A Review Paper on Productivity Improvement by Value Stream Mapping

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***Abstract*: Value stream mapping (VSM) is a lean manufacturing tool, which originated from the TPS, is known as "material and information flow mapping." This mapping tool uses the techniques of lean manufacturing to analyze and evaluate certain work processes in a manufacturing operation. This tool is used primarily to identify, demonstrate and decrease waste, as well as creates flow in the manufacturing process. VSMs can be created merely using paper and pencil. It helps to identify and eliminates non-value added activities. This paper discusses the utilization of lean manufacturing techniques in Manufacturing Industry. The VSM used to improve the flow of information and materials thereby improvement in the productivity eliminating wastes.**

***Key words*: Current state map, Future state map, Cycle time, Lean manufacturing.**

INTRODUCTION

Value Stream Mapping has the reputation of uncovering waste in manufacturing, production and business processes by identifying and removing or streamlining non-value-adding steps. The process is analyzed for opportunity to drastically reduce and simplify it to the fewest actions necessary. By reducing wastefulness the proportion of value adding time in the whole process rises and the process throughput speed is increased. VSM is a systematic methodology to identify wasted time and actions in a manufacturing process. In more recent times VSM it has been used to re-engineer businesses because it identifies unnecessary effort and resources to permit simplification and streamlining of operations [1].

VSA can be defined as a method by which managers and engineers seek to increase the understanding of their company's development efforts for the sake of improving such efforts. The method centers onthe metaphor of development tasks which add value to a final product, efficiently linked together to form a continuously flowing stream of value. VSM, thus can be simply stated as the method by which the outcomes of Value Stream Analysis are depicted or illustrated. VSM of a process serves to describe a highly complex real system in a less complex 2-D format. This simplification of the system facilitates insight and understanding which provides a common language for communication of that insight.

VSM represent very efficient tool for visualization of activities within production flow focused on activity duration with the purpose to eliminate non-value added activities. Besides shortening of lead time, cost reduction is also imperative for every company, so monitoring and control of manufacturing cost over the time can be driving force for improvement. Standard (traditional) accounting system that is suitable for mass production, is focused on real cost of product calculation, how to allocate indirect manufacturing costs, excluding time dimension. Mass production era is over and new accounting systems are needed for modern manufacturing strategy, such as lean manufacturing [4].

LITERATURE SURVEY

This section of the paper provides the brief background about VSM. A value stream map is an end-to-end collection of processes /activities that creates value for the customer. A value stream is all the actions (both value added and non-value added) currently required to bring a product through the main flows essential to every product: (a) the production flow from raw material into the hands of the customer, and (b) the design flow from concept to launch. Standard terminology, symbols, and improvement methods allows VSM to be used as a communication tool for both Internal communication and sharing techniques and results with the larger lean community [1].

R.M. Belokar et.al studied that VSM process is analyzed for opportunity to drastically reduce and simplify it to the fewest actions necessary. By reducing wastefulness the proportion of value adding time in the whole process rises and the process throughput speed is increased. This makes the redesigned process more effective (the right things are being done) and more efficient (needing fewer resources) [1].

S. Santhosh kumar,& M. Pradeep kumar suggested that tools of lean manufacturing and line balancing are used to reduce the cycle time in an assembly plant, which contains non-value added activities and work [2].Hugh L. McManus and Richard L. Millard showed that the concept of Value Stream Analysis and Mapping (VSA/M) as applied to Product Development (PD) efforts. Value Stream Analysis and Mapping is a method of business process improvement [3].

DanijelaGracanin et.al introduced the framework for value stream optimization by combining value stream costing and cost-time profile. Value stream mapping represent very efficient tool for visualization of activities within production flow focused

on activity duration with the purpose to eliminate non-value added activities. Besides shortening of lead time, cost reduction is also imperative for every company, so monitoring and control of manufacturing cost over the time can be driving force for improvement [4].

Rahani AR & Muhammad al-Ashraf suggested that as VSM involves in all of the process steps, both value added and non-value added are analyzed and using VSM as a visual tool which helps to see the hidden waste and sources of waste. A current state map is drawn to document for knowing how things are actually operated on the production floor. Then, a Future State Map is developed to design a lean process flow through the elimination of the root causes of waste and through process improvements [5].

Value Stream Mapping Principles

Value Stream Mapping has increasingly been applied by leading manufacturing companies throughout the world. It has proven to have many positive outcomes which include such concepts as reduced cycle time, decreased cost, reduction of defects and waste. VSM aims to achieve the same output with less input; such as less time, less space, less human effort, less machinery, less material and less cost. VSM is one first needs to understand the basic principles that guide it. Some major principles includes recognizing wastes, having standard processes, having a continuous flow, pull-production, quality at the source and maintaining continuous improvement. Companies such as Toyota, Pratt & Whitney, Sikorsky, Delphi, Ford, and many others companies have achieved large savings by implementation of Lean principles in their manufacturing activities.

The Five S's are some rules for workplace organization which aim to organize each worker's work area for maximum efficiency.

Sort – Sort what is needed and what is not needed so that the things that are frequently needed are available nearby and as easy to find as possible. Things which are less often used or not needed should be relocated or discarded.

Straighten (Set in order) – Arrange essential things in order for easy access. The objective is to minimize the amount of motion required in order for workers to do their jobs. For example, a tool box can be used by an operator or a maintenance staff who must use various tools.

Scrub (Shine) – Keep machines and work areas clean so as to eliminate problems associated with un-cleanliness. In some industries, airborne dust is among the causes of poor product surface or color contamination. To be more aware of dust, some companies paint their working places in light colors and use a high level of lighting.

Stabilize (Standardize) – Make the first 3 S's a routine practice by implementing clear procedures for sorting, straightening and scrubbing.

Sustain – Promote, communicate and train in the 5 S's to ensure that it is part of the company's corporate culture. This might include assigning a team to be responsible for supervising compliance with the 5 S's.

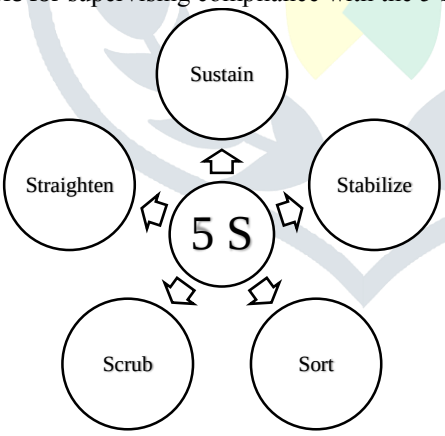

Fig 1: 5 S Diagram

VSM TOOLS: VSM is the process of visually mapping the flow of information and material as they are preparing a future state map with better methods and performance. The table no 1 indicates about the tools used in VSM and its advantages to eliminate different types of wastes in manufacturing industry.

Table 01: VSM Tools

S.N	VSM Tools	Overall Identification	Usage
1	Process Activity Mapping	Detailed Mapping of the order fulfilment	To identify lead time and productivity opportunities for both physical product flows and information flows.
2	Supply chain Response Matrix	Evaluation of inventory and Lead Times	To allow assessing the need to hold stocks within the short lead-Time.
3	Production Variety Funnel	Shows the Number of product variants at each stage of the manufacturing process	To identify inventory by combining the flexibility of the plant with short.
4	Quality Filter Mapping	Identifying the quality problems in the order fulfillment process	To show where three different types of quality

VSM METHODLOGY:

To start improving productivity by identifying waste and then removing it by implementing lean principle in the industry there is no other tool better than VSM. VSM is a visualization tool oriented to the Toyota version of Lean Manufacturing (Toyota Production System). It helps to understand and streamline work processes using the tools and techniques of Lean Manufacturing. The goal of VSM is to identify, demonstrate and decrease waste in the process. A manufacturing system operates with timing of step-by step activities. The various steps in implementation of VSM are shown in Figure 1 and are discussed in the following sections. The process analysis is carried out by collecting the data from various enquiries with expertise in shop floor, workers and directly participating in measuring the time of various processes [1].

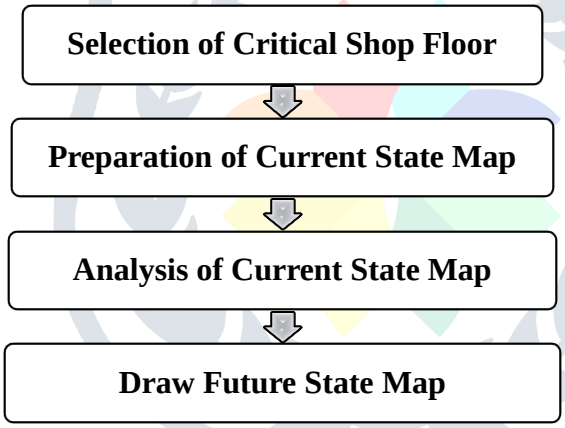

Fig 2: VSM Methodology [1]

VSM is an effective tool for the practice of lean manufacturing. VSM approached the entire process flow in a four-step methods as shown in figure 2 is explained below

Selection of Critical Shop Floor: In an industry, there are so many sections which are interconnected and are involved in converting raw materials to useful products and to reach those products to the customers. Any variation in the material flow in these sections effect on the productivity of the company so VSM can be used where such deviations are present.

Preparation of Current State Map: After selecting the critical shop floor in an industry the first work is to produce a diagram or map showing the actual material and information flows or Current State on how the actual process operates by identifying the main process and collecting the data from the main process.

Analysis of Current State Map:

After drawing current state map based on actual process information, analyze the collected data and find out what are the obstacles which effect the productivity of the industry. Calculate the cycle time, cost, quality, wastes and productivity with respect to current state map. Finding the reason behind the problem in the current stream line & applying new techniques or methods to overcome the problem for making the streamline flow smooth.

Table No 2 indicating about the mathematical tools and techniques which involved in decreasing in the non-value added activities in the manufacturing Industry. The different authors have achieved particular target by using VSM tools.

Table 02: Mapping of Mathematical tools/ Techniques used in VSM

Mathematical Tools/Techniques	Authors	VSM Principles	Target
Line Assembly	S. Santhosh kumar (2014), Christian & Armin(2008,)	Elimination of the non-value added activities	Cycle time reduction in truck body assembly
eVSM	R.M.Beloker et.al (2012)	Cycle time reduction	Cycle time reduction in inner wheel housing
Cost-Time Profile	Danijela Gracanin et.al (2013)	removal and mitigation of the major wastes	Cost reduction
Ward/LEI map, Gantt chart, Process flow map, Lean Enterprise Model.	Hugh L. McManus et.al (2002)	Remove redundancy, simplify, and Standardize, Improve communication systems.	Product Development
Process Metrics	Rahani AR et.al	Reduction in waiting time	Improvement in production flow

Outcomes from Value Stream Mapping:

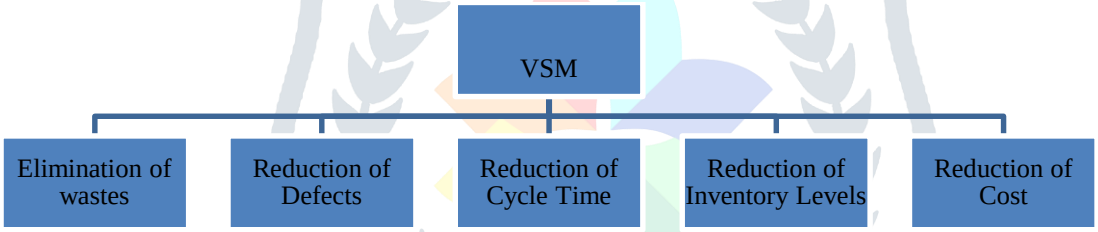

Fig.3 Layout of Expected outcomes

- **Elimination of Waste:** VSM is such a tool which identifies the wastes from working place and hence eliminates it from production lines.
- **Reduction of Defects:** VSM identifies the cause for defects during the process by analyzing the current state map and creates the future state map which is free from defects.
- **Reduction of Cycle Time:** By applying VSM technique, non-value added activities are eliminated, hence Cycle time of production is reduced.
- **Reduction of Inventory Levels:** Once the VSM eliminates the wastes from the stream line, proper utilization of inventory is possible by VSM.
- **Reduction of Cost:** Cost of production can be control by reductions of all types of wastes.

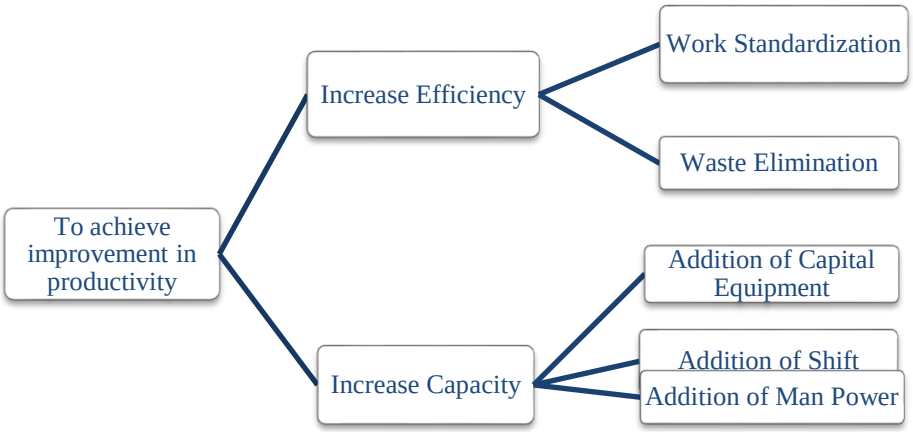

Fig 04: Flow Chart of Achieving Improvement in Productivity

Conclusion:

VSM is continuous improvement process; we must keep on changing future state into current state that will not end during our life. VSM have been proven to be a greatly useful tool to eliminate some waste in a cycle and find there are more waste for us to eliminate in next cycle, during which lean becomes a habit or culture. The technique of lean tool can be applied to every situation in a company by finding out what customer wants and eliminating waste. The idea is to create culture in which people at various levels of an organization are continuously improving their production every day & in every way.

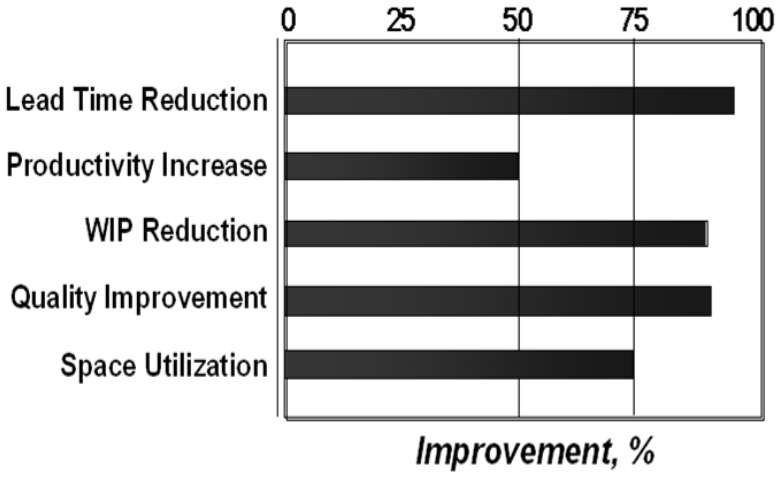

Fig 05: Typical benefits of waste elimination initiative

References:

[1] R.M. Belokar, Sandeep Singh Kharb, Vikas Kumar "An Application of Value Stream Mapping In Automobile Industry: A Case Study", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Vol.-1(2), July 2012.
[2] S. Santhosh kumar, & M. Pradeep kumar, "Cycle Time Reduction of truck body assembly in an automobile industry by lean principles", Procedia Materials science 5 (2014), pp.1853-1862.
[3] Hugh L. McManus and Richard L. Millard "Value Stream Analysis and Mapping for Product Development", Proceedings of the International Council of the Aeronautical Sciences23rd ICAS Congress, 8-13 September, (2002), Toronto Canada.

[4] DanijelaGracanina, BorutBuchmeister, BojanLalic "Using Cost-Time Profile for Value Stream Optimization", Procedia Engineering 69 (2014), pp. 1225 – 1231.
[5] Rahani AR, Muhammad al-Ashraf "Production Flow Analysis through Value Stream Mapping: A Lean Manufacturing Process Case Study", Procedia Engineering 41 (2012), pp.1727 – 1734.
[6] Dr. Cemil CEYLAN, "Value Chain Analysis using Value Stream Mapping: White Good Industry Application", Proceedings of the 2011 International Conference on Industrial Engineering and Operations Management Kuala Lumpur, Malaysia, January (2011), pp.22 – 24..
[7]Mahmoud Al-Odeh et.al, "Value Stream Mapping: Recreating an Industrial Environment in an Educational Setting", Proceedings of The (2014) IAJC/ISAM Joint International Conference ISBN, pp.978-1-60643-379-9.
[8] Johan Tingström et.al, "Implementing Value Stream Mapping – VSM in a R&D organization",NordDesign (2010), pp.25-27.
[9] Muhammad AbdusSamadEt.Al, "Value Stream Mapping To Reduce Manufacturing Lead Time In A Semi-Automated Factory", Asian Transactions On Engineering (Ate Issn: 2221-4267) Volume 02 Issue 06.
[10] Palak P. Sheth1 Et.Al, "Value Stream Mapping: A Case Study of Automotive Industry", Ijret (2014), pp..2321-7308.
[11] Abu Md. Saifuddoha et.al, "Minimization of waste by applying value stream mapping in the supply chain of cement industry", IOSR Journal of Business and Management (IOSR-JBM), (2013), pp.79-84.
[12]Romero D&Chávez Z, "Use of Value Mapping Tools for Manufacturing Systems Redesign", Proceedings of the World Congress on Engineering (2011), pp.6-8.
[13] DanijelaGracanina et.al "Using Cost-Time Profile for Value Stream Optimization", Procedia Engineering (2014) pp.1225 – 1231.
[14] Schönemann, M. et.al "Integrating product characteristics into extended value stream modeling", Procedia CIRP (2014) pp.368 – 373.
[15] W. M. Goriwondo et.al "Enhancing Lean Manufacturing Using The Value Stream Mapping Tool In Pharmaceutical Operations : A Case Study Of A Pharmaceutical Manufacturing Company In Zimbabwe.