Application of value stream mapping in a forging industry – A case study

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***Abstract* - Manufacturing organizations always needs some ways to reduce production lead time, eliminate waste and increase quality to survive in today's competitive world. Lean manufacturing is such a technique used by industries all over the world in past few decades. It consists of various tools and techniques to reduce waste and increase productivity. One of the major tools in lean manufacturing is Value stream mapping (VSM). VSM shows all the activities from customer order to final product through different processing steps. In this paper VSM is used in a forging industry for a product named saddle. Data was collected from organization and a current state VSM was drawn. The production lead time in current state VSM was 14.9 days. Major waste was found out from current state VSM. Using lean tools and techniques a future state VSM was suggested and production lead time was reduced from 14.9 days to 9.5 days. E draw max version 7 software was used for drawing maps.**

***Key words*—lean manufacturing, Value stream mapping.**

I. INTRODUCTION

Throughout the world Lean Manufacturing has increasingly been applied by leading manufacturing companies. Many positive outcomes such as reduced cycle time, decreased cost, reduction of defects and waste are the benefits of lean manufacturing. Lean manufacturing achieves the same output with less input; such as less time, less space, less human effort, less machinery, less material and less cost. In order to visually display where waste occurs in the process, a VSM is drawn. VSM is used to map all the value added activities and non – value added activities from the transformation of raw materials to final product [1]. VSM brings all processing steps at one place and it shows the big picture of shop floor rather and improves the each area at the production line. It is used to draw attention to different wastes and eliminating them in future state map [2].

II. LITERATURE REVIEW

VSM was developed in the year 1995 for helping researchers or practitioners to identify waste with the use of suitable tools [3]. Abdulmalek and Rajgopal have applied VSM in process sector, in a steel mill [4]. Development of VSM is needed for lean implementation [5]. Sahoo et al., [6] implemented VSM in a forging industry and improved all aspects of production system. Bhim Singh et al., [7] reported a case study of a manufacturing firm. They compared current state and future state map and witnessed a 92.58 percent reduction in lead time, 2.17 percent reduction in processing time, 97.1 percent reduction in WIP and 26.08 percent reduction in manpower requirement.

III. RESEARCH METHODOLOGY

The objective of this research was to draw current state VSM and future state VSM for a product named saddle of a forging industry. The literature review was done on value stream mapping. The next step was to develop the current state VSM for the product saddle. The current information was collected directly from the company by discussions with managers, and production supervisors. Information such as customer demand, general process flow, and supply of raw material were also collected. Each step of the production process was also observed and as much data as possible was collected. The cycle time for each production step was observed directly from the forging shop floor for each process. Using this data, current state VSM was drawn showing the material and information flow. Analysis on the current state map was done and non -value added time was found out from it. Major wastes were also identified from current state VSM. Thereafter, the future state map was made with some suggestions. Lean tools and techniques was suggested for improvising the material and information flow and reducing waste and thereby reducing production lead time. Various lean tools such as 5S, TPM, kanban, SMED were used.

IV. VALUE STREAM MAPPING

Lean manufacturing is a manufacturing process that does not produce waste [8]. VSM is one important tool among various lean tools [9]. Value stream mapping uses arrows, metrics and symbols to show and improve the flow of inventory and information required to produce a product which is delivered to a customer. It visually represents waste and enables to identify various wastes in the production path [10]. VSM mainly consists of two types ie, current state VSM and future state VSM. Current state VSM collects the complete data, workflow and information within a plant, whereas future state VSM improvises the current state VSM by identifying and eliminating with lean tools [11].The production initiates when the customer orders the requirements of the

product to the production planning and control department by electronic media. Then the material moves sequentially through billet cutting, blocking, finishing, inspection, heat treatment, shot blasting, grinding, punching and finally, inspection. After studying the manufacturing processes of the saddle from the shop floor directly, noted all the activities that were involved during the production process. Then the data required for drawing Current state VSM were collected from the shop floor. The data collected includes number of operators, cycle time, set up time etc... of every process. Using these data a current state map was drawn using E-draw (software used to create VSM) which is shown in the fig1. Current requirement of the Customer is 80 saddles in a period of 2 weeks. There are 3 shifts per day each with 7.5 hours working time available for the production.

The production lead time and total cycle time were calculated from the current state map and found to be 14.9 days and 13716 minutes respectively. The study of the current state map identifies that waiting time, setup time and transport time was the major wastes in the production.

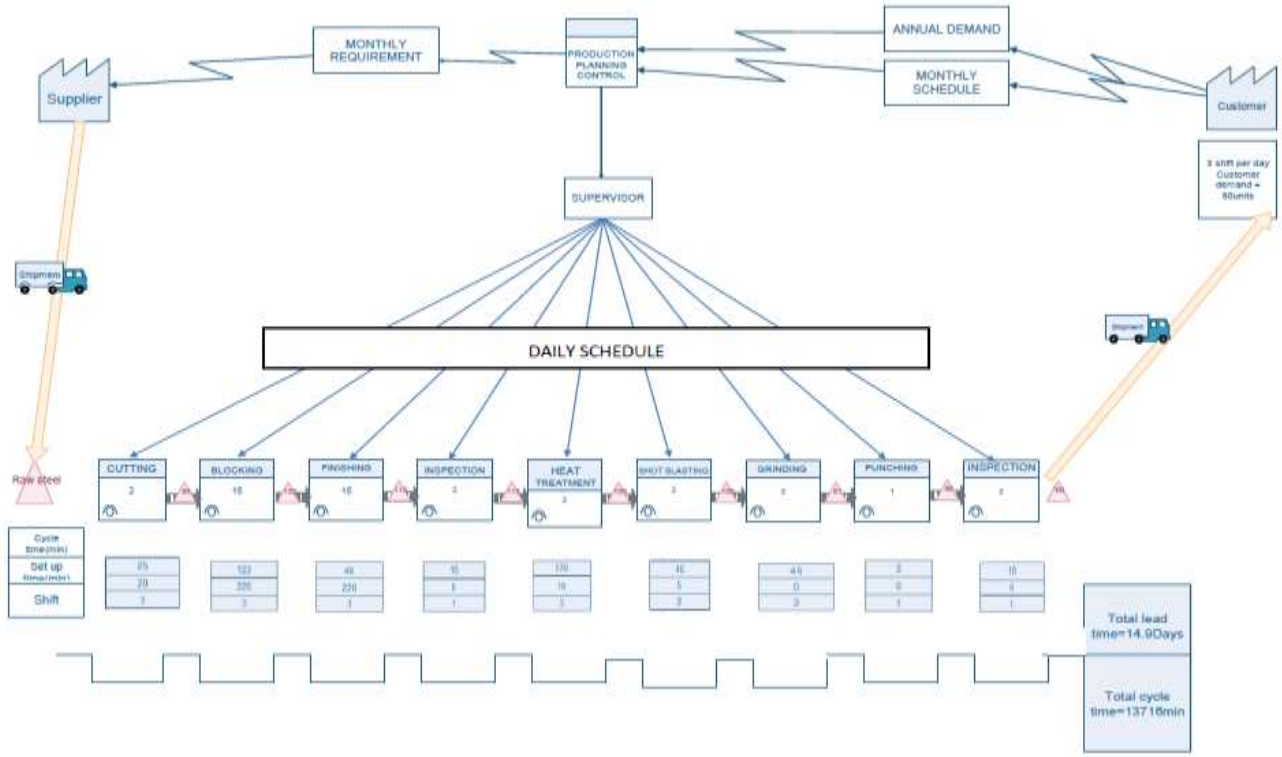

Fig: 1. Current state VSM.

The current state of the production process is not capable to meet the customer order and a better planning is required. The waiting time can be eliminated using 5S and as well as leveling the work in process in between the process. The Kanban card system enables to produce only the required number of products, avoiding the overproduction, in addition. " Kanban is a visual signal to support flow by 'pulling' product through the manufacturing process as required by the customer"[12].The setup time can be reduced by using the SMED technique. About 35% of setup time could be reduced using the technique. Quality Circle and TPM were also proposed to reduce the wastes. Forging manipulator was suggested to reduce transport time. With these available techniques, an estimate of the future time was calculated and a future state VSM was constructed (figure 2).

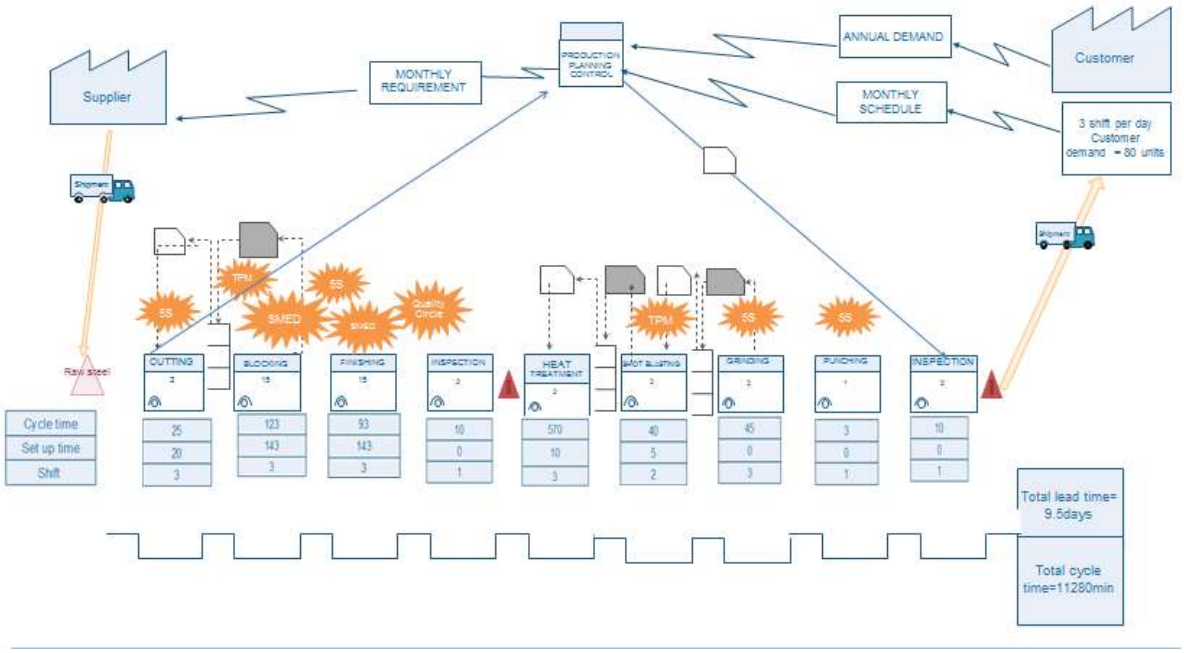

Fig: 2. Future state VSM.

V. RESULT

In current state map various waste related to process were identified and total lead time was 14.9 days. In order to reduce the waste following lean tools were adopted 5S, TPM, Quality circle and SMED to develop future state VSM. Lead time was reduced to 9.5days in the future state map. Figure 3 shows the comparison of production lead time.

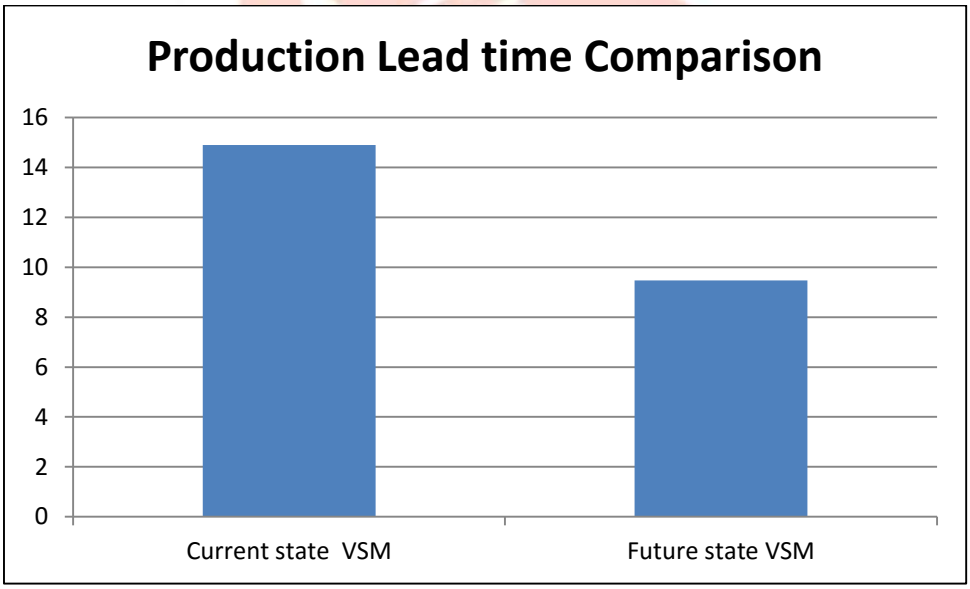

Fig: 3 Comparison of production lead time

VI. CONCLUSION

Manufacturing lead times for the production of saddle was approximately 14.9 days. Various wastes were identified using the current state VSM for the selected product. The major waste identified in the manufacturing process of saddle was waiting time between the processing stations. In order to reduce the waste various lean tools such as SMED, 5S, Kanban, Quality circle, Total productive maintenance are suggested. In the future state value stream map, the production lead time of saddle is significantly shortened from 14.9 days to approximately 9.5 days. There by implementation of VSM various lean wastes can be reduced effectively in order to reduce the production lead time and to improve product quality.

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