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

Akhmad Sutoni*, Ali Subhan¹, Widy Setyawan¹, Fitri Oktavia Bhagyana¹, and Mujiarto²
¹Teknik Industri, Universitas Suryakancana, Cianjur, Indonesia
²Department of Mechanical Engineering, Universitas Muhammadiyah Tasikmalaya, Indonesia
*tbungsu13@gmail.com

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 Analytical Hierarchy Process (AHP). With this method, in addition to looking at performance, can also see the location of the metrics that must be improved 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 will 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:

\[
\text{Absolute Score} - \text{Worst Score} = \text{Score} - 0
\]

\[
\text{Absolute Score} - \text{Worst Score} \times 100 - 0
\]

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 \( nx \left( \frac{n-1}{2} \right) \) 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

| 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:

| No  | Matrix | Actual Score | Scale |
|-----|--------|--------------|-------|
|     |        |              |       |
Example of Metric Calculation:

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

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 Planning 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 to pick 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:

Absolute Score – Worst Score = Score – 0

| No | Matrix                        | Best | Actual | Worst | Score   |
|----|--------------------------------|------|--------|-------|---------|
| 1  | Forecast Inaccuracy            | 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   |

| No | Matrix                        | Best | Actual | Worst | Score |
|----|--------------------------------|------|--------|-------|-------|
| 1  | Time to identify new product specifications | 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  | Devisation 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 responsiveness         | 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 100. For Deliver-Responsiveness final output calculation 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 | 50.00 | 0.111 | 5.55  |                 |
| Source |             |        |       |                 |
| Reliability | 72.23 | 0.075 | 5.42  | 76.62           |
| Responsiveness | 74.99 | 0.696 | 52.19 |                 |
| Flexibility | 83.00 | 0.229 | 19.01 |                 |
| Deliver |             |        |       |                 |
| Reliability | 84.73 | 0.875 | 74.14 | 86.64           |
| Responsiveness | 100.00 | 0.125 | 12.50 |                 |
| Return  |             |        |       |                 |
| Reliability | 78.33 | 0.125 | 9.79  | 97.29           |
| Responsiveness | 100.00 | 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.

References
[1] Chopra, S., Meindl, P. 2001. Supply Chain Management Strategy, Planning and Operations. New Jersey: Prentice-Hall, Inc..
[2] Pires, S.R.I., Aravechia, C.H.M. 2001. Measuring Supply Chain Performance. Orlando.
[3] Klapper, L., Hamblin, N. 2000. Supply Chain Management: A Recommended Performance Measurement Scorecard. Departement of Defense USA.
[4] Supply Chain Council. 2008. Supply Chain Operations Reference, Expeditionary Combat Support System, [http://www.supply-chain.org].
[5] Delipinar, G.E., Kocaoglu, B. 2016. Using SCOR model to gain competitive advantage: A Literature review. Procedia - Social and Behavioral Sciences 229 (2016) 398 – 406.
[6] Milambo, D., Phiri, J. 2019. Aircraft Spares Supply Chain Management for the Aviation Industry in Zambia Based on the Supply Chain Operations Reference (SCOR) Model. Open Journal of Business and Management, 2019, 7, 1183-1195.
[7] Equbql, M.D.A., Ohdar, R. 2017. A Comprehensive Supply Chain Performance Measurement And Evaluation (Cspme) Methodology. International Journal of Mechanical and Production Engineering Research and Development (IJMPERD), Vol. 7(2) p1-18.
[8] Miguel Afonso Sellittoa, M.A., et al., 2015. A SCOR-based model for supply chain performance measurement: application in the footwear industry. International Journal of Production Research.
[9] Abdullah, M.A., et. Al. 2018. Performance analysis of Supply Chain Management with Supply Chain Operation reference model. Journal of Physic.: Conf. Ser. 1007 012029.
[10] Kurien, G.P., Qureshi, M.N. 2011. Study of performance measurement practices in supply chain management. International Journal of Business, Management and Social Sciences Vol. 2(4), pp. 19-34.
[11] A. Sutoni. 2018. Determination of regional main products with fuzzy logic approach in regional Sula Island of North Maluku Province. in 3rd International Conference on Digital Arts, Media and Technology, ICDAMT.

[12] A. Sutoni. 2020. Analysis of Coconut Supply Chain as Industry Potential in Sula Islands Regency, North Maluku Province. Jurnal Media Teknik & Sistem Industri Vol. 4 (1), pp18-24.

[13] Wibowo, M.A., Sholeha, M.N. The analysis of supply chain performance measurement at construction project. The 5th International Conference of Euro Asia Civil Engineering Forum (EACEF-5), Procedia Engineering 125, pp 25 – 31.

[14] A. Sutoni and D. R. Kurniadi. 2020. Analisis Risiko Dalam Construction Supply Chain : Studi Kasus Pada Proyek Renovasi Gedung Kantor Vedca. Jurnal Media Tek.dan Sist. Ind., Vol. 3(2).

[15] Bukhoria, I.B., Widodo, K.H., Ismoyowatia, D. 2015. Evaluation of Poultry Supply Chain Performance in XYZ Slaughtering House Yogyakarta using SCOR and AHP Method. The 2014 International Conference on Agro-industry (ICoA) : Competitive and sustainable Agro-industry for Human Welfare, Agriculture and Agricultural Science Procedia 3, p. 221 – 225.

[16] Kurien, G.P., Qureshi, M.N. 2012. Performance measurement systems for green supply chains using modified balanced score card and analytical hierarchical process. Scientific Research and Essays Vol. 7(36), pp. 3149-3161.

[17] K. Suryadi, MA. Ramdhani. 1998. Sistem Pendukung Keputusan. PT Remaja Rosdakarya, Bandung