

Supply Chain Performance Analysis in the Cocoa Industry Using SCOR AHP Method: Case Study of PT XYZ in Bali

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Abstract

PT XYZ is a cocoa processing company that requires a supply chain performance evaluation, as previous measurements have focused mainly on profit without considering process effectiveness. This study aims to measure supply chain performance using the Supply Chain Operations Reference (SCOR) framework and the Analytical Hierarchy Process (AHP). A total of 30 indicators across the five core SCOR processes were evaluated, weighted using AHP, and priority improvement indicators were identified. The results show a supply chain performance score of 87.46 (Good). Most indicators were in the excellent category; however, several remained low, including forecast accuracy (70.90, good), raw material planning accuracy (19.13, poor), number of trouble machines (66.67, average), and inventory accuracy for finished products (0.00, poor). In addition, the timely delivery performance by suppliers (90.83, excellent) was identified as vulnerable to decline. Improvements focus on low-performing indicators through strategies such as more accurate forecasting, integrated raw material planning systems, scheduled machine maintenance, real-time finished product inventory recording, and inventory coordination with suppliers through safety stock. This study provides a basis for systematic evaluation to enhance supply chain effectiveness and support the company's operational sustainability.

Keywords: SCOR, AHP, snorm de boer, supply chain, chocolate industry.

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INTRODUCTION

The cocoa processing industry is one of the agribusiness sectors with high added value and promising economic prospects. According to data from BPS-Statistics Indonesia, Bali Province (2023), cocoa production reached 4,897 tons, an increase from the previous year's 4,736 tons. The strength of Bali's tourism branding has further enhanced the selling value of chocolate products, opening up wide market opportunities both domestically and internationally. In this context, Supply Chain Management (SCM) plays an important role because it encompasses the flow of products, information, and finances from upstream to downstream, and greatly determines business success when all parties involved are able to coordinate effectively (Shoffiyati et al., 2019).

Along with the development of the agriculture based processing industry, supply chain performance measurement has become an essential need for companies to ensure that business processes run effectively and efficiently. Through this measurement, companies can identify which parts of the supply chain are already optimal and which still require improvements in order to build competitive advantage (Suryaningrat et al., 2025). One approach that can be used is the Supply Chain Operations Reference (SCOR), which classifies supply chain activities into five main attributes. To make the measurement results more objective and targeted, SCOR is combined with the Analytic Hierarchy Process (AHP) method, which serves to determine the priority of performance indicators based on their level of importance. This combination not only detects performance gaps but also provides a structured basis for improvements according to business urgency (Aprillia & Marpaung, 2025).

PT XYZ is one of the cocoa processing industries in Bali that produces various chocolate products for local and national markets, and is currently striving to expand its reach to international markets. However, until now the company has not had a comprehensive supply chain performance evaluation system, as it is still focused on profit based measurement without considering the efficiency and effectiveness aspects of the supply chain. This condition has the potential to cause resource waste and reduces the company's competitiveness. This study aims to measure the supply chain performance of PT XYZ using the SCOR AHP approach, as well as to identify priority performance indicators for improvement so that they can serve as the basis for a systematic evaluation to enhance the operational effectiveness of the company.



LITERATURE REVIEW

Supply Chain Management

Supply chain management is a network system involving suppliers, manufactures, distributors, retailers, and logistics service providers to manage the flow of materials, products, services, and information up to the end consumer (Yateno et al., 2025). This process includes planning, management, and coordination from raw materials procurement, production, storage, to distribution, with the aim of integrating the flow of products, information, and funds from upstream to downstream in order to effectively meet demand (Wulandari & Mulyanto, 2024).

Performance Measurement

Performance measurement is a critical aspect of management, serving as the foundation for evaluating success, providing feedback, and identifying areas that require corrective actions (Rumawas, 2021). In the context of supply chains, performance measurement assesses the extent to which organizations can manage the flow of goods, information, and finances through clear, simple, value based metrics that are easily measured both quantitatively and qualitatively (Wulandari & Mulyanto, 2024).

Supply Chain Operations Reference (SCOR)

The Supply Chain Operations Reference (SCOR) model is a process based framework used to measure, analyze, and improve supply chain performance through five core processes: plan, source, make, deliver, and return. This model consists of three levels of detail, ranging from scope definition, process configuration, to technical performance indicators, enabling companies to conduct structured evaluations (Wulandari & Mulyanto, 2024). The strength of SCOR lies in its ability to provide a comprehensive view from upstream to downstream by integrating three main elements: process modeling, process measurement, and process performance evaluation. It is also equipped with five performance attributes for assessing supply chain effectiveness: reliability, responsiveness, agility, cost, and asset management (Chotimah et al., 2018).

Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a multicriteria decision making method that uses pairwise comparisons to determine priorities based on expert judgment (Saaty, 2008). This method transforms a standard scale into a relative ratio scale through normalization, allowing each criterion and alternative to be compared consistently (Saaty,

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1990). The stages of AHP begin with defining the problems and objectives, structuring the hierarchy, assigning pairwise comparison values using the Saaty scale, calculating relative weights, and testing consistency ratio (CR). The final result is a global weight that serves as the basis for decision making (Purba et al., 2015).

Snorm De Boer Normalization

Snorm De Boer normalization is used to standardize performance indicators with different units or ranges, so that actual data can be converted to a uniform scale, resulting in a more objective evaluation (Putra & Budiawan, 2025). This method has two approaches: lower is better, when a smaller values indicates more optimal performance, and higher is better, when a larger value indicates better achievement. The normalization results are expressed on a scale from 0 to 100, where a score of 0 represents the worst performance and a score of 100 reflects the best performance (Chotimah et al., 2018).

METHODS

Research was conducted at PT XYZ, Tabanan Regency, Bali. The research variables refer to the SCOR model with five core processes and 30 indicators, focusing on the performance attributes of reliability and responsiveness, which have been adjusted to the company's conditions and validated by experts and company representatives. The research stages include data collection, determination of SCOR indicators, calculation of actual values, normalization using the Snorm De Boer method (Chotimah et al., 2018), weighting with the AHP method (Purba et al., 2015), and finally, measurement of supply chain performance. All calculations were carried out using Microsoft Excel 2021.

1. Calculation of Actual Performance Indicator Values

The calculation is based on indicators at level three SCOR, which reflect the actual condition of the company's supply chain. These actual values serve to illustrate the performance achievements in each supply chain process and form the basis for assessing the company's performance level.

2. Normalization of Actual Performance Indicator Values

Normalization is done to equalize indicators with different units so that they can be compared objectively. This process uses the Snorm De Boer method with the following formula.

$$Snorm = \frac{Si - Smin}{Smax - Smin} \times 100 \dots \dots \dots (1)$$

Description:



S_i = Actual value of the performance indicator

S_{min} = Worst performance value

S_{max} = Best performance value

The normalized value is then adjusted to the assessment criteria to provide an overview of the supply chain condition, with the assessment standard shown in the following table.

Table 1. Supply Chain Performance Value Standards

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

Source: Putra & Budiawan (2025)

3. Weighting of Performance Indicators

Weighting is carried out using the Analytical Hierarchy Process (AHP) method involving four respondents, consisting of two company representatives and two experts in supply chain management. The weighting process begins with the preparation of a pairwise comparison matrix, which is then normalized to obtain weights through averaging each row. The maximum eigenvalue (λ_{max}) is calculated by multiplying the comparison matrix by the weight vector and dividing it again by each weight. Subsequently, a consistency test is performed, results are considered consistent if the Consistency Ratio (CR) ≤ 0.1 . The formulas are as follows.

a. Consistency Index (CI)

$$CI = \frac{\lambda_{max} - n}{n - 1} \dots \dots \dots (2)$$

Description:

λ_{max} = Highest eigenvalue in the matrix of order n

N = Number of criteria

b. Consistency Ratio (CR).

$$CR = \frac{CI}{RI} \dots \dots \dots (3)$$



Description:

CI = Consistency Index

CR = Consistency Ratio

RI = Random Index, the RI values according to Saaty are as follows:

Table 2. Random Index Matrix

N	2	3	4	5	6	7	8	9	10
RI	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49

Source: Alfiane et al. (2025)

4. Final Performace Value Calculation

The final supply chain performance value is calculated by multiplying the normalized value by the global weight of each indicator, then summing all results. This total value reflects the overall level of the company's supply chain performance.

RESULTS AND DISCUSSION

Determination of Performance Indicators

The performance indicators in this study were established based on the SCOR model and adapted to the company's specific conditions. The selection of indicators was conducted through questionnaires involving experts and company representatives.

Table 3. SCOR Performance Indicators

Process (Level 1)	Performance Attribute (Level 2)	Performance Indicator (Level 3)	Code
Plan	Reliability	Forecast accuracy	PRL 1.1
		Raw material planning accuracy	PRL 1.2
	Responsiveness	Planning cycle time	PRS 1.4
Source	Reliability	Percentage suppliers with EMS	SRL 2.1
		Timely delivery performance by supplier	SRL 2.2
		Delivery documents accuracy by supplier	SRL 2.3
		Delivery item accuracy by supplier	SRL 2.4



		Delivery quantity accuracy by supplier	SRL 2.5
		Order delivered faultless by supplier	SRL 2.6
		Inventory accuracy of raw material	SRL 2.8
	Responsiveness	Delivery cycle time by supplier	SRS 2.7
Make	Reliability	Adherence to production schedule	MRL 3.1
		Material efficiency (yield)	MRL 3.3
		Product defect from production	MRL 3.4
		Number of trouble machines	MRL 3.5
	Responsiveness	Raw material loading time	MRS 3.2
		Make volume responsiveness	MRS 3.6
Delivery	Reliability	Timely delivery performance by the company	DRL 4.2
		Inventory accuracy for finished product	DRL 4.3
		Delivery document accuracy by the company	DRL 4.4
		Delivery item accuracy by the company	DRL 4.5
		Delivery quantity accuracy by the company	DRL 4.6
		Order delivered faultless by the company	DRL 4.7
	Responsiveness	Quarantine time	DRS 4.1
		Delivery cycle time by the company	DRS 4.8
Return	Reliability	Return rate from customer	RRL 5.1
		Product replacement accuracy	RRL 5.4
		Defective product recyclable	RRL 5.5
	Responsiveness	Claim closure days	RRS 5.2
		Product replacement time	RRS 5.3

Source: Data Processing (2025)

Based on Table 3, there are 30 selected performance indicators according to the SCOR model. The indicators have been adjusted to the company, thus reflecting each



main process. All selected indicators will serve as the basis for supply chain performance measurement.

Final Performance Indicator Value Calculation

The calculation of performance indicators was carried out in two stages, determining the actual values based on company data and interviews, and normalizing them using the Snorm de Boer method to ensure all indicators are on a uniform scale for objective comparison. The results for each performance indicator are summarized as follows.

Table 4. Recapitulation of Final Value Calculations

Process	Performance Indicator	Actual Value	Unit	Smin	Smax	Final Value
Plan	Forecast accuracy	70.90	%	0	100	70.90
	Raw material planning accuracy	19.13	%	0	100	19.13
	Planning cycle time	4	Value	1	4	100.00
Source	Percentage suppliers with EMS	56	%	0	56	100.00
	Timely delivery performance by supplier	90.83	%	0	100	90.83
	Delivery documents accuracy by supplier	100	%	0	100	100.00
	Delivery item accuracy by supplier	100	%	0	100	100.00
	Delivery quantity accuracy by supplier	100	%	0	100	100.00
	Order delivered faultless by supplier	100	%	0	100	100.00
	Delivery cycle time by supplier	4	Value	1	4	100.00
	Inventory accuracy of raw material	100	%	0	100	100.00
Make	Adherence to production schedule	100	%	0	100	100.00
	Raw material loading time	4	Value	1	4	100.00
	Material efficiency (yield)	100	%	0	100	100.00
	Product defect from production	0.07	%	100	0	99.93



	Number of trouble machines	6	Unit	18	0	66.67
	Make volume responsiveness	4	Value	1	4	100.00
Delivery	Quarantine time	1	Day	7	1	100.00
	Timely delivery performance by the company	100	%	0	100	100.00
	Inventory accuracy for finished product	0	%	0	100	0.00
	Delivery document accuracy by the company	100	%	0	100	100.00
	Delivery item accuracy by the company	100	%	0	100	100.00
	Delivery quantity accuracy by the company	100	%	0	100	100.00
	Order delivered faultless by the company	99.85	%	0	100	99.85
	Delivery cycle time by the company	4	Value	1	4	100.00
Return	Return rate from customer	0.72	%	100	0	99.28
	Claim closure days	4	Value	1	4	100.00
	Product replacement time	4	Value	1	4	100.00
	Product replacement accuracy	100	%	0	100	100.00
	Defective product recyclable	100	%	0	100	100.00

Source: Data Processing (2025)

Based on Table 4, the normalization of final values using the Snorm De Boer method show that most performance indicators are in the excellent category (>90), indicating the company is able to maintain accuracy and reliability in its supply chain. However, several indicators have not reached the optimal levels. Raw material planning accuracy only reached 19.13 (poor), indicating weak planning process due to rough demand forecasting and difficult access to records. Forecast accuracy is at 70.90 (good), largely because sales targets are still based on nominal values and there is minimal use of historical data. The number of trouble machines scored 66.67 (average), which is due to inconsistent machine maintenance and poorly documented damaged history. Meanwhile, inventory accuracy for finished product has a value of 0.00 (poor), because the production system is order based, so products are shipped immediately without long term storage.



Additionally, timely delivery performance by supplier scored 90.83 (excellent), but is close to the threshold and still affected by delivery delays due to diminishing raw material stock. These results indicate that while most supply chain performance indicators are in the excellent category, there are still critical areas that require improvement to further optimize the overall supply chain performance.

Performance Indicator Weighting

Weighting is conducted to determine the priority level of each process, attribute, and indicator within the supply chain. The method used is the Analytical Hierarchy Process (AHP) through questionnaire assessments with a Consistency Ratio (CR) ≤ 0.1 . Weights are calculated at three levels: process, performance attribute, and performance indicator and are then multiplied to obtain the global weight. The results of the weighting are presented in the following table.

Table 5. Recapitulation of Weighting Results

Process (Level 1)	Weight	Performance Attribute (Level 2)	Weight	Performance Indicator (Level 3)	Weight	Global Weight
Plan	0.21	Reliability	0.72	Forecast accuracy	0.39	0.06
				Raw material planning accuracy	0.61	0.09
		Responsiveness	0.28	Planning cycle time	1.00	0.06
Source	0.21	Reliability	0.70	Percentage suppliers with EMS	0.10	0.01
				Timely delivery performance by supplier	0.11	0.02
				Delivery documents accuracy by supplier	0.12	0.02
				Delivery item accuracy by supplier	0.19	0.03
				Delivery quantity accuracy by supplier	0.17	0.03
				Order delivered faultless by supplier	0.16	0.02
				Inventory accuracy of raw material	0.15	0.02
		Responsiveness	0.30	Delivery cycle time by supplier	1.00	0.06



Make	0.34	Reliability	0.49	Adherence to production schedule	0.29	0.05
				Material efficiency (yield)	0.23	0.04
				Product defect from production	0.16	0.03
				Number of trouble machines	0.32	0.05
		Responsiveness	0.51	Raw material loading time	0.19	0.03
				Make volume responsiveness	0.81	0.14
Delivery	0.14	Reliability	0.81	Timely delivery performance by the company	0.16	0.02
				Inventory accuracy for finished product	0.11	0.01
				Delivery document accuracy by the company	0.06	0.01
				Delivery accuracy by item the company	0.23	0.03
				Delivery quantity by the company	0.23	0.03
				Order delivered faultless by the company	0.20	0.02
		Responsiveness	0.19	Quarantine time	0.28	0.01
				Delivery cycle time by the company	0.72	0.02
Return	0.10	Reliability	0.57	Return rate from customer	0.16	0.01
				Product replacement accuracy	0.51	0.03
				Defective product recyclable	0.33	0.02
		Responsiveness	0.43	Claim closure days	0.23	0.01
				Product replacement time	0.77	0.03

Source: Data Processing (2025)



Based on Table 5, the results at the first level show that make (0.34) is the highest priority in the supply chain, followed by plan and source (each 0.21), delivery (0.14), and return (0.10). At the second level, performance attributes are dominated by reliability in most processes, except for make, which places more emphasis on responsiveness (0.51). At the third level, each process has different indicator priorities, raw material planning accuracy (0.61) for plan, delivery item accuracy by supplier (0.19) for source, make volume responsiveness (0.81) for make, delivery cycle time by the company (0.72) for delivery, and product replacement time (0.77) for return. Overall, the global weights show that make volume responsiveness (0.14) has the highest value, indicating the importance of flexibility in the production process.

Supply Chain Performance Assessment

Supply chain performance is calculated by multiplying the normalized final value using the Snorm De Boer method for each indicator by the global weight obtained from the AHP weighting process. The total score is obtained by summing all the multiplication results, which reflects the overall supply chain performance of PT XYZ. The performance values are presented in the following table.

Table 6. Supply Chain Performance Value Data

Code	Performance Indicator	Final Value	Global Weight	Performance Score
PRL 1.1	Forecast accuracy	70.90	0.06	4.19
PRL 1.2	Raw material planning accuracy	19.13	0.09	1.80
PRS 1.4	Planning cycle time	100.00	0.06	5.92
SRL 2.1	Percentage suppliers with EMS	100.00	0.01	1.44
SRL 2.2	Timely delivery performance by supplier	90.83	0.02	1.43
SRL 2.3	Delivery documents accuracy by supplier	100.00	0.02	1.71
SRL 2.4	Delivery item accuracy by supplier	100.00	0.03	2.70
SRL 2.5	Delivery quantity accuracy by supplier	100.00	0.03	2.51
SRL 2.6	Order delivered faultless by supplier	100.00	0.02	2.35
SRL 2.8	Inventory accuracy of raw material	100.00	0.02	2.10



SRS 2.7	Delivery cycle time by supplier	100.00	0.06	6.31
MRL 3.1	Adherence to production schedule	100.00	0.05	4.92
MRL 3.3	Material efficiency (yield)	100.00	0.04	3.92
MRL 3.4	Product defect from production	100.00	0.03	2.67
MRL 3.5	Number of trouble machines	99.93	0.05	3.62
MRS 3.2	Raw material loading time	66.67	0.03	3.34
MRS 3.6	Make volume responsiveness	100.00	0.14	14.06
DRL 4.2	Timely delivery performance by the company	100.00	0.02	1.78
DRL 4.3	Inventory accuracy for finished product	100.00	0.01	0.00
DRL 4.4	Delivery document accuracy by the company	0.00	0.01	0.68
DRL 4.5	Delivery item accuracy by the company	100.00	0.03	2.58
DRL 4.6	Delivery quantity accuracy by the company	100.00	0.03	2.62
DRL 4.7	Order delivered faultless by the company	100.00	0.02	2.27
DRS 4.1	Quarantine time	99.85	0.01	0.74
DRS 4.8	Delivery cycle time by the company	100.00	0.02	1.92
RRL 5.1	Return rate from customer	99.28	0.01	0.88
RRL 5.4	Product replacement accuracy	100.00	0.03	2.87
RRL 5.5	Defective product recyclable	100.00	0.02	0.39
RRS 5.2	Claim closure days	100.00	0.01	0.97
RRS 5.3	Product replacement time	100.00	0.03	3.30
Total Performance Score				87.46

Source: Data Processing (2025)

Based on Table 6, the supply chain performance calculation for PT XYZ resulted in a score of 87.46, which falls into the Good category. Most indicators received high scores. However, there are still some indicators with low scores that could hinder the sustainability of the supply chain. Therefore, the company needs to improve aspects that are not yet optimal to ensure supply continuity.



Suggested Improvements for Performance Indicators

The evaluation results show that there are still performance indicators that have not reached optimal levels and therefore require improvement. The proposed improvements are intended to serve as a reference for enhancing supply chain performance, as summarized in Table 7 below.

Table 7. Suggested Improvements for Performance Indicators

Code	Performance Indicator	Issue	Proposed Improvement
PRL 1.1	Forecast Accuracy	Sales targets are based on nominal values without product details, and minimal use of historical data.	Apply more accurate forecasting methods (Exponential Moving Average, ARIMA, Linear Regression), regularly update forecasts based on data, and set targets per product (Armen & Jayadi, 2024).
PRL 1.2	Raw Material Planning Accuracy	Forecasting is still rough and records are difficult to access.	Implement integrated raw material planning based on MRP with accessible digital records, enabling daily needs tracking by PO and real time adjustments (Pradyasari & Widajanti, 2024)
SRL 2.2	Timely Delivery Performance by Supplier	Delivery delays due to low stock levels.	Build a joint coordination and inventory planning system with suppliers, including the implementation of safety stock and early warning systems to minimize supply delay risk (Maharani & Sari, 2025).
MRL 3.5	Number of Trouble Machine	Inconsistent machine maintenance and poor breakdown documentation.	Implement a regular machine maintenance recording and scheduling system (preventive maintenance) to improve documentation, reduce breakdown



			frequency, and enhance operational reliability (Iskandar et al., 2022).
DRL 4.3	Inventory Accuracy for Finished Product	No formal recording mechanism due to direct to order production system.	Implement real time inventory recording for finished products using spreadsheets or lightweight digital modules that link each batch to customer POs and are updated at the time of delivery (Yunita et al., 2024).

Source: Data Processing (2025)

CONCLUSION

Based on the supply chain performance measurement of PT XYZ using the SCOR AHP approach, a score of 87.46 was obtained, which falls into the Good category. This achievement indicates that, in general, the company's supply chain is operating quite well, although there are still several indicators that need improvement. Key aspects that should be prioritized for improvement include forecast accuracy, raw material planning, number of trouble machines, and inventory accuracy for finished products. On the other hand, indicators that are already in the Excellent category, such as timely delivery performance by supplier, must be maintained to ensure their consistency does not decline. Thus, this study provides a data driven overview of the company's actual supply chain conditions and can serve as a reference for other local cocoa industries in identifying critical areas and improving supply chain effectiveness.

Furthermore, this study highlights the importance of more efficient data management to support ongoing performance measurement. The company is advised to develop an integrated recording system, for example through the use of shared spreadsheets, to minimize data redundancy and enable more accurate and accessible performance monitoring. Future research is also expected to explore deeper data tailored to the company's latest conditions, add any indicators not yet covered, and combine other methods so that the resulting analysis is more detailed, comprehensive, and relevant in supporting the continuous improvement of supply chain performance.



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