

# **Analysis Using of Lean Manufacturing to Minimize Waste**

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## **Abstract**

Lean Manufacturing is an approach to system efficiency by reducing waste. This approach is done by understanding the company's general picture through the flow of information and materials on the production floor by creating value stream mapping. Problems that occur is the discovery of delay time in the production flow due to value added time and non-value added time. There is unbalanced causing increasing length of production lead time. The purpose of the research conducted to 1) Identify the value and non-value added time contained in the flow of production process 2) Conduct analysis of the VSM made and 3) Finding the root of the problem using the 5W + 1H method. VSM is made by collecting the data cycle time from the work station by the time watch study method. Current State Map show that there is a Value Added and Non-Value Added Time Time, which occurs in one cycle. Total Value Added Time was 328.8 minutes, while the total Non-Value Added Time is 5.667 days. While the manufacture of Future State Map Total Value Added Time was 328.8 minutes, while Total Non-Value Added Time is 5.125 days.

## **Keywords**

Value Stream Mapping (VSM), Value and non-value added time, 5W + 1H analysis

## **1. Introduction**

The development of the industrial world so rapidly causing increasingly fierce industry competition among industries primarily engaged in the same place. To win this competition the company is required to have a strategy for minimizing or eliminating waste throughout the production process flow continuously (Apel,Azizi,Chapel). The process flow is a sequence of jobs or activities involved in producing goods and services. Improving the production process, satisfying customers and achieving high productivity has a target company.

Throughout the production process flow are activities that provide added value (value added) and non-value-added (non value added). Non-value added activities this always result in waste. In an effort to minimize the process that do not add value (non-value added) for firms required an improvement in the flow of the production process and the flow of information through the creation of Value Stream Mapping (Feld,Nowak). Various studies use VSM as a tool. Many research topics are applied using VSM such as VSM quality, energy VSM, sustainable VSM, etc. Various studies use VSM as a tool to minimize processes that do not add value to the company. VSM such as VSM quality, VSM Energy, VSM Sustainable, etc. are often applied in various research topics. For example, process industries, automobile industries, electrical manufacturing services and others using VSM as the tool (Rother,Wilson,Yusof).

Currently a manufacture company especially as a producer of CPO (Crude Palm Oil) and palm kernel still found their value-added activity (non-value adding activity) or waste in the production process such delay as a result of the accumulation in the threshing. Buildup that occurs as a result of differences in the production capacity of each process and processing times are not balanced on threshing station. These activities ultimately lead to increased production of long lead times. The consumption of electrical energy and water usage from year to year increase was also a factor why companies should look at the waste that occurs through the manufacture of Value Stream Mapping (Edtmayr,Meudt).

Based on this problem, it is necessary to do this research related to Value Stream Mapping and any factors that cause waste throughout the production process flow. It analyzed in depth entire activities through the main flows, starting from raw material and ending with final process in shop floor (Verma).

## 2. Research Method

This research was conducted at an industry, which is engaged in the production of CPO. This research was conducted in November 2017. The study begins by reviewing and collecting data in an industry. The review is done by interviewing the value stream manager who will be the supervisor for the company (Faulkner). The data collected is the cycle time, uptime, number of operators, value and non-value added time as well as the root of the problem by the method of 5W + 1H.

From the calculation of uniformity test data and test the adequacy of the data in threshing then obtained the cycle time for the station and the station threshing where there is a delay time that causes the production of a lot of time wasted. The general objective of this study was to analyze the manufacturing activity by Value Stream Mapping (VSM) method (Azizi,Verma).

The specific objectives to be achieved in this research are:

1. Identify waste in the form of the waiting time that occurs in the production process flow through the value stream mapping.
2. Identifying value and non-value added time contained in the flow of the production process.
3. Conduct analysis of VSM made.
4. Comparing the production lead time between the current state map to the future state map.

## 3. Result and Discussion

### 3.1 Determining the Standard Time

The initial step in problem-solving research is to collect data on the cycle time threshing stations which have been subsequently calculate the standard time for each of these stations. This method starts with the calculation of the uniformity of data and the adequacy of test data and the reliability of the results of the data collection. The flowchart of steps can be seen in Figure 1.

One cycle of the compression process is started from extracting the oil from the palm fruit until the stirring using water vapor. Table of Cycle Time compression process can be seen in Table 1. One cycle of threshing process is started from a lorry in sterillizer issued and drawn into the separation station of palm fruit with empty bunches. Table of Cycle Time threshing process can be seen in Table 2.

Table 1. Pressing cycle time of pressing stations

Observation	Cycle Time (min)
1	76
2	70
3	68
4	73
5	73
6	72
7	76

Table 1. Pressing cycle time of pressing stations (Lanjutan)

Observation	Cycle Time (min)
8	78
9	70
10	76

Table 2. Threshing cycle time of threshing stations

Observation	Cycle Time (min)
1	14
2	17
3	16
4	17

5	14
6	17
7	16
8	14
9	14
10	16

1. Uniformity Test Data  
 To test the uniformity of data used statistical methods and the level of confidence and accuracy desired level gauge is a confidence level of 95% and 5% level of accuracy.
2. Adequacy Test Data  
 By using the procedures established by the Maytag Company, it will be carried out test calculations adequacy preliminary observation data for a confidence level of 95% and 5% level of accuracy.
3. Calculation of Normal Time  
 In this study, the rating value factor for the operator and the compression process threshing is 1 (Rf = 1). This is because operators working on this process works normally, so the rated rating factor for operators is 1.
4. Calculation Standard Time  
 To calculate the standard time can be obtained from the normal time which has been supplemented with the following concessions (allowance) which carried workers to meet individual needs, eliminating fatigue (tiredness), or to obstacles inevitable  
 The standard time for a compression station is 83.2 minutes and 17.6 minutes to threshing station.

### 3.2 Mapping for Each Category Process (Door-to-Door-Flow)

After having obtained the standard time for each process, the next step is mapping for each category of processes using a standard time data of each process coupled with other data such as the changeover time and uptime. It can be seen in figure below.

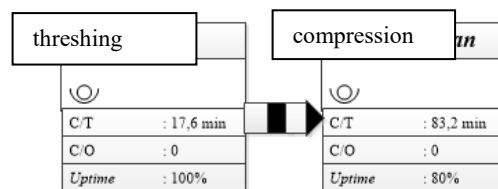


Figure 1. Material and information flow

### 3.3 Formulation of Current State Map

Once the map is complete process categories are created, at this stage of every process along the value stream coupled with the flow of material and information flow so that it becomes an integral flow in the plant.

### 3.4 Breakdown of Value Added Time (VA) and Non Value Added Time (NVA)

In this stage will be grouped all activities becomes value added and non value added. The value of the value added time obtained from the time the process contained in the VSM, it can be seen in Table 3. While the non-value added time is the lead time of each process are also included in VSM, it can be seen in Table 4.

Table 3. Breakdown of value added time

No	Stations	Time (Minute)
1	Loading Ramp	3
2	Palm Oil Steilizer	90
3	Thresher Process	17,6
4	Pressing Stations	83,2
5	Clarification Stations	15
6	Kernel Station	120

Total	328,8
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Table 4. Breakdown of non-value added time

No	Activitation	Time
1	The seeds of the suppliers are waiting to be weighed	2 day
2	Weighing the palm kernels and waiting to enter the palm oil sterilizer station	0,5 day
3	Fresh fruit bunches awaiting empty lorries coming from thresing stations	1 hour
4	Lorry that contains the stew to wait lifted by using a hoisting crane	0,5 hout
5	The oil that has been separated is waiting to be purified	2 hour
6	The product is waiting for seed processing	1 hour
7	The finished product is waiting in the tank to be sent	3 day
Total		5,667 day

### 3.5 Formulation of Future State Map

Preparation of the corrective action continues making Future State Map (Edytmayr,Faulkner). Alternative possible improvement done on every activity weeks to minimize the production of waste in the form of time waiting can be seen in table 5.

Table 5. Formulation time

No	Activities	Time	VA/NVA/NNVA	Repaired	Information	Repairing Time
1	Fresh fruit bunches are waiting for unloading	0,5 day	NVA	Elimination	Because it is a waste of time that does not provide benefits for companies and costumers	0
2	Weighting of palm kernels waiting to enter the boiling station	0,5 day	NVA	-	Because it is a waste of time that does not provide benefits for companies and costumers	0,5 day

Table 5. Formulation time (Lanjutan)

No	Activities	Time	VA/NVA/NNVA	Repaired	Information	Repairing Time
3	Fresh fruit bunches are waiting empty lorries coming from thresing stations	1 hour	NVA	Elimination	Because it is a waste of time that does not provide benefits for companies and costumers	0
4	Lorries that contains the stew to wait lifted by using a hoisting crane	0,5 day	NVA	Elimination	Because it is a waste of time that does not provide benefits for companies and costumers	0
5	The oil that has been separated is waiting to be purified	2 hour	NVA	-	Because important activities are done to smooth the production process	2 hour
6	The product is waiting for seed processing	1 hour	NVA	-	Because important activities are done to smooth the production process	1 hour
7	The finished product is waiting in the tank to be sent	3 day	NVA	-	Because important activities are done to smooth the production process	3 day

Based on the above alternative improvements can be made Future State Map in Figure 2 below. Comparison between value added activity (VA) and non-value added activity (NVA) after correction can clearly be seen in the following Figure 2.

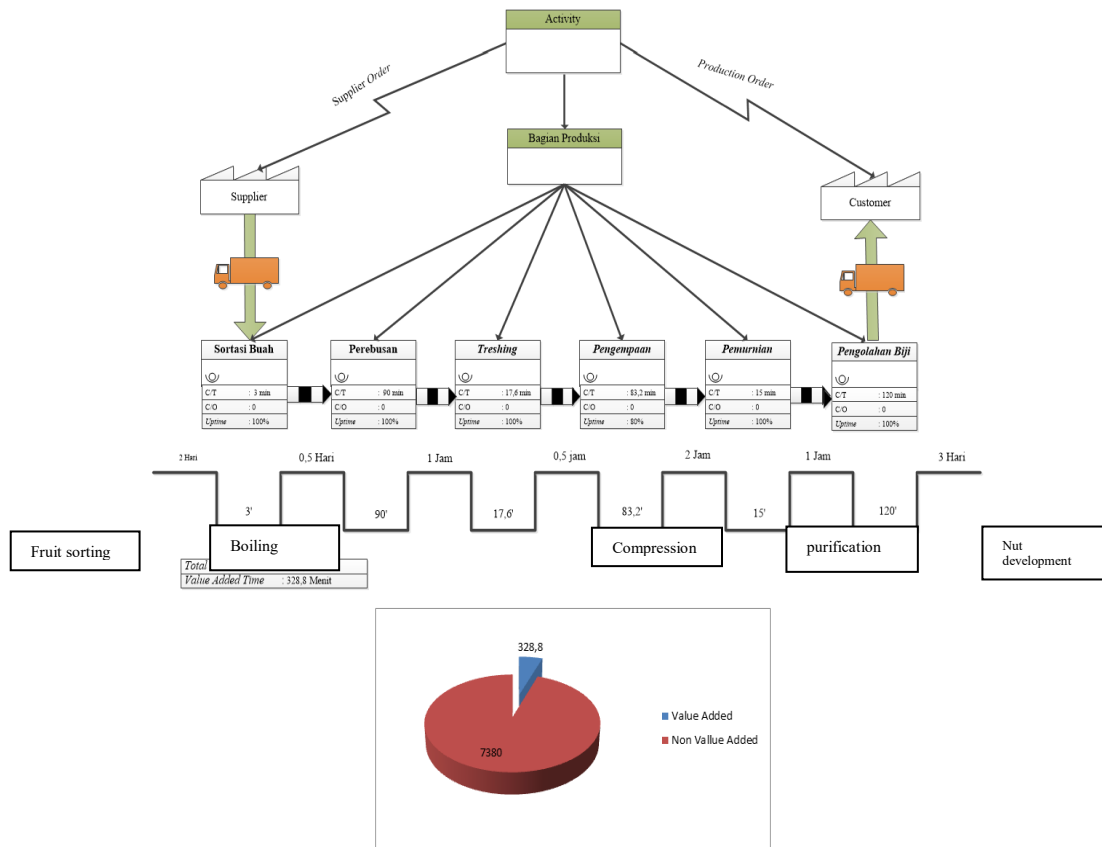


Figure 2. The comparison of VA and NVA activities

Waste in the form of the wait time that occurs then sought the cause by using the tools of 5 why that can be seen in the Table 6.

Table 6. Why-why

Waste Problem	Factor	Why	Why	Why	Why	Why
Fresh fruit bunches awaiting empty lorries coming from threshing stations	Human	Operator Fatigue	The operator works manually	The machine used is not automatical yet		
	Machine	Capstan is very difficult to use	The engine parts are rusty	The machine is lacking maintenance	Maintenance is done when the machine is damaged and can not be used	
	Method	The process of moving the truck is very long	Operator fatigue	The operator works manually		
	Environment	The operator is slow in motion	The operator is not free to move	The floor condition is very slippery	Less attention to cleanliness of the environment	
Lori that contains the stew to wait lifted by using a hoisting crane	Human	Operator fatigue	Operator works alone	The operator is only 1 person		
	Method	The forging process is to long	Hoisting cranes are operated only one	One hoisting crane is reserved		
	Machine	Hoisting cranes are difficult to	The engine parts are rusty	Engine less lubricant	No maintenance is done	No regular maintenance schedule

		move			routinely	
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The result of the determination by using the table 5W + 1H improvement can be seen in the Table 7.

Table 7. 5W + 1H

Types of Waste (What)	Source of Wastage (Where)	Person in Charge (Who)	Time is Happening (When)	Cause (Why)	Repair Suggestions (How)
Waiting/ Delay	Threshing Station	Truck station threshing operator	Moving from threshing station to loading ramp station	The machine used is not automatic yet. Machine maintenance is done when the machine is damaged and it can not be used	Establish a regular maintenance schedule on the machine so that even if the machine is not automatic yet the machine is easy to use
Waiting/ Delay	Forging Station	Forging station operator	The process of forging with a hoist	Engine capacity and timing are not sufficient for all lorries. No routine maintenance schedules	Add a machine to the forging station and create a regular maintenance schedules

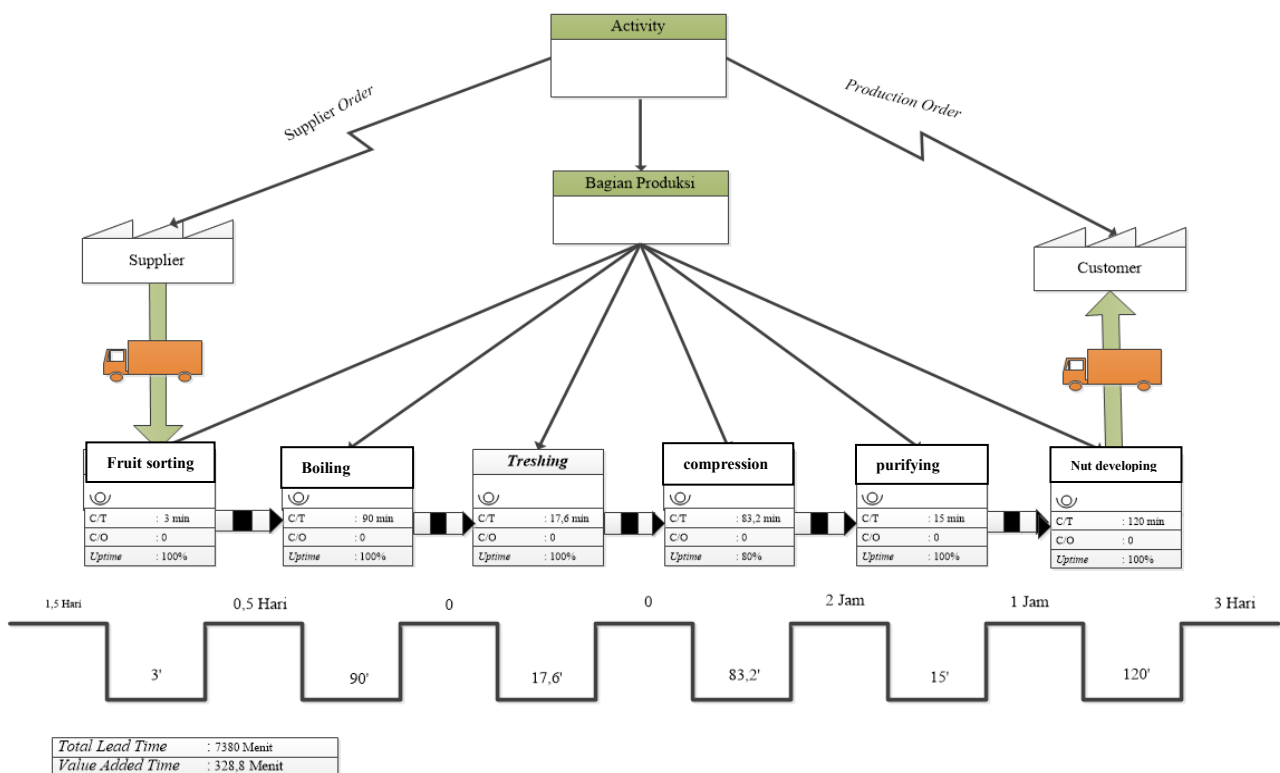


Figure 3. The value stream mapping

Based on the research conducted, it can be concluded as:

1. Waste of time to wait faced by impact on the long production lead time.
2. In the production process there are two waste item selected. Classification of waste is waiting. The waste is which contains the stew waiting for lorries to get into the station and threshing process of threshing station waiting queues to get into the compression station.
3. Factors that cause waste, among other things queue of trucks of fresh fruit bunches to enter the station compression, the process of moving lorry very long time, the capacity of the station threshing and station compression unbalanced, the charging process FFB to machine thresher too long, and the cycle time between stations threshing and compression stations that are not balanced.

4. Current State Map of making the results show that there is a Value Added and Non-Value Added Time Time, which occurs in one cycle. Total Value Added Time was 328.8 minutes, while the total Non-Value Added Time is 5.667 days. While the manufacture of Future State Map Total Value Added Time was 328.8 minutes, while Total Non-Value Added Time is 5.125 days.
5. Analysis 5W + 1H to manufacture Diagram 5 Why be one method to find the root problems in the production process and creating a table 5W + 1H be an improvement for the future.

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