

## Case Study: Maintenance Proposal of Press Parts Production for Minimize Waste by Lean Manufacturing – Value Stream Mapping (VSM)

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**Abstract**—Higher competition in businesslike field demanded each company acted as a value creator with progressive fixing performance. One of effort in increasing productivity was reducing waste. Enterprise T have seven type of extravagance were over production, transportation, inventory, over processing, motion waiting and defect. Minimize waste have bond with production time which could increase efficiency on using electricity and decreased lead time. Production process in this company showed non-value added time such as excessively material transportation in picking area and so the workers too much waited for the next schedule activity. This condition caused higher product lead time. Lean manufacturing idea necessary was implemented with using tool Value Stream Mapping – VSM. This strategy would resumed for the company maintenance and the result showed that lacking as much 26,45% of lead time could be a problem solution. Reducing lead time could be higher if the company have applied and played continue improvement.

**Keywords**—lead time, lean manufacturing, value stream mapping.

### I. INTRODUCTION

**M**ANY Efforts were did companies to be exist with belonging good quality product, competitive price and defend in market, also they were capable to fulfill fluctuate demand. This condition was recently faced some enterprises in Karawang, they worked as supplier spare part vehicle and engine in manufacture industry. Nowadays, some manufacture business realized that traditional concept from mass production must be adapted to new ideas of Lean Manufacturing [1] [2]. This thing had explained in book of *The Machine that Changed the World* that introducing lean manufacturing as a terminology which used Toyota [3]. The concept focused on decreasing lead time with reducing waste in each step process to get high quality and lower cost [4] [5] [6].

One of another ways in ascending productivity was descending waste. From the result of initial monitoring was knew that production line in one manufacture factory (see Table I) showed that there was many activities non value added time and gave lacking profit such as no efficient movement material at machine section, and excess time at once lapse than exactly time to handle the track transfer. Furthermore, operator movement did the same reality, and waiting list was be excess on raw material and also material in processing or after processed.

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Table 1. Some activities non value added time in production line

No	Type of Waste	Activity	Time (s)		Section Area
			Standard	Actual	
1	Waiting time	1)Raw material waited checking quality process	300,00	7200	Receiving area
		2)Part waited for delivered to Blanking station	17,44	54,78	Blanking process
		3)Part waited for bending process	10,15	50,22	Blanking process
		4)Part waited for delivered to final check station	25,78	83,65	Champering process
		5)Part waited for packing process	20,19	79,05	Packing process
2	Transportation	Transference of part after process from Blanking station to next station regularly with manual working	120,00	300,00	Blanking process
3	Over processing	1)Parallelism strike of hole center used hammer	-	-	Restrike process
		2)Rechecking part after plating process	-	-	Final check process
4	Unnecessary motion	Finding cutter broach after finishing part broach process	-	-	Broaching process

Activity 1-2 in Table I caused rising lead time product. Lead time was length from material (in) that waited for treated from one machine process to another and so it produced waste. This thing indicated that using resources was not maximal. Lacking waste could give efficiency, reducing waiting time, and transportation activity so could gain more productivity.

This research focused how sketch condition process (line production), any waste as along value stream, suggested solution and strategy for no value added activity. Maintenance proposal based on condition right now and decreased lead time product. Descriptive situation used tools process activity mapping from lean manufacturing method. Furthermore, selection of detailed mapping tools used value stream mapping method to identify value added activity [7] [8]. VSM was based lean production system [9] and maintenance tool to visual production process overall [10] [11], represent material and information line. The mapping purposed to know all waste in value stream and took a step to

eliminate the problems [12] and had become one of the most popular tools for lean implementation [13].

The research has done for press parts model, Arm Rear Brake. Scope of value stream was input raw material from supplier until packing product. This main project evaluated descending in lead time sector with four observation activity (see Table I)

## II. RESEARCH METHOD

Enterprise could choose the suitable method for each demand and mission, and certainly implementation in there. Method that used for lean manufacturing was value stream mapping with collecting primer data (cycle time product, change over time product, and layout work center uptime), and secondary data (demand data of product, size of batch production, number of operator, time activity, inventory, information line, and uptime. Two of the data were processed to result formation and analysis current state map, and formation future state map (see Fig.1).

Testing of primer data was presented by equations below.

- 1) Defined average value

$$\bar{X} = \frac{\sum f_i \cdot x_i}{\sum f_i} \quad (1)$$

- 2) Defined hypothesis data

$$X^2 = \sum \left[ \frac{(o_i - e_i)^2}{e_i} \right] \quad (2)$$

where

$$e_i = \pi \times N \quad (3)$$

N = number of observation data

- 3) Defined sufficiency data

$$N' = \frac{20 \sqrt{N \sum Y_t^2 - (\sum Y_t)^2}}{\sum Y_t} \quad (4)$$

where

N = size of sample

$Y_t$  = actual data

t = 1, 2, 3, ..., n

Takt time was frequent company produced one part or product in one day based on average daily of selling product to fulfill demand.

$$Takt\ time = \frac{available\ work\ time\ per\ day}{customer\ demand\ per\ day} \quad (5)$$

Equation (5) was used to synchronize the pace of production with the pace of sales [14]

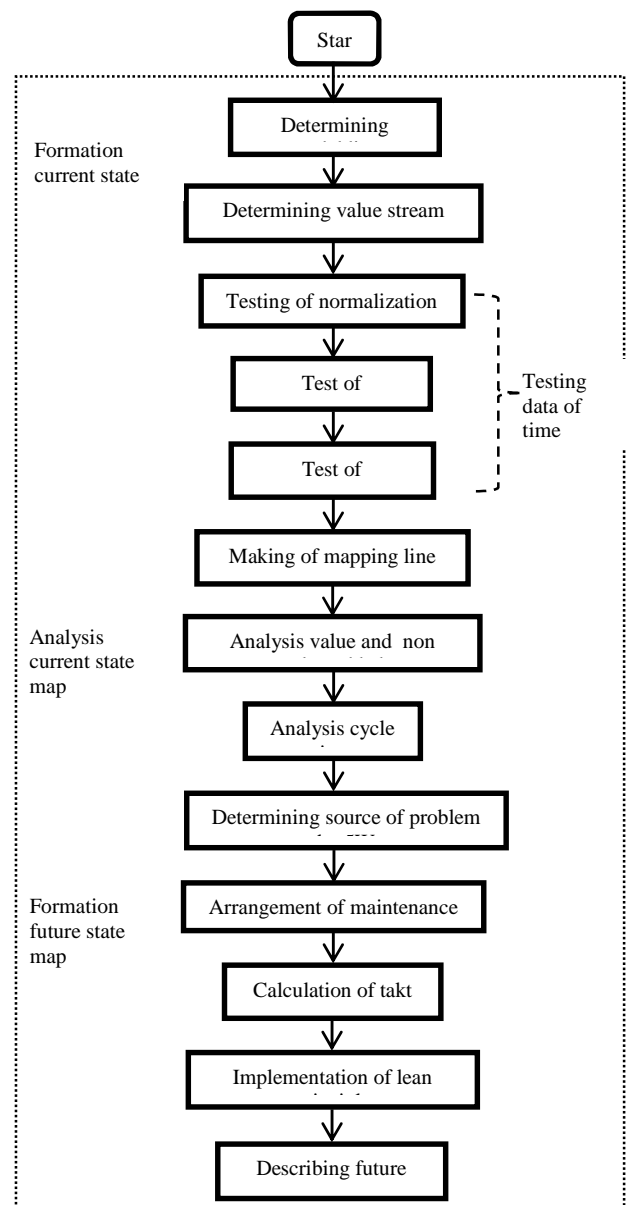


Fig 1. Research Method

## III. RESULT AND DISCUSSION

Formation future state map was made to reduce waste that analyzable in current state map. Maintenance proposal in future state map was not shortcut choice to get ideal condition that be free from waste, but rather as a form of continue improvement such as :

1. Keeping procedural working in some stations productive area
2. Developmental continue line in blanking area, spot welding, broaching final check and packing
3. Doing separation of part in initial machine process was blanking process that using different color box in each part model and different station. The thing aimed decreasing time of re-transfer part because miss using box to other process
4. Technical maintenance of moving part after process was purposed for a higher effective and efficiency. In blanking process, part after moved to next process was pulled by system and the box has been adapted for utilizing. Using trolley box as a transportation cause frequent motion of worker could descend on moving part

5. Reducing size of batch production could decrease waiting time of product or lead time
6. Doing control productivity in floor of factory could descend waiting time of product in each process

This research did maintenance activity for reducing activity non value added time and certainly descending lead time (see Table II). Changing lead time that resulted was based on estimate value stream manager and observation in field.

Based on result in Table II, changing lead time was 6 days, there was 54% decreasing activity non value added time. In another research, implementation of lean principle could give reduction of cycle time more than 40% (time coil production at the mill until the coil was ready for shipping after processing) [15]. The same result showed that a significant reduction of no value added time and increasing value added was up to 66% in garments industry by VSM [11]. The other way, VSM was a necessary but not to sufficient approach to analyze production systems issues [16]. Furthermore, implement continue improvement after maintenance condition was described in goal of future state map. The map aimed to make continue line production and eliminate as much waste that lead time was shortened by implementation of lean techniques. The company necessary re-mapped its condition at the moment and then made maintenance design again to get better situation. Maintenance proposal needed realization support and execution strategy as initial measure to improve productivity (see Fig. 2).

Table 2. Comparative lead time in current and future state map

No	Activity	Time (minute)	
		Current State	Future State
1	Storage time of raw material	10080	4320
2	Raw material waited for processed in machine or blanking process	120	54
3	Part waited for carried to Bending I process	55	10
4	Part waited for processed in Bending I	44	13
5	Part waited for carried to Pierching process	40	7
6	Part waited for processed in Perching	43	11
7	Part waited for carried to Bending II process	55	12
8	Part waited for processed in Bending II	84	17
9	Part waited for carried to Restrike process	48	5
10	Part waited for processed in Restrike	79	11
11	Part waited for carried to Spot Welding process	49	7
12	Part waited for processed in Spot Welding	48	8
13	Part waited for carried to Broaching process	68	9
14	Part waited for processed in Broaching	77	12
15	Part waited for carried to Champering process	61	11
16	Part waited for processed in Champering	76	9
17	Part waited for carried to Platting process	121	15
18	Part waited for processed in Platting	1140	1140
19	Part waited for carried to Final Check process	43	7
20	Part waited for processed in Final Check	84	13
21	Part waited for processed in Packing	79	9
22	Part was saved in Finish Good storage and waited for shipping	2280	1140
Total		14774	6840
		13	6 days
		days	

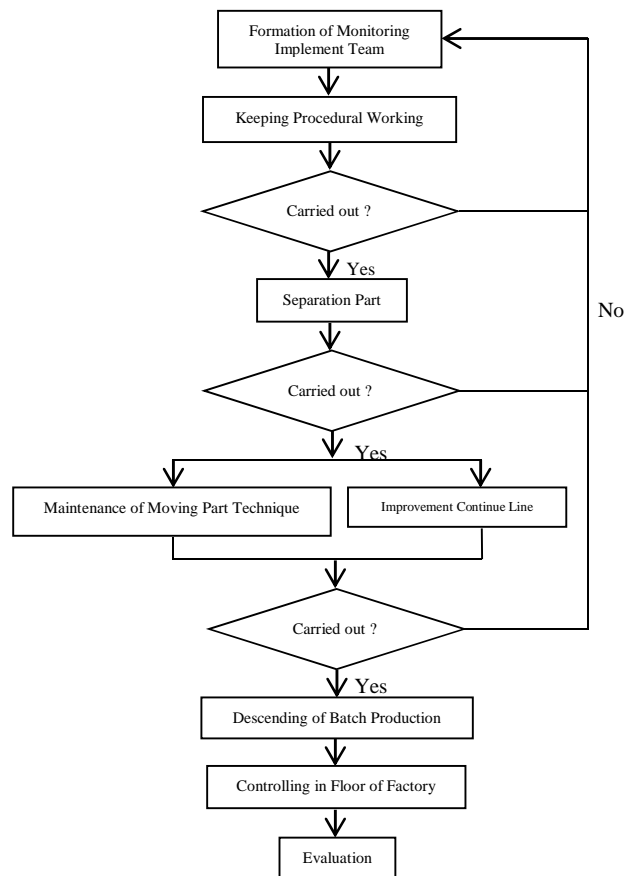


Fig. 2. Scheme of implementation strategy

#### IV. CONCLUSION

Wasting time caused load and to be disturbance in production line to next process. The main waste in this company was waiting time and motion. Sector maintenance that focused by the enterprise was receiving raw material, blanking, bending 1, pierching, bending 2, restrike, spot welding, broaching, champering, final check and packing part. By value stream mapping, the descending lead time was 54% from 13 to be 6 days in reducing non value added time activity on future state map.

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