

Improvement of Productivity Using Value Stream Mapping

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Abstract— one of the most appropriate ways to emerge the productivity for the particular area is through Lean Manufacturing. Value stream mapping is that lean manufacturing tool which helps to improve the productivity for the area through its detailed mapping. It is the visualize tool which describes the current state map followed by lean techniques resulting into the final state map that aiming at reduction of the non-value added activities throughout its phase. This paper illustrates the review of VSM techniques and its benefits in machining industry. The purpose of this paper is to highlight the effective utilization of the VSM tools for process and productivity improvements.

Key words: Lean Manufacturing, Value Stream Mapping.

I. INTRODUCTION

Lean manufacturing focuses at striving only for customer value added activities by preventing the non-value added activities comes into the plays at each of the particular phase in terms of customer perspective [1]. Working from the customer's perspective, who consumes the end products or services, value can be defined as any action or process that a customer would be willing to pay for.

Lean manufacturing is a management philosophy derived mostly from the Toyota Production System (TPS). TPS is renowned for its focus on reduction of the original Toyota seven wastes to improve overall customer value, but there are varying perspectives on how this is achieved to its best [2]. These seven wastes includes Overproduction, Defects, Inventory, Inappropriate Processing, Excessive transportation, Waiting and Unnecessary motion.

A value stream map is said to be an end-to-end collection of processes or activities involves, that creates value from the customer's perspective. A value stream usually quotes list of things such as people, tools and technologies, physical facilities, communication channels and policies and procedures. A value stream is all the actions i.e. both value added and non-value added, currently required to bring a product family through the main flows essential to every product: (a) the production flow transforming from raw material into the hands of the customer, and (b) the design flow from concept to launch. Standard terminology, symbols, and improvement methods allows VSM to be used as a communication tool for both internal communication and sharing techniques and results with the larger lean community[3].

Value stream mapping differs from conventional recording techniques, as it quotes the information at each and every stations about station cycle time, uptime or utilization of resources, setup time, WIP inventory, manpower requirement and the information flow from raw materials to finished goods. Value is from the customer's perspective and the customer is being the person who utilizes the output in terms of end product or services. Non-value-adding is everything done in the process which

contributes no value for the customer but which they are forced to pay for when they buy the product or service.

In case of internal manufacturing point of view, there are three types of operation that are to be serviced [4]. These can be distinguished are as follows:

- Non-Value Adding
- Necessary but Non-Value Adding
- Value-Adding

Non-Value adding operation is of total wasteful activity which never be come to utilized in customer perspective and hence such operations are called as pure waste. It is necessary to eliminate these non-value adding activities completely. These include activities such as Scrapping, Sorting, Storing, Counting, Moving, Documentation etc.

Necessary but Non-Value Adding operations may conclude to be wasteful but these are necessary under the present work of activities. These may includes walking larger distance in order to receive parts or components, unpacking deliveries and transfer tooling form one position to another position.

A value adding operation involves those activities which makes the final product or service by the processing of raw materials and with the help of manual labour; but in terms of customer perspective. These include valuable activities such as Machining, Processing, Painting, Assembling etc.

II. LITERATURE REVIEW

A. Nitin Pandhi and Sanjeev Verma (2012):

In this paper the author made an attempt to identify and eliminate different types of wastes with the application of Lean tools in an automotive industry. Gearbox Case machining has been selected in the paper by considering issues of high economic value and complicated processing cycle which results into excessive rework, longer lead time, and high rejection rate.

According to results found in this paper, Cycle Time has been reduced from 50 days to 40 days on prorated basis, as the proposed cycle of movement on workstations has been reduced by approximate 21%, Number of Operators involved in, Rejection Rate due to ovality caused by overheating, waiting time has reduced to a low value.

B. R.M. Belokar, Vikas Kumar, Sandeep Singh Kharb (2012):

This paper represents the application of Value Stream Mapping as one of the Lean tools to eliminate waste, and improved operational procedures and productivity in case of automobile industry with inner wheel housing as a product for case study.

Here in this case study inner wheel housing was chosen because it was most critical product from the point of view of safety purpose of the customer. There is a lot of

scope for study and go for further improvement in the process to enable higher production rate.

They improved the cycle time of welding process by introducing a new fixture and a new robot welding machine and by improving layout of weld shop and by implementation of milk run also there was reduction in lead time.

C. V. R. Murugananthan, K. Govindaraj, D.Sakthimurugan (2014):

This paper focus on the use of the value stream mapping which reduces waste in manufacturing company. In this case study which is in casting industry, the production process path is visualized by mapping the current state value stream map. After getting the entire process, wastage affecting the cycle time are identified and its causes analyzed. On the basis of all this; a future state value stream map was developed and improvement ideas are suggested.

By applying 5s technique which results in effective organization of the workplace, reduction of work's environment, and elimination of losses connected with failures and breaks, improvement of the quality and Safety of work. With the help of VSM in order to remove the non-Valued activities during manufacturing and also to reduce manufacturing lead time.

D. Peter Hines, Nick Rich (2013):

Author in this paper, outlined a new typology and decision-making process for the mapping of the value stream or supply chain. The typology was based on the identification of the particular wastes the researcher or company or value stream members who wish to reduce.

E. Palak P. Sheth, Vivek A. Deshpande, Hiren R. Kardani:

In this paper, author made the implementation of value stream mapping in automotive industry. A case study was carried out in Lear Corporation Halol. By using value stream mapping; the author observed that non-value added time was reducing by 25.6%. Also, the WIP was reduced and thereby lead time was reduced by 66.7%.

F. William M. Goriwondo, Samson Mhlanga, Alphonse Marecha (2011):

Basic aim of this paper was to use the Value Stream Mapping tool in identifying, quantifying and minimizing major wastes in a bread manufacturing set-up. This was a case study of the bread-making process analysis using the Value Stream Mapping tool. The study was; to use the Value Stream Mapping tool in troubleshooting waste generated in Bread Manufacturing and identify ways of reducing this waste while at the same time increasing the proportion of the processes that add value to the product. This was well achieved through the development of the Future State Map which has an increased throughput of 16%.

G. A. N. M. Karim, A. A. B. Jaafar, M. A. I. Abdullah, M. Haque, M. Y. Ali, S. A. Azline (2012):

The author in his study conducted on application of VSM in a metal stamping company which involves the production of different stamped parts of which the LCD TV frame. With their work as study, the efficiency of production line was

significantly increased from about 48% to more than 93% vis-à-vis a reduced batch completion cycle time.

III. WASTE (MUDA)

There were seven wastes identified by Shigeo Shingo as a part of Toyota Production System [7]. These are listed in the table 1.

Wastes	Description
Overproduction	Producing either in large stocks or too soon, resulting in adverse flow of information or goods and excess of the inventory.
Defects	Frequent errors in documentations, product quality issues, or adverse delivery performance.
Inventory	Extra storage and delay of information or products, resulting in extra cost and adverse customer service.
Inappropriate processing	Processes with the wrong set of toolings, sequencing procedures or systems, even when a simple approach may work effectively.
Excessive Transportation	Excessive movement of work labour, data sharing or goods resulting in excessive time, extra effort and additional cost.
Waiting	Long periods of inactivity for work labour, data sharing or goods, resulting in poor flow and longer lead times.
Unnecessary motion	Adverse workplace management, resulting in poor ergonomics.

Table 1 Type of Wastes

IV. TYPES OF VALUE STREAM MAPPING

VSM has three types:

A. Process level VSM –

In process level VSM, it ensures the flow of material and information within a phase or production line.

B. Factory level or door-to-door VSM –

In factory level VSM, it ensures the flow of material and information within a four walls of a factory

C. Extended level VSM –

Extended level VSM focus on the material and information flow of several companies [5]

V. VSM METHODOLOGY

The process analysis is carried out by acquiring the list of information from various enquiries with experts in shop floor level, labourers and by directly participating in measuring time for various processes. The various steps in the VSM methodology are as follows.

- Data Collection
- Current State Mapping
- Application of VSM Tools
- Creating Future State Map

A. Data Collection-

1) Customer Demand:

- What is the product family?
- How many products are required and when?
- How many variety parts are made?
- How many products are dispatched at a time?
- How often are dispatches required?
- What sort of packing is required?
- How much amount of stock does the customer hold?
- Other information like number of delivery points, delivery windows etc.

2) Information Flow:

- What kind of forecast information is given by the customer?
- What kind of call-off information is given by the customer?
- Which department does this information go to in the firm?
- How long does it stay there before being processed?
- How do they pass it to as it moves towards suppliers?
- What sort of forecast information given by suppliers?
- What sort of call-off information given by suppliers?
- What order quantities do supplier specify?

3) Physical Flow:

- How many products are wanted and when?
- How many different parts are required?
- How many products are to be dispatched at a time?
- How often do dispatches occur?
- What sort packing is make?
- How long does it take to dispatch?

- Other information like more number of suppliers for a given part number?

B. Current State Mapping:

- What kind of scheduling information is used?
- What kinds of work instructions are produced?
- Where is the information and instruction sent from and to?
- What happens when there are problems in the physical flow?

C. Application of VSM Tools involves:

Tools	Parameters
Process activity mapping	Identify lead time & productivity opportunities
Demand amplification mapping	Volume with respect to Time
Quality filter mapping	Product defects, Scrap defects & Service defects
Production variety Funnel	No .of products variant-manufacturing process path
Value adding time profile	Value adding & Non-Value adding costs- Time

Table 2 Vsm Tools

D. Creating Future State Map:

The improvement in the existing flow using various lean tools which will ultimately help in reducing inventory, lead time, changeover time and improving productivity comes to this phase of work.

VI. VSM TOOLS APPLICABILITY

Each of VSM tools is not equally applicable to any of the wastes. These are based on the kind of wastes and in which point of area we are applying at. The defining approximation weights are as shown in table 3 [7]:

Wastes/ Structure	VSM Tools						
	Process Activity Mapping	Supply Chain Response Matrix	Production Variety Funnel	Quality Filter Mapping	Demand Amplification Mapping	Decision Point Analysis	Physical Structure (Volume & Value)
Over-production	Lower	Moderate		Lower	Moderate	Moderate	
Waiting	Higher	Higher	Lower		Moderate	Moderate	
Excessive Transportation	Higher						Lower
Inappropriate processing	Higher		Moderate	Lower		Lower	
Unnecessary inventory	Moderate	Higher	Moderate		Higher	Moderate	Lower
Unnecessary motions	Higher	Lower					
Defects	Lower			Higher			

Table 3: APPLICABILITY OF VSM TOOLS

VII. CONCLUSION

Value Stream Mapping works to be an effective tool in order to improve and gather the information at each and every stations about station cycle time, uptime or utilization of resources, setup time, WIP inventory, manpower requirement and the information flow from raw materials to

finished goods. VSM works in any of the sector such as hospitability, manufacturing, service industry, automobile, machining and casting industry etc.

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