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Research Article

Value Stream Mapping: A Continuous Improvement tool for Reduction in Total Lead Time

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Abstract

This research proposes the usage of Value Stream Mapping (VSM) for reduction in total lead time by identifying and minimizing the non-value added activities in a manufacturing process for an electrical company. To be able to meet the customer demand in time without any delays there was a need for implementing lean flow technologies to understand and manage the existing process so as to increase the throughput. The existing situation of the manufacturing process was mapped with the help of VSM technique. The potential areas of improvement were highlighted as Kaizen bursts and proposed to reduce the gap between the existing state and the future state of the process. By developing a future state map which had more efficient processes, this research helped in achieving the main objectives of reduction in the total lead time, work-in-progress and the inventory levels by improving material and information flow.

Keywords: *Kaizen bursts, Lead time, Non-value added, Value stream mapping*

1. Introduction

A lean philosophy revolves around the reduction of wastes in all aspects of a business. Adapting 'Continuous improvement' initiative on an ongoing basis is the key for successful lean implementation program. Continuous improvement consists of a variety of methodologies, including Process Management, Quality Management, Performance Management, Lean, Six Sigma and more. All the different terms, techniques and methods available, there are similarities between these different approaches that they try to continuously improve business operations in order to enhance business outcomes.

As a part of continuous improvement, VSM is a lean management tool that helps to improve the existing condition of the manufacturing process by developing a future state map which can help in developing a roadmap for the organization (Russell and Taylor, 1999). It is a visualization tool which helps to identify the value added and non-value added activities and the 'total lead time' of a product in the entire supply chain.

As a result, potential areas for improvement and impact of each area on the entire supply chain are understood. Once these potential areas for improvement are discovered, a futuristic process known as 'future state' is mapped (Wilson, 2010). These two states – 'Current state' and 'Future state' helps to understand the wastes that exist in the entire business process.

2. Literature Review

Lean focuses on the whole process rather than optimizing the individual operations, the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers (Rother & Shook, 1999). Lean manufacturing is all about 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. (Taiichi Ohno, 1998)

According to Hines and Rich (1997), 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. Jones and Womack (2000) explain VSM as the process of visually mapping the flow of information and material flow and preparing a future state map with better methods and performance. VSM technique is the first stage of analysis used in most lean manufacturing implementation which provides a systematic approach for waste identification, lean tool selection and implementation (Luyster, 2002).

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3. Present work

The present study was carried out in XYZ Ltd production industry, which manufactures electrical safety devices located in Mumbai, Maharashtra (India). Present study proceeds with the mapping of the current state of manufacturing line of XYZ Ltd. VSM process symbols were used to discuss the lean implementation process in the production industry. This mapping was done by using various process symbols of VSM to visualize the material flow and information flow as the product flows in manufacturing line.

4. VSM Methodology

To start an effective program for implementation of lean manufacturing planning, designing and execution phases are the crucial ones to obtain the desired results. The topics in this section outline a typical sequence of events during the project, using a practical methodology, as mentioned below:

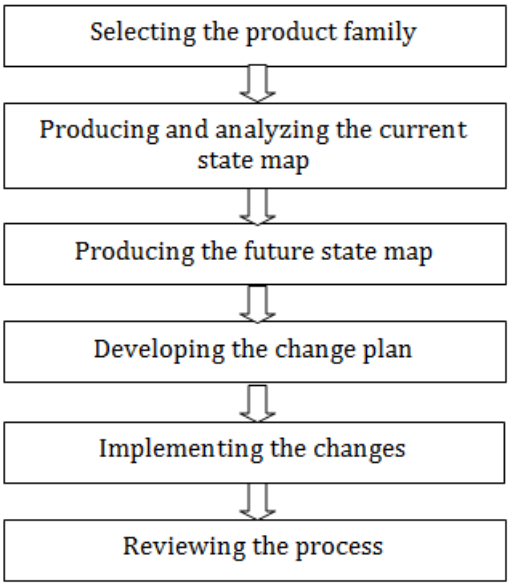

Fig.1: Steps in VSM

4.1 Selection of product family

The first step in VSM is selecting the product family to value stream. This electrical company manufactures different types of products, several product families were selected based on the similar processing steps and over common equipment. Out of several product families, one product family was selected based on the highest total annual demand.

4.2 Data collection

The process analysis started with the collection of data regarding the existing process flow, process time, setup time, number of operators, and number of shifts etc. from various enquiries with expertise in shopfloor, workers and directly participating in measuring the time of various processes. This data was collected by continuously interacting with the process planners and by visual observation at the site. The process data collection was done by walking the process and was carried out at the initial stage with a lean manager who has the knowledge about the lean principles.

4.3 Current state mapping

The current state map represents all the details regarding each process step and how each step is completed and what happens to the items being processed. The current state mapping was done at the macro level first and then at micro level. The existing situation was mapped starting from the customer end because services or products are driven by customer demand, to the manufacturer including suppliers (Fig.2). There is a need to define the current situation, identify the goal and recognize the gap between where you are and where you want to be. This will help to find the causes of problems and thus the means to improving the flow, efficiency, reliability and flexibility of the process. Mapping the operation, identifying the inventory locations, work in progress, finished goods as well as where in the value stream the customer order enters the stream considering how long it takes the product to reach the end of the value stream.

4.4 Analysis of current state map

Table 1 Analysis of current state map

No*N* N

$$No.of\ woking\ \frac{days}{year} = 2 \quad (1)$$

$$Available\ \frac{time}{year} = 480\ mins \quad (2)$$

$$No.of\ shifts = 2 \quad (3)$$

$$Annual\ demand\ for\ the\ product = 19108 \quad (4)$$

$$Takt\ time = Avaliable\ working\ \frac{time}{Annual\ demand} \quad (5)$$

$$= 236\ days * 480\ mins * 2 * \frac{60}{19108}$$

$$= 711.409\ seconds$$

$$Total\ Lead\ Time\ is\ Value\ added\ time(days) + Non\ value\ added\ time\ (days) \quad (6)$$

4.5 Future state map

The next stage was to develop a future state map to show how we want the process to operate in the future when all the possible improvements have been identified and considered. The bottlenecks were identified in the entire process, the potential areas were identified in order to reduce the total lead time, improve product transformation flow as well as improve communication flow. Amongst these seven wastes, wastes on account of inventory and the waiting time were the critical ones. The potential areas of improvement were highlighted as Kaizen bursts.

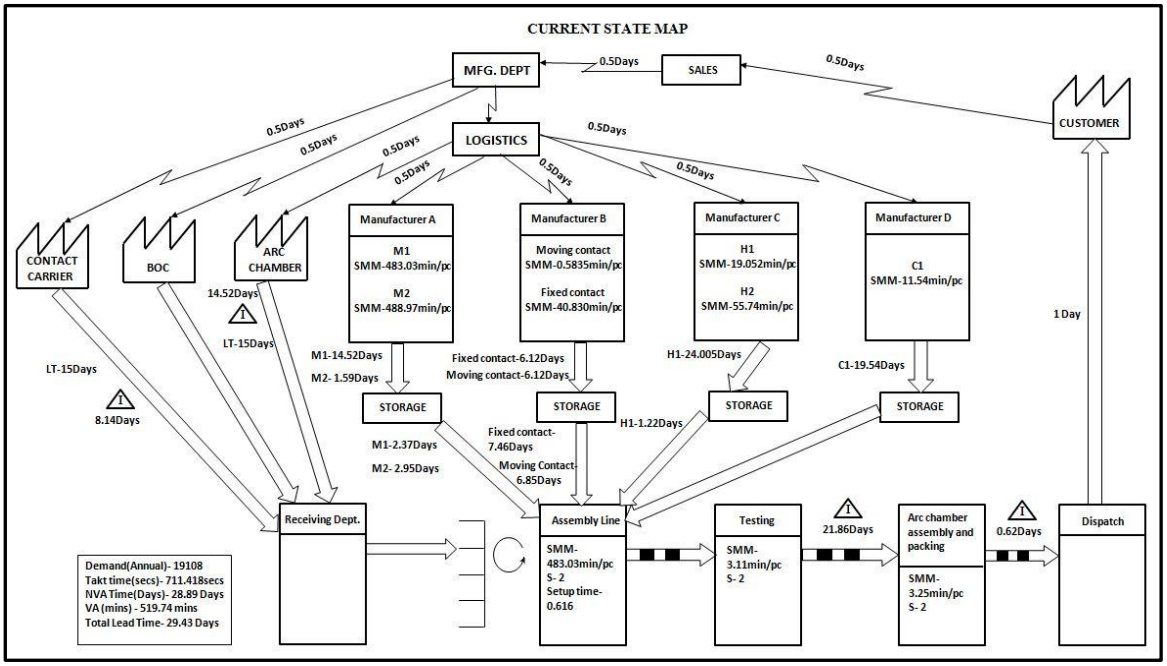

Fig.2: Current State Map

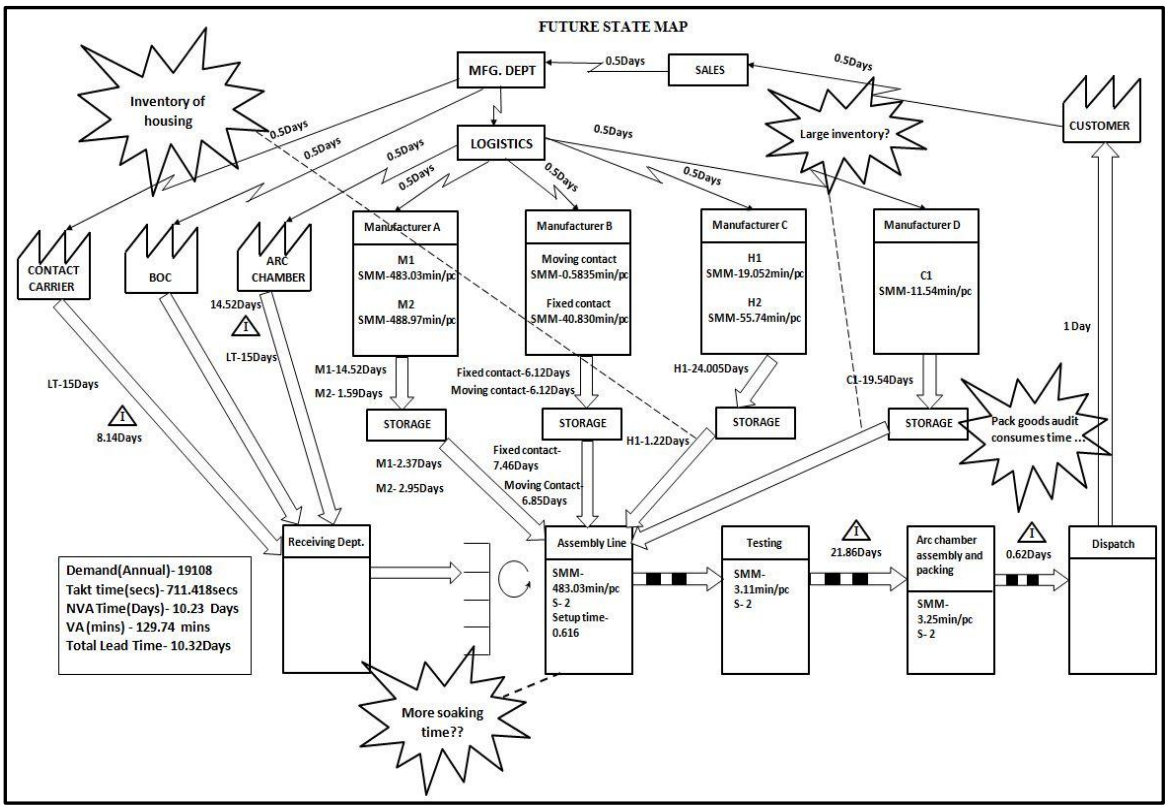

Fig.3: Future State Map

4.6 Analysis of future state map

The future state map was prepared and insisted on several areas of improvement as shown in Fig.3.

In the process of packed goods audit as shown in the current state map, there was a certain amount of inventory which was present before dispatch. A random sampling is done for the finished goods of products and if the product is as per specifications the whole lot is sent to the warehouse for dispatch to the customer. On the assembly line, the cycle time is 483.03min/pc which are comparatively higher than the other processes. This time includes the soaking time for the parts required M1, which is the curing time to provide a stronger bond between the parts. As seen in the current state map, the inventory levels are

quite higher for H1 part and the coils which is a contributor to higher non-value added time.

4.7 Proposed future state map

The analysis of the future state map shows the improvement that is made by applying lean principles and techniques in order to achieve the objectives.

Table 2 Potential areas of improvement

Potential areas of improvement		**Type**
Inventory of housing	Reducing the Changeover time and setup time of injection Molding m/c by having an automated change of die or SMED	Inventory
Soaking time-non value adding	Use of substitute material with less soaking time	Waiting time
Inventory of coils	Kanban system/ Pull production system	Inventory
Pack goods audit consumes time	Use of barcode scanner/online inspection at assembly line to have poka-yoke	Waiting time

Table 3 Evaluation and comparison of results

Areas	Current state	Future state	% improvement
Soaking time-non value adding	480 mins	90 mins	81.25%
Inventory of coils	19.54 days	1.5 days	92.32%
Pack goods audit consumes time	0.62 days	0 days	100%
Non-value added time	28.89 days	10.23 days	64.59%
Value added time	519.74 mins	129.74 mins	75.04 %
Total lead time	29.43 days	10.32 days	64.94 %

Conclusion

In this research, we observe that the lead in the current state map which is 29.43 days can be reduced in the inventory levels of the process with the help of Kanban system, which almost reduces the inventory level by 18.04 days to 1.5 days. All the above factors are great contributors to the reduction in the total lead time that is of great value to meet the customer demand.VSM is a powerful tool for lean manufacturing and allows firms to understand and continuously improve its understanding towards lean. VSM can be done in the same way for practically any business activity. Thus, identifying the importance of VSM from the above review this research proves the utility of value stream mapping as an effective tool for lean implementation which is very useful in contributing both to research field and also for organizational benefits.

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