UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Mechanical and Manufacturing Engineering Technology

LEAN WASTE ANALYSIS USING VALUE STREAM MAPPING FOR PRODUCTIVITY IMPROVEMENT FOR C/MBR COMP MID FLOOR AT PHN INDUSTRY SDN BHD

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Bachelor of Manufacturing Engineering Technology (Process and Technology) with honours

2018

ABSTRAK

PHN Industry Sdn Bhd adalah salah satu syarikat yang stabil yang mengeluarkan produk automotif untuk kereta model seperti Civic, BRV, CRV dan Accord. Dengan persaingan yang tinggi, terdapat keperluan segera bagi operasi perkilangan untuk terus berusaha untuk meningkatkan produktiviti dan pengeluaran operasi mereka. Tujuan kajian ini adalah untuk mencadangkan "Value Stream Mapping" (VSM) di syarikat pembuatan untuk mengurangkan masa pemprosesan dan "lead time" yang menyebabkan ia tidak mematuhi jumlah masa yang didapati daripada permintaan pelanggan untuk kerja-kerja yang perlu dilakukan. Alat VSM akan membawa pengkaji untuk mentakrifkan peta aliran VSM semasa dan Permodelan untuk menganalisis sisa dan peluang untuk penambahbaikan, dan akhirnya membangunkan peta aliran VSM masa hadapan untuk mencadangkan kepada syarikat bagi keluarga produk "C/MBR Comp Mid Floor". Pengkaji telah melukis dua jenis "Future Value Stream Map" iaitu "Future Value Stream Map (Initial Phase)" dan "Ideal Value Stream Map". "Future Value Stream Map (Initial Phase)" memberi kesimpulan bahawa masa pemprosesan adalah 33.1% dan pengurangan "lead time" sebanyak 72.5% dapat dicapai, sementara "Future Value Stream Map (Ideal Phase)" menunjukkan 53.9% masa pemprosesan dan 99.8% pengurangan "lead time" dapat dicapai terutamanya melalui menghapuskan kebanyakan sisa yang telah dikenalpasti.

ABSTRACT

PHN Industry Sdn Bhd is one of the stable companies that produces automotive parts for car models like Civic, CRV, BRV and Accord. As high competition, there is an urgent need for manufacturing operations to continually strive to increase the productivity and output of their operations. The purpose of this study is to propose the Value Stream Mapping (VSM) at manufacturing company to reduce the processing time and production lead time caused it not complying with the amount of time available from customer demand for the work to be done. The VSM tool will lead researcher to define the current value state map and to analyse the waste and opportunities for improvement, and finally develop the future state map to propose to the company for C/MBR Comp Mid Floor product family. It has been concluded from the constructed current state map of C/MBR Comp Mid Floor value stream that the Future Value Stream Map (Initial Phase) suggests that a 33.1% processing time and 72.5% lead time reduction could be achieved, while Future Value Stream Map (Ideal Phase) suggests that a 53.9% of processing time and 99.8% lead time reduction could be achieved mainly through eliminating most of the waste that has been identified. The productivity improvement in term of labour-hour is 37.5% and 79.3% for Future Value Stream Map (Initial Phase) and Future Value Stream Map (Ideal Phase) respectively.

DEDICATION

I would like to express my deepest appreciation and special thanks to everyone, especially to parents and family who have given their support, encouragement and good advice to me. Not forgetting the classmates and friends at Universiti Teknikal Malaysia Melaka (UTeM) whom helped directly and indirectly in this study report.

Thanks to the staff in PHN Industry Sdn Bhd who involved in assisting and providing information, advices and giving useful guidance.

Not forgetting Dr. Rohana Binti Abdullah whom gave moral support, proper guidance, and been an inspiration in completing the project.

ACKNOWLEDGEMENTS

I am grateful to God Almighty that for the countless blessings and grace that was given to me, finally, I completed my Final Year Project, accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM), as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Process and Technology).

Firstly, I would like to express my deepest appreciation and thanks to my supervisor, Dr. Rohana Binti Abdullah for helping me along the success of this study, and supervising me with full commitment and moral support. I will never forget the contribution that she gave to me, with support, encouragement, advice, assisting and providing information, and useful guidance to me. She gave me so much inspiration in completing this project. Without her, this project would not have been this successful.

Thanks to all lecturers at UTeM, especially to my panels, and other lecturers who involved with this Final Year Project, all staff in Faculty of Mechanical and Manufacturing Engineering Technology, librarian, and who struggled to educate me until I successfully completed this study and also help to complete my studies report both directly and indirectly.

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LIST OF SYMBOLS AND ABBREVIATIONS

Avail	-	Available Time
Avg	-	Average
CSVSM	-	Current State Value Stream Mapping
CT	-	Cycle Time
C/O	-	Changeover time
FSVSM	-	Future State Value Stream Mapping
FYP	-	Final Year Project
min	-	Minutes
NVA	-	Non-Value Added
PR	-	Product-routing
sec	-	Seconds
TPS	-	Toyota Production System
VA	-	Value Added
VSM	-	Value Stream Mapping
WIP	-	Work-in-process

CHAPTER 1

INTRODUCTION

1.1 Introduction

This Final Year Project which is known as (FYP) refers to the research experience conducted during the final year of degree. It is relevant to professional development before road to graduation as it enhances the knowledge on particular topics. One of the requirements in partial fulfilment for Bachelor Degree of Manufacturing Engineering (Process and Technology) is carry out studies about topics related to the learning and complete this study during the final year with a full report of the study. This study tittle will be "Lean Waste Analysis for Productivity Improvement for C/MBR Comp Mid Floor at PHN Industry Sdn Bhd".

1.2 Background of Study

This study report explores about the Value Stream Mapping (VSM) and proposes the future state VSM. It also identifies the lean tools and techniques which were used by manufacturing company in the process of VSM implementation. The Value stream mapping is a popular lean tools and technique which is able to investigate and design the travelling sequences of materials and information that needed in order for the customer to receive the product or services.

The VSM technique originated from Toyota Production System (TPS), being a part of their Lean Management tool. Value stream mapping is actually a lean manufacturing or lean enterprise technique used mainly in detecting waste in production line. Its function is to document, analyse and improve the sequence of the information or materials needed to produce either a product nor service.

It instil a systematic understanding and streamlines the work processes using the tools and techniques of lean manufacturing. Identifying, demonstrating and reducing hidden waste within the processes are the vital purpose of VSM. Waste is

defining as any action that doesn't add value to the finish good product. VSM is capable of demonstrating and reducing the number of waste during a manufacturing process. Thus, VSM initiates the higher management, engineers, production, and customers to identify waste and determine its effects. In short, VSM is a tool of communication, change management and strategic planning tool.

Every company's dream is to own the excellence and competitiveness so that probabilities to sustain and obtain success in the competition become higher. In order to achieve the goal, the producing operations must be able to continuous try to enhance their productivity and the operations output drastically. Satisfying the customer with the exact product, best quality, required quantity, and reasonable price in a very quick time is their goal (Tinoco, 2014). Each of its line in their production must consists of an effective and efficient processes implemented by their company in order to achieve the goal.

All manufacturing companies find various solutions to continues improve their process and find the way to run the plant better every day in order to survive the competitive global world. They are capable of creating and implementing effective and efficient processes in each of its line of the production. Their focus has turn to the concept of Lean Manufacturing and Standardized Work by using some tools that are available and suitable for their production line after realizing the importance of standardized work. One of the tools and techniques will be used in this research is VSM as it the best way to detect the hidden waste in the production line.

1.3 Problem Statement

PHN Industry Sdn Bhd is one of manufacturing company that operating in Alor Gajah, Melaka. It is committed to continually improve their productivity and find the way to manage the production better every day and always seeking ways of creating and implementing effective and efficient processes in each production line. This company is producing automotive spare parts and acting as the supplier source which supplies that products to Honda Malaysia Sdn Bhd, Alor Gajah.

On the initial discussion with the company regarding this study, it was revealed that there are some problems such as the processing time does not comply with the amount of time available from customer demand for work to be done and the lead time in production is too long. Thus, the raw materials are stored too long in the inventory. According to the Production Engineer, a workstation is considered to be critical if it takes 200 seconds and above to complete its task and unable to produce at least 15 pieces per hour. In short, the designed cycle time is 200 seconds per workstations and at least 15 units per hour. The organizations had tried their best to manage the company without any major or minor waste in this sector of manufacturing. However, there is not much improvement in their productivity.

This study focuses to propose the future state VSM and recognize the lean tools and techniques which was used in VSM implementation by the manufacturing company. The company can refer and consider other concept in VSM implementation. The decision was made to visualize and analyse the process flow on production line and then propose model of improvement using lean manufacturing methodology especially mapping tools which has been proven to be the powerful tool to identify wastes, improve and standardize work flow.

1.4 Objective

The objective of this study is:

(a) Develop the current Value Stream Map (VSM) to identify the waste in the process

(b) Perform analysis on the current state VSM to analyse the waste and opportunities for improvement.

(c) Propose improvements and opportunities and develop Future State Value Stream Map (VSM) and calculate productivity improvement.

1.5 Scope of Study

The scopes of this study is to identify and eliminate the hidden wastes found in the production processes by defining the current state and develop future state to propose to the management. The proposal can be implement at this company to build their basic stability by approaching to the concept of Lean Manufacturing by using some tools that are available and suitable. The aim is to integrate VSM and define the waste and propose opportunity to comply with the time required by the customer to complete that product and reduce the production lead time.

1.6 Study Limitation

To solve the problems in this study, the scope of the research need to be defined so that this study is on the right track, more focus and not too wide. The limitation of this study is:

(a) The results of this study are limited focus to manufacturing process and production scheduling activity in PHN Industry Sdn Bhd, and will not discuss any regarding financial aspect and the impact to management structure.

(b) The study only includes the development of future state developed for a value stream selected which is a product family and recommends ways to implement to improve the production process.

(c) The value stream map is intended to help to identify areas of improvement that limited to one product family selected based on value stream mapping product group criteria.

(d) The study does not include examination or validation that developed from the company in order to see the improvement in production scheduling activity.

(e) The study does not direct the company on how to implement the improvement proposal resulting by this research.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses about Lean Manufacturing. Every company's dream is to achieve higher productivity, to gain the satisfaction of their customer as well as to maintain a productive and positive employee. The best way to achieve those dreams are by implementing Lean in their company. Anything that reduces cost and time is called Lean. This chapter consists of the history, theory, and applications of Lean.

2.1 Productivity

Productivity is the ratio of outputs (goods and services) divided by the inputs (resources such as labour and capital). It can also be formulated as

$$\text{Productivity} = \text{output}/\text{input}.$$

Improving productivity is important because it helps to improve the production line of a company (Singh, 2015). Furthermore, it improves the standard of living. Other benefits of productivity are it increases production through efficient resource utilization, reduces human hazards and efforts, lower cost, enhances the quality and provide high return on Investment (ROI) & market share. There are two main type of productivity which is known as single/ partial factor productivity and multi-factor productivity.

Partial factor productivity is calculated as

: total output/individual input.

Example of individual inputs are labour, capital, material and energy. Multi-factor productivity is calculated as

Output/ (Labour + Material + Energy + Capital + Miscellaneous).

Improving productivity is improving the efficiency. In order to enhance the productivity, we can either increase the output or reduce the input such as labour cost, material cost, energy cost, capital cost and miscellaneous (Suraj,2014). Reducing the input can be done by minimizing the waste. When the amount of waste is reducing, it eventually reduces the input rate, this improves the productivity. Reducing waste means, introducing Lean Manufacturing (Womack, 2015).

2.2 History of Lean Manufacturing

The lean manufacturing concept originated at Toyota, the Japanese automaker that has been achieving success in the global competition for decades. The Toyota Production System (TPS) which is also recognized as Lean Production System was introduced in 2015. After world war 2, manufacturers especially Japanese faced vast shortage of materials, financial and human resources. In order to overcome this phenomena, Japanese leaders, Shigeo Shingo and Taiichi Ohno, mentioned that "Toyota Production System "a new, disciplined, process oriented system (Abdullah, 2013). This concept was developed to survive with the minimum amount of resources in economic crisis. Due to its vast shortages of material, financial and human resources, TPS was force to be chosen as it is a waste reduction policy. Toyota sustained and prospered because of the high efficiency and productivity of its production system. (Behrouzi, 2015). This system consists of 14 principles that can be categorized into 4P's. The 4P's stands for Philosophy, Process, People/partners and Problem solving.

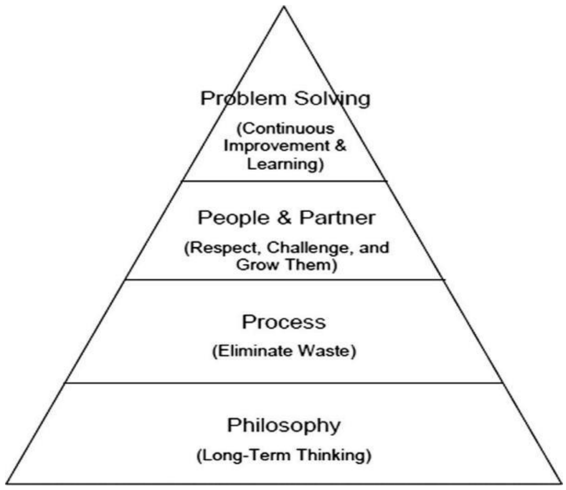

Figure 2.1: The 4P's (Womack, 2016)

2.3 Overview of Lean Manufacturing

The concept of Lean Manufacturing is based on the "waste" concept. Lean is defined as manufacturing without waste. Waste ("muda" in Japanese) consists seven types, named: overproduction waste, transportation waste, over-processing waste, defect waste, motion waste, inventory waste and waiting time waste. The goal of Lean Manufacturing is to reduce human effort and inventory waste, reaching the market on schedule and managing manufacturing stocks that are highly sensitive to customer demand while producing quality products in the most efficient and in economical manner (Bhim, 2013). The lean thinking concept determines value of any process by differentiating the value-added activities and non-value-added activities so that waste which is the non-value added activity can be eliminated. Thus, every step adds value to the process (Antony, 2014). The first step in Lean Manufacturing is determining value added activities and non-value added activities. Non value added activities can be break down into two categories named Required and Waste. Lean manufacturing gives attention to efficiency, aims to produce products and services at the minimum cost and as quick as possible. Waste do not add any value to the product. Customers are not ready to pay for the waste and manufacturers must be less wasteful to increase their profit and improve competitiveness. It is successful because of its simplicity. Just in time (JIT), total quality management, total preventive maintenance and human resources maintenance, pull, flow, low set-up, controlled processes, productive maintenance and involved employees are some example of Lean practise. (Yang, 2015).

2.4 Type of Waste

Womack and Jones (2016) define waste as an activity carried out by human which uses resources but creates no value. The simplest definition of waste is "Something that adds no Value". The customer does not invest or pay non-value added activities. Ohno has pinpoint seven type of waste which is known as Ohno's seven muda. The brief explanation of these wastes are as following:

2.4.1 Waste of Overproduction

The most serious among the seven wastes is the overproduction waste. Overproduction is either making a lot or too early. The factor contributing to this is working with bigger batches, longer lead times, lesser supplier relations, unbalanced departments, inaccurate data (actual demand) and due to other reasons. Overproduction causes higher inventory level which initiates many other problems in the organization. It also leads to excessive lead and storage times (Hines, 2017). It is the worst part of waste because it contributes to the other six wastes. The aim should be producing on time and only required products by the customer. In short, should be obeying the philosophy of Just in Time (JIT).

2.4.2 Waste of Waiting

Waiting refers to the idle time of machine and operators because of the bottlenecks or unproductive production flow on the factory. It happens when unnecessary delays within the process occur. When a product is not being processed or when an operator waits for a work to get done, it creates waiting waste. There is no value being added, when a product or operator waits as it gets the lead times increased. It includes small delay between processing of units (Capital, 2014). Waste of waiting includes, waiting for the maintenance department to restore a breakdown., waiting for the changeover to be done, and poor computer system performance (Hines, 2017).

2.4.3 Waste of Transport

When materials are transported from one location to another like moving materials between workstations is called transport waste. This is considering as a waste as it adds no value to the product and also defined as an unnecessary movement involving products, materials and supplies from one place to another (Hines, 2017). It is due to a poor layout design. Moving things can result in costs money and time, delays, increment in the cycle time, and risk of loss or damage. Unnecessary transportation can be easily detecting in old-fashioned production lines, as work-in-process and finished products are constantly pushed to different areas in a factory. Storing raw materials far away from production lines and building a storage area and a loading area at opposite ends are known as transportation waste. (Tapping, 2013).

2.4.4 Waste of Over-processing

The Over-processing waste is referring the machines and process that are not quality - capable. It occurs when we use improper techniques, bigger equipment, tighter tolerances, and carry out unwanted processes. Over-processing also occurs when complex solution is recommended for a simple procedure (Tapping, 2013). This kind of recommendations requires longer time and involves high amount of money. In lean, small and appropriate machines are used when needed in the flow. According to Rose (2015), over-processing is resulted by non-standardized techniques and uncertain quality acceptance standards. Duplication of work using tools that are more precise and completing reports in a level of unwanted detail are example of this waste.

2.4.5 Waste of Inventory

There are five category of inventory which are raw material, work in progress, logistic, spare parts (tools) and finished items. Inventory tend to increase in lead time and prevent rapid identifications of problems. Excess of Inventory leads to waste. It also causes higher inventory financing costs and storage costs. It cultivates the necessity for more manpower and equipment, and working space (Shuker, 2013). It limits the speed of production and indirectly causes issues such as imbalance production line and high number of defects. Some inventory is vital, however mostly processes can be managed effectively to avoid inventory. Examples of inventory waste includes storing raw materials ahead of requirements (Shook, 2014). In addition, inventory waste may also lead to other waste which consumes money. Inventory has to be stored where it requires space, and undergo packaging and it has to be transported to other places. It has the probability to be damaged during transport and obsolete. The waste of Inventory is the head of the other wastes. (Robinson,2014).