Online available since 2012/Oct/08 at www.scientific.net

doi:10.4028/www.scientific.net/AMR.576.727

Applying Value Stream Mapping for Productivity Improvement of a Metal Stamping Industry

A. N. M. Karim[1,a], A. A. B. Jaafar[1,b], M. A. I. Abdullah[1,c], M. Haque[2,d], M. Y. Ali[1,e], S. A. Azline[3,f]

[1]Dept of Manufacturing and Materials Engineering, Faculty of Engineering

[2]Dept of Business Administration, Faculty of Economics and Management Science

International Islamic University Malaysia, Kuala Lumpur, Malaysia

[3]Sanden Air-con Marketing (Malaysia), Hicom Glenmarie Indus.Park, Shah Alam, Malaysia

[a]mustafizul@iium.edu.my, [b]azimjaafar@gmail.com, [c]akramabdullah27@gmail.com, [d]mahbubuap@yahoo.com, [e]mmyali@iium.edu.my, [f]amyazline@yahoo.com

Keywords: Value stream mapping, Metal stamping, Cycle time, Line balancing efficiency

Abstract. To sustain in business by meeting the customer expectations with limited resources under tight schedule is a great challenge for high volume manufacturing industry. In this respect Value Stream Mapping (VSM) plays an important role as a strategic tool in streamlining the processing operations and enhances capacity utilization. This study has been conducted on application of VSM in a make-to-order metal stamping company engaged in production of different stamped parts of which the LCD TV frame is a significant one. Based on the product flow analysis, a current state VSM has been constructed using pertinent data collected from the production floor. Analysis of recorded videos and time studies were performed in order to figure out the scope of improvements in framing the future state map (FSM) in the context of cycle time reduction and line balancing efficiency. As observed from the FSM, the efficiency of production line is possible to be significantly increased from about 48% to more than 93% vis-à-vis a reduced batch completion cycle time. Thus it is obvious that with minor adjustments in the system in line with the findings of the study, the industry can make a substantial improvement in their operational efficiency.

Introduction

In this era of intense competition, the competitive edge of a company depends heavily on its ability to respond in real-time to the customer demand with superior quality of its products [1]. One way of achieving this edge is to craft a lean strategy that is designed to manufacture products in the most efficient means and by reducing wastes in various manufacturing activities, such as managing inventory and factory space, material handling, production scheduling etc. [2]. An important priority of the lean strategy pertains to value stream mapping (VSM), which shows all the steps – both value-adding and non-value adding – needed to produce a product, right from the procurement of the raw materials from the suppliers to its manufacturing on the production floor and to its ultimate delivery to the customers [3]. VSM basically provides a pictorial view of the current state of the flows of materials as well as information and the recommended future state of these flows with a view to improving the productivity and performance of a company [4-5]. Though the concept of lean thinking dates back to the beginning of the twentieth century introduced by Henry Ford in the form of assembly line, it is to the credit of Toyota to transform the concept to its current level of VSM application through a more diversified but small lot production [6]. The current study has been undertaken to check the possibility of VSM application in a local metal stamping industry in Kuala Lumpur, Malaysia. The objective is to figure out in broad sense, the areas of improvement in the fabrication and process flow lines in making the products. The investigation is confined to focus on the production line of panel frame for LCD TV specifically to illustrate a current state VSM of the production line operations for the selected part; to demonstrate the scope of improvement by generating a future state map; to evaluate line balancing efficiency for the current and the expected improved scenario, and to offer some pertinent suggestions and recommendations.

The VSM begins with writing down all operations, then dividing them into value adding (VA) and non-value adding (NVA) activities including wastes. Besides, it also highlights the status of the lead time of the activities in the supply chain from incoming parts to delivery of the finished goods. There are some commonly used icons for developing a value stream mapping with which two scenarios have been drawn: Current State Map (CSM) and Future State Map (FSM). The CSM becomes a visual tool to set up challenging targets with measurable indicators identified through brainstorming performed by the team members. Thus, through this kind of analysis the FSM is developed highlighting the improved level of the measurable indicators.

Methodology

VSM requires wide range information relevant to the repetitive operations. To get the first-hand knowledge and experience, data and information vis-à-vis product and process flows, sequence of operations and the production environment it was imperative to make several visits to the metal stamping company. Time studies were conducted to record the time of each task or activity in the production line of the stamped part. For some operations videos were used to record to conduct further verification and analyses of the methods adopted and time required in completing the various elements of tasks involved in the operations. Verbatim interviews were carried out with the concerned manager, supervisor as well as the operators engaged in production line operations to collect the first hand data and information needed to correctly estimate the various measures of performance indicators. Visio Pro 2007 software was used for developing and illustrating both current and future states of the value stream mapping by some commonly used icons.

Development of current and future VSM

The current state map of the product and process flows is developed to highlight the gaps or bottlenecks that need to be removed to enhance performance indicators such as cycle time reduction and line balancing efficiency. By suggesting adjustments, recommending for allocation of resources a future state map is drawn showing the improved level of indicators. Thus the outcome of mapping for the current state of the stamped product (LCD cover set) is illustrated in Fig. 1.

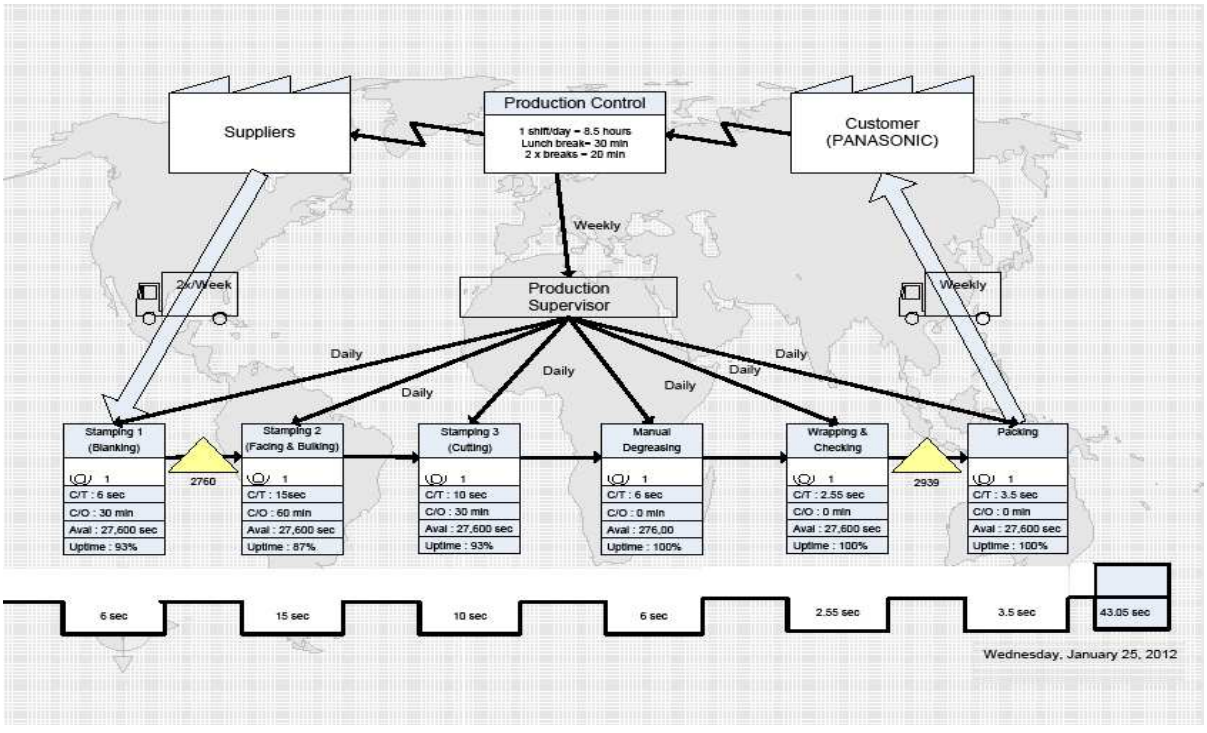

Fig. 1: Current State Map representing the current scenario

Activity cycle time, change over time, availability of the workstation and uptime are presented. Consequently the work-in-process (WIP) inventory is evaluated and shown in triangular shape yellow color boxes. The operation times or activity cycle times at various workstations as shown in

Fig. 2 are found to differ quite significantly leaving a scope of balancing the whole production line. The line balancing efficiency for the workloads at the six work stations of the production system is evaluated as the ratio of total task time and the value of multiplication of actual workstation number with the largest assigned cycle time. For the current practice, the total task time being equivalent to the sum of the activity cycle times is 43.05 seconds whereas the actual number of workstation is 6 and the largest assigned cycle time is 15 seconds (equivalent to the bottleneck workstation in this operation). Thus, the line balancing efficiency is found to be 47.83%.

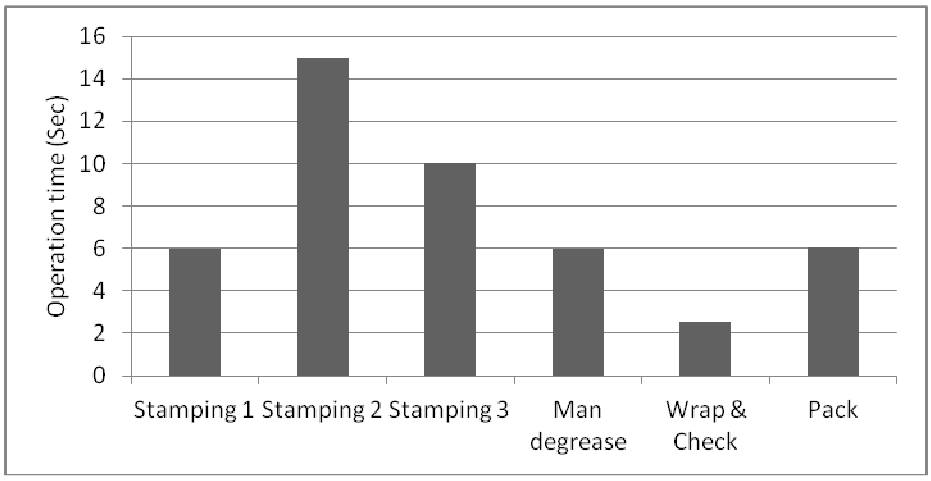

Fig. 2: Current activity or operation times at different workstations

Upon a critical analysis of the current state scenario, an attempt was made to rectify the bottlenecks to reduce the cycle time with the enhanced line balancing efficiency. As shown in Figure 2, the stamping processes 2 and 3 were identified to be the two main bottleneck stations. If additional three sets of operators, machines and dies engaged with two and one set respectively for stamping processes 2 and 3, the total cycle time is possible to be reduced. For stamping process 2, the cycle time is to be reduced from 15 seconds to 5 seconds, while for stamping process 3, from 10 to 5 seconds. Moreover, since the activity times at workstations 5 (wrapping and checking) and 6 (packing) are very short, they could be combined with a provision of freeing an operator. Thus the imbalances in the production line are minimized as delineated in Figure 3.

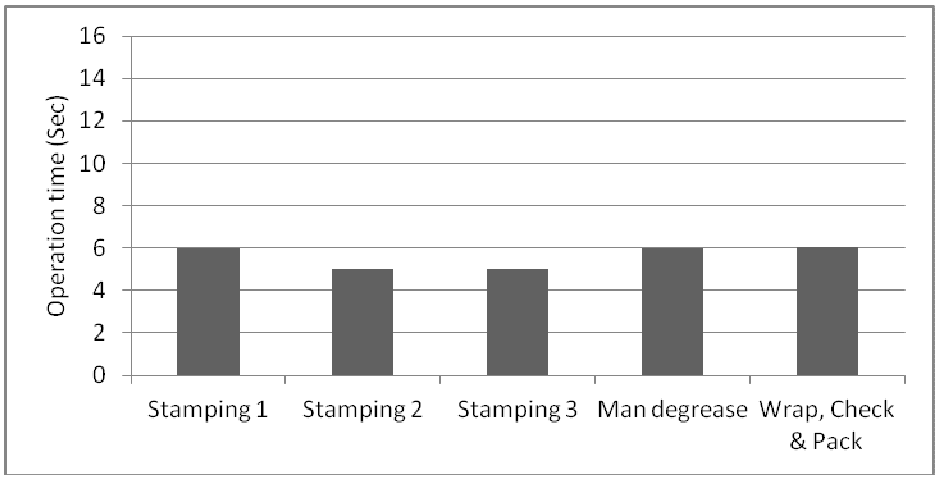

Fig. 3**:** Reduced cycle time through balancing of operations

With the suggested changes, the total task time becomes 28.05 seconds having five workstations, the largest assigned cycle time being 6 seconds, and the corresponding balancing efficiency is found to be slightly above 93%. As a result of the adjusted conditions, the perceived future state map should assume a condition as represented by Fig. 4.

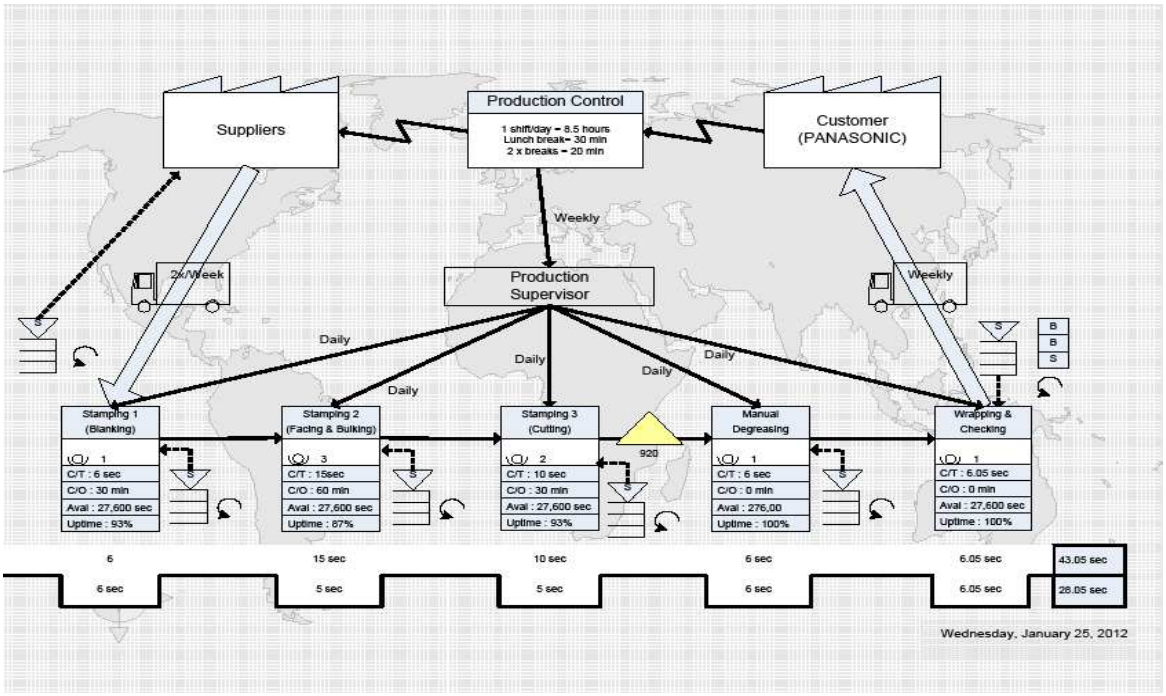

Fig. 4: Future State Map indicating the modified situation

Conclusions

Application of the value stream mapping concept is found to lead to a substantial improvement of production line efficiency for one major stamped component in a make-to-order company. With minor adjustments in the system in line with the findings, the company can be highly benefitted. Production line efficiency is possible to be significantly enhanced from a current level of about 48% to more than 93% leading to a shorter production cycle. Thus it is apparent that with the implementation of the VSM concept, capacity utilization of resources could be significantly enhanced and the make-span of the lot production would be greatly reduced. Though the overall gain due to the benefit accrued and the cost of resources incurred needs to be assessed precisely, it is likely that the cumulative improvement with VSM application for all the vital items handled by the company is deemed to make a substantial contribution with which the company is expected to enjoy a competitive edge over its rivals.

Acknowledgement

The authors would like to gratefully acknowledge the support (EDW A11 - 229 - 0776) provided by RMC, IIUM for a study on "VSM of Production Line for a High Volume Manufacturing Industry".

References

[1] Onesime, O. C. T., Xiaofei, X., and Dechen, Z. (2004), "A decision support system for supplier selection process", *International Journal of Information Technology and Decision Making,* Vol. 3, No. 3, pp. 453-470.

[2] Singh, B., and Sharma, S. K. (2009), "Value stream mapping as a versatile tool for lean implementation: an Indian case study of a manufacturing firm", *Measuring Business Excellence*, Vol. 13, No. 3, pp. 58-68.

[3] Hines, P., and Rich, N. (1997), "The seven value stream mapping tools", *International Journal of Operations & Production Management,* Vol. 17, pp. 46-64.

[4] Womack, J., & Jones, D.T. (1994), "From lean production to lean enterprise", *Harvard Business Review*, pp. 93-103.

[5] Voelkel, J.G., and Chapman, C. (2003), "Value stream mapping", *Quality Progress*, Vol. 25, No.5, pp.65-68.

[6] Womack, J., Jones, D. T., and Roos, D. (1990), *The Machine that Changed the World*, McMillan, New York, pp. 47-56.

Advances in Manufacturing and Materials Engineering
10.4028/www.scientific.net/AMR.576

Applying Value Stream Mapping for Productivity Improvement of a Metal Stamping Industry

10.4028/www.scientific.net/AMR.576.727