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Improvement of Supply Chain Performance on PT Surya Toto Indonesia Tbk

Fabiola Julia Yovita[1], Rich Randy[2], Vincent Chrisnata[3], Firdaus Alamsjah[4]
[1] Industrial Engineering Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480
[2] Industrial Engineering Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480
[3] Industrial Engineering Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480
[4] Industrial Engineering Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480, email: firdaus.alamsjah@binus.ac.id

ABSTRACT

The purpose of this research is to improve supply chain performance at PT Surya Toto Indonesia Tbk by measuring the score of the company supply chain performance using Supply Chain Operation Reference (SCOR) and identifying the existing problem. PT Surya Toto Indonesia Tbk has an overall supply chain performance score of 71,5738 out of 100 which is included in "good" category. The weakest point in the supply chain are the upside supply chain adaptability. Analyzing it further, it is known that the cause of the problem is the ordering system of raw materials in the company. Improvements are made in the design of new raw material ordering system using forecasting method and MRP lot-sizing. Using MRP lot-sizing Period Order Quantity (POQ) and Part Period Balancing (PPB) for three types of raw materials obtained supply chain performance score improvement to 73,6350, which led to cost reduction of 54,6696%, 49,3365%, and 45,4588% subsequently for raw material A, B, and C.

Key words : Lot-Sizing, Material Requirement Planning (MRP), Supply Chain, Supply Chain Operations Reference (SCOR) Model.

1. INTRODUCTION

PT Surya Toto Indonesia Tbk is a company engaged in the field of sanitary wares manufacturing, which controls 60% of the market share in Indonesia [1]. Some of its products are bathtubs, showers, sinks, bidets, faucets, and other related accessories. PT Surya Toto Indonesia Tbk from year to year has experienced an increase in average income of 11.71% every year from 2009-2016 [2]. That is because the construction of apartments and housing which are the main customers of the sanitary industry experienced an average increase of 172% each year from 2008-2014 [3]. The sanitary product market is a good market area and has great potential which means it can benefit not only PT Surya Toto Indonesia Tbk, but also for existing PT Surya Toto Indonesia Tbk competitors, and can attract new competitors to enter and compete in the market.

At present the level of competition in the global market places more emphasis on the supply chain performance aspects of the company itself. Industries have tried to design an effective IS models for high-quality Supply Chain Management (SCM). The emerging innovations in an industry needed are for their
SCM (Singh, et al. in [4]. The company's supply chain is a determinant in the competition between companies. Supply chain management leads to lower costs and a faster production cycle [5]. Supply chain has an important role in the process of material flow from suppliers to end customers, therefore companies must invest and focus on their supply chain. Several studies have proven that there is a positive influence from the implementation of supply chain management in the company's work processes, one of which is a study conducted by [6] at PT Monier in Sidoarjo which can increase profits by 15.11% by implementing supply chain management in company.

In this case, PT Surya Toto Indonesia Tbk needs to maintain and improve the performance of their supply chain so that it can; (1) utilizing the resources and capabilities that it has to meet customer desires well, (2) solving existing problems, and (3) getting profitability that is superior to competitors. However, PT Surya Toto Indonesia Tbk is faced with many demands that affect the smooth flow of their supply chains such as uncertain consumer demand patterns, the number of changes in the number of raw material needs from month to month that affects the ordering of raw materials to suppliers resulting in overstock and stock-out. Therefore it is necessary to evaluate the value of supply chain performance at PT Surya Toto Indonesia Tbk, in order to maintain the smooth flow of

supply chain flows in the company and find out the weak points that exist in aspects that affect the performance of the company's supply chain. Assessment of supply chain performance can be done using the Supply Chain Operation Reference (SCOR) 12.0 Method.

The SCOR model has been used in various businesses to measure the performance of their supply chain, one of which is PT Louserindo Megah Permai. This research was conducted by [7], using the SCOR and FAHP (Fuzzy Analytical Hierarchy Process) models. The conclusion obtained is the performance value of PT Louserindo Megah Permai is 81.02% and is included in the good category [8]. Research conducted by Nofan Hadi Ahmad and Evi Yuliawati with the title "Analysis of Measurement and Improvement of Supply Chain Performance at PT. XYZ". The place for the research was PT Sinar Mas Agro Resources and Technology Tbk, which concluded that the improvement method used was Analytical Hierarchy Process (AHP), so it was decided that the supplier to be selected in each ingredient was PT Madu Lingga Raharja Gresik by 0.38 for bleaching earth, PT Firmenich Indonesia by 0.53 for phosphoric acid, PT Allied Biotech Corporation by 0.38 for ingredient, and PT Asia Plastik Surabaya by 0.42 for packaging [8].

After conducting an assessment and knowing the weakest point of the supply chain at PT Surya Toto Indonesia Tbk, improvements can be made to improve the supply chain performance of PT Surya Toto Indonesia Tbk.

2. RESEARCH METHOD

This research was conducted at PT Surya Toto Indonesia Tbk which is engaged in sanitary production, located on M.H. Thamrin Road Km. 7 Serpong, Tangerang.

2.1 Field Observation

First, a survey or field observation is conducted on the company willing to be the object of thesis research, and finally PT Surya Toto Indonesia Tbk is willing to be the object of research. This field observation stage includes activities such as discussing with supervisors from the company to ask permission in doing thesis activities and also placement of divisions in accordance with company regulations to the author to do thesis activities at the company PT Surya Toto Indonesia Tbk.

2.2 Identification of Problems

After conducting field observations, the next step is to make observations to find and identify problems that are happening in the company. This stage includes interviews with supervisors from the company as well as guidance lecturers from BINUS University that have been determined. In the research activities, it can be stated that the problems that have been identified in this research activity are related to the problems found in the supply chain at PT Surya Toto Indonesia Tbk, so that the right method is needed to fix the problem.

2.3 Literature Study

After the problems in the company PT Surya Toto Indonesia Tbk have been identified, the next step is to study the literature which is a study of literature from various sources such as articles, journals and books (both physically and e-books) related to the problems that have been identified. Previously to be the object of research. Because in this research activity the problems that have been identified are related to the assessment of the company's supply chain, so the information learned in library studies must relate to supply chains or supply chains, supply chain management, Supply Chain Operations Reference (SCOR), and the normalization process.

2.4 Data Collection

After conducting a literature study, then collecting data related to problems that have been identified previously based on a literature study that has been done. The instruments in this data collection stage were carried out by distributing questionnaires to employees of the main divisions at PT Surya Toto Indonesia Tbk such as Production Planning and Inventory Control (PPIC), Procurement, Technical, Production, and Quality Assurance, and conducting interviews with managers and supervisor at PT Surya Toto Indonesia Tbk. The data collected are primary data and secondary data, where primary data is ordering and purchasing raw material data from suppliers of PT Surya Toto Indonesia Tbk, product production data, product delivery data to consumers, claims data from consumers to PT Surya Toto Indonesia Tbk, and data on the cycle time of production planning, production, packaging, and product delivery where the data is taken from the period January 2017 to December 2017 while for secondary data is the financial statement data from PT Surya Toto Indonesia Tbk.

2.5 Data Processing

After the supporting data has been obtained, the next step is to process data related to the principles and methods that have been studied in the literature study stage. The method used is the SCOR Model 12.0 model to assess performance and find the weakest point of the supply chain at PT Surya Toto Indonesia Tbk. The first step is to determine the performance attributes and their metrics in SCOR Model 12.0 (reliability, responsiveness, and agility) in accordance with company conditions and weighting the selected attributes by distributing questionnaires to employees of PT Surya Toto Indonesia Tbk. Furthermore, the data sufficiency test, validity, and reliability of the questionnaire that has been distributed using the SPSS program is performed, after the test results state that the questionnaire has sufficient and valid and reliable data then further determines the importance weighting value of each SCOR attribute in the questionnaire (reliability, responsiveness, and agility). The next step is to determine the assessment of the main metrics of the three

attributes based on the results of data processing of the selected metric attributes. Also determined the worst and best value of the data that has been collected as a range to do the normalization calculation so that the assessment data made is more accurate. Then the normalization results are processed again using the importance weight value from the questionnaire that has been distributed previously to determine the performance score value of each main metric on the SCOR performance attributes (reliability, responsiveness, and agility). After an assessment of the performance, the score is obtained what attributes have a bad performance score. The poor performance score is then analyzed using the FMEA method and Fishbone diagram to find the main cause of the problem. After that, the Forecasting and MRP lot-sizing method is used to correct the poor performance scores.

2.6 Result & Discussion

Furthermore, a discussion and analysis of the results of data processing is carried out, such as the supply chain performance score and the lowest value on the performance score at PT Surya Toto Indonesia Tbk, the main cause of the problem that needs to be fixed based on the FMEA fishbone diagram of the lowest value in SCOR 12.0, proposed alternative solutions from loting sizing forecasting and MRP methods that are suitable for companies, as well as improving supply chain performance obtained based on proposed alternative solutions. At this stage, theories obtained from literature study are also used as a basis for discussing and analyzing alternative solutions proposed in this study.

2.7 Conclusion & Suggestion

After analyzing based on the related literature study, some conclusions can be summarized from the report of this research activity in accordance with the objectives and formulation of the problems identified earlier. In addition, advice is also given to companies related to the problems identified in this research activity so that it is hoped that they can help the company in the future if they want to apply the methods that have been made in this research report.

3. RESULT AND DISCUSSION

3.1 Supply Chain Performance Score Analysis

In evaluating supply chain performance at PT Surya Toto Indonesia Tbk by using the Supply Chain Operations Reference (SCOR) model, the attributes chosen to be assessed are first, out of the five attributes described by [9] in SCOR 12.0 namely reliability attributes, responsiveness, and agility. The attributes of reliability, responsiveness, and agility have the weight or importance of each related to how much influence each of these attributes on the overall supply chain performance at PT Surya Toto Indonesia Tbk. Therefore a questionnaire was distributed to each employee of PT Surya Toto Indonesia Tbk in the PPIC, procurement, quality assurance, technical, and production divisions that were directly related to the supply chain at PT Surya Toto Indonesia Tbk to get the weight of each attribute.

After obtaining the existing weights, an assessment of each SCOR attribute can be carried out and calculations for supply chain performance scores at PT Surya Toto Indonesia Tbk can be done, the following is the result of the calculation:

Table 1: PT Surya Toto Indonesia Tbk Supply Chain Performance Score

No	Code	SCOR Metrics	Weight	Performance Score
1	RL.1.1	Perfect Order Fulfillment (%)	0,3392	32,5670
2	RS.1.1	Order Fulfillment Cycle Time (day)	0,3316	23,5946
3	AG.1.1	Upside Supply Chain Adaptability (%)	0,1594	6,1719
4	AG.1.2	Downside Supply Chain Adaptability (%)	0,1698	9,2404
				71,5738

Based on the existing performance scores, it was found that the total performance score of the supply chain in PT Surya Toto Indonesia Tbk is worth 71.5738 which is included in the "Good" category, but the smallest performance score value is obtained from the SCOR metric of upside supply chain adaptability. The SCOR metric for upside supply chain adaptability consists of upside adaptability for source, make, and delivery. Furthermore, the performance scores of each SCOR metric upside adaptability for source, make, and delivery are searched using the same calculation, so the performance score for each SCOR metric is shown in the following table:

Table 2: Upside Supply Chain Adaptability Metrics Performance Score of PT Surya Toto Indonesia Tbk

No	Code	SCOR Metrics	Weight	Performance Score
1	AG.2.1	Upside Adaptability (Source) (%)	0,33	10,9581
2	AG.2.2	Upside Adaptability (Make) (%)	0,33	18,4080
3	AG.2.3	Upside Adaptability (Deliver) (%)	0,33	18,1246
				47,4908

After getting the performance score of each metric of upside supply chain adaptability, then the upside adaptability (source) metric is determined as an attribute that needs to be improved because it has the smallest score of performance score of 10.9581.

3.2 Fishbone Diagram Analysis and Failure Mode Effect Analysis (FMEA)

After known the attribute that has the lowest SCOR performance value at PT Surya Toto Indonesia Tbk, namely upside agility (source) or frequent sudden demand increases, it is necessary to find out more about the main causes that cause these problems. Fishbone diagrams or cause and effect diagrams are made to find out the main causes of problems seen from the aspects of man, machine, environment, material, and method.

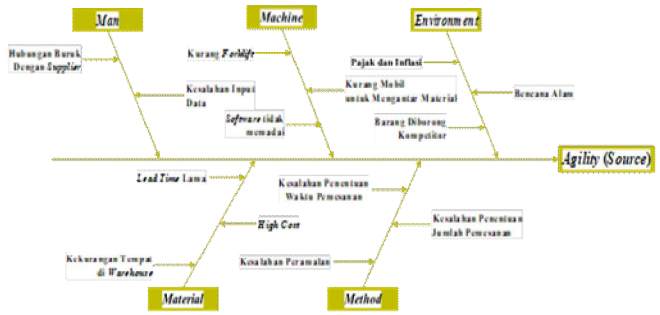

Figure 1: Fishbone Diagram

After the fishbone diagram was made and known several causes of the existing problems, it was decided to use the Failure Mode Effect Analysis (FMEA) method to narrow the causes of the problems so that it can be known which causes a need to be prioritized to be fixed. Each cause is given an assessment of the severity, occurrence, and detection values then calculated the Risk Score Value (RSV) and Risk Priority Number (RPN) and after that, a Pareto diagram is made.

In the calculation of the Pareto diagram, the data is first sorted from those that have the largest to the smallest RPN and RSV values, then the cumulative amount is calculated, and the cumulative percentage is sought. After obtaining the cumulative percent, it is known that the problem category has the cumulative percent closest to 80%. Following is the Pareto diagram for RPN and RSV:

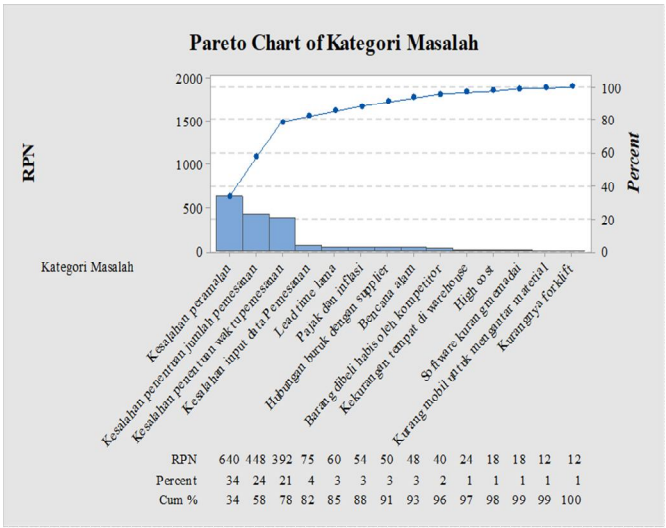

Figure 2: Pareto Chart RPN

For the RPN value, the cumulative percent closest to 80% is the problem category for determining the ordering time by 78% with an RPN value of 392.

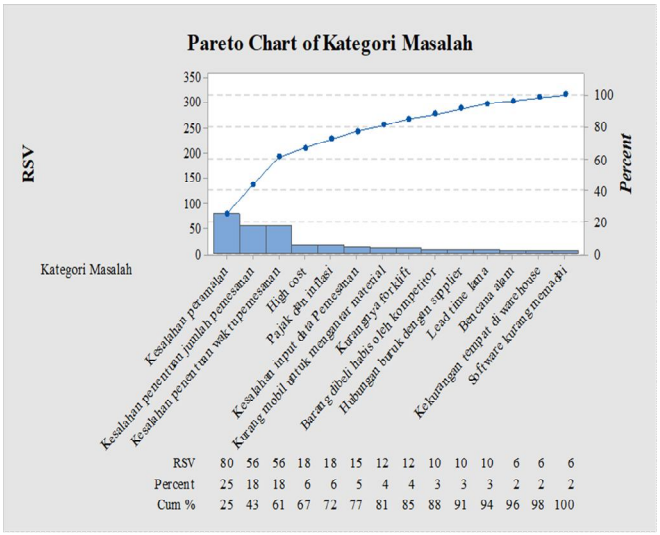

Figure 3: Pareto Chart RSV

For the RSV value, the cumulative percent closest to 80% is the problem of lacking cars to deliver material by 81% with an RSV value of 12. After knowing the two values based on the Pareto diagram, a scatterplot of the RPN and RSV values of each problem category, RPN and RSV values that are close to 80% will be used as a barrier to determine which problems need to be prioritized to be fixed on the scatterplot to be made. The results of scatterplots on RPN and RSV will be displayed in the following figure:

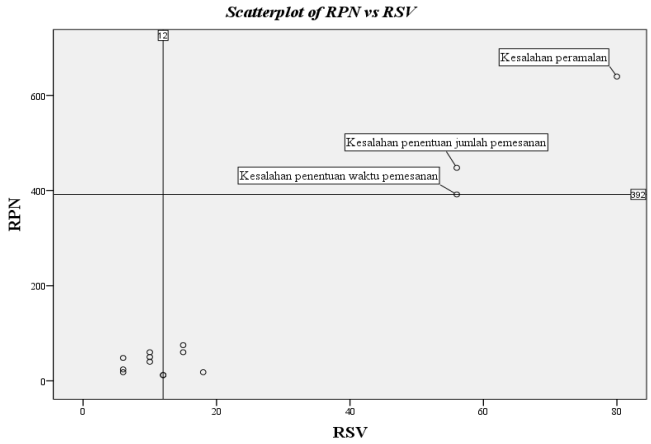

Figure 4: Scatterplot of RPN Vs RSV

There are 3 problems that need to be prioritized to be handled first, namely forecasting errors, errors in determining the number of orders, and errors in determining the time of the order. Then do the mitigation strategy by making forecasting and making a new raw material ordering system with the lot-sizing MRP method.

3.3 Forecast Analysis

Based on historical data on the use of raw materials at PT Surya Toto Indonesia Tbk in the period of January 2016 to May 2018, it can be made the results of forecasting the use of raw materials every month. First of all graphs are made from

the data of the use of these raw materials to see whether the data has trends or seasonality. The following is a graph of historical data on the use of these 3 raw materials:

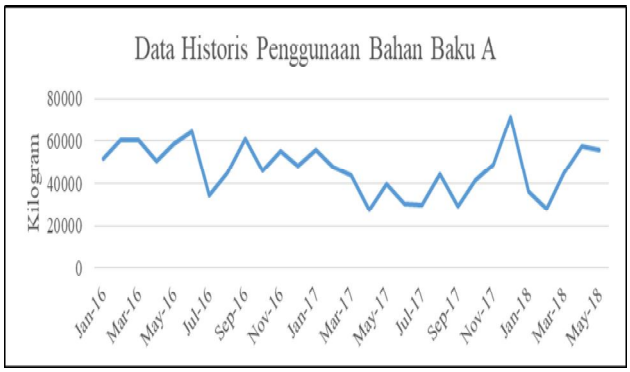

Figure 5: Historical Data of the Use of Raw Materials A

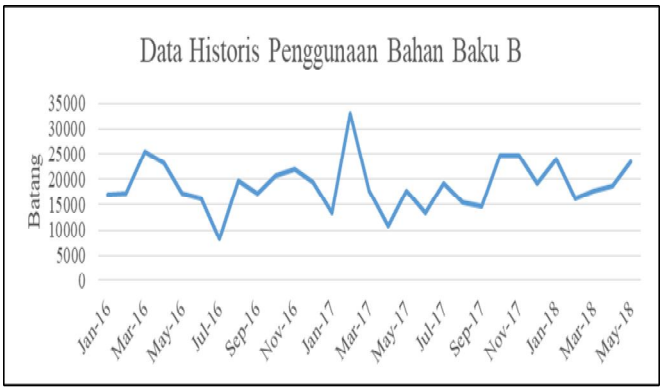

Figure 6: Historical Data of the Use of Raw Materials B

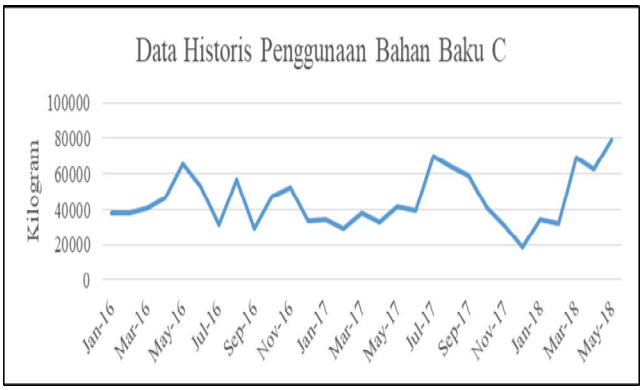

Figure 7: Historical Data of the Use of Raw Materials C

Based on the three graphs above, it can be seen that the use of raw materials A, B, and C do not have a trend or seasonality, due to the absence of repeated increases or decreases periodically, or the absence of changes in the pattern of gradual increase or decrease from raw material usage data which exists. Therefore the data is considered to be stationary and the forecasting method chosen is the moving average method 2 to the moving average 6.

Furthermore, the comparison of the error rate per period between the alternative solutions of the proposed moving average forecasting method (moving average 2 & 3) with the error rate of each period with the forecasting method used by the company now is the moving average method 6 for the three raw materials used. The results of the comparison of error rates can be seen in the following table:

Table 3: Comparison of Error Forecasting Value

	Raw Material A (%)	Raw Material B (%)	Raw Material C (%)
Moving Average 2	25,69	**30,14**	29,53
Moving Average 3	**19,03**	36,21	**28,36**
Moving Average 4	34,85	40,31	45,37
Moving Average 5	36,83	38,92	46,35
Moving Average 6	38,55	40,49	46,98

From this comparison, the method which has the smallest MAPE error percentage was chosen. For this research report, alternative solutions for companies can be proposed, namely by using the moving average method 3 for raw material A and raw material C, and the moving average method 2 for raw material B. Forecasting data can be used to make further planning.

3.4 Material Requirement Planning (MRP) Analysis

To avoid the lack or excess of raw materials in the inventory needed a plan to manage the inventory of raw materials, one of which is Material Requirement Planning (MRP). MRP is a method that considers the planning of production scheduling and inventory control in inventory such as final products and raw materials (raw materials) for production [10]. There are several lot-sizing techniques in MRP, lot-sizing in question is an adjustment of how much inventory quantity must be ordered in a certain period. Some MRP lot-sizing techniques used in this Final Project are Lot-for-Lot (LFL), Economic Order Quantity (EOQ), Period Order Quantity (POQ), Silver-Meal Heuristic, Least Unit Cost (LUC), and Part Period Balancing (PPB). The results of forecasting are then included in the gross requirements of the MRP system as a monthly demand projection during the 2017 period. All of the lot-sizing techniques are then calculated for the total order and storage costs to be compared with the costs incurred in the company's current conditions. The following is an example of the calculation of MRP Lot-Sizing Part Period Balancing for raw material A:

Table 4: Calculation Results of Total Cost and MRP Lot-Sizing PPB of Raw Materials A

Order Policy	*Part Period Balancing*						*Safety Stock*		12216,08					
Lead Time	1						*Lot Size*		25					
Periode 2017	***Past***	**Jan**	**Feb**	**Mar**	**Apr**	**Mei**	**Jun**	**Jul**	**Ags**	**Sep**	**Okt**	**Nov**	**Des**	
Gross requirements		49979	53330	50825	49252	39814	37069	32529	33219	34749	34464	38282	39855	
Scheduled receipts														
Projected on hand 1		12237,08	-41092,92	61507,08	12255,08	-27558,92	44797,08	12268,08	-20950,92	46750,08	12286,08	-25995,92	12299,08	
Net requirements		0	53389	0	0	39775	0	0	33167	0	0	38212	0	
Planned order receipts			153425			109425			102450			78150		
Planned order releases		153425			109425			102450			78150			
Projected on hand 2	62216,08	12237,08	112332,08	61507,08	12255,08	81866,08	44797,08	12268,08	81499,08	46750,08	12286,08	52154,08	12299,08	**EPP** 146528,2
Biaya Pemesanan	Rp 12.400.000,00													
Biaya Penyimpanan	Rp 11.472.047,43													
Total Biaya	Rp 23.872.047,43													
K	Rp 3.100.000,00													
h	Rp 21,16													

	P1			P4			P7			P10		
PP1	0	0		0	0		0	0		0	0	
PP2	53330	53330		39814	39814		33219	33219		38282	38282	
PP3	101650	154980		74138	113952		69498	102717		79710	117992	
PP4	147756	302736	0	97587	211539	0	103392	206109	0			

3.5 Cost Comparison Analysis

All lot-sizing techniques that have been used are then calculated the total costs of ordering and storage costs to be compared with the costs incurred in the actual conditions of the company now. After it is known that the costs incurred in the current conditions with the costs incurred using different lot-sizing techniques in the MRP can be compared which costs have smaller values. The cost of the lot-sizing MRP technique for the three raw materials (A, B, and C) will be shown in the following table:

Table 5: Comparison of Total Costs with MRP Lot-Sizing of Three Raw Materials

Types of Raw Materials	Lot-for-Lot	Economic Order Quantity	Period Order Quantity
A	IDR. 40.304.185	IDR. 32.920.681	**IDR. 23.872.047**
B	IDR. 45.092.159	IDR. 30.453.343	**IDR. 28.625.581**
C	IDR. 47.648.075	IDR. 36.646.995	**IDR. 32.651.283**
Types of Raw Materials	**Silver-Meal Heuristic**	**Least Unit Cost**	**Part Period Balancing**
A	IDR. 26.771.591	IDR. 24.975.417	**IDR. 23.872.047**
B	IDR. 31.060.721	IDR. 31.000.564	**IDR. 28.625.581**
C	IDR. 34.331.343	IDR. 35.751.283	**IDR. 32.651.283**

After choosing the lowest total cost of several types of lot-sizing MRP techniques, namely the MRP lot-sizing Period Order Quantity (POQ) and Part Period Balancing (PPB) techniques for the three raw materials, then it is compared with the company's actual costs and the decrease difference is sought. The results of the comparison and the difference in cost will be displayed in the following table:

Table 6: Comparison of Lot-Sizing MRP Costs with Company Actual Costs

Types of Raw Materials	Lowest Lot-Sizing MRP Type	Lowest Lot-Sizing MRP Cost	Company Actual Costs	Cost Reduction Difference	Percentage of Cost Reduction
A	POQ & PPB	IDR. 23.872.047	IDR. 52.662.362	IDR. 28.790.315	54,6696%
B	POQ & PPB	IDR. 28.625.581	IDR. 56.501.390	IDR. 27.875.809	49,3365%
C	POQ & PPB	IDR. 32.651.283	IDR. 59.865.340	IDR. 27.214.056	45,4588%

3.6 SCOR Performance Analysis after Repair

By making improvements in the form of designing a new raw material ordering system using the MRP lot-sizing method, the supply chain performance value calculation is performed using the SCOR method again. The calculation of the value of supply chain performance that has just taken data from the planned order release calculation results using the MRP lot-sizing method with the lowest cost, namely MRP lot-sizing and MRP lot-sizing PPB, which will be displayed in the following table:

Table 7: SCOR Performance Calculation after Repair

No	Code	SCOR Metrics	Weight	Performance Score
1	RL.1.1	Perfect Order Fulfillment (%)	0,3392	32,5670
2	RS.1.1	Order Fulfillment Cycle Time (day)	0,3316	23,5946
3	AG.1.1	Upside Supply Chain Adaptability (%)	0,1594	8,7598
4	AG.1.2	Downside Supply Chain Adaptability (%)	0,1698	8,7137
				73,6350

Initially, improvements using the MRP lot-sizing method were aimed at aspects that had the lowest performance scores, namely upside supply chain adaptability due to instability of ordering raw materials which often experienced a sudden increase in the number of messages. After improvement, the performance score for upside supply chain adaptability increased significantly by 16.23% from the value of 38.71% to 54.95%. The increase in value is because that the new raw material ordering system is more stable and follows the existing demand so that there is no excessive or insufficient ordering. In the end, PT Surya Toto Indonesia Tbk's supply chain performance score overall increased by 2.0612 from 71.5738 to 73.6350.

The increase in the value of the supply chain performance showed an increase in supply chain performance at PT Surya Toto Indonesia Tbk which affected several things, one of which was the reduction in total costs incurred for inventory costs and ordering of the three raw materials by 49.8216% (IDR. 83,880,180,91) from the company's total actual costs of IDR. 169,029,093.33 to IDR. 85,148,912.42 if using lot-sizing MRP.

4. CONCLUSION AND SUGGESTION

4.1 Conclusion

Based on the results of the analysis and discussion of the data that has been processed using related methods, then can be concluded that:

1. Factors that affect supply chain performance are determined using the Supply Chain Operation Reference 12.0 Method. It is known that the factors that affect supply chain performance at PT Surya Toto Indonesia Tbk are reliability attributes which have the main metrics of perfect order fulfillment, responsiveness attributes that have main metrics of order fulfillment cycle time, and agility attributes that have the main metrics of upside supply chain adaptability, and downside supply chain adaptability which has a weighting of each that determines the magnitude of influence on supply chain performance at PT Surya Toto Indonesia Tbk.
2. After an assessment of supply chain performance of PT Surya Toto Indonesia Tbk using SCOR 12.0 Method, obtained supply chain performance values of 71.5738 out of 100. For the attributes of reliability and responsiveness already have good values, but the lowest value is found in the upside metric supply chain adaptability of the agility attribute. Therefore to

improve the supply chain performance of PT Surya Toto Indonesia Tbk, it is sought to find out the cause of the problem on these factors and make improvements. There are known problems with the unstable raw material ordering system. Therefore, an alternative solution proposed to fix the problem is to create a system of forecasting needs and ordering new raw materials. The forecasting method chosen is the moving average 2 for raw materials B and the moving average 3 for raw materials A and C. The selected raw material ordering method is MRP lot-sizing Period Order Quantity (POQ) and Part Period Balancing (PPB) for all three types raw materials A, B, and C. Based on these improvements, an increase in supply chain performance scores of 2.0612 to 73.6350 causes a decrease in costs by 49.8216% in total for the cost of ordering and inventory of raw materials.

4.2 Suggestion

Suggestions that the author can give to the Company related to this Final Project report are as follows:

1. Companies are advised to conduct supply chain performance appraisal regularly so that they can detect if there are problems in the work process and can always make continuous improvement.
2. Companies must be more detailed in recording historical data on raw material requirements to facilitate the application of forecasting methods and MRP lot-sizing POQ and PPB.

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