

Supply Chain Performance Measurement with Supply Chain Operation References Approach (a Case Study in a Batik Company)

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Abstract

In carrying out the business activities especially in procurement process, CV. PT experienced some problems, such as incompatibility the material specifications and broken stitches on cloth. This problem causes a decrease of company productivity. Therefore, an evaluation of supply chain performance is needed in order to identify problem indicators, and determine improvement strategies for problem indicators. In this study, the measurement of the company supply chain performance is using the Supply Chain Operation Reference (SCOR) approach. The initial hierarchy model of performance measurement is adjusted to the condition of the company to measure supply chain performance using KPI performance indicators. A Snorm De Boer then is utilized to serves and equalize the matrix values derived from company annual data. The final stage in this study is measuring the importance of performance indicators using pairwise comparison weighting. The results obtained in this study are the total supply chain performance of CV. PT is 69.983 included in the average category. There are several performance indicators included in the average and marginal categories, so it needs to be improved. The improvement is given based on the practices in SCOR 12.0.

Keywords

Supply Chain, Procurement, Batik.

1. Introduction

The development of the industrial world which is increasingly fast challenging between companies is also increasingly stringent. In the past few years, excellence in supply optimization and integration has become the focus of several large corporate organizations in the world. The increasingly fierce business competition in this era of globalization requires every effort to rearrange its business strategies and challenges. The essence of competition discusses how companies implement processes in producing products that are better, cheaper and faster than produced (Amit and Zott 2010).

The high business competition is one of the reasons companies must fulfil customer orders in the right amount and time. It is intended that the company can control the market share in the community. This condition shows the importance of improving performance, not only within a company but also other parties in the supply chain involved, in order to compete with other companies or supply chains.

Performance measurement is very important because it can control the system both directly and indirectly. Performance measurement serves to keep the company on track to achieve supply chain goals. In the context of supply chain management, performance measurement is very important to support the success of a supply chain management. The concept of supply chain management is able to integrate the management of various management functions in a relationship between organizations forming an integrated and mutually supportive system (Mutakin 2011).

CV. PT is one of the batik industries that located in Solo, Central Java. In carrying out its business activities, this CV has problems starting from the procurement process to the production process which will affect the quality of batik. In the process of procurement, CV has many problems, which is the incompatibility of the specifications of the material sent, such as the incompatibility of the load of the dye drug, causing the resulting a dull colour. Another

problem is the breaking of the stitches in the cloth so that if the cloth is processed it will cause holes. This has an effect on increasing production process time and decreasing production quality.

CV. PT needs to measure supply chain performance to be able to evaluate the entire supply chain so that it can improve supply chain performance and reduce problems in the supply chain. To find out the performance of a company's supply chain, a measurement of supply chain performance is needed, one of which is the Supply Chain Operation Reference (SCOR) method. The SCOR model is a method that can represent the situation in the company. Recently studies using SCOR are implemented in many fields (Wigaringtyas 2013; Immawan and Pratama 2016; Saleh et al. 2016; Immawan et al. 2015; Immawan et al. 2015; Lee et al. 2012; Erkan and BAC 2011; Golparyar and Seifbarghy 2009; Georgise et al. 2012; Hwang et al. 2014; Wayyum et al. 2010; Zhou et al. 2011; Persson et al. 2010; Lestari et al. 2014; Kasi 2005; Hwang et al. 2014; Giannakis 2011; David et al. 2018).

SCOR provides supply chain valuation indicators which are presented in performance metrics. These metrics will be weighted using the Analytical Hierarchy Process (AHP) method to determine the level of importance by comparing the scores contained in each of these indicators, which indicators can be evaluated for improvement. The next step is to propose steps that are useful for recommendations for the company in achieving its performance goals and providing direction for the company for the strategic design process.

2. Methods

The questionnaire used in this study consisted of 3 questionnaires, namely the KPI validation questionnaire, the score determination questionnaire, and the weighting questionnaire. The KPI validation questionnaire is used to identify supply chain KPIs that the company needs. The questionnaire respondents consisted of 6 people consisting of the main director, to the production sector, the head of the procurement field, the staff of the production field, the staff of the procurement field and the shipping staff. KPI validation is done by finding the average of each indicator, if the average is more than 4, it means that the indicator is validated, if below 4, the indicator does not pass validation and is eliminated. Questionnaire indicators are derived from the Supply Chain Reference (SCOR) 12.0 reference model which combines three elements, namely business process reengineering, benchmarking and process measurement into a cross-functional framework in the supply chain (Pujawan and Mahendrawathi 2010). The SCOR model divides supply chain processes into 5 core processes namely plan, source, make, deliver and return. This model is able to describe and provide a basis for supply chain improvement for global projects as well as site-specific projects

This model also provides performance attributes and supply chain measurement metrics. Performance Attributes are a grouping of metrics used to express strategies (Paul 2014). In the SCOR model, there are five performance attributes that can be measured, namely reliability, responsiveness, agility, costs, and assets management.

Furthermore, the validated KPIs are calculated using the company's annual data and normalized using Snorm De Boer, which is:

Larger is Better:

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

Lower is Better:

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

Si = The actual indicator value that was successfully achieved

Smin = The worst performance achievement value of the performance indicators

Smax = The value of achieving the best performance of performance indicators

In this measurement, each indicator weight is converted into certain value intervals, namely 0 to 100, zero (0) is the worst and one hundred (100) is best interpreted (Vanany et al. 2005). Table 1 shows the system monitoring performance indicators. The third questionnaire is a paired comparison questionnaire. This questionnaire was used to determine the weight of each KPI indicator. Respondents to this questionnaire are Top Management who are considered experts, then this weight will be processed using the AHP method (Saaty 2008; Kusriani 2007).

Table 1. Performance indicator monitoring system.

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

The final stage is the calculation of the total supply chain performance by multiplying scores by performance weights. Then each indicator will be monitored using a monitoring table. Indicators that are categorized as average and marginal will be implemented to improve strategies.

3. Result and Discussion

3.1. Supply Chain Process

This study assesses the process of plan, source, make, deliver, and return on the CV. PT. The plan process includes the entire process of planning and controlling raw material inventory. The planning process starts at the production department, then the planning data is distributed to the procurement and financial departments to match the material requirements and budget for the production process.

The source process in this research includes the process of procuring the main material, namely more fabric supplied from P and S, as well as colour dyes from TS, MJ, WT and DS as well as suppliers of supporting raw materials. The procurement process includes scheduling delivery from suppliers, receiving and checking raw materials sent by suppliers.

The make process in this research includes 4 stages, namely the process of patterning, sticking wax using a stamp, colouring, and “ngelod”. The next activity after production of the batik cloth is finished is the quality control of the production division. Batik fabric that does not pass the test will be improved by manually making batik, while batik that has passed the test is sent to the finished warehouse. The batik cloth will then be the responsibility of the store and shipping division and will then be sent to the customer or retailer. Figure 1 shows the company's business processes.

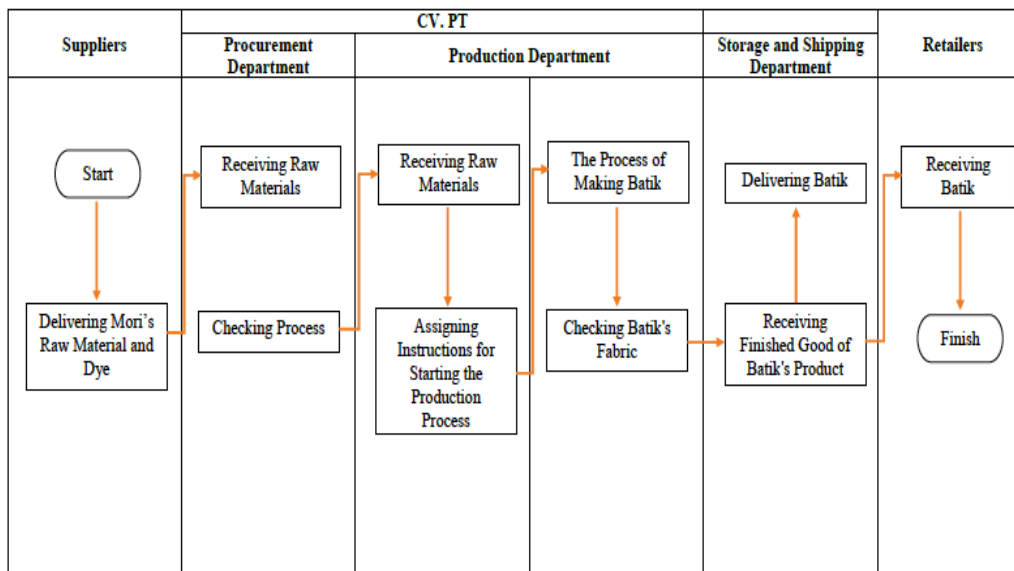


Figure 1. Business process of CV. PT.

3.2. Validated Key Performance Indicator (KPI)

Of the 38 KPIs that have been filled by 6 respondents through the KPI validation questionnaire, 25 valid KPIs were obtained and 13 KPIs were not validated and had to be deleted.

3.3. Hierarchy of SCOR

Supply chain hierarchy of CV. PT is shown in Figure 2. This hierarchy will affect the weighting of each metric. Weight at each level is part of the weight at the previous level. The validated KPI is then searched for the maximum value, minimum value, and actual value by using a weighting questionnaire. This value is obtained from the annual report of CV. PT. The three values are then normalized using Snorm De Boer to equalize the different unit parameters of each metric and get a score for each metric. The next step is weighting through a pairwise comparison questionnaire. This questionnaire was filled in by the deputy director, head of procurement and head of production. The weighting process is carried out in 3 stages namely process weighting, process attributes and metrics. Each value from the three experts is calculated using the Geometric Mean formula to obtain the weight of each metric, and then the local weight and global weight are calculated. After finding the local weights of each metric, a performance assessment is performed by multiplying each score and the weight of each metric. The results of data processing carried out obtained the total supply chain performance of CV. PT is 69.983 which is included in the average criteria.

Based on the results of data processing, there are several metrics that need improvement. There are 4 metrics that are classified as marginal namely the accuracy of shipping documentation and perfect conditions in the source process as well as the accuracy of shipping documentation, perfect conditions and procurement cycle time. in the delivery process. There are 7 metrics that are classified as average, namely raw material delivery cycle time in the source process, production cycle time, productivity, delivery performance on the specified date, finish goods delivery cycle time and current warehouse PO cycle time. Each of the metrics that are still of marginal and average value is then analysed to find the causes of the problem and provide some suggestions for improvement.

In previous studies using SCOR version 10.0 by Wahyuniardi et al. (2017) there were significant differences with SCOR version 12.0. SCOR version 10.0 has no sub-attributes while SCOR version 12.0 has been updated with sub-attributes. This causes difficulties for recommendation formulation based on the results of research using SCOR 10.0 because it is limited and does not relate to the metrics in the performance attributes. Besides, there is no information which metrics can be used to see improvements.

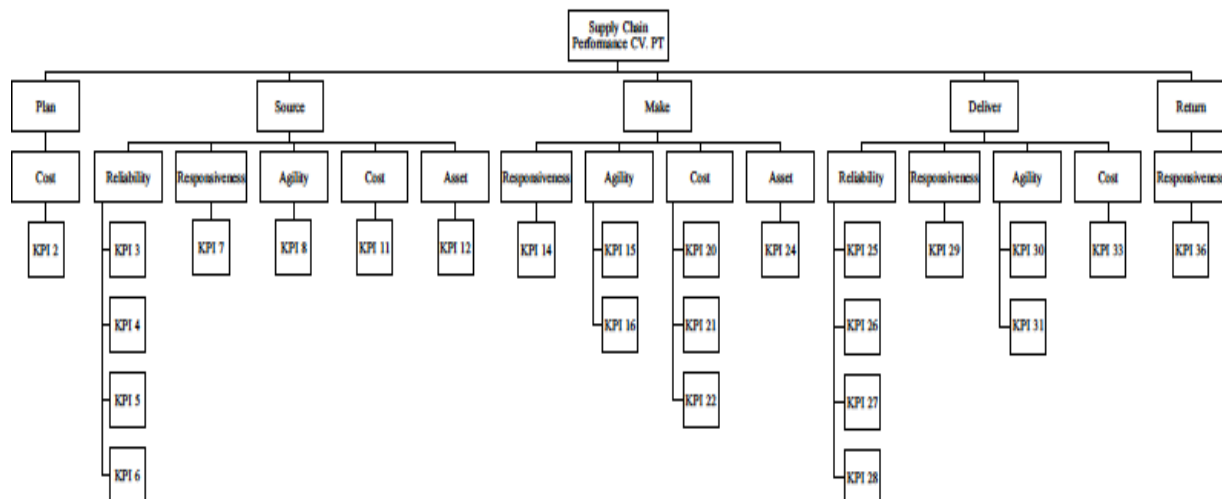


Figure 2. Supply chain hierarchy of CV. PT.

3.4. Monitoring of Performance Indicator

The results of performance monitoring of CV. PT are shown in Appendix A (Table A1).

3.5. AHP

The AHP method in this study is used to determine the importance weight of each variable and the relevant attributes in evaluating the supply chain performance of CV. PT. The data collected is the result of a paired comparison questionnaire consisting of 3 stages, namely comparison between criteria, comparison of criteria with attributes, and comparison of metrics by metrics.

Based on the data collection and processing stages carried out, there are 5 core process criteria, namely plan, source, make, deliver, and return. These criteria are then compared in pairs using a questionnaire filled out by Top Management. The results of the questionnaire were then calculated for the geometric mean to average the results of the questionnaires from the three experts. The weight calculation results obtained by global criteria weights are plan criteria have a weight of 0.201, source criteria have a weight of 0.247, make criteria have a weight of 0.247, the delivery criteria have a weight of 0.059 and the return criteria have a weight of 0.046. The total weight of the five criteria is 1. Priority level of supply chain criteria of CV. PT is shown in Figure 3.

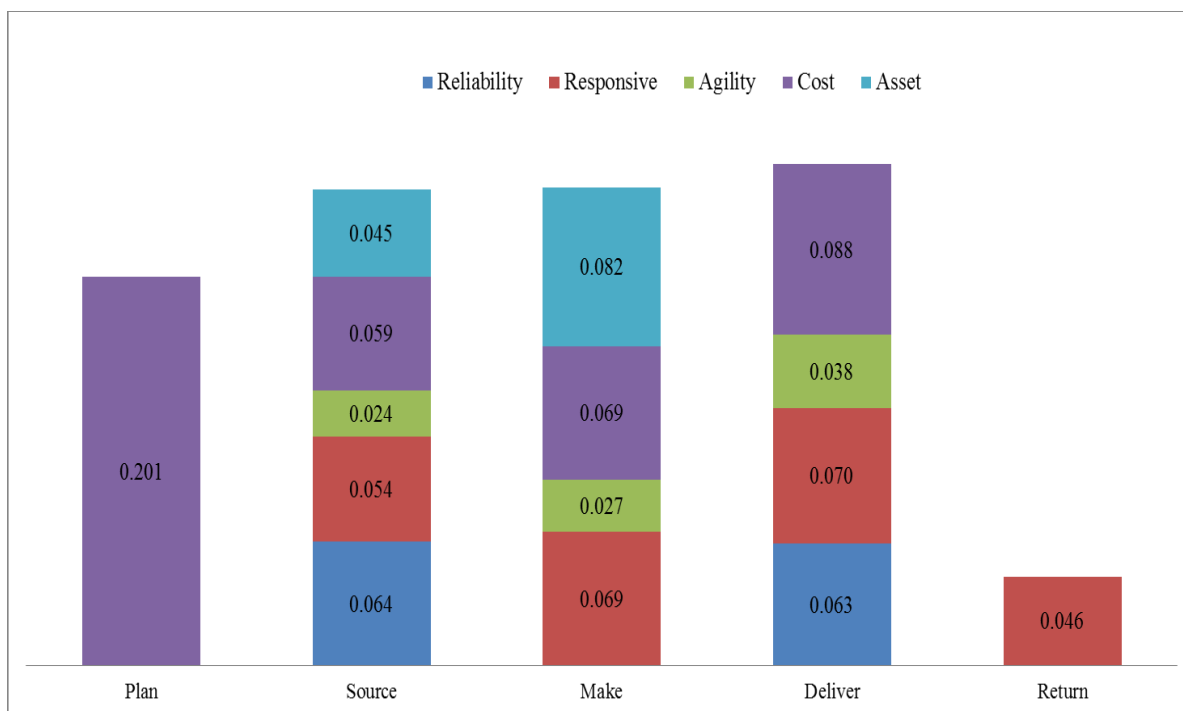


Figure 3. Priority level criteria.

In the Figure 3, it can be seen clearly the priority weighting of the successive supply chain core process criteria, namely deliver, source, make, plan, and return with the priority of each attribute. Based on priority criteria, the delivery criteria have the highest level of importance and the return criteria have the lowest level of importance in the supply chain process of CV. PT.

3.6. Proposed Improvement of Performance Indicators

Based on the results of research that has been conducted, it is obtained 11 performance indicators that require improvement. These performance indicators are shown in Table 2.

Problematic indicators are in the process of source, make, deliver, and return as well as the attributes of reliability, responsiveness, and agility. The biggest problems are with the accuracy of the documentation metrics and cycle times. This causes the low value of the company's performance so it needs to be improved to the metrics that are in the marginal and average categories. In Appendix B (Table B1), a number of recommended strategies for problems are given so that it is expected to improve company performance better.

The main raw materials for making batik are fabric, wax, dye, so the main supplier of the batik industry is the provider of these materials. Purwaningsih et al. (2016) has mapped the relationship between the batik industry and suppliers, waste management, and buyers, both individuals and organizations. In addition to discussing supply chain performance, evaluating suppliers is also important to get suppliers that are reliable, responsive and provide good prices and products.

SCOR version 11 published by APICS, Likumahwa et al. (2019) explains about metrics, processes, how to practice SCOR and organizational arrangement or people, in the last chapter SCOR accommodates environmental issues by discussing green SCOR. Conceptually, several model tests have proven that Green Supply Chain management has an influence on the Company Performance and Competitiveness (Likumahwa et al. 2019). Further research can be developed to see SCM batik with the Green Supply chain approach considering that batik also has environmental impacts that need to be considered in maintaining the sustainability of the batik industry.

Table 2. Performance indicators that need improvement.

Process	Attributes	Metric	Score	Information
Source	Reliability	Accuracy of Shipping Raw Material Documentation	50.00	Marginal
		Perfect Condition	50.00	Marginal
	Responsiveness	Raw Material Delivery Cycle Time	63.64	Average
Make	Responsiveness	Production Cycle Time	64.29	Average
	Agility	Productivity - units / orders per equivalent to full-time work hours	65.00	Average
Deliver	Reliability	Delivery Performance on Customer's Date	60.00	Average
		Accuracy of Documentation	50.00	Marginal
		Perfect Condition	50.00	Marginal
	Responsiveness	Delivery Cycle Time for Finished Goods	63.64	Average
		PO Time Cycle Purpose Current Destination	63.64	Average
Return	Responsiveness	Procurement Cycle Time	56.25	Average

4. Conclusion

Based on the results of the research that has been carried out, it can be concluded that it is obtained the 38 KPI in supply chain process (25 KPI validated and 13 KPI not validated). For a total of 25 validated KPIs, a scoring process was conducted using a score determination questionnaire. Determination of the score is performed by normalizing the annual data of CV. PT. After the scoring process, weight determination is carried out using a weighting questionnaire. From the results of these three questionnaires, it is obtained the total value of the supply chain performance CV. PT amounted to 69.983 (Average category).

After an evaluation of 25 supply chain KPIs CV. PT, there are 11 KPIs that are still in average and marginal conditions. In this case, 11 KPIs have not yet reached a reasonably good condition. This happens because there is no mature planning process in the procurement and production process and lack of coordination with suppliers.

Based on the results of research conducted the biggest problem experienced by CV. PT is the unstructured coordination between suppliers and companies and companies with customers. Therefore, the recommendation strategy given in this research is Flexible Supply Base, Supply Network Optimization, Manufacturing Planning and Scheduling, Distribution Planning, Safety Stock.

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Appendix A

Table A1. Performance monitoring.

No	Process	Attributes	Metric		KPI	Unit	Score	Information
			Level 1	Level 2				
	Plan	Cost	Total Supply Chain Management Cost	Core Process Planning Costs	2	IDR	77.78	Lower is Better
	Source	Reliability	Perfect Order Fulfilment (POF)	Fulfilment of Raw Materials	3	%	80.00	Large is Better
				Delivery Performance on a Specified Date	4	%	80.00	Large is Better
				Accuracy of Shipping Raw Material Documentation	5	%	50.00	Large is Better
				Perfect Condition	6	%	50.00	Large is Better
		Responsiveness	Order Fulfilment Cycle Time (OFCT)	Raw Material Delivery Cycle Time	7	Day	63.64	Lower is Better
		Agility	Upside Supply Chain Adaptability	Current Procurement Volume	8	Yard	71.43	Large is Better
		Cost	Total Supply Chain Management Cost	Procurement Costs	11	IDR	76.85	Lower is Better
		Asset	Cash – to – Cash Cycle Time	Number of Days to Supply Raw Materials	12	Day	71.43	Lower is Better
	Make	Responsiveness	Order Fulfilment Cycle Time (OFCT)	Production Cycle Time	14	Day	64.29	Lower is Better
		Agility	Upside Supply Chain Adaptability	Production Volume	15	Yard	75.00	Large is Better

Table A1. Performance monitoring. (Cont.)

No	Process	Attributes	Metric		KPI	Unit	Score	Information
			Level 1	Level 2				
				Productivity - units / orders per equivalent to full-time work hours	16	%	65.00	Large is Better
		Cost	Total Supply Chain Management Cost	Production cost	20	IDR	78.84	Lower is Better
			Cost of Goods Sold	Direct Labour Costs	21	IDR	76.92	Lower is Better
				Material Costs	22	IDR	76.78	Lower is Better
		Asset	Return on Working Capital	Cost of goods sold	24	IDR	71.43	Loer is Better
	Deliver	Reliability	Perfect Order Fulfilment (POF)	% Orders Sent	25	%	80.00	Large is Better
				Delivery Performance on Customer's Date	26	%	60.00	Large is Better
				Accuracy of Finished Good Shipping Documentation	27	%	50.00	Large is Better
				Perfect Condition	28	%	50.00	Large is Better
		Responsiveness	Order Fulfilment Cycle Time (OFCT)	Delivery Cycle Time for Finished Goods	29	Day	63.64	Lower is Better
		Agility	Upside Supply Chain Adaptability	Current Volume of Finished Goods Delivery	30	Yard	75.00	Large is Better
				PO Time Cycle Purpose Current Destination	31	Day	63.64	Lower is Better
		Cost	Total Supply Chain Management Cost	Shipping costs	33	IDR	70.59	Lower is Better
	Return	Responsiveness	Order Fulfilment Cycle Time (OFCT)	Return Procurement Cycle Time	36	Day	56.25	Lower is Better

Appendix B

Table B1. Analysis of performance indicators and recommendation strategies.

	Attributes	Problem	Strategic	Explanation
1	Reliability	<ul style="list-style-type: none"> ● Accuracy in Documentation of Delivery of Raw Materials ● Perfect Condition 	Flexible Supply Base	It can mitigate the agent's risk of sudden demand because it can easily change suppliers who are able to meet urgent requests.
2	Responsiveness	<ul style="list-style-type: none"> ● Raw Material Delivery Cycle Time ● Finished Goods Delivery Cycle Times ● Current Destination PO Cycle Cycle Time 	Supply Network Optimization	Mismatched delivery schedules result in overstock / shortage in the warehouse. Because it is necessary to coordinate certainty the delivery schedule and schedule of receipt of raw materials for each delivery period.
3	Responsiveness Agility	<ul style="list-style-type: none"> ● Production Cycle Time ● Productivity - units / orders per equivalent to full-time work hours 	Manufacturing Planning and Scheduling	Make detailed planning of the production process, consider the factors that cause the production process to be longer such as weather conditions and make allowance for production time in accordance with the conditions, as well as efforts to increase productivity by eliminating process wastage in all forms.
4	Reliability	<ul style="list-style-type: none"> ● Delivery Performance on Customer's Date, ● Accuracy of Documentation ● Finished Good Shipping, ● Perfect Condition, 	Distribution Planning	Demand-oriented distribution planning by taking into account the production gap and demand needs so that synchronization occurs between the demand for batik and batik production.
5	Responsiveness	<ul style="list-style-type: none"> ● Return Procurement Cycle Times 	Safety Stock	Additional supplies are held to protect or maintain the possibility of a shortage of material (Stock Out) so that the production process can continue without having to wait for the return of raw materials.