Measurement of Supply Chain Management Performance with the Supply Chain Operating References (SCOR) Method at PT. XYZ

Nur Annisa[1,a)], Sri Zuliarni[,b)]

[1,2] *Politeknik Negeri Batam, Parkway Street, Batam Centre, Batam 29461, Indonesia*

[a)]Corresponding author: nurannisa7376@gmail.com
[b)]sri.zuliarni@polibatam.ac.id

Abstract. Amidst the competition of manufacturing industry in Batam City, every company must have a strategy to create effective and efficient supply chain performance. PT XYZ is a manufacturing company that produces lifting/transporting equipment based on customer requests. This research aims to provide performance indicators (KPIs) for each supply chain process and provide performance measurement of supply chain management performance at PT XYZ which will be followed by improvement recommendations to improve performance. Performance measurement is using the SCOR method from filling out a questionnaire which is then validated and then calculated the weighting value using AHP and normalization using the SNORM de Boer method for the final result of supply chain performance. The results of the assessment of the supply chain performance of PT XYZ are rated in the Average category. In order for the supply chain management performance to be optimal, it is necessary to improve and improvise supply chain management by conducting detailed demand analysis, improving inventory management, and streamlining the flow of information on receiving customer returns.

Keywords: Performance, SCOR, Performance Indicator (KPI), AHP.

INTRODUCTION

In the industrial world, competitiveness is an inevitable challenge for every company. This condition encourages every company to continue to improve its performance to meet customer needs. The supply chain is a network structure of companies that contribute to creating and distributing goods or services to consumers with maximum efficiency and effectiveness [6]. According to [3] the SCOR (Supply Chain Operating References) method has the advantage of identifying what methods are needed to measure the effectiveness of SCM (Supply Chain Management) in a company. The importance of integrations, collaborations, and coordination for customer satisfaction are the main foundations in the SCM of a company [4].

PT. XYZ is a company in Batam that is engaged in manufacturing, especially manufacturing the assembly of transport/lifting equipment, shipping equipment such as Shackle, Anchor, Anchor Chain, Deck Fitting, Rigging Gears and various other shipping and industrial assembly tools. All the assembled tools they produce are made according to customer orders. Based on the results of the survey and also an interview with the Deputy General Manager of PT. XYZ found that PT. XYZ often experiences problems in its supply chain process, problems that often arise in inventory management, sudden changes in orders from consumers, demand forecasting that is not done properly so that there are often shortages and excess stocks, labor shortages that make work inefficient. Inventory management that is still not systematic. In addition, in this company, there is also no KPI (Key Performance Indicator) so there are no indicators to be a reference and benchmark for supply chain management in the company.

The research at PT XYZ aims to be able to provide performance indicators of each supply chain process at the company in accordance with the SCOR method which consists of the plan, source, make, deliver, and return because the SCOR method is one of the methods to measure supply chain performance [7]. This performance calculation is carried out by combining the calculation of the SCOR and AHP methods in order to obtain the final value of supply chain performance.

The SCOR method has been used by several researchers to measure the performance of supply chain performance in a company, including [3] has conducted re-search on measuring supply chain performance using the SCOR method in a state-owned company engaged in the field of plant fertilizer providers with the results of providing performance assessments along with providing proposals on KPIs that have low values such as KPI anticaking liquid material planning, yield, request cycle time, and several other low-value KPIs. Then there is a study from [5] with results that show that 28 KPIs are validated and provide an assessment obtained from the results of the combination of the SCOR method with weighting using AHP with the highest weight value, namely in the planning process (plan) with a weight of 0.240 at level one. To get the value of supply chain management performance with the SCOR Method, weighting calculations are carried out with AHP and normalising the actual value of each KPI with Snorm De Boer.

Based on the background that has been described, the researcher is interested in conducting a study entitled "Measurement of supply chain management with the supply chain operating references (SCOR) method at PT. XYZ". This research was conducted to be able to assess the performance of supply chain management performance at PT. XYZ and determine KPIs for supply chain management of PT. XYZ uses SCOR calculations combined with AHP and Snorm de Boer.

LITERATUR REVIEW

SUPPLY CHAIN MANAGEMENT

According to Mentzer, supply chain management is a system that coordinates all business strategies, including cooperation strategies from traditional business functions and strategies between business sectors. This system brings together cooperation strategies between traditional business functions and strategies between busi-ness sectors in the supply system of a company or organization. The goal is to im-prove the company's performance both individually and as a whole in the supply chain in the long term [4].

SUPPLY CHAIN PERFORMANCE EVALUATION

Supply chain management performance evaluation is an activity that involves a comparison between the results that have been achieved and the initial goals that have been or have never been achieved. This involves assessing the extent of achievement in the targets that have been set [1]. Performance measurement evaluation using SCOR has an advantage in terms of its ability to measure SCM performance from upstream to downstream of the company's internal and external parts [1].

SUPPLY CHAIN OPERATIONS REFERENCES (SCOR)

The Supply-Chain Operations Reference (SCOR) method model is an innovation in calculating supply chain management performance that was the idea of the Supply Chain Council (SCC) in 1996. The SCOR model has the ability to illustrate performance characteristics and measurement parameters in supply chain analysis [6]. The application of SCOR in analyzing the company's supply chain is able to help companies to map, improve, and communicate the implementation of SCM to every relevant stakeholder in the company [2]. The Supply Chain Operations Reference (SCOR) method model organizes the supply chain by dividing it into five core processes, namely Plan, Source, Make, Deliver, Return [1].

KEY PERFORMANCE INDICATOR (KPI)

KPIs (Key Performance Indicators) are an assessment of the extent to which an entity or company achieves its goals. KPIs are formed from a list of activities whose performance can be measured in the company, serving as a comparative tool be-tween various levels of performance. The results of KPI measurements that have been recognized by the company are used to evaluate and improve performance, as well as provide an overview of the extent to which the achievement of the targets that have been set has been successfully achieved by the company [6].

ANALYTICAL HIERARCHY PROCESS

Analytical hierarchy process (AHP) is a technique for developing a decision support model designed by Thomas L. Saaty. This approach breaks down the problem into various factors or complex criteria into a hierarchical structure. In accordance with Saaty's (1993) definition, hierarchy is defined as a representation of a multi-level structure of a problem that involves the first level in the form of goals, followed by factors, criteria, sub-criteria, and reaching the last level in an alternative form [4]. Thus, AHP helps simplify complex problems into a more managed framework.

SNORM DE BOER

The "S-Norm De Boer" normalization method by [8] is a normalization technique used in multi-criteria analysis and decision-making. S-Norm normalization is one way to transform data of different scales into a uniform form, thus allowing fair comparisons between criteria of different scales in the multi-criteria decision-making process. The role of normalization is crucial in achieving the final performance measurement value. [1].

Larger is Better

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

Lower is Better

$$Snorm = \frac{Smax - Si}{(Smax - Smin)} \times 100 \quad (2)$$

Information:
Snorm : Normalization Score
Si : Actual Indicator Value Successfully Achieved
Smin : Worst Performance Target Value from Performance Indicators
Smax : The Best Indicator Value of the Performance Indicator

TABLE 1. KPIs Validations

Monitoring System	Indicator
<40	*Poor*
40 - 50	*Marginal*
50 – 70	*Average*
70 – 90	*Good*
>90	*excellent*

Source: [8]

RESEARCH METHODS

The research process unfolds in several key stages. First, in the Identification Stage problems are identified and KPI formulation is carried out. Next the Planning Stage, where the validation of KPIs is conducted, and the actual values for each KPI are calculated. This is followed by the Assessment and Evaluation Stage, in which the importance of each supply chain process and KPI is weighted, and the normalization of the De Boer Snorm is performed. Finally, the Conclusion Stage involves calculating the final value of supply chain performance and offering recommendations for improvements.

RESULTS AND DISCUSSION

SUPPLY CHAIN PROCESS IN PT. XYZ

In fulfilling orders from customers in general, PT. XYZ starts from an incoming order and then procures goods. In the supply chain process, there are 2 types of flows, namely the production flow which is marked by a straight line and the information flow which is marked by a dotted line.

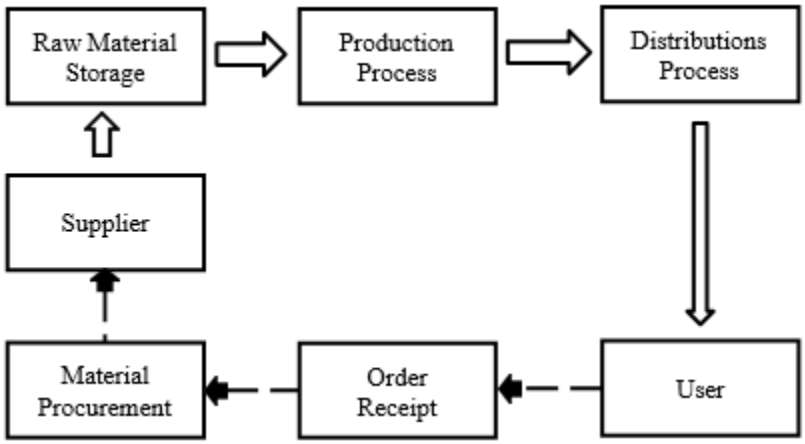

FIGURE 1. Picture Management Flow Source: Data processed, 2024

IDENTIFY VALIDATED KPIS

In the results of an interview with the General Manager of PT. XYZ there are 21 performance indicators or KPIs from the entire SCOR process. However, after validating with the owner of PT. XYZ only has 20 valid KPIs in the SCOR process. One invalid KPI is the KPI of the efficiency of the time to receive goods by consumers (DPP) in the delivery process because the efficiency of the time to receive goods by consumers cannot be predicted depending on the traffic conditions at that time and depending on the condition of the consumer warehouse whether it is available or not. The following is a list of KPIs for the SCOR Process that have been validated:

TABLE 2. KPIs Validations

SCOR Process	SCOR KPIs	Code
PLAN	Demand Forecasting Accuracy	PPP1
	Workforce Planning	PTK2
	Stock Availability Prediction	PKS3
	Accuracy of Raw Material Forecasting	PKB4
	Accuracy Determination of Raw Materials	PPB5
SOURCE	Supplier Product Quality	SKP1
	Frequency of Delivery Time On Time	SWP2
	Accuracy of Goods from Suppliers	STI3
	Availability of Units in Warehouse	SJG4

	Level of Relationship with Suppliers	SHP5
MAKE	Production Time Efficiency	MWP1
	Raw Material Efficiency	MBM2
	Defective Product Control	MKC3
	Work Machinery Breakdown	MKM4
DELIVER	Accuracy of transportation determination	DTP 2
	Accuracy of Accurate Quantity Delivery	DKJ 3
	Flawless Delivery Rate	DTC 4
RETURN	Consumer Return Rate	RRJ1
	Return Processing Time	RWR2
	Actions on Returned Items	RTR3

Source: Data processed, 2023

RESULTS OF CALCULATION OF ACTUAL VALUE OF EACH KPI

The KPIs of each process in the supply chain that are included in the SCOR method have an actual achievement value every month. The researcher took the actual value data of the last 3 months from PT. XYZ January 2024 – March 2024. The calculation of the actual value is calculated to be able to see the performance of each work indicator.

TABLE 3. Loading Factor 2 Results

Process	**KPIs**	**Actual Value**			**Result**
		Jan 24	**Feb 24**	**Mar 24**	
Plan	PPP 1	93%	84%	74%	Decreased
	PTK 2	53%	85%	74%	Fluctuatif
	PKS 3	8%	13%	16%	Increase
	PKB 4	93%	94%	93%	Stable
	PPB 5	100%	100%	99%	Stable
Source	SKP 1	100%	100%	100%	Stable
	SWP 2	94%	86%	90%	Stable
	STI 3	100%	99%	100%	Stable
	SJG 4	83%	85%	89%	Increase
	SHP 5	90,25	90,25	90,25	Increase
Make	MWP 1	100%	90%	88%	Decreased
	MBM 2	33%	84%	83%	Increase
Process	**KPIs**	**Actual Value**			**Result**
		Jan 24	**Feb 24**	**Mar 24**	
	MKC 3	99%	99%	98%	Increase
	MKM 4	200%	100%	100%	Increase

Deliver	DTP 2	100%	90%	88%	Decreased
	DKJ 3	93%	95%	88%	Stable
	DTC 4	99%	99%	99%	Stable
Return	RRJ 1	1%	1%	1%	Stable
	RWR 2	2 days	2 days	2 Hari	Stable
	RTR 3	100%	100%	100%	Stable

Source: Data processed, 2024

In **TABLE 3**, there are several KPIs that have experienced an increase in the actual value level such as the KPI of the PKS 3 plan process, the source process of KPI SJG 4 and SHP 5, have experienced an efficiency level that has continued to increase in the last 3 months. There are also declining KPIs such as the PPP 1 KPI plan process, the MWP 1 KPI making process, and the DTP 2 KPI delivery process in the last 3 months have decreased in performance, which has an impact on PT XYZ's supply chain management.

RESULTS OF SUPPLY CHAIN PROCESS WEIGHTING WITH ANALYTICAL HIERARCHY PROCEDURES (AHP)

The weighting stage between the criteria in the SCOR method, namely in the supply chain process, is filled by the General Deputy Manager to be able to find out the level of importance between the supply chain processes at PT. XYZ.

TABLE 4. Results of Calculation of Importance Weights Between Criteria

Indicator	Indicator Weight	Eigen Value
Plan	**0,368**	1,939
Source	**0,168**	0,872
Make	**0,119**	0,608
Deliver	**0,282**	1,516
Return	**0,063**	0,326
Jumlah	**1,000**	**5,261**

Source: Data processed, 2024

Based on the results from **TABLE 5**, the plan activity has the highest priority weight of 0.368 followed by the deliver activity with a weight of 0.282, the source activity with a weight of 0.168, the make activity with 0.119, and the lowest value by the return activity with a weight of 0.063. These results show that the planning process in the supply chain of PT. XYZ has a major role in the continuity of its supply chain. mNormalization of Snorm De Boer

The use of this method is to equalize the scale level of each KPI in the SCOR process and show the level of achievement of the performance of each KPI. The calculation equation used is as follows:

Variables in the de boer snorm equation include the best performance achievement value (Smax), the worst performance achievement value (Smin) and the actual value of the achievement of an indicator (Si). The results of the scoring system according to the KPI category, are in the table below:

TABLE 5. Normalization of Snorm De Boer for Each KPI by Category

KPIs	Jan 2024	Feb 2024	Mar 2024	Normalization Category
PPP 1	1.000	0.571	0.000	Larger is Beter
PTK 2	0.000	1.000	2.005	Larger is Beter

PKS 3	0.000	0.593	1.000	Larger is Beter
PKB 4	0.000	1.000	0.042	Larger is Beter
PPB 5	0.489	1.000	0.000	Larger is Beter
SKP 1	1.000	0.000	0.339	Larger is Beter
SWP 2	1.000	0.000	0.490	Larger is Beter
STI 3	0.743	0.000	1.000	Larger is Beter
SJG 4	0.000	0.286	1.000	Larger is Beter
SHP 5	1	0.649	0	Larger is Beter
MWP 1	100%	20.63%	0.00%	Larger is Beter
MBM 2	0.00%	100%	98.16%	Larger is Beter
MKC 3	79.08%	100%	0.00%	Larger is Beter
MKM 4	0	1	1	Lower Is Better
DTP 2	100%	21%	0%	Larger Is Better
DKJ 3	74%	100%	0%	Larger Is Better
DTC 4	0.00%	51.93%	100%	Larger Is Better
RRJ 1	0.00%	51.93%	100%	Lower Is Better
RWR 2	0	1	0	Lower Is Better
RTR 3	0	0	0	Larger Is Better

Source: Data processed, 2024

After getting the calculation value according to the category of each KPI. The value is adjusted in the range of 0-100 with the formula:

Normalization Value = Normalization Value of KPI Category x 99 + 1 (3)

The results of the scoring system for each KPI with a value range of 0-100, are found in the table below:

TABLE 6. Normalization of De Boer Snorm Each KPI

KPIs	January 2024	February 2024	March 2024	Snorm Score
PPP 1	100,00	57,50	1,00	**52,834**
PTK 2	1,00	100,00	67,03	**56,011**
PKS 3	1,00	59,71	100,00	**53,569**
PKB 4	1,00	100,00	5,55	**35,518**
PPB 5	50,50	100,00	1,00	**50,500**
SKP 1	100,00	1,00	33,08	**44,692**

SWP 2	100,00	1,00	49,51	**50,170**
STI 3	76,24	1,00	100,00	**59,080**
SJG 4	1,00	29,31	100,00	**43,438**
SHP 5	100,00	65,35	1,00	**55,450**
MWP 1	100,00	21,49	1,00	**40,831**
MBM 2	1,00	100,00	98,12	**66,373**
MKC 3	78,12	100,00	1,00	**59,707**
MKM 4	1,00	100,00	100,00	**67,000**
DTP 2	100,00	17,53	1,00	**39,511**
DKJ 3	71,29	100,00	1,00	**57,429**
DTC 4	1,00	52,08	100,00	**51,028**
RRJ 1	1,00	52,41	100,00	**51,137**
RWR 2	1,00	100,00	1,00	**34,000**
RTR 3	100,00	100,00	100,00	**100**

Source: Data processed, 2024

SUPPLY CHAIN PERFORMANCE VALUE

Calculation of the value of supply chain performance at PT. XYZ is a calculation of the average value of supply chain performance for 3 months (January 2024 – March 2024). Here's the calculation:

TABLE 7. Supply chain performance value KPIs

KPIs	Snorm De Boer	Final Weight	Final Scor	Final Result SCM Scor
Demand Forecasting Accuracy	52.83	0.095	5.02	**51.76** ***Average***
Workforce Planning	56.01	0.236	13.22	
Stock Availability Prediction	53.57	0.182	9.75	
Accuracy of Raw Material Forecasting	35.52	0.055	1.95	
Accuracy Determination of Raw Materials	50.50	0.432	21.82	
Supplier Product Quality	44.69	0.108	0.11	**71.65** ***Good***
Frequency of Delivery Time On Time	50.17	0.236	11.84	
Accuracy of Goods from Suppliers	59.08	0.178	10.52	
Availability of Units in Warehouse	43.44	0.600	26.06	
Level of Relationship with Suppliers	55.45	0.417	23.12	
Production Time Efficiency	40.83	0.159	6.49	
Raw Material Efficiency	66.37	0.469	31.13	

Defective Product Control	59.71	0.272	16.24	**60.56** ***Average***
Work Machinery Breakdown	67.00	0.100	6.70	
Accuracy of transportation determination	39.51	0.633	25.01	**44.50** ***Marginal***
Accuracy of Accurate Quantity Delivery	57.43	0.119	6.83	
Flawless Delivery Rate	51.03	0.248	12.65	
Consumer Return Rate	51.14	0.659	33.70	**62.52** ***Average***
Return Processing Time	34.00	0.080	2.72	
Actions on Returned Items	100.0	0.261	26.10	
Average Supply Chain Management Performance			**58.19** ***average***	

Source: Data processed, 2024

From the above results, it is known that the value of supply chain performance at PT XYZ has the lowest value in the delivery process with a value of 45.39 followed by the plan process with a value of 51.75 and then the make process with a value of 60.56. The second highest performance value was found in the return process with a value of 64.09 and the highest value in the source process with a value of 71.65. The average performance has a value of 58.19 which in this case is included in the Average category. So that improvisation and improvement are needed to reach the stage of Good and Excellent values in the Scoring System.

REPAIR RECOMMENDATIONS KPIS

From the results of the calculation of the Snorm De Boer Normalization value, there are several KPIs that have the lowest values and need to be improved so that the performance of PT XYZ's supply chain can be even better. The following KPIs with the lowest Snorm De Boer Normalization Value:

TABLE 8. KPI Analysis and Improvement Recommendations

Lowest Value KPIs	Performance Evaluations	Improvement Recomendations
Accuracy of Raw Material Needs (PKB4)	There are frequent market fluctuations and also communication between departments in terms of forecasting and lack of data analysis from previous orders.	Conducting analysis of consumer requests from previous orders, implementing a flexible production system and improving coordination and collaboration between departments.
Product quality from suppliers (SKP1)	There are often discoveries of products that do not meet orders. The raw materials shipped have damage to some parts and also the products produced from some raw materials have a short period of use.	Communicate well with suppliers to be more effective in packaging orders, determine the brand of each raw material ordered to the supplier so that the quality of the raw materials can be known and adjusted.

Production Time Efficiency (MWP 1)	There are several cases of order completion from customers that are not in accordance with the target that has been set due to the shortage of raw materials and labor	Conducting analysis for production time from previous production activities, preparing all raw material and production equipment needs and also analyzing the length of production time needed from each order, so as to determine the time agreed with the consumer
Accuracy of Exact Demand (DKJ3)	There are often changes in delivery transportation due to cargo inconsistencies and also changes from consumers and due to the unavailability of transportation services at that time.	Make regulations on the deadline for receiving order modifiers to consumers, using an information system that is integrated between all departments.
Return Processing Time (RWR 2)	The process of receiving returns takes a long time, making consumers wait for the goods they will reuse	Streamline the flow of receiving returned goods and implement good cooperation with the logistics fleet to pick up returned goods.

CONCLUSIONS

From the results of the data above, based on the research that has been carried out on the assessment of the performance of supply chain management of PT. XYZ, several conclusions can be drawn, namely:

1. Of the 21 KPIs formulated, there are 20 KPIs that are validated by the company's leaders and used as KPIs for the supply chain process of PT. XYZ.
2. The performance of supply chain performance in the last 3 months from January 2024 – March 2024 at PT XYZ shows a value of 58.19 which is classified as an average value, meaning that the company's supply chain process is still at an average level where this requires improvements in supply chain activities plan, source, make, deliver, and return at PT. XYZ.
3. The highest performance value is found in the source process (procurement) with a value of 71.65 which means that the performance in the procurement process has the best performance during the last 3 months. The lowest process performance value was found in the deliver process with a value of 44.50 included in the marginal category. This indicates that the value of supply chain performance is supported by a good procurement process and the order delivery process must be improved to get a good performance score.
4. There are also 5 below-average performance indicators, namely KPI Accuracy of Forecasting Raw Material Needs (PKB4), number of units available in the warehouse (SJG 4), production time efficiency (MWP 1), selection of distribution transportation (DTP 2), and return process time (RWR 2).
5. There are recommendations for improvement for the supply chain management of PT. XYZ based on the results of supply chain performance assessment research.
   a. Analyze consumer demand from previous orders, implement a flexible production system and establish good communication between departments.
   b. Communicate well with suppliers to determine the brand of each raw material ordered to the supplier.
   c. Conducting analysis for production time from previous production activities, preparing all raw material and tool needs and,
   d. Make regulations on the deadline for accepting order changes to consumers, using an information system that is integrated among all departments.
   e. Establishing good communication with transportation providers so that goods are picked up immediately.

REFERENCES

[1] Chotimah, R. R., Purwanggono, B., & Susanty, A. Measurement of Supply Chain Performance Using the SCOR and AHP Methods at the Urea Fertilizer Packing Unit of PT. Dwimatama Multikarsa Semarang. *Ejournal Undip*, *1*(1). 2018.

[2] Hadian Arief, M. Design of Supply Chain Performance Measurement System Using Scor Model Approach Based on Organization Strategy At Exporter of Non-Timber Forest Product (Ntfp) Company. 2016.

[3] Hidayati, A., & Pulansari, F. Performance Measurement Supply Chain Management (SCM) Using the Supply Chain Operation Reference (SCOR) Method at PT X. *IJIEM - Indonesian Journal of Industrial Engineering and Management*, *4*(2), 173. 2023. https://doi.org/10.22441/ijiem.v4i2.20506.

[4] Marfuah, U., & Mulyana, A. Pengukuran Kinerja Rantai Pasok Pada Pt. Sip Dengan Pendekatan Scor Dan Analysis Hierarcy Process (Ahp). *JISI: Jurnal Integrasi Sistem Industri*, *8*(2), 25. 2021. https://doi.org/10.24853/jisi.8.2.25-33.

[5] Putri, T. P., & Rukmayadi, D. *Pengukuran kinerja supply chain dengan menggunakan metode (SCOR) dan (AHP) (studikasus di PT MGP)*. *438*(November2022), http://repository.unissula.ac.id/id/eprint/11649.

[6] Sriwana, I. K., Hijrah S, N., Suwandi, A., & Rasjidin, R. Pengukuran Kinerja Rantai Pasok Menggunakan Supply Chain Operations Reference (Scor) Di Ud. Ananda. *JISI: Jurnal Integrasi Sistem Industri*, *8*(2), 13. 2021. https://doi.org/10.24853/jisi.8.2.13-24.

[7] Sutoni, A., Subhan, A., Setyawan, W., Bhagyana, F. O., & Mujiarto. Performance Analysis Using the Supply Chain Operations Reference (SCOR) and AHP Method. *Journal of Physics: Conference Series*, *1764*(1). 2021. https://doi.org/10.1088/1742-6596/1764/1/012155.

[8] Trienekens, J., & Hvolby, H. Performance Measurement and Improvement in Supply Chains. 2000.

[9] Waluya Jati, M. T., Ernawati, D., & Rahmawati, N. Analisis Kinerja Rantai Pasok Semen Instans Dengan Pendekatan Scor Model Dan Ahp Di Pt. Xyz. *Juminten*, *1*(5), 109–120. 2020. https://doi.org/10.33005/juminten.v1i5.198.