

APPLICATION OF LEAN MANUFACTURING BY VALUE STREAM MAPPING

¹ Shweta Sharma, ² Mahesh Kumar Jangid

^{1,2} Department of Mechanical Engineering

^{1,2} Rajasthan Institute of Engineering and Technology, Jaipur

Abstract- In this paper, the outcome of a ball industry has been increased by using the principles of lean manufacturing. As the lean manufacturing implies the reduction of waste with in the manufacturing process by categorizing all the activities and processes into three fields namely value adding, non-value adding & non-value adding but necessary. The methodology used for the project is to first prepare the current state map by collecting data from the shop floor and then analyzing it for the possible areas of improvements. After that the analysis and comparison of the suggested solutions with the old one has been done and finally proposed the future state map.

Keyword: Value stream mapping, Supermarket pull system, capacity utilization.

INTRODUCTION

Waste can be defined as “to use, consume, spend, or expend thoughtlessly or carelessly.” In every organization there is a need to eliminate waste from their activities and processes. As we identify this waste and the associated cost of these activities, it is evident that there is scope of improvement in profit. It need to be identified, and also presented to the employees in such way that everyone understands what is the waste , where it exists in the process, what are the sources, and at what it will cost for the preparation and implementation for the improvement.

METHODOLOGY

Value Stream comprises of both value adding and non-value adding activities required for manufacturing a product. Application of value stream perspective implies, working on the complete manufacturing set up, from inception to the final product and not just individual processes. The technique of Value stream mapping was applied in Tirupati ball industries with the objective of reducing waste.

It shows the applications of lean manufacturing have been less common in the process sector, in part because of a perception that this sector is less amenable to many lean techniques, and in part because of the lack of documented applications; this has caused managers to be reluctant to commit to the improvement program. Many industries in the process sector actually have a combination of continuous and discrete elements, and it is in fact quite feasible to judiciously adapt lean techniques.

Hence, there is a need to implement Lean tools in small and medium size industries. Value Steam Mapping is a tool for helping manufacturing companies to go lean and to achieve larger control of their Value Streams.

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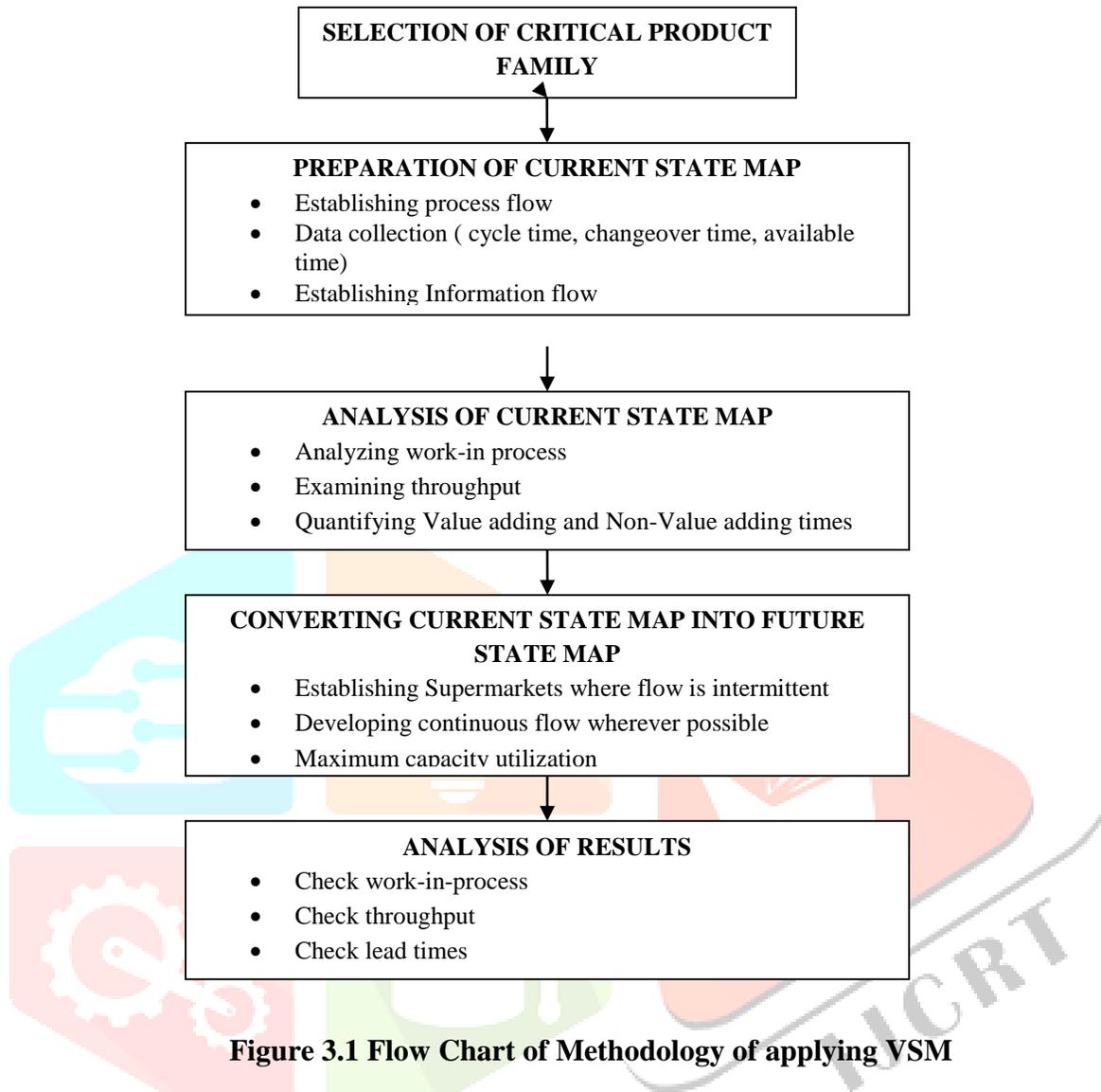


Figure 3.1 Flow Chart of Methodology of applying VSM

THE SEVEN WASTES

There are seven commonly accepted wastes in the Toyota production system

- Overproduction;
- Waiting;
- Transport;
- Inappropriate processing;
- Unnecessary inventory;
- Unnecessary motion;
- Defects.

MEASURING THE IMPEDENCE

Overproduction is regarded as the most serious waste as it discourages smooth flow of goods or services and is likely to inhibit quality and productivity. Such overproduction also tends to lead to excessive lead and storage

time. As a result defects may not be detected early, products may deteriorate and artificial pressures on work rate may be generated. In addition, overproduction leads to excessive work-in-progress stocks which result in the physical dislocation of operations with consequent poorer communication. This state of affairs is often encouraged by bonus systems that encourage the push of unwanted goods. The pull or Kanban system was employed by Toyota as a way of overcoming this problem. When time is being used ineffectively, then the waste of waiting occurs. In a factory setting, this waste occurs whenever goods are not moving or being worked on. This waste affects both goods and workers, each spending time waiting. The ideal state should be no waiting time with a consequent faster flow of goods. Waiting time for workers may be used for training, maintenance or kaizen activities and should not result in overproduction.

VALUE STREAM MAPPING

Value stream mapping (VSM) can serve as a good starting point for any enterprise that wants to be lean. VSM was initially developed in 1995 with an underlying rationale for the collection and use of the suite of tools as being “to help researchers or practitioners to identify waste in individual value streams and, hence, find an appropriate route to its removal. 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 hands of customers. VSM is the process of visually mapping the flow of information and material as they are and preparing a future state map with better methods and performance. It helps to visualize the station cycle times, inventory (WIP), at each stage manpower and information flow across the supply chain.

VALUE STREAM MAPPING TOOLS

The typology of the seven new tools is presented in terms of the seven wastes already described. In order to make improvements in the supply chain it is suggested that at least an outline understanding of the particular wastes to be reduced must be gained before any mapping activity takes place. Until now, however, there has been no decision support mechanism to help choose the most appropriate tool or tools to use.

- (a) Process activity mapping
- (b) Supply chain response matrix
- (c) Production variety funnel
- (d) Quality filter mapping
- (e) Demand amplification mapping
- (f) Decision point analysis
- (g) Physical structure mapping.

PROCESS ACTIVITY MAPPING

It has its origins in industrial engineering. Industrial engineering comprises a group of techniques that can be used to eliminate from the workplace waste, inconsistencies and irrationalities, and provide high-quality goods and services easily, quickly and inexpensively. The technique is known by a number of names in this context, although process analysis is the most common.

There are five stages to this general approach:

1. The study of the flow of processes;
2. The identification of waste;
3. A consideration of whether the process can be rearranged in a more efficient sequence;
4. A consideration of a better flow pattern, involving different flow layout or transport routing;
5. A consideration of whether everything that is being done at each stage is really necessary and what would happen if superfluous tasks were removed.

SUPPLY CHAIN RESPONSE MATRIX

The origin of the second tool is the time compression and logistics movement and goes under a variety of names.

Figure : Supply Chain Response Matrixes

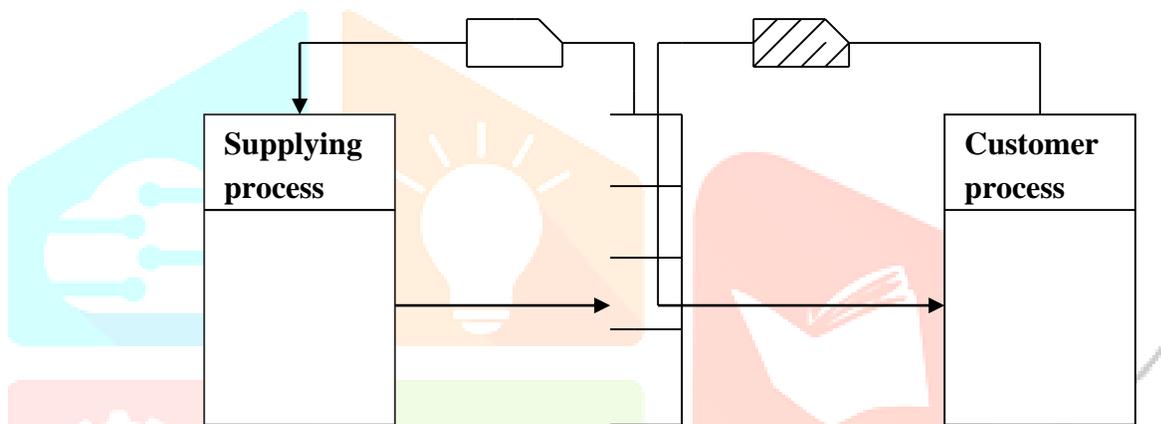


Figure : Super Market pull system

This mapping approach, as shown in Fig.1.1, seeks to portray in a simple diagram the critical lead-time constraints for a particular process. In this case it is the cumulative lead time in a distribution company, its suppliers and its downstream retailer. In Fig.1.1 the horizontal measurements show the lead time for the product both internally and externally. The vertical plot shows the average amount of standing inventory (in days) at specific points in the supply Chain.

In this example the horizontal axis shows the cumulative lead time to be 42 working days. The vertical axis shows that a further 99 working days of material are held in the system. Thus a total response time in this system of 141 working days can be seen to be typical. Once this is understood, each of the individual lead times and inventory amounts can be targeted for improvement activity, as was shown with the process activity mapping approach.

PROBLEM IDENTIFICATION

This study will address various wastes in the manufacturing of steel balls to be used in Bicycles at Tirupati ball Industry, Ajmer. Current lead times are higher and work-in-process is enormous which may lead to lost market share. Also non-value adding time such as time in waiting, loading and unloading time, material handling time are very large as compare to value adding time.

An attempt will be made to initialize the implementation of lean manufacturing system using VSM . VSM will be used to identify the non-value added activities and to reduce the waste and lead time.

To reduce non-value adding time, Value stream mapping will be used to help identify potential areas of improvement and suggest ways to fix problem areas. A current state map will help identify areas that cause excessive lead times, and not at all contributing to the final product's value, which the customer is willing to pay for.

Lean manufacturing methods will be used to create a future state map. The future state map will suggest ways to reduce manufacturing lead time and increase throughput.

RESULT OUTCOMES SURVEY

Tirupati ball industry was established in 1989. It is manufacturing steel balls for mainly used in Bicycles. They are involved in the manufacturing of four sizes of steel balls – 1/4", 1/8", 5/32" & 3/16". Their annual production capacity is 350 tones and turnover is approximately 7 crores.

Their major customer is M/S HERO cycles in Ludhiana. Their 20% production is being purchased by Hero cycles. The Industry is fulfilling 50% requirement of Hero cycles.]

Other customers are big dealers situated in Ludhiana. The Industry is supplying balls to Hero cycles for the last 18 years and has gained a good reputation for timely delivery and quality products.

Manufacturing process of steel balls is briefly explained as follows:

1. Heading : The balls are cold forged as rough spheres on cold heading machines.
2. Flashing : The balls are ground under pressure between rotating grooved cast iron plates to remove flash.
3. Heat treatment : To get the mechanical and metallurgical properties needed to ensure structural integrity of balls, they are heat treated and then tempered under precisely control conditions.
4. Stone grinding : The hardened balls are then ground under pressure between a rotating grinding wheel and a stationary cast iron plate.
5. Tumbling / Barreling: The balls are tumbled in rotating barrels with varying compounds to provide a lustrous finish.
6. Rough / Finish Lapping : The balls are carefully lapped to their final dimensions between grooved cast iron plates, one rotating and one stationary.
7. Inspection : All balls are thoroughly checked and inspected after each process to assure spherical and dimensional accuracy, fine surface finish and consistent high quality.
 - a. The Inspection process at Tirupati ball industry is manual. The wastage in Flashing & Grinding process is of the order of 25-30%. The defects in final product are 2–3 %.
 - b. Raw material is high carbon high chrome wire which is also specified as EN–31 in Indian Standards and SAE 52100 in US Standards. It is used for 1/8" & 5/32" balls. For Steel balls of 3/16" & 1/4" high carbon steel wire AISI 1065 is used.

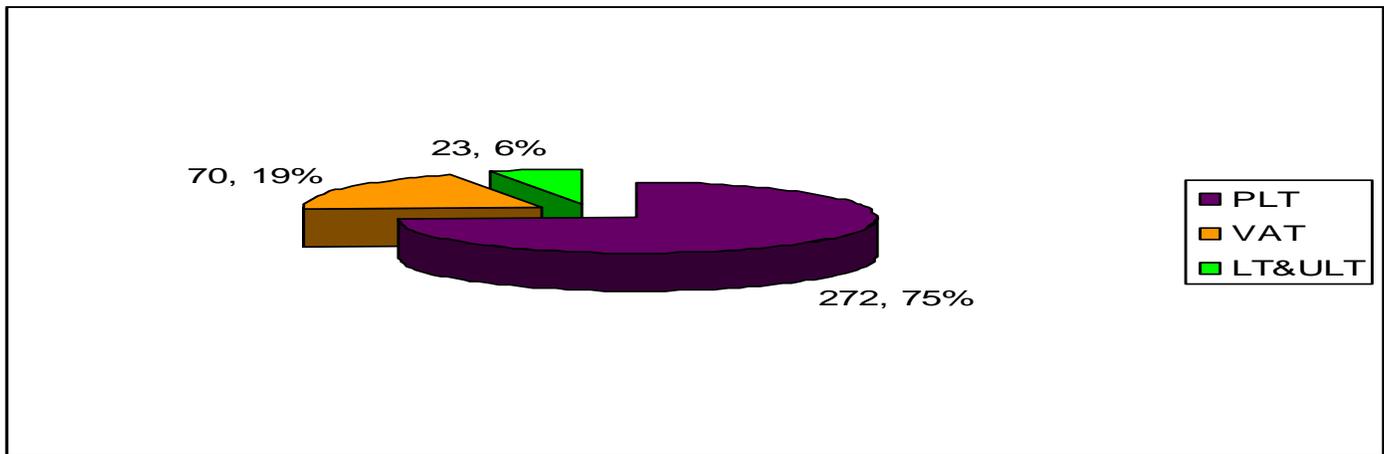


Figure: Value and Non-value added times (in hours)

Analyzing Work-in-Process (WIP)

The biggest flaw observed from the current state map was the amount of work-in-process at various stages of the manufacturing of steel balls. Approximately 16 tons of semi-finished and raw material was lying within the manufacturing line which was a pure waste. Out of this, 7 tons of forged balls were lying as WIP after the heading operation. The outcome of the discussions with the management lead to the conclusion that heading is much specialized operation requires highly skilled labors, as this process governs the quantum of defects in the final product. In case one or more of the operators, operating the headers, do not report on duty, there is likelihood that the whole process may come to halt because of unavailability of forged balls for further processing. For this reason, management was bearing this large amount of WIP. So management was of the view, that instead of raw wire, they should have forged balls because then they will have freedom to set the pace of production for rest of the processes.

Lean principles needs to be applied to reduce such huge amount of WIP. As told by the management heading operation was specialized and management cannot afford to stop the headers as whole of the processing will come to a halt so headers were assumed critical machines, and to make them operative all the time preventive maintenance rather than break down maintenance was suggested. Fig.3.15 shows amount of work-in-process before each working station.

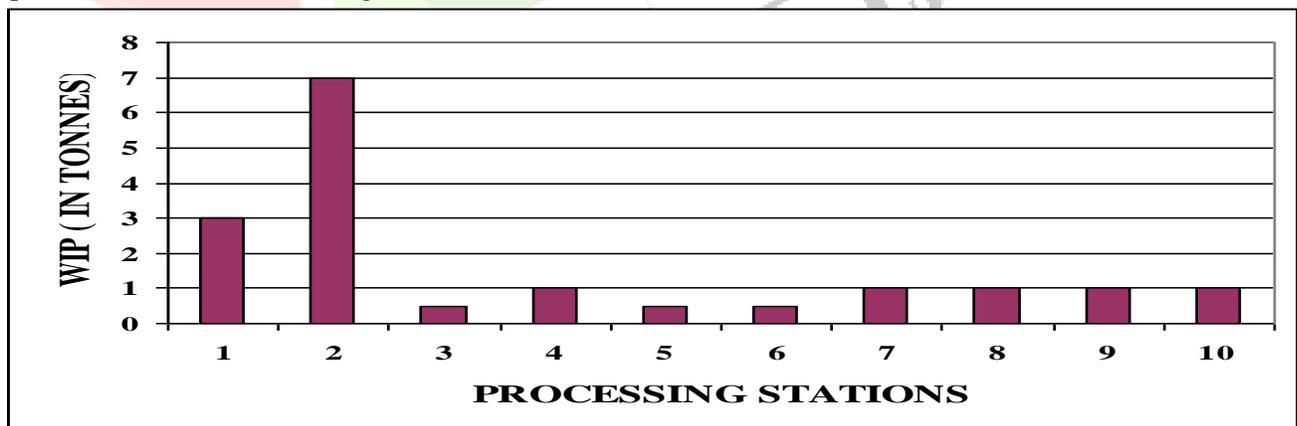


Figure: Work in process

RESULT CLASSIFICATIONS

Complete process was studied and the data were collected from the shop floor. A current state map was drawn.

Following improvements were suggested:

- A. Use of supermarkets to reduce work-in-process and process lead times.
- B. To ensure continuous flow of material, wherever possible.
- C. (iii) For achieving maximum capacity utilization, management was suggested to procure one flasher and one rotary furnace.
- D. Use of standard size containers to carry the semi-finished balls.
- E. To reduce the travel distances layout should be improved.
- F. Inspection process should be mechanized.

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