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IMPROVING LEAN MANUFACTURING SYSTEM USING VALUE STREAM MAPPING ANALYSIS

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Abstract

This study aims to identify waste in company x and provide recommendations for improvements in the scope of *gembos* paper production. Thus, this research can be beneficial in solving problems in the production scope, especially in identifying waste. An appropriate method is needed to identify the waste in the scope of production, namely by using the Value Stream Mapping method as the first step in identifying waste in the paper production scope, then proceed with using the five whys method to find out the root of the problem and to help provide a solution to a problem that exists on the paper production floor at company X. The results of this study describe the current state mapping as a mapping on the scope of production, then proceed with value streams in the fourth each process starting from receiving raw materials, preparing elliptical machines, elliptical machine processes, and the paper making machines. Displaying the results of five whys explained the root of the problem and provide solutions or recommendations based on the analysis, thus this research is beneficial for companies in helping to solve problems that occur on the production process so that the production system can be effective and efficient.

Keywords: Lean, Production process, Value stream mapping.

1. Introduction

The manufacturing industry in the current era of globalization is designing production processes to become efficient by reducing waste. Indirectly, companies must realize that some things that happen within the company are waste. One of the often-unnoticed waste is motion waste, where all workers engage in activities without adding value to the products they produce. Lean is one of the methods used in the manufacturing system to minimize waste and can be applied to small-scale manufacturing companies [1, 2]. One tool used to implement lean is Value Stream Mapping (VSM), which is widely used in various companies to minimize waste [3, 4]. However, in this era of globalization, we also encounter many manufacturing companies that still need to regulate the production system in each of their factories optimally. Suboptimal production system tends to cause problems in the scope of their production, such as waste from every lean production from inventory manufacturing. Only after the final inventory will make the company be effective and efficient. Hence, we need to fix this problem by using the lean manufacturing method to reduce the problems in the company [5]. VSM identifies value-added and non-value-added activities to improve the production system [6].

VSM has also been used to eliminate non-value-added activities so that it can be a solution in increasing cycle time in laminated door component production companies. The company can increase its production activities [7]. The VSM method has also been carried out on chili farmers to improve their supply chain by reducing the lead time and increasing the production flow so that the chili supply chain can get maximum results [8]. Timber companies have also used the VSM method to reduce non-value-added time in each division [9]. The VSM method has also been used in garment companies to minimize waste in another garment production. This method can solve the problems in the company, with the results of the method in the form of improvements to the existing work system [10]. Dairy companies have also used lean manufacturing methods to solve waste on a dairy factory's production floor [11].

This research aims to identify waste in the *gembos* paper production company to improve the existing work system and a good work structure to become effective and efficient. Thus, this research can significantly help resolve existing problems in the company.

2. Method

This company is located in Karawang. The first step in this research is to establish a relationship with the company, discuss the current scope of production, and ask about the problems that occur at this time in the company. Collecting data in this study is by direct observation of the company and seeing the scope of paddy paper production, data taken in the production scope, namely starting from the cycle time of every padlock paper production process, observing the existing work system on the padded paper production floor and discussing with the supervisor on the floor of this padded paper production. Four processes were observed, starting from the arrival of raw materials, the preparation of the elliptical machine, the elliptical machine process, and the paper-making machine process.

After observing and receiving the information, the next step is collecting data using the Value Stream Mapping (VSM) and the five whys methods. The VSM

method displays the current state mapping, where current state mapping is helpful for the mapping process that occurs in the scope of production. This method shows the processes that occur on the padlocked paper production floor and can find out the problems that occur at this time. After showing the VSM method, the next step is to continue with the 5 whys method, which analyses any flawed working system until the root problem is resolved so that it displays some recommendations on this five whys method.

The following process is after the data is processed and get recommendations for improvement with the two methods, namely the next step is to provide improvements to the company to provide a better work system so that it can be helpful for the company.

3. Results and Discussion

The results obtained from processing are by displaying the padlocked paper production flow as a reference for displaying the current state mapping of this paper production company. The production process flow and current state mapping models can be seen in Figs. 1 and 2.

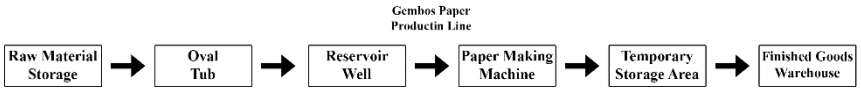

Fig. 1. Flow of paper production.

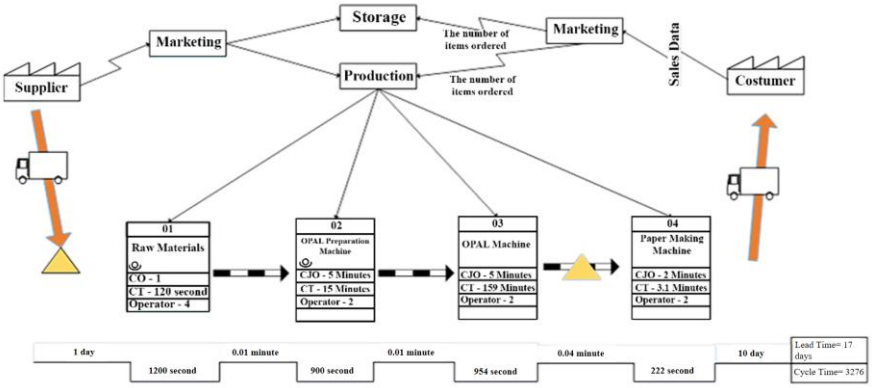

Fig. 2. Current state mapping of the paper production floor.

Based on Figs. 1 and 2, there are four stages in the process of making padlocks, starting from the raw material retrieval, where four operators are working on the retrieval. The next step is to proceed to the elliptical machine preparation stage with two operators. After preparing the elliptical machine, the same number of people enters the elliptical machine process but for a different process, and the last one is the paper-making machine process with two operators from each of the above processes time and description. After displaying the current state mapping, the following process creates a value stream per process. Reducing lead time could increase production through VSM [12].

The results of the VSM in the current condition only show the current process. Of course, this is the first step to simplify waste analysis within the production floor's scope. Current state mapping and future state mapping can also integrate [13]. Lean manufacturing is a production process used in manufacturing systems, partly due to the belief that this sector needs to be more open to many lean techniques and documented applications. Consequently, managers are more committed to implementing improvement programs. This paper presents an approach to tackle these two issues in the manufacturing system. We demonstrate this using the steel industry, where numerous lean techniques can be suitably adapted. Additionally, for managers considering implementing lean manufacturing but uncertain about the possible results, we show that detailed simulation models can be utilized to evaluate fundamental performance metrics and analyse system configurations [14].

The results of the VSM above have also been carried out on research on the garment production floor at a company in India, with the result that it is necessary to rearrange it in a particular sewing room with VSM analysis. VSM helps comprehend process inefficiencies in value streams and pinpoint appropriate lean techniques for process enhancement. Creating future state maps should be viewed as something other than the culmination of analysing the value stream. It is crucial to note that the value stream should be regularly reviewed until the desired future state is achieved [10].

The process of receiving raw materials has several sub-processes. From some of these activities, it is known that activities can be categorized into value-added and non-value-added activities. The non-value-added activities are the activities of warehouse operators waiting for raw materials to be unloaded and operators placing work tools in any place when finished using, the VSM image is shown in Fig. 3.

Raw Material Receiving	Raw Material Receiving	Raw Material Receiving	Raw Material Receiving	Raw Material Receiving	Raw Material Receiving
The car enters for document checking and weighing	The car enters the raw material warehouse	The process of unloading raw materials from the truck	The warehouse operator waits for the raw materials to be unloaded	Arrangement of raw material	The operator places the tools in any place after finishing the work
C/T = 10	C/T = 2	C/T = 17	C/T = 17	C/T = 30	C/T = 1
C/0 = -	C/O = -	C/O = -	C/O = -	C/O = -	C/O = -
Operator = 1	Operator = 1	Operator = 1	Operator = 4	Operator = 4	Operator = 4

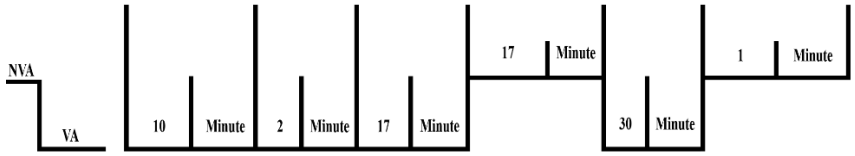

Fig. 3. VSM processing on raw material receipt.

These activities were completed using the five whys method with recommendations for improvement, namely providing direction to the operator at work to facilitate the operator's work, then supervising the operator while working to avoid being idle on the operator and rearranging the work system in order to get

optimal results. The five whys method can improve the production system [15], as for The results of the five whys method are shown in Figs. 4 and 5:

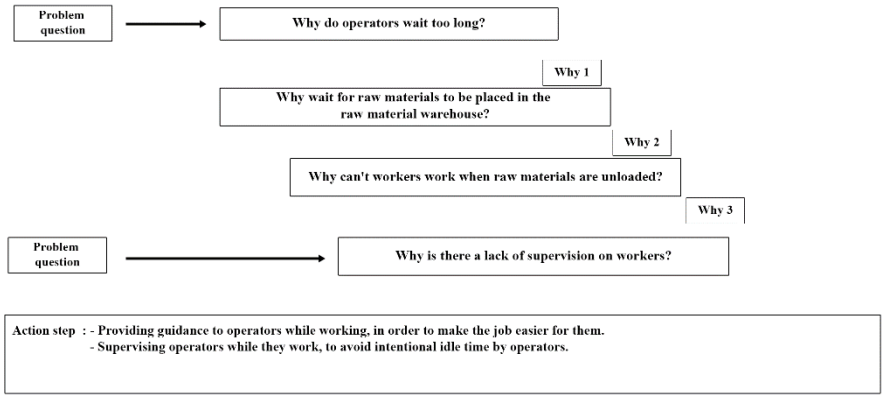

Fig. 4. Five whys in receiving raw materials (inspection).

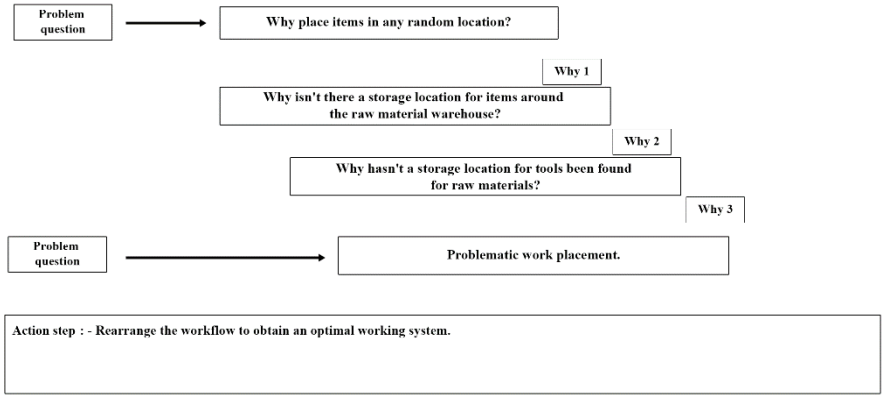

Fig. 5. Five whys in receiving raw materials (motion).

The previously mentioned solution has also been utilized to address issues in production facilities. Specifically, "Simple work" refers to an efficient and practical approach to completing tasks in the shortest time possible by optimally utilizing resources like humans, machines, and materials. Standardizing involves employing analytical techniques to establish a series of Standard Operating Procedures (SOPs). These SOPs outline the work processes operators should follow, including the steps involved and the sequence in which they should be completed [16].

The elliptic machine preparation process has several sub-processes, and each activity that does not have added value are analysed using the five whys method to find out the root cause of the problem. In contrast, the activity is the operator waiting for the water to be full. Completion of the five whys method from activities that do not have added value, namely by holding training in advance about the stages of the process in detail, there must be a standard set by the company so that

operators are accessible at work and continuous supervision so that the production floor runs smoothly.

The elliptical machine process has several process stages. In contrast, the process stages that do not have added value are the process of the operator waiting for the maturity of the material and the operator waiting for the addition of water in the elliptical tub. Activities without added value were analysed using the five whys method. The recommendation for improvement using the method is the existence of an automatic work tool that can read the maturity of the pulp in order to minimize the occurrence of failures at the time of printing and always provide direction to each worker to minimize idle operators.

A number of the solutions mentioned earlier have also proved helpful in addressing issues encountered by textile firms. In this industry, following a standardized approach to work is considered the most reliable, effortless, and efficient way of carrying out tasks. However, the main aim of standardization is to create a foundation for enhancing job performance. The objective is to maximize human potential rather than relying solely on machines, as the flexibility of human workers offers more advantages than machine-based operations. By implementing lean manufacturing techniques, textile companies can achieve improvements that minimize waste. Lean manufacturing is a strategy that can be applied in large and small companies where all employees can improve operations to meet customer needs [17].

The process of the paper-making machine has several stages of processing, as for the non-value-added activities, namely the process of the operator waiting for the pallet and the operator waiting for the paper thickness to be reached. Next is to analyse these activities using the five whys method. As for the results of the five whys method analysis, namely continuous supervision of each operator, there must be an update on the current work system in order to produce a better work system, engine renewal that must have semi-automation in the paper cutting section, and there must be a tool to move the padded paper that has been produced from the paper machine.

The lean manufacturing method has also been used in shoe companies with problems on the production floor, namely the leading cause of waste, such as defects in raw materials and long delays on the production floor. The solution given is to analyse the current work system and needs to be changed so that it can reduce delays on the production floor, as well as the solution to the problem of defects obtained from raw materials, namely, to prevent the occurrence of defective raw materials, it is essential to improve the method of transporting them from suppliers [18]. The suggested solution to address the issue of process waste in the net fishing company involves an analysis of the current work system to identify and eliminate sources of waste, such as delays, excessive production of defective products, and work processes that do not contribute to added value [19].

Value Stream Mapping is a crucial tool in lean manufacturing that allows companies to comprehend and continuously enhance their approach toward lean thinking. Connecting various elements such as processes, tools, people, and reporting helps organizations achieve lean goals. It promotes clear and concise communication between the shop floor and management about the lean perspective and provides precise information and material flows. The team's effectiveness in using Value Stream Mapping is demonstrated as they walk through the production process, interact with workers, and observe the transformation of raw materials into finished

products. The Value Stream Map should be easily understandable by operators and management [20]. This map can improve overall equipment performance and manufacturing system efficiency [21] and communication [22, 23].

4. Conclusion

The solution using the lean manufacturing approach to the Value Stream Mapping (VSM) method is the right step because this method first describes the problems that occur by displaying the current state mapping so that problems on the production floor can be followed up with existing lean manufacturing methods such as the five whys method. Thus this method can be used on several problems in the manufacturing scope.

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