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Combination of supply chain operation reference and analytical hierarchy process methods in measuring supply chain management performance in the metal industry

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ABSTRACT

The metal manufacturing industry's supply chain faces problems with inaccurate sales demand analysis, with a 9% discrepancy between forecasted and actual demand. Production activity times are 23% inconsistent with established plans. Shipments of goods are inconsistent with sales orders, preventing the metal company from achieving its delivery targets. This study aims to analyze supply chain performance measurements and provide suggestions for improvements to the results of these measurements. This research method combines the Supply Chain Operation Reference (SCOR) and Analytical Hierarchy Process (AHP) methods. This study identified 17 selected performance indicators and prioritized attributes, namely reliability, responsiveness, and agility. The results of data processing through performance indicator weighting yielded a total SCM performance score of 90.90, with 5 performance indicators requiring improvement. Therefore, the proposed improvements focus more on these 5 dominant indicators. The contribution of this study to the analysis of SCOR and AHP performance measurements is that companies are expected to maximize their supply chains, thereby increasing industrial productivity and gaining a competitive advantage.

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1. INTRODUCTION

Competition in the industrial world is now increasingly fierce and has become a challenge for manufacturing companies [1]. To remain able to survive in this competition, companies are required to be able to create and apply business strategies to be able to compete in producing goods/services that are higher quality, affordable, and faster than their competitors in meeting consumer demand [2]. To achieve this goal, cooperation between all parties is needed, starting from suppliers as providers of raw materials, factories that produce finished goods, transportation companies, and distribution networks that distribute products so that they can be received by customers [3]. Understanding the active participation of all parties in the flow of business activities produces a concept known as Supply Chain Management (SCM) [4].

Good SCM is the key to determining a company's competitive advantage. As long as the company can maintain the performance of its supply chain, the company can continue to compete and progress. [5]. SCM can speed up product development, minimize production time, lower production costs, and optimize product quality, so some companies consider SCM to be an integral part of their strategy [6]. Based on this, companies need to measure SCM performance, which aims to enable companies to know the extent of SCM performance in their business so that they can reduce costs, meet customer satisfaction, and increase company profits [7].

To determine the performance of a company's supply chain, a measurement basis is needed. The basis that can be used is the Supply Chain Operation Reference (SCOR) method. The matrices in the SCOR model are renowned for being able to link business processes, performance matrices, practice standards, and people skills in an integrated structure [8]. Measurement activities using the SCOR method can help companies in mapping, developing, assessing, and monitoring supply chain performance levels [9]. The SCOR method provides general process-oriented information for communication between supply chain partners in five core processes, namely plan, source, make, delivery, and return. These five processes will become indicators in measuring supply chain performance [10]. Apart from that, the processing can be collaborated with the Analytical Hierarchy Process (AHP) method; by using AHP, you can determine the main priorities and criteria used as alternatives [11], [12].

In this study, researchers conducted research at a company operating in the metal industry. This research was conducted in the metal industry because this industry produces a wider variety of product types than other industries, such as plastics. The company's main production products are sheet metal and color-coated sheet metal. Based on the product form, there are two types. The first type is semi-finished products, which include coils (rolled metal), plates, and small coils. The second type of product, namely finished products, includes corrugated and roll-formed products. The company's target market segments in marketing its products are industrial, retail, and projects with various types of product variations. In addition, another reason for using the SCOR and AHP methods is used to measure SCM performance in the metal industry because SCOR provides a comprehensive industry standard framework for defining supply chain processes, while AHP helps determine weights and priorities for measuring performance based on various complex metrics. The selection of the metal industry can be based on its complexity and unique nature that requires structured and multi-criteria performance evaluation, such as complex raw material management, global supply chains, and the importance of operational efficiency.

So far, this metal company has implemented SCM to manage the flow of goods from suppliers until the products are received by consumers. However, until now, the metal company has never carried out a comprehensive measurement of its supply chain performance, so its supply chain performance is not known, and sometimes, problems occur. Every pending industry measures the supply chain to find out where the bottleneck is, causing problems that can cause the supply chain process to be disrupted and stagnate [13]. This problem is in the planning process (source), especially in sales demand planning. This, of course, affects the availability of raw materials and the production process (make) and causes the delivery process to experience delays. The forecasting and actual demand can be seen in Figure 1.

Figure 1 shows that the company is not thorough in analyzing monthly sales demand. This is due to fluctuations in customer demand, where each month, there is an average difference of approximately 1,000 tons in customer demand. In December 2022, the lowest demand projection planned by the planning department was 4,021 tons, but actual customer demand was 5,021 tons. This also has the potential to lead to inaccurate raw material procurement planning, resulting in production problems due to stagnant raw materials. The following is the production schedule from October 2022 to March 2023. The planning and actual production can be seen in Figure 2.

Figure 2 shows that each month, production activities did not proceed according to plan. On average, actual production was five days behind the planned production schedule each month. This was due to delays in raw material supplies, additional items requiring prioritization, machine breakdowns, and inaccurate scheduling of production operators, which hampered production. The existence of several problems that occur in the company's supply chain flow has an impact and leads to problems in delivering products to customers that are not met [14]. The sales results and outstanding orders can be seen in Figure 3.

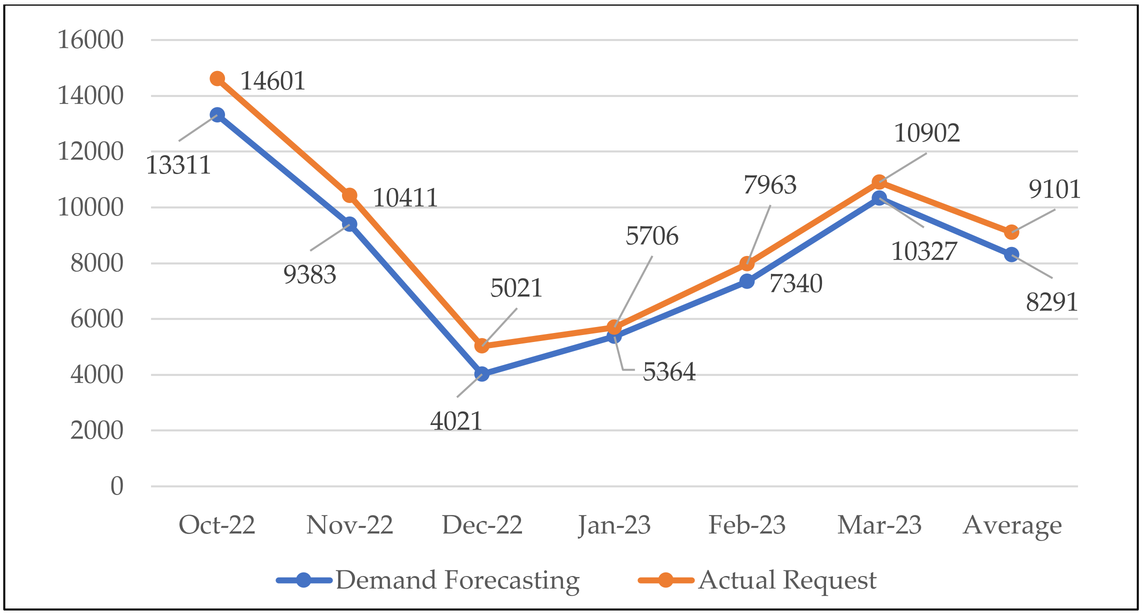

Figure 1. Forecasting and actual demand

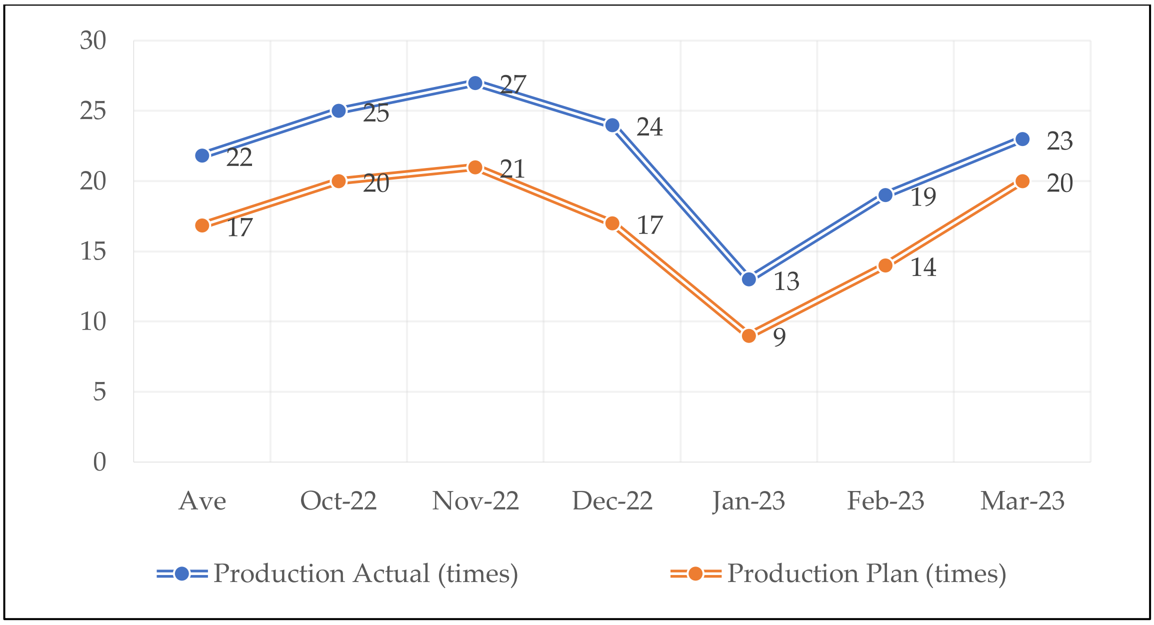

Figure 2. Planning and actual production

Figure 3 shows that shipments have not kept pace with sales orders for several months in the past six months, preventing the metals company from achieving its delivery targets. On average, there is still a monthly difference of 1,771 points between actual shipments and sales orders. This is a result of several previous supply chain issues, indicating that the company's SCM performance is unstable in meeting consumer product needs. Based on this, researchers are motivated to provide suggestions so that metal companies know how SCM performs in their companies, especially in product distribution channels. Later, the results of performance measurement can be used as material for evaluating company performance and creating good strategies for the future and as a determinant of company operations.

Apart from these problems, metal companies also do not know what indicators are needed to assess SCM performance measurements, especially in distribution, so companies also do not know what effective improvements are needed to improve the company's SCM performance. Therefore, researchers want to measure the SCM performance of metal companies, where the measurements that will be carried out are identifying the supply chain management system and the cooperation system between the company and the parties involved, using the SCOR method for mapping performance indicators and the AHP method for data processing [15], [16]. This is done so that each process and supply chain attribute's performance value can be known. That way, companies can find out which supply chain sectors need to maintain their quality performance and which sectors need to be improved so that they can hopefully create a better company SCM [17].

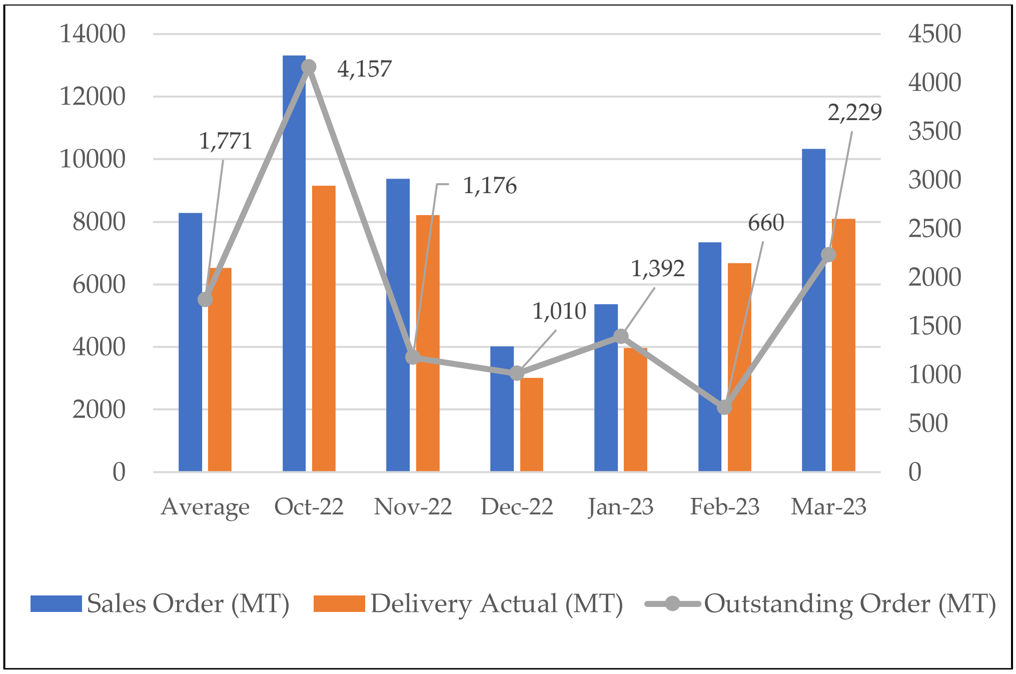

Figure 3. Sales and outstanding orders

The latest research is found in the research object, namely one of the metal companies in Indonesia. This research also applies the SCOR method in analyzing problems that occur and the AHP method in analyzing factors that influence the fulfilment of customer orders. Other research in the metal industry analyzes its supply chain using the SCOR, Lean, and Six Sigma methods [18]. Meanwhile, in other industries, for example, in the automotive industry, the SCOR method can be used to improve the automotive spare part supply chain. [19]. The contribution of this research to the performance measurement analysis of the SCOR and AHP methods is that it is hoped that companies can maximize the supply chain to increase industrial productivity and gain a competitive advantage. Meanwhile, other research in analyzing company performance measurements uses the Analytic Network Process (ANP) method [20]. This research aims to analyze supply chain performance measurements and provide suggestions for improvements to the results of the metal company's supply chain performance measurements.

2. MATERIALS AND METHODS

The research carried out is of the type of descriptive quantitative research. The source of the data and information was obtained through a questionnaire, which was used to collect data from internal expert judgment. The internal expert judgement used in this research was based on 3 internal experts' judgments who had more than 10 years of experience, were more than 40 years old and had bachelor's degrees, including warehouse supervisors, production supervisors and purchasing supervisors. Data collection techniques are an important factor in the success of research. In collecting data, there are several ways to obtain the data needed by researchers, including making questionnaires, observations, interviews, and documentation [21]. The steps for this research can be seen in Figure 4, and the explanation of the research stages can be found in eight stages.

Step 1 is designing SCOR performance indicators; data was collected by identifying various activities related to the company's supply chain, and then designing SCOR performance indicators based on these conditions. The development of SCOR performance indicators is based on 5 indicators that have been carried out by previous research. The process of selecting performance indicators is based on the SCOR performance indicators. This method has 5 main process stages, namely, plan, source, make, delivery and return [22]. Then, these 5 indicators can be taken from the treatment conditions that have been implemented by the industry. The SCOR performance matrix refers to three levels, namely processes (level 1), attributes (level 2), and performance indicators (level 3). Other research also uses the SCOR method to select process variables that can be used, namely plan, source, make, delivery and return variables [10].

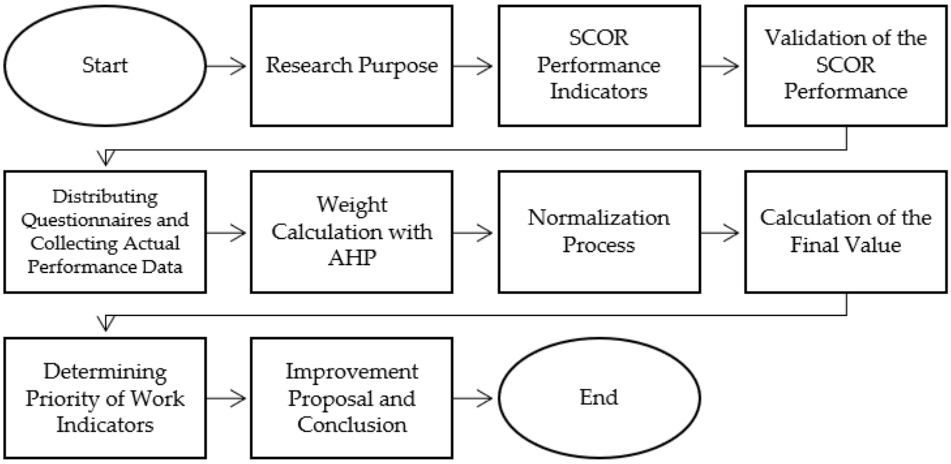

Figure 4. Research framework

Step 2 involves validating the SCOR performance questionnaire, where the performance indicators obtained are compiled and validated. Indicators that are declared valid are attributes that are approved by the company and can be used for the company's supply chain performance indicator questionnaire. If the indicators are not appropriate or invalid, they will be revised or corrected again until approved by the company [8].

Step 3 is distributing questionnaires and collecting actual performance data: indicators that have been declared valid are then compiled into a paired comparison questionnaire. The questionnaire was given to three internal experts for judgment, including the warehouse supervisor, production supervisor, and purchasing supervisor. These three internal expert judgements were selected based on observations at the company, and they understood the company's supply chain process from raw materials to finished products and customers. The three internal expert judgements will be given a paired comparison questionnaire, as well as attached information regarding the explanation of the process, attributes, performance indicators, and how the assessment is carried out, and then the three internal expert judgements will provide a weighting score based on their understanding and the conditions experienced by the company.

Step 4 is the calculation of weight with AHP: weighting is done using the AHP method. The weighting aims to identify the level of importance between processes, the level of importance between attributes in each process, and the level of importance between performance indicators for each attribute and process. The level of importance is weighted on a scale of 1 to 9. Calculate the normalization of each criterion and sub-criterion. Normalization is calculated with the aim that there is no need for repetition when data is processed [23]. The formula used in this research refers to the equation number used in the supply chain approach.

$$Normalization = \frac{Column\ value\ a_{11} \ldots\ldots a_{51}}{\sum Colomn\ value\ a_{11} + \cdots + a_{51}} \tag{1}$$

After normalization, a normalization matrix is obtained. The normalization matrix is used to get the weight values for each criterion. This calculation uses a formula:

$$Weight\ value = \frac{\sum Row\ value\ a_{11} + \cdots + a_{15}}{n} \tag{2}$$

where n *is* the number of criteria, and c is the weighting result matrix, is multiplied for each criterion by the weight value column. This calculation uses a formula:

$$Matrix\ multiplication = \ Row\ value\ a_{11} \ldots\ldots a_{15}\ \times Weight\ value\ column\ a_{11} \ldots\ldots a_{51} \quad (3)$$

Calculation of the maximum eigenvalue for each criterion in the matrix resulting from matrix multiplication. This calculation uses a formula:

$$Eigen\ value = \frac{\Sigma\left(\frac{\Sigma\ Row\ value\ a_{11} \ldots\ldots a_{15}}{Weight\ value\ column\ a_{11} \ldots\ldots a_{51}}\right)}{n} \quad (4)$$

where ∑ Row value a_11…..a_15 is the sum of the row data values of the matrix multiplication table, Row value a_11…..a_51 is the weight of the criteria, and n is the Number of criteria.
Global weight calculations can use formula equations:

$$Global\ weight - 1 = process\ weight\ \times\ attribute\ weight\ \times\ performance\ indicator\ weight \quad (5)$$

Testing hierarchical consistency. If the CR is lower than the specified limit, then the data can be accepted. Meanwhile, if the CR is higher than the specified limit, then the assessment needs to be repeated. The formula used is:

$$CI = \frac{\lambda maks - n}{n - 1} \quad (6)$$

where λ max is the Eigenvalue, and n is the Number of criteria or sub-criteria calculated.
The CR calculation is obtained from the formula:

$$CR\ = \frac{CI}{RI} \quad (7)$$

where CI is Consistency Index, CR is Consistency Ratio, and RI is Random Index
An explanation regarding the RI value used in data processing can be seen in Table 1. Meanwhile, an explanation of the consistency ratio value can be seen in Table 2.

Table 1. Random consistency index

n	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

Table 2. Consistency ratio

n	**2x2**	**3x3**	**4x4**	**5x5**
CR	0%	5%	8%	10%

The actual value calculation is a calculation of the actual performance value of each performance indicator. The performance indicators calculated are those that were previously validated and declared valid. Performance value calculations are carried out using actual data collected from the field or interviews with related parties.

$$Actual\ Performance\ Value = 100 - \left(\frac{planned\ value\ -\ actual\ value}{planned\ value} \times 100\%\right) \quad (8)$$

Step 5 is the Snorm de Boer Snorm normalization process: Snorm de Boer normalization calculations are used to equalize the measurement scale of actual performance values because each performance indicator has a different measurement scale [24]. The Snorm de Boer method was chosen because it standardizes the assessment scale for various performance indicators with different units and parameters. Furthermore, the normalization results allow companies to conduct in-depth and systematic analysis of business processes and metrics that require improvement. The Snorm de Boer normalization process is carried out using a formula:

$$Snorm\ = \frac{(Si - Smin)}{(Smax - Smin)}\ \times 100 \quad (9)$$

where Si is the actual indicator value that was successfully achieved, Smin is the worst performance target value of the performance indicator, and Smax is the best performance target value of the performance indicator.

Step 6 is the calculation of the final value of supply chain performance: calculation of the final value of a company's supply chain performance begins by calculating all weights from the product of process weights, attribute weights, and performance weights. Next, the final value of supply chain performance is obtained by multiplying all weights by the process performance value from the results of the Snorm de Boer equation.

$$Value\ of\ incompetence\ = 100\ -\ Value\ of\ Snorm\ de\ boer \tag{10}$$

$$Frequency\ = Value\ of\ incompetence\ x\ Global\ weight \tag{11}$$

Step 7 is determining work indicator priorities: In the assessment, not all performance indicators are prioritized. There are several indicators whose weight is greater than other indicators. This weight can present the priority performance indicators determined by the company. This performance indicator priority can be used to improve related performance. Step 8 is proposed improvements and conclusions: after analyzing and discussing the results, proposals for improvements regarding SCM will be obtained for the relevant company. Apart from that, conclusions and suggestions will also be obtained, and recommendations for similar research in the future will be provided.

3. RESULTS

In the SCOR method, business processes are divided into five parts, namely source, plan, make, deliver, and return. Each process is then further broken down into subprocesses that provide detailed explanations of related activities.

3.1. Design of SCOR Performance Indicators

Before getting the right performance indicators, it is necessary to have an accurate understanding of the supply chain assessment and agreement with the research site. Based on the SCOR framework model, there are five processes in the supply chain, namely plan, source, make, deliver, and return. From each process, there are five attributes, namely reliability, responsiveness, agility, costs, and assets. From the five attributes that are aligned with the company's objectives, theories, and previous research, performance indicators or KPIs are obtained, which include five processes and three attributes, namely the attributes of reliability, responsiveness, and agility [25]. The cost and assets criteria were not used due to research limitations, which did not discuss the company's financial aspects.

The process of selecting performance indicators is based on the SCOR performance indicator. This method has 5 main process stages, namely plan, source, make, deliver, and return. The process of determining indicators begins by creating and compiling indicators based on company conditions, theoretical studies, and previous research, which will later be compiled into a paired comparison questionnaire. The paired comparison questionnaire will later be used to assess supply chain performance in metal companies, so before the questionnaire is used to assess performance, the next step is to validate the questionnaire to find out whether the indicators that have been prepared are valid or invalid.

3.2. Validation of the SCOR Performance Questionnaire

After being prepared, the performance indicators or KPIs are validated by three people from the metal company to find out whether all the indicators are valid and can be measured according to the company's current conditions. Validation is carried out in accordance with the attributes used, including reliability and responsiveness at each stage of the process. Next, each attribute's performance indicators are proposed by the three experts to be assessed in a measurable and structured manner. These three experts are the warehouse supervisor, production supervisor, and purchasing supervisor.

Based on the results of the validation that has been carried out, several indicators are invalid, so it is necessary to revise the performance indicators. The next validation step is after obtaining 17 performance indicators, which have been validated by 3 experts in determining the questionnaire, and then the results of data collection will be recapitulated in the company's Key Performance Indicators (KPI). The next step is data processing using face validation techniques and SCOR method calculations. The following are 17 performance indicators that have been revised and will be used as guidelines for the paired comparison questionnaire, which can be seen in Table 3.

Table 3. Performance indicators for the paired comparison questionnaire

Process	Attribute	Performance Indicator	Description
Plan	Reliability	Sales Demand Planning	Accuracy in forecasting sales demand
		Raw Material Procurement Planning	Accuracy in forecasting raw material needs
	Responsiveness	Production Planning	The time needed to make production planning
Source	Reliability	Receipt of Raw Materials	Receipt of raw materials according to the type and quantity ordered from the supplier
		Return of Raw Materials	Raw materials returned to suppliers due to defects or poor quality
	Responsiveness	Lead Time for Receipt of Raw Materials	The timeliness required by the supplier to fulfil orders for raw materials
Make	Reliability	Suitability of Production Results	Suitability of the type and quantity of products produced with customer requests
		Product Defect	Production products that do not pass inspection
	Responsiveness	Production Time	Accuracy of the production process schedule following production planning
	Agility	Production of Additional Products	The time required to produce additional products
Delivery	Reliability	Conformity of Products That Have Been Sent	Conformity of products sent with customer requests
		Order Fulfillment	Ability to fulfil company deliveries with specified targets
	Responsiveness	Delivery time	The company's punctuality in delivering products to customers
	Agility	Additional Product Delivery	The time required to prepare additional shipments
Return	Reliability	Product Return Rate	Product is the percentage of defective products returned by customers
		Product Replacement Return	Replacement of defective products with the correct quantity and type
	Responsiveness	Complaint Service	The time required to resolve and resolve customer complaints

Based on Table 3, validation activities are carried out by internal expert judgements who are experts in the company's supply chain. The results of the validation will later be assessed, and suggestions and input will be provided regarding indicators that need to be revised or improved. After validation, of the 25 indicators, only 17 indicators are valid and can be used to assess supply chain performance. These indicators include 5 criteria, 3 attributes, and 17 performance indicators. Cost and assets criteria are not used because this research does not discuss the company's financial aspects. In the next step, a valid questionnaire can be given to three people from the company who understand the company's supply chain, namely the warehouse supervisor, production supervisor, and purchasing supervisor.

3.3. Distribution of Questionnaires and Collection of Actual Performance Data

After obtaining a valid paired comparison questionnaire, the questionnaire is then weighted. The aim of weighting the questionnaire in pairs is that the relative level of importance of all performance indicators can be determined. Filling out the questionnaire was carried out by comparing each process, process attributes, and indicators for process attributes, carried out by three predetermined internal expert judgements. Then, the data processing of each weighting is carried out using the AHP method [26]. There are three levels in the weighting process, including:

Level 1, gives weight to each process, namely plan, source, make, deliver, and return. Level 2, giving weight to each attribute of each supply chain criterion. These attributes include reliability, responsiveness, and agility. Level 3, giving weight to each performance indicator or KPI for each attribute.

The process used in the questionnaire consists of five processes, including plan, source, make, deliver, and return. The results of the questionnaires from the three internal expert judgements, which have been processed into a matrix for each core process, can be seen in Table 4.

Table 4. Combined process matrix

Proses	Plan	Source	Make	Delivery	Return
Plan	1.000	0.997	0.478	0.210	0.583
Source	0.997	1.000	0.478	0.270	0.585
Make	2.080	2.080	1.000	0.689	2.759
Delivery	4.718	3.659	1.437	1.000	4.217
Return	1.704	1.710	0.359	0.236	1.000
Total	10.499	9.446	3.752	2.405	9.144

Based on Table 4, the delivery process has the highest comparison value against the plan, namely 4.718, and the plan weight has the highest total value, namely 10.499. The results of this matrix process comparison can provide an initial indication of the relative priority of each process, but the final weight must be calculated through a normalization process.

3.4. Processing of SCOR Performance Questionnaire Weighting Results

This weight calculation is obtained by calculating the average cell value per row, which has been previously normalized. The calculation simulation can use Eq. (2).

$$Average\ P = \frac{0.095 + 0.106 + 0.127 + 0.087 + 0.064}{5} = \frac{0.479}{5} = 0.096$$

Based on Table 5, the interpretation of the average value indicates the relative weight or priority of each SCOR process. The delivery process has the highest weight of 0.419, indicating that the delivery aspect is the most important in the supply chain based on the assessment that has been carried out.

Table 5. Combined process weight value

Proses	Plan	Source	Make	Delivery	Return	Amount	Average
Plan	0.095	0.106	0.127	0.087	0.064	0.479	0.096
Source	0.095	0.106	0.127	0.112	0.064	0.504	0.101
Make	0.198	0.220	0.267	0.286	0.302	1.273	0.255
Delivery	0.449	0.387	0.383	0.416	0.461	2.097	0.419
Return	0.162	0.181	0.096	0.098	0.109	0.647	0.129

3.4.1. Matrix Multiplication Calculations

This calculation is carried out by multiplying the matrix between all cells in Table 4 by the value of each column cell in Table 5, the results of which can then be seen in Table 6. Example of a calculation simulation using Eq. (3): Where the value for P-P=1 in Table 5 is multiplied by the weight column cell value P=0.096 in Table 6, so that 1 x 0.096 is 0.096. Based on Table 6, the highest process comparison result is the comparison of delivery to return, at 0.544. Meanwhile, the lowest process comparison is the comparison of plan and source to return.

Table 6. Combined process matrix multiplication

Proses	**Plan**	**Source**	**Make**	**Delivery**	**Return**
Plan	0.096	0.101	0.122	0.088	0.075
Source	0.096	0.101	0.122	0.113	0.075
Make	0.200	0.210	0.255	0.289	0.356
Delivery	0.453	0.370	0.366	0.419	0.544
Return	0.164	0.173	0.092	0.099	0.129

3.4.2. Calculation of Maximum Eigen Value

This calculation is carried out by finding the average result of dividing the matrix multiplication calculation by the existing weights. The results of the calculation simulation using Eq. (4) can be seen in Table 7.

Table 7. Combined eigenvalue of combined processes

Proses	**Plan**	**Source**	**Make**	**Delivery**	**Return**	**Total**	**Average (weight)**	**Total/Average (*Eigenvalue*)**
Plan	0.096	0.101	0.122	0.088	0.075	0.482	0.096	5.021
Source	0.096	0.101	0.122	0.113	0.075	0.507	0.101	5.020
Make	0.200	0.210	0.255	0.289	0.356	1.310	0.255	5.137
Delivery	0.453	0.370	0.366	0.419	0.544	2.152	0.419	5.136
Return	0.164	0.173	0.092	0.099	0.129	0.657	0.129	5.093
Average (λ max)								5.081

Based on Table 7, the average eigenvalue result is 5.081 to calculate the CR value. The eigenvalue comparison results are based on the comparison of each process to test the consistency of the assessment given in the pairwise comparison. Example of a calculation simulation using Eq. (4):

Total P = 0.096 + 0.101+ 0.122 + 0.088 + 0.075 = 0.482

$$\text{Then, } \frac{Total\ P}{Bobot\ P} = \frac{0{,}482}{0{,}096} = 5.021$$

$$Eigen\ value\ max\ \frac{5.021 + \cdots + 5.093}{5} = 5.081$$

3.4.3. Calculation Consistency Index

This calculation uses the formula Eq. (5).

$$CI = \frac{\lambda\ \max - n}{n-1} = \frac{5.081 - 5}{5-1} = 0.020$$

Consistency ratio calculation. The CR calculation is obtained from formula Eq. (6):

$$CR = \frac{CI}{RI}$$

The RI value information table can be seen in Table 2 because in the combined process using a 5x5 matrix, the RI value used is 1.12. If the resulting CR value is greater than the standard, then the assessment carried out is considered inconsistent, so it is necessary to redistribute the pairwise comparison matrix questionnaire. The CR value for Combined Internal expert judgements uses Eq. (7).

$$CR = \frac{CI}{RI} = \frac{0.020}{1.12} = 0.018$$

Because the CR value is ≤ 0.1, the resulting values for the combined internal expert judgement process are consistent and acceptable. In Table 8, it can be observed that of the 5 criteria used, the highest process weight is the deliver process with a value of 0.419. This indicates that the company prioritizes this process over other processes. Meanwhile, priority criteria can be observed in Table 8.

Table 8. Weight process

Process	Weight
Delivery	0.419
Make	0.255
Return	0.129
Source	0.101
Plan	0.096

Based on Table 8 that the global weight calculation aims to find out which processes, attributes, and performance indicators are most important. This can be seen from the weight of the processes, attributes, and performance indicators themselves. The greater the weight, the greater the level of importance of the process, attributes, and performance indicators.

The global weight calculation is obtained by multiplying the process weights, attributes, and performance indicators. Example of calculation for global weights using Eq. (5). Complete calculation results can be seen in Table 9.

$$Global\ weight\ PR - 1 = 0.096\ \times 0.884\ \times 0.451 = 0.038$$

Based on Table 9, at level 2, namely attribute weighting, three attributes are compared: reliability, responsiveness, and agility. Based on the weighting, for each process carried out, the reliability attribute has a greater weight than the weight of the responsiveness and agility attributes. A high reliability weight indicates that the company prioritizes creating products with optimal quality. However, there is no significant difference in weight between the three tributes. This is because the speed of time and responding to something unexpected greatly influences consumer satisfaction. The reliability weight that has the highest value is in the planning process, namely 0.884.

The weighting of the plan process performance indicators includes 3 performance indicators, namely sales demand planning, raw material procurement planning, and production planning. The three indicators that have the highest weight are 0.549 in the raw material procurement planning performance indicator, this shows that this indicator is more important than the other two indicators. The results of weighting performance indicators in the sourcing process show 3 performance indicators, namely receipt of raw materials, return of raw materials, and lead time for receipt of raw materials. These three indicators have the highest weight, namely 0.734 in the raw material receipt performance indicator, this shows that this indicator is more important than the other indicators. The results of weighting performance indicators in the production process show 4 performance indicators, namely conformity of production results, defective products, production time, and additional product production. These four indicators have the highest weight, namely 0.571, in the performance indicator of the suitability of production results. This shows that this indicator is more important than the other indicators.

The results of weighting performance indicators in the delivery process contain 4 indicators, namely the suitability of products that have been sent, order fulfilment, delivery time, and delivery of additional products. These four indicators have the highest weight, namely 0.50, for the performance indicator of conformity of products that have been sent and order fulfilment. This shows that this indicator is more important than the other indicators. The results of weighting performance indicators in the return process contain 3 indicators, namely product return rate, product replacement return, and complaint service. These three indicators have the highest weight, namely 0.550 in the product return rate performance indicator, this shows that this indicator is more important than the other indicators. Another research analyzing supply chain performance used the SCOR and AHP methods at the Green Avenue apartment in East Bekasi. The results of weighting the performance of each indicator are that the weight level 1 is the largest for the source indicator, which is 0.274, then the weight level 2 is the largest for the source, delivery and return indicators, namely 1,000. Furthermore, from the results of the level 3 weighting, the return indicator has the largest weight, namely 0.820 [10].

Table 9. Global weight

Process	Weight	Attribute	Weight	Performance Indicator Code	Performance Indicator	Weight	Global Weight
Plan	0.096	PR	0.884	PR1	Sales Demand Planning	0.451	0.038
				PR2	Raw Material Procurement Planning	0.549	0.047
		PRe	0.116	PRe	Production Planning	1.000	0.011
Source	0.101	SR	0.676	SR1	Receipt of Raw Materials	0.734	0.050
				SR2	Return of Raw Materials	0.266	0.018
		SRe	0.324	SRe	Lead Time for Receipt of Raw Materials	1.000	0.033
Make	0.255	MR	0.606	MR1	Suitability of Production Results	0.571	0.088
				MR2	Product Defect	0.429	0.066
		MRe	0.304	MRe	Production Time	1.000	0.078
		MA	0.090	MA	Production of Additional Products	1.000	0.023
Delivery	0.419	DR	0.641	DR1	Conformity of Products That Have Been Sent	0.500	0.134
				DR2	Order Fulfillment	0.500	0.134
		DRe	0.225	DRe	Delivery time	1.000	0.094
		DA	0.134	DA	Additional Product Delivery	1.000	0.056
Return	0.129	RR	0.618	RR1	Product Return Rate	0.550	0.044
				RR2	Product Replacement Return	0.450	0.036
		RRe	0.382	RRe	Complaint Service	1.000	0.049

3.5. Snorm de Boer Normalization Process

This calculation is done by dividing the number contained in each matrix cell by the total for each process column. The Snorm de Boer method is needed to normalize previously obtained data, namely, performance weighting. This step functions to equalize the units of each indicator. Normalization for the combined process can use Eq. (1), and the calculation simulation results can be seen in Table 10.

$$Normalization\ P - P = \frac{Column\ cell\ value}{Total\ column\ value} = \frac{1}{10.499} = 0.095$$

Table 10. Joint process normalization

Proses	Plan	Source	Make	Delivery	Return
Plan	0.095	0.106	0.127	0.087	0.064
Source	0.095	0.106	0.127	0.112	0.064
Make	0.198	0.220	0.267	0.286	0.302
Delivery	0.449	0.387	0.383	0.416	0.461
Return	0.162	0.181	0.096	0.098	0.109

Based on Table 10, the normalization matrix is used to calculate the weight vector (priority) of each process, which is for the use of AHP and weight calculations. The discussion of this study shows that the eigenvalue is 5.081, reflecting the level of inconsistency in the measurement assessment. Although not perfect, this inconsistency is still acceptable if the CR is below the specified limit. If the CR result is > 0.10, this indicates a significant inconsistency in the assessment. The data should be reviewed, and the pairwise comparison matrix should be re-evaluated. Meanwhile, the CR result of 0.018 or 1.8% obtained indicates that the assessment made by the decision maker is very consistent and reliable.

3.6. Supply Chain Management (SCM) Performance Measurement

Supply chain performance assessment is carried out through supply chain performance evaluation based on assessment attributes that have been prepared and implemented at the performance indicator level. Each performance indicator has a different weight with a different measurement scale. Therefore, normalization needs to be carried out to equalize these parameters. In this case, there is an important role of normalization to achieve the final value of performance measurement. Normalization is carried out using the Snorm de Boer formula. Calculation of the final value of a metal company's SCM performance can be obtained by multiplying the actual normalized performance value (Snorm de Boer) with the final AHP weight of each performance indicator, resulting from the final weight, namely the multiplication of the weights of level 1, level 2 and level 3. To get the Snorm value, you have to use the formula Eq. (10), and the results calculation of supply chain management performance values can be observed in Table 11.

$$Snorm = \frac{(3.33-1)}{(4-1)} \times 100 = 77.78$$

Based on Table 11, each indicator parameter has an Smin value, which is the worst value as the worst limit that can be achieved in performance, for example 0% accuracy or zero on-time delivery. This is the lowest theoretical benchmark that can be accepted to measure performance. Meanwhile, the Smax value is the best value representing the achievement of a perfect target. If the performance target of a metric, such as raw material procurement or PR2, is perfect accuracy or providing 100% of orders, then the Smax set is 100. Correlation with the Snorm de Boer method shows that the results of normalization of the Si value to a scale of 0–100, in the PR2 parameter indicator, have a low Snorm de Boer value (79.77), but its weight is quite large (0.046), so the final value is still quite significant.

The final value of SCM using AHP can be determined, so that handling of each performance indicator can be implemented for each performance indicator. Based on Table 11 about the calculation of normalized values, it is known that the lowest value is in the production time with code MRe indicator which only has a score of 76.41, while the highest value is in the performance indicators for planning raw material procurement, production planning, receiving raw materials, suitability of production results and suitability of production results which each have a score of 100. All scores obtained by all aspects will influence the final calculation results of supply chain performance in the metal industry. Obtaining a high score is because the company has been able to achieve the best score in accordance with the goals that have been set, while obtaining a low score is because the company has not yet maximized it, so further efforts are needed must improve supply chain performance so that the goals can be achieved.

Table 11. Performance value supply chain management

No	Code	Performance Indicator	Si	Smin	Smax	Snorm de Boer	Global Weight	SCM Final Value
1	PR1	Sales Demand Planning	90.38	0.00	100	90.38	0.038	3.56
2	PR2	Raw Material Procurement Planning	79.77	0.00	100	79.77	0.046	5
3	PRe	Production Planning	4	1	4	100.00	0.011	1
4	SR1	Receipt of Raw Materials	100	0	100	100.00	0.050	5
5	SR2	Return of Raw Materials	0.39	100	0	99.61	0.018	1.99
6	SRe	Lead Time for Receipt of Raw Materials	90.28	0	100	90.28	0.033	2.71
7	MR1	Suitability of Production Results	100	0	100	100.00	0.088	9
8	MR2	Product Defect	0.22	100	0	99.78	0.066	6.98
9	MRe	Production Time	76.41	0	100	76.41	0.077	6.11
10	MA	Production of Additional Products	3.34	1	4	77.78	0.023	1.56
11	DR1	Conformity of Products That Have Been Sent	99.99	0	100	99.99	0.134	13
12	DR2	Order Fulfillment	79.10	0	100	79.10	0.134	10.28
13	DRe	Delivery Time	92.31	0	100	92.31	0.094	8.31
14	DA	Additional Product Delivery	3.33	1	4	77.78	0.056	4.67
15	RR1	Product Return Rate	0.06	100	0	99.94	0.044	4
16	RR2	Product Replacement Return	100	0	100	100.00	0.036	4
17	RRe	Complaint Service	3.83	1	4	94.44	0.049	4.72
			Total					90.90

3.6.1. Sales Demand Planning

Sales demand planning is accurate in predicting sales demand; this indicator has a Snorm de Boer norm score of 90.38. This indicator score is included in the good performance indicator monitoring system. This value shows that the performance indicator is very good in predicting sales demand. The sales demand planning performance indicator has a final SCM value of 3.56. Forecasting sales demand is needed to plan production quantities that are adjusted to production forecasting to produce a slight difference in the ratio between the two, which is still within tolerance [27].

3.6.2. Raw Material Procurement Planning

Raw material procurement planning is accurate in predicting demand for raw materials; this indicator has a Snorm de Boer norm score of 79.77. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in predicting demand for raw materials. The raw material procurement planning performance indicator has a final SCM value of 5.00. Forecasting demand for raw materials in the form of materials or equipment is very important for accurate material planning and supporting the sustainability of raw material supplies [28].

3.6.3. Production Planning

Production planning is the time needed to carry out the planning process; this indicator has a score of 100. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in determining the time needed for the planning process. The production planning performance indicator has a final SCM value of 1.00. Proper production planning can support improving product quality so that waste activities in production can be minimized [29].

3.6.4. Receipt of Raw Materials

Receipt of raw materials is receipt of raw materials that match the type and quantity ordered from the supplier; this indicator has a Snorm de Boer score of 100. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is good in carrying out receipts. raw materials that match the type and quantity ordered from the supplier. The performance indicator for receiving raw materials has a final SCM value of 5.00. The suitability of the type and quantity of material ordered from the supplier is important in reducing the time for receiving raw materials from the manufacturer [30].

3.6.5. Return of Raw Materials

Returned raw materials are raw materials that are returned to the supplier due to defects or poor quality when they are being produced and are being produced. This indicator has a Snorm de Boer norm score of 99.61. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in returning raw materials to suppliers due to defects or poor quality. The raw material return performance indicator has a final SCM value of 1.99. Wasted selection time and non-conformity of ordered materials are activities that have no value, so material returns need to be eliminated in the supply chain of receiving materials to the warehouse [31].

3.6.6. Lead Time for Receipt of Raw Materials

Lead time for receiving raw materials is the accuracy of delivery of raw materials by suppliers; this indicator has a Snorm de Boer norm score of 90.28. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in carrying out accuracy in the delivery of raw materials by suppliers. The lead time performance indicator for receiving raw materials has a final SCM value of 2.71. Measuring the correct time for receiving materials, both processes and receiving raw materials, can improve delivery to the next section [32], [33].

3.6.7. Suitability of Production Results

Conformity of production results is the suitability of the type and quantity of products produced with customer demand; this indicator has a Snorm de Boer score of 100. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in conforming to the type and quantity of products produced according to customer requests. The performance indicator for the suitability of production results has a final SCM value of 9.00. Accuracy and suitability of production results in the form of colours and production quantities following customer requests [34].

3.6.8. Product Defect

Defective products are production products that do not pass inspection; this indicator has a Snorm de Boer norm score of 99.78. This indicator score is included in the excellent performance indicator monitoring system, this value shows that the performance indicators are very good for production products that do not pass inspection. The defective product performance indicator has a final SCM value of 6.98. Improving quality or reducing production defects can improve company performance well in line with company expectations or targets [35].

3.6.9. Production Time

Production time is the accuracy of the production process schedule by production planning, this indicator has a Snorm de Boer norm score of 76.41. This indicator score is included in the good performance indicator monitoring system. This value shows that the performance indicator is good enough in scheduling the production process following production planning. The production time performance indicator has a final SCM value of 6.11. Balancing the production schedule with production planning will reduce inventory stock by minimizing stock percentage differences [36].

3.6.10. Production of Additional Products

Additional product production is the time needed to make deliveries; this indicator has a Snorm de Boer norm score of 77.78. This indicator score is included in the good performance indicator monitoring system, this value shows that the performance indicator is good within the time required for delivery. The additional product production performance indicator has a final SCM value of 1.56. Additional production is an inefficient time-wasting activity due to production forecasting errors [37].

3.6.11. Conformity of Products That Have Been Sent

The suitability of the product that has been sent is the suitability of the product that has been sent with the product ordered by the consumer. This indicator has a Snorm de Boer norm score of 99.99. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in terms of conformity of the product that has been sent with the product ordered by the consumer. The conformity performance indicator for products that have been shipped has a final SCM value of 13.00. Products sent to customers must follow customer requests because this is customer fulfilment or satisfaction in business [38].

3.6.12. Order Fulfillment

Order fulfilment is the company's ability to fulfil deliveries within one month with a specified target. This indicator has a score of 79.10. This indicator score is included in the good performance indicator monitoring system. This value shows that the performance indicator is good enough for the company's ability to fulfil delivery within one month with the specified target. The order fulfilment performance indicator has a final SCM value of 10.28. Delivery of products tailored to customer requests according to their requirements is an obligation for suppliers in the service industry [39].

3.6.13. Delivery Time

Delivery time is the percentage of the company's punctuality in delivering products to customers; this indicator has a Snorm de Boer norm score of 92.31. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in terms of the company's timeliness in delivering products to customers. The delivery time performance indicator has a final SCM value of 8.31. Accurate delivery times with agreed lead times is a way of thinking about delivery time efficiency [40].

3.6.14. Additional Product Delivery

Additional product delivery is the percentage of time needed to make delivery; this indicator has a Snorm de Boer score of 77.78. This indicator score is included in the good performance indicator monitoring system; this value shows that the performance indicator is good in the time needed to make a delivery. The additional product delivery performance indicator has a final SCM value of 4.67. The Kanban system can balance between suppliers and recipients of goods, thereby reducing the risk of sending additional products [14].

3.6.15. Product Return Rate

The product return rate is defective products returned by customers; this indicator has a Snorm norm score of 99.94. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in defective products returned by customers. The product return rate performance indicator has a final SCM value of 4.00. What needs to be eliminated is the rate of product returns from customers to suppliers because the product does not comply with customer requirements [41].

3.6.16. Product Replacement Return

Replacement of returned products is the replacement of defective products with the right quantity and type. This indicator has a Snorm de Boer score of 100. This indicator score is included in the excellent performance indicator monitoring system, this value shows that defective products are replaced with the right quantity and type. The return product replacement performance indicator has a final SCM value of 4.00. It is hoped that goods that have been received by customers will be well received, because if there is a product replacement, it means that the product inspection system by the supplier is not good and appropriate [42].

3.6.17. Complaint Service

Complaint service is the percentage of time needed to resolve and resolve customer complaints; this indicator has a score of 94.44. This indicator score is included in the excellent performance indicator monitoring system. This value shows that the performance indicator is very good in the time needed to resolve and resolve customer complaints. The complaint service performance indicator has a final SCM value of 4.72. One of the good producers is to serve all forms of complaints and answer them quickly, meaning things like that provide customer satisfaction [43].

3.7. Proposed Improvement Priorities

The results of the supply chain performance assessment are categorized as good, although not perfect. Therefore, improvements are needed so that the company's supply chain performance will be more optimal. These improvements must be carried out in stages and require dominant corrective action for SCM problems.

There are a total of 17 company performance indicators assessed. Based on 17 performance indicators, 20% were taken, namely, 5 performance indicators. Subcriteria are selected based on the weight x value of the company's supply chain incompetence. The higher weight indicates that the performance indicator is more important for the company. Meanwhile, a higher incompetence score indicates lower performance, or the supply chain has a lower ability to handle problems. The improvement team agreed to choose the top 5 or most dominant value results, which will be priority improvements, because they have a big influence on the indicators in the company's KPI. The results of the calculation between weight and disability value can be seen in Table 12.

Table 12. Improvement priorities

Performance Indicator	Global Weight	Snorm de Boer	Value of Incompetence	Frequency	Percentage (%)	Cumulative Percentage (%)
DR2	0.134	79.10	20.90	2.80060	31.08	31.08
MRe	0.077	76.41	23.59	1.81643	20.16	51.24
DA	0.056	77.78	22.22	1.24432	13.81	65.05
PR2	0.046	79.77	20.23	0.93058	10.33	75.38
DRe	0.094	92.31	7.69	0.72286	8.02	83.40
MA	0.023	77.78	22.22	0.51106	5.67	89.08
PR1	0.038	90.38	9.62	0.36556	4.06	93.13
SRe	0.033	90.28	9.72	0.32076	3.56	96.69
RRe	0.049	94.44	5.56	0.27244	3.02	99.72
MR2	0.066	99.78	0.22	0.01452	0.16	99.88
SR2	0.018	99.61	0.39	0.00702	0.08	99.96
DR1	0.134	99.99	0.01	0.00134	0.01	99.97
MR1	0.088	100.00	0.00	0.00000	0.00	99.97
SR1	0.050	100.00	0.00	0.00000	0.00	99.97
RR1	0.044	99.94	0.06	0.00264	0.03	100.00
RR2	0.036	100.00	0.00	0.00000	0.00	100.00
PRe	0.011	100.00	0.00	0.00000	0.00	100.00
Total				9.01	100.00	

Example of calculation using Eqs. (10) and (11):

$$Incompetence\ value\ DR2 = 100 - 79.10 = 20.9$$

$$Frequence\ DR2 = 20.9\ x\ 0.134 = 2.8006$$

Based on the calculations carried out, it is proven that the 5 prioritized performance indicators obtained a value of around 86%. This value indicates that there is at least an 80% reduction in the total value of disability with 20% of the existing sub-criteria. This indicates the need to increase the value of supply chain performance because incompetence can be handled [44].

Based on the results of data processing in Table 12, the yellow performance indicators are obtained, which are performance indicators that require suggestions for improvement. In making an improvement plan, the proposal is based on the results of discussions and suggestions with the internal expert judgements (warehouse supervisor, production supervisor, and purchasing supervisor) as well as several results of previous studies related to SCM. Suggestions for improving performance indicators for the five dominant problems can be seen in Table 13.

Table 13. Proposed improvements to performance indicators

Performance Indicators	Problem	Root Cause Analysis	Proposed Improvements
Order fulfilment (DR2)	The product to be shipped is not yet ready, or some products have not been produced yet	There was a bottleneck in the process of receiving materials from suppliers because their arrival was late	Immediately inform customers about delivery schedules that do not match the customer's initial request because the product is not ready stock and coordinate with the planning department to meet the needs of customer requests.
	Late sales orders	Customers do not check emails containing invoices and payment deadlines	Confirm with customers regarding payments.
	Customer requests to delay delivery	Customers do not have a large warehouse, thus causes delays in delivery	Give customers a maximum limit of 14 days regarding product collection and delivery.
Production time (MRe)	Waiting for the previous production stage, which takes quite a long time	There is material stockpiling up in the semi-finished section because a machine has stopped during repairs	Coordination with the planning department regarding scheduling of semi-finished product production (CGL/CCL) or subsequent production stages and production support readiness
	There are technical problems with production machines and production-supporting facilities	The production machine is in a state of incomplete repair and production support is waiting for spare parts	Checking machines and production supporting facilities (cranes & forklifts) regularly according to schedule.
Additional Product Delivery(DA)	The product to be shipped is not yet ready, or some products have not been produced yet	The lack of production capacity is because several production machines are still not able to run normally	Coordinate with the planning department regarding production scheduling and readiness to support the production of urgent or priority products.
	Unpredictable delivery schedule planning makes it	Transportation facilities for sending products to customers are	Add transportation facilities for sending products to customers, or add delivery service vendor options

Performance Indicators	Problem	Root Cause Analysis	Proposed Improvements
	difficult to get delivery services	considered inadequate	
Raw Material Procurement Planning (PR2)	Companies are not precise in analyzing demand patterns, so there are still deficiencies in meeting consumer demand	The forecasting section is less than optimal in calculations and is still lacking in analyzing obstacles that arise both internally and externally	Companies should pay more attention to forecasting product demand so that demand is met.
Delivery time (DRe)	Unavailability of the fleet from the delivery service	Fleet service providers run out of transportation stock and are less prepared to fulfil transportation	Adding transportation facilities to send products to customers or using more than 1 delivery service.

4. DISCUSSION

This research employs the SCOR and AHP methods to identify 17 selected performance indicators and main priority attributes, specifically reliability, responsiveness, and agility. The results of this research identify five performance indicators that require improvement in supervision, as they are significantly contributing to the problem. The 5 indicators that are priority improvements are order fulfilment, production time, additional product delivery, raw material procurement planning, and delivery time. Meanwhile, other research has resulted in recommendations for priority improvements in 4 performance indicators, which are expected to help improve the company's supply chain performance, namely the fulfilment of raw materials, structures, defective products, and requests that can be met by the company [10]. This is different from this research, which produced 5 performance indicators that had the lowest values, meaning they had a large influence on the continuity of the supply chain. The five performance indicators in this study are Order Fulfilment (DR2), Production Time (MRe), Additional Product Delivery (DA), Raw Material Procurement Planning (PR2), and Delivery Time (DRe).

This research related to SCM is part of the body of knowledge of industrial engineering on SCM, where this research analyzes SCM performance using a combination of SCOR and AHP methods. In theory, the implications of this research can be used as a reference regarding the application of SCM performance measurement. Meanwhile, the practical implications of this research can be used as a reference for implementing the SCOR and AHP methods in analyzing SCM performance measurements in the manufacturing industry, so that SCM can be carried out effectively and efficiently.

Supply chain management in terms of calculating effectiveness is very important, because from other research in the field of SCM in the automotive sector, SCOR and AHP methods are also needed in solving problems in the supply chain [19]. A combination of SCM approaches can also be done by adding research methods, including the SCOR method and the Lean Manufacturing approach, in analyzing supply chain management [18], [45].

The managerial implication of this research is that every supply chain process will experience problems if at each stage there is a dominant problem called a bottleneck. Therefore, there is a need for further analysis using the SCM approach and analysis with calculations using the SCOR method and hierarchical improvements using the AHP method. If this is done correctly, there will be no problems in the supply chain, so customers will feel satisfied with timely delivery, and customer requests in accordance with actual delivery and order wishes will be achieved by the metal industry. Researchers provide input to improve Order Fulfilment (DR2), it is necessary to implement applications/technology in a more sophisticated demand forecasting system and integrate it with the inventory system to improve planning accuracy (PR1). In the Raw

Material Procurement Planning (PR2) performance indicator, it is necessary to develop long-term partnerships with key raw material suppliers to reduce temperature and waiting time. Meanwhile, increasing Production Time (MRe) is achieved by implementing continuous improvement programs (e.g., lean manufacturing) to optimize production workflows and reduce downtime.

The limitation in this research lies in the unrevised KPI targets, as management typically reviews KPI targets at the beginning of each year. Therefore, no revisions were made to the KPIs at the time of this study. This study also has an inappropriate KPI threshold; the target threshold (Smin/Smax) in the Snorm de Boer normalization is set too low or unrealistically, which can result in artificially high scores. For example, if the worst-ever accident is omitted, the score will appear better than it actually is.

5. CONCLUSION

This research found 17 performance indicators, which were compiled into a paired comparison questionnaire using the SCOR method. Meanwhile, the results of the questionnaire that has been distributed are based on validation from 3 experts, resulting in data processing carried out using the AHP method. The results of the AHP method have received global weight, with the highest results obtained at 0.134 in the Conformity of Products Sent (DR1) and Order Fulfilment (DR2) indicators. Meanwhile, for the actual value of the normalized performance indicators, the lowest value was obtained, namely 76.41 for the production time indicator (MRe), while the highest value was obtained for the performance indicators for raw material procurement planning, production planning, raw material receipt, suitability of production results and suitability of results. production, which has a value of 100. After obtaining the actual value of the normalized performance indicators and calculating the level of importance using the AHP method, the final result of SCM performance in metal companies is 90.90. Proposed improvements to performance indicators are designed using the principle of problem dominance with the aim that the company can meet customer demands. Based on the calculations, 5 priority performance indicators were obtained, namely DR2, namely order fulfilment, MRe, namely production time, DA, namely delivery of additional products, PR2, namely raw material procurement planning and DRe, namely delivery time. In further research, the researcher recommends that in the future, we take performance measurements by reducing waste in activities using the Lean Manufacturing (LM) method combined with Green Manufacturing (GM) to preserve the surrounding environment.

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