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Research Article

Value Stream Mapping: A Case Study of an Assembly Line in an Automotive Industry

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Abstract

A value stream is the sequence of processes of creating, producing, and delivering a good or service to the market. A value stream may be internal to a company, or it may include external suppliers in addition to internal processes. Value Stream Mapping (VSM) is the one of the lean manufacturing tool. It captures the information at individual stations about station cycle time, up time or utilization of resources, set-up time or change over time, work in process inventory, man power requirement and the information flow from raw material to finish goods. It covers both value adding as well as non-value-adding activities. However, VSM method is used to explore the wastes, inefficiencies, non-value added steps in a single, definable process.This paper addresses the implementation of value stream mapping in automotive industry (assembly line). The main focus of this paper is to map the current state to give details about the existing position and identify various problem areas, followed by the future scope.

Keywords: *VSM, Value added and non value added time, Lead time, LM*

1. Introduction

Nowadays in a competitive market, companies require small lead times, low costs and high customer service levels. As such, companies pay more effort to reduce lead time. The most critical issue faced by manufacturers today is how to deliver their products or materials quickly at low cost and good quality. Several methods and approaches exist such as computer simulation, statistical analysis, and lean tools for improving the efficiency and productivity by determining the best combination of resources in production lines, construction process, energy, services and supply chains. One of the effective management approaches is Lean Manufacturing (LM) system that has taken by many manufacturing firms in different forms and names. The first goal of LM is to improve productivity as well as to decrease the cost by eliminating waste or non-value added activities

There are five steps to implement lean thinking in a company:

1) Define value from the perspective of the customer,
2) Determine the value streams,
3) Achieve Flow,
4) Schedule production using Pull, and
5) Seek perfection through continuous improvement.

Value Stream is all the steps, both value added and non-value added required taking a product or service from raw material to the customer.

VSM has three types

1. Process level VSM – In process VSM, material and information flow with in a particular cell or production line. 2. Factory level or door-to-door VSM –In factory level VSM,material and information flow within a four walls of a factory. 3. Extended level VSM – Focusing material and information flow of several companies.
From this case study we are focusing on Extended level VSM as all he factors. The goal of this paper is to apply one of the most significant lean manufacturing techniques called Value Stream Mapping (VSM) to improve the processes in an automotive industry.

2. Literature review

Palak P. Sheth, Vivek A. Deshpande, Hiren R. Kardani(2014) in their work on value stream mapping in an automotive firm, executed the VSM method effectively in the industry. The case study was basically a factory level or door to door VSM type. They have prepared a current state map to give details about the existing position and identify various problem areas in the work place. A Future State Map is also made to show the implementation of the action plan. This paper mainly focuses on the implementation of value stream

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mapping in automotive industry. Further a paper prepared by Jafri Mohd Rohania, Seyed Mojib Zahraee (2015) on Production line analysis via value stream mapping has considered a colour industry for their case study. The main goal of this paper is to apply one of the most significant lean manufacturing techniques called Value Stream Mapping (VSM) to improve the production line of a colour industry.To achieve this goal, lean fundamental principles was implemented to construct VSM for identification and elimination of wastes by using team formation, product selection, conceptual design, and time-frame formulation through TAKT time calculation.

3. VSM methodology

VSM has four major steps as given by Rother and Shook.

1. Select a product family
2.Draw Current state map
3.Draw future state map
4.Develop work plan for implementation future state.

4. Case study

A case study was conducted at an automotive industry, in the assembly line. The automotive industry is a leading producer of Speedometers. The production line was properly examined and a major product contributing to highest non value added time was selected for the case study. All the primary and secondary data was collected for further study. Both, value added and non-value added time along with the lead time of the product was calculated. The Bottleneck operations were identified.

4.1 Selection of Product Family

The first step is selection of critical part family. For this study only one product contributing to highest non-value added time was selected over the entire product.

4.2 Current State Map

Before draw a current state map collect a require data to draw current state map. Data collecting method: Method that will be used in collecting data needed is observation to the activities that performed in the shop floor. Data is collected by using a stopwatch.

Process Name	Cycle Time(sec) (Value added)	Operator
Stepper motor assembly and soldering +LCD assembly	88.49	1
Back cover and dial assembly	70.19	1
Visor screw fixing +vibration testing	57.51	1
Functional inspection	123	1
Illumination inspection	87.68	1
Total cycle time	426.87	-
Th. Operators	5	-

Step-1 Calculate TAKT Time

The purpose of TAKT time is to serve as a management tool to indicate at a glance whether production is ahead or behind. TAKT time is defined as net available time divided by customer demand. TAKT time is the maximum amount of time in which a product needs to be produced in order to satisfy customer demand. The term comes from the German word TAKT, which means pulse. Set by customer demand, TAKT creates the pulse or rhythm across all processes in a business to ensure continuous flow and utilization of capacities (e.g., man and machine).

TAKT time = Available time/ Customer demand

Where production time available = total production time – breaks – maintenance activities – shift changeover – clean down time and
Customer demand = amount of units required by customer/ time period.
Data available- One shift only.
Operator-One operator for each process
Working days-Six days per week
The net available time is the total operation time during a specific period, meaning the total amount of time, which adds value on value stream. Customer Demand can be determined on customer forecast or based on the currently customer order.

Step-2 Understand customer demand

Customer demand based on monthly or weekly. Customer demand is 17000parts/month

Step-3 Map the process flow

This step involves various processes to complete the product. In addition, measure relevant data to put in a value stream mapping box. Moreover, see the WIP between two processes.WIP for all the processes was physically counted.

Step-4 Map the material flow

The flow of material from raw material to finished goods is given by supplier to customer.

Step-5 Map the information flow

The information flow provided demand information. Information are given by electronic or manually. The manual information flow, basically consist of flow

during the internal work in the firm, whereas the electronic flow includes the flow of information in between the supplier and customer.

Step-6 Draw the Time line

Calculate production lead times for inventory triangles by dividing quantity of inventory by the customer daily requirement.

Table General VSM symbols

Customer	Customer	Leveling Loading	OXOX
Supplier	Supplier	FIFO sequence flow	FIFO
Data Boxes		Physical Pull	
Kaizen Event	XXX	Schedule	
Manufacturing Process	PROCESS	Go-See scheduling	
Buffer (or Safety) Stock		Operator (Manpower)	
Supermarket		Withdrawal Kanban	
Inventory		Production Kanban	
Electronic information flow		Kanban Collection Point	
Manual information flow		Signal Kanban	
Push system		Truck/Vehicle	
Material goods to customer		Forklift	

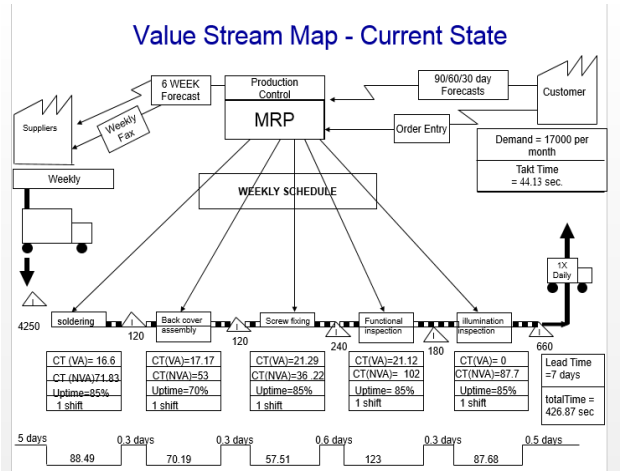

Fig Current state value stream mapping

Conclusion

The aim of this paper was to develop a value stream map for an automotive assembly line to determine wastes that did not add value to the product.

We have recognized the important value added and non-value added activities in the assembly line. The value added time was found to be 76.24 sec and non-value added time was found to be 350.8sec. TAKT time was 51.92sec (present demand). Future mapping should be done. More investigation can be done by simulations.

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