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Lean Modelling – A Case Study for the Indian SME

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Abstract - **This paper work presents a model of implementation of lean manufacturing for improving productivity and quality, by conducting a case study in a small scale industry at Ranchi, Jharkhand. The purposes of this paper are to identify waste related problems, cause of equipment failure, bottleneck problems and rectify them. The above problems are analysed in concern with rejection control, inventory control, waiting time, set time and eliminating non value added time / activities. The complete problem is identified and depicted by value stream mapping. This paper conclude with discussing improvements and it proposes Value stream mapping lean tools can be applied in small scale industries for reduction of wastage and increasing productivity.**

Keywords - Value Stream Mapping, Lean Manufacturing, Small scale industry.

1. INTRODUCTION

In India the SSE are producing more than 8000 components and consist of Traditional Cottage & house hold Industries and modern small scale Industries. Out of these units more than 80% are family owned, around 17% are partnership and only 2% are Limited companies. The modern MSMEs are incorporating new technology and advanced manufacturing systems in their plants, using information technology to get connected with the world, focused on quality products with variety and changing from the traditional working to a world class manufacturing organizations [Goyal et al., 2013a, 2013b, 2013c, 2012]. The technology gap is alarming and the expenditure on R&D in an Indian Industry is less than 0.6% on average of its turnover as against the world average of 2.5%.the most problem faced by the MSMEs has been in accessing technology and maintaining competitiveness[Methew et al.,2004; Phanden et al. 2011, 2012a, 2013]. In this growing competition these MSME's focusing on more output without implementing proper tools which is resulting in one of the seven wastages.

These wastes can be reduced by implementing lean techniques. Lean Manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste [Womack et al., 1996]. It is derived from the Toyota Production System and its key thrust is to increase the value-added work by eliminating waste and reducing incidental work. [Ohno et al., 1988] The technique often decreases the time between a customer order and shipment, and it is designed to radically improve profitability, customer satisfaction, throughput time, and employee morale. [Acganga et al., 2005].The main tool in analyzing wastes and time consumption throughout the manufacturing cycle in lean manufacturing is Value stream mapping.

A value stream map is typically created as a one-page flow chart depicting the current production path or design path of a product from the customer's request to delivery. [Manil G et al., 2012] An important goal of value stream mapping is to identify processes that do not provide value so they can be improved. In lean production, value can be thought of as anything the customer is willing to pay for Processes that do not provide value are called waste.[Bhim singh et al.,2009] Value stream maps document the current state of the value stream as well as the future state of the value stream and define any gaps between the two.

2. CASE STUDY

A study was conducted in small scale industry, which is CNC manufacturing unit located in Jharkhand and they are manufacturing CNC Precision Machined Components, Aluminum & Zinc Alloy Pressure & Gravity Die Castings. The company is accrediting with ISO 2001 Certified. The study discusses the implementation of Value Stream Mapping carried out in the CNC machining Centre of the industry. The main aim was to reduce the cycle time and cost.

The objectives for the implementation of the lean manufacturing tools in this industry are

- To study the Current State Value Stream Mapping by collecting the data.
- To identify the problems faced by the Industry in terms of Non Value Added time

· To propose Future State Value Stream Mapping which can increase the Value added time and reduce non value added time.

3. ADOPTED METHODOLOGY

3.1Value Stream Mapping

A value stream is a collection of all actions value added as well as non-value added that are required to bring a product or a group of products that use the same resources through the main flows, from raw material to the arms of customers. [Hugh et al., 2002] Value stream maps are a very common technique when you're implementing a lean system.

- Identify the "present state" and "future state" of the production process
- Model the information flow, material flow, and lead time from beginning to end of the value Stream.

3.2 Value Stream mapping symbols is shown below

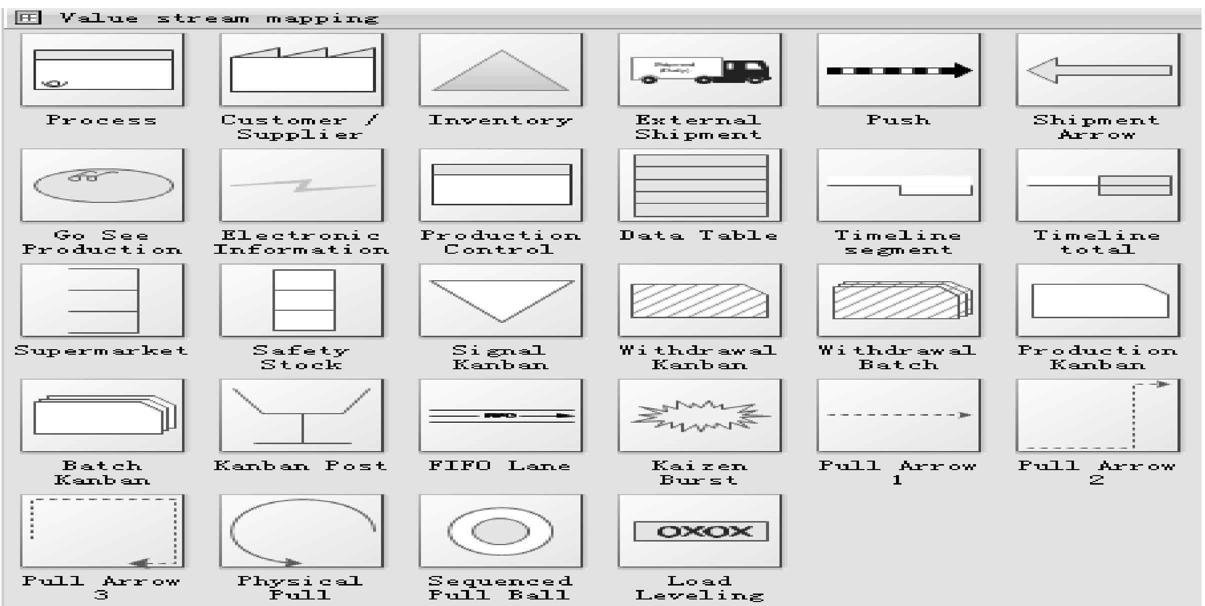

Figure 1: Value Stream Mapping Symbol [Hines P et al., 1997]

4. METHODOLOGY

4.1Current state map: - Mapping the value stream always starts with the customer demand.[Shook J et al.,1999] to create current value stream map these following step are followed –

Step -1Calculate Takt time: Takt time for this process is 42 sec.

Step-2Understand Customer Demand: Customer demand is monthly or daily demand of customer as per need .Customer demand for this process is 600 psc/ day.

Step -3Mapping The Process flow: This step involves various processes which are in sequence to complete product development and calculation of cycle time, changeover time, and uptime for each.

Step -4Map the material flow: The flow of material form row to finish good is given by supplier to customer.

Step -5Map information flow: The information flow is also incorporated to provide demand information. Which is an essential parameter for determining the process in the production system? Various data regarding cycle time (C/T), changeover time (C/O), uptime, take time etc.

Step- 6Calculate total product cycle time: After both material and information have been mapped. A time line is displayed at the bottom of the map showing the processing time for each operation and the transfer delay between operations. The time line is used to identify the value adding step, as well as waste .in the current system PLT for our process is 5 day.

Step -7Detail off-line activities :Activities like placing of order , supply of material .daily schedule , monthly forecast etc is involved in this section which is well executed by transportation ,supplier icon and information flow line .

Step-8Identify opportunity for improvement: Gathering of opportunity and also to write a summary on these observations to further improve throughput rate and to draw a future state map which show change in process.

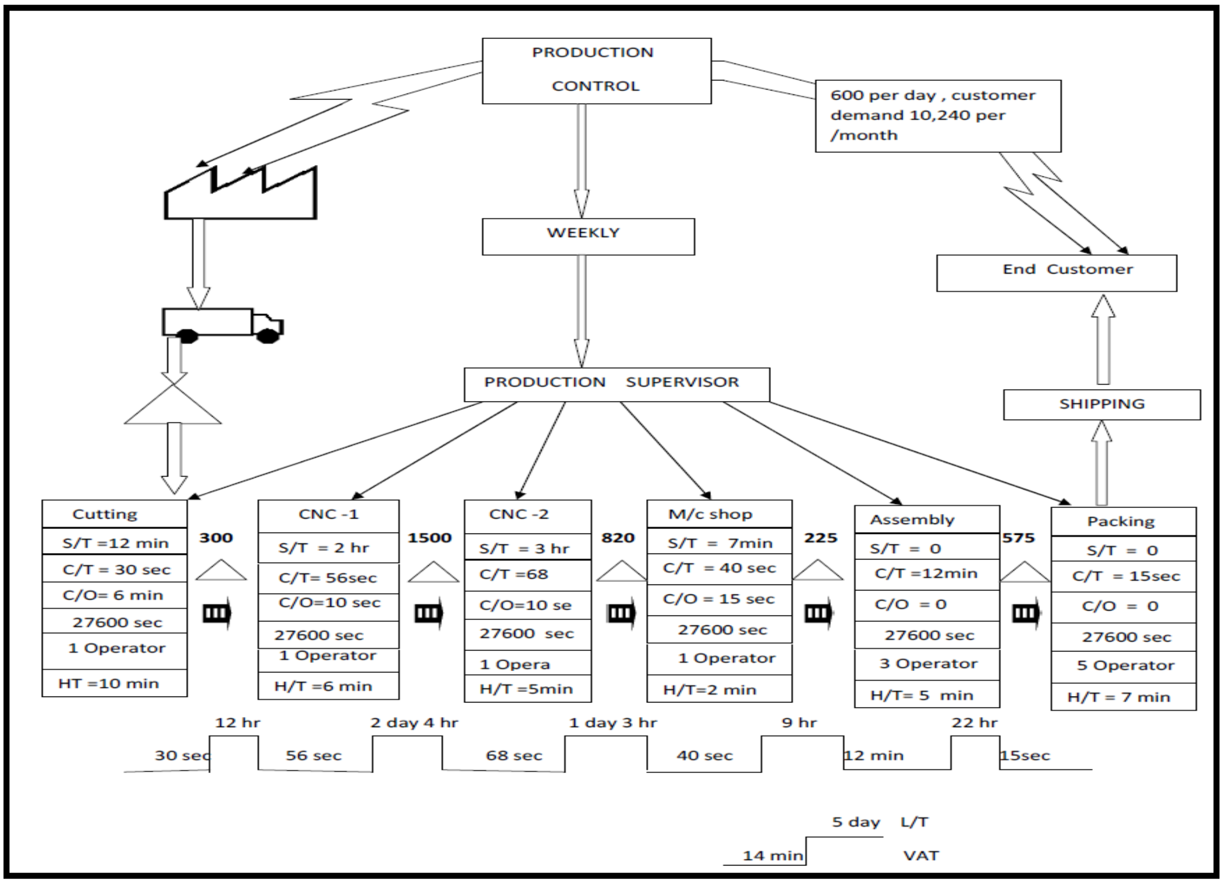

Figure 2 current state map

Analysis of Current State Map:

The current state map is a fancy way of saying 'what happens now' or the 'as-is' process. The current state map should show all the process steps and sufficient detail on how each step is completed and what happens to the items being processed. This will enable us to spot the causes of problems and thus the means to improving the flow, efficiency, reliability and flexibility of the process. It can be as detailed or as simple as you need and can also exist in a number of different versions for consumption by different internal or external groups. We analyzed in our CSM that PLT for assembly process is 5 days and value added time is 14 mints. We have found wastage during changeover of one process to another.

4.2 Creating Future State Map:

To create future state map these are following findings-
Product Lead Time (PLT) **-** 5 Days
Value added time **-** 14 min
Product Cycle Efficiency (PCE) **-** 0.388**%**

These four wastes need to be reduced or eliminated first in order to move the system closer to the one proposed in the future value-stream map. They are:
(1) Defects.
(2) Waiting time.
(3) Inventory.
(4) Material handling.

Data Analysis

Here calculate the value addition percentage in the different process. Also analyzed the causes of different problems and suggested their remedial actions. Reducing lead time by improving production.

1. Cutting
In this process, the cycle time is 30 sec, changeover time is 6 min and daily average output is 600 pcs/day, and setup time is 12 min. After noticing all that, the most of the time is spent in handling of material between inventory and cutting shop. The outcomes of this research is that, some implementation for some area is required which will improve production as well as reduce inventory also.

2. CNC
In this process, the cycle time is 56 sec, changeover time is 10 sec and set up time is 2 hr. CNC machine generated a high rate of defects which required the operator to spend extra non-value added time reworking the products. As per the conclusion, the CNC machine which create a defect that to needed to rework. In addition, inspection time is also added for this reason.

3. VMC
In this process the cycle time is 68 sec, changeover time 10 sec and set up 3 hr . CNC operator sometimes idles while waiting for parts to arrive from the VMC machine. The cycle times are different: 56 sec in CNC machine, 30 sec in cutting, and 68 sec in VMC machine. In this situation bottleneck problem is occurring. The waiting time will be eliminated by Kanban (pull system).

4. Machining shop – In the machine shop cycle time is 40 sec, changeover time 15 sec and set up time 7 min. in this shop affected by scale formation and dimension ,goes further next process, lead to increase waste in time and money. For a suggestion, the industry will properly use GO –NO GO gauge for measured dimension.

5. Assembly shop – In the assembly shop cycle time is 12 min and changeover time is 20 sec

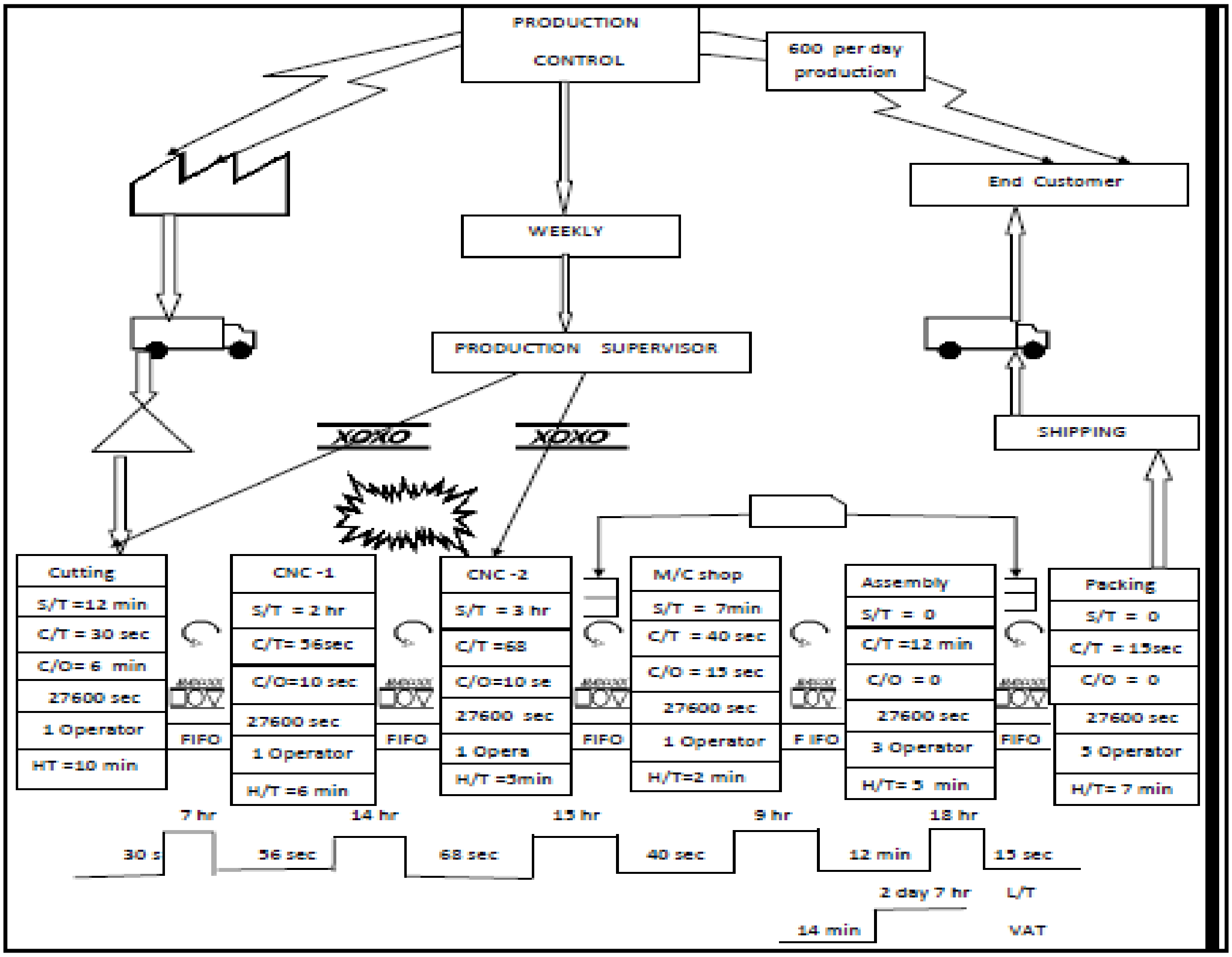

Figure 3 future state map

Analysis of Future Stream Map:

In Future State Map for assembly process two processes are gathered to reduce non value added time during processes. Supermarkets are placed between processes to reduce inventory wastages during process and to turn process from build to stock to make to order. Make to order process lead to assembly of parts when order placed by customers. It results reduction in inventories. The information and communication flow between processing lines improved by scheduling pacemaker in the process as well process turned from push to pull by Kanban system. On this research we have made some sizeable improvements. Production Lead-time (PLT) has gone from 2 days 7 hr and the process cycle efficiency (PCE) has gone from 0.388% to 0.476%.

4.2.1 Identify bottleneck process

The bottleneck process is the operation with the longest time.(from the example ,this is CNC-2 machine at 68 second)

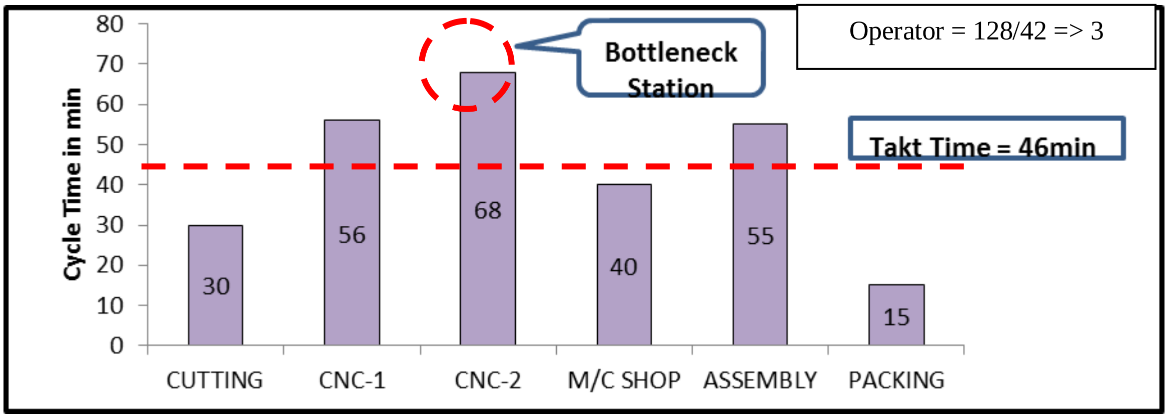

Figure 4: Bottleneck process

Takt Time is the rate of a completed product needs to be finished in order to meet customer demand.

Calculate available time = working time minus regular 'non-direct' time (stand-up Meetings, breaks, vacations, sick time, cleaning, etc.). This is simply the work time in the time period selected, regardless of the number of people actually doing the work.[William M et al., 2001]

Takt Time = Available Minutes for Production / Required Units of Production

Calculation for Takt Time:

Takt time cannot be measured with a stop watch. It can only be calculated. To calculate takt time think touchdown, or T/D, since we simply divide the net available time by the customer demand.

Customer Requirements = 600 per day
One shift = 8 Hours = 480 Min
We consider our production process is 85% efficient
and then there is 408 min in one shift. Now time required = 27,600/ 620

Takt Time = 46 second

5. RESULTS AND CONCLUSION

By the following proposed implementation path of the improvements, the performance of the production process can be improved. This paper work has been done for improving the overall productivity of a small scale industry by implementing the lean methodology. Expected results for some key parameters are presented in the following table:

Comparison of production in process (no. of pieces per shift)

PROCESS	CURRENT STATE	FUTURE STATE
SECTION	-	-
CNC-1	12 hr	7 hr
CNC-2	2 day 4 hr	14 hr
M/C SHOP	1 day 3 hr	15 hr
ASSEMBLY	9 hr	9 hr
PACKING	22 hr	18 hr

In the current situation this results in a average work in progress and Lead time before improvement 5 day By implementing Value Stream Mapping the non value added activities were identified and measures are taken for the improvement of the system. In the future state Lead time after improvement is 2 day 7 hr and saving in lead time 2 day 3 hr.

6. CONCLUSION

In the above mentioned case study, work has been done on identifying the waste related areas as a study of lean manufacturing. It has been found that the reason for non-value added activities are due to wrong handling material, long distance, defect and improper inventory. After literature study in the field of lean tools we concluded that the VSM is an effective tool for eliminating these wastes and study also suggested the ways to reduce non value added times in a manufacturing process. Large reductions in time consumption can be achieved by reducing the waiting time of a job during production process. Most important point is that in this improvement process, no new machines were purchased nor were operators expected to work faster or harder; only procedures and layouts were changed to allow the product to flow more smoothly through the manufacturing process. And this activity reduced the manufacturing lead time intern increased the productivity of a small scale industry.

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