



An Application of Lean Manufacturing to Enhance the Runtime in the Machine Shop

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Abstract:

In this competitive world the challenges against manufacturing firm are on time delivery and quality. So it is necessary to run machine at maximum possible time. So ultimately the think or the view developed that how to increase the efficiency of the machine. This paper describes the use of value stream mapping to improve the efficiency of machine shop. Generally there is mind set to use value stream mapping for whole process including all process stage and information. In this paper an effort is to carry out to use value stream mapping to identifying the wastes occurring during machining only.

Keywords: Kaizen, Runtime, TPM, Visual Management

1. Introduction

There are a series of steps that need to be followed to assure success:

1. Develop a clear sense of urgency to change.
2. Build the sense of urgency within the Senior Management Team.
3. Create an agreement on the Strategic / Business Plan and Strategic Vision with clear superior performance goals throughout the organization.
4. Communicate the Vision, Lean Implementation Plan, and Superior Performance Goals to the organization.
5. Empower and train the group that will start the implementation.
6. Implement a pilot with a liberal time line to demonstrate the feasibility and success of the plan.
7. Expand the effort to other areas.

One of the methods of recording a product's production path, material and information is Value stream mapping. Value stream mapping can be used by management, engineers, production associates; schedulers, suppliers, and customer to recognize identify waste and its causes. Value stream mapping starts with current state while focusing on the desired goal. Various lean tools are used to improve the current state of the process.

A value steam mapping is visual representation on the process or system describing the all steps of process and information flow in the process or system differentiating value added and non

value added activity. To improve the production process Value stream mapping is a communication tool, a business-planning tool, and tool to manage change in production processes. VSM personnel first of draw the current state by gathering information on plant floor. In the Value stream mapping various matrices like runtime, WIP, lead time etc. Rother & Shook provide seven guidelines to follow when generating the Future State Map for an improved manufacturing system (Rother and Shook, 1999, p. 44-54):

1. Produce to takt time
2. Develop continuous flow
3. Use supermarkets to control production where continuous flow does not extend upstream
4. Schedule based on the pacemaker operation
5. Produce different products at a uniform rate (Level the production mix)
6. Level the production load on the pacemaker process (Level the production volume)
7. Develop the capability to make “every part every (EPE) <time period>”

To make the value stream mapping following are the key element

1. The customer requirement
2. Process in order
3. Key performance indicator
4. Supplier with material flow
5. Information and physical flow
6. Total lead time

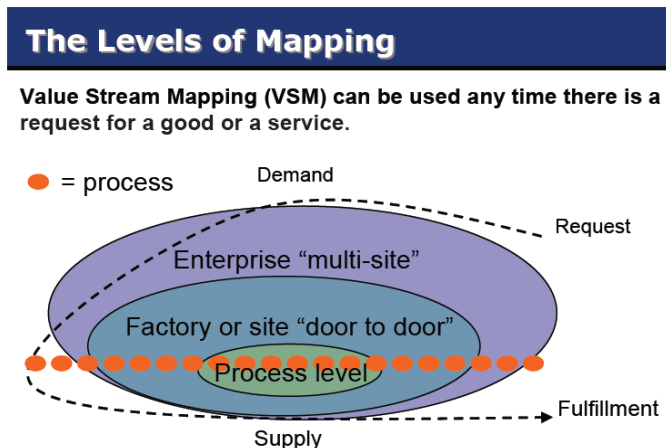


Fig. 1 The Levels of Mapping

The studies available in literature show that in any organization about 70-90% activity are non-value added that can be eliminated by applying lean. Also, with the application of 5S and Kanban Tooling resulted decrease in work-in-progress (WIP)? By the effective application of the Lean Manufacturing it becomes possible to obtain the effectiveness of manufacturing strategies and identify the potential opportunities for improvements

There are some Lean Tools which are helpful for increasing efficiency. In today

competitive market it is very essential to implement the Lean concept in the organization. To implement lean in the organization it is essential to know the current state of the organization and then implement the lean tool step by step, it is not possible to implement the entire lean tool simultaneously. Another advantage of the Value stream mapping is to know the level of seven wastes in the system and in future state the seven waste levels are reduced step by step. This seven waste are as under

1. Overproduction: To produce the product more than customer demand
2. Over Processing: Unnecessary process to meet the customer requirement.
3. Inventory: This is excess inventory as raw material, work in process inventory, finished product, spare parts etc
4. Defect: This is the non conformation of product
5. Excess movement: This is the unnecessary motion in the specific workstation. It occurs

due to bad design of the workstation.

6. Transportation: This is the movement of the product between the workstation factory to organization etc
7. Waiting: This is non productive time which occurs due to improper line balancing of the lines

The above waste can be reduced by the various lean tools like

1. Just-in-time
2. Kaizen
3. SMED
4. Standard work
5. Visual Management
6. TPM
7. Kaban cards
8. Value Stream mapping

2. Runtime and Big losses

The following are the major losses in process

1. Breakdown
2. Setup\Adjustment
3. Small Stops\Idling,
4. Speed loss,
5. Startup Rejects
6. Production Rejects

The runtime looks at theses losses and gives a percentage number of how much time it took to produce the good related to the time it could have taken in an ideal world

Runtime can be calculated by formula= $\frac{\text{Total Productive time}}{\text{Total time}}$

2.1 TPM

TPM, a unique Japanese system of managerial expertise, was created in 1971, based on the PM (preventive maintenance or productive maintenance) concept introduced from the United States in the 1950 through the 1960s. Subsequently, in the 1970s through the 1980s, TPM gradually developed as its remarkable achievements became recognized. TPM now permeates entire company structures, every line of business, and all parts of the world; this is evidenced by a sharp increase in the number of business establishments receiving PM awards based on TPM, the shift from production-sector TPM to company-wide TPM and the growing number of countries in which TPM is practiced.

2.2 Kanban

Kanban is a flag or signal back to a previous operation which tells that operation to produce more products thus pulling production through the process. There are many different types of Kanban systems that use, from ConWIP to bin systems, basically the imagination is your only limiting factor in designing your Kanban system for your lean implementation.

2.3 SMED

Single minute exchange of Die or SMED is the lean manufacturing technique that uses to reduce setup times. The aim is to reduce changeover times down to single minutes rather the hours that many companies take.

2.4 5S

The 5S's actually stand for Japanese terms, which loosely translate as Sort, Set in Order, Shine, Standardize, and Sustain. A place for everything. Everything in its place. 5S is probably one of the best known lean manufacturing tools, it is a methodical way to make workplace more organized and ergonomic, the benefit of 5S can be significant; often 10% to 30% improvements in efficiencies are realized.

2.5 Kaizen

The Japanese typically use Kaizen as an ongoing process of many small improvements which together adds up to a major improvement across the whole company.

2.6 SMED

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2.7 VSM

Value stream mapping is one of the most important tools of lean manufacturing, it allows mapping out whole value stream from materials through to customer and identifying the areas of waste and delays. Through the creation of current value stream maps, can highlight the problems and create future state maps and action plans to improve value streams.

3. Research Methodology Adopted

The mapping effort starts with determine the Value Stream to be improved and involves extensive scoping efforts to identify the practical limits of the mapping activity. The topic or process should be one that the customer would perceive as creating value. Ideally it is existing process that has a clear start and end points and has indicator of performance metrics will need to be established to gage improvements. With the Value Stream identified, the appropriate mapping participants are selected, trained and prepped for the VSM activities to come.

Once the mapping team is in place, it draws the Current State Map that shows how things really work (not how the process is documented or how it should work). This is the "as-is" condition with all of the problems, inefficiencies, and flaws displayed for the entire team to see. It is crucial that the Current State Map be an honest depiction of what is really happening. In order for the greatest improvements to take place, there must be thorough documentation of all non-value added activities. It is critical at this point that the mapping team takes the next step and identifies the wastes in the system and – more importantly – the root causes of those wastes. Waste is just a symptom that points to problems within the value stream (or system). The identification of the root causes leads to the elimination of problems and the prevention of similar problems from reoccurring.

Generally there is approach to use Value Stream Mapping for whole system, considering the each department in the organization. In this paper VSM is used to improve the production effectiveness of the machine shop.

Following steps is to be followed to improve the efficiency of the machine shop.

1. Studying the flow of the process in the machine shop.
2. Drawing the current state of the machine shop by gathering one month data
3. Brainstorming with supervisor, operator and top management for the kaizen implementation

4. Drawing future state
5. Sustain the improvement action suggested in the future state

Some of the symbol used in Value Stream Mapping

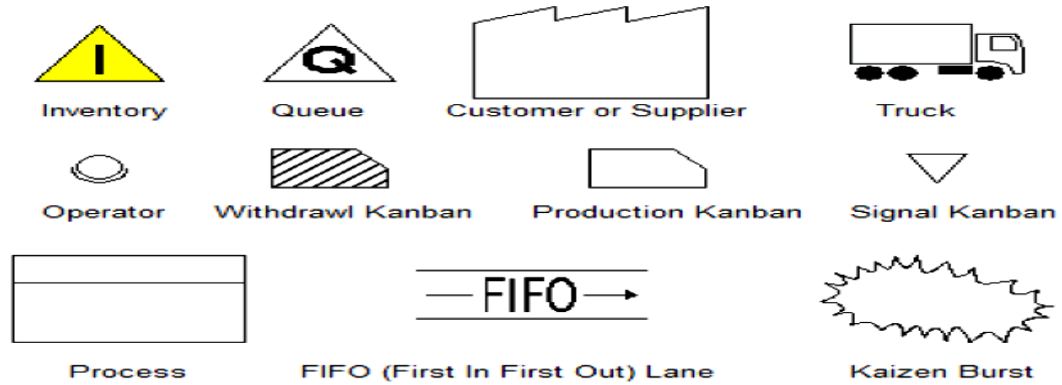


Fig. 2 Symbols

4. Some of the abbreviation used in the VSM

- RT- Runtime
- TC- Tool Change
- BD- Break Down

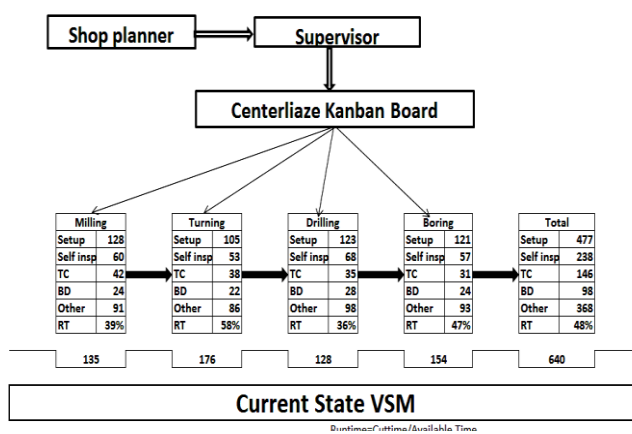


Fig. 3 Some of the abbreviation used in the VSM

operation. In this current state total setup time is too high which is around 477hrs with 25% of total process time. Whereas self inspection, tool change(TC) and Break down(BD) Contribute with 12%, 8% and 5%.and overall Runtime of the machine shop is 48%. From these figure observation should be made that it is necessary to take some steps for increase cut time or to reduce the stoppages. The category other stoppages is consists of remaining number of small stoppages which cannot be identified as separately. From this current state it can be clearly defined the area of improvement at which need to be attack for improvement.

4.1 Current State Value Stream Mapping

As below diagram shows the graphically presentation of technical process of components in the form of value stream mapping. It starts from shop planner from whom machine shop obtain short term planning and respective kanban cards of manufacturing components. That kanban cards place on the centralize production leveling board by shop supervisor. The kanban show the information of sequence of process to be followed with work center name for the components. The standard ration followed by turning, drilling and boring

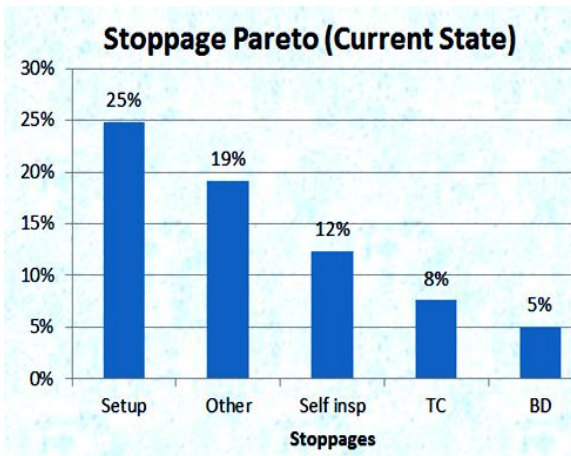


Fig. 4

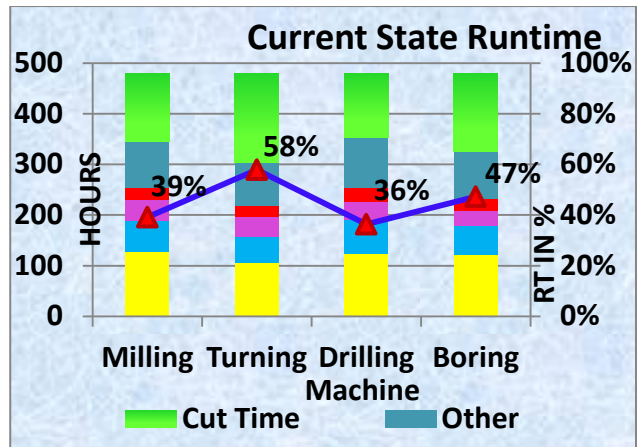


Fig. 5

5. Brainstorming for the root causes of delay

To find the root cause of the waste find in the current state is found by the conducting the daily runtime meeting with operator and supervisor. Following reason came out for the waste in the current state

- Self-inspection

The self- inspection time is increased due to the unnecessary measurement carryout by the operator during the machining

- Vertical head change time

The vertical head is changed in current state by directly with the help of the crane due to this there is too much difficulty in alignment of the head with spindle

- Break-Down time

Too many breakdown is occur due to improper maintenance procedure carrying out by operator

6. How to implement the TPM concept in the future state value stream mapping

To reduce the break down time, introduced cleaning and inspection checklist. Cleaning and inspection checklist is the graphical picture of components of the machine which should be clean and inspect at specific interval. Another concept is to introduce tagging activity. Tagging is nothing but inspection of whole machine with maintenance people and tag the part which is found improper.

7. Implementation of the Visual management in the shop

In the visual management part introduced the centralize setup board. The centralize setup board just give the supervisor the checklist for the status of the components. Checklist include

8. Implementation of Kaizen in the future state

Small improvement introduced in the future state value stream mapping is vertical head change tool to reduce the vertical head change time. In the current state value stream mapping the head change is carried out by directly which include more manpower, more time and safety issues.

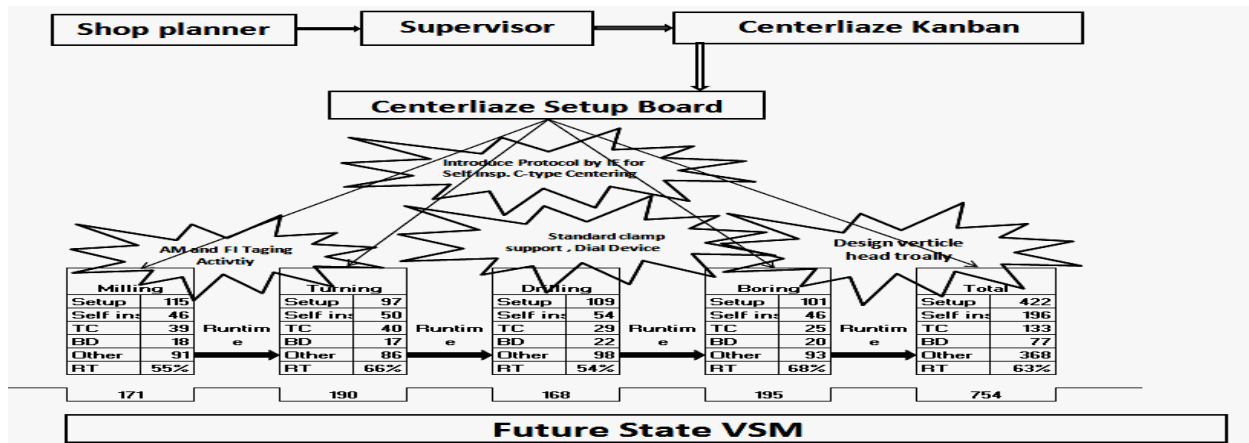


Fig. 6

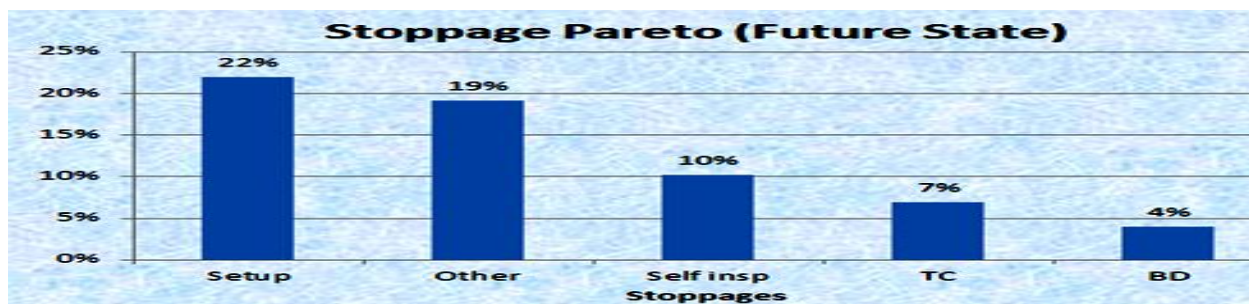


Fig. 7

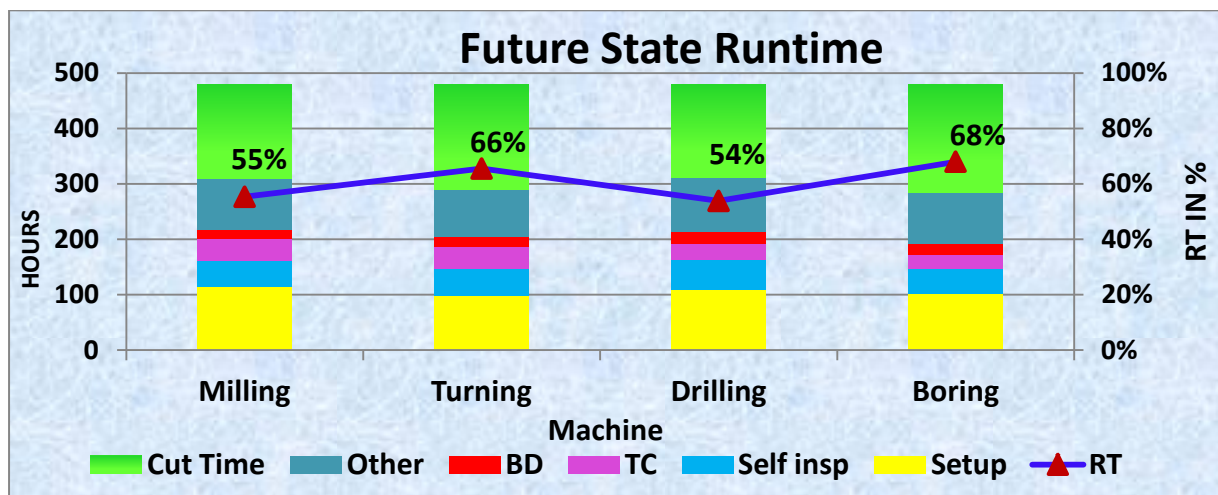


Fig. 8

9. Results

Due the improvement action taken form current state in the future state setup time decrease by 3%, self-inspection 2%, break down time and tool change time by 1%. Overall runtime increased by 13%.

10. Conclusion

And of this paper it is found that value stream mapping is one of the lean tool that describes current issues occur in the process. The biggest advantage of the value stream mapping is that it is so simple that it can be used by any level of the person there is no special training required to

use value stream mapping in organization.

Advantage of the Value Stream Mapping

1. Interrogates the manufacturing process to supply chains, distribution channels and information
2. Links production control and scheduling function such as production planning and demand forecasting to production scheduling and shopfloor control using operating parameters for the manufacturing system ex. Takt time which determines the production rate at which each processing stage in the manufacturing

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