

Value Stream Mapping and its Applications – A Technical Review

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Abstract - Value-Stream Mapping is the process by which an existing manufacturing process is studied and analyzed from beginning to end. It is classified as a lean manufacturing method for increasing productivity and efficiency. Value Stream Mapping involves combing through each and every part of the manufacturing process, from obtaining raw materials to delivery for the customers. It also follows various principles that help inefficacy of the process. In this paper, the study is carried out and explained the factors that are affecting the manufacturing process and increases productivity. The application of value stream mapping provides the entire cleansing process over the modern-day industry.

Key Words: Value Stream Mapping, Industrial Improvising, Productivity, Efficiency, Lean Manufacturing.

1. INTRODUCTION

Throughout the modern industrial age, engineers have tried to make their output better, in terms of quality and terms of quantity. Many problems arise due to miscommunication between people enabling those processes. This can be solved if the problems are identified before the effects are huge.

These problems can be solved using Value Stream Mapping.

Value stream mapping follows a principle of extreme classification of the materials used in the process. It involves many steps that are to be followed. This was formulated by the Toyota Corporation in the 1950s, and by the 1990s almost all manufacturers started using it.

1.1 Steps

- **Identifying and analyzing the processes involved:** The analysis involves the obtaining of raw materials to packaging and delivering the end product to the customers. Every detail, time is taken, machine working conditions, etc.
- **Creating a manufacturing route for the product:** This encapsulates all the analysis done in the previous step, sorting it by processes and creating a proper flow route in chronological order.
- **Sorting customers and sorting materials:** Customers are classified as product families based upon their industry of work. Materials are also grouped like this so as to reduce the time taken for end product delivery.
- **Create a sequence for the product families:** The sequence formation helps in identifying different paths for different products which are required by different industries.
- **Highest Value family is identified:** Product families which are grouped are evaluated on their value. Values are their profits, market changes, the volume of retail, etc. The family with the highest value is worked on first.
- **Flow Chart Generation:** A flow chart is generated incorporating all the processes and all the product families are created. The flow chart specifies the flow of processes in the manufacturing system.
- **Review hands-on process on the floor:** The flow of processes is checked physically; the processes are checked for any unnecessary waste.
- **Data Recollection:** After the implementation of all the different real-time data is collected again. It is checked for any discrepancies. I found the steps are carried out again.

1.2 Symbols used

Table -1: Symbols used in Value Stream Mapping

Symbols	Term	Meaning
	Process	It represents the processes encompassing an entire department.
	Inventory	It represents the inventory during a process.
	Shipment	It represents the movement of all materials involved in the flow.
	Customer	It represents the end point of the flow of product
	Electronic Flow	It represents a communication between two parts of the stream.
	Kaizen Burst	It represents an activity that involves immediate action.
	Go See	It represents confirming something visually.

2. REDUCTION OF CYCLE TIME IN MACHINING PROCESS

Lean Manufacturing was used in a factory to improve the cycle time in a factory, with the help of value stream mapping. Lean Manufacturing is the process of manufacturing that identifies the five most important aspects of manufacturing, and apply them as principles. Value stream mapping is a method of Lean Manufacturing that uses arrows and boxes to indicate the flow of processes in a manufacturing plant. Here value stream mapping is used to reduce cycle time in the crankshaft production. The way that is implemented are:

➤ **Implement the Modified Process by eliminating and combine operations**

In facing and centering machine, the heads are used for milling and drilling. This causes the time taken to be 135 seconds. A Special cartridge was designed to hold more tools. This brought down the cycle time to 70 seconds.

➤ **Implement the modified process by optimizing the process parameters**

The time for roughing and finishing operations were based on the cutting speed calculations. These were then optimized by calculations. The time taken was brought down to 111 seconds from 170 seconds.

➤ **Implement the modified process by tooling improvement and introduce CNC lathe**

The crankshaft operation was done with a grinding machine. Since the grinding operation was slower, a special collet. This reduced the cycle time from 201 seconds to 105 seconds.

Hence there were some positive results were observed. The crankshaft production had a singular flow of production, small-batch supply was frequently being completed. Inventories between machines were removed, as it had no value. Lean manufacturing system implemented in this paper is done in a crankshaft manufacturing cell to eliminate the 8 nonvalue adding wastes like overproduction, waiting, unnecessary transport movement, defects, and unused employee creativity from the manufacturing system and also to create product mix flexibility in the manufacturing cell.

3. VALUE STREAM MAPPING OF ROPE MANUFACTURING

Value stream mapping is used as a method to make rope manufacturing more efficient. It is implemented on a 12 strand rope which is the end product. Value Stream Mapping is the process of removing waste as a factor in manufacturing systems. Usually, these methods help to increase output levels, quality, and various other factors. But in the real world waste should also be removed so as to improve performance levels.

VSM is divided into five phases. These phases are a selection of a product family, current state mapping, future state mapping, definition of a work plan, and achievement of the work plan.

Some tools that are used to help in the redesign of manufacturing systems are:

- Flow Charts
- Structural Analysis
- Architecture Software
- Simulation Software

The flow of processes from receiving the order to shipping is taken into account. The time taken for each process is measured and specified. The list of processes includes receiving the order, schedule creation, ordering raw materials, and the manufacturing processes that take the bulk of the time. After the product is manufactured, it is packaged and shipped after which it gets delivered. Value Stream Mapping aims to reduce the time in some of the areas so as to get better product output.

Some of the production processes involved are twisting, braiding, splicing, packaging, and shipping. The modifications that were made to decrease time are the addition of safety stock, the elimination of a redundant scheduler, revising a setup sheet, revising the plant layout.

These changes improved the time taken from 68% to 33%. The time is taken for start to end changed from 36 days to 9 days. About 7 minutes are saved each day for material handling in each order after the revisions.

4. LEAN MANUFACTURING IMPLEMENTATION USING VALUE STREAM MAPPING: A CASE STUDY OF PUMPS MANUFACTURING COMPANY

Here lean manufacturing is implemented in pump manufacturing. The objective of implementing Value Stream Mapping is to understand the current state manufacturing process for the pump family selected. Identify the key areas of waste, problem, and opportunity across the process, develop a 'future state vision' of process, reduce waste, reduce inventory, reduce Production Lead-time.

In this case, different ways were used to imbibe VSM. Some methods used were understanding customer demands, calculating the time taken, mapping the product flow, mapping the information flow, calculate product flow time, detail off-line times, identify opportunities for improvements.

Some of the irregularities are Firefighting to meet market demand at short notices, high lead time for die cast rotors and stator windings high cycle time for rotor shaft machining, multiple material movements for Delivery casing and Impeller causing high inventory, variable stock in Finished Goods store, extra processing of impeller increasing lead time, high inventory at input and output of CED, cycle time improvement for assembly and packing, reduction of stator rejection at mandrel operation, engagement of operators is not balanced.

After the implementation of VSM, the total lead time for a product was 54 days. Process lead time fell from 37 days to 23 days.

5. APPLICATION OF VALUE STREAM MAPPING TO ELIMINATE WASTE IN AN EMERGENCY ROOM

The objective here is to improve the emergency room conditions by waste removal. Value stream mapping is used to identify the systems that need improvement and to represent the work flow using arrows and symbols. They represent the work happening at each station. It also represents the time taken at each station for the work to be completed.

6. CONCLUSION

The cases of application of Value Stream Mapping proved that working time and results are produced within lesser time and with more productivity. In the rope manufacturing facility, the implementation of Flow Charts, Analysis & Simulation Software, etc. proved to increase its efficiency from 36 to 9 days. In the Pump Manufacturing Facility, other factors like consumer feedback, product flow map, information flow map were taken which decreased the number of days taken from 37 days to 23 days. So, Value Stream Mapping not only increases product output and work efficiency but it also creates a clear idea for the users on how different factors involved affect its target.

Value Stream Mapping can be applied to all forms of industry, after which the results turn out to be better.

- Higher output was recorded.
- Costs were cut majorly.
- Time taken was cut down drastically.

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