

An Application of Value Stream Mapping in Automotive Industry: A Case Study

R.M. Belokar, Vikas Kumar, Sandeep Singh Kharb

Abstract: Studies on applications of lean in a continuous process industry are limited. There is lot of opportunities for improvement in the process industries like automobile industry if lean tools are utilized. This paper addresses the application of Value Stream Mapping as one of the Lean tools to eliminate waste, and improved operational procedures and productivity. Current state map is prepared and analyzed and suggested to improve the operational process. Accordingly the future state map is drawn. The study reveals that there is an improvement in the takt time by implementing the proposed changes if incorporated in the future state map.

Index Terms: Current state map, future state map, takt time, Value Stream Mapping (VSM)

I. INTRODUCTION

Before giving the definition of VSM it is important to understand what Value and Value Stream is. Focus on value in the context of what the customer/end-user is prepared to pay for. To carry out this activity the company needs to understand what the customer requires in terms of features and performance, and how much they are willing to pay for the product. The outcome of this activity is a clear understanding of what products the customer requires. These requirements may not be feasible immediately, but it provides a true representation of customer need.

The value stream is the entire creation process for a product. The value stream starts at concept and ends at delivery to the customer. Every stage the product goes through should add value to the product, but often this is not the case. Mapping of the value stream aids the identification of value adding and non-value adding (i.e. waste) activities; some examples are listed below.

Value adding activities

Machining, Processing, Painting, Assembling

Non value adding activities

Scrapping, Sorting, Storing, Counting, Moving, Documentation etc.

A value stream map is an end-to-end collection of processes/activities that creates value for the customer. A value stream usually includes people, tools and technologies, physical facilities, communication channels and policies and procedures. 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.

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. It helps to visualize the station cycle times, inventory at each stage, manpower and information flow across the supply chain. VSM enables a company to 'see' the entire process in both its current and desired future state, which develop the road map that prioritizes the projects or tasks to bridge the gap between the current state and the future state.

The value stream mapping is used to analyze & map in order to reduce the waste in processes, enable flow, and to make the process for better efficiency. The purpose of value stream mapping is to highlight sources of waste and eliminate them by implementing the future-state value stream that can become a reality. The goal is to build a chain of production where the individual processes are linked to their customer(s) either by continuous flow or pull, and each process gets as close as possible to producing only what its customer(s) need when they need it.

II. LITERATURE REVIEW

Balkema and Rotterdam (2004) have created current state map for a steel producer, a steel service center and first-tier component supplier. The current state map identifies huge piled of inventory and long lead-time. In the future state map target areas were subjected to different lean tools including kanban, supermarket, and continuous flow.

Ballard and Howell (1994) suggest that, the value stream mapping can serve as a good starting point for any enterprise that wants to be lean. It provides a common language for talking about manufacturing process. It ties together lean concepts and techniques which help to avoid "cherry picking". It forms the basis for an implementation plan by helping to design the whole flow.

Halpan and Kueckmann (2001) explain value stream mapping in aircraft manufacturing. They draw current and future state maps were developed with the objective of reducing lead time according to customer requirements. The implementation of the future state map attained lead-time reduction. Summer, 1998 has described Activity Based Costing (ABC), identify various cost components and analyze the relative contribution to the total cost.

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The essence of ABC is that, product consumes activity, activity consumes resource and resources generate cost. Thus it is necessary to develop the relationship between activity, cost drivers and activity measures. Target costing is to anticipate the acceptable market price through intensive customer focus. Design and manufacturing team's allies to bring the product within the target cost. Target cost is the cost that can be incurred while still earning the desired benefit. The objective of the present work is to demonstrate how a manufacturing system operates with timing of step-by step activities.

Taiichi Ohno (1988), Womack et al (1990), Womack and Jones (1998, 2005), Daniel. T. Jones (2006), Rother and Shook (1999), and Peter Hines and Nick Rich (1997) have studied the implementation of Value Stream Mapping effectively.

Taiichi Ohno (1988) could not see waste at a glance (especially across a geographical area). He developed Material and Information Flow Mapping (VSM) as a standard method for mapping the flows visually and it became the standard basis for designing improvements at Toyota - as a common language. It became one of their business planning tools. VSM is now utilized throughout the world, in many businesses to strategically plan and it is the starting point to any lean transformation and implementation. The value stream mapping was extended in the field of aircraft manufacturing also. Abbett and Payne (1999) have discussed the application of value stream mapping in an aircraft manufacturing unit. They have developed the current and future state maps with the objective of reducing lead time according to customer's requirements.

New (1993), and Jones et.al (1997) and other researchers developed individual tools to understand the value stream. VSM extends guidance for improvements in the process, identifies the need to improve workflow and finally shows avenues to reduce waste.

Shingo (1989) has discussed the strategies for the effective implementation of Value Stream Mapping in a wood industry. He also opines that loops can be formed to identify the similar processes and these loops will be helpful in identifying the non value activities in a systematic manner. He has suggested the ways to eliminate non value added activity and proposed measures to increase the Value added ratio.

III. OBJECTIVE OF RESEARCH

Today, automotive suppliers have a great concern over improving quality and delivery and decreasing cost, which leads to improved system productivity. In order to remain competitive, waste from the value stream must be identified and eliminated so to run system with maximum efficiencies.

A Production is to order and large numbers of different products are produced, each in relatively small volume. A Production shop consists of number of machine centres, each with a fundamentally different activity. The problems of machine shop are delayed deliveries, long queues, and high work in process inventories, improper utilization. These problems increase overall cost of production. The need for customized products/parts with reduced lead times together with the requirement of global competitiveness requires that products/parts be produced in small batch sizes as per customer's requirement. The processing in small batch sizes necessitates the adjustment in the flow of production through different processes as per their processing speeds. In addition

it requires close monitoring of processes to reduce process variability (defect free production), efficient planned maintenance of all machines (for increased availability) and reduction in non value added activities such as setup times, movement of material in between the work processes and additional processing of material. The efficient utilization of machines while producing in small batches reduced WIP inventories, reduced throughput times and reduction in lead times leads to competitive manufacturing. It is need for machine shop manufacturing system to adopt lean environment.

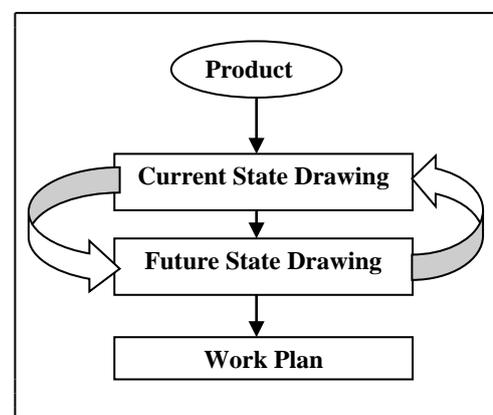
To improve productivity by identifying waste and then removing that by implementing lean principle in this industry we focus our attention on VSM tool. Value Stream Mapping enables a company to identify and eliminate waste, thereby streamlining work processes, cutting lead times, reducing costs and increasing quality and hence productivity. The goal of VSM is to identify, demonstrate and decrease waste in the process, highlighting the opportunities for improvement that will most significantly impact the overall production system. In this study lean concepts are introduced using VSM in working environment.

IV. VSM METHODOLOGY

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. The Value Stream Mapping method (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. Waste being any activity that does not add value to the final product, often used to demonstrate and decrease the amount of 'waste' in a manufacturing system. VSM can thus serve as a blue print for Lean Manufacturing. This section presents a methodology to develop a value stream mapping to identify material and information of current state.

Generally VSM has four major steps as given by Rother and Shook (1996):

1. Product
2. Drawing current state
3. Drawing future state
4. Develop work plan for implementation of future state.



V. CASE STUDY

A case study was carried out in an automobile industry CAPARO LIMITED located at Bawal (Rewari) in India. 150 Products are manufactured there. But main tunnel floor was chosen because it was most critical product from the point of view of safety purpose of the customer. There is a lot of scope for study and go for further improvement in the process to enable higher production rate. Hence this was selected for the case study.

$$\begin{aligned} \text{Takt Time} &= \text{Available time/ customer demand} \\ &= 27 * 1320 * 60 / 50000 \\ &= 42.7 \text{ sec.} \end{aligned}$$

Number of shifts per day = 3,

Number of working days = 27

Net working time per day = 1320 min.

Demand for month = 50000

Cycle time = 43 sec

Lead time = 8 sec

Production per day = $1320 * 60 / (43 + 8) = 1550$ parts per day

VI. RESULT

When cycle time for each process is compared with takt time it is found that cycle time of welding process exceeds the takt time so there is need to improve the process capability of welding process to meet the demand of customer within the time.

So it can be improved by using various lean tools but here we are improving the cycle time of welding process by introducing a new welding machine and by improving layout of weld shop.

Cycle time before improvement = 43sec.

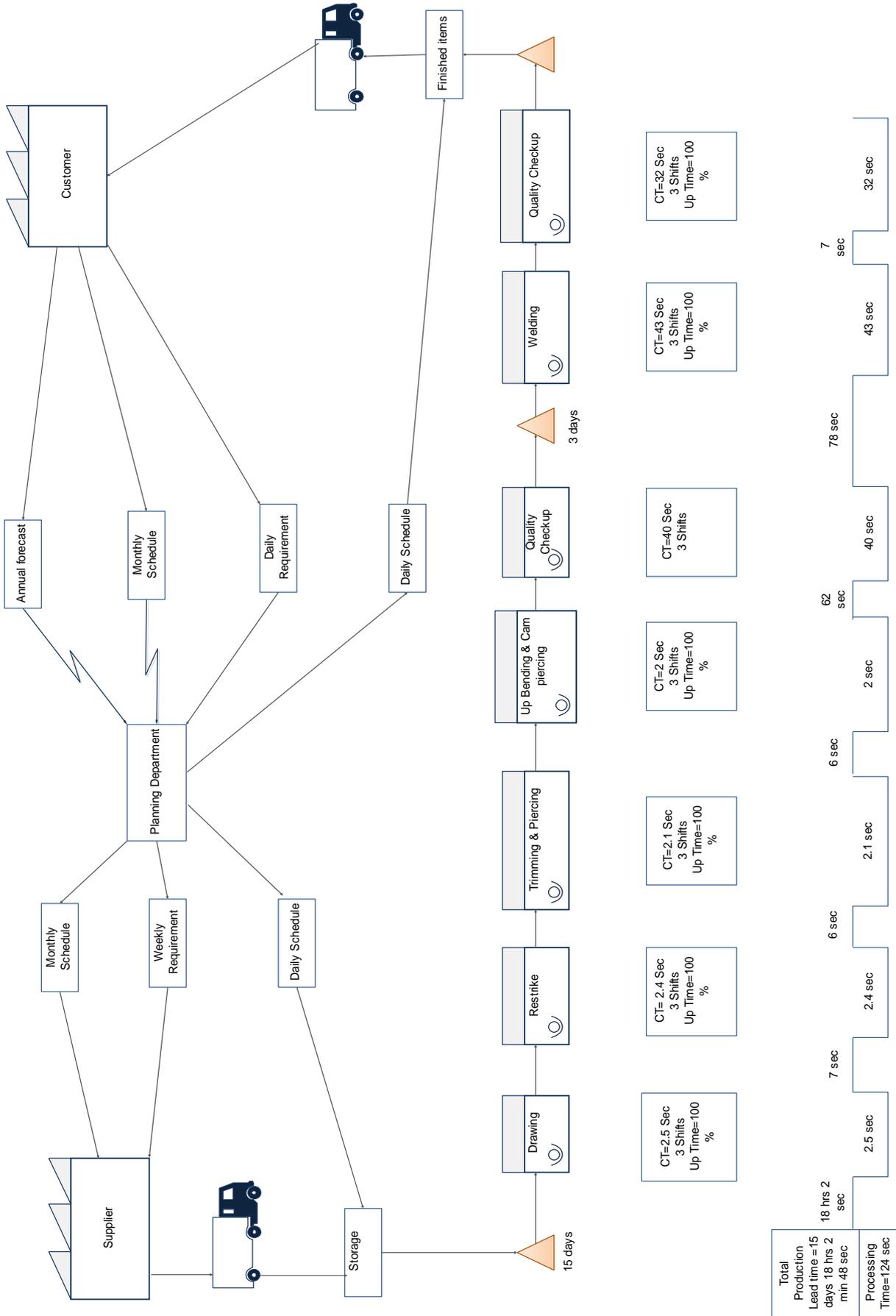
Cycle time after improvement = 22 sec.

% improvement in production = $(2600 - 1550) / 1550$

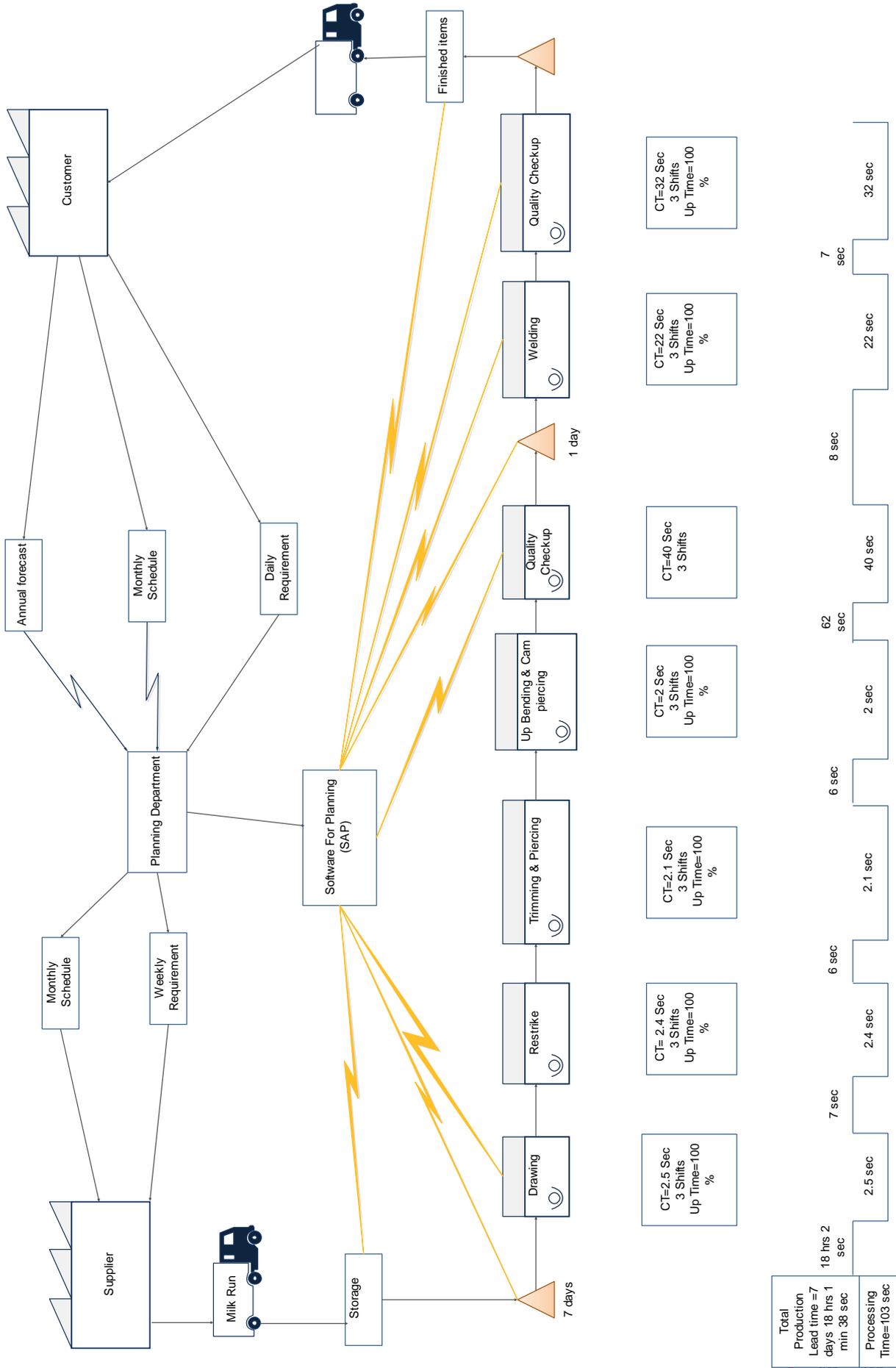
There is near about 67% improvement by improvement in value adding activities.

VII. CONCLUSION

Lean production means continuous improvement, 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 you to eliminate in next cycle, during which lean becomes a habit or culture.



Current State Map



Future State Map

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