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Performance Analysis Using the Supply Chain Operations Reference (SCOR) and AHP Method

Akhmad Sutoni 1 , Ali Subhan1 , Widy Setyawan1 , Fitri Oktavia Bhagyana1 , and Mujiarto2*

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Abstract

This research was conducted to see the performance of P.T. X. Planning assessment is carried out on the performance of the supply chain for the production, warehouse, and shipping of goods. The method used is the Supply Chain Operations Reference (SCOR) and Analythical Hierarchy Process (AHP) . With this method, in addition to looking at performance performance, can also see the location of the metrics that must be improved again and which must be maintained. So the companys work system will be better. The calculation results will be used as a reference to be able to increase customer satisfaction and will increase company revenue. The results obtained are the highest and lowest values of each Plan, Source, Deliver, and Return metrics. P.T. X performance is Good, with a total calculation result of 80.48. **(Approx. 133 words)**

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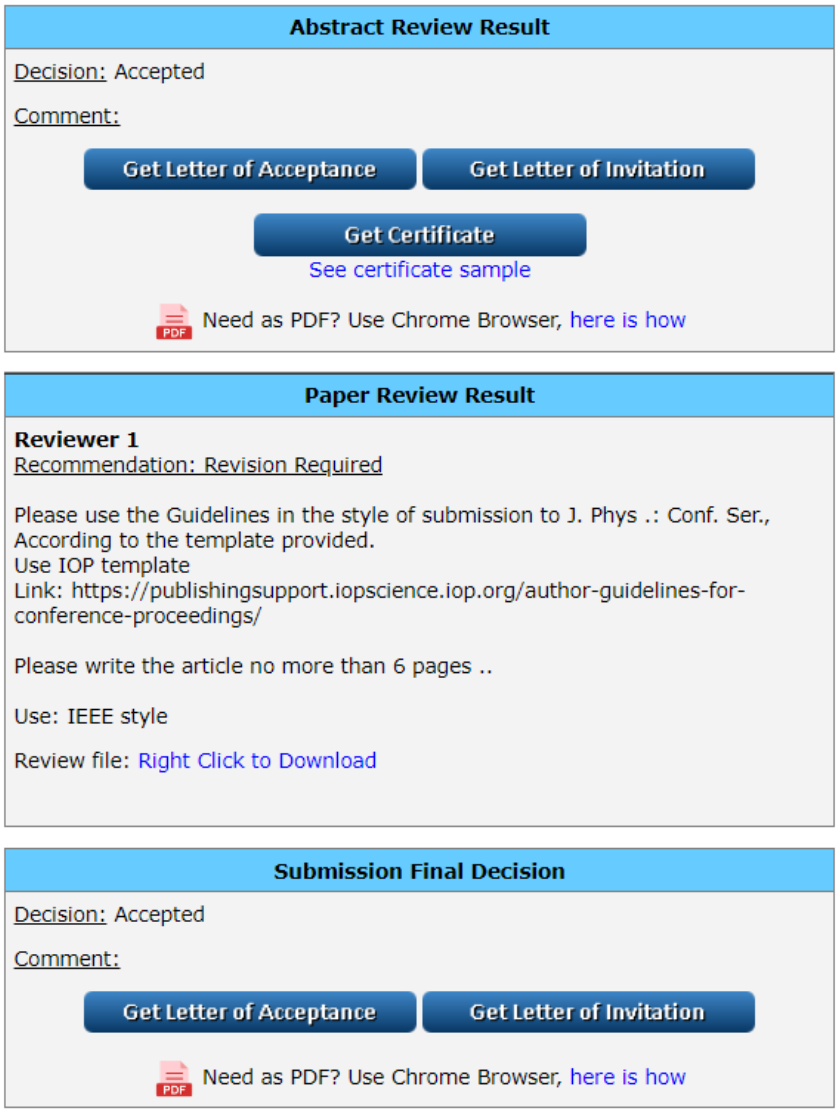

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Date: 11 October 2022

Letter of Acceptance for Abstract

Dear Authors: Akhmad Sutoni* 1 , Ali Subhan1 , Widy Setyawan1 , Fitri Oktavia Bhagyana1 , and Mujiarto2

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"Performance Analysis Using the Supply Chain Operations Reference (SCOR) and AHP Method"

has been reviewed and accepted to be presented at PVJ-IS 2020 conference to be held on 15-16 July 2020 in Tasikmalaya, Indonesia.

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Akhmad Sutoni[*1], Ali Subhan[1], Widy Setyawan[1], Fitri Oktavia Bhagyana[1], and Mujiarto[2]

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Abstract. This research was conducted to see the performance of P.T. X. Planning assessment is carried out on the performance of the supply chain for the production, warehouse, and shipping of goods. The method used is the Supply Chain Operations Reference (SCOR) and Analythical Hierarchy Process (AHP) . With this method, in addition to looking at performance performance, can also see the location of the metrics that must be improved again and which must be maintained. So the company's work system will be better. The calculation results will be used as a reference to be able to increase customer satisfaction and will increase company revenue. The results obtained are the highest and lowest values of each Plan, Source, Deliver, and Return metrics. P.T. X performance is Good, with a total calculation result of 80.48.

Keywords: Supply Chain, SCOR (Supply Chain Operations Reference), Matrix.

1. Introduction

At this time, PT. X has never measured the performance of the Supply Chain and therefore there is often a sizable loss in terms of costs that have been made. The problem that occurs is in the order system. Inventory and Lead Time of Essential Lights and Genie Lights. Both lights are items that are often ordered by consumers. And it is also an item whose turnover is fast and uncertain. The purpose of this study was to design a model for measuring Supply Chain performance at PT. X by using absolute value calculations and actual values. Supply Chain Management involves many parties in it, both directly and indirectly in an effort to meet consumer demand. Here the Supply Chain not only involves manufacturers and suppliers but also involves many things, including transportation, warehouses and consumers themselves [1]. With the rapid development of the world industry, it is important to develop the concept of performance appraisal in the field of Supply Chain Management. In this field, concepts such as partnership, outsourcing, vendor managed inventory, etc. are needed to help in measuring supply chain performance [2]. Industries in general measure performance of the Supply Chain with the aim of reducing costs, meeting customer satisfaction and increasing their profits [3]. There are several characteristics that must be met by indicators, namely Universality, Measurability, Consistency [2].

There are other supply chain performance measurement methods, namely the Supply Chain Operations Reference (SCOR) model developed by a professional institution, the Supply Chain Council (SCC). The reference model process is a concept for obtaining an integrated measurement framework [4].

There are 5 scopes of the SCOR process, namely Plan, Source, Make, Deliver, and Return. In SCOR it is divided into levels for measuring its performance. Within level one SCOR each aspect will be raised. Namely regarding reliability, responsiveness, flexibility, cost and assets. Realibility aspects include Inventory inaccuracy, Defect Rate, Stockout Probability, Forecast Inaccuracy, Inventory level for Packaging, Incorrect quantity of deliveries for Lamps, and Return rates from PT. X to supplier. Responsiveness aspects include Planning Cycle Time and Source Item Responsiveness. Aspects of Flexibility include Minimum Order Quantity, and Make Volume Flexibility. Cost aspects include

Defect Rate, and Machine Maintenance. Assets aspects include Payment Term, and Cash to Cash Cycle Time.

The second level of SCOR, is described about the mapping of the company's supply chain that will be measured its performance. As for the third level, every component in the second level mapping is broken down so that it gets something detailed from these components. At level three, parameters for each metric and component to be measured are started [4].

The best value will be represented by the number one hundred (100) in the normalization process, while the worst value will be represented by the number zero (0) in the normalization process. The normalization process is carried out by interpolating between these values, so that the same unit of measurement is obtained for each metric measured. The calculation formula in the normalization process is as follows:

$$\frac{\text{Absolute Score} - \text{Worst Score}}{\text{Absolute Score} - \text{Worst Score}} = \frac{\text{Score} - 0}{100 - 0}$$

In previous studies [5] - [10] analyzed supply chain performance using the SCOR approach in the company. Research [11] in the selection of regional superior products with one of its variables is the assessment of the sustainability of the supply chain. [12] in a study entitled Analysis of the Coconut Supply Chain as Industry Potential aimed at identifying and analyzing the management of the coconut industry supply chain. [13] - [14] a study with the aim of analyzing supply chains in construction work. Studies from [15] - [16] analyze supply chain performance using the SCOR and AHP methods.

2. Methods

The method used is the Supply Chain Operations Reference (SCOR), then the data is processed using AHP. The data collection is done based on observations and interviews, literature studies, and documentation of data recording from the company. In the AHP method, the following steps are taken [17], defining the problem, creating a hierarchical structure, making a comparison matrix, doing Defining a pairwise comparison so that the total rating is as much as nx [(n-1) / 2] fruit, where n is the number of elements compared. The results of the comparison of each element will be a number from 1 to 9 which shows the comparison of the importance of an element. If an element in the matrix is compared with itself, the comparison results are given a value of 1. Scale 9 has been proven to be acceptable and can distinguish the intensity between elements.

3. Results and Discussion

3.1. Data Purchasing and Inventory

Table 1. Actual Purchase of Essential and Genie Lights

Month	Type Essential			Type Genie		
	Purchasing	Sales	Inventory	Purchasing	Sales	Inventory
1	454	300	154	500	356	144
2	0	20	134	100	148	96
3	0	100	34	0	30	66
4	400	286	148	500	420	146
5	700	600	248	480	285	341
6	250	225	273	0	30	311
7	0	72	201	500	490	321
8	0	35	166	0	150	171
9	400	268	464	660	560	442
10	520	450	534	240	220	462
11	0	50	484	0	22	440
12	516	350	134	0	36	404
Total	3240	2456	2974	2980	2391	3344
Average	270		257,83	248,33		278,7

3.2. Absolute Value Calculation

. Absolute value or the actual value obtained from the processing of raw data obtained from various sources at PT. BRS. One example of calculating the absolute value or the actual value of a measurement indicator is the calculation of the yield metric. Yield data from the production is in the

form of yield of each brand produced for each month. The average yield (units) per month from January to December is 328, 84, 65, 353, 443, 128, 281, 93, 414, 335, 36, 193, with a total of 2753 units. The absolute value of the yield per month is 2753/12 = 229,417.
The results of calculating the absolute value (actual) of each Plan-Reliability metric are as follows:

Table 2. Calculation of absolute Plan-Reliability values

No	Matrix	Actual Score	Scale
1	Foracest Inaccuracy	3,058	Percent/Month
2	Inventory Level For Packaging	1,015	Month
3	Internal Meeting	2	Times/Month
4	Number Of Trainee For PPC	4	Person
5	Number For PPC Employee	2	Times/Year

The number of demand forecasts is 931 units consisting of 448 Essential types, and 483 Genie types.
Example of Metric Calculation:

$$Forecast\ Inaccuracy = \frac{[\text{demand forecast - Actual request}]}{\text{Actual request}} \text{x}\,100\%$$

By following the formula, another absolute value calculation can be obtained. Calculation of absolute Plan-Responsiveness values for Matrix Time to identify new product specifications = 3 days, and for Matrix Planing cycle time = 2 days.
Calculation of absolute value Source-Reliability for the Matrix: Defect rate = 0.1% / month, Source fill rate = 100% / month, Incorrect quantity of deliveries for lamps = 0% / month, Meeting with client projects = 6 times / year, Deviation lamp arrival schedule = 21 days, Number of trainees in Purchasing = 2 people, and Number of trainees with client projects = 2 times / year.
Calculation of absolute value Source-Responsiveness for the Matrix: Purchase order cycle time = 60 days, Source lead time = 14 days, and Source responsiveness = 2 days.
Calculation of absolute value Source-Flexibility for the Matrix: Source Flexibility = 2 suppliers, and Minimum order quantity = 0 units / month.
Calculation of absolute value Deliver Reliability for the Matrix: Fill rate = 100% / month, Stock rate probability = 0% / month, Orders ready topick by customer = 100% / month, Number of visits to customers = 2 times / month, Meeting with customers = 12 times / month, Number of trainees for marketing = 3 personal / training, and Training for marketing employees = 2 times / year.
Calculation of absolute value Deliver Responsiveness for Matrix: Deliver deadline (Inside the java island) = 7 days / order, and Deliver deadline (Outside the java island) = 14 days / order.
Calculation of absolute value of Return Reliability for Matrix: Customer complain = 2 times / year, and BRS to client project = 1% / month.
Calculation of absolute Return Responsiveness value for the Matrix: Supplier repaired time = 30 days, and Product replacement time = 2 days.

3.3 Normalization Value Calculation

Example Calculation:

$$\frac{\text{Absolute Score} - \text{Worst Score}}{\text{Absolute Score} - \text{Worst Score}} = \frac{\text{Score} - 0}{100 - 0}$$

Table 3. Plan Reliability score calculation

No	Matrix	Best	Actual	Worst	0	100	Score
1	Forecast Inacc uracy	1	3,058	5	0	100	48,55
2	Inventory level for packaging	0	1,015	20	0	100	94,93
3	Internal meeting	2	2	1	0	100	100
4	Number of trainee for PPC	4	4	1	0	100	100
5	Training for PPC	4	2	1	0	100	33,33

Table 4. Plan Responsiveness score calculation

No	Matrix	Best	Actual	Worst	0	100	Score
1	Time to identifity new product specific actions	5	3	1	0	100	50

2	Planning cycle time	1	2	3	0	100	50

Table 5. Calculation of Source Reliability scores

No	Matrix	Best	Actual	Worst	0	100	Score
1	Defect rate	0,2	0,1	1	0	100	100
2	Source fill rate	1	1	0,5	0	100	100
3	Incorrect quantity deliveries for lamp	0	0	5	0	100	100
4	Meeting with client project	12	6	2	0	100	66,666
5	Devivatin lamp arrival schedule	7	21	30	0	100	39,130
6	Number of trainee in purchasing	2	1	0	0	100	50
7	Number of trainee in client project	4	2	0	0	100	50

Table 6. Calculation of Source Responsiveness scores

No	Matrix	Best	Actual	Worst	0	100	Score
1	Purchase order cycle time	30	60	120	0	100	100
2	Source lead time	7	14	21	0	100	50
3	Source responsivennes	1	2	5	0	100	75

Table 7. Calculation of the Source Flexibility score

No	Matrix	Best	Actual	Worst	0	100	Score
1	Source flexibility	3	2	0	0	100	66,667
2	Minimum order quantity	0	0	10	0	100	100

Table 8. Deliver Reliability score calculation

No	Matrix	Best	Actual	Worst	0	100	Score
1	Fill rate	1	1	0,75	0	100	66,667
2	Stockout probability	0	0	0,75	0	100	100
3	Order ready to pick by customer	1	1	0,7	0	100	100
4	Number of visit to customer	2	2	1	0	100	100
5	Meeting with customer	17	12	2	0	100	66,667
6	Number of trainee for marketing	5	3	0	0	100	60
7	Training for marketing employee	3	2	0	0	100	66,667

Table 9. Deliver Responsiveness score calculation

No	Matrix	Best	Actual	Worst	0	100	Score
1	Deliver deadline (Inside the java island)	7	7	21	0	100	100
2	Deliver deadline (Outside the java island)	14	30	14	0	100	100

Table 10. Calculation of Return Reliability scores

No	Matrix	Best	Actual	Worst	0	100	Score
1	Customer complain	0	2	6	0	100	66,667
2	Return rate PT. BRS to client project	0	1	10	0	100	90

Table 11. Calculation of Return Responsiveness score

No	Matrix	Best	Actual	Worst	0	100	Score
1	Supplier repaired time	30	30	90	0	100	100
2	Product replacement time	2	2	7	0	100	100

3.4 Weighting of Importance with AHP

Weighting of the level of importance at level one and two, is done by using the method of the Analytical Hierarchy Process (AHP). The value obtained is based on the results of the questionnaire. AHP data processing using Expert Choice Software. Weighting of importance for level one is done by

comparing in pairs between aspects of the plan, source, deliver and return. The pairwise comparison results of level one weighting are as follows:

Table 12. Level One Pair Comparison Results

	Source	***Deliver***	***Return***
Plan	1,0	1,0	6,0
Source		2,0	3,0
Deliver			8,0

Using Expert Choice Software, the calculation of the weighting of importance for Level one and Level two is declared Consistent.

3.5. Calculation of Final Value of Supply Chain Performance

Calculation of the final result of Supply Chain performance is done by multiplying each score that has been obtained with the weight of each scope, aspects, and metrics.

Table 13. Calculation of the final Plan-Reliability

No	Matrix	Score	Weight	Score x Weight
1	Forecast inaccuracy	48,55	20%	9,71
2	Inventory level for packaging	94,93	20%	18,986
3	Internal meeting	100	20%	20
4	Number of trainee for PPC	100	20%	20
5	Training for PPC	33,33	20%	6,666
			Total	75,36

Table 14. Calculation of the final Plan-Responsiveness

No	Matrix	Score	Weight	Score x Weight
1	Time to identify new product	50	50%	25
2	Planing cycle time	50	50%	25
			Total	50

Table 15. Calculation of the end result Source-Reliability

No	Matrix	Score	Weight	Score x Weight
1	Defect rate	100	14,28%	14,28
2	Source fill rate	100	14,28%	14,28
3	Incorrect quantity	100	14,28%	14,28
4	Meeting with suppliers	66,667	14,28%	9,52
5	Deviation lamp arrival schedule	39,13	14,28%	5,59
6	Number of trainee	50	14,28%	7,14
7	Number of trainee with	50	14,28%	7,14
			Total	72,23

Table 16. Calculation of the final source-responsiveness

No	Matrix	Score	Weight	Score x Weight
1	Purchase order cycle time	100	33,33%	33,33
2	Source lead time	50	33,33%	16,67
3	Source responsivennes	75	33,33%	25,00
			Total	74,99

Table 17. Calculation of the final result Source-Flexibility

No	Matrix	Score	Weight	Score x Weight
1	Source flexibility	67	50%	33,33
2	Minimum order quantity	100	50%	50
			Total	83

Table 18. Deliver-Responsiveness final output calculation

No	Matrix	Score	Weight	Score x Weight
1	Deliver deadline (Inside the java island)	100	50%	50
2	Deliver deadline (Outside the java island)	100	50%	50
			Total	100

Table 19. Calculation of the final result of Deliver-Reliability

No	Matrix	Score	Weight	Score x Weight
1	Fill rate	100	14,28%	14,28
2	Stockout probability	100	14,28%	14,28
3	Order ready to pick by customer	100	14,28%	14,28
4	Number of visit to customer	100	14,28%	14,28
5	Meeting with customer	66,67	14,28%	10
6	Number of trainee for marketing	60	14,28%	8,57
7	Training for marketing employee	66,67	14,28%	10
			Total	84,73

Table 20. Calculation of the final return-reliability

No	Matrix	Score	Weight	Score x Weight
1	Customer complain	67	50%	33,33
2	Return rate from PT BRS to supplier	90	50%	45
			Total	78,33

Table 21. Calculation of the final return-responsiveness

No	Matrix	Score	Weight	Score x Weight
1	Supplier repaired	100	50%	50
2	Product replacement time	100	50%	50
			Total	100

Setelah diketahui hasil akhir dari masing-masing aspek, maka hasil akhir tersebut akan dikalikan dengan bobot dari setiap aspek. Bobot tiap aspek tersebut telah dihitung pada sub bab sebelumnya dengan metode AHP.

Adapun hasil perhitungannya adalah sebagai berikut :

Table 22. Calculation of the Final Value of Each Scope

	Aspect	Final score	weight	Total	Total per scope
Plan	Reliability	75,36	0,889	67,00	72,55
	Responsiveness	50	0,111	5,55	
Source	Reliability	72,23	0,075	5,42	76,62
	Responsiveness	74,99	0,696	52,19	
	Flexibility	83	0,229	19,01	
Deliver	Reliability	84,73	0,875	74,14	86,64
	Responsiveness	100	0,125	12,50	
Return	Reliability	78,33	0,125	9,79	97,29
	Responsiveness	100	0,875	87,50	

Table 23. Calculation of Supply Chain Performance Value of PT.

Aspect	Total per scope	weight	Performance
Plan	72,55	0,317	23,00
Source	76,62	0,225	17,24
Deliver	86,64	0,400	34,66
Return	97,29	0,058	5,64
		Total	80,54

From the results of data processing that has been carried out, the Supply Chain performance value of PT. X is 80.54 and can be said Good, most of the metrics measured have a pretty good score. The figure is obtained from the calculation of the Final Value of each Scope and ends with the Calculation of Supply Chain Performance Value.

The total number of performance is high because most of the metrics measured have a pretty good score. Some metrics with a high enough value that is above or equal to 70 are as follows:

Table 24. High Score Matrix

Aspect	No	Matrix	Score
Plan (Reliability)	2	Inventory level for packaging	94,93
	3	Internal meeting	100
	4	Number of trainee for PPC	100
Source (Reliability)	1	Defecrate	100
	2	Source fill rate	100
	3	Incorrect quantity deliveries for lamp	100

Source (Responiveness)	1	Purchase order cycle time	100
Source (Flexibility)	2	Minimum order quantity	100
Deliver (Reliability)	1	Fill rate	100
	2	Stockout probability	100
	3	Orders ready to pick by customer	100
	4	Number of visit to customer	100
Return (Reliability)	1	Return rate from PT. BRS to client project	100
Return (Responsiveness)	2	Client project repaired time	100
	3	Product replacement time	100

The metrics above have a good score, so that Supply Chain performance in PT. X as a whole has a good value. For example, the Number of trainees for PPC has a high score of 100. This shows that every employee of the PPC section always gets training on Production Planning to the maximum even though in the implementation of the training sometimes not all employees are present and this requires good communication at work.

With the good performance value, this shows that the Supply Chain of PT. X is still well controlled. This is supported by the existence of Client Projects that are of sufficient quality and are responsible for this task. In addition, PT. X also paid enough attention to the problems of production, storage and delivery of goods to consumers, so that consumers can meet their needs. Consumer needs are always met properly, this is indicated by the Stockout Probability metric which has a very high score.

However, there are several metrics that need to be considered by the company because it has a fairly low score, which is below or equal to 50. These metrics include:

Table 25. Matrix with Low Scores

Aspect	No	Matrix	Score
Plan (Reliability)	1	Forecast Inaccuracy	48,55
	5	Training for PPC	33,33
Plan (Responiveness)	1	Time to identifity new product specifications	50
	2	Planing cycle time	50
Source (Reliability)	5	Deviatuon lamp arrival schedule	39,130
	6	Number of trainee in purchasing	50
	7	Number of trainee in client project	50
Source (Responsiveness)	2	Source lead time	50

The matrices above have a low score. This is because the actual value of the matrices is still far from the best value targeted by the company, thus making the performance value of the Supply Chain of PT. X can't be maximal.

1. Forecast Inaccuracy, companies should have accuracy in forecasting.
2. Training for PPC & Purchasing, Number of trainees in Purchasing & Client Projects. Employee training is still lacking by PT. X. This is due to the minimal budgeted costs for training costs.
3. Time to Identify the new product specifications & planning cycle of the team. When companies identify, plan, and develop new products, it should not be in a short time, because new product development will shape the company's future, so it must be really well controlled in order to produce new products that are successful in the market.
4. Deviation lamp arrival schedule. In the departure date of the lamp arrival, if the order arrives late it can hamper the consumer order process. In this case, PT. X must determine the minimum inventory limit in the warehouse.
5. Source lead time. At lead time, companies should be able to shorten / shorten lead time.

For those who have high value and productivity must be maintained are as follows:

1. PLAN, consisting of Inventory Level for Packaging, Internal Meeting, Number of Trainees for PPC.
2. SOURCE, consisting of Defect Rate, Source Fill Rate, Incorrect Quantity Deliveries for Lamps, Purchase Order Cycle Time, Minimum Order Quantity.

3. DELIVER, consisting of Fill Rate, Stockout Probability, Orders Ready To Pick by Customer, Number of Visit to Customer, Deadline Deliver (inside and outside Java).

Based on the analysis, the Supply Chain performance value at PT X is 80.48, and can be said to be Good. From the results of these calculations, it can be seen that the Matrix with a High score value has more number of matrices than the Matrix with a Low score value. It can be said that PT. X is good.

4. Conclusion

Based on the analysis and discussion, it can be concluded that, the Final Value of Supply Chain Performance in PT. X is 80.54. This value is a good value because, the final result category between 80 to 89 is good. The results of the final value, due to the results of the matrix which has a high value also besides that there is also a matrix value that has a low value and this must be considered also because for the matrix that results are small, improvements need to be made so that later it will have the value of the performance results the maximum.

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Authors	Akhmad Sutoni* 1 , Ali Subhan1 , Widy Setyawan1 , Fitri Oktavia Bhagyana1 , and Mujiarto2
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Performance Analysis Using the Supply Chain Operations Reference (SCOR) and AHP Method

Akhmad Sutoni[*1], Ali Subhan[1], Widy Setyawan[1], Fitri Oktavia Bhagyana[1], and Mujiarto[2]

[1]Teknik Industri, Universitas Suryakancana, Cianjur, Indonesia

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Abstract. This research was conducted to see the performance of P.T. X. Planning assessment is carried out on the performance of the supply chain for the production, warehouse, and shipping of goods. The method used is the Supply Chain Operations Reference (SCOR) andAnalythical Hierarchy Process (AHP) . With this method, in addition to looking at performance performance, can also see the location of the metrics that must be improved again and which must be maintained. So the company's work system will be better. The calculation results will be used as a reference to be able to increase customer satisfaction and will increase company revenue. The results obtained are the highest and lowest values of each Plan, Source, Deliver, and Return metrics. P.T. X performance is Good, with a total calculation result of 80.48.

1. Introduction

The purpose of this study was to design a model for measuring Supply Chain performance at PT. X by using absolute value calculations and actual values. Supply Chain Management involves many parties in it, both directly and indirectly in an effort to meet consumer demand. Here the Supply Chain not only involves manufacturers and suppliers but also involves many things, including transportation, warehouses and consumers themselves [1]. With the rapid development of the world industry, it is important to develop the concept of performance appraisal in the field of Supply Chain Management. In this field, concepts such as partnership, outsourcing, vendor managed inventory, etc. are needed to help in measuring supply chain performance [2]. Industries in general measure performance of the Supply Chain with the aim of reducing costs, meeting customer satisfaction and increasing their profits [3]. There are several characteristics that must be met by indicators, namely Universality, Measurability, Consistency [2].

There are other supply chain performance measurement methods, namely the Supply Chain Operations Reference (SCOR) model developed by a professional institution, the Supply Chain Council (SCC). The reference model process is a concept for obtaining an integrated measurement framework [4].There are 5 scopes of the SCOR process, namely Plan, Source, Make, Deliver, and Return. In SCOR it is divided into levels for measuring its performance. Within level one SCOR each aspect w ill be raised. Namely regarding reliability, responsiveness, flexibility, cost and assets. The second level of SCOR, is described about the mapping of the company's supply chain that will be measured its performance. As for the third level, every component in the second level mapping is broken down so that it gets something detailed from these components. At level three, parameters for each metric and component to be measured are started [4].

The calculation formula in the normalization process is as follows:

$$\frac{\text{Absolute Score} - \text{Worst Score}}{\text{Absolute Score} - \text{Worst Score}} = \frac{\text{Score} - 0}{100 - 0}$$

In previous studies [5] - [10] analyzed supply chain performance using the SCOR approach in the company. Research [11] in the selection of regional superior products with one of its variables is

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2. Methods

The method used is the Supply Chain Operations Reference (SCOR), then the data is processed using AHP. The data collection is done based on observations and interviews, literature studies, and documentation of data recording from the company. In the AHP method, the following steps are taken [17], defining the problem, creating a hierarchical structure, making a comparison matrix, doing Defining a pairwise comparison so that the total rating is as much as nx [(n-1) / 2] fruit, where n is the number of elements compared. The results of the comparison of each element will be a number from 1 to 9 which shows the comparison of the importance of an element. If an element in the matrix is compared with itself, the comparison results are given a value of 1. Scale 9 has been proven to be acceptable and can distinguish the intensity between elements.

3. Results and Discussion

3.1. Data Purchasing and Inventory

Table 1. Actual Purchase of Essential and Genie Lights

Month	Type Essential			Type Genie		
	Purchasing	*Sales*	*Inventory*	*Purchasing*	*Sales*	*Inventory*
1	454	300	154	500	356	144
2	0	20	134	100	148	96
3	0	100	34	0	30	66
4	400	286	148	500	420	146
5	700	600	248	480	285	341
6	250	225	273	0	30	311
7	0	72	201	500	490	321
8	0	35	166	0	150	171
9	400	268	464	660	560	442
10	520	450	534	240	220	462
11	0	50	484	0	22	440
12	516	350	134	0	36	404
Total	3240	2456	2974	2980	2391	3344
Average	270		257,83	248,33		278,7

3.2. Absolute Value Calculation

Absolute value or the actual value obtained from the processing of raw data obtained from various sources at PT. BRS. One example of calculating the absolute value or the actual value of a measurement indicator is the calculation of the yield metric. Yield data from the production is in the form of yield of each brand produced for each month. The average yield (units) per month from January to December is 328, 84, 65, 353, 443, 128, 281, 93, 414, 335, 36, 193, with a total of 2753 units. The absolute value of the yield per month is 2753/12 = 229,417.

The results of calculating the absolute value (actual) of each Plan-Reliability metric are as follows:

Table 2. Calculation of absolute Plan-Reliability values

No	Matrix	Actual Score	Scale
1	*Foracest Inaccuracy*	3.058	Percent/Month
2	*Inventory Level For Packaging*	1.015	Month
3	*Internal Meeting*	2	Times/Month
4	*Number Of Trainee For PPC*	4	Person
5	*Number For PPC Employee*	2	Times/Year

The number of demand forecasts is 931 units consisting of 448 Essential types, and 483 Genie types.

Example of Metric Calculation:

$$Forecast\ Inaccuracy = \frac{[\text{demand forecast - Actual request}]}{\text{Actual request}} \text{x } 100\%$$

By following the formula, another absolute value calculation can be obtained. Calculation of absolute Plan-Responsiveness values for Matrix Time to identify new product specifications = 3 days, and for Matrix Planing cycle time = 2 days.

Calculation of absolute value Source-Reliability for the Matrix: Defect rate = 0.1% / month, Source fill rate = 100% / month, Incorrect quantity of deliveries for lamps = 0% / month, Meeting with client projects = 6 times / year, Deviation lamp arrival schedule = 21 days, Number of trainees in Purchasing = 2 people, and Number of trainees with client projects = 2 times / year.

Calculation of absolute value Source-Responsiveness for the Matrix: Purchase order cycle time = 60 days, Source lead time = 14 days, and Source responsiveness = 2 days.

Calculation of absolute value Source-Flexibility for the Matrix: Source Flexibility = 2 suppliers, and Minimum order quantity = 0 units / month.

Calculation of absolute value Deliver Reliability for the Matrix: Fill rate = 100% / month, Stock rate probability = 0% / month, Orders ready topick by customer = 100% / month, Number of visits to customers = 2 times / month, Meeting with customers = 12 times / month, Number of trainees for marketing = 3 personal / training, and Training for marketing employees = 2 times / year.

Calculation of absolute value Deliver Responsiveness for Matrix: Deliver deadline (Inside the java island) = 7 days / order, and Deliver deadline (Outside the java island) = 14 days / order.

Calculation of absolute value of Return Reliability for Matrix: Customer complain = 2 times / year, and BRS to client project = 1% / month.

Calculation of absolute Return Responsiveness value for the Matrix: Supplier repaired time = 30 days, and Product replacement time = 2 days.

3.3 Normalization Value Calculation

Example Calculation:

$$\frac{\text{Absolute Score – Worst Score}}{\text{Absolute Score – Worst Score}} = \frac{\text{Score – 0}}{100 - 0}$$

Table 3. Plan Reliability score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Forecast Inacc uracy*	1	3.058	5	48.55
2	*Inventory level for packaging*	0	1.015	20	94.93
3	*Internal meeting*	2	2	1	100
4	*Number of trainee for PPC*	4	4	1	100
5	*Training for PPC*	4	2	1	33.33

Table 4. Plan Responsiveness score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Time to identifity new product specific actions*	5	3	1	50
2	*Planning cycle time*	1	2	3	50

Table 5. Calculation of Source Reliability scores

No	Matrix	Best	Actual	Worst	Score
1	*Defect rate*	0.2	0.1	1	100
2	*Source fill rate*	1	1	0,5	100
3	*Incorrect quantity deliveries for lamp*	0	0	5	100
4	*Meeting with client project*	12	6	2	66.666
5	*Devivatin lamp arrival schedule*	7	21	30	39.130
6	*Number of trainee in purchasing*	2	1	0	50
7	*Number of trainee in client project*	4	2	0	50

Table 6. Calculation of Source Responsiveness scores

No	Matrix	Best	Actual	Worst	Score
1	*Purchase order cycle time*	30	60	120	100
2	*Source lead time*	7	14	21	50
3	*Source responsivennes*	1	2	5	75

Table 7. Calculation of the Source Flexibility score

No	Matrix	Best	Actual	Worst	Score
1	*Source flexibility*	3	2	0	66.667
2	*Minimum order quantity*	0	0	10	100

Table 8. Deliver Reliability score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Fill rate*	1	1	0.75	66.667
2	*Stockout probability*	0	0	0.75	100
3	*Order ready to pick by customer*	1	1	0.7	100
4	*Number of visit to customer*	2	2	1	100
5	*Meeting with customer*	17	12	2	66.667
6	*Number of trainee for marketing*	5	3	0	60
7	*Training for marketing employee*	3	2	0	66.667

Table 9. Deliver Responsiveness score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Deliver deadline (Inside the java island)*	7	7	21	100
2	*Deliver deadline (Outside the java island)*	14	30	14	100

Table 10. Calculation of Return Reliability scores

No	Matrix	Best	Actual	Worst	Score
1	*Customer complain*	0	2	6	66.667
2	*Return rate PT. BRS to client project*	0	1	10	90

Table 11. Calculation of Return Responsiveness score

No	Matrix	Best	Actual	Worst	Score
1	*Supplier repaired time*	30	30	90	100
2	*Product replacement time*	2	2	7	100

3.4 Weighting of Importance with AHP

Weighting of the level of importance at level one and two, is done by using the method of the Analytical Hierarchy Process (AHP). The value obtained is based on the results of the questionnaire. AHP data processing using Expert Choice Software. Weighting of importance for level one is done by comparing in pairs between aspects of the plan, source, deliver and return. The pairwise comparison results of level one weighting are : For Plan, Source = 1,0; Deliver = 1,0; and Return = 6,0. For Source, Deliver = 2,0; and Return = 3,0. For Return, Deliver = 8,0. Using Expert Choice Software, the calculation of the weighting of importance for Level one and Level two is declared Consistent.

3.5. Calculation of Final Value of Supply Chain Performance

Calculation of the final result of Supply Chain performance is done by multiplying each score that has been obtained with the weight of each scope, aspects, and metrics. For Calculation of the final Plan-Reliability with Weight 20%, the Total Score multiplied by Weight is 75.36. For Calculation of the final Plan-Responsiveness with Weight 50%, the Total Score multiplied by Weight is 50. For Calculation of the end result Source-Reliability with Weight 14.28%, the Total Score multiplied by Weight is 72.23. For Calculation of the final source-responsiveness with Weight 33.33%, the Total Score multiplied by Weight is 74.99. For Calculation of the final result Source-Flexibility with Weight 50%, the Total Score multiplied by Weight is 83. For Deliver-Responsiveness final output calculation

with Weight 50%, the Total Score multiplied by Weight is 100. For Calculation of the final result of Deliver-Reliability with Weight 14.28%, the Total Score multiplied by Weight is 84.73. For Calculation of the final return-reliability with Weight 50%, the Total Score multiplied by Weight is 78.33. For Calculation of the final return-responsiveness with Weight 50%, the Total Score multiplied by Weight is 100.

After knowing the final results of each aspect, the final results will be multiplied by the weight of each aspect. The weight of each aspect has been calculated in the previous sub-chapter with the AHP method. The calculation results are as follows:

Table 12. Calculation of the Final Value of Each Scope

Aspect		Final score	weight	Total	Total per scope
Plan	*Reliability*	75.36	0.889	67.00	72.55
	Responsiveness	50	0.111	5.55	
Source	*Reliability*	72.23	0.075	5.42	76.62
	Responsiveness	74.99	0.696	52.19	
	Flexibility	83	0.229	19.01	
Deliver	*Reliability*	84.73	0.875	74.14	86.64
	Responsiveness	100	0.125	12.50	
Return	*Reliability*	78.33	0.125	9.79	97.29
	Responsiveness	100	0.875	87.50	

Table 13. Calculation of Supply Chain Performance Value of PT.

Aspect	Total per scope	weight	Performance
Plan	72.55	0.317	23.00
Source	76.62	0.225	17.24
Deliver	86.64	0.400	34.66
Return	97.29	0.058	5.64
		Total	80.54

The total number of performance is high because most of the metrics measured have a pretty good score. Some metrics with a high enough value that is above or equal to 70. With the good performance value, this shows that the Supply Chain of PT. X is still well controlled. This is supported by the existence of Client Projects that are of sufficient quality and are responsible for this task. In addition, PT. X also paid enough attention to the problems of production, storage and delivery of goods to consumers, so that consumers can meet their needs. Consumer needs are always met properly, this is indicated by the Stockout Probability metric which has a very high score.

However, there are several metrics that need to be considered by the company because it has a fairly low score, which is below or equal to 50. The metrics above have a low score. This is because the actual value of the matrices is still far from the best value targeted by the company, thus making the performance value of the Supply Chain of PT. X can't be maximal.

1. Forecast Inaccuracy, companies should have accuracy in forecasting.
2. Training for PPC & Purchasing, Number of trainees in Purchasing & Client Projects. Employee training is still lacking by PT. X. This is due to the minimal budgeted costs for training costs.
3. Time to Identify the new product specifications & planning cycle of the team. When companies identify, plan, and develop new products, it should not be in a short time, because new product development will shape the company's future, so it must be really well controlled in order to produce new products that are successful in the market.
4. Deviation lamp arrival schedule. In the departure date of the lamp arrival, if the order arrives late it can hamper the consumer order process. In this case, PT. X must determine the minimum inventory limit in the warehouse.
5. Source lead time. At lead time, companies should be able to shorten / shorten lead time.

Based on the analysis, the Supply Chain performance value at PT X is 80.54, and can be said to be Good. From the results of these calculations, it can be seen that the Matrix with a High score value

has more number of matrices than the Matrix with a Low score value. It can be said that PT. X is good.

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	Purchasing	*Sales*	*Inventory*	*Purchasing*	*Sales*	*Inventory*
1	454	300	154	500	356	144
2	0	20	134	100	148	96
3	0	100	34	0	30	66
4	400	286	148	500	420	146
5	700	600	248	480	285	341
6	250	225	273	0	30	311
7	0	72	201	500	490	321
8	0	35	166	0	150	171
9	400	268	464	660	560	442
10	520	450	534	240	220	462
11	0	50	484	0	22	440
12	516	350	134	0	36	404
Total	3240	2456	2974	2980	2391	3344
Average	270		257,83	248,33		278,7

3.2. Absolute Value Calculation

Absolute value or the actual value obtained from the processing of raw data obtained from various sources at PT. BRS. One example of calculating the absolute value or the actual value of a measurement indicator is the calculation of the yield metric. Yield data from the production is in the form of yield of each brand produced for each month. The average yield (units) per month from January to December is 328, 84, 65, 353, 443, 128, 281, 93, 414, 335, 36, 193, with a total of 2753 units. The absolute value of the yield per month is 2753/12 = 229,417.

The results of calculating the absolute value (actual) of each Plan-Reliability metric are as follows:

Table 2. Calculation of absolute Plan-Reliability values

No	Matrix	Actual Score	Scale

1	*Foracest Inaccuracy*	3.058	Percent/Month
2	*Inventory Level For Packaging*	1.015	Month
3	*Internal Meeting*	2	Times/Month
4	*Number Of Trainee For PPC*	4	Person
5	*Number For PPC Employee*	2	Times/Year

The number of demand forecasts is 931 units consisting of 448 Essential types, and 483 Genie types.

Example of Metric Calculation:

$$Forecast\ Inaccuracy = \frac{[\text{demand forecast} - \text{Actual request}]}{\text{Actual request}} \text{x } 100\%$$

By following the formula, another absolute value calculation can be obtained. Calculation of absolute Plan-Responsiveness values for Matrix Time to identify new product specifications = 3 days, and for Matrix Planing cycle time = 2 days.

Calculation of absolute value Source-Reliability for the Matrix: Defect rate = 0.1% / month, Source fill rate = 100% / month, Incorrect quantity of deliveries for lamps = 0% / month, Meeting with client projects = 6 times / year, Deviation lamp arrival schedule = 21 days, Number of trainees in Purchasing = 2 people, and Number of trainees with client projects = 2 times / year.

Calculation of absolute value Source-Responsiveness for the Matrix: Purchase order cycle time = 60 days, Source lead time = 14 days, and Source responsiveness = 2 days.

Calculation of absolute value Source-Flexibility for the Matrix: Source Flexibility = 2 suppliers, and Minimum order quantity = 0 units / month.

Calculation of absolute value Deliver Reliability for the Matrix: Fill rate = 100% / month, Stock rate probability = 0% / month, Orders ready topick by customer = 100% / month, Number of visits to customers = 2 times / month, Meeting with customers = 12 times / month, Number of trainees for marketing = 3 personal / training, and Training for marketing employees = 2 times / year.

Calculation of absolute value Deliver Responsiveness for Matrix: Deliver deadline (Inside the java island) = 7 days / order, and Deliver deadline (Outside the java island) = 14 days / order.

Calculation of absolute value of Return Reliability for Matrix: Customer complain = 2 times / year, and BRS to client project = 1% / month.

Calculation of absolute Return Responsiveness value for the Matrix: Supplier repaired time = 30 days, and Product replacement time = 2 days.

3.3 Normalization Value Calculation

Example Calculation:

$$\frac{\text{Absolute Score} - \text{Worst Score}}{\text{Absolute Score} - \text{Worst Score}} = \frac{\text{Score} - 0}{100 - 0}$$

Table 3. Plan Reliability score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Forecast Inacc uracy*	1	3.058	5	48.55
2	*Inventory level for packaging*	0	1.015	20	94.93
3	*Internal meeting*	2	2	1	100
4	*Number of trainee for PPC*	4	4	1	100
5	*Training for PPC*	4	2	1	33.33

Table 4. Plan Responsiveness score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Time to identifity new product specific actions*	5	3	1	50
2	*Planning cycle time*	1	2	3	50

Table 5. Calculation of Source Reliability scores

No	Matrix	Best	Actual	Worst	Score
1	*Defect rate*	0.2	0.1	1	100
2	*Source fill rate*	1	1	0,5	100
3	*Incorrect quantity deliveries for lamp*	0	0	5	100
4	*Meeting with client project*	12	6	2	66.666
5	*Devivatin lamp arrival schedule*	7	21	30	39.130
6	*Number of trainee in purchasing*	2	1	0	50
7	*Number of trainee in client project*	4	2	0	50

Table 6. Calculation of Source Responsiveness scores

No	Matrix	Best	Actual	Worst	Score
1	*Purchase order cycle time*	30	60	120	100
2	*Source lead time*	7	14	21	50
3	*Source responsivennes*	1	2	5	75

Table 7. Calculation of the Source Flexibility score

No	Matrix	Best	Actual	Worst	Score
1	*Source flexibility*	3	2	0	66.667
2	*Minimum order quantity*	0	0	10	100

Table 8. Deliver Reliability score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Fill rate*	1	1	0.75	66.667
2	*Stockout probability*	0	0	0.75	100
3	*Order ready to pick by customer*	1	1	0.7	100
4	*Number of visit to customer*	2	2	1	100
5	*Meeting with customer*	17	12	2	66.667
6	*Number of trainee for marketing*	5	3	0	60
7	*Training for marketing employee*	3	2	0	66.667

Table 9. Deliver Responsiveness score calculation

No	Matrix	Best	Actual	Worst	Score
1	*Deliver deadline (Inside the java island)*	7	7	21	100
2	*Deliver deadline (Outside the java island)*	14	30	14	100

Table 10. Calculation of Return Reliability scores

No	Matrix	Best	Actual	Worst	Score
1	*Customer complain*	0	2	6	66.667
2	*Return rate PT. BRS to client project*	0	1	10	90

Table 11. Calculation of Return Responsiveness score

No	Matrix	Best	Actual	Worst	Score
1	*Supplier repaired time*	30	30	90	100
2	*Product replacement time*	2	2	7	100

3.4 Weighting of Importance with AHP

Weighting of the level of importance at level one and two, is done by using the method of the Analytical Hierarchy Process (AHP). The value obtained is based on the results of the questionnaire.

AHP data processing using Expert Choice Software. Weighting of importance for level one is done by comparing in pairs between aspects of the plan, source, deliver and return. The pairwise comparison results of level one weighting are : For Plan, Source = 1,0; Deliver = 1,0; and Return = 6,0. For Source, Deliver = 2,0; and Return = 3,0. For Return, Deliver = 8,0. Using Expert Choice Software, the calculation of the weighting of importance for Level one and Level two is declared Consistent.

3.5. Calculation of Final Value of Supply Chain Performance

Calculation of the final result of Supply Chain performance is done by multiplying each score that has been obtained with the weight of each scope, aspects, and metrics. For Calculation of the final Plan-Reliability with Weight 20%, the Total Score multiplied by Weight is 75.36. For Calculation of the final Plan-Responsiveness with Weight 50%, the Total Score multiplied by Weight is 50. For Calculation of the end result Source-Reliability with Weight 14.28%, the Total Score multiplied by Weight is 72.23. For Calculation of the final source-responsiveness with Weight 33.33%, the Total Score multiplied by Weight is 74.99. For Calculation of the final result Source-Flexibility with Weight 50%, the Total Score multiplied by Weight is 83. For Deliver-Responsiveness final output calculation with Weight 50%, the Total Score multiplied by Weight is 100. For Calculation of the final result of Deliver-Reliability with Weight 14.28%, the Total Score multiplied by Weight is 84.73. For Calculation of the final return-reliability with Weight 50%, the Total Score multiplied by Weight is 78.33. For Calculation of the final return-responsiveness with Weight 50%, the Total Score multiplied by Weight is 100.

After knowing the final results of each aspect, the final results will be multiplied by the weight of each aspect. The weight of each aspect has been calculated in the previous sub-chapter with the AHP method. The calculation results are as follows:

Table 12. Calculation of the Final Value of Each Scope

Aspect		Final score	weight	Total	Total per scope
Plan	*Reliability*	75.36	0.889	67.00	72.55
	Responsiveness	50	0.111	5.55	
Source	*Reliability*	72.23	0.075	5.42	76.62
	Responsiveness	74.99	0.696	52.19	
	Flexibility	83	0.229	19.01	
Deliver	*Reliability*	84.73	0.875	74.14	86.64
	Responsiveness	100	0.125	12.50	
Return	*Reliability*	78.33	0.125	9.79	97.29
	Responsiveness	100	0.875	87.50	

Table 13. Calculation of Supply Chain Performance Value of PT.

Aspect	Total per scope	weight	Performance
Plan	72.55	0.317	23.00
Source	76.62	0.225	17.24
Deliver	86.64	0.400	34.66
Return	97.29	0.058	5.64
		Total	80.54

The total number of performance is high because most of the metrics measured have a pretty good score. Some metrics with a high enough value that is above or equal to 70. With the good performance value, this shows that the Supply Chain of PT. X is still well controlled. This is supported by the existence of Client Projects that are of sufficient quality and are responsible for this task. In addition, PT. X also paid enough attention to the problems of production, storage and delivery of goods to consumers, so that consumers can meet their needs. Consumer needs are always met properly, this is indicated by the Stockout Probability metric which has a very high score.

However, there are several metrics that need to be considered by the company because it has a fairly low score, which is below or equal to 50. The metrics above have a low score. This is because

the actual value of the matrices is still far from the best value targeted by the company, thus making the performance value of the Supply Chain of PT. X can't be maximal.

- Forecast Inaccuracy, companies should have accuracy in forecasting.
- Training for PPC & Purchasing, Number of trainees in Purchasing & Client Projects. Employee training is still lacking by PT. X. This is due to the minimal budgeted costs for training costs.
- Time to Identify the new product specifications & planning cycle of the team. When companies identify, plan, and develop new products, it should not be in a short time, because new product development will shape the company's future, so it must be really well controlled in order to produce new products that are successful in the market.
- Deviation lamp arrival schedule. In the departure date of the lamp arrival, if the order arrives late it can hamper the consumer order process. In this case, PT. X must determine the minimum inventory limit in the warehouse.
- Source lead time. At lead time, companies should be able to shorten / shorten lead time.

Based on the analysis, the Supply Chain performance value at PT X is 80.54, and can be said to be Good. From the results of these calculations, it can be seen that the Matrix with a High score value has more number of matrices than the Matrix with a Low score value. It can be said that PT. X is good.

4. Conclusion

Based on the analysis and discussion, it can be concluded that, the Final Value of Supply Chain Performance in PT. X is 80.54. This value is a good value because, the final result category between 80 to 89 is good. The results of the final value, due to the results of the matrix which has a high value also besides that there is also a matrix value that has a low value and this must be considered also because for the matrix that results are small, improvements need to be made so that later it will have the value of the performance results the maximum.

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