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LEAD TIME REDUCTION USING LEAN MANUFACTURING PRINCIPLES FOR DELIVERY VALVE PRODUCTION

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ABSTRACT

Lean manufacturing is now one of the most powerful manufacturing control systems in the current trend. In present competitive and challenging market, industries needs to improve their strength and must concentrate on to their process flows. Lean manufacturing is the solution to improve their quality and increasing profit for manufacturing over the international market. Lean manufacturing provides varieties of tools and strategies which can help in identification of waste, reduction or elimination of waste, manufacturing product with better quality, lowering the product cost, reducing human effort and reducing product manufacturing time. This paper demonstrates various lean manufacturing. Lean manufacturing is a precise approach for economical utilization of raw product and eliminating waste through continuous improvement, and aimed to provide qualitative product to the customers.

Lead time is the time spent between the original customer order and final delivery of the product. Project work is being carried out at XYZ organization in Gaziabad, U.P., India. Lean manufacturing is a production practice that considers expenditure of resources for any goal other than creation of value for the end customer to be wasteful and thus a target for elimination. Lead time is calculated by adding value added time and non-value added time. Delivery valve is a non-return valve between the high pressure for the fuel injection system and pump plunger. On observing the present system of delivery valve production the current lead time was calculated and was found to be 14.60 days. The lean tools that are applied in this project are First-In-First-Out (FIFO), a method for organizing the component buffer where the oldest entry or bottom of the stack is processed first which eliminates inventory which in turn reduces the lead time and Value Stream Mapping (VSM) to map the present and the future state. Application of these lean tools has resulted in the reduction of lead time by one day i. e. 13.60 days.

Keywords: Lead time, Value Stream Mapping, First-In-First- Out, Customer Takt Time.

I. INTRODUCTION

In today's competitive business world, companies require small lead times, low costs and high customer service levels to survive. Silver Et Al. [1] defined lead time as the time spent that elapses between the placement of an order and the receipt of the order into inventory, lead time may influence customer service and impact inventory costs. In an attempt to reduce lead time, businesses and organizations found that in reality 90% of the existing activities are non-essential and could be eliminated. Harrington [2] proposes by eliminating the non-value adding activities from the processes and Streamlining the information flow significant optimization results can be realized.

II. METHODOLOGY

- 1.) Value Stream Mapping-The ultimate goal of VSM is to identify all types of wastes in the value stream and to take step to try and eliminate these. Waste can be a part of a process that takes time and resources but adds no value to the product [3].
- 2.) **Takt time** –It can be defined as the time required for producing one unit of daily salable quantity. It helps with the synchronization of assembly, production and sales rhythm.
- 3.) FIFO –It is a system of keeping track of the order in which information or materials are to be processed. The goal of FI FO is to prevent earlier orders from being delayed in favor of newer orders which would otherwise result in increased lead time and unhappy customer s regarding the earlier orders.

III. OBJECTIVES

- 1.) To study the present lead time for delivery valve production.
- 2.) To analyze the factors responsible for non-value added time.
- 3.) To analyze the customer takt time for each process in the loop for F003 component.
- 4.) To implement First-In-First-Out (FIFO) between the component loop and the finish match grinding (assembly) loop.

- 5.) To prepare a detailed recommendation for new layout this reduces man and material movement.
- 6.) To reduce the inventory of F003 component and re calculating the lead time.

IV. VALUE STREAM MAPPING

Primary data was collected about the inventory, process time at each process for the delivery valve production and mapping was done for the entire value stream. [Fig 1]

Value added time = process time / available time

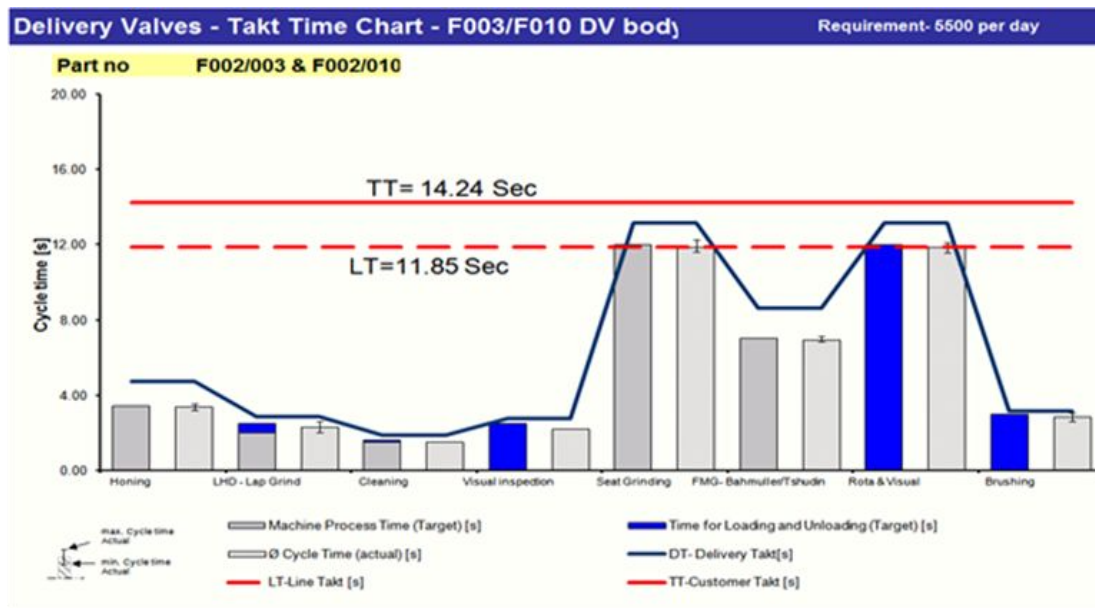
Non value added time = inventory / requirements

Like this lead time for each process was calculated and finally the lead time was found to be 14.60 days. There was too much of buffer stock between the component and the finish match grinding (FMG) loop. There are two main types of components produced- part no F003 which covers 20% of the total delivery valve production and part no 642 covers the rest. The total delivery valve requirements are 28500 parts per day out of which F003 requirement per day is 5500 parts.

V. TAKT TIME

Takt time chart was drawn for F003 component based on the requirements and was indicating that FMG is the bottle neck process with the takt time of 11.85 sec.

Takt time chart:



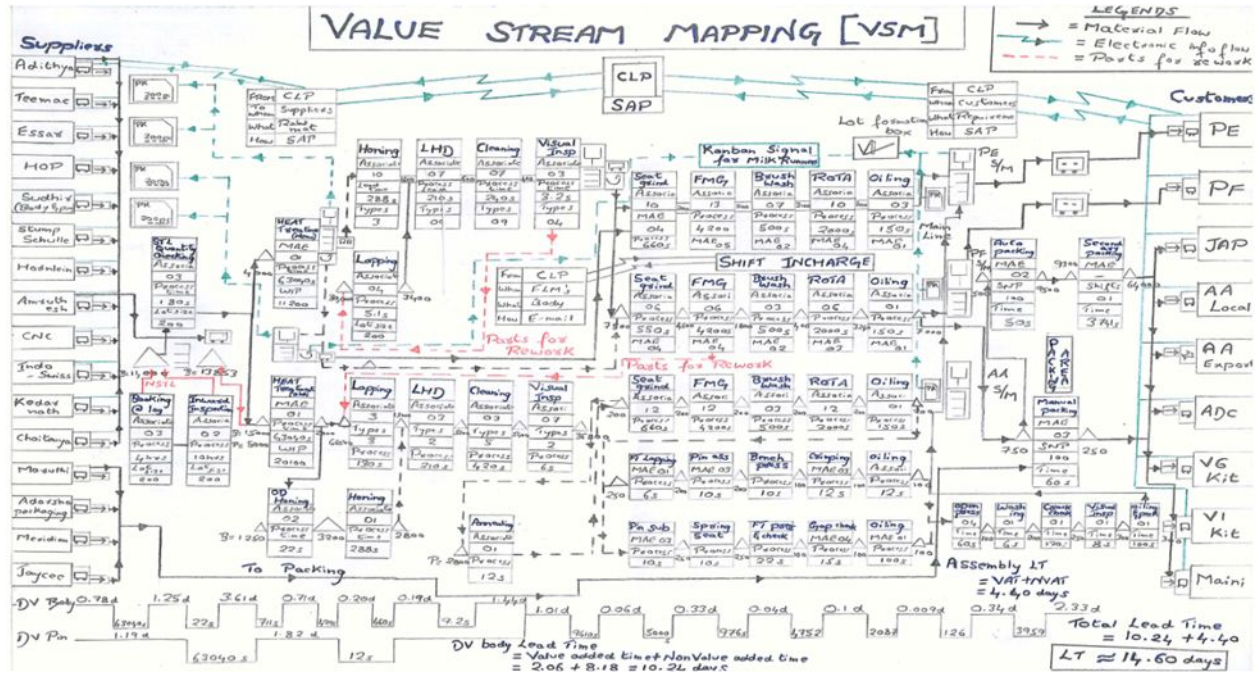


Fig 1: Value Stream Mapping

Also the requirement of machine & equipment (MAE) and manpower were defined for producing F003 component. Overall Equipment Effectiveness (OEE) is a way to monitor and improve the efficiency of the manufacturing process. OEE has become an accepted management tool to measure and evaluate machine productivity [4]. There are three factors required to calculate i.e. $OEE = \text{availability} \times \text{performance} \times \text{quality}$. For each process OEE was calculated.

Table 1: Requirement for F003 part production

Process	No. of MAE	Manpower	OEE in %	Process	No. of MAE	Manpower	OEE in %
Honing	1	1	71	Seatgrinding	1	1	90
LHD	1	0.5	80	Tschudin	2	2	80
Cleaning	0.5	0.5	80	Brush wash	1	1	90
Visual Insp	0.5	1	90	Rota	1	3	90

VI. LAYOUT CHANGES

Earlier machines were at a distance of 30mtrs away from component loop and they were decoupled by supermarket. The assembly cells were shifted closer to the component loop to establish FIFO between those two loops. This resulted in migration from supermarket to FIFO eliminating the inventory storage between those two loops. There was reduction in man and material movement as well.

VII. FIFO CALCULATIONS

For F003 component FIFO calculation was done according to the organization's standards to determine the maximum number of parts to go into each cell at a time. Milkrun – cyclical material transport with defined schedule.

Table 2:Data for FIFO max calculation

1.	Machines	8 no	6.	Smallest no of parts in a tray	100 pcs
2.	Cycle time	42 sec	7.	Milkrun frequency	120 mins
3.	Change over time	0	8.	Planned operating time/ day	1305 mins
4.	OEE	84%	9.	Shifts	3
5.	Delivery takt time	12 sec (as FMG is the bottle neck process)			

Calculations:

1.) Max loss of process	POT (1-OEE) =1305(1-0.84) = 209 sec.....Eq. 1	4.) Total loss	Eq.1 + Eq.2 + Eq.3 = 209+0+70 = 279
2.) Time loss for one change over	= 0 sec (not required to changeover).....Eq. 2	5.) No of parts	279 * 60 / 42 =400
3.) Time to produce one SNP	cycle time * SNP / 60 = 42 * 100 / 60 = 70 sec..... Eq. 3	6.) No of SNP	4 trays

As per the FIFO calculation maximum of 400 parts was defined and the production was started. There was a smooth flow of parts between the processes. Man and material movement was reduced. More importantly it resulted in complete elimination of buffer stock between the component and the FMG loop thereby reducing the lead time.

VIII. CONCLUSION AND SCOPE FOR FUTURE

Finally recalculating the lead time after the establishment of FIFO for F003 component is 13.60 days i.e. reduction in the lead time by one day. Further reduction in lead time can happen if the FIFO methodology is implemented for the other part 642 as well.

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