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Value Stream Mapping (VSM) – A Case Study in Manufacturing Industry

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ABSTRACT

Value is needed performance at minimum cost. Each activity must add value in the organization. If there is no Value addition, then it is non-value addition activity which is treated as Waste. Waste is undesirable & results in organization's downfall. This paper applies the principal of lean in manufacturing facility with a purpose to eliminate waste. Value Stream Mapping tool was used to expose the waste in the process flow and identify the kaizen activities required for improvement. The results achieved in the proposed plan showed significant improvements in the productivity and better utilization of resources with high quality service.

Keywords— Lean Methodology, Value, VSM, Current state, VSM, Future state VSM, etc

1. INTRODUCTION

The Lean methodology implementation started with the creation of a VSM of the existing situation. Products, information, or services flow through a value stream. A value stream is all the actions (both value added, and nonvalue added) currently required to transform raw material into a finished product, from the suppliers to the end users. Mapping of flow of Value from Entry gate to Customer end is called VSM. VSM helps to:

- (a) Identify the kaizen activities required to improve.
- (b) Identify waste in the process.

By focusing efforts on reducing wasteful activities, manufacturing organizations can become more productive, stay competitive in market, become more profitable & attain organizational goals. The general wastes that occur during process are:

1.1 Over Production

Manufacturing an item before it is actually required. This creates excessive lead time, results in high storage costs, and makes it difficult to detect defects.

1.2 Waiting

Waiting because of poor material flow, operation dependency - that is next assembly line waiting for subassemblies to be completed & feed to them and waiting due to distances between work centers is too great. Linking processes together so that one feeds directly into the next can dramatically reduce waiting.

1.3 Transportation

Transporting product between processes is a cost incursion which adds no value to the product.

1.4 Inappropriate processing

Use of expensive high precision equipment's where simpler tools would be sufficient.

1.5 Unnecessary Inventory

Inventory in the form raw material ordered in excess of customer requirement (To get bulk discounts) and of finished goods sitting in warehouse (In case customer orders them).

1.6 Unnecessary Motion

Ergonomic waste in all instances of bending, stretching, walking, lifting & reaching.

1.7 Defects

Quality defects resulting in rework or scrap are a tremendous cost to the organization. Associated costs include quarantining inventory, re inspecting, rescheduling & capacity loss.

Case Study

Case study performed in a manufacturing organization at Hyderabad. General information about the organization is a manufacturing organization having Production, Quality, Research & development, Sales & Purchasing, Human Resource Management, Accounting and Finance Department. Working shifts are three, 8.5 hours, 8.5 hours and 7 hours. Case study is done for production department working in three shifts. The cycle time required for each process is given in Table 1.

Manufacturing Process Cycle time

Table 1

| Process | Cycle Time in hours |
|--------------------|---------------------|
| Sub Assembly | 23 |
| Main Assembly | 16 |
| Testing | 4 |
| Quality Inspection | 3 |
| Finished Goods | 2 |

Takt Time Analysis

Takt time is the average time between the start of production of one unit and the start of production of the next unit, when these production starts are set to match the rate of customer demand. The manufacturing organization as explained above works in three shifts. The first & second shift include 30 minutes lunch break, 20 minutes breakfast & 10 minutes tea time. Net available time in first & second shift = 510-30-20-10 = 450 minutes each. For third shift the total break is of 30 minutes. Net available time in third shift = 420 – 30 =390 minutes.

Total available time in three shifts = 450+450+390=1290 Minutes.

On an average, the customer demand is 1 unit per day and available time is 1290 minutes. So, the Takt time is calculated below.

Takt time = Available time/ Customer demand

Takt time = 1290/1 = 1290 Minutes.

Takt Time = 21.5Hrs

VSM

Value stream mapping is a recognized method used as part of Six Sigma lean methodologies. With the process flow & cycle time available, we can draw the value stream map of current state. The VSM is created by a predefined set of icons shown in Figure 1 below:

| | | | |
|-----------------------------|--|-------------------------|--|
| Customer | | Leveling Loading | |
| Supplier | | FIFO sequence flow | |
| Data Boxes | | Physical Pull | |
| Kaizen Event | | Schedule | |
| Manufacturing 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 | |

Figure 1: Value Stream Mapping Symbols

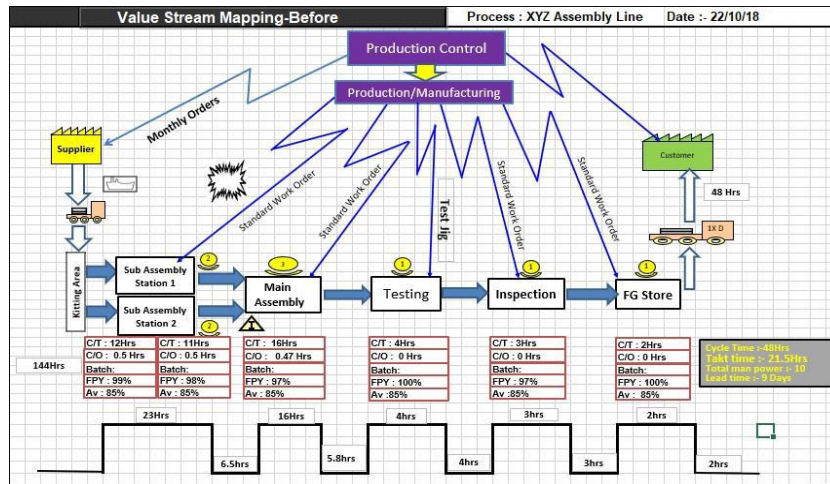


Figure 2: Current state value stream mapping

The process starts when warehouse delivers raw material to sub assembly line. The sub assembly team has to count the raw material as per move order and segregate & handover the main assembly team it's material. After sub assembly finishes its processes, they push the product towards main assembly. If the main assembly line is free, they will receive the sub assembly and start further processing or else the sub-assemblies stand as inventory. After main assembly is completed, the product goes for testing. Since main assembly cycle time is more, the waiting time for testing team is more. Quality inspection is done after testing is completed. The quality team after inspection puts a OK / NOT OK / HOLD tag on the product and on that basis further Acceptance / Rejection / Rework will be done. When accepted, the FG team looks for final shipment of the product. After study the current process and map we identified some of the problems which occur during the process.

Major Problems

- Over-processing in the form of counting & segregation of raw material.
- Excess Inventory storage in sub assembly line due to uneven loading of work in sub & main assembly.
- Waiting time for testing team.
- Defect leading to rework or rejection.

Proposed Plan

- The plan is to do BOM segregation in system & provide it to warehouse team so that they can do all the counting's and deliver ready kitting's to assembly line.
- Do level loading of work load in sub & main assembly to reduce inventory storage in sub assembly as well as reduce waiting time for testing team.
- To set quality inspection after each station to arrest defects immediately & avoid rework & rejection.

Future State VSM

- Eliminated material counting, segregation and reduced cycle time by 25 – 30 minutes of sub assembly team.
- Level loaded the work stations resulting in reduced inventory & saved shop floor space.
- Implemented kaizen & increased one manpower in main assembly team to reduce its activity time by 1.33Hrs which also reduced waiting time for testing team by about 1Hr.
- Eliminated over processing on defective parts by implementing station wise inspection.

The improved future state after implementing proposed plan is shown in the Figure 3 below.

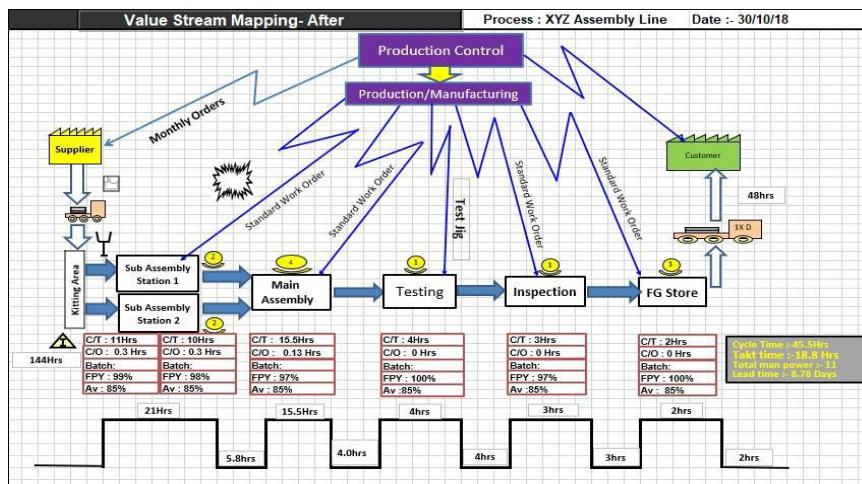


Figure 3: Future state value stream mapping.

3. RESULT

- The Improved cycle time for each process in future state mapping is given in Table 2.

Table 2

| Process | Cycle Time in hours |
|--------------------|---------------------|
| Sub Assembly | 21 |
| Main Assembly | 15.5 |
| Testing | 4 |
| Quality Inspection | 3 |
| Finished Goods | 2 |

- Comparison of results between Current State & Future State is shown in Table 3.

Table 3

| Item | Current State Mapping | Future State Mapping |
|------------|-----------------------|----------------------|
| Cycle Time | 48 hrs | 45.5 hrs |
| Takt Time | 21.5 hrs | 18.8 hrs |
| Lead Time | 9 days | 8.78 days |

4. CONCLUSIONS

- In general, it was shown that the Value Stream Mapping is an ideal tool of six sigma Lean methodology to expose the waste in a value stream and to identify tools for improvement.
- In the Implementation of lean, Value stream mapping is suited to start the Process, it very quickly yields benefits such as Improved quality, Reduction in lead times, Reduced Inventory and Better use of Resources.
- The results achieved in the proposed plan showed significant improvements in the process flow of assembly line which improves Overall efficiency.

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