



INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

“Investigation of Cycle Time Reduction through Value Stream Mapping : A Review”

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ABSTRACT

In any organisation Cycle time for any part of manufacturing process should be considered as a viable option when an organization is approaching to improve cost base, efficiency and customer response. Value stream mapping is an easy and most effective paper and pencil tool that helps you to see and understand the flow of information and material as a product or service makes its way through the value stream. This paper proposes how this valuable tool VSM can be implemented effectively for loading and unloading of the materials. Forming a current state map of non-value added activities, also derive a future state map for reducing the cycle time and improve the process efficiency.

KEYWORDS : *Cycle time reduction, Value added and non-value added activities, Value stream mapping.*

I. INTRODUCTION

Lean Manufacturing means “A systematic approach to eliminate waste through continuous improvement by flowing the product at the demand of the customer.” Taiichi Ohno once said that “Lean Manufacturing is an approach which is all about looking at the time line right from the moment the customer gives an order till the point when we collect the cash. And we always approach to reducing that time line by eliminating the non – value added wastes” (Ohno, 1988). VSM is considered as one of the most powerful Lean tool sin an organization approaching to plan, implement and improve with its Lean journey. The car manufacturing industry- Toyota was the very first company to implement VSM techniques to implement Lean concepts and tools. It is a graphical tool which is created using a predefined set of standardized icons that helps the organization to see and understand the flow of material and information as the product goes along different stages. After drawing the value stream it helps the organization to differentiate value adding activities from non- value adding activities (the current condition) and identify kaizen opportunities. The real benefit is, it gets the company away from isolated point kaizen and builds towards a true system based on the flow of materials and information across the entire value stream (Liker and Meier, 2007). By practicing VSM, the organization can streamline its business processes and achieve the goal of eliminating wastes remarkably. Value stream management is a process of planning and linking lean initiatives through systematic data capture and analysis which consists of eight steps.

1. Commit to lean
2. Choose the Value Stream

3. Learn about Lean
4. Map the current State
5. Identify Lean Metrics
6. Map the Future State (using the demand, flow, and leveling concepts)
7. Create lean Plans (VSM)
8. Implement lean Plans (VSM)

II. . LITERATURE SURVEY

Planning and Scheduling In the Automotive Industry: A Comparison of Industrial Practice at German and Japanese Makers Thomas Staebelin, Katsuki Aoki (July 2014) discussed that providing customization of products is an important way of attracting customers, but it can increase the complexity of planning and scheduling processes in the order fulfilment system. In order to improve this understanding, they compared the order fulfilment system of German and Japanese auto makers as a sample of industrial practice. As part of this research they conducted two in-depth case studies at one German and one Japanese auto maker to map planning and scheduling functions along the order fulfilment process. However, contrary to common perception, planning and scheduling processes differ much less between auto makers even in the light of regional differences concerning order fulfilment, different levels of product variety and mixed-model line manufacturing practice. We found less variation between planning and scheduling functions than conventional operations management knowledge would predict in the light of greatly differing levels of product variety, manufacturing conditions, and managerial practice of order fulfilment. The implications on the design and management of planning and scheduling functions vary between makers in our case study, but do not follow the traditional theoretical path. There are two limitations that need to be acknowledged regarding the present paper. The first limitation concerns the cross-disciplinary nature of this research [1].

Value Stream Mapping To Reduce The Lead-Time Of Product Development Process: Satish Tyagi, Alok Choudhary, Xianming Cai, Kai Yang (Nov 2014) have analyzed that product development (PD) is a broad field of endeavor dealing with the planning, design, creation, and marketing of a new product. The main focus of this paper is to exploit lean thinking concepts in order to manage, improve and develop the product faster while improving or at least maintaining the level of performance and quality [2].

Performance Improvement Suggestions For Ground Handling Using Lean Solutions Approach: Ibrahim.A.Nugroho, Ustika.H.Riastuti, Hardianto Iridiastadi made a study on observations of nearly all of the existing activities in the process of baggage handling, passenger handling, and aircraft interior cleaning activities at PT Garuda Indonesia were executed. Data collection was carried out by direct observation through interviews, as well as measuring time using stopwatch, and various manual distance measurements. After knowing the causes of various activities that did not add value to the process, then proposals for improvements that could be used by PT Garuda Indonesia were made. Based on the analyses that had been made to the existing conditions, suggestions to improve the performance of baggage handling, passenger handling, and aircraft interior cleaning were made; with the lean principals as the references. Then, future state maps were drawn. There was some differences between the current state maps and the future state maps, considering the alternatives of suggestions that had been made. There were some assumptions used in the future state maps, because it was almost impossible to differences on the airport environment for just some research purposes. Thus, the suggestions made had to be simple but very much applicable [3].

Production Flow Analysis Through Value Stream Mapping: A Lean Manufacturing Process Case Study: Rahani AR, Muhammad al-Ashraf (2012). The team described a case where Lean Production (LP) principles were adapted for the process sector of an automotive part manufacturing plant. Value Stream Mapping (VSM) is one of the key lean tools used to identify the opportunities for various lean techniques. Current State Map is drawn to document how things actually operated on the production floor. Then, a Future State Map is developed to design a lean process flow for LP initiative on a product (Front disc, D45T) through the elimination of the root causes of waste and through process improvements. The use of the VSM improved the approach in LP initiatives as it reveals obvious and hidden waste that affected the productivity of D45T production. The VSM applied to assess the expected impact of a change in the production process resulted in savings (lower rejection rates) and to a certain extent, a positive view was due to the fact that there were substantial gaps between standardized work and real work – this gap meant that workers did not follow strictly assembly standards and improvising

the SOP could be a key driver in continuous improvement sustainability on the production floor as operators are fully aware on the long-term commitment to practice Lean[4].

Assessing Lean Systems Using Variability Mapping: A.Deif (2012). A new approach to assess lean manufacturing based on system's variability is proposed. The assessment utilizes a new tool called variability source mapping (VSM) which focuses on capturing and reducing variability across the production system. The new tool offers a new metric called variability index to measure the overall variability level of the system. Based on the mapping and the new metric, VSM suggests a variability reduction plan guided by a recommendation list of both lean techniques as well as production control policies. An industrial application is used to demonstrate the new tool. Results show that VSM managed to reduce the overall variability level of the system as well as non-value added activities. Finally, the new variability index was successfully applied as a leanness assessment metric. This paper presented a new tool (to be added to lean improvement tools) dedicated for variability capturing and reduction. VSM offered a system variability metric called variability index (VI) based on a weighted average of the overall cycle time and flow variability. VI is used to track improvements achieved due to the implementation of VRP. However, it can also be used as leanness metric to measure the overall leanness of the production system from a variability perspective. In conclusion, it is time for the lean manufacturing paradigm to take the next step by not only recognizing the power of variability reduction but also offering more comprehensive tools to capture and manage that problem[5].

Cycle Time Reduction Of A Truck Body Assembly In An Automobile Industry By Lean Principles: S.Santhosh Kumar, M.Pradeep Kumar (2014). Assembly line balancing is the process of assigning operations to workstations along an assemble line, in such a way that the assignment is optimal in some sense. This paper deals with studying the existing operation time for assembling, line balancing to avoid station delay, and the implementation of lean tools resulting in a shortening of the cycle time in an assembly line. Based on the studies, the main operations and strategy of the company and the time taken for the assembly line have been calculated. Initially the cycle time of the total assembly was 90min., After the line balancing the cycle time has been reduced to 37.5min and efficiency has increased up to 30.09%[6].

Abbett and payne have discussed the purpose of value stream mapping in an airliner manufacturing unit. They have urbanized the current and future state maps by means of an aim of reducing lead time according to customer's demands[7]. Hines and rich has suggested that the value stream is "the specific activities within a supply chain required to design order and provide a specific product or value." Taiichi Ohno could not see waste at a glance (especially across a geographical area). He developed material and Information Flow Mapping (VSM) as a standard method for mapping the flows visually and it became the standard basis for designing improvements at Toyota—as a common language. It became one of their business planning tools. VSM is now utilized throughout the world, in many businesses to strategically plan and it is the starting point to any lean transformation and implementation. The value stream mapping was extended in the field of aircraft manufacturing also [8].

McDonald point out that the VSM creates a common language for production process thus is facilitating more thoughtful decisions to improve the value stream. This will effectively reduce the wastes and improves the productivity [9].

Ritesh Bhatt and Shivakumar made an attempt to improve the productivity using Value Stream Mapping and Kanban Approach- "Change is constant", is the phrase today most of the industries believe in and act upon. Value Stream Mapping (VSM) and Kanban are the techniques believe in and act upon[10].

Value Stream Mapping used to Reduce The Lead-Time in process of product development Satish Tyagi, Alok Choudhary, Xianming Cai, Kai Yang have concluded that product development is a vast field of dealing with the design, planning, creation, and marketing of a new product. The main concern of this paper is to utilise lean thinking concepts in order to improve, manage and develop the product faster while improving and maintaining the level of performance and quality. This research discusses the aim and associated problems with product development process for a study of case in Gas Turbine manufacturer. All the proposed changes to the same industry will result in the reduction of lead time for the design stage reducing thus the overall PD lead time by 50%. Investigation of the manual factor in analyzing the performance in future state process is clearly a topic further [11].

A Lean Manufacturing Process Case Study--Production Flow Analysis Through Value Stream Mapping: Muhammad al-Ashraf , Rahani AR. The team explained a case where Lean Production principles were implemented for the process flowing of an automotive part manufacturing plant. Value Stream Mapping is one of an important lean tools used to identify the opportunities for various lean techniques. Current State Map is proposed to document how the things are actually

operating on the production floor system. Then, for a change a Future State Map is developed to design a lean process flow for LP initiative on a product through the elimination of the root causes of waste and through process improvements. The use of the Value Stream Mapping improved the approach in Lean Production initiatives as it reveals but obvious and hidden waste that are affecting the productivity of D45T production. The Value Stream Mapping applied to assess the expected impact of the changes in the production process resulted in savings (lower rejection rates) and to a certain extent, a positive sight was due to the fact that there were appropriate gaps between standardized work and real work – this gap means that workers did not follow strictly the assembly standards and improves the SOP could be a key driver in the continuous improvement sustainability on the production floor process as operators are fully aware on the long-term commitment to practice Lean[12].

Assesment of Lean Systems Using Variability MappingA.--Deif. It is new approach to implement lean manufacturing based on system's variability is proposed. This assessment utilizes a new tool which is called as variability source mapping (VSMII) which is focusing on capturing and reducing variability across the production system. The new tool which offers a new metrices called variability index to measure the overall variability level in the system. Based on the mapping and new metrices, VSMII plans a variability reduction plan which is guided by a recommendation list of both production control policies. lean techniques as well . An industrial application is used to demonstrate this new tool. Results shows that VSMII has managed to minimise the overall variability level of the system as well as non-value added activities. At last , the new variability index was successfully proposed as a leanness assessment metric[13].

Cycle Time Reduction Of A Truck Body Assembly In An Automobile Industry By Lean Principles--M.Pradeep Kumar S.Santhosh Kumar. Assembly line balancing is a process of assigning operations to workstations along with an assembled line, in such a way that the assignment is optimal in some sense. This paper deals with some system studying the existing operation time for assembling, line balancing to avoid station delay, and the implementation of lean tools resulting in a shortening of the cycle time in an assembly line. Based on these studies, the main operations and strategy of the company and the time taken for the assembly line is calculated. Initially the cycle time of the total assembly was 90min.,After the line balancing the cycle time has been reduced to 37.5min and efficiency has increased up to 30.09%[14].

III. VALUE STREAM MAPPING METHODOLOGY

To start improving productivity by identifying waste and then removing it by implementing lean principle in the industry there is no other tool better then VSM. The Value Stream Mapping method (VSM) is a visualization tool under the umbrella of Lean Manufacturing (Toyota Production System) tools. It helps in understanding and improving work processes, the goal of VSM is to identify, demonstrate and decrease waste in the process. The various steps in the VSM methodology are shown in Figure1 and are discussed in the following sections. The process analysis is carried out by collecting the data from various enquiries with expertise in shop floor, workers and directly participating in measuring the time of various processes.

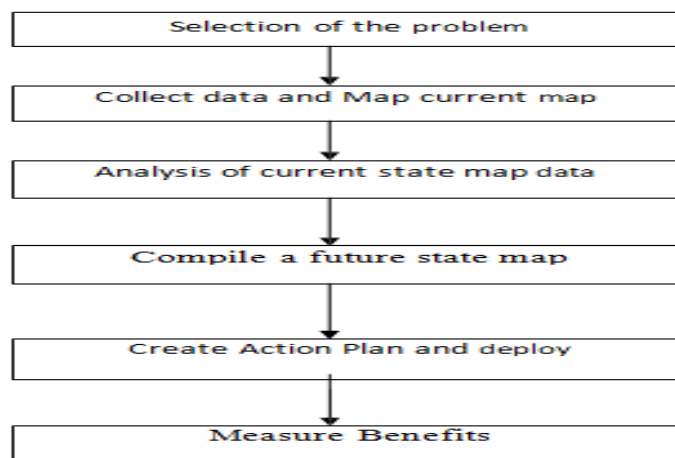


Figure1: Methodology Flow Chart

IV. RESULT AND DISCUSSION

The results of the different papers reported in literature and discussed above are summarized in this section.

a) Reduction in TAKT time: Figure 2 shows the reduction in TAKT time of four different industries after value stream mapping implementation.

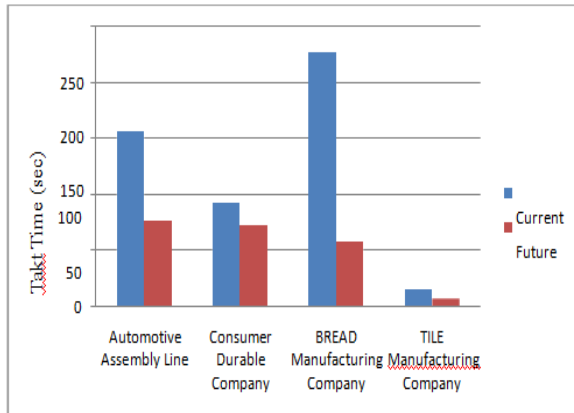


Figure2: Reduction in TAKT time

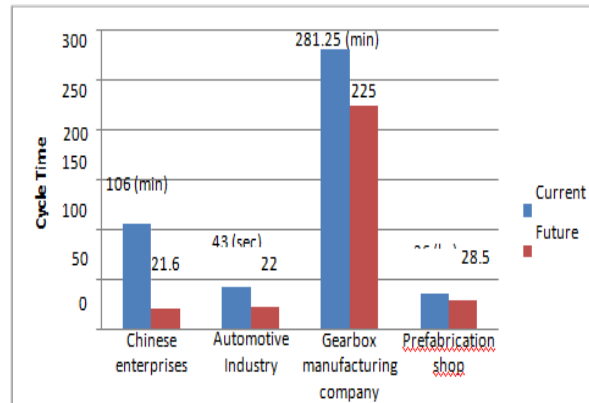


Figure3:Reduction in Cycle Time

b) Reduction in cycle time: Figure3 shows comparative cycle time before and after VSM in different industries.

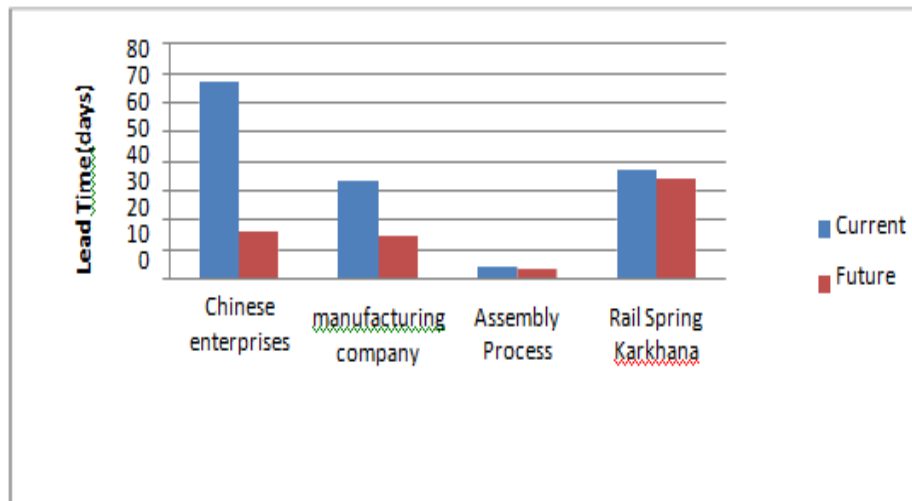


Figure 4:Reduction in Lean Time

c) Reduction in Lead Time and Inventory:- Value Stream Mapping is also helpful in inventory reduction. According to Bo & Mingyao inventory in current state map was reported as 327,000 units and in future state map it was 65000 units. Rajenthirakumar & Thyla shows that the inventory in current state map was reported as 2200 units and in future state map it was 200 units. In the study by K. P. Parantharan et.al [5] the inventory found in current state map was 5 units and in future state map it was 2

V. CONCLUSION

Based on the various studies it is examined and proposed that the implementation of Value Stream Mapping (VSM) has become interesting preference for the researchers. This literature survey has observed that the researchers are merely applying Value Stream Mapping (VSM) with some other lean tools. Implementation of other innovative methodologies such as Critical Chain Project Management, and concurrent engineering is clearly a matter of future research. In addition to all, the

extension of VSM implementation on other critical process and finally to whole enterprise from raw material to finished goods in customers hands will be targeted in the future. Value stream mapping (VSM) is proved to be quite effective tool for reducing the cycle time and all other wastes by a proper line balancing which are involved in the current state process. VSM provides the facility of projecting the estimated gains in different scenario by creating different future state maps, and then selecting the most feasible beneficial state. This enables the company to implement a feasible improvement plan with full confidence and knowledge of expected gains the practicality of VSM is amply demonstrated by several recorded case studies in literature, some of which have been reviewed and reported in this paper. This study show considerable improvement in lead time, cycle time, takt time and inventory for different types of industries. It can be concluded that VSM is an effective tool for identifying the processing wastes and improving overall effectiveness and efficiency and is equally applicable to different types of manufacturing industry.

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