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Lean Implementation on Indian manufacturing firm

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Abstract—In today's market every manufacturing industry is trying to implement 'Lean' in its operations. This emergent need of reducing waste and getting efficient production had created a boom for the Lean Production (LP). Many people from corporate firms and management associates want a productive tool for achieving this task. Value Stream Mapping (VSM) is the solution to such emerging need, it identifies the source of waste practices and tries to scale down them analytically. VSM in this way measures all the value and non-value added processes, to evaluate the origin of wastes, their effect on different operation of industry and the processes in between. In this paper we have implemented VSM technique on a small scale industry to showcase its effect on cost of production, production lead time and the developing some procedure for reduction of root cause of this loss. Considering the current processes of the industries operations Current State map is developed to show how actual production is taking place at the industry before implementing any lean procedure. A Future State Map is finally developed considering the lean behaviours to reduce the waste production and to increase its productivity. This is inspected along with its takt time calculation. Thus, by curbing these wasteful practices we will show how manufacturing performance of the company can be upgraded by employment of VSM.

Index Terms— Value Stream Mapping (VSM), Lean Production, Takt time, Production- Lead Time, Current State Map, Future State Map.

I. INTRODUCTION

In this revolutionized era of emerging lean, industries are working towards achieving goal of implementing lean to get off a boost in production processes over other industries. Statistically it has been validated that industry having "Lean Manufacturing" access different advantages over industries believing in mass production (Fleischer and Liker, 1997). Value Stream Mapping (VSM) is one of the lean practices which removes waste and optimize the production process depending on the operations and process involved in the production. Monden and Womack et al. (1999) had given the concept of this value stream mapping where both inter and intra- related company's value added streams need to be mapped together. Mohanty et al (2007) noted that even though companies implement lean among their different processes, but then also they are not able to get significant improvement. This is due to insufficient knowledge of where to implement lean. For efficiently implementing lean, preparing a flowchart of different processes and analysing them according to their waste production is a must.

Value Stream Mapping consist of mapping of flow of material in an industry and documenting it in a form of production and information flow. The immediate objective is to diagnose entire waste flow from the chart and eliminate those wastes (Rother and Shook, 1999). Value Stream Mapping was conventionally developed for researchers to get an overview of discharged wastes in respective value streams, and then finally finding an escape route for cautiously removing this waste. And now it became a most demanding tool for achieving such practices for industries.

Many improvisations have been executed in the industries by the adoption of VSM. A tabulated charts using simulation software have been developed by Anand and Kodali (2009) to study the processes in Indian Automotive industry and improving their production time accordingly. Seth et al (2008) studied various origins of waste production in supply chain of cottonseed oil industry. Snyder et al. (2005) carried out the VSM implementation at a health care centre. Thus it has wide spectrum which helps to improve the quality of the product and productivity of the industries. Here we are devising the ways for implementing the Value Stream Mapping on Indian Manufacturing Industry, to increase its production capability by minimization of waste materials.

Process starts off with managing the workflow. It comprises of documenting the entire process, collecting the data and customer delivery. Betting on the complexity of the processes additional data can be acquired. All this data need to be comprised on a single map i.e. Value Stream. It contain various information of the processes like Cycle Time, change over time, Takt time, work in process time, equipment performance level etc. considering the scale of the industry and complexity of production processes, crucial relationship is developed among the manufacturing process and control measures are used to manage these process.

II. LITERATURE REVIEW

VSM concept was introduced in mid 1990s, during the time when Hines and Riches (1997) objectified the waste in the form of individual value streams and tried finding new ways for removing them. Huang and Luis (2005) tried to decrease Work In Process (WIP) time and Logistics cost using VSM. Similarly, Kumar et al (2006) used the concept of VSM to collaborate it with Six Sigma Technology to achieve improvement in process capability and overall effectiveness. Chen and Meng (2010) used this concept for Chinese firm to restrict waste to a certain level of achieving lean. Dentz et al (2009) achieved labour efficiency, quality and efficient communication between workers with the help of VSM.

Considering their work many authors have started working in the field of "Lean Manufacturing" introducing other tools for productively setting up the industries.

VSM has been accepted worldwide for improving productivity and quality of the industry with minimum wastes of time and its resources. Our main aim is to remove this waste and to decrease the production time of our processes. Nicholas (1998) explained that the waste can be of any form and can exist at any particular production unit at any time. This waste not only consumes the resources of our production unit but also harms in long run. Jones and Womack (2000) explained VSM as the visual map for the flow of information and material, and then developing ways for better production process. According to Tapping and Shuker, 2003 VSM portraits all the value added and non-value added activities of a production unit, and provides us a pictorial representation of work for which the customer is willing to pay. These all are an attempt for having a lean approach for a better supply chain management.

Current state map and future state maps showcase the changes we make to highlight lean production in an industry. These current state map and future state maps are an integral part of VSM and are used by many researchers and practitioners for displaying their work towards achieving lean production.

Yang and Lu (2010) used the concept of VSM in the liquid crystal display firm to improve their cycle time and inventory cost. We and Wu (2009) used VSM in their Taiwanese automotive industry to decrease cost of production and lead time with the help of lean tools in corporation with the PDCA cycle. Kalsaas (2002) used the same in Norway based Automotive Industry. VSM has also been used in small cycle manufacturing unit to identify and remove the waste (Grewal, 2008).This VSM can be used in any manufacturing, automobile, oil refinery sector, and is very efficient in its process. Like VSM, many tools are emerging to be used in business firms, social firms also for their improved output. Several researchers like Forza et al (1993), Jessop and Jones (1995), Cusumano and Nobeoka, 1998, Barker, 1994 and Lamming, 1993 had also used this VSM in different sectors and got a great response in their work. That's why the need of new tools and their applications in different sectors is increasing and will always remain in a good demand in market.

TABLE 1. Terminology used in VSM

Takt Time	Rate at which company produce a product to satisfy the customer demand.
Production Lead Time	Total time taken from arriving of raw material to shipment of finished goods.
Value Adding Time	Total time use for adding value to product.
TQM	Ability to produce high quality products and services to customer.
Current State Map	Current position of a shop floor in an industry
Future State Map	Future position of a shop floor in an industry to maximize the output by reducing waste.

III. OVERVIEW OF MANUFACTURING FIRM

The firm taken for our case study is situated at the suburb of Jaipur, Rajasthan. It deals with manufacturing of household consumable goods to cater the need of the people of rural and urban areas of Rajasthan. This firm was established in 2003 at the outskirts of Jaitpura area, Jaipur covering an area of 10,000 sq. m. with annual turnover of around 25 crores. The company employees 200 personnel including all the staff i.e. worker to top management.

IV. MAPPING PROCEDURE

Our present work deals with collection of data of various processes incorporated in the firm. This data comprises of takt time involved in different processes and cycle time through each process. The data is then mapped in a paper showing the flow of information and material through different section of the shop floor and time consumed during different operations.

The primary steps involved in mapping are:

1. Different symbols are drawn representing supplier, production line and customer. An appropriate space is incorporated among these symbols.
2. All the data of different stages of the production line's such as takt time, process time, change over time are filled in the boxes below the VSM symbols.
3. The requirement of product on monthly/daily basis are obtained.
4. Transfer of goods i.e. one after the other, shipping and receiving product is shown with the help of arrows at appropriate positions.
5. Work In Progress (WIP) is depicted in the form of icons in-between the workstations.
6. Then with the help of lean tools, analysis is done to prepare processed plan.
7. Future State Map is then devised and the improvisations are then highlighted.

A.CURRENT STATE MAP

For proper portrayal of the current state map data is collected from consulting workers, managers and engineers and compiled accordingly. **Figure 1** depicts the current state map of the production line. It consists 2 batches per day with particular batch working for 7 hours. The demand per month is 150 Tonnes, with average working day per month is 30:

$$\text{TAKT Time} = \frac{\text{Available working time per shift}}{\text{Customer demand per shift}} = \frac{7*2*60}{(150/30)}$$

$$= 168 \text{ min}$$

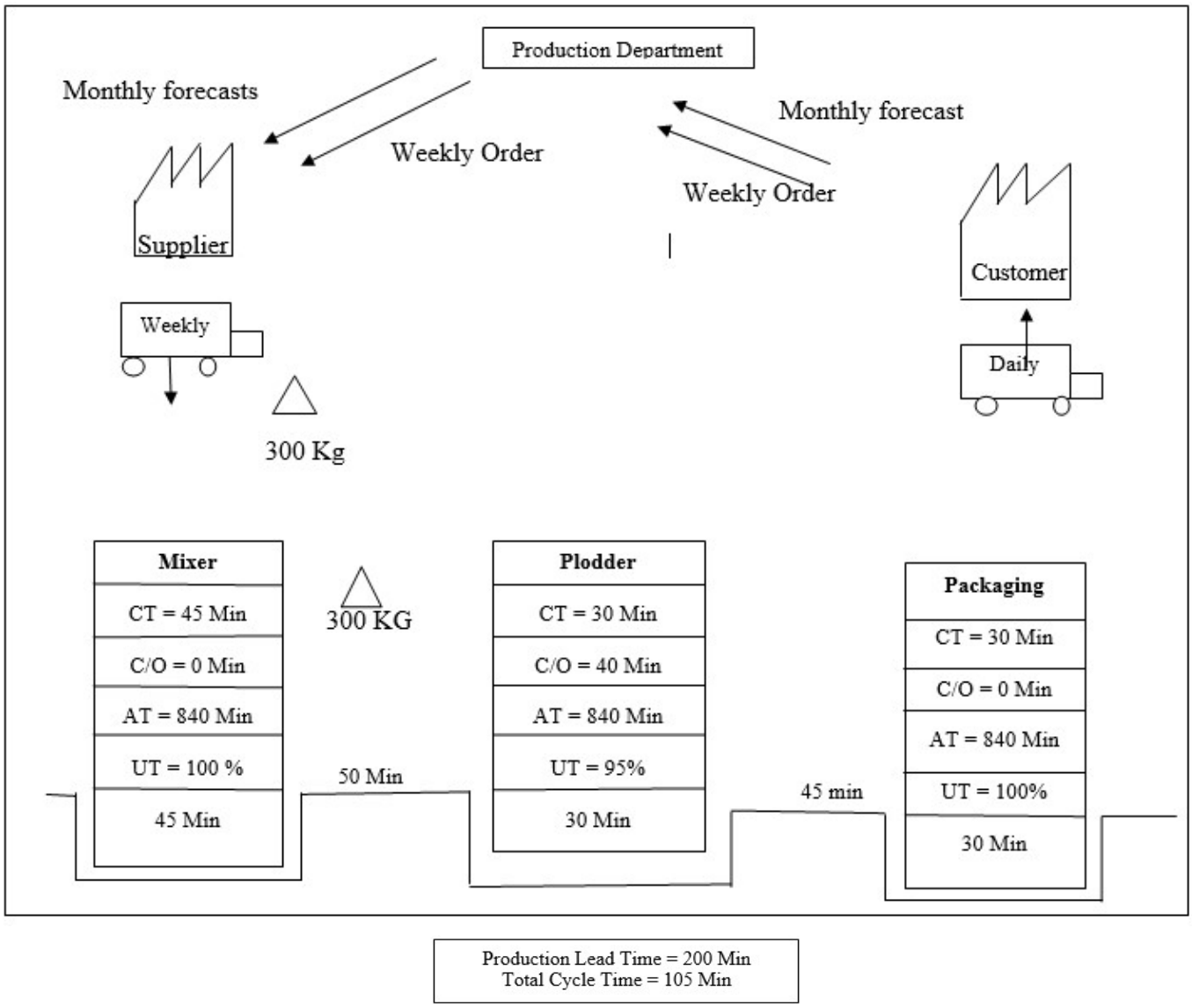


Figure 1: Current State Map

Demand come from the customer to the managerial department of the company. Then managerial department sends the requirement to different suppliers for raw material. Generally inventory is sustained for 7 days, then it is moved from raw material shop to finished good shop through various process on shop floor like mixing, ploddering and packaging. Then production lead time and total cycle time is carefully marked on the current state map. Inventory storage points in between the stages are shown in triangles. The timeline at the base of the current state map has two components. The fundamental of analysis is the production lead time and second component is processing time. Total cycle time is calculated by adding the processing time for all the process in the value stream

Analysis of current state

We have made relevant assumptions for the proper analysis of the workflow. Day to day order dispatching to the customer take place, while receiving of raw materials is done for every 7 days. The process timing of every operation is mentioned in the map, additionally the change over time of die used in ploddering machine are also demonstrate

the steep or elevated work in process inventory is shown by a triangle between mixer and plodder. For every batch of

production i.e. 300 Kg, definite processing time or value added time is 105 min and production lead time is 200 min. It displays a significant scope of improvement, as a particular batch stays for around 200 min in an inventory while value added time for the identical batch is just 105 min.

B. FUTURE STATE MAP & PROPOSED CHANGES

By analysing the current state map we are capable of finding the loopholes in production units and their respective operations. It requires a high precision analysis of time related to several shifts and hourly demand. Considering it future state map is developed in which the foremost revision was to supply the raw material on per batch basis instead of shift wise. An immense level management and coordination of information flow is needed to fulfil the task. To tackle hourly demand Kanban system is proposed. It helps for faster and efficient flow of information. Kanban system in production helps from flowing dispatch to raw material flow. It was observed that one week inventory is required to be kept because of poor communication with supplier. This leads to put on a hold to other operations which establishes resources wastefulness. An electronic information flow can help us to reduce it to daily supply of material.

We can setup up plodder and packaging machine together to reduce the delay between these two processes. “Single Minute exchange of Die - SMED” can be implemented in plodder machine to reduce the time taken to change the die between different products. For effectively managing the production a “5S” concept can be incorporated in the industry. It consist of 5 steps which need to be followed:

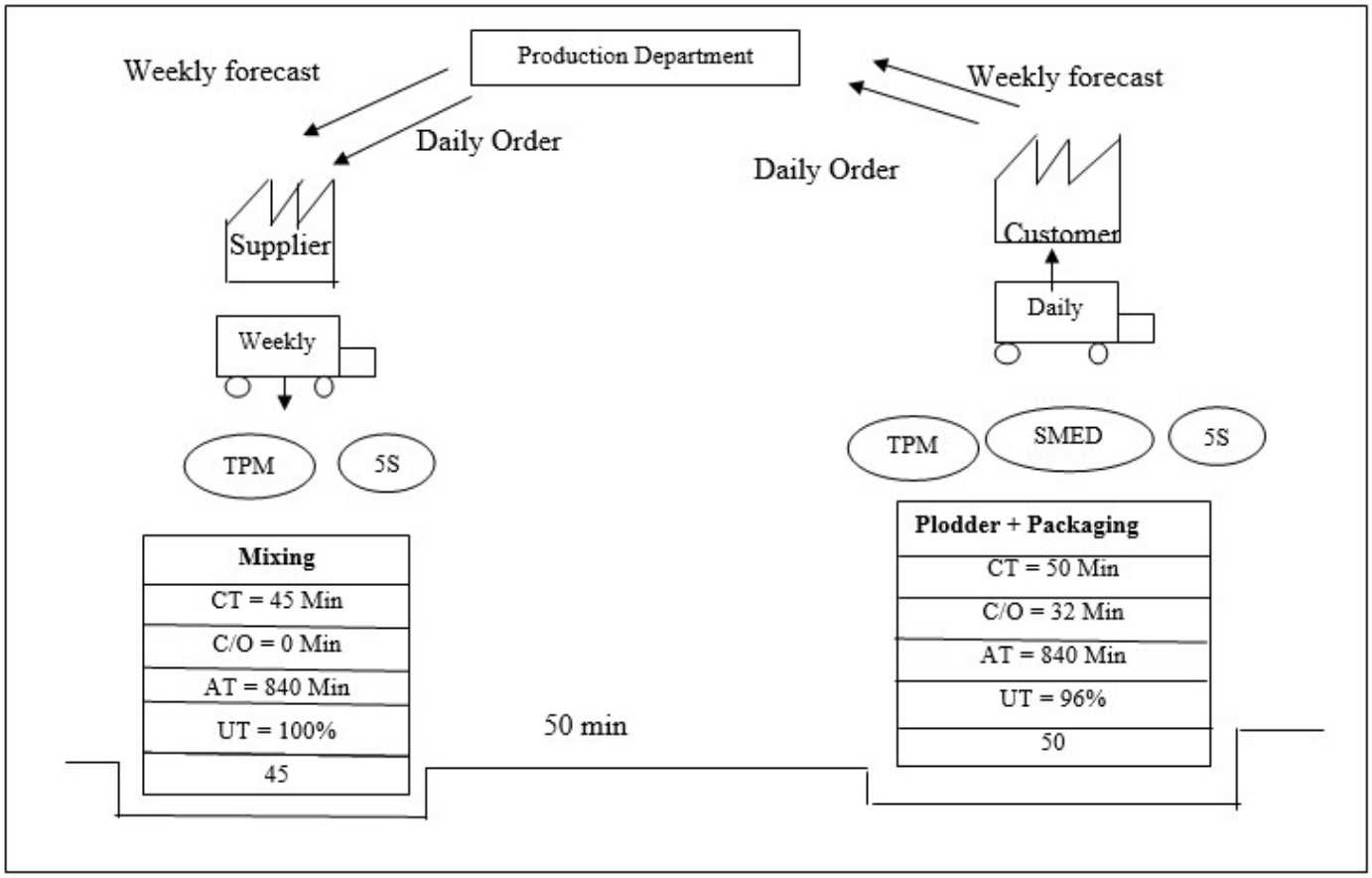
1. Sort – withhold only crucial items in the workplace.
2. Set in Order – Arrange items to promote efficient work flow.
3. Shine – keep the shop floor clean.
4. Standardize – fixed standards for a persistently organised workplace.
5. Systematize – Maintain and review standards.

In order to counter the variation in takt time a buffer system for the material is implemented. A safety inventory system i.e. availability of additional inventory is available in case of disruptions occur in production line.

Analysis of Future State Map

Depending upon the data analysis of current state map, changes are adopted and put forward in the form of Future State Map shown in **Figure 2**.

Specific calculations are done and correlating it with current state map we can see the production lead time has reduced to 14.5 min from 20 Min. Also the total cycle time has reduced to 95 min from 105 min. Significant reduction in work in progress inventory can help the industry to save costs. This will lead to reduction of unwanted waste to be indulged in production processes and decreasing its overall time of manufacturing the finished products. Now industry will be able to deliver hourly rate and high quality product within significant time frame. The most important criteria i.e. lean have been achieved.



V. CONCLUSION

The goal of this paper from the start was to incorporate lean in the industry for having a better production output by reducing its takt time and waste production. It is demonstrated that by the use of VSM as a tool we can improve their production capability and take them a step forward towards achieving Lean Manufacturing. The paper shows a clear relationship between processes, customer requirements and their work flow. Handling of processing units inappropriately and unsystematic networks was the key cause of inefficient supply chain. The comparison of current state model and Future State Model clearly shows us the 27.5% percent decrease in the lead time and 9.5% percent decrease in our processing time, which is huge aspect towards achieving lean. This shows the robustness of VSM technique to identify production lag and to implement lean among its processes. It also sets a benchmark for future researchers and practitioners to how to boost their machining operations and flow management by incorporating this technique.

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