IMPLEMENTATION OF VALUE STREAM MAPPING IN A MEDIUM SCALE INDUSTRY

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Abstract: *Today's Customers are demanding products at less cost and at highest quality. Due this complex situation manufacturing organization has to juggle around with resources. They always seek optimum performance from each every resource in the organization. This also demands reduction in wastages at each and every stage of manufacturing. Lean manufacturing is one such philosophy which is mainly focused on identifying and eliminating wastages from each step in the production chain of the product. Lean concepts can help manufacturing organizations to have check on wastages. Value Stream Mapping (VSM) is one of the important lean tools which provide a broader picture of material and information flow starting with raw material and ending with the customer. This paper presents use of VSM in medium scale manufacturing organization. Implementation of VSM in the organization reduced the non value added time by 27.81% and Cycle time by 15.95 %. The overall improvement in productivity is found to be 18.55 %.*

Keywords: *Lean Manufacturing, Value Stream Mapping, Productivity, Lead Time*

1. INTRODUCTION

The philosophy of lean manufacturing is to focus on identifying and eliminating wastages from each step in the manufacturing cycle of a product. These wastages may be energy, time, motion and resources. Many of the tools and techniques of lean manufacturing are being effectively used by many manufacturing organizations to identify and eliminate wastages through continuous improvement. The main objective of lean manufacturing here is to keep cost down [1]. Similar to other lean tools Value Stream Mapping (VSM) also identify all types of wastes in the value stream and take steps to eliminate these. Many researchers have developed number of tools to optimize individual operations within a supply chain, most of these tools fall short in linking and visualizing the nature of the material and information flow throughout the company's entire supply chain. Taking the value stream viewpoint means working on the big picture and not individual processes [2].

The process of VSM starts with drawing a current state map. The current state map is analyzed for the issues like bottlenecks, delays, excess time for loading, unloading or may be in actual manufacturing. The main task here is to identify value added and non value added processes. Once these issues are resolved future state map is drawn which gives idea about improvements in the process. Few advantages of VSM are:

- It identify sources of wastes within the process
- Locate the bottlenecks
- Gives overall picture from start of the production process to the end
- It helps to improve productivity

If carefully implemented VSM is very effective tool for improvement of productivity and to visualize various resources in simple way. Rahani and Ashraf [1] reported about effectiveness of VSM in finding out hidden wastages and improvement in productivity. According to them significant amount of the time spent on the production system is usually non-value added time. They reported

lower rejection rates due to VSM implementation in the production process. According to Crowe and Arisha [6] value stream mapping, is a very effective tool in mapping the current and future state of organizations lean activities. VSM implementation has a major influence on overall productivity of organization. It also gives realistic view of organization. Their framework accounts for the current value and non-value activities in the company and through simulation they have highlighted the activities that should be used when developing the future state map. Manjunath et al. [3] showed that VSM is a powerful tool in lean manufacturing which helps firms to understand and to improve continuously to work towards becoming lean enterprise. It connects people, process, tools and even documents required data to achieve lean goals. It delivers clear communication between shop floor teams and management regarding lean outlooks. They compared a current state and future state map of manufacturing firm and observed that reduction of 38.2 % in lead time, process time reduction by 2.65 %, and 48.3 % reduction in inventory. Friday, May 11, 2018

Khalid et al [4] reported that lean has been extensively implemented by many organizations especially in manufacturing to improve productivity and to remain competitive in the market. VSM is the most essential tool in the step of implementing lean because through VSM has a great capability to identify hidden wastages. Hines and Rich [5] reported that VSM is new typology and decision-making process for the mapping of the value stream or supply chain. According to them VSM allows an extension of the effective internal waste reduction philosophy pioneered by leading companies such as Toyota. Belokar et al. [6] reported VSM have been proven to be a greatly useful tool to eliminate some waste in a cycle and find there are more waste for you to eliminate in next cycle, during which lean becomes a habit or culture. According to Verma and Sharma [7] value stream mapping is an effective tool of lean manufacturing to reduce the wastage in any process by segregating value added and non-value added activities.

Rohani and Zahraee [8] reported that VSM is the most significant lean manufacturing technique. They used VSM to improve the production line of a color industry. To achieve this goal, lean fundamental principles was implemented to construct VSM for identification and elimination of wastes by using team formation, product selection, conceptual design, and time-frame formulation through takt time calculation. Based on the future VSM, final results showed that by implementing some lean thinking techniques, Production Lead-time (PLT) decreased from 8.5 days to 6 days, and the value added time decreased from 68 minutes to 37 minutes. According to Romero and Arce [9] implementation of VSM in the manufacturing sector is still growing stage. They reported that VSM can improve the visibility of the value stream and the performance of manufacturers. Their study promotes the importance of sharing valuable ideas about the potential positive results that this technique offers, by adapting it to different environments and thus, carry out better research, especially in the cases where its performance does not appear to be good enough. They further mentioned that VSM is capable to enhance the outcomes of many areas besides manufacturing. Kumar et al. [10] reported that VSM helps to identify non value added activities in the process thus helps to increase the usage levels by the proficiency of shop floor practices aimed at increased human and machine productivity, so that the process improvement is possible. They further mentioned that VSM helps in mapping current and future state maps for the process also, is the powerful tool for lean manufacturing and allows companies to understand and continuously improve its goals towards lean achievement.

This paper presents implementation of VSM in a medium scale industry in Western Maharashtra. Current state map was drawn for the present scenario in industry for a product lever. After studying current state map possible changes are suggested and implemented. A future state map is drawn and improvements are quantified.

2. METHODOLOGY OF RESEARCH WORK

Following block diagram indicates the flow of work which is carried out during this investigation (Fig.1).

3. CASE STUDY AND DISCUSSIONS

This case study is carried out in a medium scale industry (Avison Industries) in Western Maharashtra (MIDC SHIROLI, KOLHPAUR). The component is lever for valve body with weekly demand of 350 pieces from Genuine Engineers. It is received as a casting from M-Steel. Someviews of actual component are shown in figure 2 and 3.

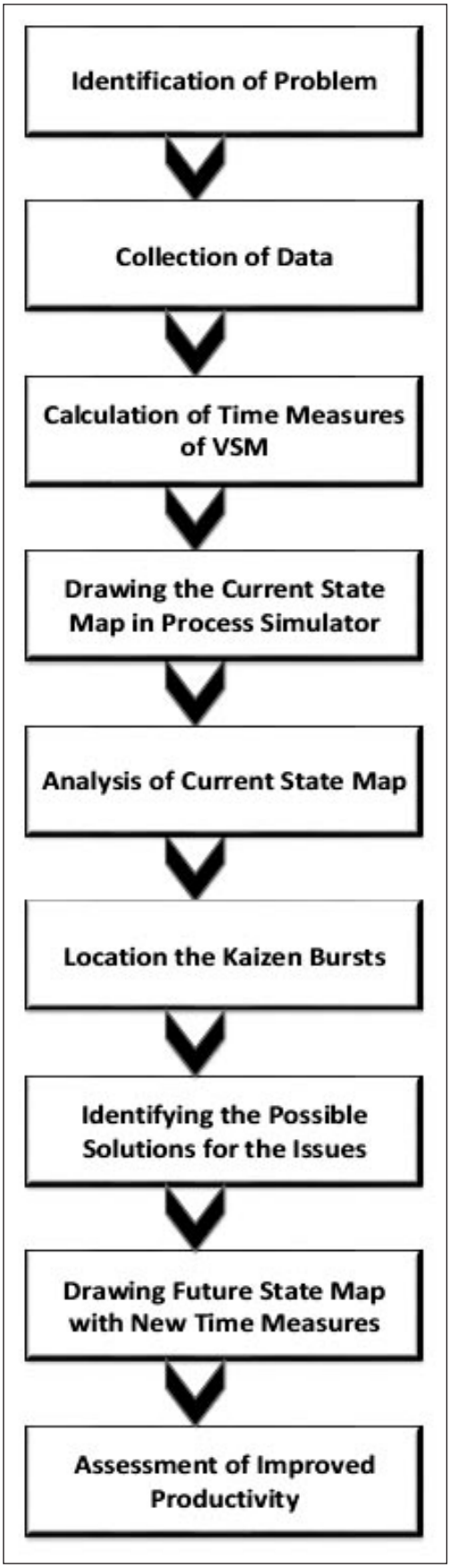


Fig 1. Flowchart of VSM Implementation

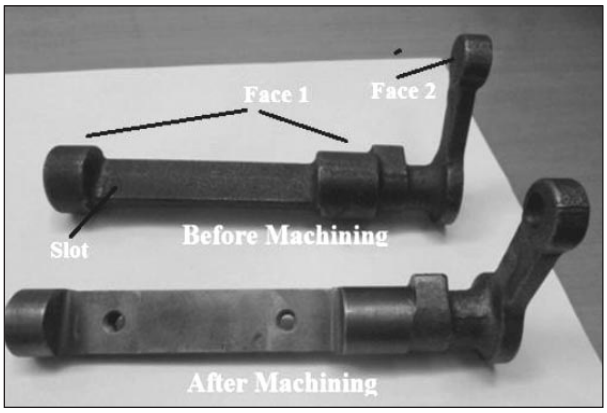


Fig 2. Lever Before and After Machining (One View)

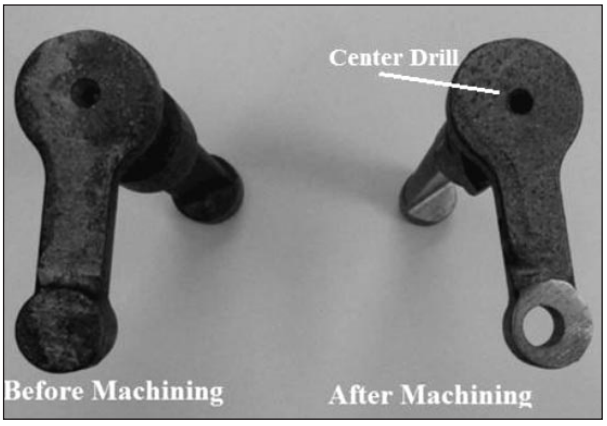
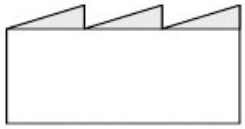
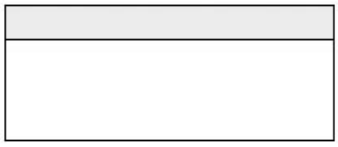
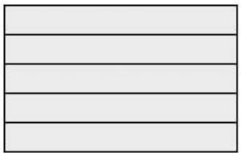
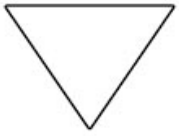
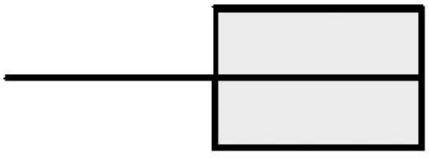


Fig 3. Lever Before and After Machining (Second View)

The component has many machining operations which are mentioned below.

Sr No	Operation
1	Loading component from one side on Drilling Machine
2	Centering from one Side
3	Loading from other side
4	Centering from other Side
5	Moving component to CNC Turning Center
6	Loading component on CNC Turning Center
7	Turning all Faces (Face 1)
8	Unloading component from CNC Turning Center
9	Moving component to VMC
10	Loading component on VMC
11	Slot Milling, Tapping and Side Milling (Slot)
12	Unloading component from VMC
12	Loading component on Drilling Machine
13	Drilling and Reaming (Face 2)
14	Unloading component from Drilling Machine

Table 1: Value Stream Mapping Symbols and their Meaning (Used in Current Analysis)

Symbol	Meaning	Symbol	Meaning
	Customer or Supplier		Electronic Information
	Kaizen Burst		Manual Information
	Production control		Shipment Truck
	Data Table		Timeline segment
	Storage		Timeline total
	Push Arrow		Operator

Firstly all the processes and their sequence of operation, the time involved in manufacturing is noted using stop watch. With all time measures and sequence, a current state map is drawn using process Simulator in Microsoft Visio. In value stream mapping many symbols are used to specify different activities in the manufacturing. However in table 1 , the symbols which are used in the current analysis are shown. Once the sequence of manufacturing a product is finalized, the appropriate symbols for each activity are selected. By using these symbols the outline of map is drawn. Data tables are used to show the details of the each process. These data tables can give information like cycle time, uptime etc. Below these data tables timeline is drawn to indicate value added time and non value added time. Towards the left hand side of each data table non value added time (like loading, unloading) related to that process is shown whereas below the data table value added time of that process is shown. The total value added and non value added time is shown with Timeline Total block in map.

Figure 4 shows the current state map of the process. The respective cycle times and other non value added time for each step are shown on the timeline of the map. Initially when current state map was drawn and its analysis pin pointed two major issues in the current process.

1. While doing the center drilling on the drilling

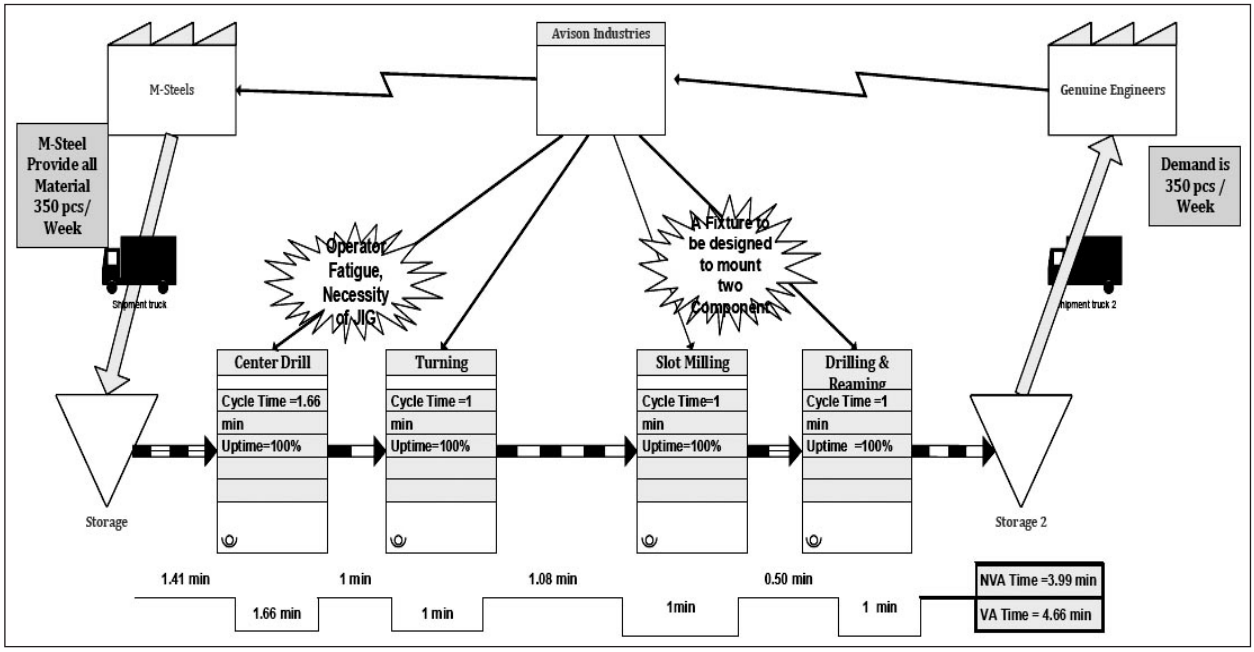


Fig 4. Current State Map with Kaizen Bursts

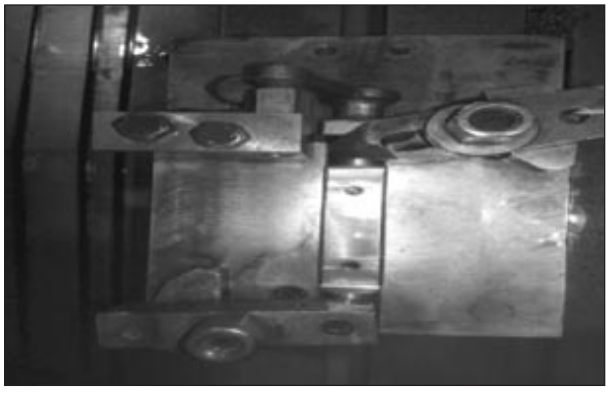


Fig 5. Single Component Fixture (Before)

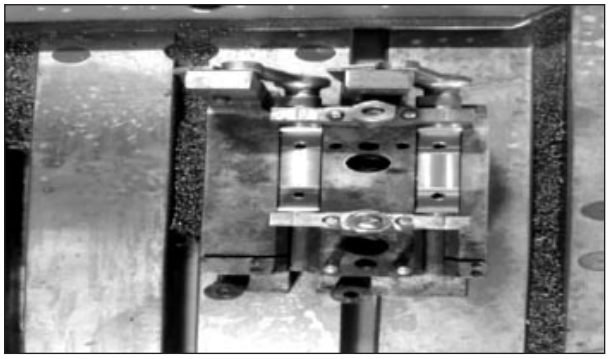


Fig 6. Double Component Fixture (After)

machine, the operator is clamping the component for one face and then does the center drilling. Then he has to locate and clamp for the other face and then have to do the center drilling for other face. This is quiet time consuming and causing fatigue to the operator. So here one jig is used, due to which the operator is able to load the component easily without causing fatigue. Due to this change, the loading time is reduced from 85 sec (1.41 mins) to 45 sec (0.75 mins) for each component.

2. For the slot milling, tapping and side milling operations, currently one component was clamped with fixture as shown in Figure 5. With some discussions and considering the machine limitations, new fixture is manufactured on which two components are clamped at a time which is shown in Figure 6. This change has worked effectively, as the tool change time is reduced, as once the tool comes it does operation for both components and then goes back. Also with slight change in clamping arrangement, two components are loaded and unloaded with the new fixture. Using the double component new fixture, the loading and unloading time is reduced to 38 sec (0.63 mins) as compared to 65 sec (1.08 mins) with previous setup of single component fixture. Also as the tool change time is reduced per component, for the operations with VMC, the cycle time is reduced to 45 sec (0.75 mins) compared to 60 sec (1min) with old fixture.

The results for cycle time and non-value added time (NVA) with current and future state map are shown in table 2. Whereas the improvement

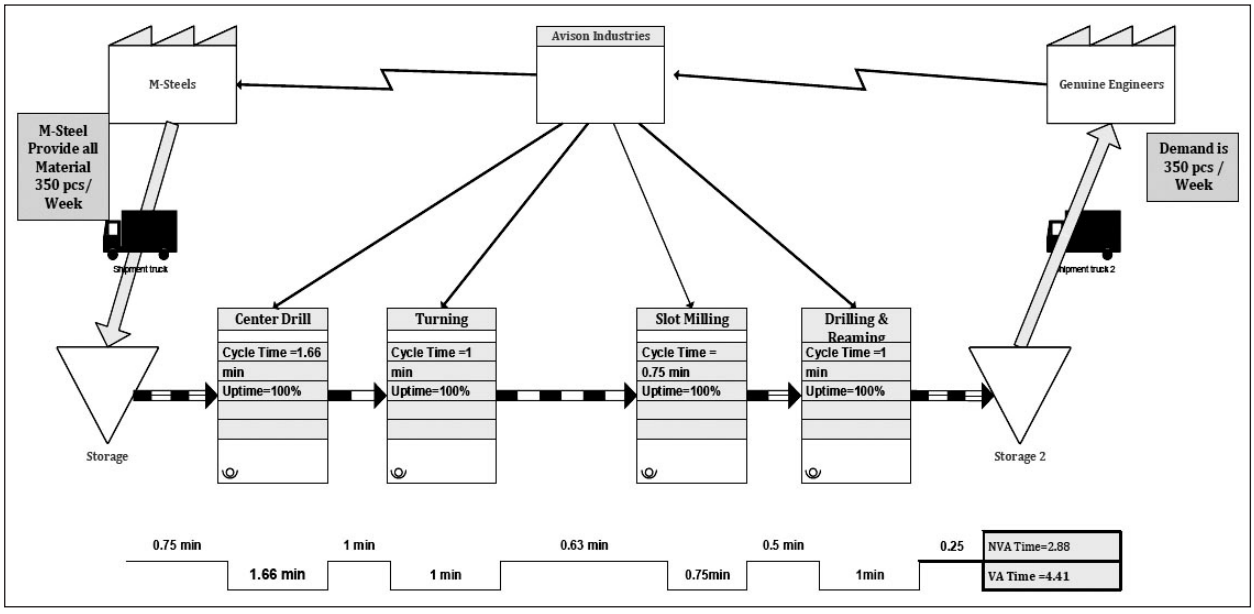


Fig 7. Future State Map

Table 2: Reduction in Cycle Time and NVA after Implementation of VSM

Time Measure	Current State Map	Future State Map	% Reduction
Cycle Time	8.65 Mins	7.29 Mins	15.95 %
NVA	3.99 Mins	2.88 Mins	27.81 %

Table 3: Improvement in Productivity

Current State Map	Future State Map	% Improvement
291 per week	345 per week	18.55 %

in productivity for shift of 8 hours (productive time 7 hours) for a week is shown in table 3.

With all the changes and new time measures the future state map drawn which is shown in Figure 7. All the changes as per the new method are shown on the time line of future state map.

4. CONCLUSION

Due to the importance of lean manufacturing tools for improvement in productivity, value stream mapping is done for medium scale industry in this case study. With the current state map it was observed that the non-value added time like loading and unloading the component also the tool change time could be reduced with some efforts. After discussion with the supervisors and the operators the changes were submitted to the owner. These changes are like manufacturing a jig and a new fixture which is having less cost. After implementing these changes, the time study was done and future state map was drawn. With these changes the cycle time is reduced by 15.95% and the non-value added time is reduced by 27.81%. Also the productivity is improved by 18.55 %.

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