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ANALYSIS OF LEAN MANUFACTURING TO REDUCE WASTE IN THE BURGER BREAD PRODUCTION PROCESS

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ABSTRACT
UD. Matahari is a trading business manufacturing types of bread whose main product is burger buns. UD. Matahari is located in Sudirman street Pasar Aceh, Johan Pahlawan district, Meulaboh city. From the results of observations on the production process flow, there are still activities that do not provide added value and inefficient material transfer. So that it has an impact on the time for making burger buns which becomes longer and makes it difficult for the company to meet the average consumer demand; for this reason, process activities are grouped into Value Added Activities (VA) and Non-Value Added Activities (NVA) categories, also included in waste. This study aims to identify waste sources and provide improvements to reduce waste in making burger patties with a lean manufacturing approach. The tools used in this research are Process Activity Mapping (PAM) and Value Stream Mapping (VSM). The results of grouping activities using Process Activity Mapping showed that the amount of time in operating activities was 14522.05 seconds, transportation activities were 5297.46 seconds, and inspection activities were 45.19 seconds. In comparison, there was a delay of 575.47 seconds. After that, mapping the actual conditions of the burger bun production process was carried out into Current Value Stream Mapping with Value added Activities and Non-Value added Activities, respectively, of 14567.24 seconds and 5872.93 seconds. Whereas in the Future Value Stream Mapping analysis, the activity mapping of the burger patties production process after the proposed improvements to waste was made by reducing the time for non-value added activities from actual conditions to 2038.34 seconds, while the value-added activities increased to 14969.26 seconds.

Keywords: VSM; PAM; NVA; Lean Manufacturing.

I. INTRODUCTION
In the era of globalization and technological advances, the development of high, middle, and low-level manufacturing production is increasing [1]. This will undoubtedly increase competition between companies in the industrial sector, especially companies that produce similar products, to improve product quality, timeliness, and production capacity according to market demand. However, many medium-sized industries are still experiencing difficulties in their business so far [2]. This is because there is still much wastage in the production process [3].

In terms of productivity, a production process is needed in which some activities create added value in various ways, with the primary objective being to reduce waste, increase production efficiency and shorten production lead time, and meet consumer demands to the fullest.

UD. Matahari is a trading business manufacturing types of bread whose main product is burger buns [4].The bread-making location on Sudirman street Pasar Aceh, Johan Pahlawan district, Meulaboh city. [5]. There are eight workstations: mixer machine, dough roll machine, press machine and dough divider, dough forming, evaporation machine, oven machine, the place for cooling and packing bread into packages, and bread storage racks [6].

Based on the results of observations in making burger patties, there are still activities that are not added value and inefficient material transfer [7] [8]. This causes the bread-making time to be longer, thus affecting the company in fulfilling the average consumer demand per day, which is ± 1,000 burger patties or 77 packs. At the same time, the current production process conditions only produce 910 buns or 70 bags in one production. Several factors,

such as humans, machines, methods, materials, and the environment, cause the length of time in the production process [9] [10].

Based on the background of these problems, to reduce waste which causes the production process to take longer, it is necessary to carry out an analysis using lean manufacturing tools, namely Value Stream Mapping (VSM), to map the actual conditions of the burger patties production process and Process Activity Mapping (PAM) to identify activities that no added value (Non-Value added Activities) which are included in the waste and can be minimized. Therefore it is a concern for researchers to conduct an "Analysis of Lean Manufacturing to Reduce Waste in the Production Process of Burger Bread"

II. LITERATURE AND METHOD

Lean manufacturing is a method in industrial management that focuses on using and empowering continuous resources (continuous improvement effort) to create value for customers as efficiently as possible [11]. The trick is to eliminate the waste in the process to make it more effective and efficient, with better output quality [12]. According to Hines & Rich (2005), activity is an operation in the production process; in the production process itself, there are three process activities which are defined as follows:

Non-Value Added (NVA).

These activities do not add value from the customer's point of view. This activity is waste and must be reduced or eliminated [13]. An example of this activity is waiting for time or delay, such as a machine operator just watching the machining activity that is currently running, then waiting for goods to arrive, waiting for people to work at the previous station, waiting for processes that have not been completed at the last or subsequent stations, piling up (work in process). Due to low engine capacity, waiting for repairs in the event of damage to the engine and double handling or manual handling [14] [15].

Necessary but Non-Value Added (NNVA).

Is any activity carried out or required under current conditions that do not increase the product's value but are necessary to prevent the supply process from being disrupted? Examples are walking activities to pick up parts, check products, determine the size of pieces to be cut, unpack deliveries, and transfer tools from one hand to another. To reduce this activity, make operating procedure changes more straightforward and accessible, create new layouts, coordinate with suppliers, and create activity standards [16] [17].

Value Added (VA).

It is an added value, which means that any activity that changes the nature of a product's shape or characteristics is to the customer's wishes. Examples include cutting, mixing, processing, and so on, which are necessary process activities [18].

Value Stream Mapping (VSM) is a visual method for mapping production lines (from ordering raw materials to finished products ready for distribution) along with the value streams in the company so that later an overview of the materials and information available from each company is obtained [19] [10] [20]. For each workstation, identify the location of the occurrence of waste, and describe the required lead time based on each process characteristic [21] [22].

An example of a value stream mapping image can be seen in Figure 1 below:

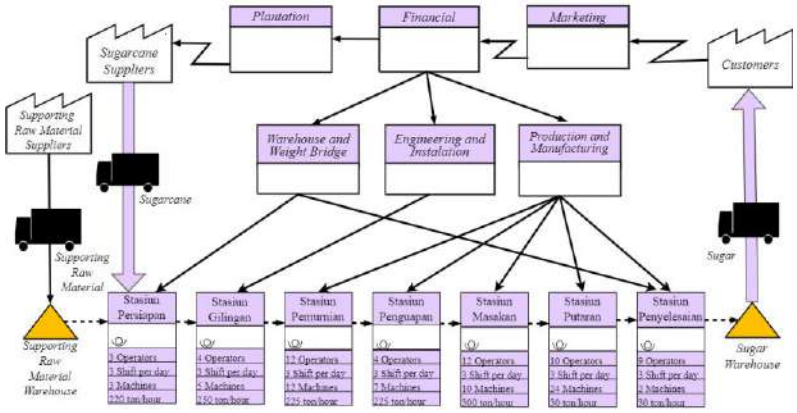

Fig. 1: Value Stream Mapping

Time measurement is observing and recording the working times of elements and cycles using tools prepared by researchers, such as stopwatches, observation sheets, and stationery [23]. The purpose of measuring time is to find the time needed to complete a job after considering the adjustment and allowance factors [24]. The first thing to do is preliminary measurements [25].

The purpose of preliminary measurements is to determine how many measurements must be made for the desired levels of accuracy and confidence [26] [27].

Time measurement is grouped into two, namely:

1. Direct time measurement, namely, the researcher is directly at the location where the object is being observed [28]. The size is the work time workers spend completing their work. For example, the stopwatch time study and work sampling methods[29] [30] [31].
2. Indirect time measurement, that is, the researcher is not directly at the location of the measurement object [32]. This measurement can be done by analyzing the formulation and available time data. For example, activity raw time data and movement time data [33].

III. RESULTS AND DISCUSSION

Based on the results of the current value stream mapping, it was found that the amount of time for value-added activities in the process of making burger buns was 14203.90 seconds. At the same time, the amount of time from the results of non-value-added activities is 938.81 seconds. The time for non-value-added activities is still considerable, affecting the company's productivity and time efficiency. Based on the current value stream mapping image, the waste in making burger buns is caused by waiting activities (delay) and inefficient transportation.

In this study, the causes of waste were identified using a cause and effect diagram to determine the hypothesis of root causes and potential causes on the production floor. Factors analyzed are human, material, machine, work methods, and the environment.

Based on the observational data, it is known that there are 22 work activities in the description of the process of work activities carried out. From the analysis carried out, the source of waste can be identified, namely the existence of waste waiting and waste transportation. Based on the design, the proposed improvements to the 9th work activity are combined with the 10th activity so that the 10th waiting activity becomes a value-added activity after being mixed, and the 14th waiting activity can be eliminated by using a moving tool, namely a wheeled rack. At the same time, simplification of some transportation activities can also be carried out in activities 1, 9, 15, 17, and 19. The improvements in manufacturing lead time can be seen in Table 1 as follows:

Table: I Calculation of Manufacturing Lead Time for Repairs

No	Activity	Code	Standard Time (seconds)
1	Take flour, eggs, yeast, sugar, salt, butter, and milk from the raw materials warehouse.	A1	403.07
2	Weigh the flour, sugar, and butter using a scale.	A2	119.85
3	Pour the raw materials in the order of the recipe into the mixer.	A3	146.45
4	Turn on *the mixer* and the process of *mixing* raw materials into the dough.	A4	1119.79
5	Put the dough temporarily on the table.	B1	113,36
6	Check the quality of the dough; if there are lumps, add butter.	B2	45,19
7	Divide the dough and grind it using a rolling machine to avoid lumps.	B3	80.15
8	Kneading the dough on a floured table, the dough is flattened and cut lengthwise.	B4	15.76
9	The dough is placed and shaped according to the standard *press machine process*.	C1,2	402.02
10	The dough is *pressed,* and occasionally the dough is pushed into the *press machine*.	C3	82.96
11	Take an empty baking sheet.	D1	320.71
12	Take one by one the dough from the mini *conveyor* and form the dough into the pan.	D2	753.36
13	Insert the stack of baking sheets into the evaporation chamber.	E1	151.26
14	The bread dough is a developing process and is controlled by workers.	E2	9324.62
15	Removing the pile of dough after evaporation into *the oven*.	F1	80.37
16	Bread dough in *the oven* and controlled by workers.	F2	1874,61
17	Take out the cooked bread to the cooling place.	G1	212.48
18	The process of cooling the bread to be packaged.	G2	363,34
19	Take the bread from the tin and put it in the plastic packaging, and tie the packaging.	G3	787,62
20	Transfer the packaged bread to the bread storage rack.	H1	610,63
Total			17007.61

Source: Data Processing

Before calculating the process cycle efficiency, first classify work activities that are value added (value-added time), necessary but not value added (necessary nonvalue added), and those that are not value added (nonvalue added time) can be seen in Table 2 as follows:

Table III: Work Activities Based on Categories (VA, NNVA, and NVA) Repair

No	Code	Value Added Time (second)	Non-Value Added Time (seconds)	Necessary Non-Value Added Time (second)
1	A1			403.07
2	A2	119.85		
3	A3			146.45
4	A4	1119.79		
5	B1		113,36	
6	B2	45,19		

7	B3	80.15		
8	B4	15.76		
9	C1,2	402.02		
10	C3	82.96		
11	D1			320.71
12	D2	753.36		
13	E1			151.26
14	E2	9324.62		
15	F1			80.37
16	F2	1874,61		
17	G1			212.48
18	G2	363,34		
19	G3	787,62		
20	H1			610,63
Total		14969,26	113,36	1924.98
	Proposal			

Source: Data Processing

The calculation of *process cycle efficiency* for all work activities is as follows:

$$Process\ Cycle\ Efficiency = \frac{Value\ Added\ Time}{Manufacturing\ Lead\ Time}$$

$$= \frac{14969,26}{17007,61}$$

$$= 88,01\ \%$$

Future Value Stream Mapping (FVSM) maps the proposed production process, including the flow of information and materials. This mapping aims to compare *Future Value Stream Mapping* (FVSM) with *Current Value Stream Mapping* (CVSM) against the waste that occurs. The *Future Value Stream Mapping* (FVSM) for making burger patties.

Based on the results of the mapping that has been designed by making improvements to *waste*, it can be seen that the mapping of process activities in the expected future state that the value-*added activity* is 14969.26 seconds, and the total *manufacturing lead time* is 17007.61 seconds so that *a process cycle efficiency* of 88 is obtained. .01%.

After calculating the time of the making of burger buns, *the manufacturing lead time* has improved. Comparison between *Manufacturing Lead Time* before and after repairs can be seen in Table 3 as follows:

Table IIIII: Comparison of Manufacturing Lead Time Before and After Repair

Information	Manufacturing Lead Time (seconds)
actual	20440,16
Proposal	17007,26

Source: Data Processing

The comparison of *process cycle efficiency* before and after improvements can be seen in Table 4 as follows:

Table IVV: Comparison of Process Cycle Efficiency Before and After Repair

Condition Description	*Process Cycle Efficiency*
actual	71.26%
Proposal	88,01%

Source: Data Processing

The grouping of activities based on value-added (*Value Added),* necessary but not value added (*Necessary Non-Value Added*), and nonvalue added (Non-*Value Added*), respectively, is compared with the actual conditions and after improvement can be seen in Table 5 as follows :

Table V: Comparison of the Number of Activities Before and After the Repair

Condition Description	Number of Activities	Activity (*Value Added*)	Activity (*Necessary Non-Value Added*)	Activity (Non-*Value Added*)
actual	22	11	8	3
Proposal	20	12	7	1

Source: Data Processing

IV. CONCLUSIONS

The conclusions from the research that has been done are as follows:

1. Based on the results obtained, several activities do not add value to the burger patties production process and are included in the types of waste transportation and waiting. Activities that are not added value and transportation waste are moving the bread dough pans into the evaporation chamber, putting the bread dough pans into the oven machine, bringing the bread pans to a cooling place, and taking raw materials from the warehouse. While other non-value-added activities are wasted waiting due to the action not being completed in the previous process, the move is delayed because the pans must be stacked onto the top of the drawer after all the pans are filled with bread dough.
2. The way to reduce waste in the burger patties production process is by implementing a work method improvement design combining the 9th and 10th work activities, eliminating the 14th work activity, and simplifying the inefficient moving work activities in the 15th, 17th, and 17th work activities. 19 uses a baking sheet equipped with wheels so that it is easier for workers to move it, and more pans are loaded in one move; meanwhile, for the simplification of activity 1, namely implementing raw material inventory planning that is placed on the production floor according to the needs of the dough which will be processed in two productions but only done once.

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