The Productivity Analysis of Traffic Accident Handling Using Blocher Productivity Theory On Tangerang – Merak Toll Road, Indonesia

(Case study at PT Marga Mandalasakti)

Pahrul Roji[1)], Hernadewita[2)]

[1]Universitas Mercu Buana, Indonesia. pahrulroji@gmail.com

[2]Universitas Mercu Buana, Indonesia. hadeita@yahoo.com

Abstract

Tangerang – Merak toll road is managed by PT Marga Mandalasakti (PT MMS) which has total length of 72.45 km and spreads along West Tangerang to Merak Port Gate. The volume of traffic on 2015 was 135.000 vehicles per day with 660 cases of accident. Accident Handling Time (AHT) was ruled by government regulation that should be fulfilled by less than 65 minutes and measured by respond time and handling time combined. By the year of 2015, the average AHT on Tangerang – Merak Toll Road was 68.3 minutes/accident handling. The data shows that there is a time gap 3.3 minutes longer than minimum standard regulation of AHT and made low productivity index. The Productivity Mathematics model for handling time was described as the speed of handling divided by number of officers, then the best way to increase the productivity is by accelerating accident handling process by factors that affect AHT. The factors which affect AHT is accident time, location, weather, type of accident, final position of vehicle and number of victims.

Keywords: *Productivity, Toll Road, Accident, Respond Time, Handling Time*

PRELIMINARY

Tangerang – Merak toll road is located on Banten province as the west end part from Trans Java road network which connects Java Island and Sumatra Island through Merak Port. Moreover, the toll road is the important part of Banten Province economic activities where many industrial area grows significantly then the toll existence is supporting supply chain system of industries on Banten Province. It can be shown by traffic growth on last 5 years with the average of 7.2% annually with daily traffic on 2015 finally reached 135.000 vehicles. In order to escalate the service to customer, PT MMS keeps maintaining, developing, and extending the area of main lane so the number of traffic volume compared to road capacity (V/C) could be hold below than 80% which means the road condition is relatively conducive that other connected toll road.

Some research has been conducted by Satriotomo (2011) about Semarang City toll road services effectiveness and by Kirom (2010) about performance and effectiveness of Jakarta – Cikampek toll road which was considered hasn't fulfilled some services attribute based on government regulation that is written on ministry public work and settlement decree no 16 on 2014 about minimum toll road services standard especially on traffic services such as respond time, handling time that road officers do when facing the accident. The standard of respond time is maximum at 30 minutes while maximum handling time for victims and the vehicle is 20 and 15 minutes then the total time of accident handling is 65 minutes.

Assuming that time unit that is needed by accident handling services team is not fixed and depended on certain location and type of vehicles, so the total time that the team needs to handle every accident case on service system is cumulative time (respond time + victim handling time + vehicle handling time). This condition is in line with information that has been explained on that ministry decree which was formulated by National Toll Road Regulator. Therefore, the longest time will be affected by accident scene, the final of vehicle position and type of vehicle itself The condition will automatically applied equally since the accident itself is unpredicted. The accident handling is considered finished and over when victims (if there is any) has been evacuated to the hospital and the crashed vehicles don't block the main lane or transaction lane on toll gate.

Tangerang-Merak toll road is important conector of Java and Sumatera island and it is connected with other toll road as mentioned before like Jakarta – Tangerang toll road, Jakarta – Cikampek toll road, also Jagorawi toll road etc. Although the accident rate trends on those toll road was decreased from year to year, but if it is examined from the level and type of accident, Tangerang – Merak toll road accident on 2015 has higher number than the others as the table listed below

PT MMS as the operator, recorded that number of accident on 2015 was about 660 cases with the average of accident handling time of 68.3 minutes (PT MMS, 2015), this shows that the accident handling time was still above from the minimum services standard that requires below than 65 minutes.

Productivity number of accident handling was seen by speed of accident handling time per single accident. The long time of accident handling is a loss for company because productivity level is also considered low and it automatically effects to company negative image from toll road user as the main customer. The other loss also shows up while the accident causes long queue when one of lanes is impassable for them. The possible way that could be done by the toll road operator is by increasing the productivity of road officers in managing accident handling by fixing traffic service system.

According to that needs, then mathematics modelling analysis is urgently required to determine productivity number of accident handling time and to solve what factors which affect it the most.

Problem identification related to productivity problem on Tangerang – Merak toll road is the operator still not able to fulfill the minimum service standard. Officer's productivity on giving traffic services based on accident handling time is still considered low (minimum limit of accident handling time should be below 65 minutes).

The focused factors that need to be analyzed in order to increase the traffic service especially accident handling on Tangerang – Merak toll road is more about how to determine the factors that affect needed time of officer to get to the accident scene on time (respond time), then what factors that affect handling time, and the last is how to determine productivity of officer in handling the accident.

The purpose of this research are.

- Determining factors that affect speed of respond time when officers handle the accident
- Determining factors that affect speed of handling time on accident scene
- Determining productivity of officers when handle the accident

LITERATURE REVIEW

Productivity Concept

According some experts, productivity is defined as .

- Relation between real result (product or service) with a real input (Sinungan, 1987)
- Effeciency level in producing products or services which means delivering a well utilization way from available sources to produce product or service (Sinungan, 1987)
- According to L. Greenberg on Sinungan, 1987 that comparison between expenditure total in certain time divided by input total along that period
- Comparison price unit between input and output (Sinungan, 1987)
- Drucker explained definition of productivity as balance state between entire production factors that produce much output through source efficiency & optimization
- Mali explained its definition as listed below : "Productivity is a measurement that defines how efficient the source used is"
- Organization For Economic Cooperation (1950) : Productivity is ratio between output with one of production factors such as : capital, investment, and raw materials
- Kendrick explain that productivity is a relation between output from products and services with human source input that is used in production process
- National Productivity Board of Indonesia, productivity contains ratio definition between achieved result with entire used sources

According to Blocher (2000) Productivity is relation between some outputs which is produced and some inputs that is needed to produce that outputs. According to Husien Umar (1999), productivity means ratio of achieved result (output) with entire used sources (input). In other hand, quality performance and achieved results is work components from productivity. Therefore, productivity is combination of efectivity and efficiency so that it can be measured by using this formula:

$$Productivity = \frac{The\ resulting\ output}{Input\ used} = \frac{achievement\ of\ objectives}{the\ use\ of\ resources}$$

$$= \frac{effectiveness\ of\ the\ execution\ of\ tasks}{efficient\ use\ of\ resources}$$

$$= \frac{Effectivity}{Efficiency} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Toll Road

Toll road is public road which is part of road network system. Due to its state as national road, the road user needs to pay toll (Government regulation of Indonesia number 15, 2005)

Toll road was built with the purpose to accelerate efficiency of distribution services to support economic growth and to develop area by regarding national road network masterplan

(Government regulation number 15 2005, 2nd article, 2nd paragraph).

Traffic Accident

According to constitution No. 22 on 2009 about traffic and road transportation, traffic accident is a unexpected moment in road that occurs accidentally involving vehicle with and or without other road user that causes victims / property loss.

According to Warpani (2002) and Mulyadi (2011), the main factor of huge number of accident rate in Indonesia is human error factor that caused by omission, negligence, inadvertence of drivers or other road users while driving by obeying politeness and rules of traffic in public road.

The high number of accident traffic and the huge amount of loss because of it needs serious treatment on improving driving safety.

According to Constitution No. 38 on 2004 about Road 12th article, first paragraph, stated that the act that is mentioned which could disturb the road function is every single of act or event that disturbs road function such as length of range or point of view disruption, side obstacle appearance that lowers the vehicle's speed or causing traffic accident that damages the road structure and infrastructure, complementary building and road equipment.

According to Warpani (1993), the accident is caused by many factors and not only because the driver itself or unaware pedestrian. Between those main factors of accident traffic are damaged parts of vehicle, vehicle's design, human error, road surface and road design. The accident that is caused by road design is the reason of many traffic accident fully or partially like bend, alignment, intersections, signs and other engineering side on the road. Many important traffic indication on urban area in developing countries can be explained as listed below :

1. Unsatesfying road infrastructure condition such as narrowed road and poor quality
2. The number of vehicles is increasing annually but not accompanied with road availability
3 Many slow traditional transportation like dokar or becak disturb road flows and occurs congestion
4 Lack of dicipline, politeness, awareness of driving on each drivers so it keeps causing chaos
5. Some of traffic adjustment doesn't seem able to guarantee the convenience of driving

From those field researches and studies, can be concluded that traffic accident may be affected by human factors, vehicle, road environment and interaction or combination on more than 2 those factors.

METHODOLOGY

This research is a quantitative model problem solving with analysis approaching based on traffic accident theories, factors analysis that affects respond time and handling time, the measurement based on productivity theory and optimum services analysis scheme from primary data collecting stages using direct observation or survey and secondaries data and collecting other supporting information for needs of measurement simulation and analysis.

Measurement method and analysis regarding officer's placement scheme design could be conducted by assumption or previous PT MMS evaluation result as secondary data. Mean while the number of services unit that operated for the most optimum score will be analyzed by finding services scheme with the lowest cost value.

1. Respond time and affecting factors analysis
2. Handling time and affecting factors analysis
3. Traffic accident handling time analysis
4. Productivity model analysis
5. Officer's productivity analysis
6. Conclusion
7. Finish point

Steps of the research

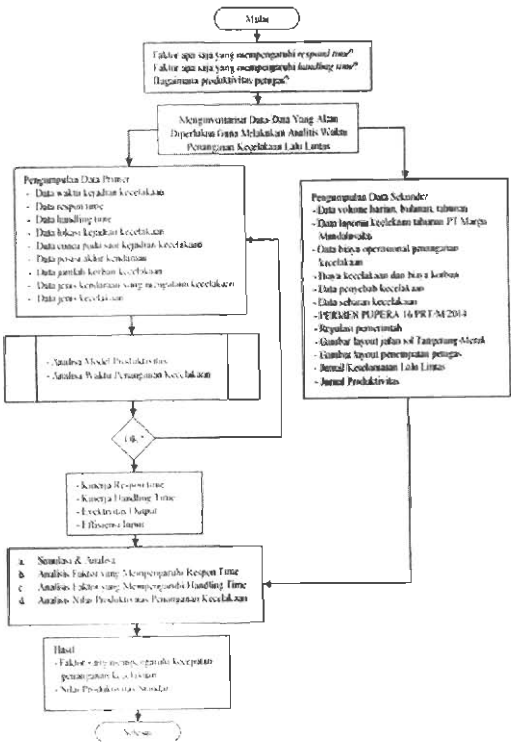

Fig 1. Research Step

RESULT AND DISCUSSION

Accident Handling based on Time of Accident

Based on April 2016 period data, the accident handing that needed the longest time occurred on 23:59 o'clock with total time of 127 minutes. If t is analyzed based on 3 hours interval, then the longest time occurred on interval from 15.00 – 18.00 with the average time of 62 minutes,

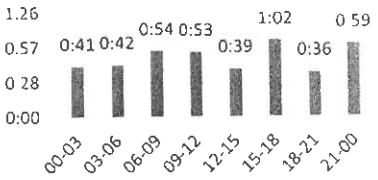

Fig 2. Accident handling time based on Time of Accident on April 2016

On May 2016 period, the accident handing that needed the longest time occurred on 14.18 o'clock with total time of 102 minutes If t is analyzed based on 3 hours interval, then the longest time occurred on interval from 09.00 – 12.00 with the average time of 60 minutes,

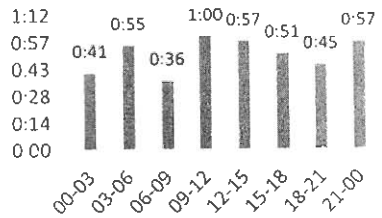

Fig 3. Accident handling time based on time of accident on May 2016

Accident Handling based on Location of Accident

Accident handling time based on location of accident on April 2016 period data. Based on the data, it can be figured out that there were 7 point of locations with handling service time more than 65 minutes.

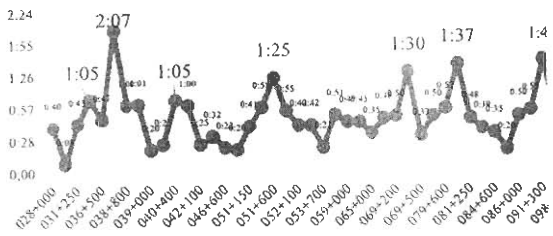

Fig 4 Accident handling time based on Location on April 2016

Meanwhile on May 2016 period, there were 6 point of locations with handling service time more than 65 minutes.

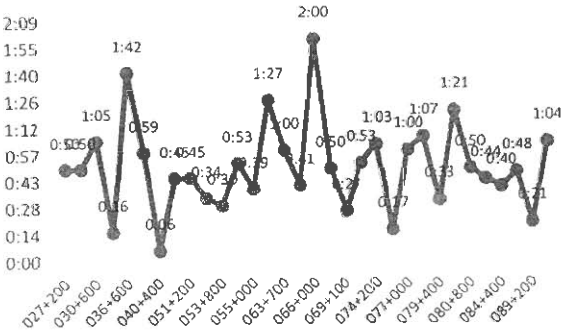

Fig 5. Accident handling time based on Location on May 2016

Accident Handling based on Type of Accident

Based on April 2016 period data, there were 4 types of accident that occurred. The longest accident handling time was 127 minutes which was Back-Hit Accident. Meanwhile the traffic accident handling time in average was 58 minutes which was Streak-Hit Accident.

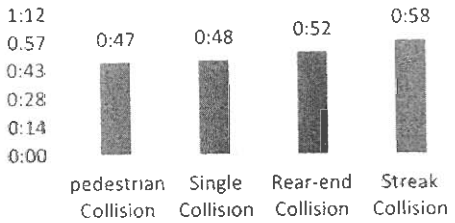

Fig 5. Accident handling time based on type of accident on April 2016

If it is analyzed on April 2016 period, based on type of accident with handling service time more than 65 minutes, there were 3 cases occurred on Hit-Back accident with the average of handling time of 94 minutes.

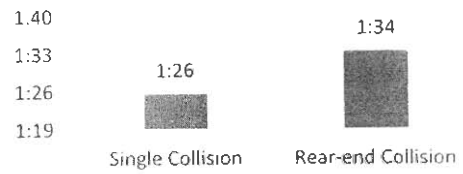

Fig 6. More than 65 minutes handling time based on type of accident on April 2016

Meanwhile on May 2016 period, there were 3 types of accidents occurred. The longest accident handling time was 120 minutes which was Single Accident. Meanwhile the traffic accident handling

time in average was 51 minutes which was Single Accident.

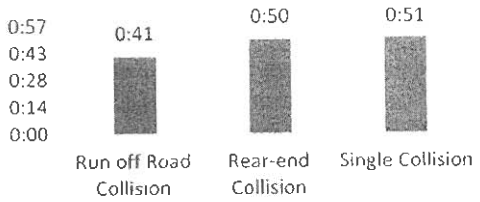

Fig 7. Accident handling time based on type of accident on May 2016

If it is analyzed on May 2016 period, based on type of accident with handling service time more than 65 minutes, there were 6 cases occurred on Single accident.

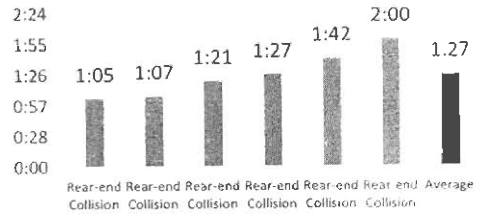

Fig 7. More than 65 minutes handling time based on type of accident on May 2016

Accident Handling based on Final Position of Vehicle

Based on April 2016 period data, the average accident handing that needed the longest time occurred on accident with final position of vehicle on road median.

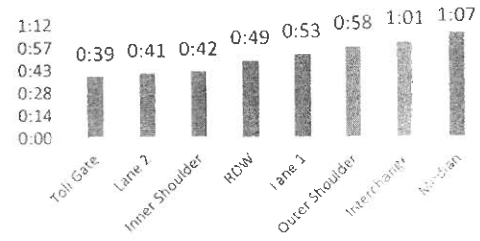

Fig 8. Accident handling time based on vehicle final position on April 2016

Based on May 2016 period data, the average accident handing that needed the longest time occurred on accident with final position of vehicle on toll gate.

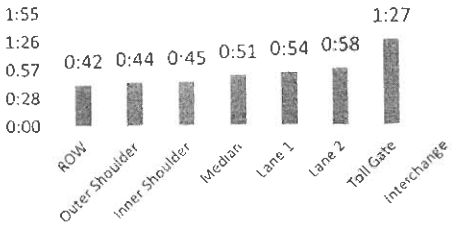

Fig 9. Accident handling time based on vehicle final position on May 2016

Accident Handling based on Type of Vehicle

The data survey showed the handling service time based on type of vehicle on April 2016 data period. In average there were 2 types of vehicle that needed handling time more than 65 minutes. They were small truck with handling time of 1 hour 13 minutes (73 minutes), and tank truck with handling time of 1 hour 53 minutes (113 minutes).

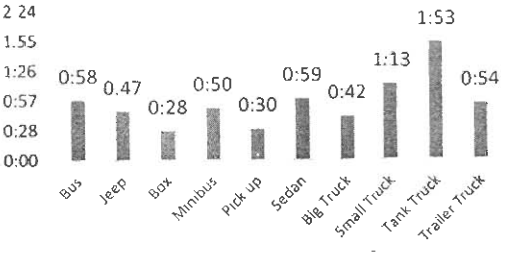

Fig 10. Accident handling time based on type of vehicle on April 2016

The data survey showed the handling service time based on type of vehicle on May 2016 data period. In average there were 3 types of vehicle that needed handling time more than 65 minutes. They were big truck with handling time of 1 hour 15 minutes (75 minutes), small truck with handling time of 2 hours 0 minutes (120 minutes) and tank truck with handling time of 1 hour 42 minutes (102 minutes).

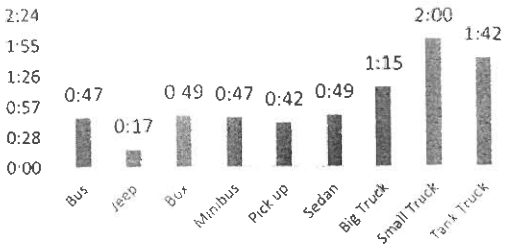

Fig 11. Accident handling time based on type of vehicle on May 2016

Accident Handling based on Victim

Traffic accident handling time analysis based on number of victim showed that in average the handling still less than 65 minutes.

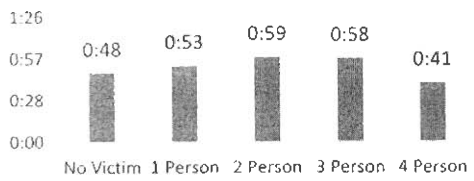

Fig 11. Accident handling time based on numbers of victim

If it is analyzed on April and May 2016 period, based on type of accident with the longest handling service time was on dead victim.

Fig 12. Accident handling time based on type of victim

Accident Handling based on Weather

The data survey showed that the handling service time with more than 65 minutes based on weather on April 2016 data period was only occurred when it was raining when the driving visibility of officer is impaired, the accident scene became slippery and made the officer got difficult to evacuate the victims and vehicles. Moreover, on rainy condition, the risk of upcoming accident becomes higher so the temporary warning signs installment should be put in a longer range than if it is on sunny day.

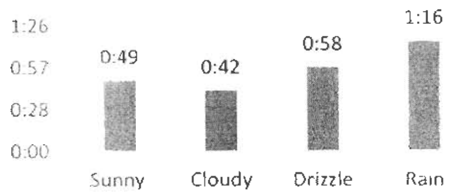

Fig 13. Accident handling time based on weather on April 2016

In average, the May 2016 period data showed the same result with what was happened on April 2016 which said that the handling time that exceeded the maximum handling time limit, occurred only when it was rainy day.

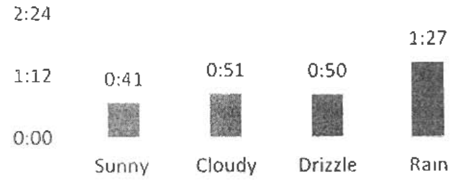

Fig 13. Accident handling time based on weather on May 2016

Productivity Model Analysis

Traffic accident is the most avoided event of people even from driver or toll road user including operator of it. That makes accident service handling output can not be defined by quantity of given services.

Based on government regulation references, so it is very relevant if time unit is used as output parameter of a traffic accident handling service (TAHC), where TAHC is addition of respond time and handling time. So the equation of TAHC becomes this:

TAHST=RT+HT ....(2)

Information,

TAHST = traffic accident handling service time (minutes)
RT = Respond time (minutes)
HT = Handling time (minutes)

If government regulation set the maximum accident traffic handling service time on less than 65 minutes, so the output effectivity of accident handling becomes this :

Output Effectivity = MSTAHT/TAHC ....(3)

Information,

MSTAHT = Minimum standard of Traffic Accident Handling Time (65 minutes)
TAHST = traffic accident handling service time (minutes)

Accident handling service input could be defined as number of officer that handle the traffic accident on the road. Minimum standard of officer's number are 2 officers, so the standard officer's number when handling the accident are 8 persons. On measuring the productivity of accident handling, the police officer is not included as input category.

From the explanation above, then input of efficiency on traffic accident handling service can be defined as this equation.

$$Input\ Efficiency = \frac{Actual\ number\ of\ officer}{Standard\ number\ of\ officer} \quad (4)$$

where,

Number of officer =TSO+MO+CO+RO ... . (5)

Information,
TSO = Traffic services officer
MO = Medical Officer
CO = Crane Officer
RO = Rescue Officer

Based on explanation above about output effectivity on equation (3) and input efficiency equation (4), on accident handling service (1), then the productivity model for accident handling service can be measured by using this equation :

$$Productivity = \frac{Effectivity}{Efficiency} = \frac{\left[\frac{MSTAHT}{TAHST}\right]}{\left[\frac{Actual\ number\ of\ officer}{Standard\ number\ of\ officer}\right]} \quad ..(6)$$

Information,
MSTAHT = Minimum standard of Traffic Accident Handling Time (65 minutes)
TAHST = traffic accident handling service time (minutes)

Based on model on eqution (6), then the accident handling service productivity number is defined on productivity index of 1. Therefore it can be explained that if productivity index is more than 1, then the productivity of is classified as good category and if it is productivity index is less than 1, then the productivity of is classified as poor.

PT Marga Mandalasakti Accident Handling Productivity Analysis

Productivity model on equation (6) is used on this analysis to measure the productivity index on 2015 historical data and on survey period in April and May 2016.

The Analysis result showed that accelerating the respon time and handling time will increase productivity index of accident handling service significantly Tabel 1 show the productivity of accident handling on PT Marga Mandalasakti.

Tabel 1. PT Marga Mandalasakti Accident Handling Productivity

Parameter	2015	2016	
		April	May
RT	12.5	6	6
HT	55.8	50	50
TAHC	68.3	56	56
Average number of officer	8	8	8
Productivity	0.95	1.16	1.16

The measurement result shows that on 2015, the productivity index number of PT Marga Mandalasakti accident handling time is 0.95 meanwhile it changes and becomes better in April and May 2016 with the number 1.16

Conclusion

From analysis result that has been measured, it can be concluded that there are 8 factors that could affect traffic accident handling service time (TAHST). The factors are accident time, location, weather, type of accident, final position of crashed vehicle, number and type of victim.

Productivity model could be implemented to measure TAHST by starting to define output effectivity and input efficiency first on accident handling service process.

The Analysis result showed that accelerating the respon time and handling time will increase productivity index of accident handling service significantly.

Suggestion

PT Marga Mandalasakti has possibility to keep on increasing accident traffic handling service performance by activating it on accident early detection system automatically so the accident could be traced and detected in real time and doesn't use conventional report anymore.

Traffic services' scheme nowadays that requires the officer to do observation seems not that really relevant knowing the traffic volume always increased. The observation function should be replaced by using camera technology to ease the process.

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