Implementation of lean manufacturing for frozen fish process at PT. XYZ

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Abstract. PT. XYZ is a company specialized in the processing of fishery products particularly in frozen fish fillet. The purpose of this research was to identify the type of waste and determine the recommendations of minimizing waste Lean manufacturing approach was used in the identification of waste by describing the Value Stream Mapping (VSM) and selecting tools in the Value Stream Analysis Tools (VALSAT). The results of this research showed that the highest waste that generated was the defect of leak packaging on fillet products with an average of 1.21%. In addition to defect, other insufficiencies were found such as: unnecessary motion, unnecessary overhead, and waiting time. Recommendations for improvements that given include reduction of time at several stages of the process, making production schedules, and conducting regular machine maintenance. VSM analysis shows reduced lead time of 582.04 minutes to 572.01 minutes.

1. Introduction

PT. XYZ is a company specialized in the processing of fishery products, particularly in freezing of fish. The products of this company are: red snapper, anggoli, grouper, nike anchovy, *kapasan* which later will be processed into fillet, whole round, whole gutted, whole gilled and gutted, and whole gilled gutted and scaled fish products. The products are exported to foreign countries such as China, Vietnam, Malaysia, America, European Union and Australia. PT. XYZ aim to improve productivity. One of the efforts is minimizing the waste that generated during the production process. Among several types of waste that generated is a defect in the form of leak packaging of fillet product. The company target is a zero defects, but the defect still exceeds the expected target.

The approach that can be used to identify and minimize waste is lean manufacturing. Lean manufacturing is a quality management philosophy that focuses on reducing waste and eliminating unnecessary steps in the operations [1]. The methods that can be used in lean manufacturing are Value Stream Mapping (VSM) and Value Stream Analysis Tools (VALSAT). VSM is a visual presentation of the current process flow, which is then analyzed for its improvement to produce future state map [7]. While VALSAT serves as a method to

analyze the most dominant waste generated in the production process and to provide recommendations for improvement [3].

2. Research method

The scope of the study was limited to red snapper fillet products. There were 12 types of waste observed. However, this study did not analyze the production cost. The study was conducted until giving a recommendation of improvement. The data collection was divided into two, namely primary and secondary data collection. There were several stages in the present study as follow:

1. Determination of the standard time

At this stage, observations were conducted by controlling the processing time using a stopwatch. The formula for calculating cycle time, normal time, and standard time has been described elsewhere[6]:

Cycle time formula:

$$Ws = \frac{\sum Xi}{N}$$

Note:

Xi = observation time

N = number of observations

Normal time formula:

Wn = Ws x Rf

Note:

Ws = cycle time

Rf = rating factor

Standard time formula

$$Wb = Wn \ x \ \frac{100\%}{100\% - \% \ allowance}$$

Note:

Wb = standard time (default time)

Wn = normal time

2. Creation of Current State Map

3. Identification of Waste

4. Selection of VALSAT Tools

5. Creation of Future State Map

3. Results and Discussion

One of the fish products manufactured by PT. XYZ is a frozen fish fillet. The type of fillet that observed was red snapper fillet with natural cut and skin-on weighing 6-10 oz (170.1-226.8 gram).

3.1 Determination of the Standard Time

The data required in the standard timing was observation of 14 stages of the process measured by using a stopwatch. The first step was to select a trained worker to be observe at each stage of the process. One calculated cycle is the production process in a master carton pack containing ± 20 fillets or equivalent to ± 10 fish weighing ± 4.54 kg. Data cycle time (Ws), normal time (Wn), and standard time (Wb) are shown in Table 1.

Table 1. Data of Ws, Wn, Wb.

No	Process	Cycle Time (minutes)	Normal Time (minutes)	Standard Time (minutes)
1	Materials Sorting	1.45	1.65	2.02
2	Washing 1	2.38	2.72	3.27
3	Scaling	2.96	3.47	4.20
4	Filleting	9.41	11.39	13.72
5	Separation of thorns	3.36	3.90	5.54
6	Trimming	8.94	10.55	12.64
7	Sizing	0.91	1.01	1.24
8	Washing 2	1.57	1.79	2.17
9	Wrapping	3.29	3.75	4.29
10	Vacumming	1.34	1.65	2.03
11	Arrangement of fish	0.62	0.68	0.78
12	Freezing	480.00	480.00	480.00
13	Metal Detecting	0.33	0.37	0.40
14	Secondary Packaging	1.34	1.53	1.75
	Total	517.9	524.46	534.05

Source: Processed Primary Data (2016)

3.2 Creation of Current State Map

Current state map was made based on the current condition of the red snapper fillet production process. Movement of material through various processes/facilities during manufacturing is shown in this map [4]. Current state map production process of red snapper fillet at PT. XYZ is shown in Figure 1. The analysis performed when making the current state map was by grouping activity time during production process into value added (VA), non-value added (NVA), and necessary but non-value added (NNVA). The main key in grouping these activities is to take the consumer perspective that can also be used to differentiate waste [9]. Current state map has a total time of VA of 530.39 minutes and NVA (including NNVA) of 51.65 minutes.
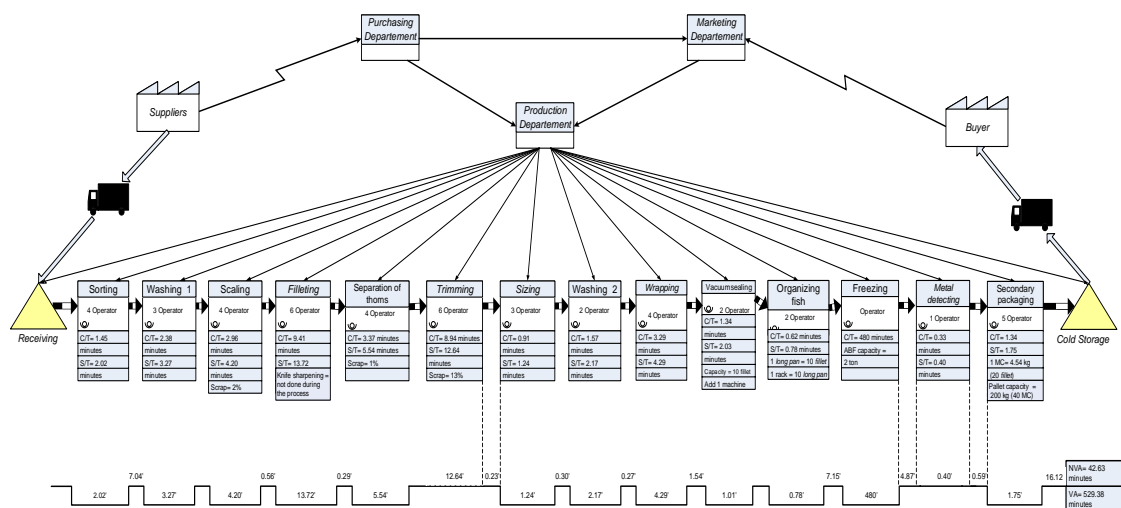
Figure 1. Current State Map

3.3 Identification of Waste

The waste identification was performed by recasting the results of the 12 waste questionnaires that had been distributed to the plan manager, the quality assurance manager, the head of production department, and the supervisors of the production lines. Wastes that have the highest value was the most dominant waste occurs ie defect with an average value of 2.67. While the

waste with the lowest value was overproduction worthed an average of 0. The result of questionnaires distributed to respondents is presented in Table 2.

Table 2. Result of questionnaires

No.	Waste/inefficiencies	Mean	Rangking
1	Overproduction	0.00	8
2	Waiting	0.78	3
3	Transportation	0.67	4
4	Inappropriate processing	0.56	5
5	Unnecessary inventory	0.56	5
6	Unnecessary motion	1.22	2
7	Defect	**2.67**	**1**
8	Power and energy	0.78	3
9	Human Potential	0.44	6
10	Environmental pollution	0.56	5
11	Unnecessary overhead	1.22	2
12	Inappropriate design	0.22	7

Source : Processed Primary Data (2016)

3.4 Selection of VALSAT Tools

The selection of tools at this stage was based on the correlation value between each tool with the dominant waste. The tools chosen in this research were the overall supply chain effectiveness mapping. Overall supply chain effectiveness mapping provides a measure of the total effectiveness of each process area or part of the supply chain. Overall supply chain effectiveness mapping can be calculated using the following formula [8]:

Supply Chain Effectiveness= *Components Available for use x On Time Delivery Performance x Quality of Incoming Goods*

The value of component available for use and on time delivery performance of each process was obtained from Gantt charts based on the data of measured time during observation. While quality of incoming goods is obtained from the observation, expert opinion and historical data company. The overall supply chain effectiveness of the red snapper fillet production process is presented in Figure 2. Some stages of the process have a low percentage of effectiveness. This was due to the inaccuracy of time by means of cart displacing between processes and the waiting times. In addition, the presence of vacuum plastic packaging leaked in the vacuum process can cause the percentage of subsequent processes to be low.
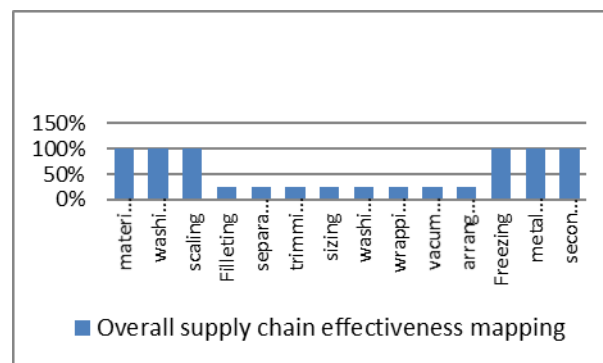
Figure 2. *Overall supply chain effectiveness* of red snapper fish fillet

### 3.5 Causes of Waste Analysis

Analysis of the cause of waste can be done after viewing the current state map or through VALSAT tools selected. The dominant waste, which was the defect due to a leaky vacuum plastic. The average percentage of the leaky vacuum plastic on the quality filter mapping was 1.21%. As a result of this waste, there was a re-processing that will certainly increase the production lead time. Fishbone diagram of the defect is shown in Figure 3.
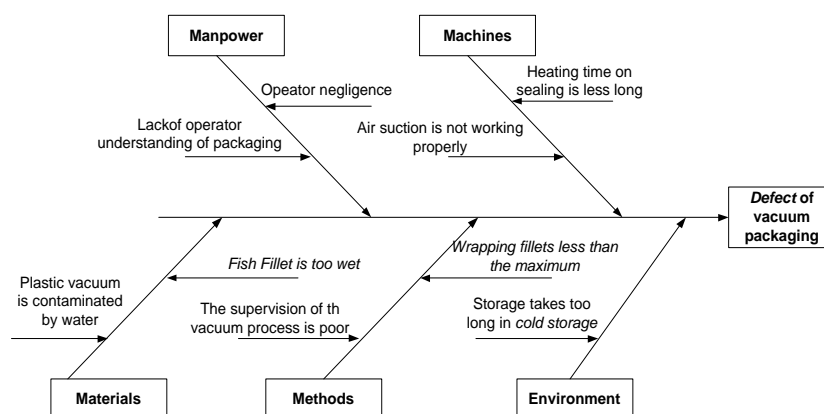
Figure 3. Fishbone diagram of defect

3.6 Creation of the future state map

The futures state map shows the output of the proposed improvements through an overview of the current state map [10]. The main focus of the creation of future state maps was the minimization of time on non-value added activities. At the current state map it was recorded that the total time of non valued added was 51.65 minutes. After the recommendation of improvement with certain assumptions, the total time of non value added was reduced to 42.63 minutes. Details of time reduction can be seen in Table 3. Future state map of red snapper fillet process is shown in Figure 4.
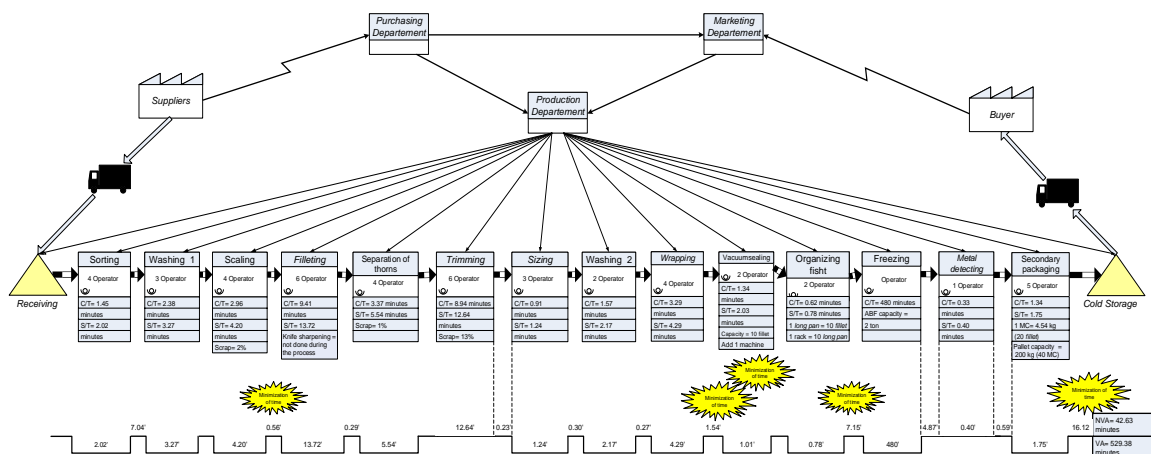
Figure 4. Future State Map

The following is an explanation of the proposed reduction time:

a. Waiting time due to knife blade activity is done when the process resulted in the accumulation of raw materials of fish to be in filleting.

b. Stacking on vacuum processing can be overcome by adding 1 vacuum sealer machine. The addition of vacuum sealer machine is based on brainstorming and discussion with the company to avoid bottle neck. The waiting time for the previous vacuum process will be reduced to 1.19 minutes (2.39 minutes: 2), while the vacuum processing time will be reduced from 2.03 minutes to 1.01 minutes (2.03 minutes: 2). If the capacity of red snapper fish fillet in 1 day is 80 MC, then the amount of time deducted for such activity is 95.53 minutes (1.19 minutes x 80 MC) and the amount of vacuum time is reduced to 81.09 minutes (1.01 minutes x 80 MC).

c. In the secondary packaging process with 4 operators, there is full pallet waiting activity before being taken to cold storage room. The full pallet waiting time is 17.50 minutes. Recommendations are given to optimize the workforce that is not currently performed in production activities.

Table 3. Details of reduction time.

No	Activity	Current state time (minutes)	Future state time (minutes)	Reduction time (minutes)	Reduction time (minutes)
1	Sharpen the fillet knife	1.26	0.00	1.26	10.08
2	Waiting for the vacuum sealer is ready	2.39	1.19	1.19	95.53
3	Vacuum	2.03	1.01	1.01	81.09
4	Waiting for the push rack is full	6.14	3.07	3.07	49.12
5	Waiting for the pallet is full	17.50	14.00	3.50	7.00
	Total	29.32	19.27	10.03	

4. Conclusion

From the research, there are 12 identified waste. Wastes with the highest ratings were defect (2.67), unnecessary motion (1.22), unnecessary overhead (1.22), waiting (0.78), and power and energy (0.78). The percentage defect of leaked primary packaging was 1.21%. Identified waste occurred due to the uncertain arrival of raw materials, the timing of delay, leaky vacuum plastic packaging, and the exhaustion and negligence of workers during the production process. Recommendations for improvements that given include reduction of time at several stages of the process, making production schedules, and perform regular machine maintenance. VSM analysis shows reduced lead time of 582.04 minutes to 572.01 minutes.

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