Implementation Plan Of Multi Lane Free Flow (MLFF) System For Toll Road in Indonesia (Case Study of Dr.Ir.Sedyatmo Toll Road)

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Abstract: In 2019, a contactless Single Lane Free Flow (SLFF) system simulation was carried out with the Flo-based RFID (Radio Frequency Identification) tec
hnology on the Sedyatmo Toll Road, which will later be implemented the Multi Lane Free Flow (MLFF) system.

The Vissim simulation results of the maximum capacity of toll road with the automatic toll gate (ATG) + Flo system are 3188 - 3849 vehicles / hour, average speed is 16 km / hour. A density of 6.31 vehicles / km and the maximum capacity of the Full Flo system is 3543 - 4597 vehicles / hour, average speed of 22 km / h, a density of 6.31 vehicles / km. Responses from toll road users choosing contactless payment technology stickers are glazed by 96%.

Keywords: Toll road, Multi Lane Free Flow, Capacity.

1. INTRODUCTION

In 2017 the Minister of Public Works and Public Housing issued regulation Number 16 / PRT / M / 2017 concerning Non-cash Toll Transactions on Toll Roads, where in CHAPTER IV Article 6 point 1 states that the Implementation of Fully Non-Cash Toll Transactions on all toll roads as of October 31 2017. Point 2 states the implementation of transactions that fully use contactless-based technology as of December 31, 2018. In 2019 a simulation of the contactless Single Lane Free Flow (SLFF) system was carried out with the Flo-based RFID (Radio Frequency Identification) technology on the Sedyatmo Toll Road. SLFF is a non-stop payment system in every line of transactions, this SLFF system has been tested by several Toll Road Regulatory Agency such as Jasamarga and Marga Mandala Sakti which hopefully this system can be implemented by mid-2020.

This research focuses on the study of the application of the MLFF system at the Cengkareng toll gate, namely the Prof. Dr. Ir. Sedyatmo from Jakarta to Soekarno Hatta Airport and from Soekarno Hatta Airport to Jakarta toll road. Dr. Ir. Sedyatmo was the object of study because the toll gate had implemented the Single Lane Free Flow (SLFF) system. The Free Flow system itself is still new in application in Indonesia, this makes there are still many considerations in the application of this system. There are at least 3 aspects that become the object of study, namely the readiness of toll operators, the readiness of toll road users and the cost requirements for the tools used in the free flow system.

The purpose of this research is to study the theoretical capacity that occurs in the Multi Lane Free Flow system, to examine the responses of toll road users and Toll Road Business Entities when the free flow system is implemented during the transaction process on toll roads, Assessing the benefits of toll road users and the Agency. Toll road businesses in the use of the Multi Lane Free Flow system, Reviewing electronic toll collection technologies that are applied to the Multi Lane Free Flow system.

2. LITERATURE REVIEW

2.1 Minimum Service Standards (MSS) for Toll Roads

One of the aspects needed to ensure smooth, safe, comfortable and efficient toll road operation are related to the service system and operations carried out. Minimum Service Standards (MSS) are several parameters related to the physical condition of the toll road itself as well as the service process provided to users. This MSS can be considered as a level of performance (Level of performance), while from the user's point of view, this MSS can be considered a level of service.

Table 1 Toll Road Minimum Service Standards Related to Accessibility

No.	Substance	Minimum Service Standards			Information
		Indicator	Scope / Scope	Benchmark	
1	Travel Speed Average	Travel Speed Average Normal Condition	• Inner City Toll Road • Outer City Toll Road	• ≥ 40 km / hour • ≥ 60 km / hour	Fulfillment time every moment (under normal conditions
2	Accessibility	Transaction Speed Average	• Toll Gate system • open	Maximum of 6 seconds each Vehicle	Fulfillment time every moment
			• Closed system Toll Gates: • Entrance booth - Exit booth	Maximum of 5 seconds each Vehicle Maximum of 9 seconds each Vehicle	
			• ATG - Toll Gate Take a Card - Transaction Toll Gate	Maximum of 4 seconds each Vehicle Maximum 5 seconds per vehicle	Re-done electronic transaction instruments every 180 days and installation "help button" on the transaction tool
		Number of Queues Vehicle	• Toll Gate	A maximum of 10 vehicles per Substation in normal condition	All toll booths must be open except in the past conditions not solid cross

Source: Minister Public Works and Public Housing Decree no16 / PRT / M / 2014

2.2 Electronic Toll Collection System

Electronic Toll Collection (ETC) system which can shorten the transaction time at toll booths with the principle of E-Payment or Cashless Payment, namely electronic payments without using cash. Electronic Toll Collection (ETC) System has two types, semi-automatic and full automatic. For the Semi Automatic type, the vehicle still has to stop for a moment when entering the toll booth to carry out card scanning until the portal opens and the vehicle can continue its journey. Meanwhile, the Full Automatic type of vehicle does not need to stop when making transactions (Free Flow System). The transaction process is carried out wirelessly between the electronic unit installed in the On Board Unit (OBU) vehicle and the computer network located at the toll road. the use of a semi-automatic system requires a smart card to open toll gates,

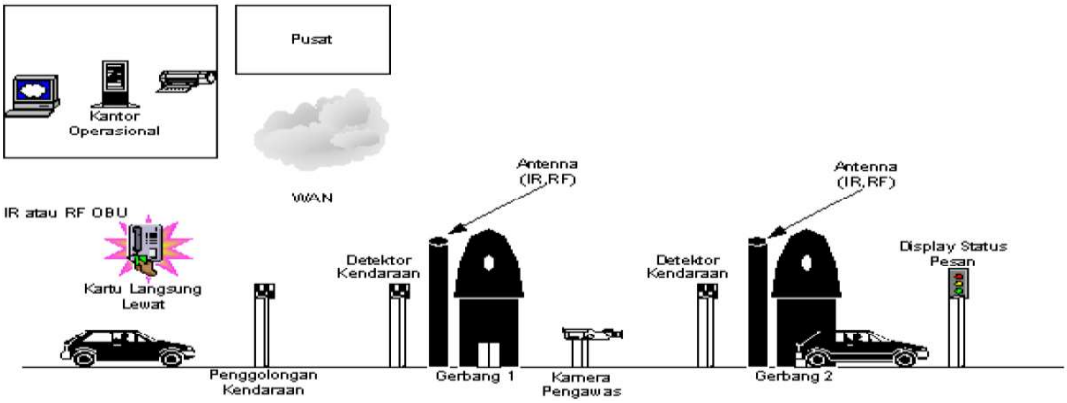

Figure 1 Illustration of an automatic Electronic Toll Collection

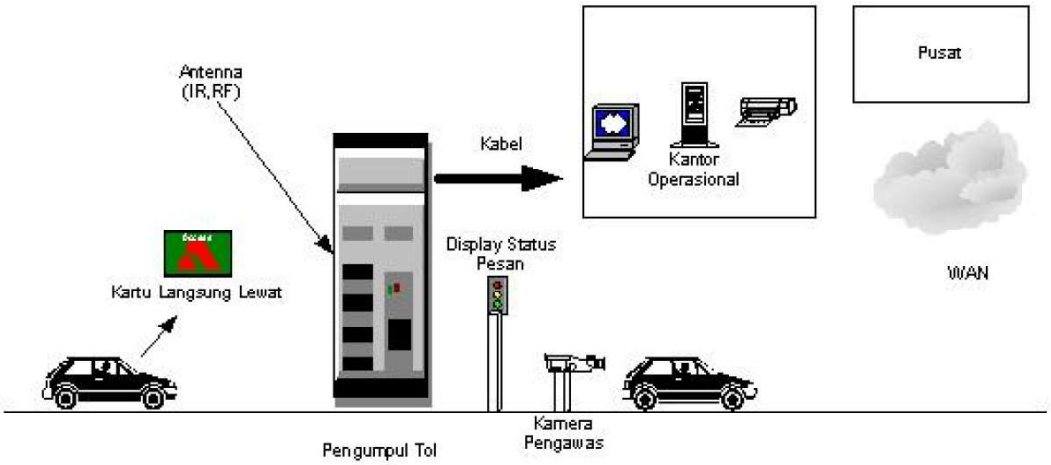

Figure 2 Illustration of Semi Automatic Electronic Toll Collection

Currently, the electronic toll collection schemes in various countries mostly use ETC-compatible technology such as the global navigation satellite system (GNSS), dedicated short range communications (DSRC), or mobile communication. however, in some cases, toll schemes using human assistance are still applied, depending on the legal system applied.

2.3 The Use of ETC in Some Countries

At first the electronic toll collection system was first introduced in 1997 in Norway, which was then implemented in the ring toll that borders the cities of Oslo, Bergen and Trondeim. In 1990 the toll payment system using a smart card (Smart Card) was introduced. The smart card uses infrared technology as a new technology used to collect toll rates in several countries, such as Japan, Korea and Malaysia. This electronic payment is introduced with additional discounts for frequent or intensive use of the card when transacting at toll gates. It was only around 2000 that the payment system could be applied to toll roads in each of these countries.

The European Commission directorate-general for mobility and transport conducts research on electronic toll collection systems in Europe. This study introduces the main principles in which toll schemes have been and are being implemented throughout Europe, with a focus on schemes that fall within the scope of EETS (Europen Electronic Toll System).

Table 2 Overview of long distance based toll system

Tolling Schemes	Technology used	Country
Free Flow	GNSS with ANPR, and / or DSRC	Hungary, Slovakia, Belgium
Free Flow	GNSS with Infrared and / or DSRC	Germany
Free Flow	DSRC	Austria, Belarus, Czech Republic, Poland, Portugal, Turkey, UK.
Free Flow	ANPR	UK
Free Flow	ANPR and DSRC OBU	Portugal
Free Flow	Tachograph	Liechtenstein, Switzerland
Free Flow	RFID	Turkey
Free Flow	DSRC	Bosnia and Herzegovina, Croatia, France, Greece, Ireland, Italy, Norway, Poland, Portugal, Serbia, Spain, UK

Source: European Commission Directorate-General For Mobility And Transport

Table 3 Remote based toll system for Heavy Vehicles

Case Study	Main characteristics
LKW Maut - Germany	• First GNSS-based tolling solution using a thick-client OBU; • The OBU is not mandatory and there is a manual booking alternative for occasional use; • The operating model is based on a public-private partnership model
"EMyto" – Slovakia	• GNSS-based scheme where the scheme rules have been amended to extend the network coverage; • Enforcement is not-based on a real-time interrogation of the OBU (it relies on a post-processed ANPR method).
Czech Republic	• Free-flow tolling scheme using DSRC
TIS-PL – France	• First country to introduce an Electronic Toll Service Provider into the value chain (in 2007) and reflects the nationwide interoperability between tolling concessionaires.
HU-GO – Hungary	• The newest GNSS-based free-flow tolling scheme in Europe. • The scheme enables HU-GO-certified telematics providers to offer tolling services to their customers using in-vehicle equipment that is not-dedicated to tolling.
HGS – Turkey	• Available for Heavy Vehicles and Light Vehicles • Large scale tolling solution based on RFID sticker • The enforcement relies on ANPR technology

Source: European Commission Directorate-General For Mobility And Transport

2.4 Electronic Toll Collection System in Indonesia

The toll collection system in Indonesia has increased from time to time, this is because more and more vehicle users prefer to use toll roads to achieve their goals so that the demand for improving toll road services is getting bigger. The implementation of electronic-based toll collection in Indonesia began in 2007 with the adoption of the e-Toll contactless smart card, which is used to pay entrance fees. This card uses the RFID system. E-Toll users only need to insert a card to pay tolls in 4 seconds, faster than paying cash which takes 7 seconds. Gradually, at the end of January 2009, the e-Toll Card was implemented on the Jakarta Inner Ring Toll Road, Prof. Toll Road. Dr. Sedyatmo, and Tangerang-Merak Toll Road. As a development of the e-Toll card, an e-Tollpass has also been launched so that toll payments can be made faster.

e-Tollpass is a new service in collaboration with Bank Mandiri with toll operators that allows transactions at toll booths without the need to stop and open vehicle windows. For this transaction, an on-board unit installed in the vehicle is required. The use of e-Tollpass, however, is limited to toll booths that have a special e-Tollpass sign.

In early 2009 several toll road management companies, namely Jasa Marga (Manager of toll roads within the city of Jakarta), Citra Marga Nurasaphala Persada (Manager of the Cawang-Tanjung Priok-Pluit toll road) and PT. Marga Mandalasakti (Manager of the Cikupa-Merak toll road) collaborated and appointed Bank Mandiri to manage the ETC system for the sections it operates.

The transaction process for the E-Toll Pass special substation is as follows:

1. Vehicles entering the special E-Toll Pass substation must travel at a speed of about 20 km / hour.
2. The antenna installed at the substation will communicate with the OBU installed in the vehicle for the authentication process.
3. If the data is authentic and meets the requirements. The system will record the relevant information (entrance / exit gate code, transaction time, vehicle class, tariff charged, remaining balance value, etc.)
4. The portal will open automatically and the vehicle can continue its journey.

2.5 Multi Lane Free Flow (MLFF)

Multi lane free flow (MLFF) is a system that enables high-speed free flow for all road users. With MLFF, the current toll roads on toll roads can be replaced with multilane roads. By using a marker with a reader in the gantry across the highway to detect vehicles and reduce use of the existing Electronic Toll Collection (ETC) when fully implemented. Using only video and automatic number plate recognition it is also possible to have an MLFF system without the use of markers and readers.

By implementing the MLFF system, traffic congestion on toll road sections can be reduced because this system allows high speed toll free flow. The costs of maintaining and operating this toll collection system are also much lower than the current system. With the implementation of MLFF, toll road operators at toll gates can be minimized. MLFF on the other hand will use a fee collection system at the end where the reduction in toll collection and user accounts will be handled by the toll road operator's office. This new concept means minimizing the use of toll gates that are no longer needed) thereby reducing construction and operating costs. As for users, they just need to get a sticker label and register with their vehicle.

2.6 Space Mean Speed

Speed is used as the main performance measure of the expressway segment, because it is easy to understand and measure, and is a necessary input to the cost of using the expressway in the economic analysis. Travel speed is defined as the space average speed of a light vehicle along a freeway segment:

$$V = L / TT \quad (1)$$

Where,

V = speed of light vehicle space (km / h)
L = Length of segment (km)
TT = The average travel time of light vehicles along the segment (hours)

To determine the average speed of a vehicle, you can use an average speed based on time (time mean speed) or an average speed based on space (space mean speed). Time mean speed is defined as the average speed of all passing vehicles at a point formed on a road section within a certain period of time. Meanwhile, the space mean speed is defined as the average speed of all vehicles on a road for a certain period of time.

1. Time Mean Speed (TMS)
   Average speed based on the individual speed of all vehicles on the road.

$$\boldsymbol{Ut} = \frac{L}{n}\left(\frac{1}{t1} + \frac{1}{t2} + \frac{1}{t3} \ldots\ldots\right) \quad (2)$$

2. Space Mean Speed (SMS)
   Average speed based on the travel time of vehicles crossing a road.

$$\boldsymbol{Us} = \frac{L}{\frac{1}{n}\sum ti} \quad (3)$$

Where,

L = Length of road strip (m)
N = Number of vehicle samples
ti = vehicle travel time

2.7 Micro Simulation Model Using Vissim Program

Vissim is included in the microscopic category software which has the advantage of being able to model various types of vehicles including motorbikes, cars and non-motorized vehicles. Vissim is Microscopic flow simulation software for modeling traffic (especially urban areas). It was developed by PTV (Planung Transport Verkehr AG) in Karlsruhe, Germany in 1992. The name comes from "Verkehr Städten - SIMulationsmodell" (German for "traffic in the city - simulation model").

Vissim transportation modeling software was developed to be able to model urban traffic and public transportation which is composed of 2 main facilities, namely, a traffic simulator (vehicle movement) and a signal state generator (traffic lights). The main capability and facility of the Vissim software is the facility of complex modeling of junction behavior, which can be described as what happens in reality. Other advantages include multimodal facility features, flexibility in network coding, and 3D animation output.

3. RESEARCH METHODOLOGY

The methodology to be carried out in this study in outline consists of several stages, including the Preparation Stage, the Data Collection Stage, the Data Processing Stage, the Simulation Stage, Analysis and Discussion, the Completion Stage (Conclusion and Reccomendation). The preparation stage is compiled a study framework for all activities in the preparation of this research. These activities include preparing and studying the background, objectives and methodology of the research.

Data collection at this stage is divided into two, namely primary data collection and secondary data collection. Primary data collection is obtained from direct surveys in the field, namely by conducting interviews or distributing questionnaires to toll road users and calculating vehicle travel time when entering toll booths, while secondary data collection requires a price list for operation and maintenance of contactless substations from the toll operator. .Primary data collected is the response of toll road users by means of questionnaires, responses of toll

road business entities by means of interviews, technology applied at toll gates by interviewing toll road business entities, traffic flow and vehicle speed by means of field surveys for 2 hours on a day work and holidays. The secondary data collected is a picture of the research location and the benefits obtained by toll road users and business entities by collecting a list of the unit price of investment, operation and maintenance at toll gates.

The stage when modeling with vissim software is to create an existing road and then input the speed distribution which consists of several variations of speed. After inputting the speed of the vehicle, it determines the driver's habits such as the distance when overtaking, the position when overtaking and the distance between vehicles. Then input the type of vehicle to be modeled such as a sedan, truck or bus vehicle.

The next process is input demand, which at the time of input demand is carried out in stages, starting with 1000 vehicles. After the input it will be seen the maximum current obtained during the vissim analysis at a certain time period. If the flow has not reached the maximum in a certain period, then additional input demand is carried out in a multiple of 1000 vehicles until it reaches the maximum flow.

4. DATA AND ANALYSIS

4.1. The Survey Location

The survey location was carried out in 2 places, namely the Kapuk toll gate and the Cengkareng toll gate as shown in the following figure.

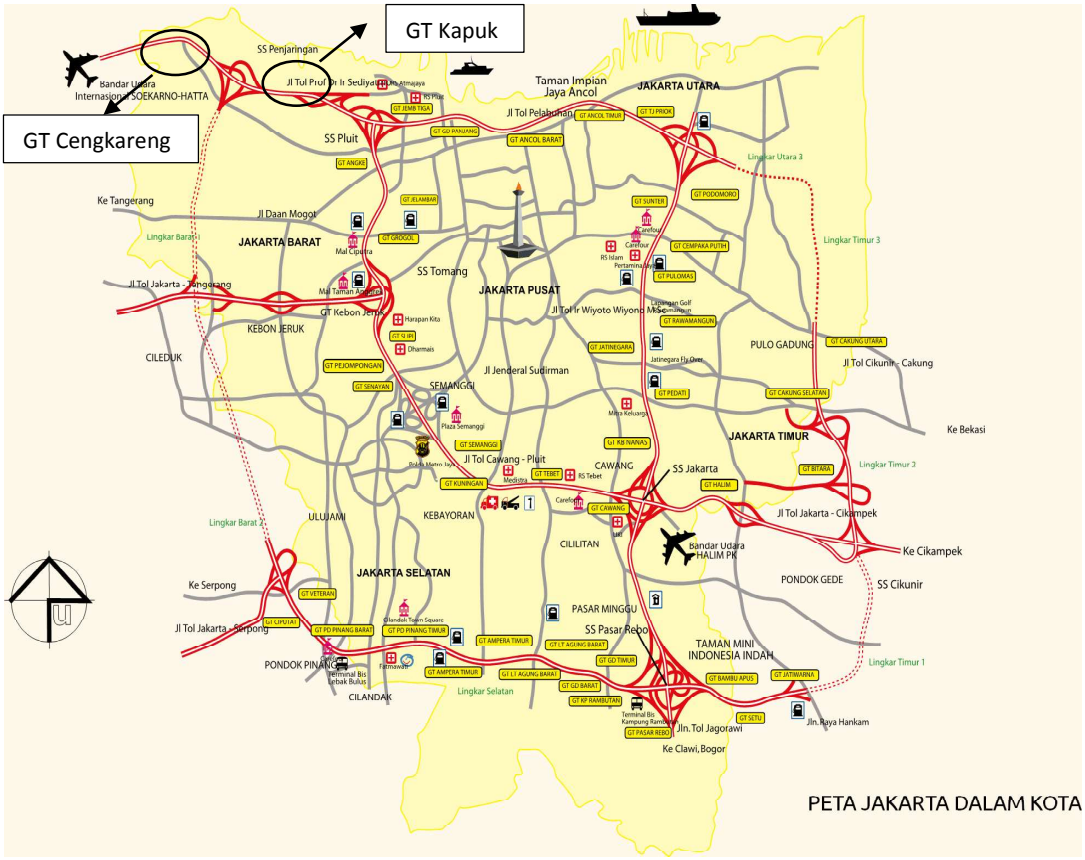

Figure 3 Toll Network Map

4.2 Capacity Analysis Based on Vissim Simulation

In calculating the substation capacity with Vissim simulation, two existing models are made, namely the ATG + Flo model and the Full Flo model (MLFF). The ATG + Flo model is a type of toll gate that still uses two types of payment technology, namely by tapping and contactless (SLFF), while the Full Flo model is all types of toll gates using contactless technology as a payment system or can be called Multi Lane Free Flow (MLFF). In this model the ATG + Flo is made based on actual conditions, namely the length, width, and placement of substations using the ATG system and substations using the Flo (Contactless) system. The next model is the Full Flo (MLFF) model which is made based on the same existing conditions but the system at all substations uses the flo system. for more details, see the existing image below.

Table 4. Vissim Simulation Results

No.	Toll gates	Gate Type	Maximum Vehicle Capacity (Vehicle / hour)	Average Speed (Km / h)	Average Density (Kend / Km)
1	Kapuk	ATG + Flo	3849	16	6.31
		Full Flo	4597	22	6.31
2	Cengkareng	ATG + Flo	3188	16	4.44
		Full Flo	3543	24	4.42

From the simulation results at the two toll gates, namely the Kapuk toll gate and the Cengkareng toll gate, it can be seen that the maximum capacity of the Full Flo gate type (MLFF) is greater than (ATG + Flo). In the MLFF system, the transaction time at toll booths by reducing the speed is better than the ATG system. The absence of queues when making transactions means that the vehicle speed in the MLFF system is faster than the vehicle speed in the ATG system. When a vehicle enters a toll booth to make a transaction on the flo system, the vehicle reduces its speed by about 15-20 km / hour so that at the time of transaction the time required is equal to 0 seconds.

During the simulation at the two toll gates, when determining the maximum capacity, there will be a buildup of vehicles at the end of the toll gate. change in vehicle lanes from more than 10 lanes at the toll plaza to 2 lanes at the end of the toll gate. The buildup of existing vehicles does not only occur at toll booths with the ATG system but also toll booths with the Flo system. Based on previous research, the vehicle capacity at the Cengkareng toll gate is 1673 vehicles / hour, the difference in the number of vehicles occurs because the number of substations during the simulation is different, in this study the number of substations is more. Differences also occur in variations in speed and variations of vehicles crossing toll gates, in this research there are more variations in speed and more vehicles.

4.3 Response Of Toll Road User

The study of the application of the multi lane free flow system in terms of toll road users and Toll Road Business Entities. In this study, the responses of toll road users were carried out at the Kapuk Toll Gate and the Cengkareng Toll Gate. When collecting toll road user response data, the main target of respondents is users who frequently use the Dr. Ir. Sedyatmo toll road, especially users of the Kapuk Toll Gate and the Cengkareng Toll Gate. From the results of the research conducted, it was obtained a sample of respondents applying the Multi Lane Free Flow System as many as 110 people in which 85 respondents were from the Kapuk Toll Gate and 25 respondents from the Cengkareng Toll Gate.

The majority of people's cellphones are now sophisticated and can support toll payment applications in them so that this can save on toll road payment costs. The OBU and the stickers on the headlamp both use a contactless system but the difference is in the sensor system that works. The sensor system at the OBU itself uses DSRC (Dedicated short-range communications) while the sensor on the sticker on the headlamp uses RFID (Radio Frequency Identification). According to previous research, toll road users prefer payment technology using OBU compared to E-Toll, which is 98%. choose an easier payment technology.

4.4 Response of the Toll Road Regulatory Agency and Toll Road Business Entities

The history of free flow technology in Indonesia itself, the initial idea was when we saw the problems that occurred on the toll road at the gate, namely when the transaction process was carried out there were delays caused by queues of vehicles. Then look at the development of the ITS (Intelligent Transportations System) plan where the fastest development at this time is the development of ETC (Electronic Toll Collection) because other developments require other agencies. Initially, the technology applied to toll gates was tap and go where the vehicle made transactions with a card and then the barrier at the toll gate would open. Now the application of technology at toll gates is more advanced using a contactless system, where the vehicle no longer has to paste the card but the toll gate already has sensors to detect vehicles entering the toll booth then the barrier will open itself. The sensors that are being applied now use DSRC and RFID. DSRC is used on vehicles that have an OBU (On Board Unit) while RFID is used in vehicles that have Sticker flow, for the application of RFID itself is still very limited.

The initial implementation of free flow itself was in March 2013, namely creating two dedicated lines through a hybrid system with DSRC technology, namely the use of OBU. For the initial use, we see the implementation carried out in Malaysia where they have successfully implemented a multi lane free flow system with a barrier. For now we are conducting trials at more than 100 points in Jakarta regarding the application of a flow system using two sensors, namely DSRC and RFID, for the application of commercial RFID which is applied to the Bali toll road. In the application of the free flow system at this time still uses two technologies, namely DSRC and RFID, for the difference itself is the reading of the payment system. In DSRC, the toll payment system reads using the OBU (On Board Unit). This OBU is attached with a card in it then when the vehicle will cross the toll gate, the sensor on the toll gate will read the OBU in the vehicle. In RFID, the reading of the toll payment system uses a flo sticker attached to the headlights of the vehicle. For the transaction process itself, RFID is connected to the Flo application on a smartphone.

The use of operating and maintenance costs from DSRC and RFID technology itself is basically not much different, from the BUJT itself, it looks more from the ability of the community itself to choose technology that is more effective and efficient as toll road users. For the price from the OBU itself, the market now ranges from 300 to 500 thousand and for the

flo sticker itself, it is now around 30-50 thousand. But in its own use, OBU has a lifespan of 7 years, so after 7 years it has to be recalibrated while flo stickers have a life of 2 years then have to buy a new sticker. For the application of ETC technology now, especially the application of free flow, we are still adhering to the Minister of Public Works and Public Housing issued regulation Number 16 / PRT / M / 2017 but from Toll Road Regulatory Agency itself there are plans to make new regulations related to this matter. In the substance of the proposed regulation itself, we still use the substance of the old regulation, but there are several additions related to the parties involved in this regulation. The enforcement referred to here is the scenario of people who cannot pay or lack of balance in transaction time at toll gates.

4.5 Analysis of Profits obtained by Toll Road Business Entities.

The analysis is carried out by looking at the comparison of the construction, operation and maintenance period at the automatic toll gate (ATG), NIrouches Substation.

- Initial Development Costs
  At present, on the Sedyatmo toll road, several electronic toll collection systems are implemented, namely the automatic toll gate (ATG) and the non-touch gate (Free Flow).
- Operating costs
  The operational and maintenance costs carried out by toll road operators have very important aspects in seeing the benefits that will be obtained, in analyzing the Toll Road Regulatory Agency profits with the data obtained, it can be seen which toll gate systems have expensive operational and maintenance costs.
- Periodic Fees
  The periodic maintenance costs incurred by the Toll Road Business Entities are the periodic maintenance costs for substation equipment 3 and 5 years later, the periodic maintenance costs for the equipment for the 8 years period. For the comparison of the periodic costs of the Automatic Toll Gate (ATG) and the Non-Touch Substation, the costs are quite significant.

Table 5. ATG Single, Multi and Contactless ATG comparison

No.	Advantage Aspects	ATG Single	ATG Multi	Contactless
1	Initial Investment Costs	IDR 370,920,000	IDR 444,400,000	IDR 305,250,000
2	Operating costs	IDR 230,457,000	IDR 365,997,000	IDR 220,457,000
3	Periodic Fees	IDR 163,700,000	IDR 207,430,000	IDR 591,500,000

4.6 Profit Analysis for Toll Road Users

Toll road users also have their own advantages from implementing the ATG system and the contactless system. The benefits of toll road users can be seen from the time lost when toll road users make transactions at toll booths. Lost time value is a cost that should not be incurred by vehicles or toll road users. The value of the time lost of toll road users referred to here is the value in the analysis year which is then multiplied by the difference in the time of the transaction between the ATG substation and the Nirsouch substation.

Table 6. Calculation Results of Vehicle Lost Time Value Saving

No.	Type of Substation	Time value (Transaction Time)	Time saving	Time value (vehicle / day)	Time value (vehicle / month)	Time value (Kend / year)
		(seconds)	(seconds)	(Rp)	(Rp)	(Rp)
1	GTO	3.0	0	0	0	0
2	Contactless	0	3	68.72	1511.95	18,143,40

From the results of the analysis carried out, toll road users benefit from the implementation of a contactless system at toll booths. this time value savings occurs when compared to the ATG system. Henceforth, a comparison of the cost of the equipment that will be used by toll road users is then carried out during the transaction process. The comparisons made are as follows.

Table 7. Comparison of Lost Time Value and Equipment Cost

No.	Description	Type of Substation	
		ATG	Contactless
1	Average value of lost time (IDR / vehicle / year)	0	3
2	Transaction tools used	E-Toll	RFID stickers
3	Investment costs of additional Transaction tools used	-	IDR 25,000

It can be seen from Table 7 that if toll road users want to use a contactless system, they must pay an investment cost of Rp 25,000 in equipment. This price is much cheaper when compared to other contactless investment equipment such as OBU which reaches IDR 300,000 - IDR 500,000. If we compare the investment in contactless equipment with the time value lost per year, it will be comparable.

5 CONCLUSIONS AND RECOMMENDATION

5.1 Conclusion

From the results of the analysis carried out, the following conclusions were obtained:

1. The vissim simulation results obtained the maximum capacity. The maximum capacity at the toll gate for the ATG + Flo system is 3188 - 3849 vehicles / hour, and the maximum capacity for the Full Flo system is 3543 - 4597 vehicles / hour.
2. The response from toll road users regarding the selection of contactless tools 96% chose stickers on the front glass while 4% chose OBU, this is because OBU tools themselves are more expensive than stickers.
3. Based on interviews with Toll Road Business Entities, the application of the Multi lane free flow system is an advanced system from the ATG.
4. Benefits for Toll Road Business Entities, especially in initial investment and operational costs. In the initial investment, Toll Road Business Entities no longer needs to build an existing toll plaza, saving toll gate construction costs. Operational costs are cheaper because roll paper as proof of transaction is no longer needed because it is replaced by digital proof of transaction.

5. Multi lane free flow system at toll gates can provide time value savings for toll road users compared to ATG. The savings in the value of lost time are Rp. 68.72 / day, IDR 1511.95 / month and IDR18,143.40 / year.
6. According to the Toll Road Business Entity, the technology being studied in the current multi lane free flow is RFID and GNSS technology.

5.2 Recommendation

After carrying out this research process, the advice that can be given is that in further research it is better to examine the impact of advantages and disadvantages to the surrounding environment caused by the application of RFID, DCRC, GNSS technology and so on at toll gates, because during the survey, radiation from the technology contained in the survey was carried out. toll gates render the drone inoperable.

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