UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PRODUCTIVITY IMPROVEMENT BY EMBEDDED VALUE STREAM MAPPING (VSM) AND SIMULATION IN ASSEMBLY MANUFACTURING COMPANY

KHAIRIAH BINTI MUHAMAD SUKRI

B091910016

BACHELOR OF MANUFACTURING ENGINEERING TECHNOLOGY (PROCESS AND TECHNOLOGY) WITH HONOURS

2022

Faculty of Mechanical and Manufacturing Engineering Technology

PRODUCTIVITY IMPROVEMENT BY EMBEDDED VALUE STREAM MAPPING (VSM) AND SIMULATION IN ASSEMBLY MANUFACTURING COMPANY

Khairiah Binti Muhamad Sukri

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

2022

PRODUCTIVITY IMPROVEMENT BY EMBEDDED VALUE STREAM MAPPING (VSM) AND SIMULATION IN ASSEMBLY MANUFACTURING COMPANY

KHAIRIAH BINTI MUHAMAD SUKRI

A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this thesis entitled " Productivity Improvement By Embedded Value Stream Mapping (VSM) and Simulation In Assembly Manufacturing Company " is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : Khairiah Binti Muhamad Sukri

Date : 26/1/2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

Signature : 

Supervisor Name : Ts. Dr. Mohd Soufhwee Bin Abd Rahman

Date : 27/01/2023

DEDICATION

Most notably, the highest gratitude and grateful to Allah s.w.t. for His mercy and love. This thesis is dedicated to my parents, Muhamad Sukri Bin Ibrahim and Sabariah Bt Othman, who has always been supportive, encouraging, and wise. I am also extremely grateful to my thesis supervisor, Ts. Dr. Mohd Soufhwee Bin Abd Rahman, for his essential advice, ongoing support, and patience during my thesis journey. Their vast expertise and experience have inspired me in my academic research and daily life. Remember the classmates and friends at Universiti Teknikal Malaysia Melaka (UTeM) who directly and indirectly assisted in this report. Last but not least, Thanks to the staff in EPMB Peps-Jv Melaka Sdn Bhd, who was involved in administering and providing information, advice, and giving helpful guidance.

ABSTRACT

Lean Manufacturing (LM) is a successful global method used in business sectors to enhance operations continuously. LM is a way for businesses to be ahead of the competition by making manufacturing systems more productive and efficient. With higher advanced technology, the industrial environment has taken manufacturing systems to a new level known as Industrial 4.0. In this study, combination of Value Stream Mapping (VSM) and Arena Simulation Software as LM tools to eliminate waste during the production process. Research has been published on the practical application of VSM and Arena simulation, proving that performance has improved. A Case study to resolve the manufacturing company's current situation regarding the production line's output needed to meet the company's target. This company generates too many LM Motion and Waiting Waste in the production lines. Motion waste occurs because there is an unnecessary movement by the manpower of the production line due to the sharing robots simultaneously at the right and left sides. For waiting, there are Non-Value-Added processes (NVA) identified from the kitting process to the child part inspection. Therefore, this study aims to apply the VSM and Arena Simulation to overcome the waste in the production line by mapping and analyzing the current state process to suggest the best solution for the company to increase productivity. The combination method with Discrete Model Simulation (DES) allows for monitoring the line production in a virtual model using the simulation model. An Arena simulation model can be used to make strategic decisions to improve the production line output. As a result, the company's production line suggested running one side only at one time in the production line to increase daily output from 120 units per day to 132 units, showing that the productivity increased by 10 %. There are currently eight operators on the production line, but only four will be assigned under the proposed solution. The number of operators used in the inspection process is reduced, which benefits the company by lowering costs. Thus, the company's operational performance will improve, and this research objective will be achieved.

ABSTRAK

Pembuatan Kerja (LM) adalah teknik global yang berjaya digunakan dalam sektor perniagaan untuk meningkatkan operasi secara berterusan. LM adalah cara syarikat mendahului persaingan dengan menjadikan sistem pembuatan lebih produktif dan cekap. Dengan teknologi canggih yang lebih maju, persekitaran industri telah membawa sistem pembuatan ke tahap baru yang dikenali sebagai Industrial 4.0. Kajian ini menggunakan gabungan Value Stream Mapping (VSM) dan aplikasi Arena Simulation sebagai alat LM untuk menghilangkan pembaziran semasa proses pengeluaran. Beberapa Penyelidikan telah diterbitkan, membuktikan bahawa prestasi telah meningkat. Penyelidikan ini menyajikan kajian kes untuk menyelesaikan situasi semasa syarikat pembuatan mengenai output pengeluaran yang diperlukan untuk memenuhi sasaran syarikat. Syarikat ini menghasilkan terlalu banyak pembaziran untuk menunggu di barisan pengeluaran. Pembaziran pergerakan berlaku kerana terdapat pergerakan yang tidak perlu oleh tenaga kerja barisan pengeluaran kerana robot perkongsian secara serentak di sebelah kanan dan kiri. Untuk menunggu, terdapat proses yang Tidak Dinilai (NVA) yang dikenal pasti dari proses pemasangan ke pemeriksaan pemasangan bahagian. Oleh itu, kajian ini bertujuan untuk menerapkan Simulasi VSM dan Arena untuk mengatasi pembaziran di barisan pengeluaran dengan memetakan dan menganalisis proses keadaan semasa untuk mencadangkan penyelesaian terbaik bagi syarikat untuk meningkatkan produktiviti. Kaedah kombinasi dengan Simulasi Model Discrete (DES) memungkinkan untuk memantau pengeluaran garis dalam model maya menggunakan model simulasi. Model simulasi Arena dapat digunakan untuk membuat keputusan strategik untuk meningkatkan output pengeluaran. Hasilnya, barisan pengeluaran syarikat mencadangkan menjalankan satu sisi hanya pada satu masa di barisan pengeluaran untuk meningkatkan output harian dari 120 unit sehari menjadi 132 unit, menunjukkan bahawa produktiviti meningkat sebanyak 10 %. Pada masa ini terdapat lapan pengendali di barisan pengeluaran, tetapi hanya empat yang akan ditugaskan di bawah penyelesaian yang dicadangkan. Bilangan pengendali yang digunakan dalam proses pemeriksaan dikurangkan, yang memberi manfaat kepada syarikat dengan menurunkan kos. Oleh itu, prestasi operasi syarikat akan meningkat, dan objektif penyelidikan ini akan dicapai.

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious, the Most Merciful

First and foremost, I would like to thank and praise Allah the Almighty, my Creator, my Sustainer, for everything I have received since the beginning of my life. I want to express my gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for providing the research platform.

My deepest gratitude goes to my supervisor, Ts. Dr. Mohd Soufhwee Bin Abd Rahman for his support, advice and inspiration. His constant patience in guiding and providing priceless insights will forever be remembered.

Last but not least, from the bottom of my heart, gratitude to my parents, Muhamad Sukri Bin Ibrahim and Puan Sabariah Binti Othman, for their endless support, love and prayers. Finally, thank you to all my friends who provided me with the assistance, support, and inspiration to embark on my study. for their endless encouragement, affection, and prayers. Finally, thank you to all of my friends who helped, supported, and inspired to begin my studies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

LM	-	Lean Manufacturing
VSM	-	Value Stream Mapping
EPMB		EP Manufacturing Bhd
TPS	-	Toyota Production System
LOB	-	Line of Balance
WIP	-	Work In Progress
DES		Discrete Model Simulation
NVA	-	Non-Value Added
VA	-	Value Added

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter outline the study's background, problem statement, research objective, scope of research, expected result and summary for Chapter One. The structure of this report briefly explained the ideas of the project to improve the overall visualization of the study sequence.

1.1 Background

As technology growth, the industrial environment is undergoing a revolution to an entirely new digital industrial technology known as Industrial 4.0. The global manufacturing environment has changed due to the new paradigm. Advanced technology makes data collection and control more accessible, allowing for a more flexible and faster manufacturing process. Industrial 4.0 significantly improves the performance and productivity of every manufacturing company by connecting sensors and machines through the system.

Nowadays, most businesses face a significant challenge in maintaining their position in this competitive global economy. Manufacturers must satisfy customer demand with low-cost and high-quality products for a better chance of survival. Customers have become the primary focus of industries. As a result, industries have become more customer-focused and have made significant efforts to reduce their lead times. Businesses and organizations discovered that 90 % of existing activities were non-essential and could be eliminated to reduce lead time. Organizations then focus on cycle time as a productivity measure that reduces delivery time and improves quality, resulting in more satisfied customers.

Lean Manufacturing (LM) is a way for businesses to stay ahead of the competition by making their manufacturing systems more productive and efficient. Industrial players aspire to increase productivity and profit by reducing cost, waste, cycle time and lead time. LM increased satisfaction among employers and employees. Employees prefer a lean workplace's streamlined, efficient environment, and this system resonates positively with customers.LM must also have management support, constant communication, and the proper use of information technology for it to work. LM is a business strategy that reduces manufacturing waste without compromising productivity. These things make a company that represents a culture change.

This project used the Arena Simulation program and Value Stream Mapping (VSM) as a lean tool. VSM is a method for visualizing the whole manufacturing process, including the flow of information and materials, to overcome waste. Simulation modelling will be used to make the current VSM tool work better. When VSM and simulation are used together, the manufacturer can see how the current production flow works, which can help the management improve the operation. System most manufacturing applications and case studies illustrate how firms have adopted, developed, and applied Lean principles. LM can concentrate on lowering the production cycle time to respond more to customer demand while using fewer resources and enhancing product quality and processes.

1.2 Problem Statement

Manufacturers are finding it difficult to compete in this competitive global economy. Many businesses are looking for new ways to improve the quality and productivity of their supply. Productivity improvement is always the top priority in business because it directly affects a company's profits. When the LM method is applied to the production line, total production costs are reduced.

EP Manufacturing Bhd (EPMB) Peps-Jv Melaka Sdn Bhd generates too much LM waste in the production lines as motion and waiting. The first problem is motion waste. Motion waste happens because there is the unnecessary movement by the manpower of the production line due to shared machines in which the robot must handle the right and left sides at the same time. The spot-welding robot is programmed to operate on a first-come, first-served system. The first station that has finished loading child parts into the jigs station will undergo the welding procedure. Next, LM waste is waiting. When manpower is idle or working slowly, the previous process is prevented from being completed. Operators are idle because the robot has broken down and is awaiting child parts delivered by other operators from other workstations. Then unbalanced Station Workloads. It occurs due to ineffectively grouping tasks and job floor to balance capacities and process flow among the manpower. The last problem is the Inaccuracy of Cycle Time due to the time and weather. Precise estimation is required to shorten the duration of the process as productivity increases and the Cycle time decreases. This company intends to improve its production line with a new strategy for dealing with product unpredictability. VSM and Arena simulation is needed to analyze the LM wastes in the production line to ensure customer satisfaction.

1.3 Research Objective

Several objectives are established to achieve the goal of the study indicates, as below:

a) To recommend an approach of combination between VSM and Arena simulation in process improvement.

b) To validate the recommended methodology for VSM and Arena simulation.

c) To suggest an improvement in decision-making by using the recommended methodology.

1.4 Scope of Research

This research study includes three key elements: (1) LM, (2) VSM as LM tools, and (3) Arena Simulation-based data analytics as a decision-making tool. The researcher recently studied how these elements should be implemented. Thus, investigating how to manage LM using Industry 4.0. Consequently, it focuses on productivity, economic factors, and worker utilization, consistent with Malaysia's Industry 4.0 objectives. In this thesis, an effort has been made to preserve LM thinking (principles, philosophy, and tools) and how these can be combined to support process improvement. This project's scope should be evaluated and observed until the improvement proposal process for the EPMB Peps-Jv Melaka Sdn Bhd to ensure the project is on track and under control.

1.5 Summary

This chapter provides an advanced conceptual understanding of the project's background that guide the project improvement research. There are three main goals for the research in this study that provide a clear perspective on the thesis flow.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review aims to present the applications of VSM in various industrial sectors and their effectiveness, impacts, and valuable outcomes after implementation. Furthermore, this part comprises all the definitions and ideas using the LM Tools and Techniques. This chapter discusses LM, a type of LM Waste, and illustrates how VSM and Arena simulation can increase manufacturing productivity.

2.2 LM History

LM is a performance-based process used in manufacturing organizations to gain a competitive advantage in a global market. According to Gupta and Jain (2013), a Toyota Japanese automobile company, pioneered the concept of LM in the 1950s, which became known as the Toyota Production System (TPS). The primary goal of TPS was to reduce waste and Non Value-Added (NVA) activities to reduce costs and increase production. Over the last two decades, manufacturing firms operating in a rapidly and highly competitive market have adopted LM thinking principles.

According to Leksic et al. (2020), the TPS was created by Eiji Toyoda and Taiichi Ohno and served as a new production system. By integrating this Japanese manufacturing approach into manufacturing organizations, customers' expectations and desires were met with minimal resources while simultaneously attracting the attention of western manufacturing competitors. The detailed history of LM before the 1950s (Ribeiro et al., 2019) is discovered in Figure 2.1 below.

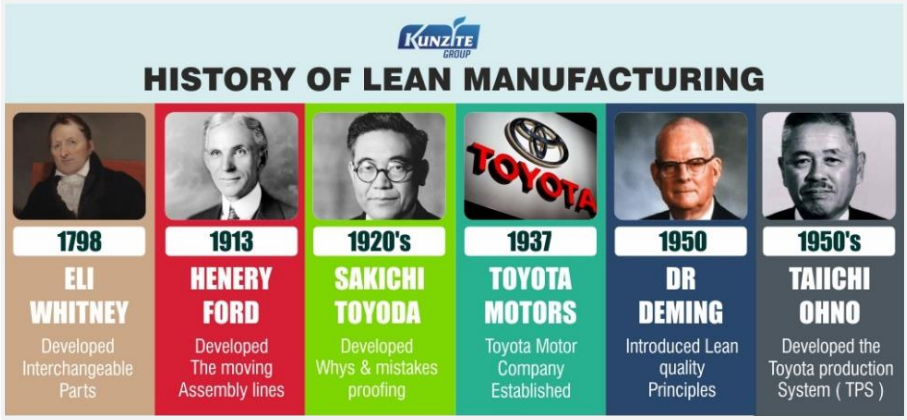

Figure 2.1 History of LM before the 1950s (Ribeiro et al., 2019).

2.3 Lean Manufacturing

LM is the process of eliminating waste from a manufacturing system. Waste is defined as anything that does not add value to the final product. Simultaneously, LM aims to produce goods that meet customers' needs while reducing NVA manufacturing practices. According to the LM principle, waste is anything that does not add value to the customers' willingness to pay for it (Sanders et al., 2017). The goal of LM is to produce the same amount of output with fewer inputs, such as less time, space, human effort, machinery, material, and cost (Abhishek Dixit et al., 2015). LM operationalized in the conceptualization of three different lenses:(1) Philosophy, (2) Principles, and (3) Tools and techniques (Arlbjørn et al., 2011), as shown in Figure 2.2.

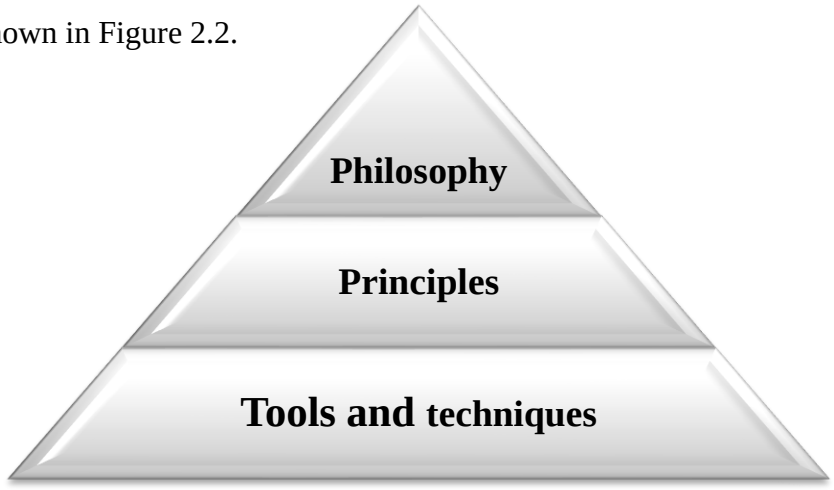

Figure 2.2 Conceptualization of LM in production (Arlbjørn et al., 2011).

2.3.1 Type of LM Waste.

Waste is defined as a step in the manufacturing process that is unnecessary and does not benefit to the customer. According to the TPS, seven original wastes are referred to as Muda in Japanese. Muda is a Japanese term that means waste. These wastes must be identified and eliminated to create an LM working environment. It refers to the state of being ineffective, unnecessary, or idle. Taiichi Ohno, a former Toyota executive, identified and formalized the first seven forms of waste. TIMWOOD refers to transportation, inventory, motion, waiting, overproduction, overprocessing, and defects (Zahraee et al., 2020). According to Taiicho Ohno, Toyota's chief engineer, there are seven types of waste, as shown in Figure 2.3 below.

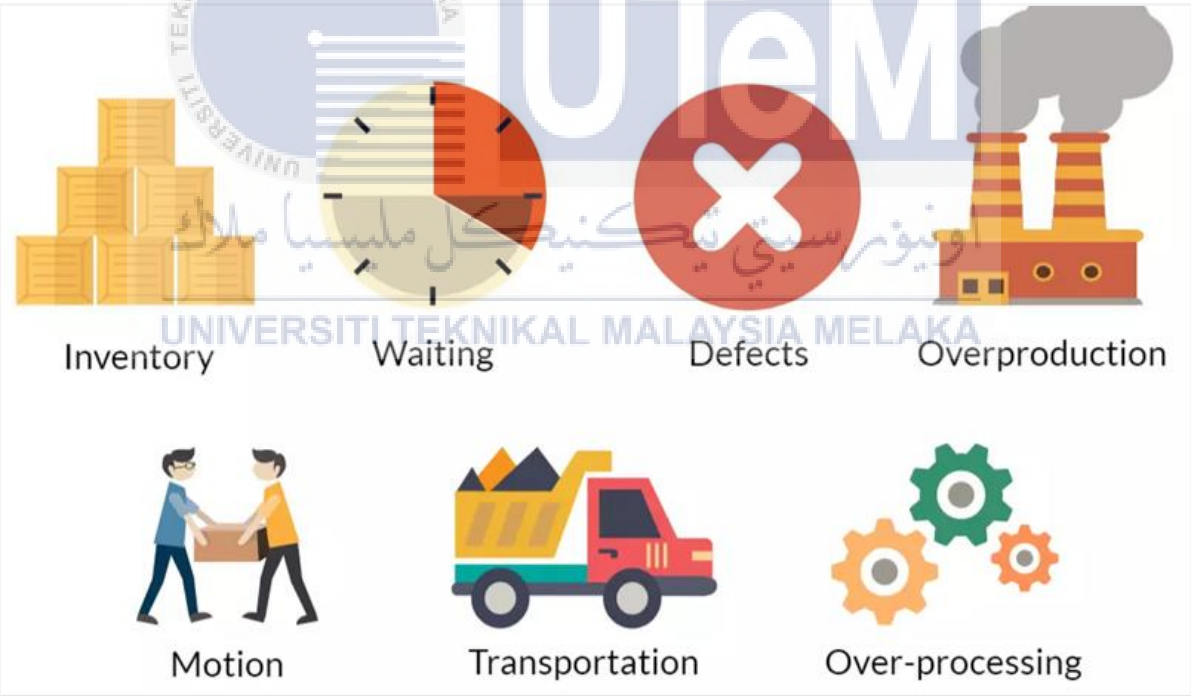

Figure 2.3 Types of Lean Waste