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Identification and Elimination of Waste Activities in The Gray Yarn Processing Company

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Abstract

This study aims to identify the types of waste and recommend improvements to minimize waste that occurs in the gray yarn processing company. Value Stream Mapping (VSM) is used to analyze the flow of materials and information throughout the production process. The main objective is to identify and eliminate waste, thereby improving efficiency and productivity in manufacturing operations. The biggest types of waste in the grey yarn processing production process of the preparation department are Unnecessary motion and Overprocessing waste types at 30% each, Unnecessary Inventory at 20%, and transportation at 20%. The recommendations given can reduce the overall lead time from 58967 seconds to 58771 seconds.

Keywords: lean manufacturing, value stream mapping, minimize waste

INTRODUCTION

Productivity is an approach that involves various disciplines to set effective goals, plan strategies, and implement methods that improve the efficient use of resources while maintaining high quality (Manullang, 2020In manufacturing companies, the presence of non-value-added activities, often referred to as waste, leads to increased consumption of resources such as energy, labor, and time. This inefficiency negatively impacts the production process. Implementing the Lean Manufacturing concept is an effective approach to addressing this issue and is considered a critical strategy for gaining a competitive edge in the industrial sector. A key aspect of this approach involves minimizing waste, defined as any activity within the process flow,from input to output transformation,that does not contribute value (Johan & Soediantoro, 2022).

One widely utilized technique in Lean Manufacturing for analyzing and mapping the flow of information and materials throughout the production process is Value Stream Mapping (VSM). VSM is a visual tool that facilitates the design and analysis of the information and material flows required to deliver goods or services to customers (Maryadi, Tamalika, Ardaysi, MZ, & Azhari, 2023). Additionally, VSM can be applied in research contexts to identify and eliminate waste, thereby enhancing the efficiency and effectiveness of investigations.

The company is a textile manufacturing company that produces woven sarongs. The production process is quite complex because it processes from gray yarn into woven sarongs. Based on field studies and observations, several data on the problems that occur in the production line are obtained, which in essence are problems related to the imbalance of workers' abilities with the quantity of orders and the demands of completion time. In meeting customer demand and satisfaction, the company always tries to increase its production in a timely manner. To increase productivity, an effort is needed to identify waste on the production floor.

This study aims to identify the types of waste and recommend improvements to minimize waste that occurs in the gray yarn processing process. The difference between before and after recommendations given.

By applying the Lean Manufacturing method using Value Stream Mapping and kaizen tools, it is expected to identify various types of waste that occur on the production floor. VSM will be given improvement proposals to minimize waste. While kaizen to make improvements and as a suggestion for improvement for the company. The use of fishbone diagrams is also very helpful in identifying the causes and root causes related to the waste that occurs. Thus, appropriate improvement recommendations can be determined to minimize the waste that has been identified.

Lean Manufacturing

Lean manufacturing is a production philosophy that focuses on minimizing waste and optimizing processes so that it will provide the best value to customers (Gupta et al., 2013; Varela et al., 2019). This philosophy was originally developed as part of the Toyota Production System (TPS) and has since evolved into a comprehensive framework that incorporates various strategies and tools aimed at improving efficiency, improving quality, and reducing costs (Arul et al., 2014; Saleem, 2022).

Besides being a philosophy, Lean manufacturing is also a methodology that integrates practices in Just-In-Time (JIT), 5S (Sort, Set in Order, Shine, Standardize, Sustain), and Kaizen (continuous improvement) production to streamline operations and increase productivity (Singh et al., 2018; Nordin et al., 2014). There have been many studies that show that this philosophy/me topology has significantly improved organizational performance (Saleem, 2022; Paradise & Revelation, 2023; Worley & Doolen, 2015; Laia & Marwan, 2024).

Lean manufacturing has been widely applied and assisted small and medium-sized enterprises in improving their operational performance and market competitiveness (SMEs) (Qureshi et al., 2022; Dora et al., 2013; Wirawan & Suryati, 2023). On the other hand, Lean manufacturing can interact very well with modern trends in digital technology in Industry 4.0 so that it allows for real-time data analysis and process optimization (Saad et al., 2023).

The main challenge of implementing Lean manufacturing is related to company culture. Leadership and a strong dedication to lean implementation are key to the success of lean programs. Strong and dedicated workforce is an important condition for fostering an environment conducive to Lean practices (Landry & Ahmed, 2016; Abolhassani et al., 2016). In addition, Lean implementation should be seen as a holistic process, where complementary management controls are used to fully realize the potential benefits of Lean practices (Nielsen et al., 2018).

Value Stream Mapping

Value Stream Mapping (VSM) is one of the main tools of a lean methodology designed to visualize and analyze the flow of materials and information throughout the production process. The main objective is to identify and eliminate waste to improve productivity and efficiency in manufacturing operations (Dadashnejad & Valmohammadi, 2018; Anuar & Mansor, 2022).

The VSM will provide a visual representation of the current state of the production system allowing the institution to find inefficiencies and point out areas that need to be improved (Diah et al., 2018; Nasution et al., 2018). With this systematic mapping process, the implementation team can focus on finding activities that do not add value to the entire flow of materials and information so as to reduce waiting time and operational costs (Sarifudin et al., 2019; Kunyoria, 2022; Ma'sum & Setiafindari, 2022; Novitasari & Iftadi, 2020; Sharmak, 2022).

VSM has been successfully used in various industries, both manufacturing and services. In the automotive sector, VSM has been instrumental in identifying wastage that significantly improves production performance (Anuar & Mansor, 2022; Kasanah & Suryadhini, 2021; Rahani & al-Ashraf, 2012). On the other hand, VSM has also been used in the service industry environment such as healthcare. VSM can optimize patient flow and treatment processes. This demonstrates its versatility beyond traditional manufacturing settings (Henrique et al., 2015).

The VSM process typically involves three main steps: (1) identifying areas of waste, (2) creating a map of current conditions to illustrate current operations, and (3) developing a map of future conditions to detail proposed improvements (Kunyoria, 2022) and Singh et al., 2006). Cross-functional team collaboration is required in the mapping process to foster a culture of continuous improvement (Fashtali et al., 2016) which is now often known as Continuous Value Stream Mapping (Sus-VSM) (Faulkner & Badurdeen, 2014).

The success of effective VSM implementation depends on a supportive organizational culture and understanding of Lean principles (Lasa et al., 2008; Muñoz-Villamizar et al., 2019). Therefore, comprehensive training and strong leadership are essential to ensure that VSM is implemented effectively as part of a broader Lean strategy (Pei & Pei, 2016).

METHODS

This research uses a quantitative descriptive approach. This approach was chosen to map the flow of the existing production process, identify waste, and develop an improvement plan based on the analysis of the data obtained. Thus, this research is oriented towards solving real problems in the field using quantitative data interpreted descriptively.

This research consists of several main stages, namely (1) Process Identification, at the initial stage, researchers made direct observations to the production area to understand the existing workflow. Initial data was collected, including cycle time, waiting time, throughput, and inventory levels. (2) Making a Current State Map, after the initial data is collected, the researcher compiles a current state map using VSM. The current state map is a visualization of the ongoing production process. At this stage, material flow, information flow, process time, distance traveled, and waste in each production step are depicted. This visualization helps to identify non-value-added steps. (3) Waste Analysis (Waste Identification), using Lean Manufacturing principles, researchers analyze the waste that occurs in the process and calculate Value-Added Time (VAT) and Non-Value-Added Time (NVAT) to determine process efficiency. (4) Making Future State Map, based on the results of the current state map analysis and waste identification, the researcher compiled a future state map. The future state map is a more efficient process design with renewal steps, such as reduction of waiting time, reduction of inventory, implementation of a pull system, and elimination of steps that do not provide added value. (4) Implementation and Evaluation, recommendations from the future state map are applied to the production process. After implementation, key performance indicators (KPIs) such as total lead time, production time efficiency, and waste reduction are re-measured.

RESULT AND DISCUSSION

Retrieval of waiting and bottleneck time data is done by reducing the previous process time with the current process, if it is positive, it is included in the waiting time, but if it is negative, it is included in the bottleneck time. The following is the total lead time data in the preparation department production process.

After obtaining the data that supports the preparation of value stream mapping, the next step is to compile the current state value stream mapping for the production process in the preparation department. Current state value stream mapping is described in the following Figure 1.

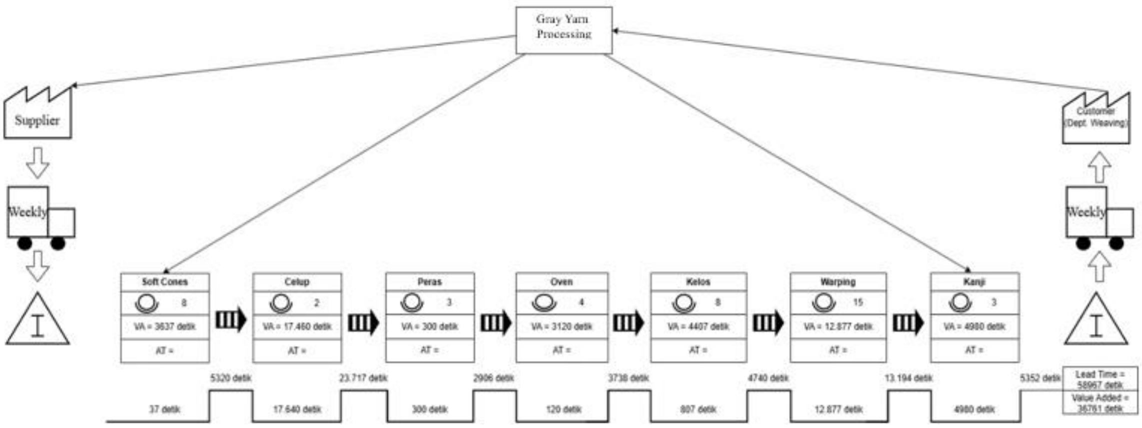

Figure 1. Initial Value Stream Mapping

Waste Analysis

The analysis of 7 *wastes* was carried out by conducting interviews with employees in the preparation department of PT Sukorejo Indah Textile, this was to find out the weighting of *waste* that often occurs in the *production value stream*. Based on the results of the calculation, the score for the type of *overproduction* waste is 0, the type of *defect* waste is 2, the type of *unnecessary inventory* waste is 1, the type of *unnecessary motion* waste is 2, the type of transportation waste is 1, the type of *waiting* waste is 0, and the type of *overprocessing* waste is 2, with a total score of 6.

Table 1. Initial Process Activity Mapping (PAM) Recapitulation

Activity	Quantity	Total time	Percentage	Total
Transportation	7	4080	7%	
Storage	4	960	2%	
Operation	59	39783	68%	100%
Delay	5	13800	23%	
Inspection	2	210	0%	
NVA	9	1456	2%	
NNVA	21	20616	35%	100%
VA	47	36761	62%	
Total Time		58833		

Process Activity Mapping *identification of the production process was carried out*. Based on the results of the time recapitulation, it was explained that the highest number of activities carried out in the operation and the VA value was 47. The highest percentage of each activity is the variable operation with a total time of 39783 seconds. The percentage value of the variable VA was 62%, NVA was 2%, and NNVA was 35%. Then the Process Cycle Efficiency value was obtained of 62%. Recapitulation into activities in the production process of the preparatory department is as follows:

Based on the PAM table above, there are some recommendations, follows:

1. Improvements need to be made related to the activity of taking stainless cones. The location *of the stainless cones* is too far from the machine so it takes more time to pick them up, so the placement of *the cones* can be closer to the machine so that the operator can shorten the time of the picking process.
2. Similar to *the cone's* activity location, the location of the raw material or *grey* thread is also a little too far, so the placement *of the grey* yarn can be closer to the machine so that the operator can shorten the time of the picking process.
3. It is necessary to rearrange related to gray thread arranging activities. In this process, the operator takes the thread and arranges it around the machine which can cause fatigue for the operator because he has to lift the thread and put it on the floor and can cause injury to the waist. This can be eliminated by the operator picking up the thread when the machine is ready.
4. The activity of taking *cones* for checking is a waste of time because the process of checking the hardness of *soft cones* can be carried out while the thread is still on the machine, so this activity can be eliminated.
   In this process, the QC will check the *doping* sample by spending 90 seconds. This will hinder the next process because it takes too long. Therefore, the QC is expected to speed up the checking time so that the time needed is more efficient.
5. Improvements are needed in the activity of storing *doping* results on *pallets.* The location *of the pallet* is sometimes very far away with *doping results,* so the operator has to push the cart far enough and takes a long time. Therefore, it is better to place *the pallet* closer to the machine so that the operator does not have to spend too long moving places.
6. The general assistant prepares and arranges yarn that is ready to be dyed in a narrow location and is not directly used, thus hindering the mobility of workers in the area. This can be eliminated, so that it can make the production process effective and efficient.
7. The process of moving the thread from the stick to the squeezer takes 300 seconds with a short distance. Therefore, operators can shorten the time so as not to hinder the next process.
8. The process of arranging the results of squeezing on *pallets* takes 300 seconds which causes disruption to the next process. Therefore, the addition of general helpers is very necessary so that the time required to organize can be more efficient.
9. In the activity of picking and putting activities on *pallets*, the general assistant moves by pushing the pallet manually which results in a long process time, the use of forklifts is needed so that it can cut time and effort.
10. In activity to take cones to check the results of the loss, it is a waste of time because the process of checking the hardness of the loss results can be done while the thread is still on the machine, so this activity can be eliminated.
11. In check the results of the results, the QC will check the doping result sample by spending 120 seconds. This will hinder the next process because it takes too long. Therefore, the QC is expected to speed up the checking time so that the time needed is more efficient.

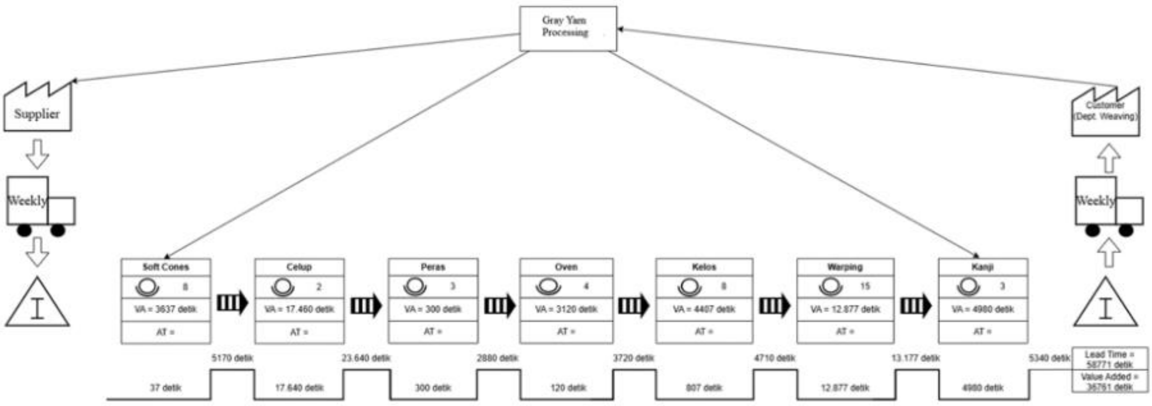

Figure 2. Value Stream Mapping

Based on the graph above, it can be seen that there is a decrease in the number of Nonvalue Added (NVA) activities which initially had 9 to 5 NVA activities. Based on the overall improvement recommendations that have been proposed by researchers by looking at the root causes of problems with Fishbone diagram tools and from activities in each process with detailed mapping tools Process Activity Mapping (PAM), the company can eliminate and reduce the time of some ineffective activities in the production process in the preparation department. Recommendations are proposed in the form of evaluating or eliminating activities that have no added value and improvements that can be given in each activity. The company can save time from 58833 seconds to 58637 seconds. Table 2 is recapitulation of the proposed PAM Data.

Table 2 Process Activity Mapping (PAM) Recapitulation for Proposed Improvement

Activity	***Quantity***	***Total time***	***Percentage***	***Total***
Transportation	7	4080	7%	
Storage	4	960	2%	
Operation	55	39587	68%	100%
Delay	5	13800	23%	
Inspection	2	210	0%	
NVA	5	1260	2%	
NNVA	21	20616	35%	100%
VA	47	36761	63%	
Total Time		**58637**		

CONCLUSION

Based on the results of data processing and discussion above, the conclusions that can be drawn based on the research are:

1. The largest types of waste in the production process of gray yarn in the preparation department are waste types *of Unnecessary motion* and *Overprocessing* by 30%, Unnecessary *Inventory* by 20%, and transportation by 20%.
2. Recommendations that can be given are in the form of eliminating and reducing the time *of Non-Value Added* (NVA) and *Necessary Non-Value Added* (NNVA) which are included in *the waste* of activities in the process of processing gray yarn into production yarn in the preparation department. The difference before and after the study was that there was a reduction in the overall *lead time,* which was from 58967 seconds to 58771 seconds. Eliminate *unnecessary Non-Value Added* (NVA) activities during the production process and reduce the time of *Necessary Non-Value Added* (NNVA) activities.

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