On Value Stream Mapping and Its Industrial Significance

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Abstract—Competition among manufacturing industries becomes more challenging that many companies try to become more efficient by decreasing costs and streamlining their operation. Value Stream Mapping is one of the effective tools in Lean to analyze and improve the production system. VSM is a map that helps to see the hidden wastes, and most important it helps to identify the source of wastes existing. It also enables to visualize the potential alternatives of waste's elimination and thus the improvement. Recent years, the used of simulation has arisen to compliment and support the application of VSM to be more effective, flexible and powerful. The objective of this paper is to explore the issues exist in VSM and describe its significance to the industry. In this paper, we compile and evaluate relevant information on lean manufacturing and VSM.

Index Terms—lean, value stream mapping, simulation

I. INTRODUCTION

Within the growth of today manufacturing industries, most companies have received high customer demand. Those companies in the same field of business have to compete among them to obtain trust from customer about their products and services. Hence, for the sake of the companies, it becomes increasingly crucial to analyze and improve the manufacturing system and the corresponding planning system continuously.

Lean manufacturing has been widely known as an approach for working improvement. Many manufacturing companies have been trying to implement Lean in order to strive in the global market. Within Lean there are numerous techniques and tools that can be applied. One of the primary and effective tools is Value Stream Mapping (VSM) used for quick analysis of process flow and material flow in a manufacturing system. It is also effective to evaluate the non-value added activities through the system. However, VSM has limitation that is it only gives a static picture of the system. At Toyota, it is the Material and Information Flow Mapping.

In recent years, the used of simulation has arisen as an important role in the development of industries. Simulation is a process that imitates the activity during the operation of a real system, in a computer, with a focus on process flow, logic and dynamic [1]. It helps to evaluate and improve system performance. In the case of VSM, simulation can be a tool to overcome the limitation. Banks [2] defines simulation as imitation of the operation of a real-world process or system over time. Simulation describes and analyzes the behavior of a system, asks what-if questions about the real system, and aid in the design of a real system. In addition, Lian and Van Landeghem [3] state that simulation model could help managers to see the effects before a big implementation and after Lean transformation.

II. ISSUES IN VSM

Currently manufacturing companies are competing in a tough global market among themselves. An effective management of the whole system within a company can help to remain within the competitiveness industry. Effective management and planning for a company will bring improvements, which will benefit to the company. The improvements are by mean in terms of eliminating wastes in the whole system or process namely as reduction of a process lead-time, inventory, direct labor, indirect labor, space requirement, quality cost and material cost.

As in manufacturing industry, there will be systems or process flows that cannot be seen or visualized easily by the naked eyes. The VSM can provide a good view. The map identifies the source of wastes and improves the system by eliminating the wastes as much as possible. From the map, generated, appropriate action and planning to improve value-added steps and eliminate non-value added steps in the current system would be easier to do.

Somehow, a fundamental limitation of VSM is that it is a manual method for mapping and analysis of the flows of products, materials, people, information, etc. in manufacturing facilities [4]. The manual method of VSM only produces a static model within a system that makes the observation and evaluation processes of the map difficult. For example, predicting inventory levels throughout the production process is usually impossible with only a future state map [5]. This is due to the inventory levels that will vary for different scenarios. Profozich [6] stated one could not use a static tool to study a dynamic problem. A static tool gives an optimistic performance assessment. The greater the variability within the system, the greater the error...

Manuscript received September 1, 2013; revised, November 27, 2013.
produces in a static analysis. However, VSM gives only a snapshot of the situation on the shop floor at one specific moment.

In addition, developing a manual VSM is time consuming. The map is developed by using hand and depending on how complex the process or system; it can take a lot of time to finish. This is because during the process of mapping, iterative steps or flow would occur. Due to the manual method, VSM lacks capability for rapid development and evaluation of different alternatives in improving Current State Map when time and budget constraint exists. It does not give a predictable outcome from the changes made on it.

III. THE VSM

A. Overview

All the actions, both value added and non-value added, currently required to bring a product through the main flows essential to every product: the production flow from raw material into the arms of the customer, and the design flow from concept to launch; define a value stream. VSM helps in visualizing a system by the representation both material and information flow for any manufacturing or administrative process. It enables companies to map the flow of products coming in the back door as raw material, through all manufacturing process steps, and off loading dock as finished product.

It analyzes the flows of material and information currently required to bring a product or service to a customer. By creation of a common language through a process, VSM selects to remove the non-value added activities. Moreover, it allows the users to understand where they are and what wasteful acts they can eliminate.

VSM provides an overall system that views all products and relates the manufacturing process to supply chains, distribution channels, and information flows. It also provides a company with a “blueprint” for strategic planning to deploy the principles of Lean Thinking to facilitate their transformation into a Lean Enterprise. The benefits of VSM are:

1) See the flow of the value stream.
2) Identify and eliminate wastes.
3) Prioritize activities to achieve the future state.

B. Map Development

A VSM project involves the development of maps known as the Current State Map (CSM) and the Future State Map (FSM). A CSM shows work processes as they currently exist. This is vital to understand the need for change and to understand where the opportunities lie.

A CSM breeds an FSM whereby a FSM improves the value-adding steps and eliminates the non-value adding steps (1). These are the wastes in the current system. We have:

\[ \text{VSM} \leftrightarrow \text{CSM} \leftrightarrow \text{FSM} \]  

There are six tips to facilitate the mapping process [4]. Firstly, collect the current-state information while walking along the actual path of material and information. Secondly, walk along the entire door-to-door value stream in order to get a sense of the flow and sequence of processes. Begin at the shipping end and work upstream. Do not rely on standard times or information not collected personally. Map the whole value stream by one person. Lastly, draw the map by hand and pencil. We have the routine for this process (2):

\[
\begin{align*}
\text{Begin} \\
\text{Add CurrentState;} \\
\text{Create FlowSequence;} \\
\text{Search EndPoint to StartPoint;} \\
\text{Exclude StandardTime & ThirdPartyInformation;} \\
\text{Develop ValueStreamMap;} \\
\text{End}
\end{align*}
\]

IV. THE SIGNIFICANT OF VSM

Integration of simulation and VSM appears to be an effective and more holistic approach to process management and improvement within the context of lean production [5]. Discrete Event Simulation can provide important information for implementing FSM in a complex system [3], [5], [7]. One example, Abdulmalek and Rajgopal [8] utilize VSM via simulation to demonstrate to the manager the benefits of implementing lean in continuous process production such as eliminating waste, maintaining better inventory control, improving product quality, and obtaining better overall financial and operational control.

The combination of VSM and simulation gives great flexibility and power to experiment possible alternatives to see the state of the production system under different circumstances by using varying parameters that produces a decision making [9]. Coppini et al. [10] show in their case study that the results from the comparison between CSM and FSM allowed huge in improvement. Moreover, the simplicity of this tool in terms of its understanding and utilization is another advantage. In fact, simulation adds another dimension to VSM, which is time. There are possibilities for simulated VSM paving the way towards better Lean understanding by decision-makers and faster Lean implementation [9], [10]. Mok et al. [11] suggest that integration VSM and simulation in construction
industry improves the results in all aspects of work productivity. In short, VSM is convenient to use in all different kinds of manufacturing and is easy to use [12]. The utilization of simulation provides important advantages for most companies which including the following:

1) Choose correctly: Simulation lets a user to test any proposed changes or additions without affecting resources to their acquisition.

2) Compress and expand time: By compressing or expanding time, simulation allows a user to speed up or slow down phenomena so that user can investigate them thoroughly.

3) Understand why: Certain phenomena occur in a real system that makes managers often wants to know why. Simulation allows a user to seek an answer for the “why” questions by reconstructing the scene and taking microscopic examination of the system to find out why the phenomena occur.

4) Explore possibilities: Once a valid simulation model has developed, user can explore new operating procedures or methods without expense and disruption of experimenting with the real system.

5) Identify constraints: Bottleneck operations can disturb the production efficiency. Simulation performs the bottleneck analysis so that the cause of delays in work in process, information, materials, or discover the other processes.

6) Develop understanding: Simulation studies aid in providing understanding about how a system really operates rather than indicating someone’s prediction about how a system will operate.

7) Cost saving tool: Since a change or modification to a system after installation is highly cost, simulation is a wise investment.

V. SUMMARY

Lean has been extensively implemented by many organizations especially in manufacturing to improve productivity and maintain in the competitive market. VSM is the most essential tool in the step of implementing lean because through VSM, it helps to see great benefits of applying lean principles. Instead of the benefits offered, some issues have been highlighted in traditional VSM that prevented its usage in broader perspective. The issues can be summarized as follow:

1) VSM using manual method produces a static model that only gives a snapshot of the situation in the system at a specific time

2) It is time consuming to develop a VSM depending on the complexity of a system

3) Traditional VSM does not gives predictable outcome to the changes made for the FSM

From the issues highlighted, there is a need to develop complementing tool to enhance and maximize its applications. Simulation is the best tool to compliment and advance the VSM. After being simulated, prediction for FSM and comparison before and after improvement can be made. Thus, it allows quickly “just do it” actions without interrupting the production process.

ACKNOWLEDGMENT

The authors wish to thank Universiti Teknikal Malaysia Melaka for supporting this research by grant identification: PJP/2010/FKP (17A)/S750.

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