcycles passing through the protocol streets. However, if 1 percent of motorcycles pass through a protocol street, then the government should provide a land at least 195 thousand meter square (the land needed for a motorcycle in a unit of parking lot is 1.5 meter square). It is better that the prohibition for motorcycles to pass through Sudirman street is implemented only in the hours of departure and office return, that is from 6 to 9 am and from 5 to 8 pm and it would be better to implement if ERP has been ready for implementation on cars.

Analysis on the use of fund resulted from ERP

Concerning the source of ERP fund, it can be obtained in some ways, such as: (1) It comes from Regional Revenue and Expenditure Budget, and (2) It comes from private sector through a BOT (Built Operation and Tansfer) scheme. The investment is made by private sectors, then they operate it. After reaching the Break Even Point and they get some profits, the system and equipment of ERP is handed over to the Proveince Government of DKI Jakarta. The use of ERP fund is in accordance with the use implemented in some countries, such as to support/build/develop new transportation initiatives and integrated transportation policies.

Trials

It is mentioned in the Act No. 22 Year 2009 concerning Traffic and Road Transport in Article 133 that traffic need management is necessary for improving the efficiency and effectiveness of space utilization and for controlling traffic movement. It is the limitation that can be implemented by charging retribution fee for traffic control. Electronic gate is only installed in front of Panin Bank building on Sudirman street. The trials are performed in stages for the three months. As many as 50 equipment of On-Board Unit or OBU are distributed randomly to car users working in the offices on Sudirman street. The police number of vehicle and OBU equipment are installed on 5-10 cars, and a sensoring ERP gate (gantry) is installed around the street to capture the signal from OBU. The identity of a car with OBU passing through the gate will be read by the gantry.

The tariff applied is dynamic. If there are still many vehicles passing through the ERP area, the tariff will be higher and continues to increase up to the standard speed of 35 km/hour. The traffic law enforcement is electronically based, that is on Electronic Law Enforcement (ELE) so that there is no need for ticketing at the OBU place. It uses one-face system not two-face system which is frequently used in transactions at the toll entrance and exit. It means, when a vehicle pass through ERP area, with the speed of 80 km/hour, it is automatically OBU will record directly. Morover, the camera used is the application camera which can identify the police number of cars.

The drivers whose car is not attached with OBU or their OBU balance runs out, the electronic gate of ERP can detect the police move and record the data. Then the data will be given by the officer of transportation service to the police who will send the speeding ticket to the address of vehicle to the address of vehicle owner. The owner should pay the fine to License Bureau Office. If he/she does not come to pay the fine, he/she will be charged at the time of vehicle tax payment. ERP will not only apply to the cars with Jakarta Raya police number; vehicles coming from outside Jakarta will face the same regulation.

When ERP is implemented, vehicle owners from outside Jakarta who everyday pass through the area of paid road should immediately install OBU not to be fined/ticketed. OBU equipment will be provided in the traffic units at the police office. All entrances to Jakarta city will be equipped with the places renting OBU like in Singapore. The system in trial now still finds difficulty in detecting the police number of the vehicle without OBU passing through ERP gate. The problem is that many cars have modified their police numbers. The result of trials recommends a system accomplishment.

Utilization of ERP Result for Jakarta

The ERP result for DKI Jakarta can be used to, among others: (1) Build road infrastructure, (2) Build IT facilities for road infrastructure, (3) Develop mass transport mode such as MRT and Busway, (4) Support the facilities of green transportation mode, (5) Build other facilities and infrastructures in DKI Jakarta, and (6) Build “Park and Ride” in Jakarta.

Result of Primary Data Collection and Processing concerning Paid Road Zone (ERP)

Based on the result of primary data processing, especially concerning the traffic and density on some protocol streets in Jakarta, such as on Sudirman street toward National Monument (Monas) at non-rush hours or low hours, it is found that the average of cars passing through is 3,562.5 per 60 minutes. After being recounted it is found that there are 5,000.8 units of passenger cars passing through per 60 minutes. After regarding some assumptions, the

calculation finds that Sudirman street toward Monas has V/C (Vehicle to Capacity) ratio as many as 20.34%.

On Semanggi-Senayan street, the average of cars passing through (at the combined low and peak hours) is 2,681.7 per 60 minutes. After re-counting, it is found that there are 3,805.0 units of passenger cars passing through per 60 minutes. After regarding some assumptions, the calculation finds that the V/C ratio on Semanggi-Senayan street at non-rush hours is 15.46%, whereas at rush hours the average number of cars passing through is 10,678 per 60 minutes, and its V/C ratio is 70.14% (very high) with 17,266.0 units of passenger cars per 60 minutes.

On Sudirman-Thamrin street, the average of cars passing through at non-rush hour is 2,937.3 per 60 minutes, V/C ratio 17.94% with 4,415 units of passenger cars per 60 minutes. Whereas on Senayan-Semanggi street, the average of cars passing through at non-rush hour is 3,288.0 and there are 4,717.8 units of passenger cars per 60 minutes, and V/C ratio 19.17%. At rush hours, there are 8,755.5 units of passenger cars per 60 minutes, and V/C ratio 35.57%.

CONCLUSION

Some criteria for roads, corridors or areas of road traffic control by limiting the number of motor vehicles through an electronic paid road system are, among others: (1) it must have two directions where each of them has two lanes; (2) mass transport network and services are available in the route in accordance with the minimum standard of service and legislations; (3) it has the comparison between the traffic volume of motor vehicle and the road capacity in one of the directions equal or more than 0.9 at peak hours; and (4) it can only be passed through by motor vehicles with average speed at peak hours equal or less than 10 km/hour. Senayan-Semanggi street, the average of cars passing through at rush hours, there are 8,755.5 units of passenger cars per 60 minutes, and V/C ratio 35.57%, while 11.875 passenger cars passing Sudirman-Thamrin street during low hours 10:00-11:40 AM, and it is estimated the average number of passenger cars is 2,997.3 units per 60 minutes.

The ERP implementation in Jakarta uses Single Gantry which is a right solution based on such factors as road aesthetics, easiness of installation, and costs (including operational cost). Paid Road System or Electronic Road Pricing is the implementation of electronic-based paid road in the paid zone. Paid Road System 1 or ERP1, namely Dedicated Short Range Communication uses Gate and electronic equipment, digital communication, and cellular network. Whereas Paid Road System 2 or ERP2, namely New Gen ERP and Vehicle Positioning System uses Gate and electronic equipment, digital communication, and cellular network and supported by satellite aids. Vehicles do not need to stop to be accessed by or to access ERP equipment.

The provincial government of Jakarta has well prepared the implementation of ERP2, including the Local Regulation, Trials, Planning, Funding, Determination of Paid Road Zone, Auction Process. ERP implementation needs to pay attention to all the related aspects, especially legal aspect. In formulating policies, the government should consider win-win solution, pro-poor and can enhance the added value of business sector. The source of fund for ERP may come from APBD or from private sector through a BOT (Built Operation and Transfer) scheme. The utilization of ERP fund has been in accordance with what has been implemented in several countries, such as to support/build/develop new initiatives concerning transportation and integrated policies on transportation.

Technically, ERP can be implemented in Jakarta (replacing 3 in 1 policy). Paid ERP will have not changed Jakarta to become a new Jakarta with no traffic jam if it is not accompanied with the implementation of other policies on transportation, namely which replace the use of private cars with the use of public vehicles (mass transportation). The responses from drivers toward ERP are such as using alternative transportation modes, travelling together with friends or family members and making joint payment.

The Indonesian government is currently still preparing ERP as a long-term strategy to unravel congestion in Jakarta. The system which is planned to take effect from 2019 will replace the restrictions on vehicles with even odd systems. Implementing an odd-even system is only a temporary policy and solution. Public transport services and ERP applications especially ERP2 are expected to overcome long-term congestion.

According to the research conducted, there are few research limitations that it does not discuss the investment cost analysis and the operation of ERP2 system, however, Sudirman-Thamrin Streets do need ERP2. This study only discusses how the feasibility of ERP2 can be implemented and implemented by the Jakarta City Government based on institutional and regulatory studies to be effective because currently only technical studies have been carried out. The proposed study has the potential to help Jakarta City Government to strengthen their policy in implementing the ERP program and should be explored in further work.

REFERENCES

Agarwal, S., & Koo, K. M. (2016). Impact of electronic road pricing (ERP) changes on transport modal choice. Regional Science and Urban Economics, 60, 1–11.

Arnold, J. (2013). Congested and Nowhere to Go: Congestion, Road Infrastructure, and Road Pricing in Metro Vancouver. BC Business Council Retrieved from http://www. bcbc. com/content/1027/RoadPricingPaper_FINAL. pdf. [Oct. 13, 2013].

Bertacche, M. (2008, January). Milan Introduces Congestion Charge to Cut Pollution. Bloomberg News. Retrieved from http://www.nysun.com/foreign/milan-introduces-congestion-charge-to-cut/68854/ [January 3, 2008]

Bharathy, C. M., Subramaniam, T. P., Deepakraj, G., & Swetha, S. (2016). Implementation of Electronic Road Pricing in India (ERP). Asian Journal for Convergence in Technology (Ajct)-Ugc Listed, 3.

Bisnis Indonesia. (2010). Application Implementation Center for ERP. Retrieved from http://bataviase.co.id/node/390480.[November 21, 2010]

DKI. Regarding Electronic Road Pricing (ERP) Traffic Control. (2016). Jakarta.

DKI Jakarta Provincial Statistics Agency. Jakarta Transportation in 2015 (2015). Jakarta.

Goh, M. (2002). Congestion management and electronic road pricing in Singapore. Journal of Transport Geography, 10(1), 29–38.

Karyono, A. B. (2016). Analysis of the Effectiveness of the Implementation of Electronic Road Princing System on Jalan Ir. H. Juanda, Bandung City. Perpustakaan Pusat Unikom (Digital Library)., Bandung.

Menon, G., & Guttikunda, S. (2010). Electronic road pricing: experience & lessons from Singapore (SIM-air Working Paper Series, 36, e2011.). Singapore.

Peraturan Pemerintah Republik Indonesia. Manajemen Dan Rekayasa, Analisis Dampak, Serta Manajemen Kebutuhan Lalu Lintas (2011). Jakarta: UU RI: Peraturan Pemerintah Republik Indonesia Nomor 32 pasal 60 tahun 2011.

Raharjo, H. A. (2012). The Alternative Solution for Traffic Problem in Jakarta–Indonesia. International Journal of Business and Management Studies, 1(2), 315–320.

Rasetyono, A. P. (2017). Science and Technology: Comprehensive Solution to Overcoming Traffic Congestion. Jakarta. Retrieved from https://www.ristekdikti.go.id/iptek-solusi-komprehensif-atasi-kemacetan-lalu-lintas/[July 23, 2007]

Rizal, M., Maulina, E., Purnomo, M., & Febrian, A. (2017). Electronic Road Pricing (ERP): A Systematic Mapping Study. In International Research Conference on Economic and Business (p. 13). Bandung: Proceedings International Research Conference on Economic and Business Facing Future Economic: Challenges and Perspectives.

Rizki, M., Karsaman, R. H., Santoso, I., & Frazila, R. B. (2016). Route Divert Behavior in Jakarta Electronic Road Pricing Policy Implementation. INTERNATIONAL JOURNAL OF TECHNOLOGY, 7(4), 571–580.

Santos, G. (2004). Road Pricing: Theory and Evidence (Volume 9-1). London: Elsevier Ltd (Copyright: © JAI Press).

Sugiarto, S., Miwa, T., Sato, H., & Morikawa, T. (2015). Use of latent variables representing psychological motivation to explore citizens' intentions with respect to congestion charging reform in Jakarta., 3(1), 46–67.

Susantono, B. (2010, November). Electronic Road Pricing (ERP) One Solution to Congestion Problems in the City of Jakarta. Retrieved from [November 21, 2010]

Talukdar, M., & Hassan, M. (2014). Prospect of Electronic Road Pricing in Hong kong. International Journal of Architecture and Urban Development, 4(2), 27–32.

Tjandra, L. O., Nugroho, S., & Utomo, D. (2016). Electronic road pricing system prototype. In Technology of Information and Communication (ISemantic). In International Seminar on Application for IEEE. (pp. 126–129). Semarang.

Transport Department. (2017). Feasibility Study on Electronic Road Pricing - Final Report. Hongkong. Retrieved from http://www.td.gov.hk/filemanager/en/content_524/erp_eng.pdf [March 21, 2017].

UK, A., & Pettinger, T. (2007). Economics Essays: Advantages of Electronic Road Pricing in the UK. [online] Econ.economicshelp.org. Available at: http://econ.economicshelp.org/2007/02/advantages-of-electronic-road-pricing.html [March 29, 2016].

Walker, J. (2011). The acceptability of road pricing. RAC Foundation. London.

Waze.com. (2016). Waze Index Reveals Where in The World are the Best and Worst Places to be a Driver. Retrieved from Ggogleweblight.com/?lite_url=http:/ [September15, 2016].

Yudhistira, M. H. (2015). On the Effects of the Electronic Road Pricing Plan in the Jakarta Metropolitan Area. [Doctoral dissertation, 政策研究大学院大学/National Graduate Institute for Policy Studies]. National Graduate Institute of Policy Studies.