

MAINTENANCE PERFORMANCE MEASUREMENT TRANSJAKARTA BUS AT PERUM DAMRI SBU BUSWAY CORRIDOR I & VIII USING MAINTENANCE SCORECARD

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SBU Busway Corridor I & VIII is a unit business of Perum Damri which is operate the TransJakarta Bus at Corridor I & VIII. An assessment and evaluation performance already done by Perum Damri only for the Strategic Business Unit (SBU) level but it has not yet to do the measurement on maintenance division using the comprehensive performance measurement model. In this research, maintenance performance measurement of TransJakarta bus based on Maintenance Scorecard (MSC) of SBU Busway designed earlier. First stage of this research is to determine the rating scale, weights and normalization for each Key Performance Indicator (KPI). The result of the KPI obtained through Focus Group Discussion and the weights of KPI retrieved by pairwise comparison method use Expert Choice 11 software using a scale of 1 to 5. The total Maintenance Scorecard SBU Busway corridor 1 & VIII is 3,46 that mean it is a good maintenance condition (3,4 – 4,2 is good range). There are 7 (seven) KPI have lower score; one KPI at Productivity, Safety, and Quality perspective than 2 KPI at Environment and Learning. SBU Busway of Perum Damri need to increase these KPI and sustaining good performance of KPI to optimal maintenance.

Keys word: Maintenance Performance Measurement, Maintenance Scorecard, Key Performance Indicator.

1. INTRODUCTION

1.1. Background

Maintenance is a part of asset management of a company that need always to be done, so that for every company their assets continuously available or ready to use. To increase the maintenance performance is important and the first stage to be done is using the performance measurement model. One of the models to measure the performance of maintenance is a maintenance scorecard (MCS). MCS is a model of a comprehensive performance measurement whose aim is to measure the maintenance performance for a company [7].

Maintenance performance measurement based on model MSC at Perum Damri get to know the maintenance performance of bus at SBU busway Perum Damri thoroughly at every level starting from the corporate (Perum Damri), strategic (SBU busway) and functional level (the maintenance division). The result of performance measurement can help Perum Damri to formulate and make a

decision for a new maintenance strategy. This strategy has to improve strategic objective, measure and target based on the value KPI's who have yet good especially when the weights is larger. Perum Damri has to be increase the performance of maintenance division SBU busway in order to win a new contract from Jakarta Transportation Company. (TransJakarta).

Seen from the achievement of the vision and mission of Perum Damri SBU Busway Corridor I & VIII there are not yet measured the achievement of the value added by the awarding of the maintenance Division

The Maintenance Performance Measurement System (MPMS) where is designed earlier use MSC model that equipped with key performance indicators (KPI). The function KPI is to describe the actual conditions of TransJakarta bus maintenance [4]. Indicators are already available that had been based solely on the assessment and performance evaluation that is only done at the level of the SBU, had come in a comprehensive performance measurement system on the maintenance

division. Performance measurement system needs to be applied by perform performance measurement and the results is analysed to improve the maintenance strategy of MSC model.

The purpose of this research to be achieved is:

- a. To get the result maintenance performance measurement use the maintenance scorecard (MSC) model
- b. To give improvement proposal from the result have not fulfilled

2. THEORETICAL BACKGROUND

Maintenance Scorecard (MSC) is a comprehensive approach to build and implement strategy in area asset management. MSC inform maintenance workers, management and company owner about factors that promote successful in the country and to come. As a methodology performance measurement, msc built using indicators management known as key performance indicator (KPI) to develop and implementation of strategy[8].

MSC also used for measuring performance in assets management about what is done, how performance so far and how each the act of was in line with the purpose company. In MSC, the determination of strategic objectives have been divided into three level that is the level of corporate who see competitive advantage the in Perum Damri, the level of advantage in SBU busway and strategic asset to division maintenance. In each level there are six perspective; productivity, cost effectiveness, safety, environment, quality, and learning.

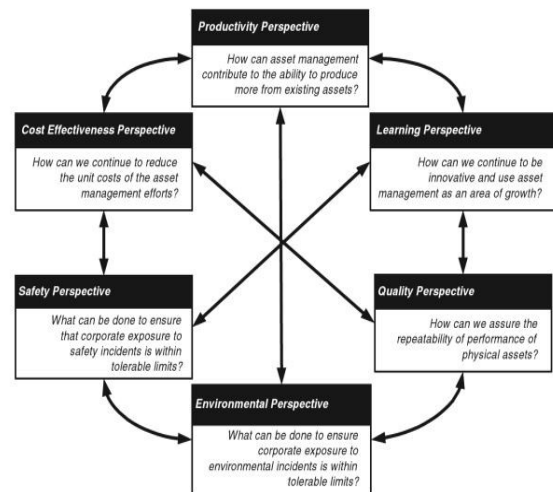
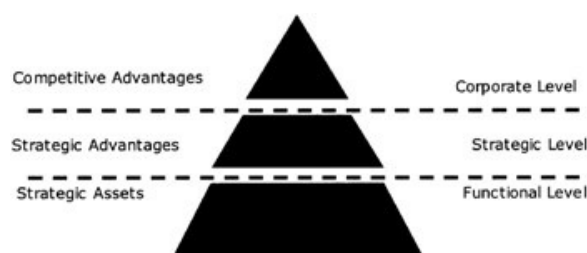


Figure 1 Hierarchies of Objectives and Maintenance Scorecard Model [8]

KPI is an important performance benchmark that will give an overview of the performance of the assets, systems, departments, sites or companies in the territory of a particular performance[8]. The recommended stages for the determination of performance indicators are:

1. Determining the relationship between the objectives of the company and the main operational perspective.
2. Map relation of strategy to a process which demanded in any area of perpektif.
3. Determine a metrics short-term and medium-term that drives the results of new in every perspective
4. Determine gap and reliance on organizations that may be need to linked to get the success of company
5. Implement metrics as scorecards and supervision individuals than to secure the results of strategic

Previous studies [4] have design systems performance measurement bus maintenance of TransJakarta SBU busway of documentation model MSC in perspective productivity, cost effectiveness, safety, environment, and quality, that objective and KPI measure that can be seen the following.

Table 1. Documentation of MSC Model at Productivity, Cost Effectiveness, Safety, Environment, and Quality Perspective

PRODUCTIVE PERSPECTIVE					
How can asset management contribute to the ability to produce more than existing assets ?					
Corporate Level		Strategic Level		Functional Level	
Objectives	Measures	Skill, Capacities and Abilities	Measures	Execution Objective	Measures
Increasing availability of buses Armada (KPI-CPI)	Availability	Increasing the amount of workers (KPI - SPI)	The amount of extra labour	% Presence of workers (KPI - FP1)	% Presence of workers
				Decreasing of MTTR (KPI - FP2)	MTTR

COST EFFECTIVENESS PERSPECTIVE					
How can we continue to reduce the unit costs of the asset management efforts ?					
Corporate Level		Strategic Level		Functional Level	
Objectives	Measures	Skill, Capacities and Abilities	Measures	Execution Objective	Measures
Optimal use of budget (KPI - CCE1)	Appropriate budget planning and realization	The use of spare parts in accordance to the specification (KPI - SCE1)	% Spare part accordance to the specification	Allocation of funds for spare part purchasing (KPI - FCE1)	% Allocation of funds for spare part
				Decreasing of overtime (KPI - FCE2)	Average of overtime

SAFETY PERSPECTIVE					
What can be done to ensure that corporate exposure to safety incidents is within tolerable levels ?					
Corporate Level		Strategic Level		Functional Level	
Objectives	Measures	Skill, Capacities and Abilities	Measures	Execution Objective	Measures
Rate of accident works	Rate of work accident	Preparation and Development of SOPs	% of adherence to SOPs	Decreasing of labour violations	The number of violations of labor

minimum (CS1)		(KPI - SS1)		(KPI - FS1)	procedure
				Controlling the use of APD in daily work (KPI - FS2)	Checklist of use APD

ENVIRONMENTAL PERSPECTIVE					
What can be done to ensure that corporate exposure to environmental incidents is within tolerable levels ?					
Corporate Level		Strategic Level		Functional Level	
Objectives	Measures	Skill, Capacities and Abilities	Measures	Execution Objective	Measures
The expansion of mass transit network sustainable cooperation (KPI - CE1)	the number of networks of cooperation	Increasing the coordination between TransJakarta about street condition (KPI - SE1)	% Doing coordination with TransJakarta	Decreasing the amount of the waste (KPI - FE1)	Rate of waste disposal
				Decreasing of public complaints (KPI - CE2)	Public complaints rate

QUALITY PERSPECTIVE					
How can we ensure the repeatability of performance of physical assets ?					
Corporate Level		Strategic Level		Functional Level	
Objectives	Measures	Skill, Capacities and Abilities	Measures	Execution Objective	Measures
Increase customer satisfaction in service (KPI - CQ1)	The No. of passengers complaint	Increasing bus interval time head to head (KPI - SQ1)	Bus Interval time head to head	Scheduling regularly (KPI - FQ1)	% maint. work against the schedule
				Decreasing of repair frequency (KPI - FQ1)	The No. of repair in one period

LEARNING PERSPECTIVE					
How can we continue to be innovative and use asset management as an area of growth ?					
Corporate Level		Strategic Level		Functional Level	
Objectives	Measures	Skill, Capacities and Abilities	Measures	Execution Objective	Measures
Workers certification (KPI – CL1)	% of Worker with certificate	Increasing drivers ability (KPI – SL1)	Rate of Driver Violations	Increasing On The Job Training Activity (KPI – FL1)	The number of OJT be done
		Increasing Training Programme for Mechanics (KPI – SL2)	% of Mechanics who follow the training		

Source : Didien, et.al, 2016

The strategy map of model MSC refer on a strategy map of balanced scorecard that was created by Kaplan and Norton (1996, 2001, 2007) depicting a hierarchy at every level and every perspective. The following strategy map of MSC for the performance of maintenance SBU busway.

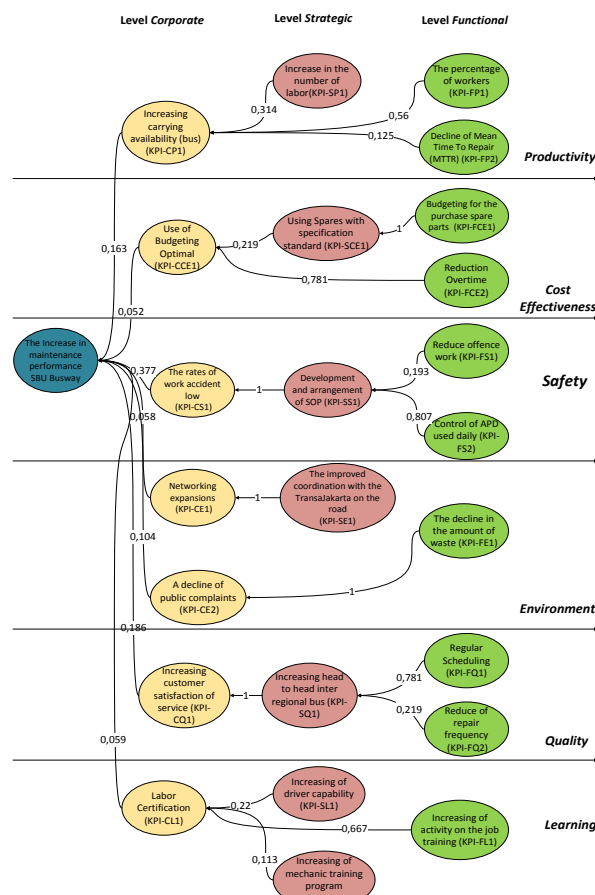


Figure 2 Strategy Map of MSC Maintenance Performance Transjakarta Bus SBU BUSWAY

To get a performance score required weights to every strategic objectives and KPI. Weight obtained by using the method pairwise comparison such as is used in Analytical Hierarchy Process (AHP) Saaty which then need to normalize the weight. The results of weighting uses software Expert Choice 11.

3. RESEARCH METHOD

Maintenance Performance Measurement use documentation model MSC, strategy and KPI map, weights and a scale of measurement for each KPI. The data collection was done to get a score every KPI and followed by performance measurement Transjakarta bus maintenance namely by provide a score on each KPI and multiplied them with weights have normalized to get a score total. KPI that can not be covered or the percentage of achievements low, sought

cause to making proposal repair performance and repairs model.

		4	1 – 3 hours		
		5	< 1 hour		

4. MAINTENANCE PERFORMANCE MEASUREMENT USE MAINTENANCE SCORECARD SCHEME

4.1 The measurement of maintenance performance score every level on the six perspective

The measurement done by way of inserting the data obtained from the company and then match it with the range of already defined and judge based on Likert scale scoring. If the KPI that is not owned by the company, it will be given the estimated score based on the agreement between researcher. with experts who are experts in their fields.

Table 2 Measurement Result of Productivity Perspective

Level	KPI	Score	Range	Mean	Score
Corporate	Availability	1	< 85%	103%	5
		2	85.1 – 90%		
		3	90.1 – 95%		
		4	95.1 – 100%		
		5	>100%		
Strategic	The amount of extra workers	1	< 88%	80%	1
		2	88.1 – 91%		
		3	91.1 – 94%		
		4	94.1 – 97%		
		5	97.1 – 100%		
Functional	% Presence of Workers	1	< 80%	99%	5
		2	80.1 – 85%		
		3	85.1 – 90%		
		4	90.1 – 95%		
		5	95.1 – 100%		
Functional	Mean Time To Repair (MTTR)	1	>7 hours	3 hours	5
		2	6 – 7 hours		
		3	5 – 6 hours		
		4	4 – 5 hours		
		5	< 4 hours		

Table 3 Measurement Result of Cost Effectiveness perspective

Level	KPI	Score	Range	Mean	Score
Corporate	% Appropriate budget planning and realization	1	> 103%	100%	3
		2	101 – 103%		
		3	100%		
		4	97 – 99.9%		
		5	< 97%		
Strategic	% Spare part accordance to the specification	1	< 88%	100%	5
		2	88 – 91%		
		3	91.1 – 94%		
		4	94.1 – 97%		
		5	97.1 – 100%		
Functional	% Allocation of funds for spare part	1	< 4%	8%	5
		2	4 – 5%		
		3	5.1 – 6%		
		4	6.1 – 7%		
		5	7.1 – 8%		
Functional	Average of overtime	1	>7 hours	1 hour/month	5
		2	5 – 7 hours		
		3	3 – 5 hours		

Table 4 Measurement Result of Safety Perspective

Level	KPI	Score	Range	Mean	Score
Corporate	Rate of work accident	1	> 3 times	2	3
		2	3 times		
		3	2 times		
		4	1 times		
		5	0 times		
Strategic	% of adherence to SOPs	1	< 80%	--	3
		2	80 – 85%		
		3	85.1 – 90%		
		4	90.1 – 95%		
		5	95.1 – 100%		
Functional	No. violations of labor procedure	1	> 3 times	7 times/month	1
		2	3 times		
		3	2 times		
		4	1 times		
		5	0 times		
Functional	Checklist of use APD	1	< 88%	100%	5
		2	88 – 91%		
		3	91.1 – 94%		
		4	94.1 – 97%		
		5	97.1 – 100%		

Table 5 Measurement Result of Environment Perspective

Level	KPI	Score	Range	Mean	Score
Corporate	The number of networks of cooperation	1	< 2	1	1
		2	2		
		3	3		
		4	4		
		5	5		
Strategic	Public complaints rate	1	> 3 times	4	1
		2	3 times		
		3	2 times		
		4	1 time		
		5	0 time		
Functional	% Doing coordination with Trans Jakarta	1	0 – 20%	--	3
		2	20.1 – 40%		
		3	40.1 – 60%		
		4	60.1 – 80%		
		5	80.1 – 100%		
Functional	Rate of waste disposal	1	> 61%	0%	5
		2	41 – 60%		
		3	21 – 40%		
		4	1 – 20%		
		5	0%		

Table 6 Measurement Result of Quality Perspective

Level	KPI	Score	Range	Mean	Score
Corporate	The number of passengers complaint	1	> 25 complaints	19	3
		2	21 – 15 complaints		
		3	16 – 20 complaints		
		4	11 – 15 complaints		
		5	< 10 complaints		
Strategic	Bus Interval time head to head	1	> 20 minutes	10.1 minutes	1
		2	15 – 20 minutes		
		3	10 – 15 minutes		
		4	5 – 10 minutes		
		5	< minutes		
Functional	% maintenance work against of the schedule	1	> 3 times	--	5
		2	3 times		
		3	2 times		
		4	1 time		
		5	0 time		
Functional	The number of repair in one period	1	0 – 20%	17%	1
		2	20.1 – 30%		
		3	30.1 – 40%		
		4	40.1 – 50%		
		5	>50%		

Table 7 Measurement Result of Learning Perspective

Level	KPI	Score	Range	Mean	Score
Corporate	% of Worker with certificate	1	0 – 20%	100%	5
		2	20.1 – 40%		
		3	40.1 – 60%		
		4	60.1 – 80%		
		5	80.1 – 100%		
Level	KPI	Score	Range	Mean	Score
Strategic	Rate of Driver Violations	1	> 3 times	4 times	1
		2	3 times		
		3	2 times		
		4	1 time		
		5	0 time		
Level	KPI	Score	Range	Mean	Score
Functional	% of Mechanics who follow the training	1	0 – 20%	93%	5
		2	20.1 – 40%		
		3	40.1 – 60%		
		4	60.1 – 80%		
		5	80.1 – 100%		
Level	KPI	Score	Range	Mean	Score
Functional	The number of OJT be done	1	< 2 times	0	1
		2	2 times		
		3	3 times		
		4	4 times		
		5	>4 times		

4.2 Calculation of Maintenance Performance Score

The calculation of the value of the performance is done by way of doing the multiplication between weighting normalization predetermined with the score set for each KPI, after it's all summed up the results of the multiplication.

Table 8 Measurement Result of Every Perspective

<i>Productivity</i>			
KPI	Normalized Weight	Score	Weight x Score
Increasing availability of buses Armada (KPI-CPI)	0,5	5	2,5
Increasing the amount of workers (KPI – SPI)	0,16	1	0,16
% Presence of workers (KPI - FP1)	0,28	5	1,4
Decreasing of Mean Time To Repair (KPI – FP2)	0,06	5	0,3
TOTAL			4,36

<i>Cost Effectiveness</i>			
KPI	Normalized Weight	Score	Weight x Score
Optimal use of budget (KPI – CCE1)	0,45	4	1,8
The use of spare parts in accordance to the specification (KPI – SCE1)	0,1	5	0,5
Allocation of funds for spare part purchasing (KPI – FCE1)	0,1	5	0,5
Decreasing of overtime (KPI – FCE2)	0,35	5	1,75
TOTAL			4,55

<i>Safety</i>			
KPI	Normalized Weight	Score	Weight x Score
Rate of accident work is minimum (CS1)	0,45	4	1,8
Preparation and Development of SOPs (KPI – SS1)	0,1	3	0,3
Decreasing of labour violations (KPI – FS1)	0,1	1	0,1
Controlling the use of APD in daily work (KPI – FS2)	0,35	5	1,75
TOTAL			3,95

<i>Environment</i>			
KPI	Normalized Weight	Score	Weight x Score
The expansion of mass transit network sustainable cooperation (KPI – CE1)	0,18	1	0,18
Decreasing of public complaints (KPI – CE2)	0,32	1	0,32
Increasing the coordination between TransJakarta about street condition (KPI – SE1)	0,18	3	0,54
Decreasing the amount of the waste (KPI – FE1)	0,32	5	1,6
TOTAL			2,64

<i>Quality</i>			
KPI	Normalized Weight	Score	Weight x Score
Increase customer satisfaction in service (KPI – CQ1)	0,33	3	0,99
Increasing bus interval time head to head (KPI – SQ1)	0,33	3	0,99
Scheduling regularly (KPI – FQ1)	0,26	5	1,3
Decreasing of repair frequency (KPI – FQ1)	0,07	1	0,07
TOTAL			3,35

KPI	Normalized Weight	Score	Weight x Score
Workers certification (KPI – CL1)	0.5	5	2.5
Increasing drivers ability (KPI – SL1)	0.11	2	0.22
Increasing Training Programme for Mechanics (KPI – SL2)	0.06	5	0.3
Increasing On The Job Training Activity (KPI – FL1)	0.33	1	0.33
TOTAL			3.35

4.3 The Measurement of Percentage Maintenance Performance Achievements Every Perspective.

Having acquired value the result of calculation, then done maintenance performance measurement Transjakarta bus Perum Damri SBU busway corridor I & VIII based on a method of maintenance scorecard, as for report will described through table below;

Table 9 Measurement Result of Maintenance Performance TransJakarta Bus SBU Busway Corridor I & VIII Perum Damri Use Maintenance Scorecard

Perspective	Weight	Score	Value	Maximum Value	% of Achievement
Productivity	0,16	4,36	0,698	0,800	87,2%
Cost	0,05	4,55	0,228	0,250	91,0%
Safety	0,38	3,95	1,501	1,900	79,0%
Environment	0,16	2,64	0,422	0,800	52,8%
Quality	0,19	3,35	0,637	0,950	67,0%
Learning	0,06	3,35	0,201	0,300	67,0%
TOTAL			3,686		

In table above showed weight obtained from the questionnaire 2, the weighting by using pairwise comparison and followed by normalizing weight. A maximum value obtained if weight multiplied by the highest scores is 5. While the percentage grade achievements is a subdivision of between scores actual multiplied by with weights the results of normalization divided by a score maximum (5) multiplied by with weights the results of normalization

Table 10 KPI Document Every Perspective with value of score is 1

Perspective	KPI	Score
Productivity	The amount of extra workers	1
Safety	The amount of work procedure complaints	1
Environment	The number of cooperation network	1
Environment	The rate of customer complaints	1
Quality	The amount of repair in a period	1
Learning	The rate of driver violations	1
Learning	The number of On Job Training be done	1

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

1. There are seven strategic objectives in competitive advantages (the corporate level), seven strategic objectives in strategic advantages (the strategic level), and ten strategic objectives in strategic assets (functional level). And there were 24 strategic objectives with KPI and weights.
2. The maintenance performance result show productivity perspective get value of 0,71, cost effectiveness 0.21, safety 1.29, environment 0.43, quality of 0.63, and learning 0.19. The measurement result maintenance performance according to a scale likert; perspective productivity have a score of 4,37 (very good), cost effectiveness perspective score 4.10 (good), safety perspective score 3.41 (good), environment perspective score

2,64 (enough good), quality perspective score 3,37 (good), and learning perspective score 3.23 (enough good). The measurement result a whole maintenance performance transjakarta bus in Perum Damri SBU busway corridor I & VIII was obtained 3,46 score that is indicative of maintenance performance is good (range 3.4 - 4.2).

3. Obtained the result of six perspectives; one perspective there is cost effectiveness the value is very good, while five other perspectives have seven KPI scores at low level, there are productivity perspective for the amount of labor, safety perspective for offense procedure work, environment perspective for the number of cooperation network and community complaints level, in quality perspective for the number of improvements in any given period of time, and in learning perspective level for offense the driver and the number of activities on the job training (OJT) was done.

5.2 Recommendations

Based on research purpose to improve the maintenance performance there are if KPI have a score of one, SBU busway corridor I & VIII Perum Damri need to do;

1. Propose to add the shortage of mechanical soon because until now the number of mechanical still not reached the target.
2. Give penalty for mechanical it is being smoked on the workshop area because it will be risking of safety.
3. Increase the number of operational route by means of win the future tender to the additional route. Because it will add the kilometers of road that will affect the increase of revenue.
4. Optimize the call center to reduce time to repair the bus that need to repair in the lane
5. Increasing the quality of maintenance that the frequency of improvement can be reduced.

6. Increased capacity the driver that the number of offense the driver reduced.
7. Increased intensity activity on the job training (OTJ) to mechanical

6. REFERENCES

References should be completed in all respects and arranged in alphabetical order. All name stated in reference, shall be appear in previous text, and vice versa.

- [1] Beck, Richard and Oliver Rod. (2004). PTQ Winter 2004 : Reability and Asset Management. Selecting key performance indicator for strategy.
- [2] David, Fred R. (2013). Strategic Management : Concepts and Cases. Fourteenth Edition. Pearson: South Carolina.
- [3] Didien Suhardini, Iveline Anne Marie, Amal Witonohadi, Auliandi Fahriditya Putra (2016). Perancangan Sistem Kinerja Perawatan Bus Transjakarta Pada Perum Damri SBU BUSWAY
- [4] Emelia Sari. (2008). Jurnal LIPI. Perancangan Maintenance Scorecard dan Penggunaan Analytical Hierarchy

Process dalam Penentuan Bobot Key Performance Indicator.

- [5] Kaplan dan Norton. (2001). Strategy Maps. Harvard Business Review.
- [6] Saaty, T.L. Analytical Hierarchy Process.
- [7] Winnie Septiani, Didien Suhardini, Emelia Sari. (2012). Jurnal Universitas Diponegoro. Pengukuran Kinerja Perawatan Lokomotif PT. Kereta Api Indonesia (PERSERO) Berdasarkan Model Maintenance Scorecard.
- [8] Mather, Daryl. (2005). The Maintenance Scorecard First Edition. Industrial Press: New York

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