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Analysis of Green Logistics Application in Raw Material Transportation, Warehousing, Packaging Using Green Scor Method

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ABSTRACT

The development and competition in the automotive industry have become one of the biggest contributors to various pollution and waste caused by the movement of the industrial supply chain in Indonesia. Companies in the automotive industry are required to implement green supply chain management. Therefore, it is necessary to analyze the application of green supply chain management in companies in the automotive industry. The study was conducted at a manufacturing company located in Cikarang, which is engaged in the field of car assembly, which is a company with fairly large car production in the Indonesian automotive industry. The problem found is not achieving the target of relevant company transportation, warehousing, and packaging. The population in this study are logistics activities related to transportation, warehousing, and packaging found in the company, while the sample in this study is the activity of raw material transportation, warehousing, and packaging for the assembly process of Xpander cars. The flow of the research was carried out with the initial steps of primary and secondary data collection, then the KPI design which would later be validated by an expert. After that, the AHP is weighted and then the performance is calculated using the Green SCOR method. The results showed there were 31 KPIs which became the basis for calculating Green SCOR. The form of green logistics implementation by the company is in terms of raw material transportation, the company has used the milk-run delivery method in shipping goods from suppliers and also chose the shortest route to minimize fuel consumption, in terms of raw material warehousing, optimizing the supply method to the production line and efficiency storage of goods, in terms of raw material packaging that is minimizing the level of packaging that is damaged when storing in the warehouse area and the use of packaging such as poly boxes, pallets, dolly, racks that can be reused. The results of the Green SCOR for Green Logistics obtained amounted to 83.8668 where according to the monitoring system table the work indicators are included in the "Good "category. Improving the performance of green logistics by implementing proposed improvements will have a good impact on green supply chain management as a whole.

Keywords: Green Supply Chain Management, Green Logistics, Green Transportation, Green Warehousing, Green Packaging, Green SCOR, Analytical Hierarchy Process.

INTRODUCTION:

Awareness will be the importance of the role of Supply Chain Management in improving the company's performance continues to increase from year to year. Over time, each company increasingly focused on the performance of the components in the supply chain and also the collaboration between the actors contained in the supply chain. Movement of the supply chain has some adverse impacts on the surrounding environment. Pollution, garbage, waste, and other hazards to the environment often occur when the flow and supply chain

processes take place. Srivastava (2007) defines green supply chain management as the integration of environmental thinking into supply chain management, including product design, material purchasing and supplier selection, manufacturing processes, delivery of end products to consumers, and also product management after their useful life. Green supply chain management slowly began to enter the realm of the automotive industry in Indonesia, several companies have implemented green supply chain management in the supply chain they live. The study was conducted on one company in the automotive industry which is engaged in assembling cars from Japan. Current conditions indicate that the application form did not already know what is being done enterprises to implement green logistics and also the lack of form of performance measurement on green logistics. This causes the company to not be able to know what activities have actually been carried out related to improving the performance of green logistics, and also what activities still need to be improved to increase the value of the performance. Also, the company does not know the value of the performance of green logistics contained in the company, plus not yet known what methods should be used, as well as proposed improvements to improve the value of performance. In the absence of this, the company needs to do performance measurements related to green logistics. In terms of transportation, the large number of truck suppliers that deliver raw materials to the company causes quite a large amount of pollution so that it is indirectly bad for the environment. In terms of warehousing, the raw material is still too long to be stored in a warehouse before being supplied to the production line, this can cause a decrease in quality of the goods such as rust, brittle or other so that the raw material cannot be used again for production which then becomes garbage and does not used up . In terms of packaging raw materials or parts themselves, there are still some that only disposable packaging thereby causing the garbage is certainly not good for the environment as well as the company itself. Identification of the problem that occurs is not achieving the company's target of the number of truck arrivals every day, which is in Figure 1, not achieving the company's target for the long storage of parts less than four hours in the warehouse based on the number of suppliers, contained in Figure 2, not achieving the company's target towards packaging that can be reused by the number of parts, which are contained in Figure 3. This study discusses only the measurement of the performance of green Logistics in raw material transportation, warehousing and packaging.

Fig.1: Graph of Supplier's Truck Arrival per Day

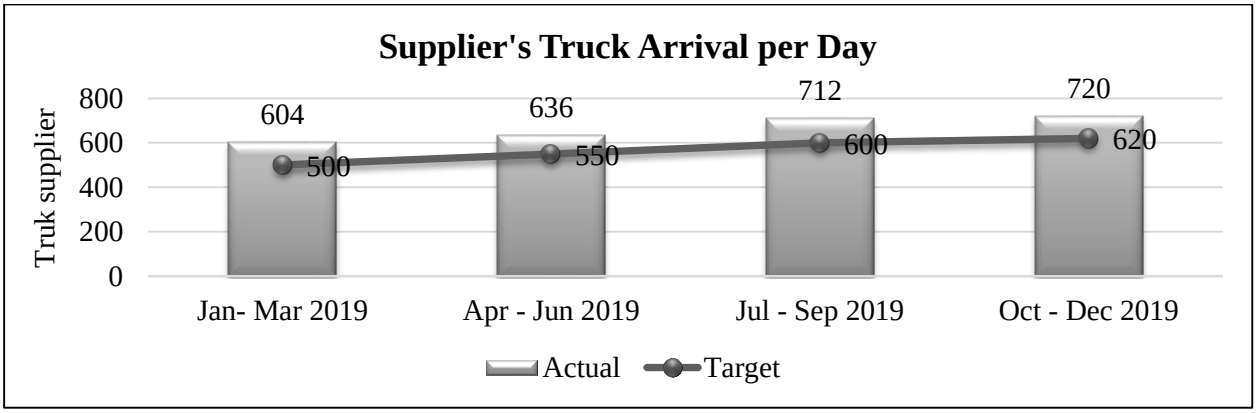


Fig. 2: Graph of Lead Time Part Less Than 4 Hour in Storage Based on Supplier

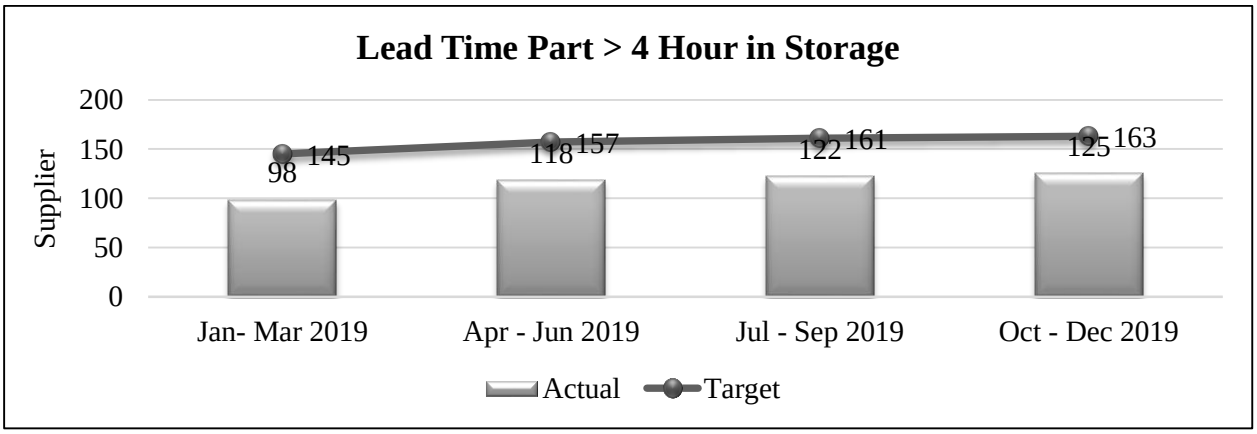
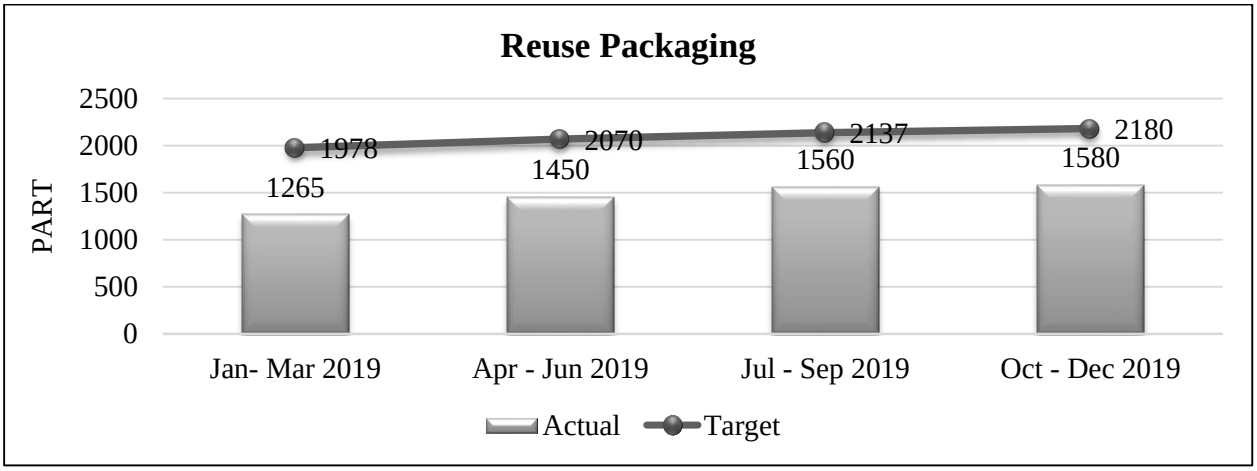


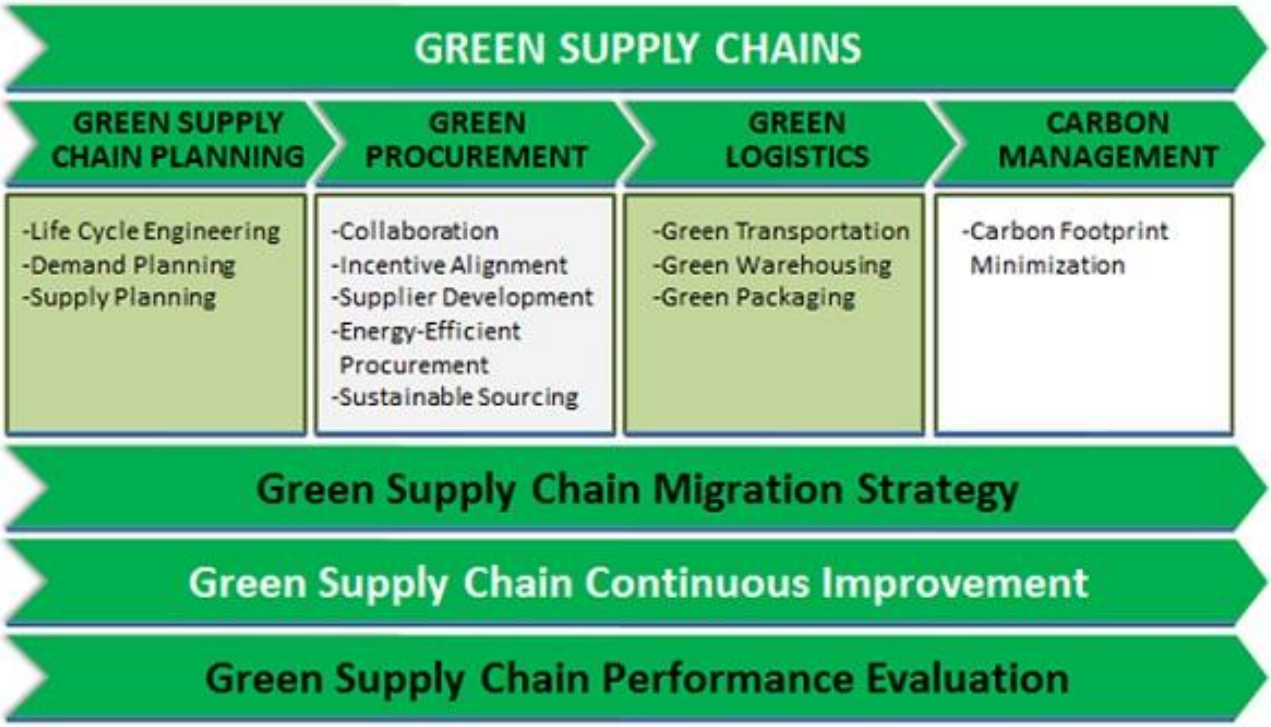
Fig. 3: Graph of Reuse Packaging Based on Part Number



LITERATURE REVIEW:

According to (Srivastava 2007), Green Supply Chain Management as the integration of environmental issues into the Supply Chain Management, including product design, material purchase raw and supplier selection, manufacturing process, to delivery of the products end to the consumer. According to the state of the art one branch of science from the concept of green supply chain consists of green logistics and reverse logistics. According to (Rodrigue et al 2017), it is said that green logistics focuses on discussing material handling, packaging and transportation.

Fig. 4: Green Supply Chain Framework



Source: Ghobakhloo et al, 2013

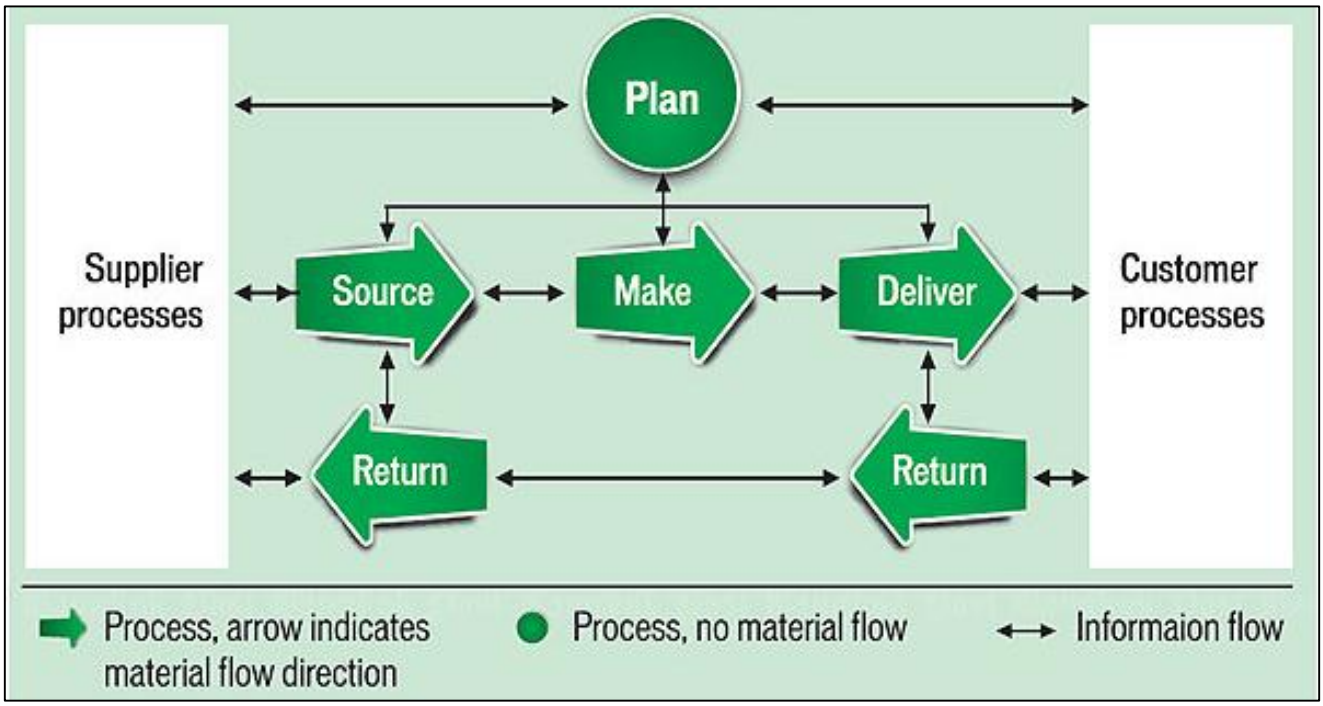
Figure 4 illustrates how to frame thoughts from the green supply chain. In the green logistics section, it is explained that the pillars that can support the performance of green logistics are green transportation, green warehousing, and green packaging. These three factors can support the creation of a strategy that can be developed into continuous improvement and then will be resumed by evaluating the performance of the green supply chain. The Green SCOR model is the result of the development of the existing SCOR model. This Green

SCOR Model adds several considerations related to the environment in which it aims to create an analysis that will give an overview of the relationship of supply chain functions with environmental aspects to create Improved management performance between the two (Taylor, 2003). There are 5 main components in the Green SCOR model used in this study, including:

1. Plan, planning to minimize energy consumption, handling and storing hazardous materials, disposal of ordinary and hazardous waste.
2. Source, selection of suppliers that are environmentally friendly, environmentally friendly packaging, materials pass quality control.
3. Make, the process of making a product by considering its effect on the environment.
4. Deliver, focus on delivery above the target, large scale distribution and flexible packaging design.
5. Return, focus on renewing products and minimal returns.

The process and information flow of the five components can be seen in the following figure:

Fig. 5: Green Supply Chain Operation Reference Model



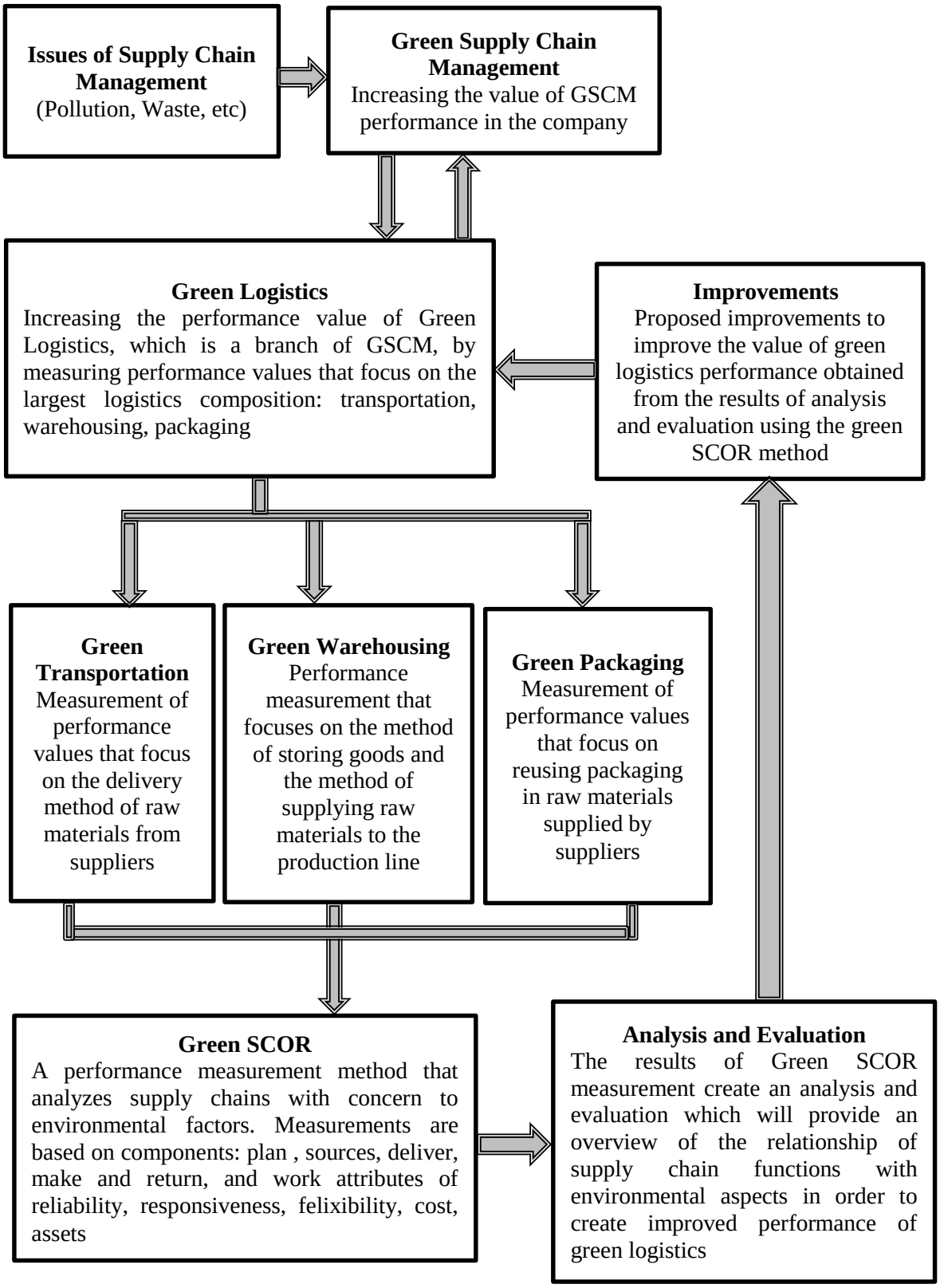
Source: Supply Chain Council, (2008)

The calculation of green SCOR requires an indicator to be measuring material. Each indicator has varying weights with different parameters, so a parameter is needed by the normalization of the parameters. The normalization process was carried out with the normalization formula of Snorm de Boer. Another method used is the AHP method, AHP is used to prioritize the priorities of the various alternatives or options available and those options are complex or multi-criteria. Based on the foundation of the theory, the following is a research thinking framework:

RESEARCH METHODOLOGY:

This research is a quantitative research. The research subjects are managers in the material handling department and general manager who heads the production control subdivision who is an expert in the supply chain and also acts as a decision-maker for the process of the supply chain. The object under study is a company engaged in car assembly manufacturing with a focus of study on measuring the performance of green logistics. The population in this study is the logistics activities related to transportation, warehousing, and packaging in the company. While the sample in this study is the activity of raw material transportation, warehousing, and packaging for the Xpander car assembly process.

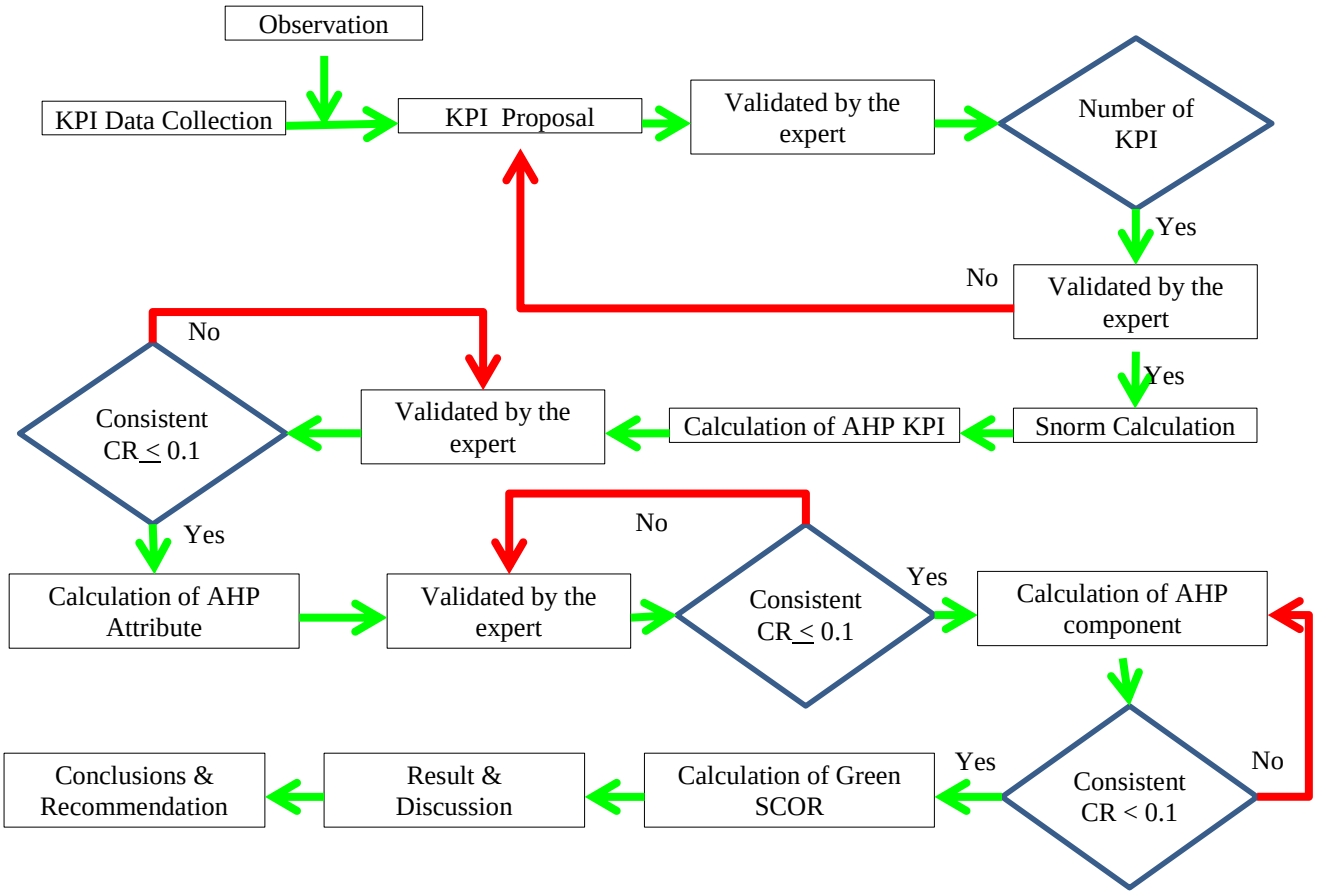
Fig. 6: Framework



Data collection methods consist of collecting primary data by conducting interviews with material handling manager and production control general manager on the topics of transportation mechanisms, warehouse layout or storage of goods, and packaging of related raw materials from suppliers, as well as direct observation of supply chain activities including material transportation standard, warehousing and packaging to get a clear picture of the problem that occurred so that it is possible to get an answer to this problem.

The research flowchart starts with collecting data taken from field studies, then designing an influential KPI for calculating the value of green logistics performance. The KPI will be validated in advance by the expert, if it is said to be feasible as a matter that affects the performance of green logistics, then the KPI must be replaced or eliminated until all KPIs are said to be appropriate as material for calculating the performance of green logistics. After that, the Snorm calculation is done for each KPI that has been set. Then AHP is weighted for each KPI, this weighting will be validated by the expert, if the results of AHP weighting on the KPI are declared inconsistent, then AHP is re-weighted on the KPI. If it has been declared consistent, then AHP is weighted in the component.This weighting will be validated by the expert. If the result of AHP weighting on the attribute is declared to be inconsistent, then AHP is re-weighted on the attribute. If it has been declared consistent, then AHP is weighted in the component. The weighting on this component will be validated by the expert, if the result of AHP weighting on the attribute is declared to be inconsistent, then the AHP is re-weighted on the component. If it has been stated consistent, then the calculation of the green SCOR performance is then performed. After obtaining the performance value from the green SCOR, a discussion of the results of the study will then be concluded with conclusions and suggestions. Here is a picture of the research flowchart:

Fig. 7: Research Flow Chart

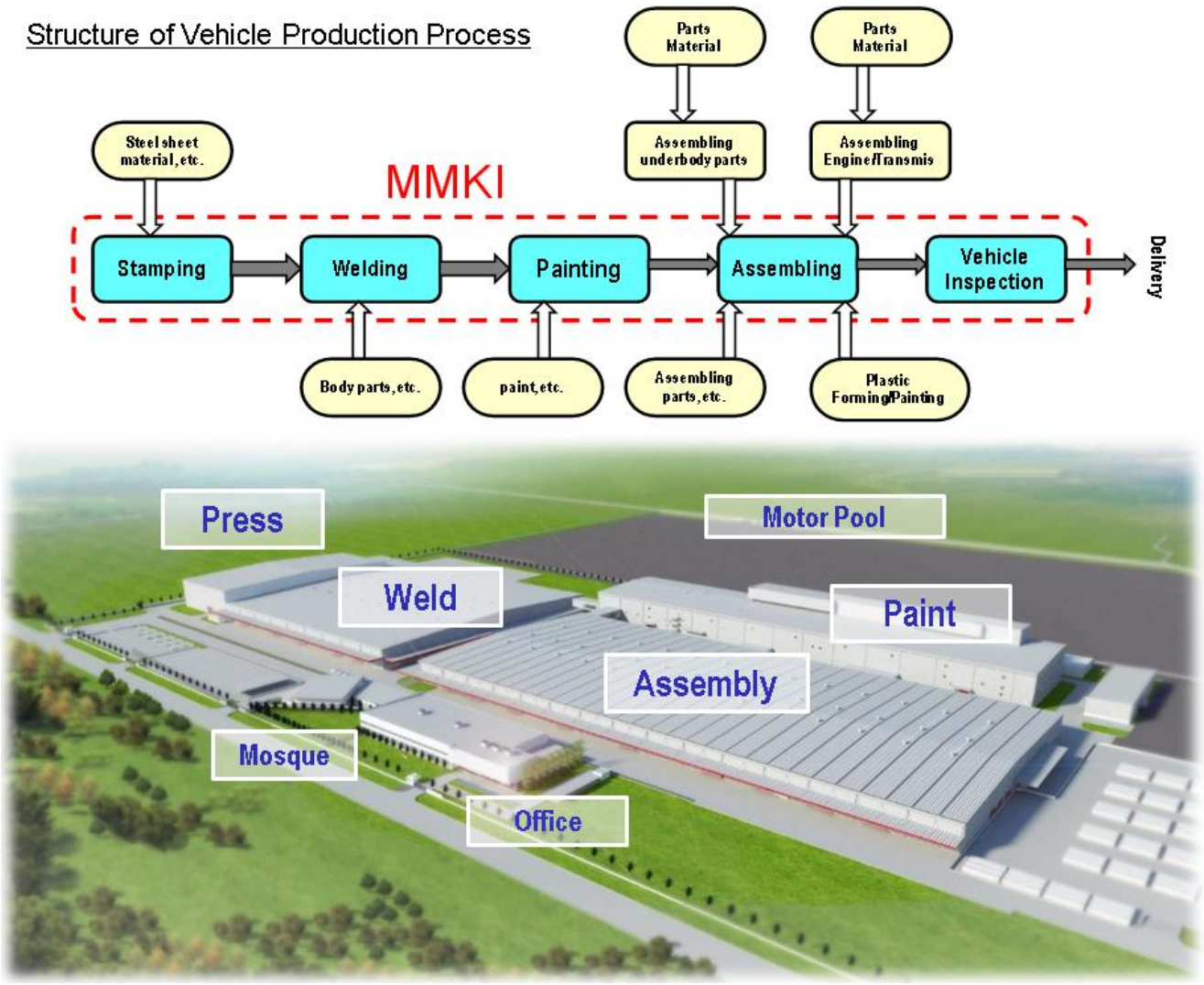


RESULTS AND DISCUSSION:

Company Processes and Activities:

The process of making a car unit starts from the press/stamping process and then continues with the welding process or often called the welding process, followed by the painting process, after which the car unit assembly or assembling process is carried out, which at this stage has the highest level of intensity in terms of receipt of goods from suppliers, which is approximately 150 suppliers with the number of trucks of approximately 650 trucks per day supplying to this assembling area, then the final check of the car unit is carried out and delivery to the distributor. The production process at the company can be seen in the following picture:

Fig. 8: Manufacture Process



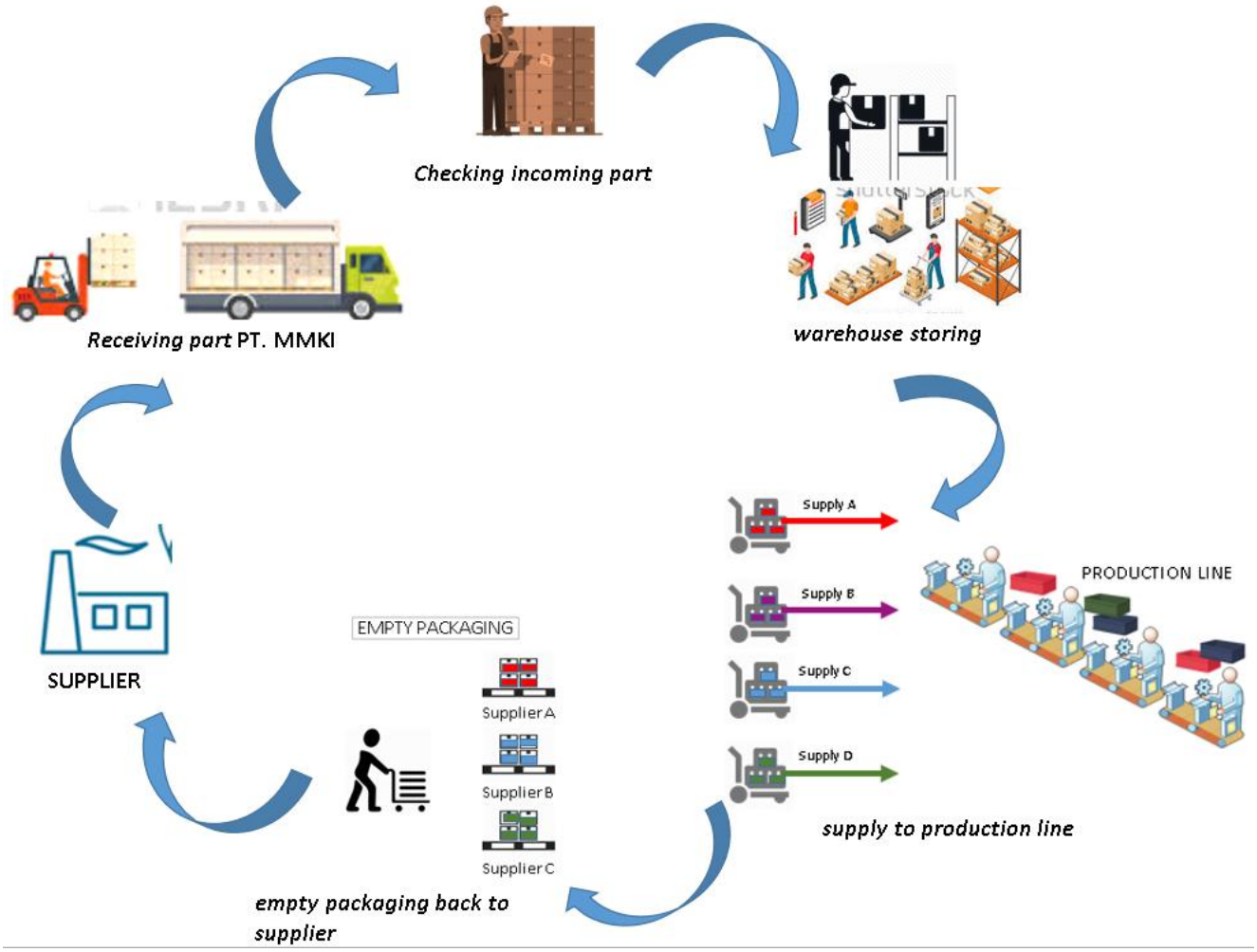
Source: Company Data

Logistical processes and activities in raw material transportation, warehousing and packaging have an important role in this company and have a very large effect in the supply chain. Green transportation, green warehousing, and green packaging become one of the concerns to increase the value of the supply chain contained in the company. The logistics process for components or parts which include transportation, warehousing, and packaging contained in the company is as follows:

Transportation includes suppliers who supply raw materials or more commonly called parts, where raw materials are used to assemble a car. The suppliers use trucks in supplying raw materials where the number of trucks needed every day is very calculated in this activity. In terms of green logistics, green transportation activities carried out by the company include optimization of routes, optimization of delivery of the number and capacity of products, optimization of fuel and optimization of loading and unloading time. Warehousing includes a variety of processes, ranging from receiving goods from suppliers, storing goods in the warehouse area, then structuring parts in the warehouse area to supplying raw material from the warehouse to the production line. Various methods are applied in each process in order to get effective and efficient results that affect the value of the supply chain itself. The process of storing parts in the warehouse area is placed not far from the production line area where the car is assembled. The warehouse has identification so that parts can be easily searched and retrieved. Whereas the determination of lead time is 4 hours, where the part has inventory for 4 hours before being used on the production line so that the inventory level is neither too small nor too much. In terms of green logistics, green warehousing activities carried out by the company include the efficient

use of storage in storing raw materials, optimizing the use of equipment in material handling activities, and also optimizing layouts in warehouses. Packaging includes the use of packaging for parts used by suppliers in sending the parts to the company and also reuse of the packaging. In terms of green logistics, green packaging activities carried out by the company include saving packaging, using environmentally friendly materials, cooperation with suppliers to standardize packaging, reducing the use of materials and time to unload and introduce recycling programs. In addition, green packaging will facilitate the arrangement of goods, can reduce the use of materials, increase the utilization of warehouse space and transportation equipment, and reduce the amount of handling needed.

Fig. 9: Logistics Raw Material Activity



Source: Company Data

Green SCOR Value Calculation:

After conducting interviews through discussions and questions and answers with managers in the material handling department and general manager who heads the production control subdivision which is an expert and decision-maker for the process of the supply chain and direct observation through observation or direct observation in the logistics department, a Key Performance Indicator is obtained (KPI), which forms the basis of calculations to determine the value of Green SCOR. This KPI has been verified directly by the expert and has an influence on the logistics performance itself. This verification is carried out to find out whether the performance indicators designed are correct and in accordance with company needs, namely by checking which indicators have not been included or do not need to be included because of the possibility of similarities with other indicators. There are 31 KPIs related to transportation, warehousing, and packaging that will be normalized by a snorm de boer with the aim of equalizing parameters because each KPI has a different weight and scale. The following table shows the results of the normalization:

Table 1: Snorm De Boer Normalization

Component	Attribute	KPI	Snorm	Category
Plan	Cost	Adding suppliers which using milk-run delivery method	40	Marginal
		Adding Logistic Partners for milk-run delivery method to increase competitive advantage among Logistic Partners	60	Average
		Lead Time parts are less than 4 hours	88,6563	Good
	Asset	Training for operators who drive forklifts	100	Excellent
		Guidance for operators in the supply to production line method	100	Excellent
		Supply parts method to production line with an automation system	60	Average
Source	Reliability	Receiving parts according to the quantity contained in the PO	87	Good
		Receiving parts according to the specified quality	90	Excellent
		Receiving parts according to the part tag label	92	Excellent
		Each area has a clear and appropriate identification	71,4286	Good
	Responsiveness	Forklift speed limit is less than the same as 7 km / h in outdoor area	76,4706	Good
		Forklift speed limit is less than the same as 5 km / h in indoor area	100	Excellent
		Receiving parts area near to the warehouse area	64,2857	Average
		Warehouse parts near to the supply area to the production line	84,8485	Good
	Flexibility	Efficient use of storage in storage parts	77	Good
	Cost	Stock parts that are not overloaded	74,8188	Good
		The level of packaging that is damaged during storage in the warehouse area	95,1234	Excellent
Make	Reliability	Receiving parts according to the gate specified	100	Excellent
		Placement of parts in accordance with the specified warehouse	75,076	Good
	Responsiveness	The process of unloading parts takes no more than 1 hour	94,0252	Excellent
Deliver	Reliability	The arrival of the truck in accordance with the specified schedule	95	Excellent
		The choice of the shortest milkrun route by the truck in the process of shipping parts to minimize fuel consumption	100	Excellent
		Cyclic supply method to the production line	60,6061	Average
	Flexibility	There is a schedule for receiving parts to maximize transportation capacity	100	Excellent
	Cost	FIFO parts usage	54,8983	Average
Return	Reliability	Level of reusable polybox usage	100	Excellent
		Level of reusable plastic skid pallet usage	94,6846	Excellent
		Level of reusable wooden pallet skid	37,0262	Poor
		Level of reusable rack / dolly	100	Excellent
	Flexibility	Usage of recyclable cartonbox	0	Poor
		Usage of recyclable plastic	0	Poor

KPIs that have values in the category of "poor", "marginal" and "average" based on a working indicator

monitoring system table (Trienekens, J. H & Hvolby, HH, 2000) are marked in red to indicate that the KPI is a priority to do the improvement.

The next step after normalization is weighting using the AHP (Analytical Hierarchy Process) method. At this stage, the pairwise comparison is discussed with the manager in the material handling department and the general manager of the production control subdivision, who are experts and decision-makers for the process of the supply chain. This is done to determine the level of importance of each level and KPI with the aim of calculating the total value of the performance of Green SCOR. This weighting is carried out for each KPI as well as components and attributes. Here are the results of AHP weighting:

Table 2: AHP Weighting Method

Component	Component Weight	Attribute	Attribute Weight	KPI	KPI Weight
Plan	0,1452	Cost	0,8333	Adding suppliers which using milk-run delivery method	0,2569
				Adding Logistic Partners for milk-run delivery method to increase competitive advantage among Logistic Partners	0,1028
				Lead Time parts are less than 4 hours	0,6403
		Asset	0,1667	Training for operators who drive forklifts	0,2767
				Guidance for operators in the supply to production line method	0,1286
				Supply parts method to production line with an automation system	0,5947
Source	0,4424	Reliability	0,5677	Receiving parts according to the quantity contained in the PO	0,2462
				Receiving parts according to the specified quality	0,5707
				Receiving parts according to the part tag label	0,1212
				Each area has a clear and appropriate identification	0,0620
		Responsiveness	0,2649	Forklift speed limit is less than the same as 7 km / h in outdoor area	0,1212
				Forklift speed limit is less than the same as 5 km / h in indoor area	0,0620
				Receiving parts area near to the warehouse area	0,5707
				Warehouse parts near to the supply area to the production line	0,2462
		Flexibility	0,0527	Efficient use of storage in storage parts	1,0000
		Cost	0,1147	Stock parts that are not overloaded	0,8333
				The level of packaging that is damaged during storage in the warehouse area	0,1667
Make	0,047	Reliability	0,7509	Receiving parts according to the gate specified	0,2491
				Placement of parts in accordance with the specified warehouse	0,7509
		Responsiveness	0,2491	The process of unloading parts takes no more than 1 hour	1,0000
Deliver	0,2909	Reliability	0,6403	The arrival of the truck in accordance with the specified schedule	0,2569
				The choice of the shortest milkrun route by the truck in the process of shipping parts to minimize fuel consumption	0,6403

Component	Component Weight	Attribute	Attribute Weight	KPI	KPI Weight
				Cyclic supply method to the production line	0,1028
		Flexibility	0,2569	There is a schedule for receiving parts to maximize transportation capacity	1,0000
		Cost	0,1028	FIFO parts usage	1,0000
Return	0,0746	Reliability	0,8333	Level of reusable polybox usage	0,2465
				Level of reusable plastic skid pallet usage	0,1211
				Level of reusable wooden pallet skid	0,0620
				Level of reusable rack / dolly	0,5705
		Flexibility	0,1667	Usage of recyclable cartonbox	0,2491
				Usage of recyclable plastic	0,7509

Comparisons are made based on the policy of decision-makers which in this case are material handling managers and general managers of production control by assessing the importance of one element to another element. This weighting with AHP also needs to be tested for consistency with the formula of consistency ratio, where the comparison is declared consistent if the results of consistency ratio are less than equal to 0, 1.
The next calculation is to calculate the final value of the performance of the Green SCOR. This calculation is done by way of multiplying each score normalization has been obtained from the normalization formula Snorm De Boer with the weight of each KPI, attributes, and components. The following is the result of the calculation:

Table 3: Calculation of KPI Value

Component	Attribute	KPI	Snorm	KPI Weight	(Snorm x KPI Weight)	Total Attribute
Plan	Cost	Adding suppliers which using milk-run delivery method	40	0,2569	10,2746	73,2120
		Adding Logistic Partners for milk-run delivery method to increase competitive advantage among Logistic Partners	60	0,1028	6,1685	
		Lead Time parts are less than 4 hours	88,656	0,6403	56,7689	
	Asset	Training for operators who drive forklifts	100	0,2767	27,6740	76,2128
		Guidance for operators in the supply to production line method	100	0,1286	12,8579	
		Supply parts method to production line with an automation system	60	0,5947	35,6809	
Source	Reliability	Receiving parts according to the quantity contained in the PO	87	0,2462	21,4208	88,3527
		Receiving parts according to the specified quality	90	0,5707	51,3594	
		Receiving parts according to the part tag label	92	0,1212	11,1459	
		Each area has a clear and appropriate identification	71,429	0,0620	4,4267	
	Responsiveness	Forklift speed limit is less than the same as 7 km / h in outdoor area	76,471	0,1212	9,2645	73,0381
		Forklift speed limit is less than the same as 5 km / h in indoor area	100	0,0620	6,1973	
		Receiving parts area near to the warehouse area	64,286	0,5707	36,6853	

Component	Attribute	KPI	Snorm	KPI Weight	(Snorm x KPI Weight)	Total Attribute
		Warehouse parts near to the supply area to the production line	84,848	0,2462	20,8910	
	Flexibility	Efficient use of storage in storage parts	77	1,0000	77,0000	77,0000
	Cost	Stock parts that are not overloaded	74,819	0,8333	62,3490	78,2029
		The level of packaging that is damaged during storage in the warehouse area	95,123	0,1667	15,8539	
Make	Reliability	Receiving parts according to the gate specified	100	0,2491	24,9060	81,2836
		Placement of parts in accordance with the specified warehouse	75,076	0,7509	56,3776	
	Responsiveness	The process of unloading parts takes no more than 1 hour	94,025	1,0000	94,0252	94,0252
Deliver	Reliability	The arrival of the truck in accordance with the specified schedule	95	0,2569	24,4022	94,6656
		The choice of the shortest milkrun route by the truck in the process of shipping parts to minimize fuel consumption	100	0,6403	64,0326	
		Cyclic supply method to the production line	60,606	0,1028	6,2308	
	Flexibility	There is a schedule for receiving parts to maximize transportation capacity	100	1,0000	100,0000	100,0000
	Cost	FIFO parts usage	54,898	1,0000	54,8983	54,8983
Return	Reliability	Level of reusable polybox usage	100	0,2465	24,6494	95,4550
		Level of reusable plastic skid pallet usage	94,685	0,1211	11,4664	
		Level of reusable wooden pallet skid	37,026	0,0620	2,2938	
		Level of reusable rack / dolly	100	0,5705	57,0454	
	Flexibility	Usage of recyclable cartonbox	0	0,2491	0,0000	0,0000
		Usage of recyclable plastic	0	0,7509	0,0000	

Table 4: Calculation of Attribute Value

Component	Attribute	Total Attribute	Attribute Weight	(Total Attribute x Attribute Weight)	Total Component
Plan	Cost	7,32,120	0,8333	6,10,076	7,37,123
	Asset	7,62,128	0,1667	1,27,047	
Source	Reliability	8,83,527	0,5677	5,01,578	8,25,334
	Responsiveness	7,30,381	0,2649	1,93,478	
	Flexibility	7,70,000	0,0527	40,579	
	Cost	7,82,029	0,1147	89,699	
Make	Reliability	8,12,836	0,7509	6,10,358	8,44,575
	Responsiveness	9,40,252	0,2491	2,34,217	
Deliver	Reliability	9,46,656	0,6403	6,06,144	9,19,480
	Flexibility	10,00,000	0,2569	2,56,900	
	Cost	5,48,983	0,1028	56,435	

Return	Reliability	9,54,550	0,8333	7,95,427	7,95,427
	Flexibility	0,0000	0,1667	0,0000	

Table 5: Calculation of Green Logistics Value

Component	Total each Component	Component Weight	Component Value
Plan	73,7123	0,1452	10,7030
Source	82,5334	0,4424	36,5128
Make	84,4575	0,047	3,9695
Deliver	91,9480	0,2909	26,7477
Return	79,5427	0,0746	5,9339
Total			**83,8668**

Green SCOR performance value for Green Logistics obtained amounted to 83.8668 which according to the monitoring system work indicators table included in the category of "Good". These results indicate that the company is already good at carrying out green logistics activities and this performance should continue to be improved.

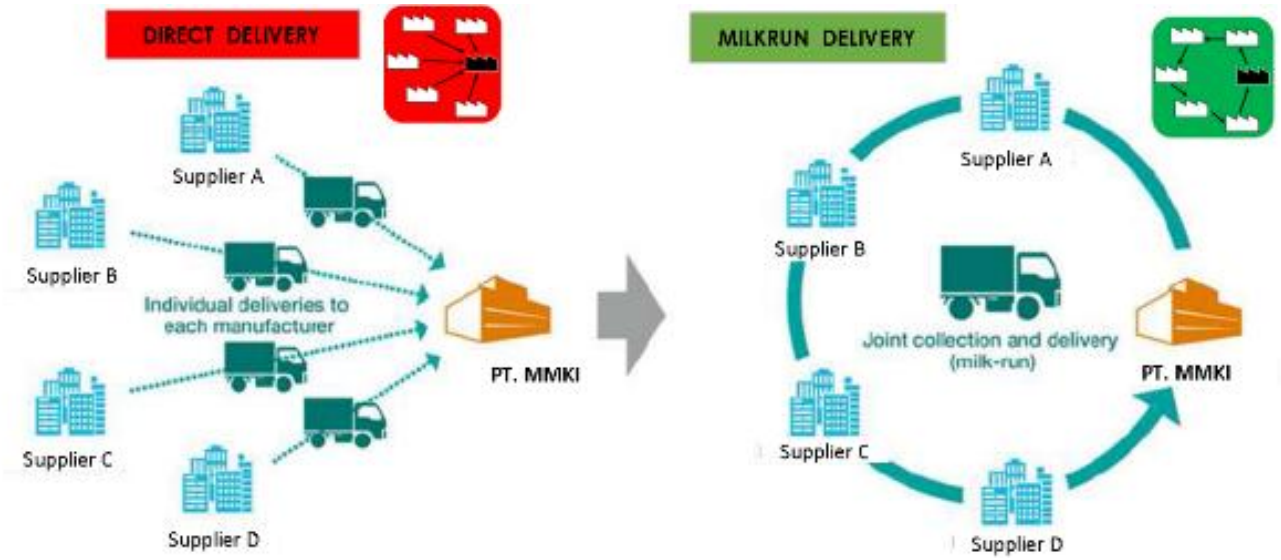
Proposed Improvement:

In this study, the performance measurement of green logistics in raw material transportation, warehousing and packaging are done by using the green SCOR method that has never been done before. The results of the performance value of green logistics are fairly good, but an increase in the value of performance must still be done in order to achieve optimal value. Increasing the value of the performance can be done by first making improvements to the KPI which is included in the category of poor, marginal and average. There are 9 KPIs that need to be given a proposed improvement strategy, namely KPI "additional suppliers using the milk-run delivery method", where the KPI is included in the marginal category. The proposed strategy for this KPI is supplier mapping based on the distance between supplier locations, although different regions. Therefore, in accordance with the company's target, the trucks used to supply goods can be reduced and looking at the side of green logistics, namely the level of pollution produced will also be reduced and this will reduce air pollution that is created. The second KPI is “adding logistics partners to the milk-run delivery method to increase competitive advantage among logistics partners "that falls into the average category. The proposed strategy that can be applied by the company is by opening a tender offer to the logistics company that has not become a partner of the company to become a logistics partner with the aim of increasing price competitiveness among logistics partners. On the other hand, also every logistics partner will compete in a healthy manner by showing the best quality which in this case is related to the timeliness of shipping goods, choosing the best route for travel and so on. The third KPI is "the existence of a method of supplying parts to the line with an automation system" that falls into the average category. The proposed improvement is given by adding the AGV system path to the reallocation of operator work. The fourth KPI is the "receiving parts area close to the warehouse" that falls into the average category. The proposed strategy is to carry out the process of receiving parts from suppliers based on the storage area of parts that have been determined based on the purpose of supply in the production line. This strategy makes it easy for operators to supply goods where the distance traveled by using lifting equipment can be reduced. The fifth KPI is "method of supply to the line in the cyclic" which enter into the category average. A proposed strategy that can be provided for this KPI is the grouping of parts storage areas based on the purpose of supply on the production line. Travel time and distance traveled by the operator-assisted by lifting equipment in carrying out the process of supplying goods to the production line will be optimal if carried out with proper and clear circulation. The sixth KPI is "FIFO parts usage" which falls into the average category. The proposed strategy for this KPI is the relayout or rearrangement of the warehouse area by creating a standard entry and exit points for goods to be supplied to the

production line. From the perspective of green logistics, a FIFO method that works well will reduce waste or goods that cannot be used so that it becomes garbage. The seventh KPI is "the level of use of reusable wooden pallet skid" that falls into the poor category. The proposed strategy is to provide identification on the wooden pallet skid and work with suppliers in monitoring the circulation of the use of wooden pallet skid for use in shipping parts. Reducing the potential of waste will have a good effect on the environment and can improve the performance of green logistics. The eighth KPI is the use of a recyclable carton box. This KPI is included in the poor category and it has not been implemented at all. The proposed improvement is to collect suppliers who still use carton boxes and together form a work team consisting of price, quality and other related departments to conduct studies to change packaging in reusable forms such as poly boxes or corrugated boxes. Another proposed improvement is that if you must continue to use carton box, the company will cooperate with other companies that are in the field of carton box recycling. Both of these strategies can reduce or even eliminate traces of the carton box which will then cause garbage. The ninth KPI is the use of recyclable plastic. Not much different from the previous KPI where the KPI is included in the poor category and there is still plastic that is leftover from use in packaging. The proposed strategy is to form a project to eliminate plastics and or change the use of plastic packaging into foam sheets or miramates.

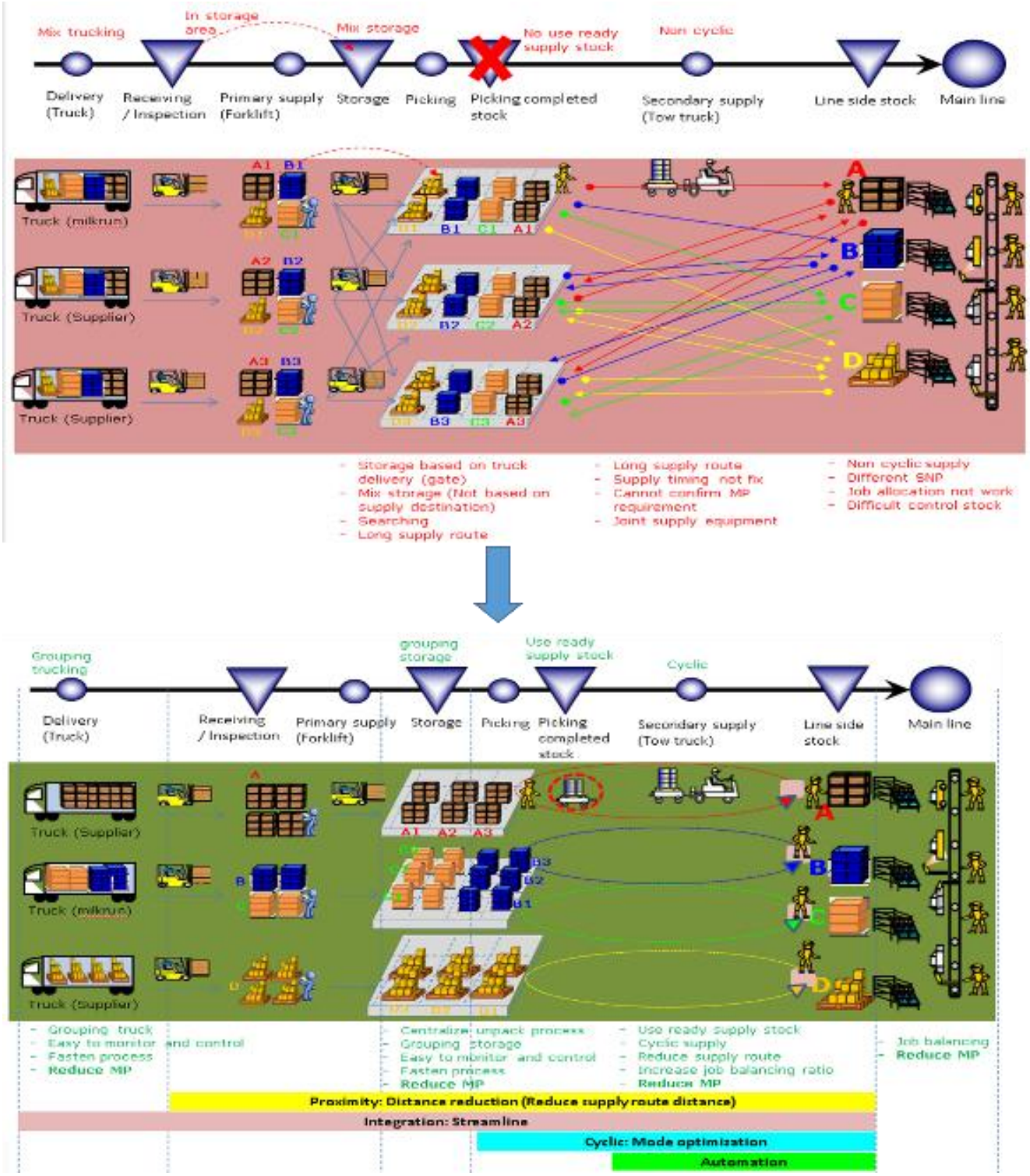
In the transportation section, there are 2 KPIs that need to be improved, in general, the focus is on the delivery method. It can be concluded that with more suppliers using the milk-run delivery method compared to direct delivery, the number of trucks coming in to deliver raw material will be much reduced. Viewed from the side of green logistics, this is certainly good for the environment because it will reduce air pollution that is created. The following is a description before and after the implementation of green transportation by the company:

Fig. 10: Application of Green Transportation in Company



In the warehousing section, there are 4 KPIs that have poor value. If seen as a whole, the most important thing to improve is the method of storing parts in the warehouse area and also the method of supply from the storage area to the production line. In terms of green logistics, a good storage method will minimize the waste created and also facilitate the process of finding goods and subsequent processes. Then the supply method which does not take a long time and has a clear circulation will facilitate the work of the operator and also minimize the work of the lifting equipment. In this way, it will increase the effectiveness, efficiency and also the performance of green logistics.

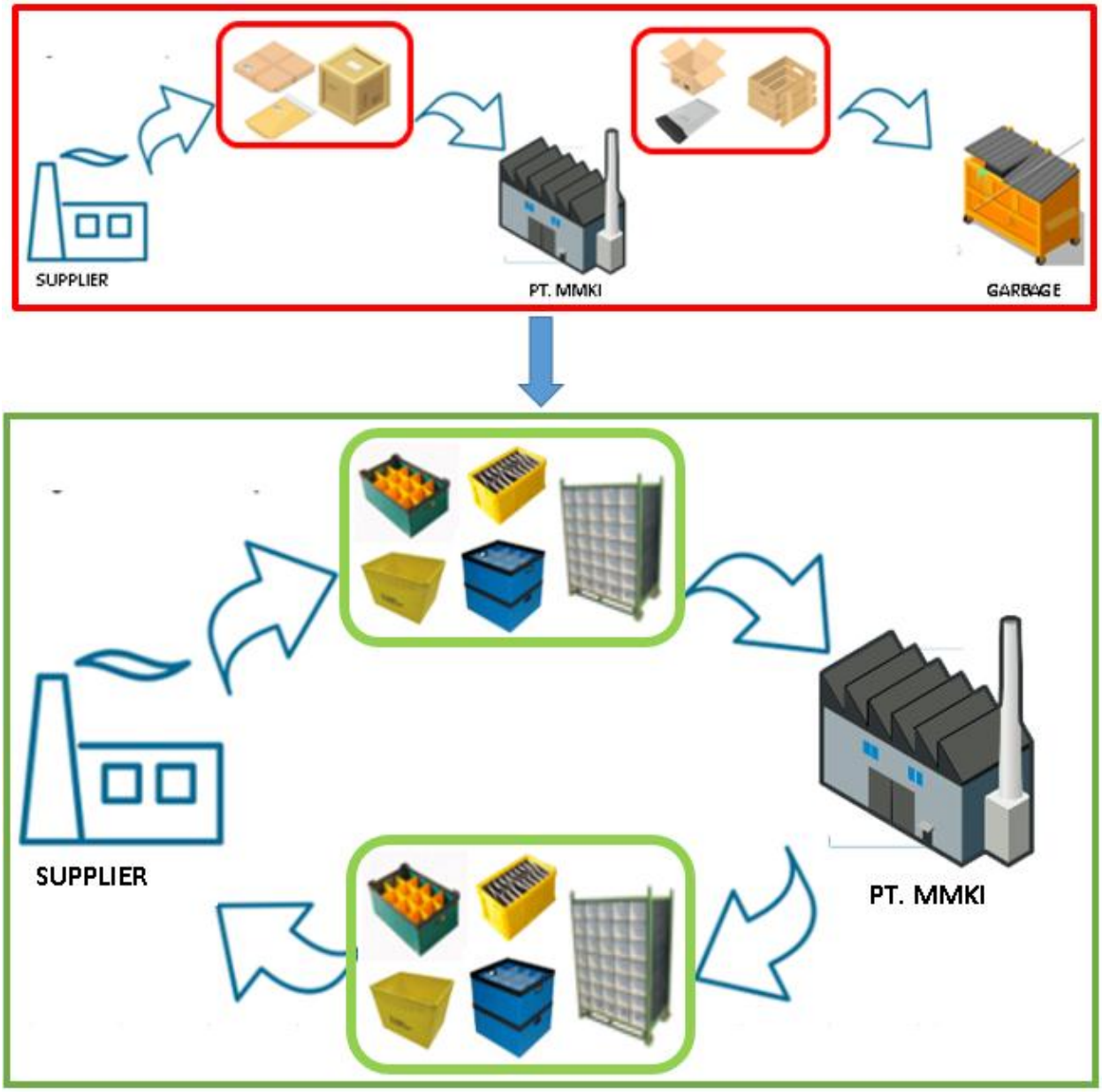
Fig. 11: Application of Green Warehousing in Company



In the packaging section, there are 3 KPIs that fall into the poor category. This needs special attention because if left unchecked in a bad impact on the environment. The third KPI has a problem with the level of reuse in the packaging, with the re-skid can not use wood pallets, carton box and plastic it will be able to generate garbage. Therefore, companies should consider giving identification on skid wooden pallets, then eliminating the type of plastic packaging or changing the type of plastic packaging and carton box into packaging that can

be reused for a long period of time. From the perspective of green logistics, by carrying out this proposed improvement, the amount of waste that will be generated can be reduced. The following is a description before and after the implementation of green packaging by the company:

Fig. 12: Application of Green Packaging in Company



Proposed strategies that include transportation, warehousing, and packaging can be implemented by companies to improve the performance of green logistics. After implementing the strategy, it can be tested again the results of the performance of the green logistics. Improved performance of green logistics will certainly have a good impact on the company and the surrounding environment as well as a good impact on green supply chain management as a whole.

CONCLUSIONS:

The conclusion of this study shows the form of green logistics implementation by the company in terms of raw material transportation. The company has used the milk-run delivery method in shipping goods from suppliers and also chose the shortest route to minimize fuel consumption, providing training to operators who drive the forklift, receipts raw material or parts according to the quantity, quality and actual goods that have been set at the PO and also the place of receipt (gate) of the appropriate goods, the use of forklifts with a predetermined

speed limit, the process of loading and unloading of goods with a time that is not too long in order to minimize consumption fuel from the forklift, has a supplier truck arrival schedule and raw material receipt schedule to maximize transportation capacity. The form of green logistics implementation in the company in terms of raw material warehousing is the company has a guide for operators in the supply method to the production line and also the automation supply method with the aim of minimizing waste and work from lifting equipment, storage time of goods in the warehouse which is not too long before being supplied to the production line in order to maintain the quality of the goods, have a clear and suitable layout identification and placement of goods in accordance with the specified area, use of raw material in a FIFO, efficient use of material storage areas. The form of green logistics implementation in the company in terms of raw material packaging is that the company minimize the level of packaging damaged during storage area warehouse, the use of packaging such as poly box, pallet, dolly, a rack that can be reused. This is done in order to reduce the amount of waste that will be generated so that it can be good for the environment.

The results of the Green SCOR for Green Logistics obtained amounted to 83.8668 which according to the monitoring system work indicator table included in the category of "Good", but there were 9 KPIs that were included in the unfavorable category. Thus, it is necessary to propose improvements to KPIs that are included in the poor, marginal and average categories.

Proposed improvements or proposed strategies related to the three parts, namely transportation, warehousing, and packaging. In the transportation section, the use of the milk-run delivery method is recommended that the number of trucks coming in will be much reduced so that it will have a good impact on the environment because it will reduce the air pollution that is created. The warehousing section focuses on improving the method of storing parts in the warehouse area and also the method of supply from the storage area to the production line. This strategy will ease the work of operators and minimize waste and work from lifting equipment. The packaging section focuses on reuse packaging by the supplier in the next part of shipping. Provision of identification on skid wooden pallets, then eliminate the type of plastic packaging or replace the type of plastic packaging and carton box into packaging that can be reused for a long period of time. Improved performance of green logistics will have a good impact on overall green supply chain management.

RECOMMENDATIONS:

Recommendation for the company that is the company should provide guidance on Green Supply Chain Management and Green Logistics to employees so that the activities of Green Supply Chain Management and Green Logistics can be well coordinated and can be evaluated together. Then the measurement of green logistics performance can be done again or periodically after the proposed strategy has been successfully implemented by the company. This is useful to see whether the proposed improvements that have been implemented can improve the performance of green losgistics or not. Besides, suggestions for improvement in the KPI that are included in the good enough category can be done by looking at the potential development that exists to continue to get better green logistics performance results.

Recommendations for further research can be made especially in the automotive industry to get a comparison of results from the performance of Green SCOR and also continuous improvement for companies in the automotive industry.

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