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by Amelia Makmur

THE FULLFILLMENT OF SAFETY SERVICE SUBSTANCE IN MINIMAL SERVICES STANDARD OF INDONESIAN TOLL ROAD

AMELIA MAKMUR
Civil Engineering Department, Krida Wacana Christian University
Jln. Tanjung Duren Raya 4, Jakarta Barat, Indonesia

MEIKE KUMAAT
Civil Engineering Department, Sam Ratulangi University
Jln. Kampus Bahu, Manado, Indonesia

RANTO P RAJAGUKGUK
Secretariat, Badan Pengatur Jalan Tol Kementerian PU-PR
Jln. Pattimura No 20 Kebayoran Baru, Jakarta Selatan, Indonesia

ABSTRACT: One of The Minimum Services Standards for Safety on Toll Road's goals is for safety driving, which is also to reduce the accident rate. But in fact, the fulfillment of the Toll Road Minimum Service Standards for some indicators of The Safety Services Substance still can not be fulfilled optimally by toll roads in Indonesia. On the other hand, the level of accidents that occur on some toll roads provided a fairly high number. So, it is necessary to do the hypotheses to observe the behavior of the accident data on 2012 and 2013. Based on this hypothesis testing, the result shows that there is a decreasing accident rate on 2013. As for the fulfillment of The Safety Services Substance's indicators, there are three indicators have increased fulfillment of Toll Road Minimum Service Standards on 2013. These indicators are Road Signs, Street Lighting (PJU) and Toll Road's fence (Rumija). There is only 38% of indicators in The Safety Services Substance have been increasing for fulfillment the Minimum Service Standards. Hypothesis Testing result that has been done on these parameters provided that decreasing the accident rate did not follow the increasing all the indicators of The Safety Services Substance.

Key Words: Minimum Services Standards, accident rate, Safety Service Substance, Indicators

1. Introduction

Road infrastructure plays a strategic role in supporting all the activities of the economic, social, cultural, and defense and security. The role of this path has implications for the government's efforts to implementation the best quality of road infrastructure for the community[1] One of the government's efforts in realizing the implementation of the quality road infrastructure, is stated the Toll Road Minimum Service Standards as a reference for the fulfillment services for toll roads in Indonesia. Minimum Service Standards, or abbreviated to SPM for Toll Road, issued through the Minister of Public Works 392/PRT/M/2005 on Minimum Service Standards Toll Road. Toll Road Regulatory Agency (BPJT) as part of the government, conducts a regular monitoring to assess the achievement of the SPM Toll Road indicators by the Toll Road Operator (BUJT). With the Minimum Service Standards is expected the accident rate can be lowered, in other words driving on the toll road will be smooth and safe. However, from the results of the regular monitoring in the field still found some indicators that often can not be met by the toll road sections, in particular for Safety Services Substance (BPJT, 2013).

Based on the results of the monitoring and evaluation data of the indicators from Safety Services Substance in 2012 and in 2013 found many indicators are still unmet. While the accident rate of the accident data report still provided the fairly high rate of accidents on some toll roads (BPJT, 2013). In theory there should be a relationship between the fulfillment of Minimum Services Standards indicators on the toll road, especially for Safety Services Substance with the level of accidents that occur on the toll road sections. With the limitations of existing data, Hypothesis Testing needs to be done to determine the increase or decrease in the indicators of Minimum Services Standards and the level of accidents on the toll roads.

The purpose of this study and presented in this paper, is to determine the compatibility between fulfillment of Minimum Services Standards from Safety Services Substances with the

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[1] Monitoring and Evaluation of the National Transport Policy Team, 2009

accident rate that occured in 2012 and 2013. The results of this evaluation are expected to be a recommendations for the implementation of the Toll Road Minimum Service Standards in the future.

The scope of this study related to the results of the monitoring and evaluation data of the accidents rate and the fulfillment of the Minimum Service Standards for Safety Services Substance in 2012 and 2013 from the 21 toll roads which have a similar and complete supporting data. For the Minimum Service Standards in this Safety Services Substance, hypothesis testing is not performed for Accident Handling indicators and indicators Security and Law Enforcement. This is due to the achievement of Minimum Service Standards for the indicators have already fulfilled a maximum of 100% in 2012 and 2013. Methodology to provide the data behavior and determine the compatibility between fulfillment of Minimum Services Standards from Safety Services Substances with the accident rate that occurred in 2012 and 2013 by using the Hypothesis Testing for pairing data.

2. Minimum Services Standards of Toll Roads and Toll Road Accidents

2.1. *Minimum Services Standards of Toll Roads for Safety Services Substances*

Minimum service standards for toll roads in Indonesia refers to the Regulation of the Minister of Public Works No. 392/PRT/M/2005 on Minimum Service Standards Toll Road. Minimum Service Standards has 21 (twenty-one) indicator is incorporated in 6 (six) service substances. The substance of these services are: Toll road conditions, The average of Traffic speeds, Accessibility, Mobility, Safety, Rescue unit or the rescue and relief services. The substance of services that will be addressed in this study is the Safety Services substance. Safety Services Substance has the goal of safety and smoothness for toll road users. This substance consists of several indicators of traffic regulation means that the expected accomplishments all met or 100% of the benchmarks specified. The indicators of Service Safety Substance is an indicator of vehicle traffic control, namely: Road Sign, Road Markings, Guide Post/Reflectors, The pegs on each 1 kilometer, Public Street Lighting (PJU), Rumija fences, The handling of accidents, as well as Security and Law Enforcement.

2.2. *Traffic Accidents Rate*

Under Law No. 22 of 2009, article 1, paragraph 24, accident is an event in Jalan unexpected and unintentional involve vehicles with or without other road users which resulted in human casualties an/or loss of property. Traffic accident as stipulated in Law No. 22 of 2009, on Road Traffic and Road Transport in Article 229 paragraph (1) states that the accident is classified into: a. Light Traffic Accidents; b. Medium Traffic Accidents; or c. Heavy Traffic Accidents. In the next verse in the same chapter is given a definition for Traffic Accidents for Light Traffic Accidents, which is an accident which resulted in damage to vehicles and/or goods. Whereas for Medium Traffic Accident, is the accidents which resulting in minor injuries and damage to vehicles and/or goods. While the Heavy Traffic Accidents is accidents resulting in death or serious injury. Traffic accidents contemplated in this Act may be caused by the negligence of road users, appropriateness of Vehicles and Roads and/or the environment.

As for the traffic accident data, regulated by Article 233 of Law No. 22 of 2009. In this article mentioned that each scene of the accident shall be recorded in the form of traffic accident data, accident data while it is part of the forensic data, which should also be supplemented by data derived from hospital. The accident data managed by the Indonesian National Police and may be used by supervisors Traffic and Road Transport. Similarly with the management of toll roads did, where all accidents which have occured along the toll roads are also recorded and reported by the Operator Toll Road as an evaluation and forensic data which is also administered by the Indonesia National Police. In reporting the calculation of the rate of accidents on the toll roads to use the data Daily Traffic Average (LHR) is there to perform the calculation of the accidents rate for 100 million vehicles.km. Other data used in this calculation are data segment length, LHR for both directions, the number of days, so it can be formulated as follows: The accident rate per 100 million.km = (number of accidents x 100 million) / (Total LHR on to a 2-way segments x length x number of days). The accident rate figures are next used to analyze the accident rate on the toll roads (BPJT, 2013).

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2.3. Traffic Accidents Rate

Hypothesis test is a method used to prove the truth of the nature of a given population based on sample data. In conducting research using sample data, the hypothesis must be verified[2]. In general, we want to test the hypothesis that the truth (the alternative hypothesis-H_a) will be compared as compared with the hypothesis wrong hypotheses, which later we will reject (the null hypothesis-Ho). The decision to accept or reject Ho made based on statistics obtained test values derived from the data. The benefits of hypothesis testing is to test the hypothesis test the truth of a hypothesis and determine which decision will be accepted hypothesis test as follows:

$H_o : \mu_1 - \mu_2 = 0$ (1)   → Statement to be rejected

$H_a : \mu_1 - \mu_2 < 0$ (2)   → Statement can not be rejected

Where:

$p_{-value} < 0{,}005$ then H_o can be rejected

$|t_{-value}| > t_{tabel}$ then H_o can be rejected

3. Hypothesis Testing

3.1. Data of The Minimum Services Standards of Toll Roads and Toll Road Accidents

Based on secondary data obtained from the Monitoring and Evaluation Report on the toll road in 2012 and 2013 from the Toll Road Agency (BPJT), obtained data of the calculation of accident rates calculated from the rate of accidents per 100 jt kend.km and Traffic Daily Average, as shown in Table 3.1.

Table 1. Traffic Volume and Average Daily Rate Toll Road Traffic Accidents in Indonesia

No	Toll Road	Length (km)	Volume LHR/day (vehicles)		Accident rate/100 million vehicles	
			2012	2013	2012	2013
1	Jakarta-Bogor-Ciawi	59	507,841	539,997	9.60	10.11
2	Jakarta-Tangerang	33	292,255	306,895	12.06	11.59
3	Cawang-Tomang-Cengkareng	23.55	470,232	468,664	7.24	7.72
4	JORR	50.42	387,722	394,938	8.37	6.18
5	Pondok Aren-Bintaro-Ulujami	5.55	142,819	153,084	10.24	6.90
6	Jakarta-Cikampek	83	517,385	534,867	16.51	13.08
7	Padalarang-Cileunyi	64.4	149,236	156,980	10.22	9.32
8	Cikampek-Purwakarta-Padalarang	58.5	14,406	15,956	13.56	12.80
9	Palimanan-kanci	26.3	50,566	51,900	34.29	19.09
10	Semarang Section A,B,C	24.75	122,587	133,467	10.91	10.83
11	Surabaya-Gempol	49	203,264	221,109	9.50	10.02
12	Belawan-Medan-Morawa	42.7	59,014	64,595	14.81	13.88
13	Cawang-Tj.Priuk-Pluit	27.05	239,779	239,730	22.92	24.25
14	Tangerang-Merak	73	103,085	112,775	73.84	68.35
15	Surabaya-Gresik	20.7	122,160	76,702	3.50	0.95
16	Serpong-Pondok Aren	7.25	142,819	153,084	10.24	6.90
17	Bogor Ring Road (Seksi I)	3.85	31,011	34,125	0.00	0.00
18	Kanci-Pejagan	35	10,365	8,345	142.25	109.00
19	JORR (W1-Kebon Jeruk-Pejaringan)	9.85	56,044	64,085	21.43	34.70
20	Surabaya-Mojokerto (Seksi I)	1.89	23,714	28,064	28.64	17.66
21	Semarang-Solo (Seksi I)	11	13,725	14,834	33.58	58.61

As for compliance with the Minimum Service Standards for Substance Highway Safety Services in 2012 and 2013 is shown in Table 2.

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[2] Ott, R. L., & Longnicker, M., 2010

Table 2. The Fulfillment result of Toll Road Minimum Services Standards for Safety Services Substance

No	Toll Road	Length (km)	1.Road Sign		2. Marking Sign		3. Guide Post		4. Peg.km		5. P Lighting street (PJU)		6. Rumija Fence		7. Handl Acc		8. Security & L enforce	
			2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
1	Jakarta-Bogor-Ciawi	59	88.89%	83.33%	100.00%	86.67%	83.33%	80.00%	100.00%	93.33%	88.89%	90.00%	0.00%	83.33%	100.00%	100.00%	100.00%	100.00%
2	Jakarta-Tangerang	33	88.89%	100.00%	100.00%	93.33%	94.44%	83.33%	100.00%	100.00%	88.89%	93.33%	22.22%	83.33%	100.00%	100.00%	100.00%	100.00%
3	Cawang-Tomang-Cengkareng	23.55	88.89%	83.33%	100.00%	96.67%	100.00%	86.67%	100.00%	100.00%	75.00%	66.67%	66.67%	86.67%	100.00%	100.00%	100.00%	100.00%
4	JORR	50.42	77.78%	100.00%	100.00%	86.67%	97.22%	90.00%	100.00%	96.67%	80.56%	90.00%	44.44%	86.67%	100.00%	100.00%	100.00%	100.00%
5	Pondok Aren-Bintaro-Ulujami	5.55	77.78%	100.00%	100.00%	93.33%	77.78%	70.00%	100.00%	100.00%	83.33%	96.67%	77.78%	86.67%	100.00%	100.00%	100.00%	100.00%
6	Jakarta-Cikampek	83	100.00%	100.00%	100.00%	80.00%	83.33%	86.67%	100.00%	96.67%	86.11%	80.00%	0.00%	80.00%	100.00%	100.00%	100.00%	100.00%
7	Padalarang-Cileunyi	64.4	66.67%	86.67%	100.00%	90.00%	91.67%	93.33%	100.00%	100.00%	63.89%	80.00%	22.22%	80.00%	100.00%	100.00%	100.00%	100.00%
8	Cikampek-Purwakarta-Padalarang	58.5	88.89%	96.67%	77.78%	80.00%	94.44%	90.00%	100.00%	96.67%	75.00%	76.67%	22.22%	80.00%	100.00%	100.00%	100.00%	100.00%
9	Palimanan-kanci	26.3	100.00%	90.00%	100.00%	90.00%	94.44%	83.33%	100.00%	90.00%	100.00%	100.00%	66.67%	83.33%	100.00%	100.00%	100.00%	100.00%
10	Semarang Section A,B,C	24.75	100.00%	96.67%	88.89%	90.00%	100.00%	100.00%	100.00%	100.00%	97.22%	96.67%	100.00%	93.33%	100.00%	100.00%	100.00%	100.00%
11	Surabaya-Gempol	49	88.89%	86.67%	88.89%	90.00%	100.00%	96.67%	100.00%	100.00%	94.44%	86.67%	66.67%	93.33%	100.00%	100.00%	100.00%	100.00%
12	Belawan-Medan-Morawa	42.7	88.89%	100.00%	100.00%	90.00%	88.89%	93.33%	100.00%	96.67%	88.89%	100.00%	44.44%	83.33%	100.00%	100.00%	100.00%	100.00%
13	Cawang-Tj.Priuk-Pluit	27.05	88.89%	100.00%	100.00%	90.00%	100.00%	93.33%	100.00%	100.00%	80.56%	93.33%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
14	Tangerang-Merak	73	88.89%	90.00%	88.89%	93.33%	86.11%	80.00%	100.00%	100.00%	97.22%	93.33%	33.33%	80.00%	100.00%	100.00%	100.00%	100.00%
15	Surabaya-Gresik	20.7	88.89%	100.00%	88.89%	86.67%	86.11%	90.00%	100.00%	100.00%	88.89%	96.67%	44.44%	83.33%	100.00%	100.00%	100.00%	100.00%
16	Serpong-Pondok Aren	7.25	100.00%	96.67%	100.00%	96.67%	94.44%	70.00%	100.00%	100.00%	77.78%	90.00%	0.00%	96.67%	100.00%	100.00%	100.00%	100.00%
17	Bogor Ring Road (Seksi I)	3.85	88.89%	90.00%	100.00%	90.00%	97.22%	80.00%	100.00%	100.00%	83.33%	100.00%	55.56%	90.00%	100.00%	100.00%	100.00%	100.00%
18	Kanci-Pejagan	35	100.00%	100.00%	100.00%	90.00%	72.22%	83.33%	100.00%	93.33%	88.89%	96.67%	33.33%	86.67%	100.00%	100.00%	100.00%	100.00%
19	JORR (W1-Kebon Jeruk-Pejaringan)	9.85	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
20	Surabaya-Mojokerto (Seksi 1)	1.89	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
21	Semarang-Solo (Seksi I)	11	100.00%	100.00%	100.00%	96.67%	88.89%	96.67%	100.00%	100.00%	97.22%	96.67%	22.22%	96.67%	100.00%	100.00%	100.00%	100.00%

3.2. Hypothesis Testing for Accident Rate

Accident rate for Hypothesis Testing was conducted to determine whether a decline in the rate of accidents from 2012 to 2013, using the Paired t test.

```
Paired T-Test and CI: Accident Rate 2012, Accident Rate 2013
Paired T for Acc. Rate 2012 - Acc. Rate 2013
N    Mean   StDev  SE Mean
AR 2012   21   23.51   31.43     6.86
AR 2013   21   21.52   26.45     5.77
Difference   21   1.99   10.62     2.32

95% lower bound for mean difference: -2.01
T-Test of mean difference = 0 (vs > 0): T-Value = 0.86   P-Value = 0.200
```
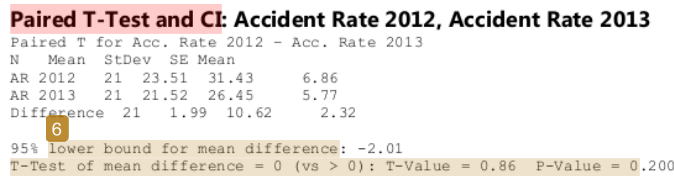
Figure 2. Model of Hypothesis Paired t test of Accident Rate

Based on the hypothesis results from Statistic program, that can be concluded as follow:
a. $p_{value} > 0,005$, $p_{value} = 0,200$ → H_o can not be rejected.
b. $t_{value} = 0,86$, DF= (21+21-2) = 40, From t Table = 2,021
   $|t_{value}| < t_{tabel}$ → H_o can not be rejected

It can be concluded that there is a decreasing accident rate data from 2012 to 2013.

3.3. Hypothesis Testing for the fulfillment of Toll Road Minimum Service Standard on Safety Service Substance

By using the Paired t test, the data of fulfillment Toll Road Minimum Service Standard on Safety Service Substance will be tested from data on 2012 dan 2013.

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Paired T-Test and CI: 2012-Road Sign, 2013-Road Sign
Paired T for 2012-Road Sign - 2013-Road Sign
            N    Mean    StDev   SE Mean
2012-RSign  21   0.9101  0.0904  0.0197
2013-RSign  21   0.9524  0.0620  0.0135
Difference  21   -0.0423  0.0937  0.0205

95% upper bound for mean difference: -0.0071
T-Test of mean difference = 0 (vs < 0): T-Value = -2.07   P-Value = 0.026
```

Figure 3. Model of Hypothesis Paired t test for the Fulfillment of Road Sign Indicator

Based on the hypothesis results can be concluded as follow:
a. $p_{value} < 0,005$, $p_{value} = 0,026$ → H_o can be rejected.
b. $t_{value} = -2,07$, DF= (21+21-2) = 40, From t Table = 2,021
   $|t_{value}| < t_{tabel}$ → H_o can be rejected

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It can be concluded that there is an increasing data of fulfillment for Road Sign indicator.
Using the similar methods, hypothesis will be used for another indicator for Safety Service Substance as shown in Table 3

Table 3. Hypotesis Analysis for fulfillment the indicators of Safety Service Substance

Indicator of Safety Service Substance	Hypotesis Analysis	Summary
Road Sign	Ho can be rejected	increasing data of fulfillment the indicator
Marking Sign	Ho can not be rejected	no increasing data of fulfillment the indicator
Guide Post	Ho can not be rejected	no increasing data of fulfillment the indicator
Pegs per km	Ho can not be rejected	no increasing data of fulfillment the indicator
Public Lighting Street (PJU)	Ho can be rejected	increasing data of fulfillment the indicator
Rumija fence	Ho can be rejected	increasing data of fulfillment the indicator
Handling the accidents		Always be fulfilled
Security and Law Enforcement		Always be fulfilled

Table 3 provided that there are 3 (three) indicators of the Safety Services Substance: Road Sign, Public Lighting Street (PJU) and Rumija fence have a increasing data for fulfillment the indicators.

4. Conclusion and Recommendation

4.1. Conclusion

Based on studies that have been done by using a hypothesis test for the fulfillment of the data of the Toll Road Minimum Service Standards for Safety Services Substance and rate of traffic accidents, can be summed up as follows:
a. The Hypothesis result provided a decreasing data of traffic accident rate on the toll roads from 2012 to 2013.
b. There are 3 (three) indicators of Safety Services Substance as a part of Toll Road Minimum Services Standards which are increased the data of fulfillment indicators (38% of all the indicators from Safety Services Substance), these indicators are Road signs, completeness and well-functioning Public Street Lighting (PJU) and Rumija fence.
c. Hypothesis Testing result that has been done on these parameters provided that decreasing the accident rate did not follow the increasing all the indicators of The Safety Services Substance.

4.2. Recommendations

From the results of the study and based on the conclusions that have been described can be given suggestions to do a similar analysis for the data of the fulfillment of the Minimum Service Standars and the accident rate in the years before and the following year, so as to provide a clear description related to the evaluation of the fulfillment of Toll Road Minimum Services Standards, especially for Safety Services Substance. The similar analysis can be done for rate of accidents' data, so it can provide usefull recommendation for toll road regulator and operators.

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