A Review of Implementation of Lead Time Reduction Techniques in Indian SMES

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Abstract- Many industries are struggling for improving productivity due to several reasons like improper production planning, delay of raw materials from suppliers, failing in product delivery commitment, inconsistency in operation management etc. Current industry scenario is on-time delivery of customer demands and offering good quality products at competitive price. In today era's Lean is a fizz word for every organization. This review study discusses an application of lean tools such as Value Stream Mapping (VSM), Kaizen, Single Minutes Exchange of Die (SMED) and 5S for better production management. It also includes use of various tools and techniques to reduce lead time. Method study is used to examine the existing manufacturing process and improvement can be sought by modifying, combining, eliminating and simplification of operational activities.

Keywords- Value Stream Mapping, Kaizen, Method Time Measurement (MTM), 5s technique

I. INTRODUCTION

Excessive Lead time is major the major challenge of Indian manufacturing industries. They are continuously striving for productivity, smooth production flow, and elimination of non value added activities. There are many remedies to resolve this. The study reveals effect implementing several methods.

This study is to capture the current scenario of lead time reduction techniques usage in Indian SMEs. Lean tools are helpful to smooth operational flow by reducing production waste. VSM is a micro-level analysis of material and information flow through the various levels of manufacturing setup. Major improvement areas are identified from the current value state map. The review of Kaizen found that resistance to change, failure to motivate employees, lack of understanding on company's strategic path and difficulties in managing continuous improvement are major barriers. MTM aim is for identifying, evaluating, reducing and eliminating waste within the value stream in terms of lean management.

II. LITERATURE REVIEW

Many case studies are identified about lean tools implementation, and they are summarized as following. It the present time, the manufacturing firms need to redefine and reconstruct their production system to tackle the competitiveness of demand by facing the current market. (Ibon Serrano Lasa, 2008). After World War II Japanese manufacturers were facing with huge shortages of material, financial, and human resources. These conditions resulted in the birth of the ''lean'' manufacturing concept. Rapid flux of competitive market lean manufacturing refers to a manufacturing paradigm based on the continuously minimizing waste to maximize flow.

To reduce waste in human effort, inventory, time to market, and manufacturing space to become highly responsive to customer demand while producing quality products in the most efficient and economical manner is the prime objective of lean manufacturing (Dinesh Seth, 2005).

Lead time is the time elapse between the customer order and the final delivery of the product. Lead time mainly calculate basis on OT: operating time, PT: process time, ST: set-up time, IT: idle time, TT: transport time, IR: inventory range. Value Stream Mapping (VSM) and Methods-Time Measurement (MTM) are helpful to reduce lead time and increase productivity based on lean principles and standardized processes (P. Kuhlang, 2011).

According to Little's law, the given production rate lead time is directly related to inventory. VSM is an effective tool to classify improvement areas and facilitate lean implementation for production industry (Bhim Singh, 2010).

To reduce cost and improving productivity by eliminating major manufacturing waste is the primary goal of lean production system (Amir Azizi, 2015). Function of the LPS was guided by five principles starting by 1-specifying value, 2-identifying the value stream, 3-making the value flow, 4-configuring of pull system by customer, and 5-pursuing towards perfection.

One of the techniques implemented by many companies to improve their competitiveness is to apply the

continuous improvement or Kaizen concept in every organization. The word Kaizen is comes from two Japanese words "Kai" which means change and "Zen" which means for the better.

2.1 Value Stream Mapping

Value Stream Mapping provides an insight on the explored areas of lean manufacturing. Value Stream Mapping is a micro-level analysis of material and information flow through the various levels of a manufacturing process (S. Vinodh, 2010). Jones and Womack defined VSM as ''the simple process of directly observing the flows of information and materials as they now occur, summarizing them visually, and then envisioning a future state with much better performance''. Various terminology used in VSM are discussed in Table 1 (Sharma, 2009).

Table 1   Terminology used for VSM

TAKT time	It is ratio of available working time per day (in minutes or seconds) to customer demand per day (in relevant units).
Production lead-time	It is the total time a component takes in its way through the shop floor, starting with arrival of raw material to shipment of finished/semi finished goods to customer.
Value adding time	It is the time which is utilized in adding actual value to the product.
Current state map	It represents the existing/ current position of shop floor of any manufacturing facility.
Future state map	It describes the proposed/future position of shop floor of any manufacturing facility in order to bring some improvement.
Kanban	Kanban is a Japanese word that means card and which is used to reduce inventory.
Pull production	Producing exactly at pace of customers requirement.

Value added and non-value added activities combination create value stream that are required to bring a product through the essential flows; starting with raw material and ending with the customer for reducing the production wastes (Amir Azizi, 2015). There are five basic steps to create VSM (Muhammad Abdus Samad, 2013).

1. Create a current VSM
2. Evaluate the current map
3. Identify problem areas
4. Create a future state VSM
5. Implement the final plan

According to Ibon Serrano (2008) VSM can be used as redesign tool for manufacturing apart from enumerating the differences between theoretical concepts proposed by VSM and real world applications. Value Stream Mapping (VSM) is visualization and streamlines work operation using the tools and techniques of Lean Manufacturing. Typical symbols are used to draw VSM as shown in Figure 1.
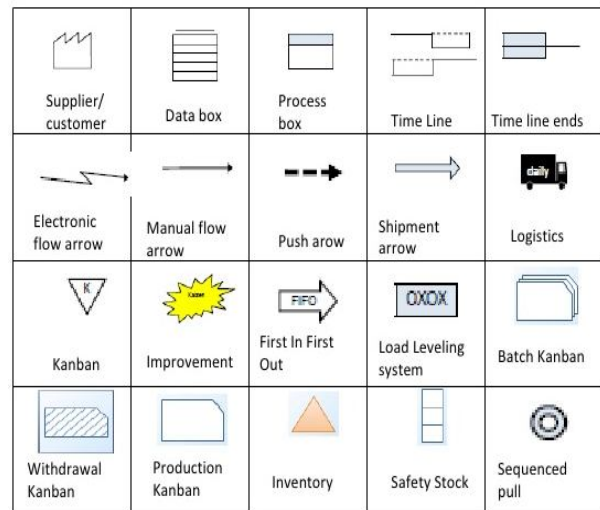

Figure 1: Value Stream Mapping symbols

2.2 Kaizen

After the World War II, Kaizen was initiated as a response towards problem faced such as limited resources and difficulties to obtain raw material by the Japanese industries. Kaizen is the Japanese word for "continuous improvement" or "change for the better" (Abdulmouti, 2015). Japanese companies started to look into how to improve their production processes by reducing waste and optimizing process efficiencies (Mohd Ghazali Maarof, 2016). The central idea of Kaizen manufacturing is elimination waste, which is required to increase profitability and productivity. Reduction of each kind of waste like as transport time, space and unnecessary workstation is the main objectives of implementing Kaizen. (Kishore B. Lad, 2016)

According to (Kishore B. Lad, 2016) cycle of Kaizen activity can be defined as:

- Standardize an operation and activities.
- Measure the standardized operation (find cycle time and in process inventory)
- Innovate to meet requirements and increase productivity
- Standardize the new, improved operations
- Continue cycle

The eventual objective of small medium manufacturing industries today is to increase productivity through system simplification, organizational potential and small incremental improvements by using modern techniques (Gurway, 2016). In competitive market, continuous improvement of manufacturing system processes has become necessary for every industry.

2.3 Method Time Measurement:

MTM is useful to determine and assess the performance level correctly. The time required to execute a particular activity depends on the method performed for this activity is called method time measurement (P. Kuhlang, 2011). According to British Standard Institute time study has been defined as "The application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance" (Raut, 2014). Method study is essentially to every industry because of increase the efficiency by eliminating unnecessary operations, avoidable delays and other forms of waste (Raut, 2014). To achieve higher productivity, better quality and achieve greater output at minimum cost by using method study and time study (Prathamesh P. Kulkarni, 2014). The procedure for creating a method study steps depicts in table 2.

Table 2   Method Study Procedure

(1)	Select	The work to be studied
(2)	Record	All relevant information about that work
(3)	Examine	The recorded information
(4)	Develop	An improved way of doing things
(5)	Install	The new method as standard practice
(6)	Maintain	The new standard proactive

Industrial Engineering terminology standard defines time study as "a work measurement technique consisting of careful time measurement of the task with a time measuring instrument, adjusted for any observed variance from normal effort or pace and to allow adequate time for such items as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal need" (Raut, 2014). Time

study is also called work measurement. It is required for planning and control of operations. Today, MTM is the most common predetermined time system in the world, thus establishing a worldwide uniform standard of planning and performance for a global business.

2.4 5s

5S is an established methodology procreating in Japan, when implemented, mitigates the waste of resources and work area in spite of increment in manufacturing & operational proficiency (Prathamesh P. Kulkarni, 2014). It improves working environment of the work stations. Name 5S is the acronym of five Japanese words of the following meanings (J. Michalska, 2007).

- ✓ Seiri (sort)
- ✓ Seiton (set in order)
- ✓ Seiso (shine)
- ✓ Seiketsu (standardize)
- ✓ Shitsuke (sustain)

5s methodology can be explained by following 5 Steps (Prathamesh P. Kulkarni, 2014).

Table 3: 5s steps

Sort	Completely Sort out & classify that which item is required and/or not required in the work area
Set in order	Arrange items in required order that are important so that they are ready to find & easy to use.
Shine	Clean the work area, tools, machine & equipments on a continuous basis in order to identify defects& maintain standards
Standardize	Ensure standard & uniform procedures and methods throughout the operation to promote changeover.
Sustain	Stay to the regulations to maintain the standard & continue to improve every day.

After reviewing the literature, Table 4 shows the summary of various tools and technique applied for lead time reduction in Indian SMEs and its benefits.

Table 4: Summary of Results derived from research articles

Sr. No.	Authors, Year	Method used	Objective	Results
1	Amir Azizi, 2015	Value Stream Mapping (VSM), SMED	Design an efficient Value Stream Mapping (VSM) to improve the productivity in Small Medium Enterprise (SME) by eliminating non-value added activities.	The machine setup time in the insertion process was reduced from 145 seconds to 54 seconds by using SMED tools.
2	(S. Vinodh, 2010)	Lean manufacturing and VSM	To identified wastes in existing manufacturing processes by using VSM techniques.	Significant reduction of lead time, total cycle time, work in progress, defects as well as appreciable improvement in uptime and on time delivery.
3	(P. Kuhlang, 2011)	Value Stream Mapping (VSM), Methods-Time Measurement (MTM)	Reduce lead time and increase productivity based on lean principles and standardized processes.	Identified non value added activity by using MTM method and increasing productivity.
4	(Fawaz A. Abdulmalek, 2007)	Lean manufacturing and VSM	Reduce production lead-time and lower work-in-process inventory.	Production lead time reduced almost 70% from its current value of 48 days to less than 15 days.
5	(Bhim Singh, 2010)	Value Stream Mapping (VSM), Takt time	Discuss the lean implementation process and its quantified benefits for the production industry with the help of value stream mapping (VSM).	Many benefits are reported such as reduction in WIP inventory by 89.47 percent, finished goods inventory by 17.85 percent, product lead time by 83.14 percent, processing time by 12.62 percent.
6	(Bharath, 2014)	VSM, FIFO, Takt time	Analyze the factors responsible for non-value added time.	Establishment of FIFO for F003 component is 13.60 days i.e. reduction in the lead time by one day.
7	(Raut, 2014)	Time & Method Study	Minimize Excess man power, Improve the Production Method, Minimize the production time	Establish the standard time for the MAHINDRA Production time and using proper work movement method for minimize the effort.
8	(Kishore B. Lad, 2016)	Kaizen, Cycle time	Kaizen implement by using systematic layout planning.	The production time reduced from about 48 min to 41.67 min. that is Cycle time reduced by 6-7minutes. Reduced searching time for material.
9	(Ibon Serrano Lasa, 2008)	Value Stream Mapping (VSM)	The value stream mapping (VSM) is a tool created by the lean production movement for redesigning the productive systems.	Reduction of the manufacturing lead time from the original 26 to 20 days.
10	(J. Michalska, 2007)	5s	Introduced the way of implementing the 5S methodology in the company.	Stock control, better usage of the working area, increasing of machines efficiency, maintenance the clean workplace, easy to check

11	(Hassan Abdulmouti,2015)	Kaizen, 5s	Implementing the Kaizen principles at Port Installed Options Center in Toyota Saudi Arabia. Using relevant Kaizen tools including Toyota Production System (TPS), 5S.	Reduce the manpower needed by 26.9% (from 349 to 275 installers). Increasing the annual output around 13% (from 188000 to 212400 vehicles).
12	(Sharma, 2009)	VSM, Lean Production	Develop the road map to tackle improvement areas to bridge the gap between the existing state and the proposed state of a manufacturing firm	92.58 % reduction in lead time, 2.17% reduction in processing time, 97.1% reduction in WIP and 26.08% reduction in manpower requirement.
13	(Muhammad Abdus Samad, 2013)	VSM, 5S, Kanban and SMED	Find the non-value added time and reduce the WIP by convert the push system to pull system.	Reduction of the manufacturing lead time from the original 9.12 days to 2.04 days.

III. REVIEW REMARKS

Following learning are made from review of research papers.

1. 5 S methodology is simple and fundamental technique to improve shop floor arrangement, better space management, reducing searching time, reducing lead time, and stock control. 5s is used as a systematic form of visual management utilizing everything for improvement of workplace efficiency.

2. SMED is useful to reduce set up time as well as changeover time in different processes. It becomes significant when batch sizes are very small.

3. The interaction of Value Stream Mapping and MTM at different levels of detail consideration contributes to the identification, elimination and avoidance of waste and thus leads to the design of efficient and effective processes.

4. VSM is a powerful tool for lean manufacturing and effective way to evaluate the non-value added activities through the system.

5. The purpose of Kaizen implementation is to improve the overall effectiveness and reduce the lead time of small scale organization. Kaizen is implemented continuously.

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