

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

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Abstract—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. A flow diagram showing the process is drawn to reflect the current state of the operation. The non-value actions are identified in each step and between each step by their waste of time and resources. The process is analysed 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). The reengineered process is flow charted in its future state with process steps and information flows redesigned, simplified and made less expensive.

Index Terms— Current state map, cycle time, future state map, lead time, takt time, Value Stream Mapping

I. INTRODUCTION

The use of Value Stream Mapping (VSM) has been attributed to the cause of much of the success that Toyota of Japan has had since the 1980's. Developed during the work conducted by Taiichi Ohno at Toyota in the 1960's and 70's, at its basic level 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 processes.

In Taiichi Ohno's words - "All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes."

(Ohno, 1988)

It is useful to explain the meaning of several key concepts used in VSM. These are: what is meant by a process, what waste is, what is meant by 'flow', what constitutes value-adding, along with what is needless non-value-adding and what is necessary non-value-adding. A process is a series of activity steps that move inventory from one step to the next to transform it into the intended output, as shown in. The output could be a physical item or a service. A process can be any type or size and cover any period of time. Each step in a

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process also consists of processes within the step. VSM is used to investigate processes to identify improvement opportunities lying in their wastefulness and lack of fluidity.

Value is from the customer's perspective, the customer being the person who uses the output. Value-adding actions and resources are those which create value for the customer. Non-value-adding is everything done in the process which contributes no value for the customer but which they are forced to pay for when they buy the product or service.

Value adding activities

Machining, Processing, Painting, Assembling

Non value adding activities

Scraping, 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 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.

II. LITERATURE REVIEW

Academics such as McDonald et al. (2002), Lian and Landeghem (2002) and Abdulmalek and Rajgopal (2007) have explored the integration of VSM with simulation. A multitude of VSM software (e.g. eVSM) is available over the internet. Such software presents the user with a dynamic view of the value stream (not static), allowing observation of the "real-time" impact of proposed improvements. Essentially it increases flexibility and information available to improvement teams. Chitturi et al.



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(2007) discussed practical issues like how to calculate Takt time, what process improvements can be done and how to handle different process and product families while mapping job shop operations using a standard VSM and also explained while drawing a VSM of a process, all pertinent data should be collected from first to the last operation with respect to it.

Chandradeep Grewal (2008) has explained the methodology of lean and VSM that can be applied for a small company and also stated that it is a powerful tool to identify the inefficiencies and improvement areas.

Bhim singh (2010) implemented Lean to production industry. The author highlighted the benefits from the all the areas of lead time, WIP, processing time, inventory and manpower.

Ibon (2008) is considered VSM is suitable tool for redesigning the production systems.

Wong (2009) has studied on adoption of lean manufacturing in the electrical and electronics industry in Malaysia. The author considered the areas viz., scheduling, inventory, material handling equipment, work processes, quality, employees, layout, suppliers, customers, safety and ergonomics, product design, management and culture for implementing.

Petter Solding et al. (2009) have presented in their paper that, the concept for creating dynamic value stream maps of a system using simulation. Creating dynamic value stream maps makes it possible to analyze more complex systems than traditional VSMs are able to and still visualize the results in a language the Lean tools.

Ohno (1988) identified that the Toyota production system has been created on the practice and evolution of one very useful technique that reduces cost and time while challenges every activity in the value stream. It is applying a methodology known as the "Five whys," "By asking why an activity is performed and then asking why after each response, it is frequently possible to get to the origin of the problem. Understanding the root cause assists in successful redesign.

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.

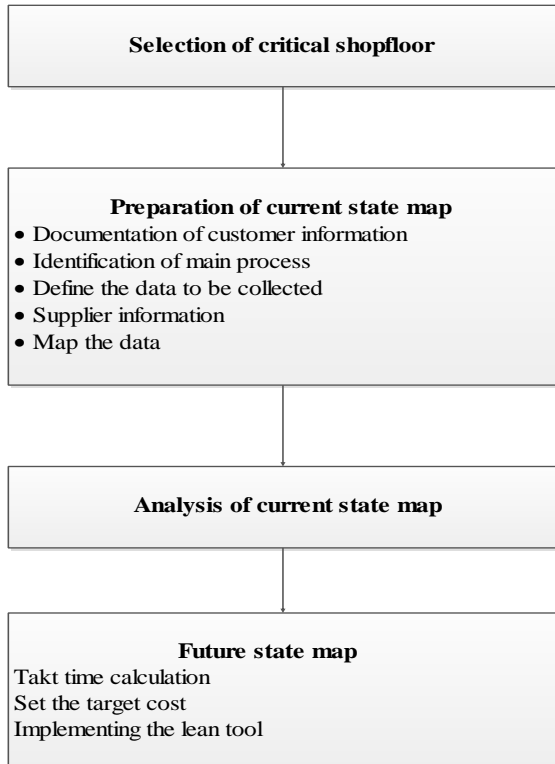
A Production is to order and large numbers of different products are produced, each in relatively small volume. A Production shop consists of number of machine centers, each with a fundamentally different activity. The problems of machine shop are delayed deliveries, long queues, and high work in process 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. 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.





VSM Implementation flowchart

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.

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 inner wheel housing 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.

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

Number of shifts per day = 3,
 Number of working days = 27
 Net working time per day = 1320 min.
 Maximum forecast Demand for month = 50000
 Cycle time = 56 sec
 Production capacity per month = $27 * 1320 * 60 / (56) = 38000$ parts

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 fixture and a new robot welding machine and by improving layout of weld shop and by implementation of milk run also there is reduction in lead time.

Comparison of the existing versus proposed process for inner wheel housing

Variables	Units	Current	Improved
In process inventory	No. of days	3	1
Production lead time	Days-hrs-minutes-sec	18-1-2-52	11-1-1-39
Processing time	Sec	124.7	107.2

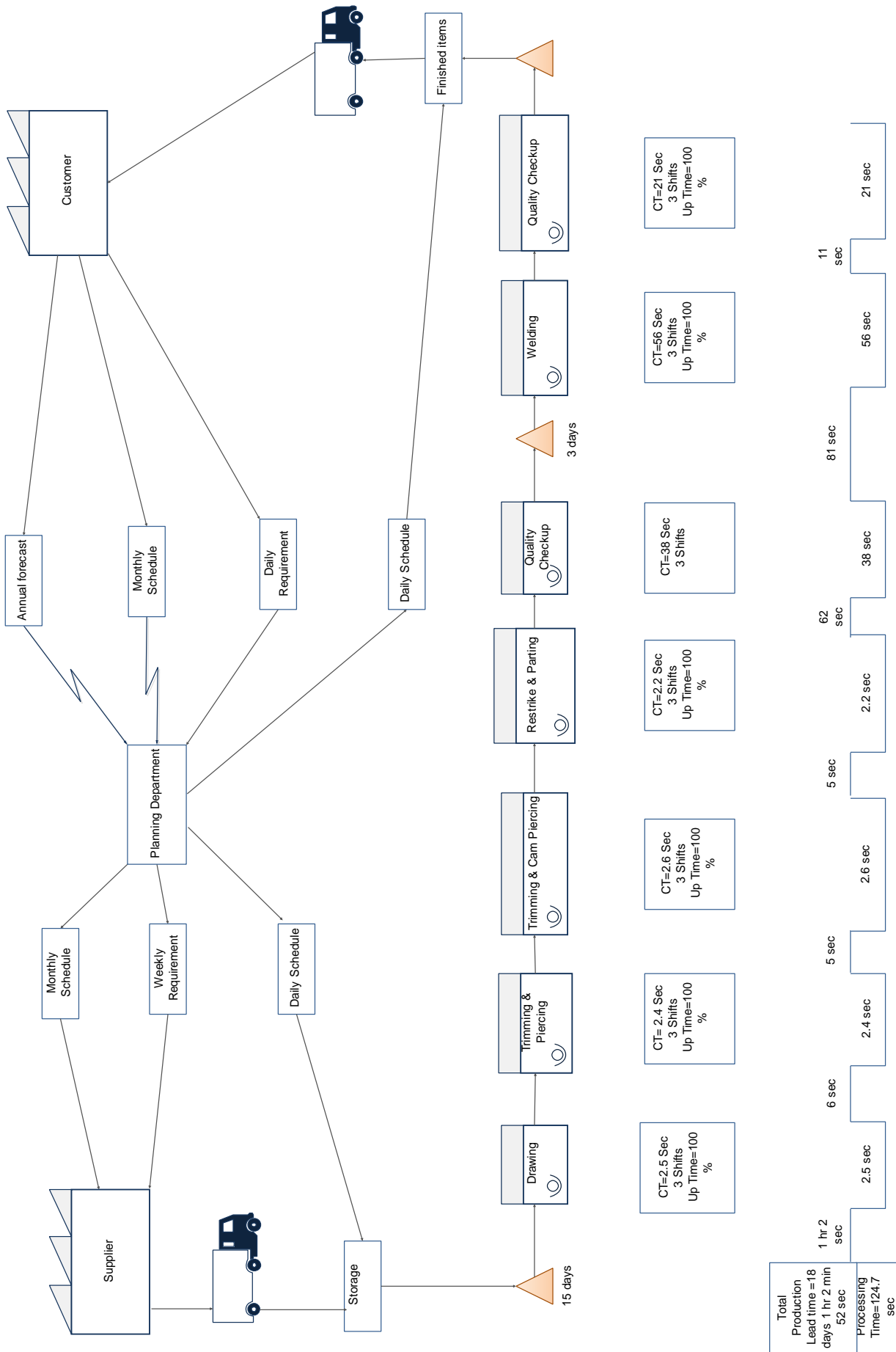
VII. CONCLUSION

The Improved production after implementation of VSM = $27 * 1320 * 60 / 38.5 = 55000$
 improvement in production = $(55000 - 38000) / 38000 = .44$

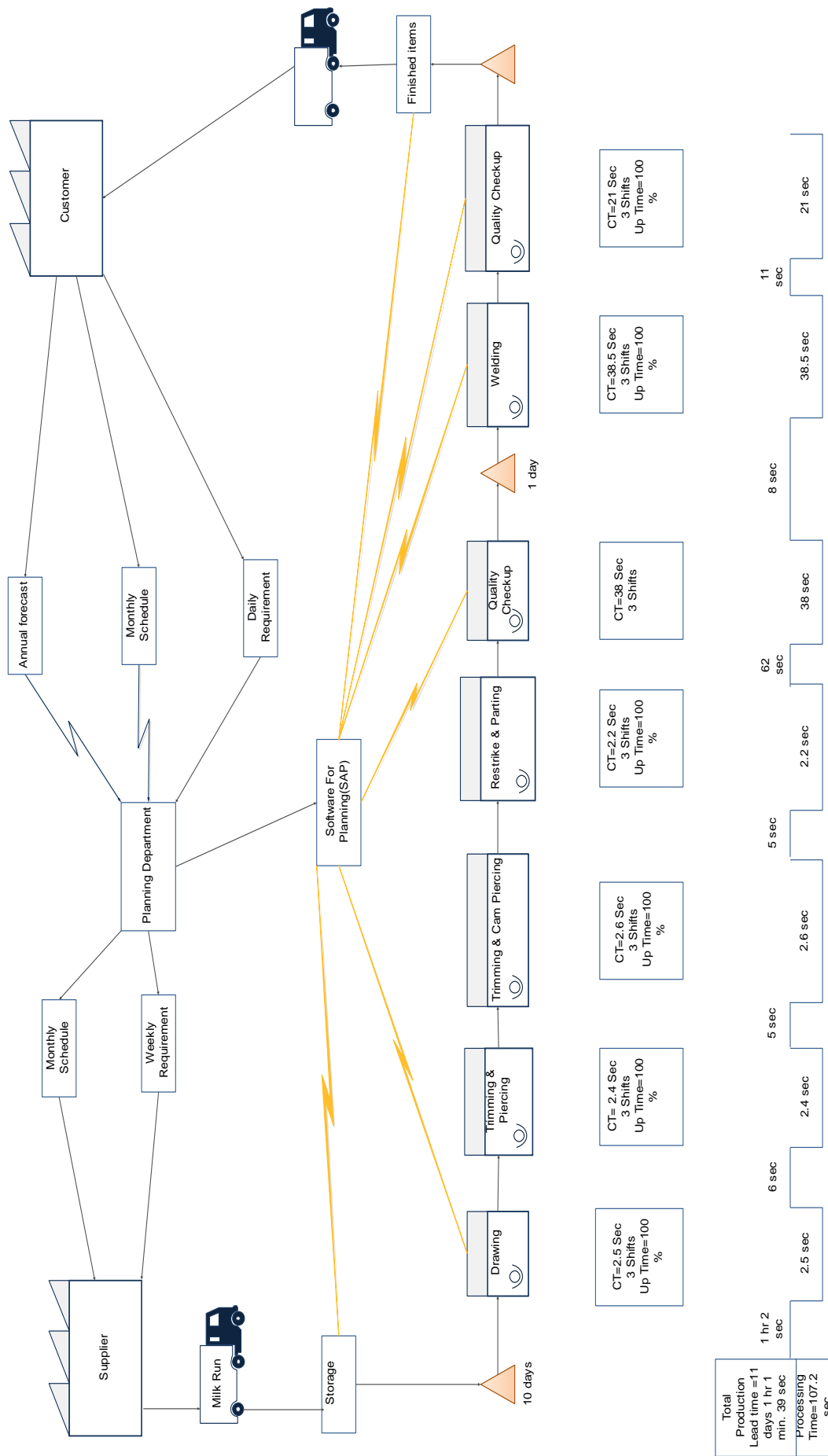
There is near about 44% improvement by improvement in value adding activities.

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.

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CURRENT STATE MAP OF INNER WHEEL HOUSING



FUTURE STATE MAP OF INNER WHEEL HOUSING

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