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*Research Paper*

# APPLICATION OF VALUE STREAM MAPPING IN SMALL SCALE INDUSTRIES

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Value stream mapping has the reputation of uncovering waste in manufacturing, production and business process by identifying and removing non value adding steps. Value stream mapping is a method of recovering a product's production path from door to door. In a process, non value added actions are identified in each step and between each step by their wastage time and resources. VSM is 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 after present study, we come to know about improvement intact time by applying the proposed changes if incorporated in future state map.

Keywords: Current state map, Future state map, Takt time, Value stream mapping

## INTRODUCTION

The use of VSM has been attributed to the cause of much of the success that Toyota of Japan has had since 1980. VSM was introduced by Taiichi Ohno in 1960 and 1970's at its basic level. It is a systematic procedure to identify wasted time and action in manufacturing process. A value stream is all the actions (value added and non value added) required to take a product from raw material to customer, the design flow from concept to completion.

**Value Added Activities:** Machining processing, assembling, painting.

**Non Value Added Activities:** Scrapping, sorting, storing, counting, documentation.

Value stream means looking at the whole picture not just individual picture improving the whole, not just individual part. The value stream is the complete making process for a product. It starts at the concept and ends at the delivery to the customer. VSM can be a communication tool, a business planning tool and a tool to manage change in the production process. VSM provides a simple yet through method that relies on current data analysis and display. It links reporting, requirements, matrices, people and lean tools to continue improvement

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and promote process learning. It gives managers and employees the same tool and language to communicate. It helps to visualize the station cycle times, inventory at each stage, manpower and information flow across the supply chain. In the production where VSM is used, the individual processes are connected to their customer(s) either by continuous flow or pull, and each process gets as close as possible in producing only what is customer(s) demand.

## LITERATURE REVIEW

Taiichi Ohno (1988), Womack *et al.* (1990), and Peter Hines and Nick Rich (1997), Rother and Shook (1999), Womack and Jones (1998 and 2005), and Daniel and Jones (2006) 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.

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.

Hines and rich (1997)has suggested that the value stream is "the specific activites within a supply chain required to design order and provide a specific product or value."

Hines(1998) found an application of value stream mapping in the distribution industry. Partsco, a distributor of electronic, electrical and mechanical component decided to map the activities between the fiem and is suppliers. Partsce introduce EDI which allowed the firm to work with its suppliers effectively and more quickly. In a short time period the company was able to reduce the lead time from 8 to 7 days.

Abbett and payne(1999) have discussed the application of value stream mapping in an aircraft manufacturing unit. The have developed the current and future state maps with the objective of reducing lead time according to customer's requirements.

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.

McDonald (2002) point out that the VSM creates a common language for production process thus is facilitating more thoughtful decisions to improve the value stream. This will effectively reduce the wastes and improves the productivity. While researches and practitioners have developed a number of tools to investigate individual firms and supply chain, most of these toll fall short in

linking and visualizing the nature of the material and infirmatin flow in individual company. Simchi-Levi (2004) are of the opinion that the customers are always concerned with their order status and sometimes they value the order status more than a reduced lead time.

Balkema and Rotterdam (2004) have created current 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.

Badrinarayana and Sharma (2007) discusses that the interdependent components from the value strem and value strem is the set of all specific actions required to bring out a specific actions requird to bring out a specific product.

Petter Solding (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.

Ritesh Bhat and Shivakumar (2011) made an attempt to improve the productivity using Value Strem Mapping and Kanban Approach- "Change is constant", is the phrase today most of the industries believe in and act upon. Value Stream Mapping (VSM) and Kanban are the techniques believe in and act upon. VSM and Kanban are the technique which fall under technical approach method and when used together as a combination gives a tremendous result.

## 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 activities such as 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.

## VSM METHODOLOGY

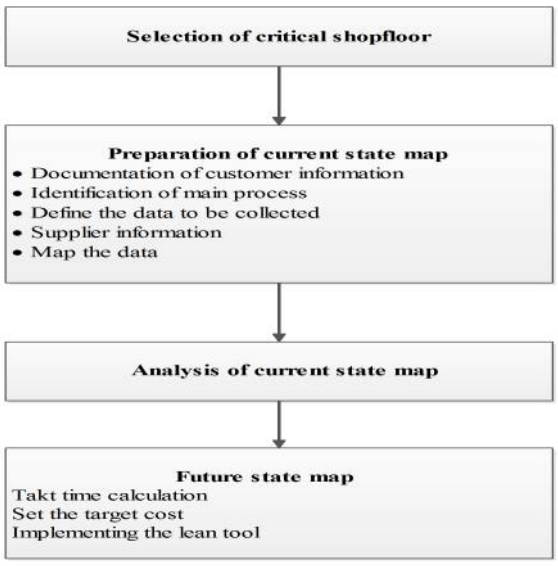
Mapping the value stream is a big picture technique that takes into consideration all the processes and seeks to improve the enterprise as a whole. The overall goal of VSM is to move from batch and push to one-piece flow and pull through the entire value stream. Using a VSM process requires development of maps: a current state map and a future state map. In the current state map, one would normally star by mapping a large quantity and high-revenue product family. The material flow (left to right) will then be mapped using appropriate icons in the rich VSM icon template. The product will be tracked from the final operation in its routing to the raw material storage. Relevant data for each operation, such as current schedule (push, pull and order dispatching rules) and amount of inventory in the queue, will be recorded. The information flow (right to left) is also incorporated to provide demand information, which is essential parameter for determining the "pacemaker" process in the production system. After both material and information flows have been mapped, a time-line is displayed at the bottom of the map showing the processing time for each operation and the transfer delays between operations.

The time-line is used to identify the value-adding steps as well as wastes in the current system. The comparisons between the processing times and takt time is a preliminary measures of the value and waste. This takt time is mostly used as an ideal time for each operation to achieve. Based on the analysis of the current state map, in than develops a future state map by improving the value adding steps and eliminating the non value adding steps.

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 implantation of future state

Figure 1: VSM Methodology



## METHODOLOGY ADOPTED

Main objective of the research is to achieve reduced lead time, reduced inventory and cycle time.

**Step 1:** To draw Current State Map by using following substeps:

***Substep 1:*** Identification and drawing the product flow from the raw material entry point of manufacturing division to the finished goods exit point of the mfd.

***Substep 2:*** Calculating the number of Work In Process (WIP) for each component at each work cell.

***Substep 3:*** Calculating the cycle time and utilization percentage of each process.

***Substep 4:*** Plotting the current state map that is essentially a snapshot capturing how things are currently being done.

**Step 2:** Create a Future State Map which is a picture of how system should look after the inefficiencies in it have been removed.

## CURRENT STATE MAP

The data regarding the cycle time, setup time and lead time was calculated from the manufacturing line of inner wheel housing. Further the details of various processes involved in the involved in the manufacturing were noted down. The various manufacturing processes used are drawing, trimming, restriking, punching/piercing and welding operations. Hence the cycle time, setup time, WIP quantity required, WIP others, number of shifts were noticed. Finally a current state map was drawn.

Maximum forecast per month is 50000 by the help of past records and increasing demand for new model of vehicles. Effective number of working days is 27 for the forecast month; number of shifts per day is 3. Available working time per day is 1320 minutes.

So as we know, Takt time = Actual working time per month/demand of product

Takt time = 27*1320*60/50000 = 42.7 sec

## ANALYSIS OF CURRENT STATE MAP OF INNER WHEEL HOUSING

For the analysis of existing status, a few assumptions are made. Regarding demand of wheel housing, it is assumed that maximum demand may reach up to 50000 per month. This is derived from past sales data at the industry under study. The current State Map

Figure 2: Inner Wheel Housing Current State Map of Manufacturing for Comparison Between Takt Time and Station Cycle Time

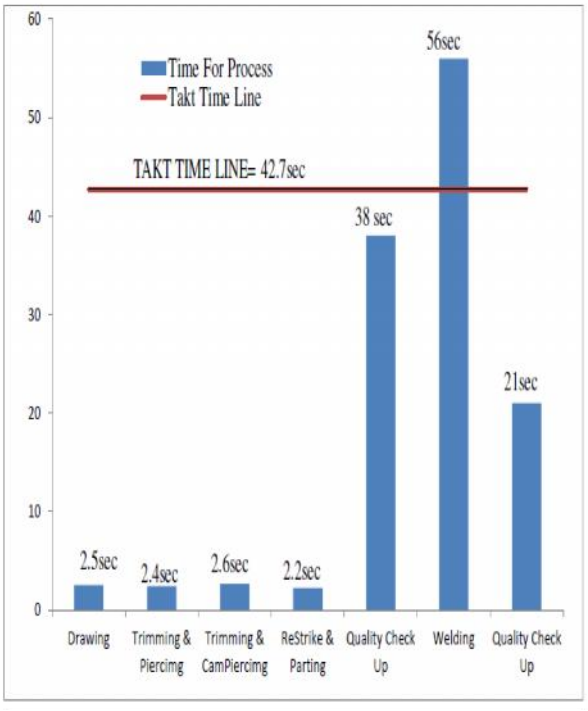
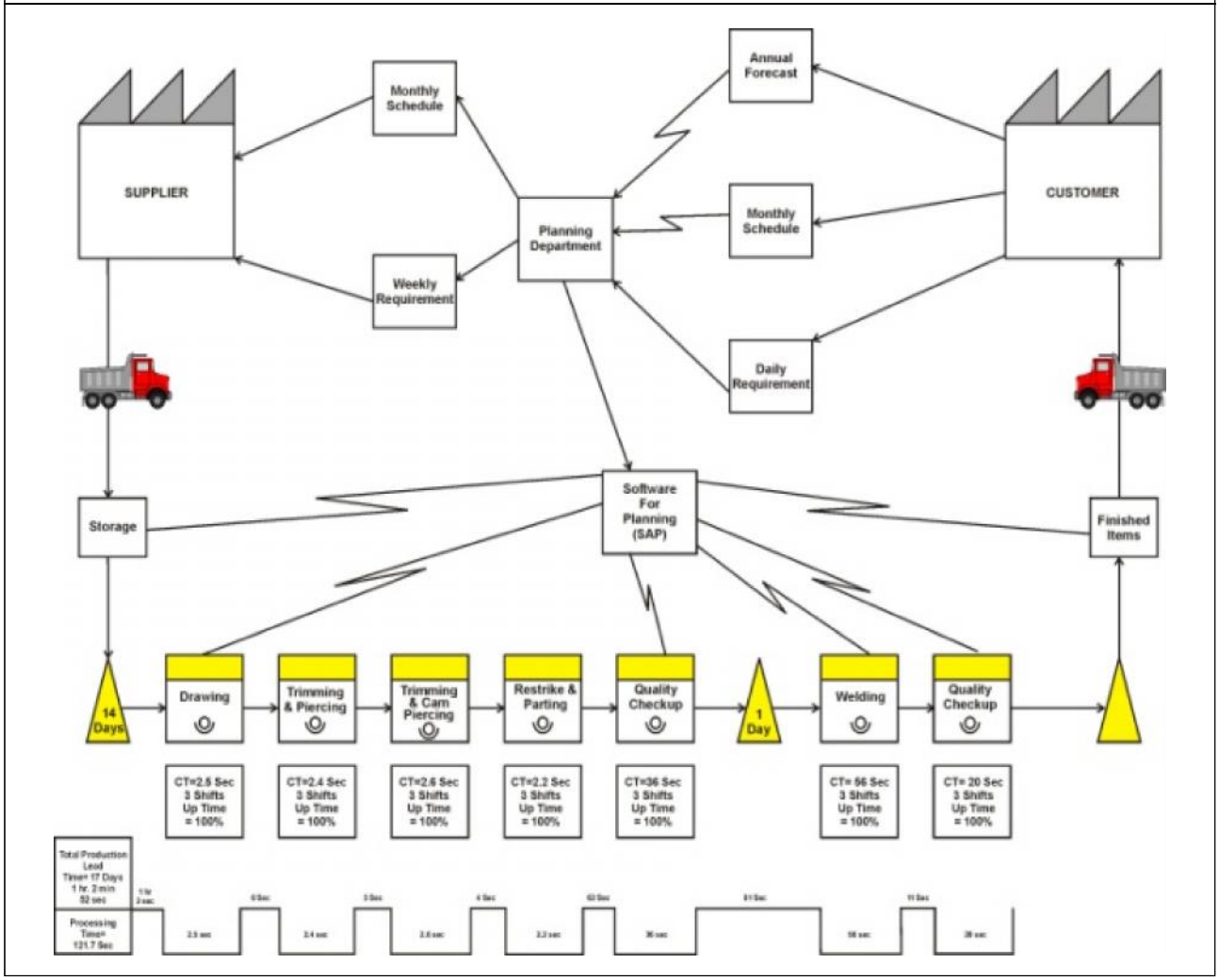


Figure 3: Current State Map for Inner Wheel Housing




captures information at a particular instance, which may vary from shift to shift. For the sake of analysis the shift and opertator variation is not considerd. Comparison of takt time with cycle time as shown in Figure 2.

## FUTURE STATE MAP

The plan of action for improving the future state value stream mapping were.

- To develop a new layout, where the line flow of the components was possible. This makes the inspection and quality control tasks much easier.
- To carry out online inspection and scrap reduction programs.
- To review the work sequence in order to reduce idle time.
- To identify value added and non value added elements and eliminate non value added activities.

With the application of Value Stream Mapping Future State Map is shown in the figure. Future State Map capture all the information and data as per requirement of takt time.

## ANALYSIS OF FUTURE STATE MAP OF INNER WHEEL HOUSING

From the calculations of.anaysis of current state map of inner wheel housing the benefits are summarized in Table 1. There are clear indications that production lead time can be reduced from (18 days, 1 hour, 2 minutes and 52 sec) to (11 days, 1 hour 1 minute and 39 sec).

And processing can be reduced from 124.7 sec to 107.2. High demand at caparo is easily achievable with reduction in both WIP and finished goods inventory in supply chain. All these proposed changes will lead to a significant cost reduction at caparo, and hence will also he[p in reducing overall costs in supply chain. Now Caparo will be in a

Figure 4: Future State Map of Manufacturing for Comparison Between Takt Time and Cycle Time

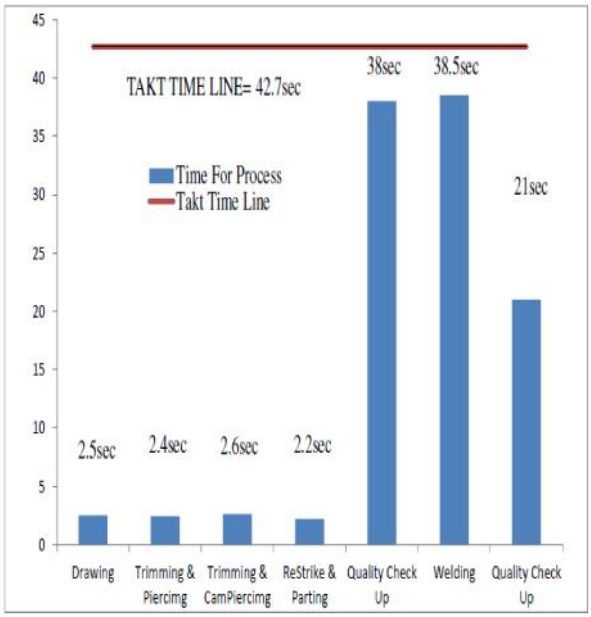



Figure 5: Future State Map

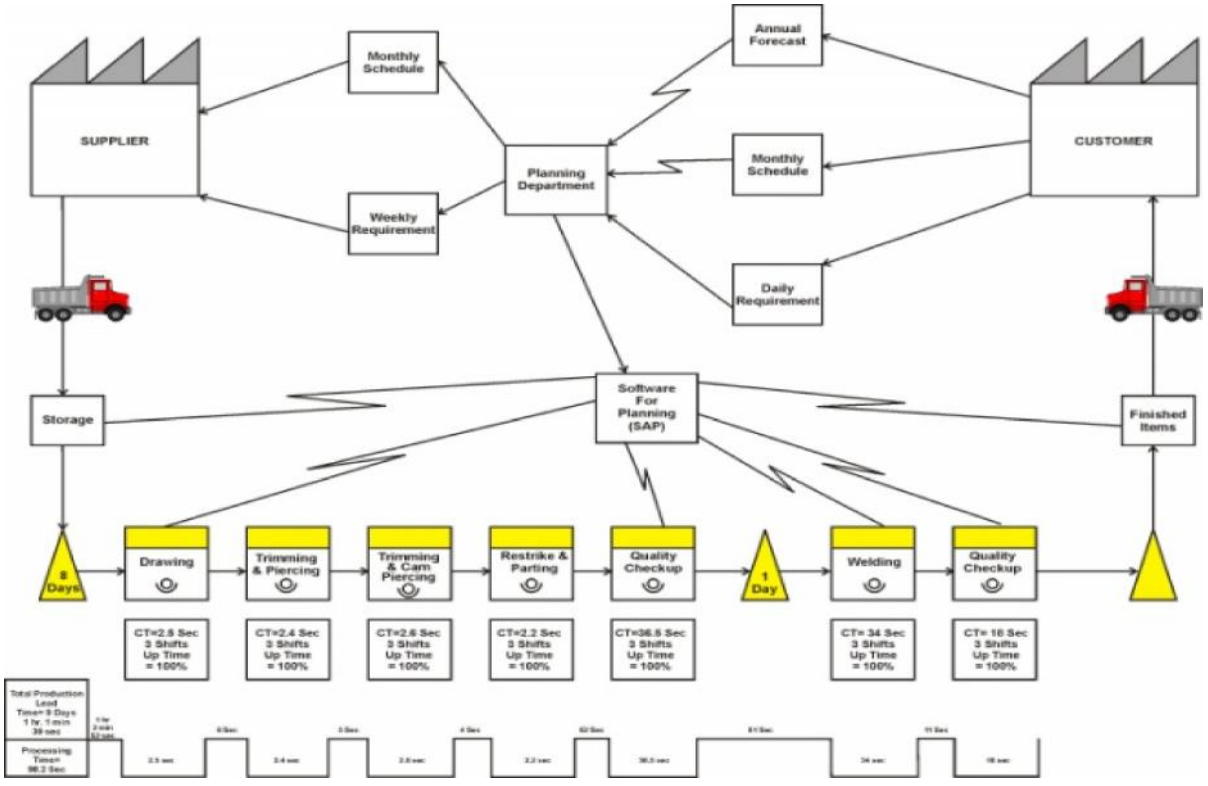


Table 1: Comparison of the Existing vs Proposed Process for Inner Wheel Housing

| Variables | Units | Current | Proposed | Percentage Changes |
|---|---|---|---|---|
| In process inventory | No. of days | 3 | 1 | 33.33% |
| Production lead time | Days-hrs-min-sec | 17 days 1 hr 2 min 52 sec | 9 days 1 hr 1min 38 sec | 52.94% |
| Processing time | Sec | 121.7sec | 98.2 sec | 80.69% |

position to deliver at an hourly rate, and high quality inner wheel housing at lower cost, which was also the requirement of lean and responsive environment. Aftr applying proposed changes station cycle time will be 98.2 sec.

## CONCLUSION

Lean production means continuous improvement, we must keep on changing the future state into current state for getting the better results. Value stream mapping helps in attaining the higher usage levels by the proficiency of shop floor practices. VSM tool has greatly proved to be a effective tool for eliminating waste in cycle time. This powerful tool only highlights process inefficiencies, transactional and communication mismatches but also guides about the improvement areas. On the shop floor time is money. If the time is wasted money is wasted. By applying the value stream mapping tool in a small scale automobile industry, a current state map is developed. By eliminating non value added activities. The future state value stream shows marked improvement in the process inventory, production lead time and processing time. In this study process inventory time reduced from 3 to 1 days resulting in improvement of 33.33%. Process lead time was reduced by 52.94% and the processing time was reduced by 80.69%.

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