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AN APPLICATION OF VALUE STREAM MAPPING TO IMPROVE MANUFACTURING PRODUCTIVITY

Abstract

Productivity important plays important role to competitive advantage. Improving productivity can be made by various techniques, depending on nature of industry. This research project studied productivity improvement in miniature circuit breaker manufacturer. Customer demand was expected to increase for coming years and it was anticipated that capacity would be insufficient to meet customer demand for specific product family. In order to meet the future demand, capability of production line had to increase. Therefore, bottle neck problem had to be solved to improve process capability. This project started in July 2022 and will end June 2023.

The objectives of this study were to reduce waste caused by bottleneck in the production line, and to increase unit per hour. Tools used to solve such a problem were Lean and ECRS techniques. Before improvement, work method and time study were carried out in production line. ECRS technique was applied by eliminating unnecessary tasks (E), combining tasks (C), rearranging workstation (R), and simplifying task (S). Lean was used to improve labor productivity and also value stream mapping was used to improve production flows both material and information. Currently, waste was decreased 14% and unit per hour was increased 16% at bottle neck process. It is expected that an increase of 20% in manufacturing capacity in year 2023 can be reached.

Introduction

Value stream mapping is a tool for process improvement that help businesses to identifying and eliminating waste in their operations. The goal of value stream mapping is to create a visual representation of the flow for materials and information as a product or service moves through the stages of production. Companies can increase efficiency and reduce costs by identifying bottlenecks and areas of inefficiency in their operations then define action to improve it. The value stream mapping process begins by identifying the current state of the production process. This includes identifying all of the steps that are required to move a product or service from raw materials to the customer. The next step is to gather data on the time and resources that are required for each step in the process. This information is then used to create a visual representation of the current state of the production process. Once the current state has been mapped, the next step is to identify areas of waste and inefficiency. This may include steps that no value added to the product, excessive inventory, or long lead times. By identifying these areas of waste, companies can make changes that will lead to increased efficiency and lower costs. VSM is required to measure and make a decision to take improvement actions such as Takt Time which is the rate at which you need to complete a product to meet customer demand.

$$Takt\ Time = \frac{Available\ Work\ Time}{Daily\ Customer\ Demand}$$

Also for Cycle Time , Process Time , Production Lead Time and Value Added Time.

Current State Mapping

The current project is being carried out at the XYZ manufacturing company in Bangkok for a specific product. The current state map is created on paper with a pencil by using various VSM symbols to represent a pictorial view of information and material flow as the product moves through the production line. Mapping is done using lean manufacturing principles, which are the foundation of VSM. All of the data required for mapping the current state is gathered by walking down the production line with employees, supervisors and support function teams. Figure 1 depicts the current state map for all processes that the represent material selected has passed through. The average daily demand is 11,356 units. The daily working time is 15.34 hours. As a result, the Takt time is 4.86 seconds. The data required for the analysis of the current state of the assembly line are obtained from VSM of current state. The production lead time (PLT) is 6.43 days, Process time (PT) is 219.3 seconds and Product Cycle time is 4.55 sec at bottle neck process. There is a significant opportunity to shorten production lead time by reducing and optimizing work in process as well as considering to reduce cycle time at bottle neck process.

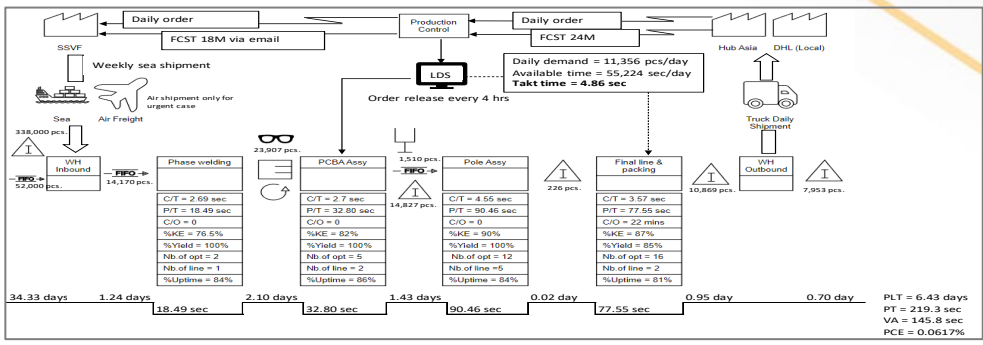

Figure 1 VSM Current State Mapping

Future State Mapping

Following an analysis of the current state, There are three key performance indicators (KPIs) Production lead time, Cycle time, and Production Efficiency are being focused on as a result of Current state mapping. WIP improvement opportunities are identified using Kanban methodology, resulting in WIP optimization in each process. The majority of the time is spent reducing WIP between the PCBA assembly process and the Pole assembly process, as well as raw materials that feed the Phase welding process. A two-bin system has been implemented to define quantity requirements, and internal kanban management must also review and adjust the quantity of kanban cards required based on customer demand forecasting, as well as establish a quarterly review procedure. Line expansion is required for the Pole assembly process, which is a product bottle neck. As a result, it will be able to increase production capability in order to meet future demand growth. On the other hand, manpower requirements must be reviewed incrementally as workstations are added. The operation leader will undertake a Kaizen initiative to improve production efficiency for Phase welding in order to decrease non-value added time (NVA) and boost employee engagement in their work area. As a result, it will be able to increase production capacity in order to meet future demand growth. Figure 2 depicts future state details. Figure 2 shows that the production lead time has been reduced from 6.43 days to 3.94 days. The process time has been reduced from 219.3 seconds to 218.09 seconds, and the product cycle time has been reduced from 4.55 seconds to 3.33 seconds.

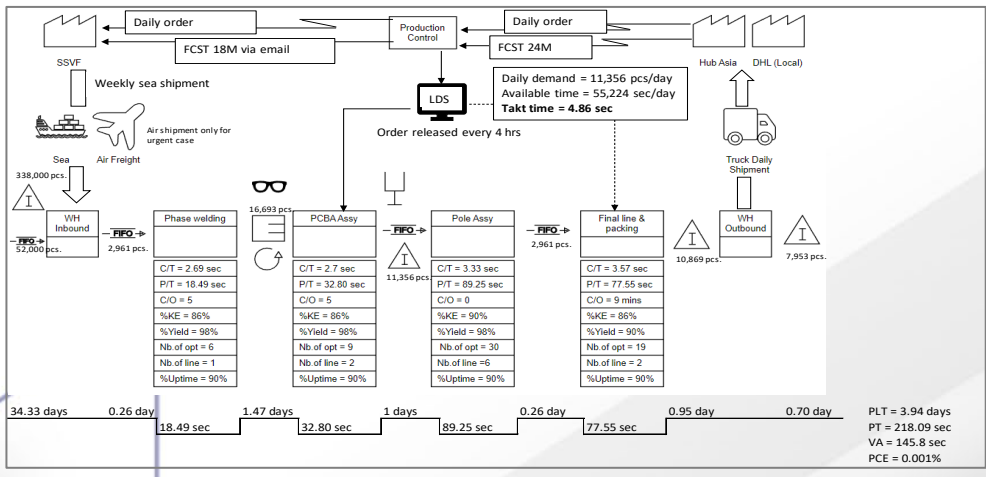

Fig.2 VSM Future State Mapping

Conclusions

It has been demonstrated that VSM is a powerful tool in lean manufacturing, assisting firms to understand and continuously improve in order to become lean enterprises. It connects people, processes, and tools, and even documents the data needed to achieve lean goals. It facilitates clear communication about lean outlooks between shop floor teams, management and customer. In this paper, the current and future states of a manufacturing firm are compared and discovered that there is a 38.7 percent reduction in lead time, a 1 percent reduction in process time, and a 26.8 percent reduction in product cycle time.

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References

[1] McCarthy, D., and Rich, N., Lean TPM A Blueprint for Change, Butterworth-Heinemann, Oxford, , 2015.
[2] McCarthy, D., and Rich, N., Lean TPM A Blueprint for Manufacturing Efficiency Improvement, Butterworth-Heinemann, Oxford,, 2015.
[3] Borris, S., Strategic Lean Mapping, McGraw Hill, New York, 2012.
[4] Myerson, P., Lean Supply Chain and Logistics Management, McGraw Hill, New York, 2012.
[5] King , P.L.,and King, J.S., Value Stream Mapping for the Process Industries, Productivity Press, Northwest, 2015.
[6] Wilson, L., How to Implement Lean Manufacturing, McGraw Hill, New York, 2010.