Design of Supply Chain Management Improvement Based on Maturity Level Measurement (Case study Company X)

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Abstract. Nowadays, supply chain is not only a part of a company, but also an advantage that might be used to increase customers' satisfaction and loyalty. The capability of supply chain management to fulfill this need to be evaluated and this can be done by measuring its supply chain maturity. The object of this research is Company X. The method used is the supply chain maturity model from Lockamy & McCormack (2004), which is based on four core business processes in supply chain, such as procurement, production, distribution, and planning, and maturity will be categorized starting from level 1 to level 5. Based on the measurements, the procurement, production, distribution, and planning business processes are still at level 2 and hence the overall maturity is at 2 *(defined).*With this result, Company X needs some improvements, and the proposed improvements are in the design of information system and performance measurement.

Keywords: Maturity assessment, Maturity level, Supply chain management, Supply chain maturity, Supply chain maturity assessment

1 Introduction

Company X is a sugar processing production company that operates with a B2B (Business to Business) system and was established in 1980. Since 2012, PT X has continued to experience a decline in sales turnover, where the decline was mainly due to the decreasing number of customers. Based on data from the Customer Service Department of Company X, it can be identified that problems causing consumers to stop buying are quality and service problems, such as late delivery of goods and product defects.

Various problems in the supply chain are certainly quite detrimental to the company, especially in the face of an increasingly competitive market. Today, business is not only a matter of mere innovation, but also how to maintain customer loyalty by providing the best service. In this case, the supply chain plays a role as the main intermediary from goods produced to consumers.

The number of processes that are part of supply chain integration certainly allows for risks and disruptions to arise in various processes in the chain. Whereas disruption in one process can have a domino effect on other processes along the supply chain. One study supported this statement also found that 54% of companies acknowledged a decline in sales and 64%

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acknowledged a decrease in the level of service to consumers due to problems and disruptions that occurred in supply chain management [1].

Therefore, considering that supply chain management has a role in increasing competitive advantage and company performance, an evaluation is needed to measure the maturity of supply chain management. This research will evaluate and measure the maturity level of Company X as the object of the case study. The resulting maturity level can be used as a basis for designing improvements for future supply chain management and at the same time being able to increase the supply chain maturity level. By doing these, it is expected that the performance and capability of the supply chain will be improved and better in dealing with problems, risks, and competition.

2 Literature Review

Supply chain management is combination of various approaches that seek to efficiently integrate between the manufactures, warehouses, distributors, and suppliers so that the product can be distributed in the right quantity, at the right time, in the right location, and aims to minimize the total costs that may arise while still meeting the level of service to consumers [2]. The entities that form a supply chain are quite many and each entity should have a good performance in order that the supply chain will function to its best. One way to determine the condition of the supply chain's performance is to measure its maturity. In this case, maturity is defined as the level of capability possessed in managing supply chain management and is based on certain criteria to be assessed. The higher the level of maturity that the company has, the better the capabilities, integration processes, and flows that occur in it [3].

There are several supply chain maturity models such as the one that developed by [4] called Operations Excellence Audit Scheme which is based on 6 attributes (control, process, resource, material, information, and organization) and 15 supporting competencies (customer satisfaction, leading technology, safety environment, visual management deployment, manufacturing planning and control system, order management, information system, layout and production flow, inventory and work in process levels, teamwork and motivation, equipment and maintenance, quick changeover, value chain integration, commonality of work, quality system deployment). Using these attributes and supporting competencies there are 6 levels of maturity, namely below average (level 2), average (level 3), above average (level 4), excellent (level 5), and best in class (level 6).

The Supply Chain Capability Maturity Model was proposed by [5] which is based on the Capability Maturity Model developed by Carnegie-Mellon University. This model is aimed to measure the maturity of an organization in integrating various functions and provide guidelines to improve the quality of the systems measured.

Another model is Supply Chain Capability Map developed by [6] which is based on *supply chain network strategic design, product and service enhancement, supply chain processes development, total network efficiency, supply chain network connectivity*. Results of measurement of 24 parameters can be categorized into each of the 5 maturity levels: *baseline*

(level 1), *functional integration* (level 2), *internal integration* (level 3), *external integration* (level 4), *cross-enterprise collaboration* (level 5).

The Lockamy & McCormack maturity model seeks to measure supply chain management maturity levels and helps provide an implementation roadmap for future improvements [7]. This model basically uses the basic concepts of SCOR (Supply Chain Operations Reference) and BPO (Business Process Orientation) standards. Basically, there are 2 main aspects measured in Lockamy & McCormack maturity model, namely the chassis and engine [8]. Chassis is an aspect that helps to achieve a higher level of management maturity and consists of process view, process structure, and process job attributes. While the engine is the aspect that controls the performance measure of supply chain management and consists of the attributes of process measurement and management system, best practice, and customer-focused process values and belief. The following is a further description of these attributes which will be used to measure the maturity level [8]:

- Process view: attributes related to documentation and job details in management.
- Process structure: attributes related to relationships and cooperation with other departments and third-party entities.
- Process job: attributes related to horizontal cooperative relationships and job division.
- Process measurement and management system: attributes related to performance measurement, both process and internal performance.
- Best practice: attributes related to methodologies or systems that can optimize work.
- Customer-focused process values and beliefs: attributes related to the considerations of third parties (consumers, suppliers, etc.) in making decisions, as well as what values exist in management.

According to [3] there are 5 maturity levels where each level has its own characteristics. For a complete list of the characteristics, see [3].

- Level 1 (Ad hoc): at this level the company is not able to manage its supply chain management properly. This level indicates the company is still lacking and needs a lot of improvements.
- Level 2 (Defined): at this level there are improvements in terms of defining the main business processes in the supply chain, although there are still many shortcomings at level 1 that have not been significantly improved.
- Level 3 or linked is a condition where the company begins to make significant breakthroughs in the management of its supply chain management, marked by significant improvements in terms of performance measures.
- Level 4 or integrated is a condition where there is a significant improvement in terms of control, regulation, and control in carrying out the main business processes in supply chain management.
- Level 5 or extended is a condition where the company has made significant improvements in optimizing its business processes. At this level, the company actually has a good competitive advantage in competing with its competitors.

The main differences or characteristics of the main improvement between one level to another in the maturity model of Lockamy & McCormack model can be seen in **Figure 1**.

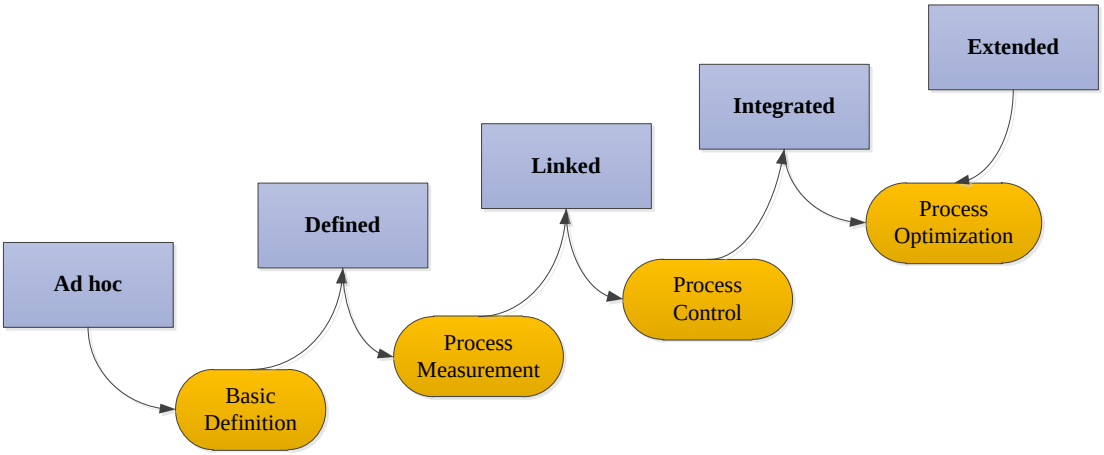

Fig. 1. Improvement characteristics of each maturity level [8]

In addition to the attributes to measure the maturity level [3] also mentioned that there are some drivers that can show capabilities in each process. The followings are the driving characteristics possessed in this model [3]:

- Predictability: this characteristic relates to the variance between the total cost achieved and the achievement of the desired target goal. The characteristics of supply chain management will be better if the target goal is achieved with the smallest total cost.
- Capability: this characteristic relates to supply chain management's ability to manage the main business processes in the supply chain. This characteristic will be even better if it is marked by the emergence of individual management capabilities and collaborative participation, both with internal and external parties.
- Control: This characteristic relates to the level of regulation and control in all activities and processes carried out. Whether or not these characteristics are good will be seen from the difference between the targets to be achieved and the results of implementation in practice so that variations between the two things play an important role as a reference if there is an increase in these characteristic elements.
- Effectiveness: this characteristic relates to the achievements that have been made by each activity. The higher the level of congruence between the target and the achievement, the better this characteristic. Usually the increase in the ability of this driving characteristic at each level will also be marked by the ability to increase the existing target.
- Efficiency: this characteristic relates to the company's ability to use resources or resources in achieving the desired goals. The level of efficiency will be better if the company is increasingly able to suppress the use of its resources. In the context of supply chain management, the characteristics of efficiency depend a lot on the best practices used by the company in order to improve continuous improvement.

In this research the Lockamy & McCormack model is used as this model not only measures the operational aspect of supply chain but also assesses other factors such as labor, values in the organization, performance and best practices.

3 Methodology

The primary data were collected using questionnaire combined with an interview method. The questionnaire given to the respondents was based on a standard questionnaire developed by [3]. Questions in the questionnaire will be based on four major business processes in the supply chain, namely the planning process, material procurement, production, and distribution of goods. Each of these business processes will have their own questions, where the total questions for the four business processes are 94 questions. Respondents will be asked to provide an assessment based on the suitability between the questions asked and the current implementation of supply chain management using a Likert type scale of 1 to 5 where 1 means none or very inappropriate, 2 means sometimes exist or a little appropriate, 3 means averagely exist or appropriate, 4 means often present or somewhat very appropriate, and 5 means always exist or very suitable.

Respondent chosen were 8 persons who have a very good understanding about supply chain in the company and they were Head of Supply Chain, Manufacturing Manager, Operations Manager, Head of Quality Division, Head of Shop Floor Production, Head of Logistics Division and Head of Purchasing Division. Each of them was given a questionnaire consisting of 94 questions. Before distributing the questionnaire, it was validated by the Supply Chain Head. After giving their responses, the average score of each business process was calculated and maturity level of each business process was debased on their responses the maturity level of the supply chain management was determined using the following score range (see Table 1).

Table 1 Score Range for Maturity Level [9]

Maturity Level	Score Range
Level 1	1.00 – 1.18
Level 2	1.19 – 2.40
Level 3	2.41 – 3.58
Level 4	3.59 – 4.41
Level 5	4.42 – 5

Results of scoring were validated by comparing the actual value or actual implementation in existing conditions with the results of the questionnaire obtained. Respondents were asked to provide evidence and facts that they know and understand each question so that the Likert type scale they chose were valid. When there is discrepancy from the validation results, the maturity level can be changed to a level that is more in line with existing conditions. The validation process is basically the same as the process of collecting data with a questionnaire, but with consultations and interviews to confirm the information given by the respondent when they filled in the questionnaire.

4 Results

Based on responses to the questions in the questionnaire Table 2 shows the maturity level of each business process. Although some business processes have maturity level of more than 2 but the overall maturity of Company X is only at Level 2 (Defined) as shown in Table 2.

Table 2 Company X Maturity Level

Business Process	Number of Questions	Average values of responses	Maturity level
Procurement of materials	15	2.267	2
Planning	32	1.957	2
Production	16	2.367	2
Distribution	31	3.395	2

To overcome the subjectivity of the respondents, results were validated by the Head of Supply Chain and also by matching the 2 characteristics of level 2, they are:

- There is a job definition for each business process in the supply as shown by the job description document.
- There is work documentation for each business process in supply chain as shown by the document in the Supply Chain Division
- There is internal collaboration between teams in each supply chain function and members know what should be done as shown by the Supply Chain Department P2A Documents.
- There is collaboration between different functions in the supply chain as shown by the flow chart of each work process listed in the P2 Document
- There are formal meetings formal between each function routinely as shown by the minutes of meetings.
- Changes must go through a formal meeting within the team. Any changes, especially in the operational sector, must go through discussions and meetings.
- Focus on customer satisfaction and needs. There is attention to consumer complaints even though not every complaint can affect strategy changes in this safe supply chain. Data collection on consumer complaints is in the customer service section.
- Have a definition of the target to be achieved. There are sales targets and desired production targets, although sometimes not all targets can be achieved. Documentation targets are in the P1 Strategy document.
- Start the planning the implementation of best practice in the supply chain.
- Start to have a performance evaluation system even though there is no clear standard. There is an evaluation, but it is done spontaneously if needed.
- Have a traditional organizational structure but not all important business processes in the supply chain have a structure. Already has a supply chain organizational structure but does not have a structure for processes planning.

5 Discussion and Analyses

Analyses were carried out for each supply chain business process by looking at attributes used in measuring the maturity.

- Material Procurement Process
  The maturity level of each attribute of material requirement process is presented in **Figure 2**.

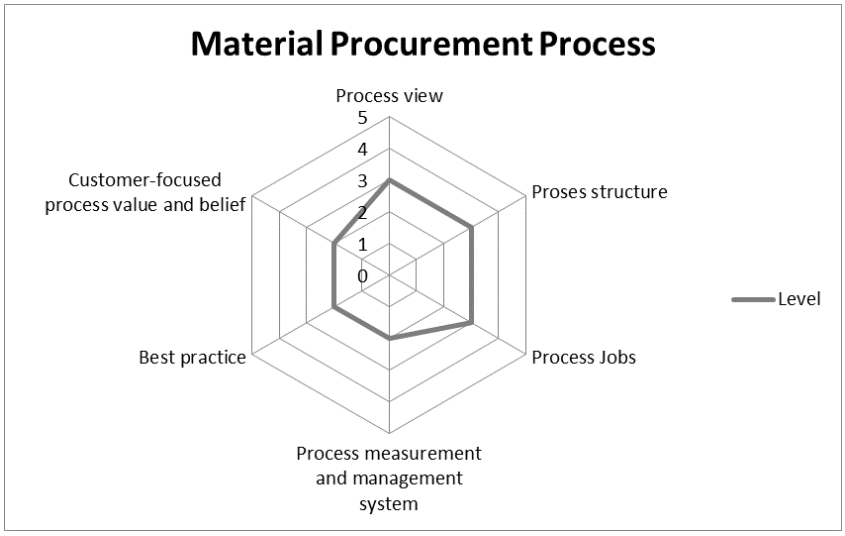

Fig. 2. Material Procurement Process Maturity level

Based on **Figure 2**, attributes that need to be improved are best practice, customer-focused process value and belief, process measurement and management system. This can be done by investing in the use of information systems, collaboration with suppliers, and making performance measures. The use of information systems can help simplify works, from ordering raw materials to the process of tracking raw material stock data so that ordering errors will not occur. So far, management often experiences errors because the warehouse stock data does not match with actual conditions. In addition, information systems can also help reduce redundancy of data and to ease operational tasks so that employees can focus on strategic tasks.

Collaboration with suppliers is especially needed to find out the stock of raw materials in the warehouse quickly so that when stock conditions run low, suppliers can immediately make deliveries automatically. However, in order to do this, management needs to select regular suppliers and use information systems as part of the foundation of cooperation.

The establishment of performance measures is mainly carried out to measure the performance of the material procurement process such as supplier selection and evaluation, as well as measuring the performance of the team in charge of material procurement.

- Production Process
  The maturity level for each attribute in the production process is depicted in **Figure 3**.

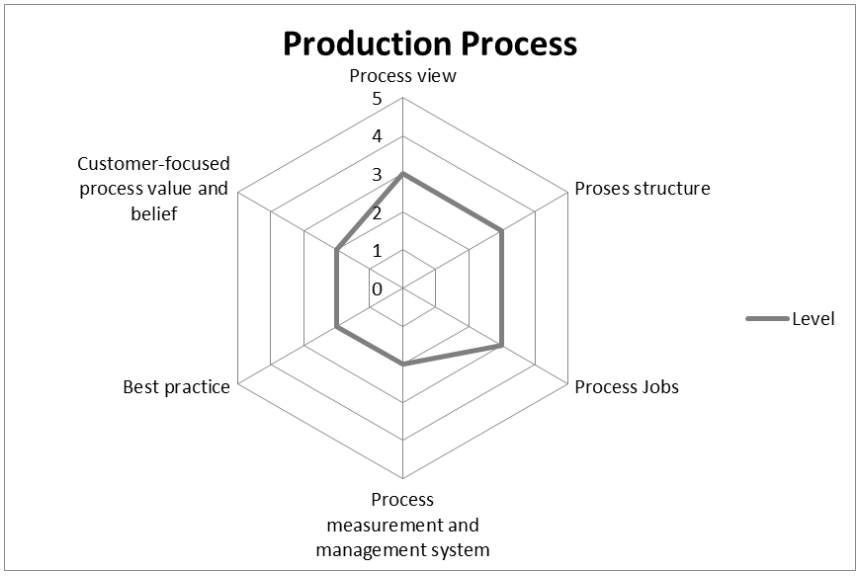

Fig. 3. Production Process Maturity Level

Based on **Figure 3**, the attributes that need to be improved are best practices, customer-focused process values and beliefs, process measurement and management systems. Things that can be improved in the production process are the development of performance measures and the use of information systems. The development of performance measures is mainly carried out to measure the suitability between the production plan and its implementation, as well as to measure the performance of the production team. The use of information systems can help to compile production schedules, time periods for each stage of the production process, and unify the stock conditions of production.

- Distribution Process
  The maturity level for distribution is shown in **Figure 4.** Based on this figure, attributes that need to be improved are best practice and process measurement and management system. To improve the distribution process, the development of performance measures using information systems, and calculation of minimum stock should be done. Performance measures are mainly carried out to measure the performance of the distribution process team and measure the percentage of conformity of the delivery process. The use of information systems can help, especially in tracking data for outgoing goods, how many are in the process of delivery, delivery schedules for each consumer, and data on distribution networks. Determination of minimum stock conditions required by the main warehouse and distribution warehouse. This is done so that management may be informed about how many minimum reserves must be needed, because currently the minimum warehouse stock has never been able to meet impromptu (unplanned) requests regardless of the amount.

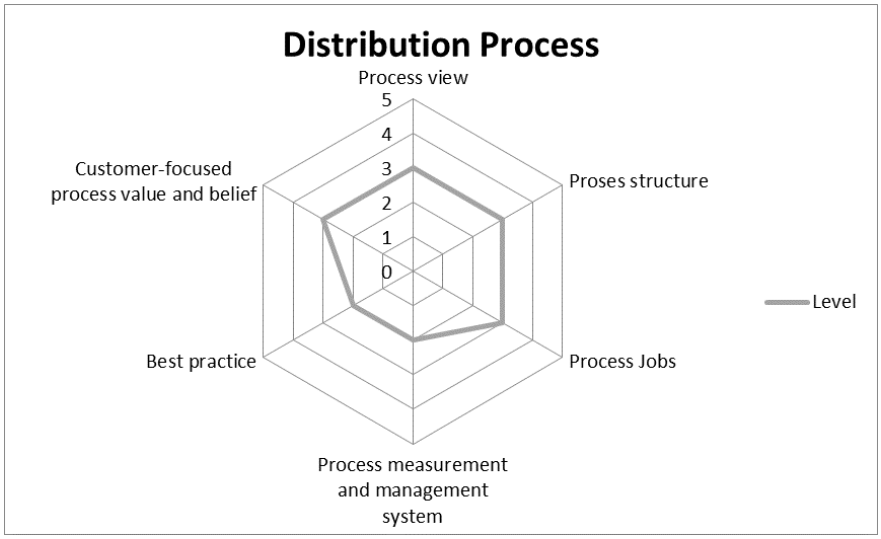

Fig. 4. Maturity Level of Distribution

- Planning Process
  The maturity level of planning process is shown in **Figure 5**

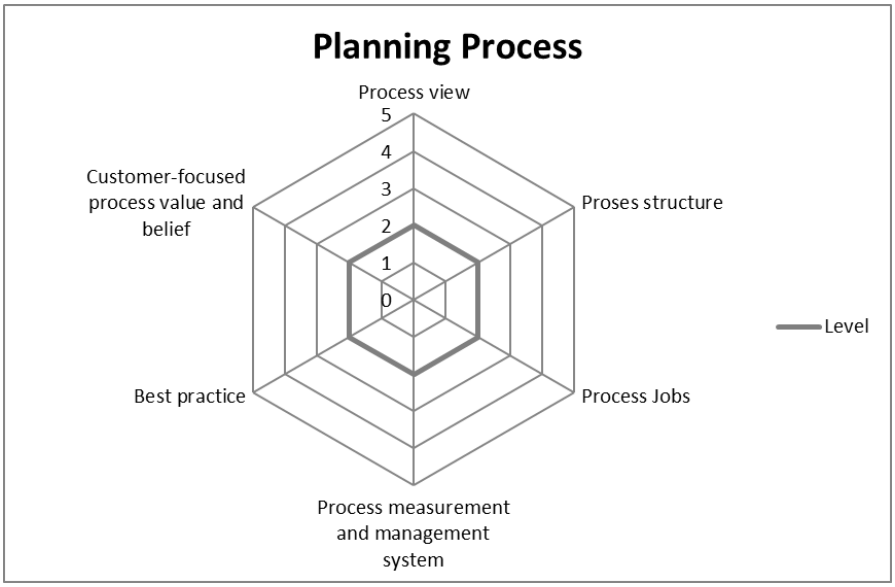

Fig. 5. Maturity Level of Planning Process

Based on **Figure 5**, the attributes that need to be improved are best practice, customer-focused process value and belief, process measurement and management system. To improve the production process, Company X may establish performance measures and the use of information systems. The development of performance measures systems is

mainly carried out to measure the suitability between the production plan and its implementation, as well as to measure the performance of the production team. The use of information systems can help to arrange production schedules, time periodization for each stage of the production process, and to monitor the condition of the stock of production results.

6 Conclusions and Recommendations

Based on the results of data processing, the maturity level of PT X's supply chain management is in level 2. Results of the analysis for each maturity attribute of all business processes in the supply chain show that nearly all needs improvement in the best practice, process measurement and management, and customer-focused process value and belief. To overcome these issues, the development and use of information systems and making performance measures are necessary.

This is in accordance with one of the characteristics of the Lockamy & McCormack model, which states that one way to increase maturity from level 2 to level 3 is to improve performance measurement.

The design of the information system can be done firstly by defining system requirements analysis and then represented in the form of DFD (Data Flow Diagram). Meanwhile, the performance measurement design can be using a form based on the concept of the Balanced Scorecard.

Further research can be done by adding more respondents, not only at the managerial level (Head of Division) but also staff members (staff at the operational level) so that statistical analyses can be used to confirm the results of the questionnaire. In addition, results of data gathering and processing can be validated for each business process before the result of the final maturity level.

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