GIJES
Greenation International Journal of Engineering Science
+62 81210467572 https://research.e-greenation.org/GIJES greenation.info@gmail.com
GREENATION RESEARCH

DOI: https://doi.org/10.38035/gijes.v3i3
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Supply Chain Management Analysis Using the Supply Chain Operations Reference (SCOR) Method in Vehicle Accessories Manufacturing Companies

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Abstract: Vehicle accessories manufacturing company is company that produces various kinds of vehicle accessories products. The company does not have a complete supply chain measurement system. This results in not covering all the company's problems so that it is not known where things need improvement. Therefore, there needs to be a method that can analyze the overall performance of the company using the Supply Chain Operations Reference (SCOR) method. The measurement is carried out with several stages, namely identifying the SCOR matrix, verifying the Key Performance Indicator (KPI), weighting using the Analytical Hierarchy Process (AHP) method and calculating Snorm de boer normalization. Based on the research results, the supply chain performance value obtained is 78.48 with the good category. There are several performance indicators that are prioritized for improvement, namely. The accuracy of planning raw material requirements, the accuracy of raw material fulfillment, handling machine and production equipment damage, product quality after the delivery process and the number of complaints from consumers. By making improvements to these indicators, it is hoped that it can help in improving the supply chain performance of the company.

Keyword: Performance Measurement, Supply Chain, Supply Chain Operations Reference, Analytical Hierarchy Process, Snorm de boer.

INTRODUCTION

Current developments in the industrial world are spurring manufacturing companies to continue making improvements to improve their performance. Companies are asked to think creatively to implement competitive strategies by producing goods or services that are of higher quality, cheaper and faster than other competitors. Consumer satisfaction is a benchmark in determining whether a company has good and advanced performance. For this reason, performance measurements are needed that can increase competitiveness and consumer loyalty (Wigaringtyas, 2013).

A vehicle accessories manufacturing company is a company operating in the field of vehicle accessories that produces various kinds of vehicle accessory products such as stop lamps, head lamps, fog lamps, water gutters, hand pulls and reflector triangles by providing quality product quality and providing various kinds of products needed by consumer.

The following is data on the number of production delays in percentage units for vehicle accessories manufacturing companies in the period July to December 2022.

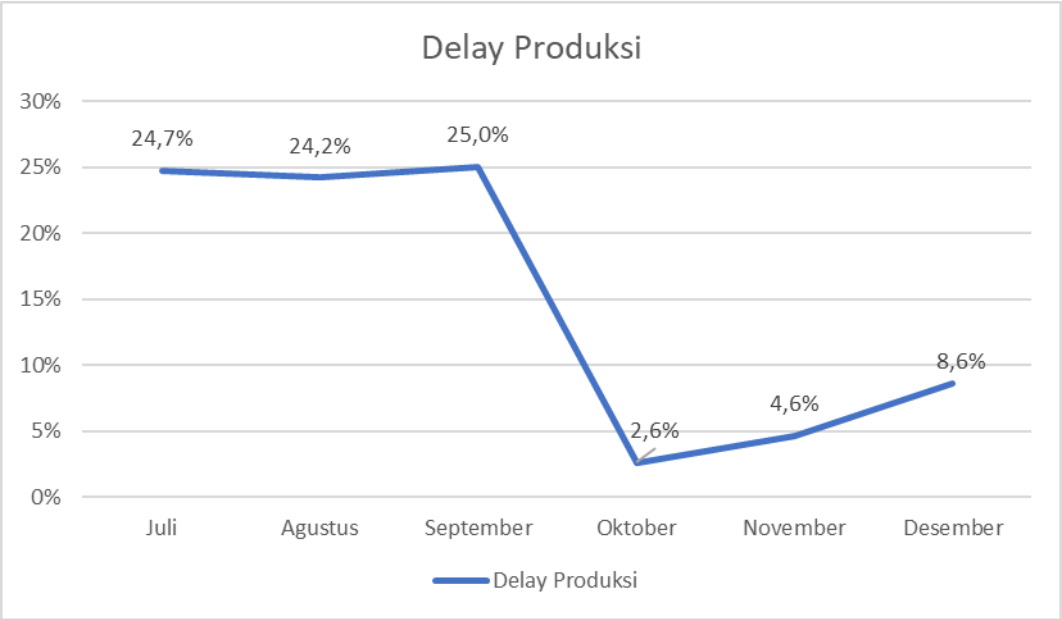


Figure 1. Production Delay Data in Companies

Based on Figure 1. the highest number of production delays is in September and the lowest is in October 2022. This results in delays in product sales to consumers, which does not rule out the possibility of having an impact on the company's income, so it is not known where things need improvement. Therefore, there is a need for a method that can analyze company performance as a whole, a more complete, systematic and more integrated SCM performance measurement framework is needed. In this research, a performance measurement method will be discussed using the Supply Chain Operation Reference (SCOR) method. The SCOR model can identify, evaluate and monitor the performance of a company's supply chain using five aspects, namely: Reliability, Responsiveness, Flexibility, Cost and Assets management.

Supply Chain Management

The term supply chain management was first proposed by Oliver and Weber in 1982. According to Manahan P. Tampubolon (2014) supply chain management is a set of approaches used efficiently to integrate suppliers, producers and warehouses with stores, so that goods are produced can be distributed to the right location, at the right time, to minimize the right time, as well as system coverage at a cost that meets service level requirements. In managing the supply chain, it is necessary to pay attention to the costs and role of each component in the manufacture and distribution of products that suit consumer desires. The goal of supply chain management is to increase efficiency and minimize costs throughout the system. The system in question is all activities and components from transportation to distribution and from raw materials to finished goods. Integrated Supply Chain from suppliers, manufacturers, warehouses and stores. This includes activities at every level of the

company, starting from strategic planning to operational implementation. (Simchi-Levi and Kaminsky, 2008).

In its application, supply chain management has several basic components according to Worthen & Wailgum (2008), including: plan, source, make, deliver, return.

Supply Chain Operation Reference (SCOR)

Supply Chain Operation Reference (SCOR) is a method developed by the Supply Chain Council to measure company supply chain performance, improve performance and communicate to parties involved in the supply chain. The SCOR model provides a business process framework, performance indicators, best practices and unique technology to support communication and collaboration between supply chain partners thereby improving supply chain management and the effectiveness of supply chain improvement (Paul, 2014).

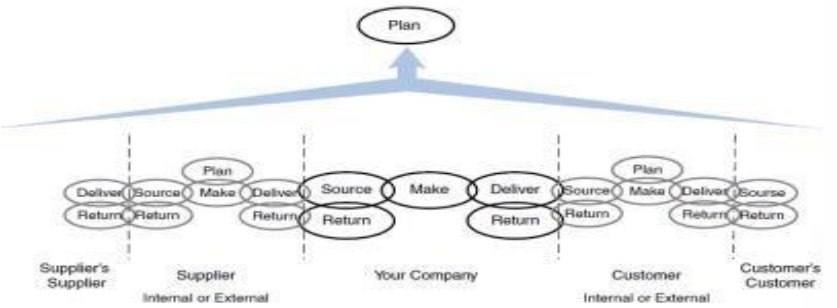


Figure 2. Supply Chain Operation Reference

In the Supply Chain Operation Reference (SCOR) model, there are several performance attributes used to evaluate a supply chain, including:

1. Reliability, is an attribute that measures the company's reliability in sending products in the right quantity, condition and time.
2. Responsiveness (speed of response) is the speed in delivering products to customers.
3. Agility is the ability to respond to changes that occur in the market.
4. Cost is a measurement of the costs required to operate a supply chain.
5. Asset management is an assessment of the ability to manage assets.

Normalization Snorm De Boer

Each performance standard has different value units (parameters), therefore normalization needs to be carried out to equalize the value units (parameters) of each performance standard which are used to calculate the final value of the company's supply chain performance. Calculation of normalization values is obtained using the Snorm De Boer equation. The de Boer snorm equation formula is as follows.

If the measurement is larger is better:

$$\text{Snorm} = \frac{SI - Smin}{Smax - Smin} \; x \; 100 \qquad (1)$$

If the measurement is lower is better:

$$\text{Snorm} = \frac{(Smax - SI)}{Smax - Smin} \; x \; 100 \qquad (2)$$

With:

SI : Actual indicator value that was successfully achieved.
Smax : The maximum achievement value of the performance metric.
Smin : Minimum achievement value from the performance matrix.

In this measurement, each indicator weight is converted into a certain value range, namely 0 to 100. Zero (0) is interpreted as the worst value and a value of one hundred (100) is interpreted as the best value. In this way, the parameters of each indicator are the same, after which a result is obtained that can be analyzed. The following are standard supply chain performance values.

Table 1. Supply Chain Performance Value Standards

Monitoring System	Performance Indicator	Information
< 40	Poor	Very less
40 – 50	Marginal	Marginal
50 – 70	Average	Currently
70 – 90	Good	Good
>90	Excellent	Very good

Key Performance Indicator (KPI)

Key Performance Indicator or KPI is a tool so that an activity or process can be followed and controlled so as to achieve the desired performance. KPI is used as a way to achieve good indicators in assessing the performance of a process or job. The way KPI works is to compare what has been determined with what has been created (Putri et al., 2016). But all successful implementation depends on good implementation of the strategy in accordance with what has been determined. A good KPI design provides deep, clear and sharp information about performance trends.

KPI design must be carefully designed to reflect work indicators that are important for the company in accordance with the company's business strategy and key success factors for the company or organization. KPI has the main objective in the management of an organization, the following are the objectives of determining KPI: (1) Linking company strategy. (2) Measuring the performance trend of the company or organization, whether there is a significant decrease or increase in performance. (3) Compare the current performance of the organization or company with past performance data. (4) KPI is used as a basis for determining KPI for other organizations or divisional or individual work targets. (5) The achievement results obtained by KPI become the basis for providing awards and consequences.

KPI can measure several aspects of an organization according to desired needs. To measure the performance of several aspects, it can be combined with other methods so that the measurement is right on target. KPIs are used to make decisions about what will be taken in the future so that the organization can improve its performance.

Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process or called AHP, is a decision support model developed by Thomas L. Saaty. This decision support model will describe complex multi-factor or multi-criteria problems into a hierarchy. Analytical Hierarchy Process (AHP) is a method for solving a complex, unstructured problem into several components in a hierarchical order, by providing a subjective value regarding the relative importance of each variable and determining which variable has the highest priority in order to influence the outcome of the problem (saaty & Vargas, 2012).

According to (Wibisono, 2016) in his book, preparing AHP consists of three basic steps, namely:

1. Hierarchical design. What AHP does first is solve complex and multi-criteria problems into a hierarchy.

2. Prioritize procedures. After the problem has been successfully resolved into a hierarchical structure, a priority procedure is selected to obtain the relative significance value of each element at each level.
3. Calculating results. After establishing preference metrics, a mathematical process begins to normalize and find priority weights for each metric.

METHOD

Types of research

This research was conducted in a quantitative descriptive manner. Descriptive is done through descriptions that describe and explain the research subject. A quantitative approach is carried out through a process of extracting information realized in the form of numbers as a tool for finding information regarding what is known (Alejos, 2017).

Types of Data and Information

The types of data and information used in this research have division as follows:

1. Primary data is basic data or main data that has an influence big in research. The primary data is obtained from the results direct observation in the field.
2. Secondary data is supporting data or complementary data study. Secondary data was obtained not directly through observations in the field.

Method of collecting data

In the data collection process, there are several stages used to obtain the required data. Here are some methods used in the data collection process in this research:

1. Interviews are one method used to Obtain data or information by communicating online directly to parties who understand the research object.
2. Observation is the process of collecting data or information using make direct observations in the field.
3. Literature study is a process of searching for relevant information and useful in research.

Identify the company's supply chain

Identification of the company's supply chain is done by observing company supply chain and compiling the company's supply chain framework with the SCOR method approach.

1. The SCOR method has three process levels, these three levels show that SCOR carries out the breakdown or decomposition process of that general to detailed so as to get the Key Performance Indicator (KPI) of the company whose performance will be measured. Designed KPIs with the SCOR approach based on the main supply chain perspective, namely plan, source, make, deliver, and return.
2. After the KPI is determined, the next step is to validate it Do these KPIs truly represent supply performance company chain.
3. AHP.KPI that has been validated is then designed based on The classification is from levels 1, 2, and 3 and weighting is carried out each of these KPIs using the AHP method.
4. Recommendations for improvements are made to the indicators needs repair. This recommendation is made based on analysis from the KPI results in the form of proposed improvements that can be implemented in company.

RESULTS AND DISCUSSION

Based on the results of interviews and additions from literature studies, a total of 26 performance indicators were obtained that were in accordance with the business processes occurring in the company, so they were used in measuring supply chain performance in

vehicle accessories manufacturing companies. The results of checking these performance indicators will then be weighted using the AHP method to determine the level of importance of each process and performance indicator.

Indicator KPI

Table 2. Identification of KPI Indicators

Level 1	Level 2	Performance Assessment Indicators (Level 3)	Code
Plan	Reliability	Accuracy of planning raw material requirements	P.I.1
		Planning according to consumer demand	P.I.2
		Accuracy of planning the raw material procurement process	P.I.3
	Responsiveness	Time period for the production scheduling process	P.II.1
		Speed of identifying new product specifications (consumer custom)	P.II.2
Source	Reliability	Accuracy in the amount of raw materials	S.I.1
		Ability to guarantee the quality of raw materials	S.I.2
		Timely fulfillment of raw materials	S.I.3
		Supplier's ability to meet demand for raw materials	S.I.4
	Responsiveness	Services for complaints about non-conforming raw materials	S.II.1
	Flexibility	Availability of raw materials	S.III.1
Make	Reliability	Accurate completion of production according to schedule	M.I.1
		Conformity of raw materials with product specifications	M.I.2
		Number of defective products	M.I.3
		Ability to produce customer orders	M.I.4
	Responsiveness	Handling products that do not meet specifications	M.II.1
		Handling damage to machines and production equipment	M.II.2
	Flexibility	Product manufacturing flexibility is not according to plan	M.III.1
Delivery	Reliability	Accuracy of the number of products sent	D.I.1
		Accurate product delivery according to schedule	D.I.2
		Accuracy of the type of product sent	D.I.3
		Product quality after the delivery process	D.I.4
	Responsiveness	Speed in the product packaging process (packing)	D.II.1
		Information to consumers regarding product delivery	D.II.2
Return	Reliability	Number of complaints from consumers	R.I.1
	Responsiveness	Employee speed in responding to complaints from consumers	R.II.1

Hierarchical Arrangement

In this hierarchy there are 3 levels, level 1 consists of 5 main processes, namely plan, source, make, delivery, and return. Level 2 consists of several basic components, namely reliability, responsiveness, and flexibility. Then level 3 consists of supply chain performance indicators. There is a hierarchical model for measuring supply chain performance in vehicle accessories manufacturing companies.

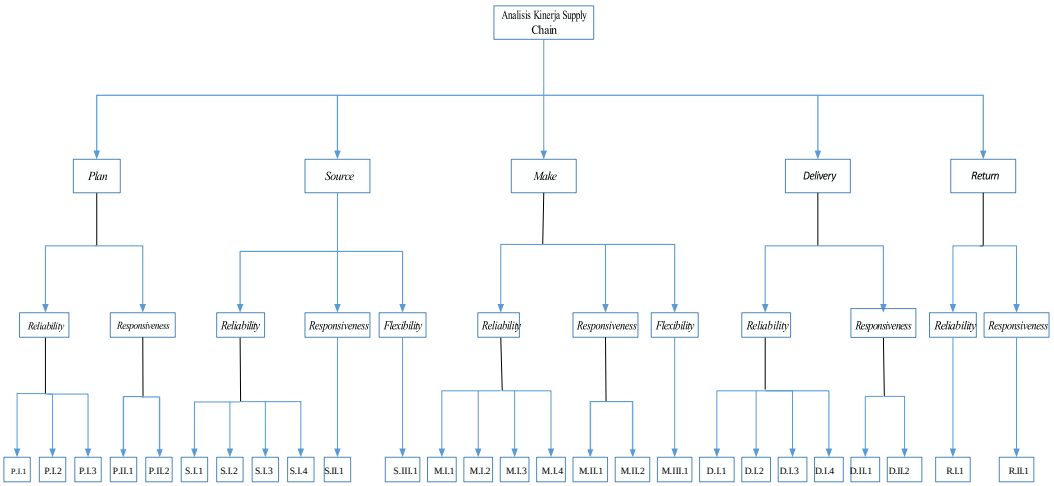


Figure 4. Results of Supply Chain Hierarchy Preparation

Results of preparing the supply chain hierarchy

KPI weighting using the AHP method

In the weighting process, data is collected from interviews. KPI weighting is carried out to determine the level of importance of existing KPIs. The model used to carry out the weighting is using the Analytical Hierarchy Process (AHP), which is processed using expert choice software.

This weighting is carried out at 3 levels, namely level 1, there are 5 supply chain processes consisting of, plan, source, make, delivery and return. At level 2 there are 3 basic capability aspects, namely reliability, responsiveness and flexibility which are appropriate to the company's conditions. The following are the weighting results using expert choice software.

Table 3. Level 1 Weighting Results

Level 1			
No	Code	Key Performance Indicator	Weight
1	P	Plan	0,362
2	S	Source	0,198
3	M	Make	0,169
4	D	Delivery	0,239
5	R	Return	0,31
Total			1

Based on Table 3. it is known that plan has a weight of 0.362, while source has a weight of 0.198, make has a weight of 0.169, delivery has a weight of 0.239 and return has a weight of 0.31.

Table 4. Level 2 Weighting Results

Level 2			
No	Code	Key Performance Indicator	Weight
1	P.1	Reliability	0,667
	P.2	Responsiveness	0,333
2	S.1	Reliability	0,443
	S.2	Responsiveness	0,387
	S.3	Flexibility	0,169
3	M.1	Reliability	0,55
	M.2	Responsiveness	0,21

4	M.3	Flexibility	0,24
	D.1	Reliability	0,75
	D.2	Responsiveness	0,25
5	R.1	Reliability	0,833
	R.2	Responsiveness	0,167

Based on Table 4. it is known that the reliability and responsiveness of the plan each have a weight of 0.667 and 0.333. Meanwhile, reliability, responsiveness and flexibility at the source each have a weight of 0.443, 0.387 and 0.2169. Meanwhile, reliability, responsiveness and flexibility in make each have a weight of 0.55, 0.21 and 0.24. Meanwhile, reliability and responsiveness in delivery have a weight of 0.75 and 0.25 respectively. Then reliability and responsiveness in returns each have a weight of 0.833 and 0.167. Weights are obtained from data processing using expert choice software.

Table 5. Level 3 Weighting Results

Level 3			
No	Code	Key Performance Indicator	Weight
1	P.I.1	Accuracy of planning raw material requirements	0,32
2	P.I.2	Planning according to consumer demand	0,413
3	P.I.3	Accuracy of planning the raw material procurement process	0,216
4	P.II.1	Time period for the production scheduling process	0,75
5	P.II.2	Speed of identifying new product specifications	0,25
6	S.I.1	Accuracy in the amount of raw materials	0,237
7	S.I.2	Ability to guarantee the quality of raw materials	0,365
8	S.I.3	Timeliness of fulfillment of raw materials	0,139
9	S.I.4	Supplier's ability to meet demand for raw materials	0,26
10	S.II.1	Services for complaints about non-compliant raw materials	1
11	S.III.1	Availability of raw materials	1
12	M.I.1	Accurate completion of production according to schedule	0,455
13	M.I.2	Conformity of raw materials with product specifications	0,263
14	M.I.3	Number of defective products	0,141
15	M.I.4	Ability to produce customer orders	0,141
16	M.II.1	Handling products that do not meet specifications	0,883
17	M.II.2	Handling damage to machines and production equipment	0,167
18	M.III.1	Product manufacturing flexibility is not according to plan	1
19	D.I.1	Accuracy of the number of products sent	0,404
20	D.I.2	Accurate product delivery according to schedule	0,305
21	D.I.3	Accuracy of the type of product sent	0,161
22	D.I.4	Product quality after the delivery process	0,129
23	D.II.1	Speed in the product packaging process (packing)	0,75
24	D.II.2	Information to consumers regarding product delivery	0,25
25	R.I.1	Number of complaints from consumers	1
26	R.II.1	Employee speed in responding to complaints/complaints from consumers	1

Based on Table 5. it is known that the indicator with code P.I.1 has a weight of 0.55, while the indicator with code P.I.2. has a weight of 0.24 and so on. The highest weight is found in indicators with codes S.II.1, S.III.1, M.III.1, R.I.1, and R.II.1, which have a weight of 1. Meanwhile, the lowest weight is found in indicators with code D.I.4 that is, it has a weight of 0.129. The weights are obtained from expert choice software calculations. Based on the weighting results above, a hierarchy of supply chain performance measurements and weights are obtained for each existing perspective.

Calculation of Normalized Values with Snorm de Boer

Measurement The process of measuring SCM performance values begins by collecting performance data from each indicator that has been validated and has its own weight. Performance indicator data collection was carried out through document study techniques by collecting historical data for 2022 which had been summarized as a company database, as well as through interviews with supervisors from relevant departments to obtain company data that was not accessible to researchers.

To determine the minimum and maximum values for each performance indicator as a reference in measuring the value of performance results, calculations are carried out based on historical data for 2022. If company data is not available, interviews are carried out with the relevant supervisor.

The following is an example of calculating the normalization score for the performance indicator "Handling products that do not meet specifications" (M.II.I) which is at Level 3 and is included in the Responsiveness matrix and Make matrix at Level 1. This indicator has the "Lower is Better" category. There is an actual performance value (Si) of 2, a maximum performance value (Smax) of 3, and a minimum performance value (Smin) of 1. The normalization process can be calculated using equation (2.1) as follows:

$$Snorm = \frac{(Smax - Si)}{(Smax - Smin} \times 100$$

$$Snorm = \frac{(3-2)}{(3-1)} \times 100$$

Snorm = 50 After obtaining the normalized value, the value will be multiplied by the weight

Score = Normalized Value × Weight

Score = Normalized Value × Weight Level 3 (3)

Score = 50 × 0.883

Score = 44.15

Then this value is added to the M.II.I Indicator score (of 5.28) and multiplied by the Level 2 Weight (of 0.21)

Score = (Total level 1 scores on these indicators) × Weight Level 2 (4)

Score = (44.15 + 5.28) × 0.21

Score = 49.43× 0.21

Score Rersponsiveness = 10

The score from the Responsiveness matrix is added up with the Reliability matrix score and the flexibility matrix score which is a derivative of the Make matrix at Level 1.

Score Plan = 10 + 36 + 9,6

Score Plan = 10 + 45,6

Score Plan = 55,6

Table 6. Recapitulation of Calculations

Code	Scale		al Value of Perform	ormance Characteri	Snorm	evel 3 Indicator Weigh	core x Weigh	Score	evel 2 Indicator Weigh t	Score	Matrix Value	Indicator	Score	Performance Va
	Minimum Lim	Maximum Limit												
P.1.1	0	100	65	*Larger is better*	65	0.327	21.26							
P.1.2	0	100	78	*Larger is better*	78	0.413	32.21	75.57	0.667	50.40452				
P.1.3	0	100	85	*Larger is better*	85	0.26	22.10				71	0.362	25.702	
P.2.1	0	2	1	*Lower is better*	50	0.75	37.50	62.50	0.333	20.8125				
P.2.2	1	3	1	*Lower is better*	100	0.25	25.00							
S.1.1	0	100	85	*Larger is better*	85	0.237	20.15							
S.1.2	80	100	90	*Larger is better*	50	0.365	18.25	61.82	0.443	27.38626				
S.1.3	0.6	1	0.9	*Lower is better*	75	0.139	10.43				54.5	0.198	10.791	
S.1.4	0.6	1	0.8	*Larger is better*	50	0.26	13.00							
S.2.1	1	2	1	*Lower is better*	50	1	50.00	50	0.387	19.35				
S.3.1	40	620	580	*Larger is better*	93	1	93.00	50	0.169	8.45				
M.1.1	75	100	87	*Larger is better*	48	0.455	21.84							
M.1.2	60	100	92	*Larger is better*	80	0.263	21.04	65.44	0.55	35.992				
M.1.3	50	150	80	*Lower is better*	70	0.141	9.87							78.48
M.1.4	0	100	90	*Larger is better*	90	0.141	12.69				55.6	0.169	9.3964	
M.2.1	1	3	2	*Lower is better*	50	0.883	44.15	49.43	0.21	10.37971				
M.2.2	1	20	14	*Lower is better*	31.6	0.167	5.28							
M.3.1	0	100	60	*Lower is better*	40	1	40.00	40	0.24	9.6				
D.1.1	70	100	90	*Larger is better*	66.6	0.404	26.91							
D.1.2	1500	30000	25840	*Larger is better*	85	0.305	25.93	77.80	0.75	58.35105				
D.1.3	1500	30000	28570	*Larger is better*	95	0.161	15.30				71	0.239	16.969	
D.1.4	90	98	96	*Larger is better*	75	0.129	9.68							
D.2.1	0	2	1	*Lower is better*	50	0.75	37.50	50.00	0.25	12.5				
D.2.2	0	2	1	*Lower is better*	50	0.25	12.50							
R.1.1	86	150	120	*Lower is better*	40.5	1	40.50	50	0.833	41.65	50.4	0.31	15.624	
R.2.1	1	3	2	*Lower is better*	50	1	50.00	50	0.167	8.35				

Calculation of Supply Chain Performance Value

To get the final Supply Chain Performance Score for this company, you need to add up all the scores on the five matrices at Level 1. The following is a recapitulation of the Level 1 Score and the results of calculating the Final SCM Performance Score.

Table 7. Calculation Results of Final Value of Supply Chain Performance

Process	Score	Weight	Final value (Score x Weight)
Plan	71	0.362	25.702
Source	54.4	0.198	10.791
Make	55.6	0.169	9.396
Delivery	71	0.239	16.969
Return	50.4	0.31	15.624
Total			78.48

The results of the recapitulation of supply chain flow performance in vehicle accessories manufacturing companies show a total value of supply chain flow performance of 78.48 in the Good category referring to the standards from the following table:

Table 8. Standard Supply Chain Performance Values

Monitoring system	Performance Indicator
< 40	Poor
40 – 50	Marginal
50 – 70	Average
70 – 90	Good
> 90	Excellent

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the results of the research and analysis carried out, several conclusions can be drawn as follows:

1. The calculation results show that the supply chain performance of vehicle accessories manufacturing companies has a value of 78.48. This value is included in the "Good"

category. In particular, there are several indicators that need to receive suggestions for improvement, namely KPI P.I.1 (21.26), S.I.3 (10.43), M.II.2 (5.28), D.I.4 (9.68), and R.I.1 (40.50).

2. There are suggestions for improvement for each indicator that has the lowest weight. In the "Plan" indicator, it is recommended to use POMQM software to forecast planning for production raw material needs. In the "Source" process, it is recommended to re-discuss existing suppliers. In the "Make" process, it is recommended to schedule regular machine maintenance. In the "Delivery" process, it is recommended to improve the checking process carried out by Quality Control. In the "Return" process, it is recommended to provide protection and a clearer identity for the product inside.

Suggestions

After carrying out this research, here are some suggestions that can be given:

1. It is recommended to continuously measure and improve supply chain performance. This is important so that companies can continue to identify and overcome problems that arise, as well as increase the efficiency and effectiveness of supply chain flows. Carrying out regular observations by all company management is also necessary so that all aspects are measured properly.
2. It is hoped that companies can consider the proposed improvements that have been provided in this research. This proposal is based on data analysis and supply chain performance measurement results. Implementing proposed improvements can help improve the performance and effectiveness of supply chain activities and flows in the company.

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