Implementation of Waste Reduction at Operational Division with Lean Manufacturing Concept

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Abstract. PT. Semen Gresik Packaging Industry (IKSG) Tuban is a subsidiary established by PT. Semen Gresik (Persero) Tbk which is tasked to fulfil the needs of packaging bags for cement production. Problems that appear often occur in a company, especially PT. IKSG is a waste that often occurs in the production flow, such as the large number of defective production bags, production machines that often stop in the middle of the production process and other problems. From these problems, this research aims to find a solution using the lean manufacturing approach in handling and reducing waste that occurs in the existing production processes in the company. Three types of waste often occur in the company, namely, defect, waiting, and overproduction, as well as recommendations for improvement based on the selected mapping from VALSAT analysis in the form of elimination of non-value, added activities on PAM mapping with the results of manufacturing cycle effectiveness (MCE). It is increased by 3.18%, the application of the master production schedule (MPS) method on SCRM mapping with a more optimal amount of production results, and the implementation of maintenance and policies in the production process to reduce defects in the QFM mapping.

1. Introduction

Making cement bags in bag factories is done to meet the needs of the cement production process. Demand for cement bags is not only for the needs of cement production in the factory, but also to meet the demand and needs in several cement industries and other industries. To meet the growing demand for cement bags, a more considerable cost is needed, and higher profits are expected.

PT. Semen Gresik (Persero) Tbk as one of the companies engaged in cement production in Indonesia established a subsidiary that will serve as a supplier of cement bags for cement production that the company does. PT. Semen Gresik Packaging Industry (IKSG) Tuban is a company engaged in the manufacture of cement bags. Problems that appear often occur in a company, especially PT. IKSG is a waste that often occurs in the production flow as there are still many pockets of production that are defective due to printing results, gluing or folding bags that are not optimal, production machines that often stop amid the production process and other problems that can cause waste. The existence of waste in the production process of a company influences income and produces a waste of time and production processes.

From these problems, the purpose of this research is to find a solution in handling and reducing the waste that occurs in the existing production processes in the company [5]. So that with the discovery of an answer about handling and handling waste, it is expected that the waste that previously often occurs can be minimized to increase efficiency and increase profits from the company itself. One method that can be
done to eliminate waste is lean manufacturing. Lean is a continuous effort to reduce waste and improve value added of products (goods/services) to provide value to customers (customer value) [1].

2. Literature Review

2.1 Lean Manufacturing

Lean manufacturing is a systematic approach to identify and eliminate waste through continuous improvement, to create a smooth flow of production processes with fast lead times and little waste. The production process that can be categorized as lean is a process that transforms input into output with activities that add value to a very low level of waste, so that the customer gets a product that is worth the expected [4]. Waste Toyota has identified a type of waste that does not add value to a business or manufacturing process. The following is a type of waste [2]: (1) Excessive procedure (overproduction); (2) Delays/ waiting time; (3) Transportation that is not necessary; (4) Excessive processing (inappropriate processes); (5) Excess inventory; (6) Excessive movement; (7) Defective products.

2.2 Value Stream Analysis Tools (VALSAT)

In principle, VALSAT is used as a tool to map specific value streams that focus on the value-adding process [3]. There are seven kinds of detail mapping tools that are most commonly used, namely:

1. Process Activity Mapping (PAM) PAM is a technical approach used in activities on the production floor. However, the expansion of this tool can be used to identify lead times and productivity both physical production flow and information flow.
2. Supply Chain Matrix Response It is a graph that illustrates the relationship between inventory and lead time on distribution channels so that there can be an increase or decrease in inventory levels and distribution time in each area in the supply chain (material area, production area, and finished product area).
3. Production Variety Funnel A visual mapping technique that attempts to map the number of product variations in each stage of the manufacturing process. This tool can be used to identify where a generic product point is processed into a specific product. In addition, this tool can also be used to show the bottleneck area in the process design.
4. Quality Filter Mapping Is a tool used to identify the location of the problem of quality defects in the existing supply chain. Evaluation of quality loss that is often done for short-term development. This tool is able to describe three different types of quality defects such as product defects, scrap defects, and service defects.
5. Demand Amplification Mapping The tools used to visualise demand changes along the supply chain. This phenomenon adheres to the law of industrial dynamics, where the demand transmitted throughout the supply chain through a series of order and inventory policies will experience ever increasing variations in each movement from downstream to upstream.
6. Decision Point Analysis Tools that show a variety of different production system options, with a trade-off between the lead times of each choice with the level of inventory needed during the lead time process.
7. Physical Structure Is a tool used to understand the condition of the supply chain at the production level. This is needed to know how the industrial operating conditions are and direct attention to areas that may not have received enough attention for development.

2.3 Value Stream Mapping

Value Stream Mapping (VSM) is a tool to identify value-added activities and non-value activities added to the manufacturing industry, to make it easier to find the root of the problem in a process [3]. This tool is able to show errors through an overview of the current state system and is used as a basis for making ideal conditions.
3. Methods
The research method is a description of the steps taken in solving the problems that exist in this study. These stages are prepared as a reference for researchers in the implementation and resolution of these problems.

![Flowchart of Research Methodology](image1)

**Figure 1.** Flowchart of Research Methodology

4. Result and Discussion

4.1 Current Value Stream Mapping
Current value stream mapping is an illustration of the current production process conditions.

![Value Stream Mapping](image2)

**Figure 2.** Value Stream Mapping
4.2 VALSAT

After knowing the description of the production process at this time using the current value stream mapping, the next step is to prepare a VALSAT matrix to find out the detailed mapping that will be used in the process of identifying waste that occurs based on the conditions in the company.

Table 1. Value Stream Analysis Tools (VALSAT)

| Waste          | Weight | Process Activity Mapping | Supply Chain Response Matrix | Product Variety Funnel | Quality Filter Mapping | Demand Amplification Mapping | Decision Point Analysis | Physical Structure |
|----------------|--------|--------------------------|------------------------------|------------------------|------------------------|-------------------------------|------------------------|---------------------|
| Over production| 2.50   | 2.50                     | 7.50                         | 0.00                   | 2.50                   | 7.50                          | 7.50                   | 0.00                |
| Waiting        | 3.17   | 28.53                    | 28.53                        | 3.17                   | 0.00                   | 9.51                          | 9.51                   | 0.00                |
| Transport      | 0.00   | 0.00                     | 0.00                         | 0.00                   | 0.00                   | 0.00                          | 0.00                   | 0.00                |
| Inappropriate Process | 0.33 | 2.97                     | 0.00                         | 0.99                   | 0.33                   | 0.00                          | 0.33                   | 0.00                |
| Inventory      | 1.00   | 3.00                     | 9.00                         | 3.00                   | 0.00                   | 9.00                          | 3.00                   | 1.00                |
| Unnecessary Motion | 0.33 | 2.97                     | 0.33                         | 0.00                   | 0.00                   | 0.00                          | 0.00                   | 0.00                |
| Defect         | 4.00   | 4.00                     | 0.00                         | 0.00                   | 27.00                  | 0.00                          | 0.00                   | 0.00                |
| Total          | 43.97  | 45.36                    | 7.16                         | 29.83                  | 26.21                  | 20.34                         | 1.00                   |                    |
| Rank           | 2      | 1                        | 6                            | 3                      | 4                      | 5                             | 7                      |                    |

4.3 Quality Filter Mapping (QFM)

Quality filter mapping is used to analyse waste type defects that occur in the process of producing pasted kraft cement bags. The following is the data defect in the production process of pasted kraft cement bags from January 2017 until December 2017.

Table 2. Percentage Defect

| Month     | Kraft Usage (kg) | Afval (kg) | Percentage (%) |
|-----------|------------------|------------|----------------|
| January   | 3,024.330        | 46.272     | 1.53           |
| February  | 1,907.310        | 36.569     | 1.92           |
| March     | 2,073.827        | 43.870     | 2.12           |
| April     | 1,983.212        | 35.284     | 1.78           |
| May       | 1,473.722        | 34.407     | 2.33           |
| June      | 2,028.698        | 35.125     | 1.73           |
| July      | 2,438.144        | 54.755     | 2.25           |
| August    | 2,238.455        | 48.789     | 2.18           |
| September | 2,782.767        | 54.658     | 1.96           |
| October   | 2,740.091        | 86.011     | 3.14           |
| November  | 2,563.824        | 61.096     | 2.38           |
| December  | 2,454.078        | 87.957     | 3.58           |
| Total     | 27,708.458       | 624.791    | 2.25           |
| Average   | 2,309.038        | 52.066     | 2.24           |
Table 3. Master Production Schedule bag’s Pasted Kraft Type 40 kg

| Years in 2017 (Unit) | Jan | Feb | March | April | May | June | July | August | Sep | Oct | Nov | Dec |
|----------------------|-----|-----|-------|-------|-----|------|------|--------|-----|-----|-----|-----|
| Actual demand        | 0   | 14.326 | 14.020 | 11.163 | 13.000 | 12.264 | 12.290 | 14.999 | 16.779 | 15.726 | 11.977 | 13.744 |
| Stock                | 0   | 0   | 0     | 0     | 0     | 0     | 0     | 0      | 0    | 0    | 0    | 0   |
| MPS                  | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 | 1.328.4 |

Information:
Actual Stock = 18.580.000; Lot Sizing = 13.284.500

Table 4. Master Production Schedule of bag’s Pasted Kraft Type 50 kg

| Years in 2017 (Unit) | Jan | Feb | March | April | May | June | July | August | Sep | Oct | Nov | Dec |
|----------------------|-----|-----|-------|-------|-----|------|------|--------|-----|-----|-----|-----|
| Actual demand        | 90.00 | 3.155.0 | 2.833.0 | 2.637.0 | 3.113.0 | 1.335.5 | 2.153.5 | 4.025.9 | 2.838.0 | 2.871.0 | 2.494.8 | 3.794.8 |
| Stock                | 0   | 0   | 0     | 0     | 0     | 0     | 0     | 0      | 0    | 0    | 0    | 0   |
| MPS                  | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 | 3.502.4 |

Information:
Actual Stock = 2.660.000; Lot Sizing = 3.502.410

Table 5. Comparative of Corporate Policy and MPS

| Comparative                | Pasted Kraft 40kg (unit) | Pasted Kraft 50kg (unit) |
|----------------------------|--------------------------|--------------------------|
| Demand                     | 150.288.500              | 31.341.606               |
| Corporate Policy           | 163.387.750              | 31.729.000               |
| MPS                        | 146.129.500              | 31.521.690               |
| Margin                     | 17.258.250               | 207.310                  |

Table 6. Comparison of Afval Amounts Before and After Repair Recommendations

| Month     | Afval (kg) Before | Afval (kg) After |
|-----------|------------------|-----------------|
| January   | 46.272           | 41.477          |
| February  | 36.569           | 31.774          |
| March     | 43.870           | 39.075          |
| April     | 35.284           | 30.489          |
| May       | 34.407           | 29.612          |
| June      | 35.125           | 30.330          |
| July      | 54.755           | 49.960          |
| August    | 48.789           | 43.994          |
| September | 54.658           | 49.863          |
| October   | 86.011           | 81.216          |
| November  | 61.096           | 56.301          |
| December  | 87.957           | 83.162          |
| Total     | 624.791          | 567.253         |
| Average   | 52.066           | 47.271          |
5. Conclusion
From the results of the research that has been done, the findings obtained are as follows: Based on the value stream analysis tools (VALSAT) identification, there are three wastes with the highest value, namely the defect of 4.00, waiting for 3.17 and overproduction of 2.50. Also, VALSAT identification also obtained 3 mapping with the highest value, namely supply chain response matrix (SCRM) of 45.36, process activity mapping (PAM) of 43.97, and quality filter mapping (QFM) of 29.83.

From the analysis of each selected mapping, the following results are obtained: From the supply chain response matrix (SCRM) analysis using a master production schedule (MPS), the optimal production amount was 17,258,250 units compared to the company's policy for 40kg pasted kraft bags. Whereas for 50kg pasted kraft bags 207,310 more optimal results were obtained from company policy in 2017. From the analysis of process activity mapping (PAM), the results of manufacturing cycle effectiveness (MCE) were 47.10%, up 3.18% from the previous 43.92%. From the quality filter mapping (QFM) analysis, the results of an increase in defects that are expected to occur is 567,253 kg during 2017, a decrease of 9.21% from the actual condition of 624,791 kg.

6. Reference
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