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Green Supply Chain Management Performance Measurement in Palembang Rubber Industry

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Abstract. *Rubber is one of the non oil-gas product from South Sumatera. However, several companies in this sector are not yet concerned with environmental aspects. Most companies have a profit-oriented goal regardless of environmental aspects especially waste management. The environmental aspect has not been integrated into the supply chain in practice so that its implementation has not been effective. Green supply chain management is a way to integrate it. Applications of green supply chain management in companies could help to minimize the impact of environmental pollution. However GSCM performance measurement has not been widely carried out in the rubber processing industry, especially those located in South Sumatra. So the aim of this research is to analyze the performance of GSCM using the green SCOR model. The results showed that the value of GSCM performance in PT. Sunan Rubber Palembang is categorized as average with a value of 64.03.*

Keywords: *Green Supply Ch,ain Management; rubber industry, Key Performance Indicators, Green SCOR*

I. INTRODUCTION

Natural rubber is one of Indonesia's leading non-oil and gas products after coconut and palm oil. So that some companies in Indonesia use natural rubber as a raw material in their production process (Sri Hertina et al., 2021). So that there are many companies in South Sumatra whose business is natural rubber processing.

Natural rubber is one of the superior products from the South Sumatra. South Sumatra is the largest contributor to the average production of natural rubber every year, which is 28.77% of the total national rubber production (Direktorat Jenderal Perkebunan, 2019). However, several companies in South Sumatra are not concerned about environmental aspects in the production process of natural rubber processing. In fact, natural rubber processing has a tendency to pollute the environment, which could come from waste water or air from the production process, especially the production locations are mostly near residential areas. (Andriani et al., 2019).

Most companies do not incorporate environmental aspects into their supply chains. The environmental aspect has not been integrated into the supply chain in practice so that its implementation has not been effective. There is a way to integrate the two through green supply chain management (Primadasa & Sokhibi, 2020). Applications of green supply chain management in companies could help to minimize the impact of environmental pollution (Natalia & Astuario, 2015).

In addition, green supply chain management can be used to measure performance that is useful for improving company performance through a series of improvements that are implemented. Along with these improvements, green supply chain management can also improve company efficiency in the supply chain (Purnomo et al., 2019).

The application of Green Supply Chain Management (GSCM) in the rubber processing industry is not widely used in South Sumatra, especially Palembang. This is because some companies are only concerned with profit oriented without considering environmental aspects. In fact, in some countries the implementation of environmental management has been carried out through the application of environmentally friendly technologies (Jabbour,

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2015) and the implementation of process activities based on ISO 14001 (Silva et al., 2020).

The research on the measurement of Green Supply Chain Management (GSCM) has been carried out in various industries, for example in the textile industry conducted by Febrianti et al. (2018), on the tanning industry by Purnomo et al. (2019) as well as in the palm oil industry by Primadasa & Sokhibi. (2020). In addition, the measurement of the performance of Green Supply Chain Management (GSCM) can be started from a small scale as in SMEs which has been carried out by Brilliana et al. (2020) and Susanty et al. (2017) to steel companies that has been done by Ritajeng et al. (2015).

However, the measurement of Green Supply Chain Management (GSCM) performance has not been widely carried out in the rubber processing industry, especially those located in South Sumatra. So the aim of this research is to analyze the performance of Green Supply Chain Management (GSCM) using the green SCOR model.

II. RESEARCH METHOD

Research Object

The object of this research is the performance of Green Supply Chain Management (GSCM) in the natural rubber processing industry in Palembang. The location of this research was carried out at PT. Sunan Rubber which starts from March to July 2022.

The Data Collection

The data collection begins with formulating Key Performance Indicators (KPI) to measure the performance of Green Supply Chain Management (GSCM) because the company does not yet have a model for measuring GSCM performance. The KPIs for measuring GSCM performance in this research were obtained from references to several journals that would be validated by company experts such as managers and heads of departments. To adjust the KPI to the company's conditions, a Group Discussion Forum was conducted (Pratiwi & Mas'udi, 2018).

The results of the indicators are then compiled into the framework of the GSCM model. The variables used are plan, source, make, deliver, return and enable which are variables from Green SCOR. Then the weighting of these indicators is carried out using the Analytical Hierarchy Process (AHP). The weighting at the Green SCOR level is done by doing pairwise comparisons on all aspects of the GSCM model variable. To get the final value of the GSCM performance calculations for each work attribute are carried out.

The Data Processing

The data processing begins with calculating the results of the validated GSCM performance indicators and continues with calculating the actual value for each indicator. And the next step is normalization of snorm de bour. It aims to align the different size scales of each performance indicator using the equation (1).

$$Snorm = \frac{SI - S\,min}{S\max - S\,min} \times 100 \quad (1)$$

where:

SI = Actual indicator value achieved

S_{min} = The worst performance score of the performance indicators

S_{max} = The best performance score of the performance indicators

The determination of the worst (S_{min}) and the best (S_{max}) performance values is based on three categories which are larger is better, lower is better and nominal is better. The weighting with AHP is carried out to determine the level of importance of each performance indicator so that priority performance indicators can be identified. The scale used for weighting the AHP method consists of 1 to 9. Then the calculation of the GSCM performance value is carried out by multiplying the final value of the performance indicator resulting from the normalization of snorm de bour with the AHP weight value of each indicator.

III. RESULTS AND DISCUSSION

Key Performance Indicator Design

Key Performance Indicators are compiled from various reputable journals. The indicators that have been validated are presented in Table 1.

Table 1. The Validated KPIs

Variabel	Dimensi	Key Performance Indicator
Plan	Reliability	Energy used
		Water used
		% of Synthetic chemical used
Source	Reliability	% Order received damage free
		% Hazardous material in inventory
		% of Supplier with an EMS or ISO 14000 Certification
	Responsiveness	Source cycle time
		% of not feasible package
	Flexibility	Upside source flexibility
Make	Reliability	Yield
		Make liquid emission
		% of recycleable material
	Responsiveness	Make cycle time
		The influence of production waste
	Flexibility	Upside make flexibility
Deliver	Reliability	Deliver quantity accuracy
		Shipping document accuracy
	Responsiveness	Deliver cycle time
Return	Reliability	% of complaint regarding missing environmental requirement from product
	Responsiveness	% of error-free return ship
Enable	Reliability	% of employee trained in enviromental requirement

Weighting of Indicators with AHP

The validated indicators are then weighted using the Analytical Hierarchy Process (AHP) method. The results of the weighting are presented in Table 2 and Table 3.

Table 2. Variable and Dimensions Weights

Variable	Weight	Dimension	Weight
Plan	0.1868	Reliability	1.0
Source	0.1326	Reliability	0.401059
		Responsiveness	0.289835
		Flexibility	0.309106
Make	0.1932	Reliability	0.381675
		Responsiveness	0.373026
		Flexibility	0.245299
Deliver	0.1704	Reliability	0.622135
		Responsiveness	0.377865
Return	0.1438	Reliability	0.5
		Responsiveness	0.5
Enable	0.1732	Reliability	1.0

Table 2 shows the weighting for variables and dimensions using the AHP method. The results from Table 2 show that the make variable has the highest weight with a value of 0.1932. Pada variable make terdapat indikator yield, make liquid emission, % of recycleable material, make cycle time, the influence of production waste dan upside make flexibility. The make variable

Table 3. Indicator Weights with AHP

Key Performance Indicator	Weight
Energy used	0.3800
Water used	0.3300
% of Synthetic chemical used	0.3000
% Order received damage free	0.3690
% Hazardous material in inventory	0.3613
% of Supplier with an EMS or ISO 14000 Certification	0.2698
Source cycle time	0.4285
% of not feasible package	0.5715
Upside source flexibility	
Yield	0.3778
Make liquid emission	0.3747
% of recycleable material	0.2474
Make cycle time	0.4920
The influence of production waste	0.5080
Upside make flexibility	
Deliver quantity accuracy	0.4784
Shipping document accuracy	0.5216
Deliver cycle time	
% of complaint regarding missing environmental requirement from product	
% of error-free return ship	
% of employee trained in enviromental requirement	

Table 4 . Normalization of Snorm de Bour and Calculation of Green SCOR Performance

Variable	Level 1 Weight	Dimension	Level 2 Weight	Key Performance Indicator	Level 3 Weight	Actual (Si)	S min	S max	SNORM	Final Weight	Normalization	Final Performance
Plan	0.19	Reliability	1	Energy used	0.38	7.49	5	10	50.2	0.07	3.62	
				Water used	0.32	15.06	10	20	49.4	0.06	3	
				% of Synthetic chemical used	0.3	0	0	5	100	0.06	5.7	
Source	0.13	Reliability	0.49	% Order received damage free	0.37	100	90	100	100	0.02	2.36	
				% Hazardous material in inventory	0.36	0	0	10	100	0.02	2.29	
				% of Supplier with an EMS or ISO 14000 Certification	0.27	0	0	50	0	0.02	0	
		Responsiveness	0.29	Source cycle time	0.43	3.9	3	7	77.5	0.02	1.26	
				% of not feasible package	0.57	0	0	20	100	0.02	2.15	
		Flexibility	0.31	Upside source flexibility	1	100	90	100	100	0.04	4.03	
Make	0.19	Reliability	0.38	Yield	0.38	95.38	80	100	76.9	0.03	2.11	
				Make liquid emission	0.37	3.38	2	7	27.6	0.03	0.74	
				% of recycleable material	0.25	51.38	44.6	60	44.38	0.03	0.8	64.03%
		Responsiveness	0.37	Make cycle time	0.49	8.42	7	10	52.67	0.03	1.81	
				The influence of production waste	0.51	66	50	100	68	0.04	2.44	
		Flexibility	0.25	Upside make flexibility	1	40	0	50	80	0.05	3.8	
Deliver	0.17	Reliability	0.62	Deliver quantity accuracy	0.48	96.59	90	100	65.9	0.05	3.33	
				Shipping document accuracy	0.52	100	90	100	100	0.05	5.48	
		Responsiveness	0.38	Deliver cycle time	1	11.05	10	15	79	0.06	5.1	
Return	0.14	Reliability	0.5	% of complaint regarding missing environmental requirement from product	1	0	0	5	100	0.07	7	
		Responsiveness	0.5	% of error-free return ship	1	0	0	5	100	0.07	7	
Enable	0.17	Reliability	1	% of employee trained in enviromental requirement	1	0	0	20	0	0.17	0	

containing the make liquid emission indicator is related to measurements to determine the percentage of companies in extracting waste from rubber washing results from suppliers. This is a concern for the company because there is no routine schedule for vacuuming the remaining rubber laundry waste.

While the results from Table 3 show that the highest indicator is % of not feasible package with a value of 0.5715. This indicator relates to the quality of the product to be produced. Decent packaging quality will increase the level of customer trust and will indirectly have a good impact on the environment (Rukmayadi et al., 2016).

The Calculation of Actual Value and Final Value of Performance Indicators

The calculation of the actual value of performance indicators are carried out using the actual data that has been collected, questionnaires and interviews for qualitative data. After obtaining the actual value of the performance indicator, then normalization be carried out on the results of the calculation of the actual value by using the snorm de bour in equation (1), so that the final value of the performance indicator will be obtained. The results of normalization of Snorm de Bour is shown in Table 4

The results of data processing using normalization snorm de bour and Green SCOR in Table 4 showed that the final performance value is 64.03. The value is categorized in average. Then these indicators will be improved. To find out the indicators that have been improved, the Traffic Light System is used. The Traffic Light System uses three color indicators which are red, yellow and green. A red indicator is given if the SNORM value shows a performance score 60 which means the performance is not satisfactory. Then a yellow indicator is given if the value shows a performance score of 60 < performance score < 80. And a green indicator is given if the performance score is 80 which means the performance is satisfactory.

Based on this, the indicators that need to be improved are energy used, water used, % of supplier with an EMS or ISO 14000 Certification, make liquid emission, % of recycleable materials, make cycle time and % of employees trained in environmental requirements. There are suggestions for improvements that can be made to minimize energy use, for example, workers must be more efficient in using operated machines. Then to minimize the use of water, workers can increase the discipline in using water during the washing process. In addition, ISO 14000 certification for suppliers must be implemented immediately. This will improve the quality of the raw materials to be received.

IV. CONCLUSION

The value of GSCM performance in the rubber processing industry at PT. Sunan Rubber Palembang is categorized as average with a value of 64.03. The indicators that are categorized as red need to be proposed for improvement. Those indicators are energy used, water used, % of supplier with an EMS or ISO 14000 Certification, make liquid emission, % of recycleable materials, make cycle time and % of employees trained in environmental requirements.

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