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Production Improvement in an Aircraft Manufacturing Company Using Value Stream Mapping Approach

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Abstract: The purpose of this study is to develop a value stream mapping for a production in an aircraft manufacturing company. The process begins with creating a current state map and understands the production flow and the current cycle times. This provides the information needed to produce a future state map. The goal is to identify and eliminate the waste, which is any activity that does not add value to the final product, in the production process. In order to collect the information needed, the study was conducted within the production facility to enable the researcher gained knowledge and familiarized with the production flow and the activities being performed at the shop floor. Parameters such as cycle times, down times, work in process (WIP) for inventory and material, and information flow paths were recorded. This information will enable the researcher to visualize the current state of the process activities by mapping the material and information flow and looking for opportunities to eliminate wastes. ARENA simulation software package was used to simulate and analyze the process flow and times. Result from the analysis shows that there are areas where the company can further improve their production system. The results show the improvement of the cycle time up to 22% based on the new proposed arrangement of the layout. Therefore the propose layout will be guided to the company in order to improve their production.

Introduction

Value Stream Mapping is a visual representation of all the specific activities, including the flow of material and information, which occurs along the value stream selected for a product family. The Value Stream Mapping process will likely reveal that a significant amount of non-value-added activities are present in the current processes. However, some of these activities are really necessary in the process therefore the idea is to minimize their impact. Many manufacturers today including the aircraft manufacturing company are now critically evaluating their processes to determine their effectiveness in bringing maximum value of product manufacturing. Factory management techniques of yesterday are being replaced by more efficient methods that greatly minimize delays, reduce costs, and improve quality. Lean manufacturing is a whole systems approach that creates a culture in which everyone in the organization continuously improves processes and production. Using simulation models of manufacturing systems, this paper aims to shed the transformation process, giving a would be practitioner tools and techniques for Lean transition and realistic expectations of system performance during the transformation.

Literature Review

Overview of value stream mapping (VSM)
Value Stream Mapping is one of the lean manufacturing tools and techniques that widely used by the manufacturing company. The focus of the approach is on cost reduction by eliminating non-value added activities. A value stream is an accumulation all activities (value added and also non-value-added) that have to bring a product or service (or a small grouping of products that make use of the same resources) over the main passes, starting with raw materials and ending with the customer [1]. Taking the value stream viewpoint means working on the big picture and not individual processes. VSM creates a common basis for the production process, thus facilitating more thoughtful decisions to improve the value stream [2].

Steps for VSM
The steps of doing value stream mapping started with choose a particular product or product family as the target for improvement. The next step is to draw a current state map that is essentially a snapshot capturing how things are currently being done. This is accomplished while walking along the actual process, and provides one with a basis for analyzing the system and identifying its weaknesses. The third step in VSM is to create the future state map, which is a picture of how the system should look after the inefficiencies in it have been removed. Creating a future state map is done by answering a set of questions on issues related to efficiency, and on technical implementation related to the use of lean tools. This map then becomes the basis for making the necessary changes to the system [3].

Simulation in support VSM
Simulation has played a significant role in evaluating the design and operational performance of manufacturing systems. Successful applications of simulation in many practical real-world problems have proved its effectiveness in approaching various problems in the manufacturing sector [4]. The information provided by the simulation can enable management to compare the expected performance of the proposed system relative to that of the existing system it is designed to replace [5]. An effective layout can reduce manufacturing costs and improve the system's performance. Therefore, simulation is an appropriate tool to evaluate the current layout, show potential areas for improvement by evaluating different layout alternatives.
There are several researchers using simulation in improving manufacturing system. For example Chan and Chan [6] present a case study in which they use simulation and expert systems to evaluate different design alternatives for a new Printed Circuit Board (PCB) manufacturing system. They predict the feasibility of each design by evaluating machine utilization, waiting time, and throughput obtained from the simulation experiments. Owens and Levary [7] was developed several designs of a food production line and use simulation to compare the proposed designs with the current line design. Mendes et al. [8] use simulation models to derive different performance measures of a mixed-model PC camera assembly line in order to help tune the line configuration for varying levels of demand. In another study, Staley and Kim [9] present the results of simulation experiments on buffer allocation in closed serial production lines consisting of reliable and unreliable workstations and show that optimal buffer allocation in these systems are less sensitive to bottleneck severity than in open production lines.

Methodology

In order to collect the information needed, the study was conducted within the production facility whereby the manufacturing method and sequence of the activities being performed at the shop floor that had been studied. Parameters such as cycle times, down times, work in process (WIP) for inventory and material, and information flow paths were recorded. Current layout and value stream

map also had been studied in order to identify the wastes and also method for eliminating that wastes. ARENA software was used to evaluate the proposed process design and effective utilization of different work station.

Result

ARENA simulation result was run for the different variable time such as delay time and average performance time for individual operation. Figure 1 and Figure 2 shows the current value stream mapping (VSM) and modified value stream mapping respectively. Line connecting each station shows the route to the next work station.

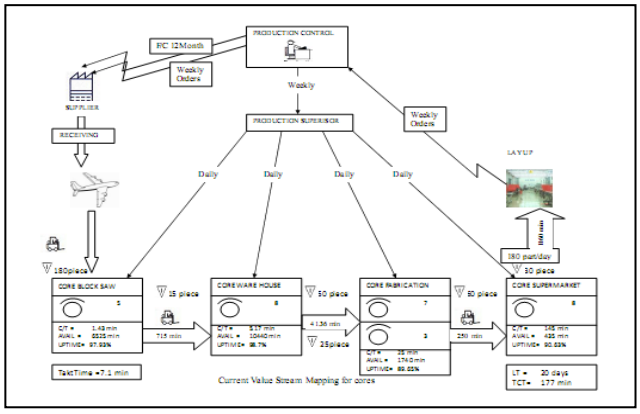

Figure 1: Current Value Stream Mapping

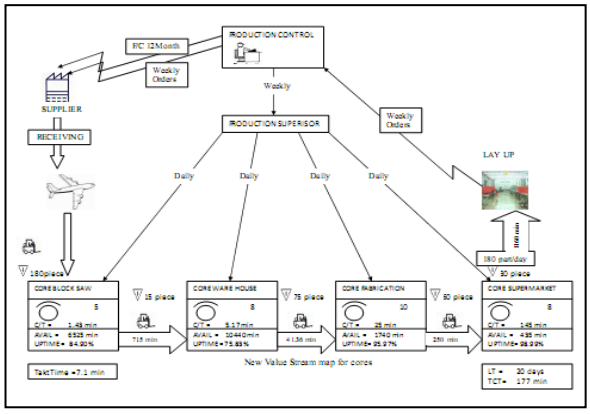

Figure 2: Modified Value Stream Mapping

Figures 3 and 4 shows the simulation diagram using ARENA for current and modified process layout.

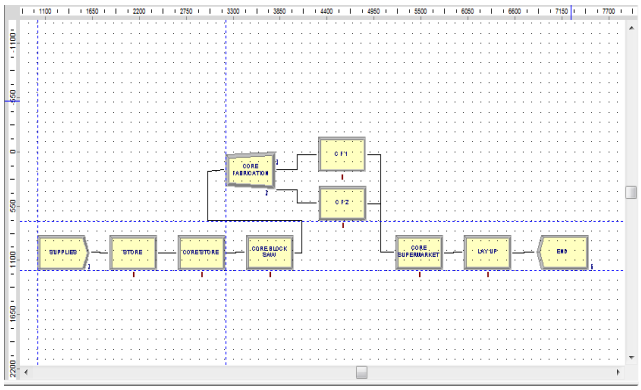

Figure 3: Current Value Stream Mapping simulated by ARENA

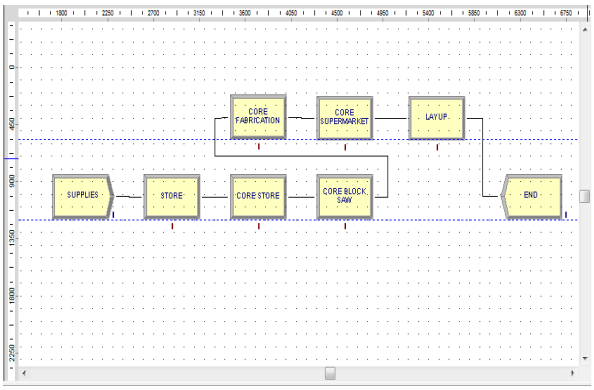

Figure 4: Modified Value Stream Mapping simulated by ARENA

In the modification of work place (WP) (Figure 5), the results shows that by eliminating non value added activities from Current Value Stream Mapping (CVSM) , reduce from 5 to 4 steps, time taken for producing one batch of product, reduced from 340.75 hours to 262.10 hours. Thus, the ratio of value creating time out of total time is about 23% decreased.

Meanwhile, changing the parameters by increasing the cores production (ICP) from 180 to 200 using a modified layout, it was found that the time taken was reduced from 340 hours to 291.41 hours. Thus, the ratio of value creating time out of total time is about 14% decreased (Figure 6). Successful applications of simulation in many practical real-world problems have proved its

effectiveness in approaching various problems in the manufacturing sector. Therefore, by simplifying the workplace layout changes, the company can achieved more effective time of doing work for their workers.

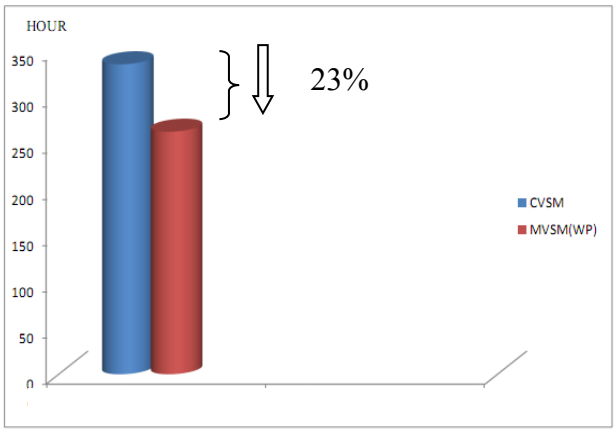

Figure 5: Comparison between CVSM and (WP)

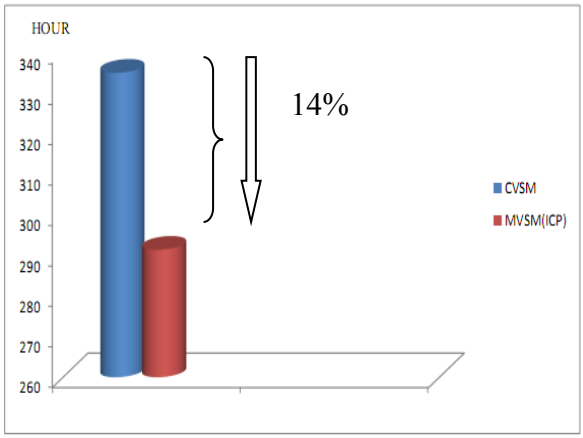

Figure 6: Comparison between CVSM and MVSM MVSM (ICP)

Conclusion

The result can be said that the proposed design is good enough to meet the requirements. The new Value Stream Mapping is an extremely valuable tool helps to apply lean aspects for continuous improvement efforts. By simulation modeling of Value Stream Mapping becomes a powerful tool for management decision making by analyzing the effect of various factors of change within the system without making the actual or physical changes, so it contributes in money saving and time. Based on the number of inputs required, a user building a simulation model with ARENA software tool should be able to complete initial construction in less the time would have required when using conventional means.

The targeted use of this simulation is to improvement event and any time that can be saved in significant difference for overall success of the project. These techniques can be implemented in any department at Aircraft Manufacturing Company and it will help them to improve the productivity at same level of resources. The ability to create and adapt simulation models quickly and easily makes it possible for more concepts to be evaluated in a short time. ARENA simulation can be a larger role and provide better support for decision makers, which will improve the outcome of the project.

References

[1] M. Rother, Shook, J., *Learning to See: Value Stream Mapping to Add Value and Eliminate Muda*. Brookline, MA: The Lean Enterprise Institute, Inc., 1999.

[2] T. McDonald, Van Aken, E.M., Rentes, A.F., "Utilizing simulation to enhance value stream mapping: a manufacturing case application.," *International Journal of Logistics: Research and Applications* vol. 5, pp. 213-232, 2002.

[3] F. A. Abdulmalek and J. Rajgopal, "Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study," *International Journal of Production Economics,* vol. 107, pp. 223-236, 2007.

[4] A. Negahban and J. S. Smith, "Simulation for manufacturing system design and operation: Literature review and analysis," *Journal of Manufacturing Systems,* vol. 33, pp. 241-261, 2014.

[5] R. B. a. Y. Detty, J.C. , "Quantifying benefits of conversion to lean manufacturing with discrete event simulation: A case study," *International Journal of Production Research* vol. 38, pp. 429-445, 2000.
[6] F. Chan, and Chan, HK, "Design of a PCB plant with expert system and simulation approach. ," *Expert Systems with Applications* vol. 28, pp. 409-23., 2005.
[7] S. Owens, and Levary, RR, "Evaluating design alternatives of an extruded food pro-duction line using simulation," *Simulation* vol. 78, pp. 626-632, 2002.
[8] R. A. Mendes AR, Simaria AS, Vilarinho PM. , "Combining heuristic procedures and simulation models for balancing a PC camera assembly line," *Computers & Industrial Engineering* vol. 49, pp. 413-431, 2005.
[9] D. Staley, and Kim, DS., "Experimental results for the allocation of buffers inclosed serial production lines," *International Journal of Production Economics,* vol. 137, pp. 284-291., 2012.