Lean Manufacturing Approach to Minimize Waste Production Using Value Stream Mapping

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ABSTRACT
In the manufacture of gloves can not be separated from the wastes that occur in production activities. Activities that do not provide added value can result in losses for the company due to the ineffective and efficient use of resources continuously during the production process. In optimizing the production system, manufacturing companies use a Lean Manufacturing approach to maintain and improve the quality of their products. The concept of Lean Manufacturing can reduce lead time and increase output by eliminating activities that do not provide added value that occur in the company's production system. The method used is Value Stream Mapping (VSM) to identify waste in the glove production process in the company that can minimize waste on the production floor and provide recommendations for corrective actions to make the process more efficient. The results of the waste that occur are defect waste, waiting waste, unnecessary motion waste and transportation waste and a reduced lead time of 103,44 minutes and a decrease in cycle time of 0,82 minutes.

Keywords: *lean manufacturing, waste, value stream mapping, gloves*

1. INTRODUCTION

The Gloves are a type of garment product that serves as a support or protection in some work activities and daily activities. Gloves that are used as personal protective equipment have a significant impact on the user. This is evidenced by the number of companies that require workers to use personal protective equipment in the form of gloves to protect workers from work accidents. In addition, the use of gloves is partly produced by the company to maintain the quality and hygiene of a company's product. The glove manufacturing process cannot be separated from the waste of all activities in the production process. Activities that do not provide added value can result in losses for the company due to the ineffective and efficient use of resources continuously during the production process. In optimizing the production system, manufacturing companies use a Lean Manufacturing approach to maintain and improve the quality of their products.

Lean Manufacturing is a concept that aims to change an organization in the company to be more efficient. This concept was developed by Toyota and is known as Just-In-Time. The Just in Time (JIT) concept developed by Toyota is to produce output that is only needed when it is needed by the customer, in the amount that suits the customer's needs and at every stage of the process in the production system carried out in the most economical or most efficient way. The concept of Lean Manufacturing can reduce lead time and increase output by eliminating activities that do not provide added value that occur in the company's production system [1, 2, 3].

The method used in the application of Lean Manufacturing is Value Stream Mapping (VSM) to identify waste in the glove production process in the company and is expected to minimize waste on the production floor and provide suggestions for corrective actions to make the process more efficient. Several studies related to value stream mapping have been carried out and obtained the results that waste must be eliminated or reduced to increase product value and further increase customer value. [4, 5, 6]

2. METHODS

The method used is Value Stream Mapping (VSM) to identify waste in the glove production process in the company that can minimize waste on the production floor and provide recommendations for corrective actions to make the process more efficient. Value stream is the flow of all production activities needed to process a

product, both value-added and non-value added. There are two main streams, namely the production flow from raw materials to the customer and the design flow from concept to implementation. It is important to apply Value Stream Mapping to know the value stream in detail to identify the exact waste and find the causes to eliminate it or at least reduce it [7, 8, 9, 10, 11].

Waste can be interpreted as a loss in the form of resources, namely material, time, labor and capital caused by activities that require direct or indirect costs but do not add value to the final product for consumers. There are seven kinds of waste [1], namely:

a. Transportation

This waste can be caused by the movement of materials from one part to another, namely between process parts, between production lines and the distribution process of materials.

b. Over Production

This waste is the most affecting of the six wastes. For example, when there is over production, the goods will be distributed, stored, inspected and maybe if there are some materials that are defective in production. Over production does not only occur in products that have no selling value but can be in the form of products that are indeed made too early.

c. Waiting

Delays in material distribution, machine breakdowns during the production process and bottlenecks can cause workers to wait short distances or even longer waits.

d. Defect

This waste can be called scrap. Scrap can be both the business and the material that makes it. It's not just the production unit that loses valuable time, it also includes the employees, the effort and energy used to make the defective unit.

e. Inventory

All inventory is a waste except sales which are profited for direct sales. There is no difference even though the inventory is raw material, work in process and finished product.

f. Movement

Represents unnecessary movement of workers, for example searching for equipment or materials. Things that often happen but are ignored as waste include workers who appear to be active but do not appear to be doing the production process. Effectiveness is not measured by how much the workers move. To avoid this waste, improvements should be made through work design and work station design methods.

g. Excess Processing

This waste of product management does not match customer expectations. Engineers who make specifications may be outside the customer's requirements so that they can waste design. Choosing raw materials, poor equipment and inefficient processes can lead to waste.

Several parameters that need to be considered in the preparation of Value Stream Mapping [7], include:

1. Inventory lead time
2. Resource
3. Cycle time
4. Lead time
5. Waiting time
6. Transportation time

The steps taken in conducting Value State Mapping (VSM) are [7, 8, 9, 10]:

1. Draw icons that represent consumers, suppliers and production control.
2. Draw a data box under the consumer icon and enter the consumer's needs in it including the amount in days and months.
3. Entering sending and receiving data, drawing the sending medium along with its frequency, drawing the sending icon and its direction under the sending medium. Finally, draw the delivery media under the supplier along with the frequency and direction.
4. Drawing operations that take place from the supplier to the consumer.
5. Enter process data such as cycle time, uptime.

6. Draw the flow of information both electronically and manually.
7. Draw inventory between processes including work in process and then calculate the time for the inventory.
8. Draw the flow of push, pull or a combination thereof.

3. RESULTS AND DISCUSSION

Value Stream Mapping is used to make improvements to the production line by mapping all production flow activities from the beginning of incoming materials from suppliers then passing through the manufacturing process to be processed into a product until it reaches the hands of consumers in one complete image. The description of the material flow is related to the processing time so that it can easily identify the waste in the glove production line. Waste is a waste that can result in company losses. Waste can be in the form of activities that do not need to be carried out during the production process.

After the data that supports the preparation of Value Stream Mapping are obtained, the next step is to develop Current State Value Stream Mapping to find out all the physical flows (materials) and information carried out during the glove production process. In addition, the preparation of Current State Value Stream Mapping is expected to be able to determine the location of the occurrence of waste, in which process there are the most obstacles or problems according to the Value Added Time and Lead Time in the glove production process. The following is the flow of the glove production process which is arranged in the Current State Value Stream Mapping:

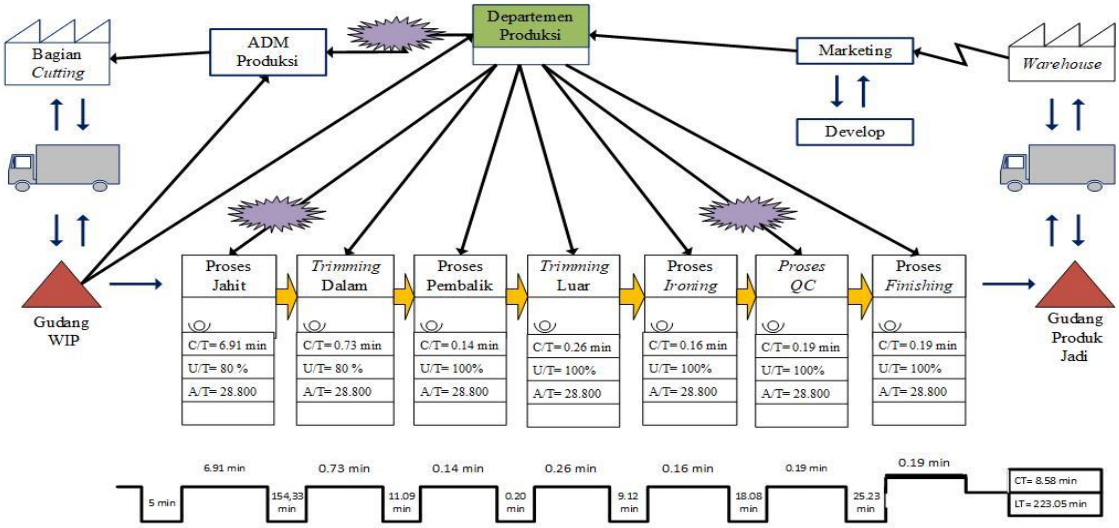

Figure 1 Current State Value Stream Mapping (CSM)

Identify Waste

The identification of waste is carried out for descriptive analysis, supported by the results of worker interviews and coupled with the results of observations in the field for one month. The types of waste that occur in the production of gloves are as follows:

a. Unnecessary Motion

This waste is caused by operator activity during the production process. These activities are in the form of movements that do not need to be carried out during the production process. The movement included workers chatting, fixing the hijab and taking the next material from the previous process because in the previous process there were problems with the machine and overwork caused by an unbalanced division of work.

b. Defect

Waste in the defect category is caused by several factors, including material input errors caused by poor communication between the Gading Unit production administration and the central factory production administration. Defects that occur are also caused by operator errors in the sewing process as well as transferring goods from the process before to the next process in the form of dirty materials because they are exposed to lipstick and the material falls to the floor, stitches go out of line and folds because the operator is not careful, the material is damaged due to the sewing process (blunt needle) and a faulty sewing machine.

c. Transportation

Waste in this section occurs in the production line because material handling is done manually by workers so that if workers reach the point of fatigue, the distribution of goods will slow down and cause bottlenecks. This sometimes causes sewing operators to assist in material handling.

d. Waiting

Waste of waiting is caused by several factors, such as waiting for materials from the central factory, running out of materials because the previous process slowed down and repairs to production machines due to blunt needles or machine component changes.

After describing the current state value stream mapping and identifying waste, it can be seen the parts that need to be improved or improved. To improve the condition of the production system on the production line, namely by making improvements to the sequence of the production process. The part that can be improved is the Future State Value Stream Mapping image below:

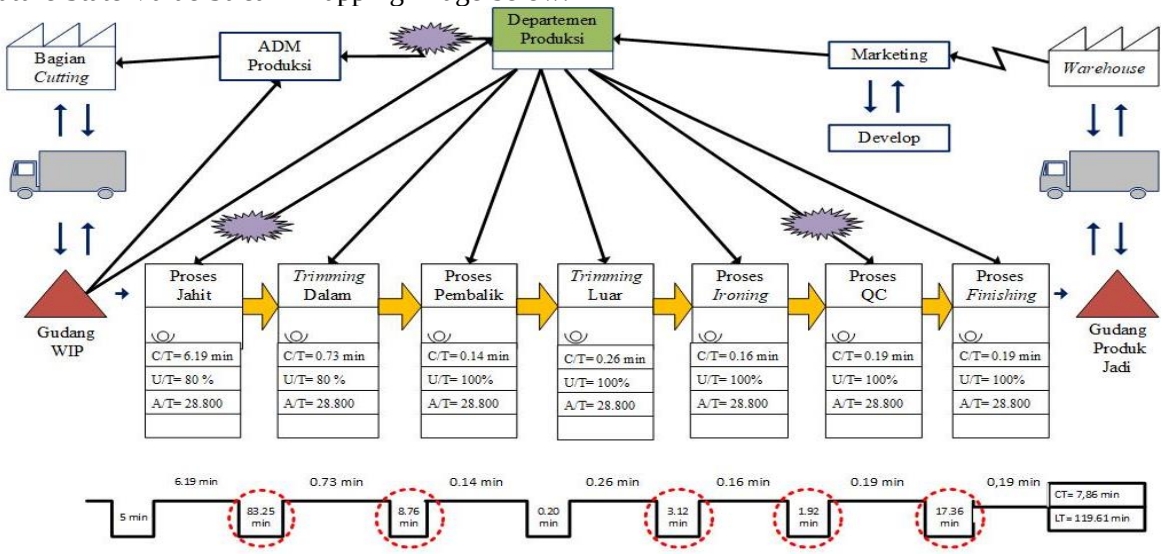

Figure 2 Future State Value Stream Mapping (FSM)

Based on the results of Current State Value Stream Mapping and Future State Value Stream Mapping, it can be seen that there is a change in lead time after improvements have been made to several material transfer processes, among others, the shift from the sewing process to the inner trimming process, which is 154,33 minutes to 83,25 minutes so that it saves time of 71,08 minutes, the transfer of material from the inner trimming process to the inverting process also decreased by 2,33 minutes from 11,09 minutes to 8,76 minutes and the transfer of material from the outer trimming process to the ironing process was 3,12 minutes because in the deep trimming process there is often a buildup of material.

This results in the inverting process waiting for the material. Therefore, the trimming process is carried out by adding manpower to speed up the production process. Outside trimming operators also need to assist with inspections of the gloves before they are transferred to the turning process to reduce fatal glove defects. In addition, in the transfer of material from the ironing process to the quality control process, the lead time decreased by 16,16 minutes, which was originally 18,08 minutes to 1,92 minutes and the lead time from the quality control process to the finishing process also decreased initially 25,23 minutes to 17,36 minutes.

From some of the suggestions for improvement above, it can be seen that the time comparison between Value Added (VA) and Non Value Added (VA) is shown in the following table:

Table 1. VA and NVA

Activity/Time	CSM	FSM	Gap
Value Added/ Cycle Time	8,58 minute	7,86 minute	0,82 minute
Non Value Added/ Lead Time	223,05 minute	119,61 minute	103,44 minute

Based on the comparison table above, the lead time can be reduced from the original 223,05 minutes to 119,61 minutes, resulting in a decrease of 103,44 minutes. In addition, the cycle time which was originally 8,58 minutes became 7,86 minutes, so it decreased by 0,82 minutes.

4. CONCLUSION

The conclusions that can be concluded are the wastes found on the company's line production are waste of defect, waste of waiting, waste of unnecessary motion, and waste of transportation. Changes that occur in the proposed improvement are reduced lead time so that there is a decrease of 103,44 minutes and cycle time decreases by 0,82 minutes.

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