THINKING PRODUCTION SYSTEM TO INCREASE PRODUCTIVITY IN ASSEMBLY LINE

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DECLARATION

I hereby, declare this thesis entitled "Thinking Production System to Increase Productivity in Assembly Line" is the result of my own research except as cited in reference. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Manufacturing Engineering (Industrial Engineering).

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DEDICATION

To my dearest parents

To my three lovely sisters

And to all my beloved friends

With lots of gratitude and love

ABSTRACT

The aim of this study is to evaluate the process of assembling a piston for a door closer manufactured by Dormakaba, a company that specializes in access control and security solution. Lean production is one of the initiatives that are applied by many manufacturers to obtain the competitive advantages in the increasingly competitive global market. Value Stream Mapping (VSM) is one of the key lean tools to identify the opportunities for other lean approaches and for waste elimination in the production system. Since the performance of the process would significantly influence that of individual partners, the implementation of lean thinking should be carried throughout the development of the VSM. This project introduces the VSM used for description, analysis and identification of improvement initiatives internally in the context of a die-casting manufacturing enterprise. It can be seen from the analysis of the "current state" and "future state" VSM that the non-value added activities which are motion and handling waste within the manufacturing plant can be reduced by the launch of lean initiatives internally. This resulted in developing a solution where the improvement has made a significant impact on reducing waste in the process using tools such as 5S, workstation design and poka-yoke. Overall, the implementation done in the assembly process is shown in the future state map which ensued in decreasing the cycle time by 25%. The recommendation plans for future case study to increase the productivity is to conduct a total productive maintenance for the punching machine in the process that is often delayed due to untrained operators and lack of information on the process management.

ABSTRAK

Tujuan kajian ini adalah untuk menilai proses pemasangan omboh untuk penutup pintu yang dihasilkan oleh Dormakaba, sebuah syarikat yang menumpukan kepada kawalan akses dan penyelesaian keselamatan. Penghasilan pengurusan proses adalah salah satu inisiatif yang digunakan oleh banyak pengeluar untuk mendapatkan kelebihan daya saing dalam pasaran global yang semakin kompetitif. Pemetaan Aliran Nilai (VSM) merupakan salah satu alat utama untuk mengenal pasti peluang untuk pendekatan kelansingan proses untuk menghapusan sisa dalam sistem pengeluaran produk. Oleh kerana prestasi proses itu akan mempengaruhi penglibatan individu yang tertentu, pelaksanaan pemikiran perihal kelansingan proses harus dilakukan sepanjang penghasilan VSM. Makalah ini memperkenalkan VSM yang digunakan untuk perihalan, analisis dan pengenalpasti inisiatif penambahbaikan secara terperinci dalam konteks perusahaan pembuatan die-casting. Ia dapat dilihat dari analisis peta "keadaan semasa" dan "masa depan" bahawa aktiviti tidak bertambah nilai itu sisa dari pergerakan dan pengendalian dalam kilang pengeluaran dapat dikurangkan dengan pelancaran inisiatif pengurusan secara dalaman. Ini dapat meningkatkan penyelesaian di mana penambahbaikan itu telah memberi kesan yang ketara dalam mengurangkan sisa dalam proses menggunakan alat seperti 5S, reka bentuk stesen kerja dan poka-yoke. Secara keseluruhannya, pelaksanaan yang dilakukan dalam proses perhimpunan didasarkan pada peta keadaan semasa yang digunakan untuk membangunkan peta keadaan masa depan yang berlaku untuk mengurangkan masa kitaran semasa sebanyak 25%. Walau bagaimanapun, rancangan untuk kajian kes masa depan dalam meningkatkan produktiviti adalah untuk menjalankan penyelenggaraan penuh produktif untuk mesin menumbuk dalam proses yang sering ditangguhkan kerana pengendali yang tidak terlatih dan kekurangan maklumat mengenai pengendalian proses tersebut.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter will describe the type of industry that will be studied upon this project. The company selected for this project is from a die-casting industry which is located in the Malaysia peninsular. This project focuses on the sub-assembly processes for a TS/90 piston damping assembly that will be explained in detail the problem that occurs during the process. This study will focus only on the sub-assembly area in the department. The rest of the chapter includes the background, objective, problem statement, scope of the study and the scope of the study.

1.1 Background

This project is conducted in Dormakaba Malaysia a die-casting manufacturing company that produces components required to assemble a door closer. Dormakaba Group produces products are delivered worldwide and offers innovative and sustainable product, services and solution on security and access solution. Dormakaba Malaysia consists of processes for pressure die-casting, gravity die-casting and sub-assembly processes in order to deliver parts another plant located in Singapore for a complete assembly of the door closer. TS/90 piston damping is a part required in the door closer have several assembly

procedures involved and Figure 1.1 shows the process of the TS/90 piston damping assembly process.

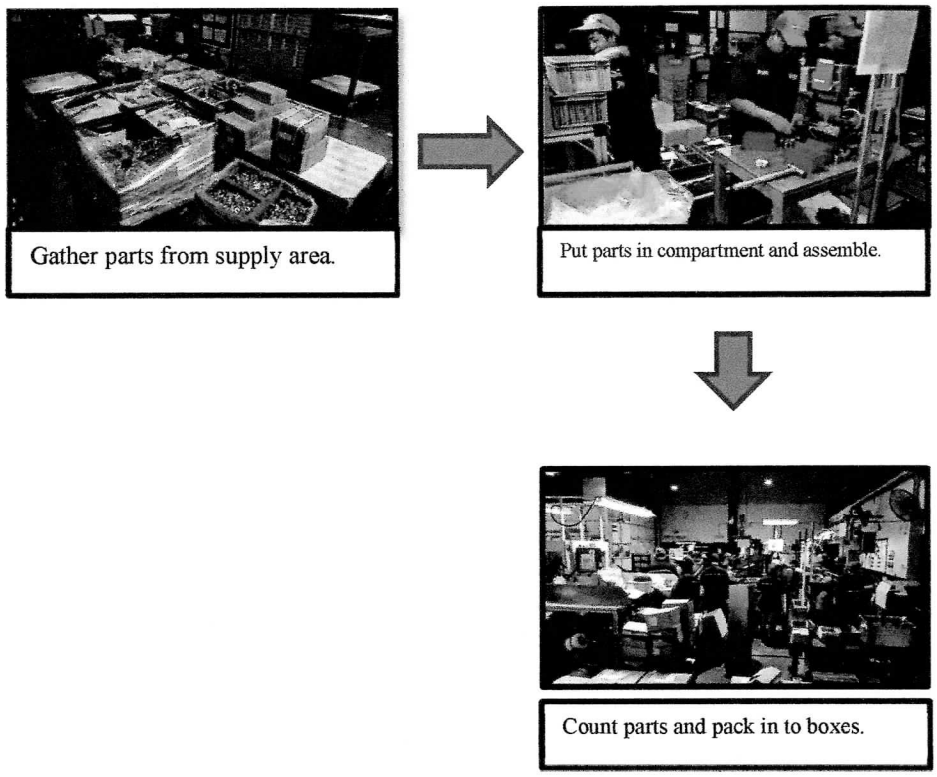

Figure 1.1: Process flow of TS/90 piston damping assembly line.

1.2 Problem Statement

Due to the effect of globalization and information technology, the need to improve the manufacturing process in terms of quality, efficiency, operator's amenity, and cost has become a key component to place oneself above other competitors, Correa (2001). According to Samad (2007), Ghazali (2015) and Fatimah (2015), a study was done on SME companies in Malaysia and one of the biggest challenges they face is the lack of productivity.

Through early observation and information obtained from engineers, Table 1.1 below the assembly line involves a semi-auto assembly process. The process is relatively new and has been running for a few months. The first problem being there are no designated location of parts. Hence, the operator would place the parts where they feel most comfortable to reach. However, this varies from one operator to another and each prefers their own way of doing their task. Further observation also shows that certain parts for the assembly are placed further from the work station due to the tight space of the workstation itself and between other neighbouring workstation.

Table 1.1: Standard work combination sheet.

Name	TS/90 Piston Damping	**Quota per shift**	720
Operator number	1	**Takt time**	35 sec

Step	**Elements**	**Time(sec)**
1	Take piston from nylon box.	1.39
2	Place bearing into a piston.	1.46
3	Secure bearing and piston with two pins using the pneumatic machine. (Automated)	8.93
4	Insert two forks into piston using Loctite.	8.33
5	Secure fork with a hammer.	1.10
6	Place finished goods into nylon box.	1.62
	Total cycle time	22.83

The second problem that occurs when observing the process happens during step 4 of the assembly. Based on Table 1.1, this process is known to be consuming the largest time in the manual assembly process. Excessive motion occurs when picking up the forks and dipping it into the glue.

1.3 Objective

1. To develop the value stream mapping (VSM).
2. To improve the current process using lean tools and technique.

1.4 Scope of Work

The term "lean thinking" was coined by Wommack and Jones to capture the essence of their in-depth study of Toyota infamous TPS. This study will aim at the application of Lean methodology and tools conducted in a die-casting industry. Lean philosophies will be used as an approach to continuously implement change and getting rid of unnecessary waste in the assembly line and also incorporate Kaizen activities into the assembly line.

To ensure the objectives of the study are achieved successfully, there are elements that need to be included which are:

i. This study of VSM focuses on the assembly process TS/90 piston damping

ii. The elements that will be studied for the process includes the assembly procedure of TS/90 piston damping.

iii. To conduct a motion time study so that production wastes can be identified.

iv. To implement the correct lean tools to overcome issues in the assembly line and increase productivity.

1.5 Significance of the study

Below is the significance of the study:

i. This study gives the opportunity to improve the work methodology of operators so work can be done more efficiently.

ii. To show the capability of the tools implemented in reducing the time taken for an operator to assemble product to meet customer demand.

iii. To improve the productivity of the assembly line.

1.6 Report Organization

This section shows the outline of the report that is required for Master Project 1 (MP1) and Master Project 2 (MP2). MP1 will cover the initial stages of the project which are Introduction (Chapter 1), Literature Review (Chapter 2) and Methodology (Chapter 3). Meanwhile, MP2 will cover the second phase of the project which is Result and Discussion (Chapter 4) and Conclusion (Chapter 5). Table 1.2 shows the structure of the project.

Table 1.2: Structure of the Project Report.

Topic	Subtopic	Explanation	Division
Chapter 1	Background of Study	Briefly explains the depiction of what will occur overall of the study.	MP1
	Problem Statement	Describes the problems faced in the company.	
	Objectives	Describes the purpose of this study.	
	Scope of the Study	Describes the scope of the study.	
	Significance of the Study	Explains the importance of the study in the topic selected.	
Chapter 2	Literature Review	Describes the past studies done related to the chosen topic to gain a better understanding of the study.	
Chapter 3	Methodology	Describes the methods and steps taken to conduct the study to achieve the objective.	
Chapter 4	Result and Discussion	Describes the data collected from the time study and the implementation of lean tools. Analysis of the results to verify the right tool is implemented.	MP2
Chapter 5	Conclusion and Recommendation	Describes the overall summary of the study to show how the objective is achieved.	

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter discusses the literature review of the basic principles of Lean manufacturing combined with Kaizen technique and how the two subjects correlate with each other. There is an abundance of methods can be used in the application of the lean methodology and kaizen methodology in the manufacturing industry. Further reviews will be done on the previous methodology of kaizen on the different approaches to gathering data to identify the problem that is occurring.

2.1 Lean Manufacturing

The concept of Lean manufacturing is a concept introduced by the Toyota Production System (TPS) which is used to implement in the manufacturing and service industry. In lean manufacturing, the area that it covers in a company is the supply chain of materials all the way to the delivery of the finished goods to the customer. Lean is a philosophy that encourages you to identify the wastes in the process, and where you step by step utilize various tools to and approaches to eliminate the waste where possible, Lindelow and Raupach (2014). The philosophy of lean has a lot to offer to the company's increasing demand for profitability, productivity, flexibility, and manufacturing at the right time, in the right quantity and quality, Liker (2009).

The demand for an increase in productivity and quality is a common demand by shareholders and customers. The potential of increased production still offers great opportunities for improvement up to 50% according to Pettersson et al (2009).

The term "lean" refers to the collection of principles and methods that focus on the identification and elimination of non-value added involved in the manufacturing or delivering processes to the customer, Womack et al (1990).

2.1.1 Lean Principle

According to the book Lean Thinking, Womack and Jones (2003), there are five principles that are needed to be met to ensure the successful implementation of lean which are,

2.1.1.1 Customer Value

This principle focuses only on the customer wants, and what customers are willing to pay for. To identify the value requires the understanding of the innovation involved in a product or technology and the processes required to be manufactured in terms of the customer's point of view. Identifying what the customer finds valuable can be deciphered and discovered by many techniques such as surveys, interviews, web analytics, and demographic information. Using these qualitative and quantitative methods can help uncover what the customer demands. Only then the customers are able to pay for the product or service at a price they can afford and align with what the company is able to develop the manufacturing processes that add value to the product or service, Womack and Jones (1991a).

2.1.1.2 Value Stream

A value stream is a process sequence to identify and mapping of the manufacturing process to develop a product or service using customer's value as a direction and determine all the activities that hold value to the customer. Value Stream Mapping (VSM) is one of the lean manufacturing tools that help understand the activities that flow the material and information in a process and hence, displays value stream. Activities that that does not contribute value to the external customer are considered waste and are classified into non-value added but necessary and non-value added and unnecessary. Pure waste should be eliminated while the necessary should be reduced as much as possible to ensure the customers are satisfied and at the same time reducing the cost of production or service, Womack and Jones (1991b).

2.1.1.3 Continuous Flow

According to Womack and Jones (1991c), continuous flow means the following step is to make certain that the flow of the remaining process to be executed smoothly without delays from disturbances. Strategies can be adopted so value-added activities can flow smoothly such as reconfiguring production process, workload levelling and training employees to be multi-skilled and adaptive. The benefits of this can reduce the lead time, eliminating waiting time, decreased defects and others to increase the value of the product.

2.1.1.4 Pull System

Pull system is like a supermarket system. When a product is taken from a shelf and scanned at the counter, the system will inform the worker to replace the space where a product has been taken before. A "supermarket" is just a buffer or a storage area located at the end of the production process for a product that is ready to be shipped, Rother and

Shook (1999). Womack and Jones (1991d) state the objective of a pull system is to restrain inventory and work in progress (WIP) while allowing material and information to run smoothly. The pull-based system is done to meet the needs of the end customer which allows Just-In-Time delivery where products are pushed out at the time and quantities it is needed so that following the value stream and working in reverse can gratify the needs of the customer.

2.1.1.5 Perfection

A perfect process delivers the right amount of value to the customer. Wastes can be prevented by achieving the first four principles: 1) identify customer value, 2) mapping value stream, 3) creating flow, and 4) applying pull system. However, following perfection is the most critical core value of them all. Lean thinking and continuous improvement should be an essential part of organizational culture and every employee should strive in the direction of perfection and delivering the product according to the customer needs. The company should be a learning organization and always find ways to be better every day.

2.1.2 Lean Tools and Techniques

There are various tools and techniques have been developed by lean experts to solve more problems that occur differently. According to Hines and Taylor (2000), the characterization of the lean tools and technique can be used in different industries and has deemed to be efficient to eliminate wastages. Table 2.1 below describes the overview of what the tool does.

2.1.2.1 5S

5S is a management tool or technique developed by Takeshi Osada during 1980s in order to constitute and sustain better quality, productivity, safe environment in an organization. The concept first raised in the Japanese manufacturing sector which stands of five Japanese words: Seiri (Organisation), Seiton (Neatness), Seiso (Cleaning), Seiketsu (Standardisation) and Shitsuke (discipline), Osada (1991).

5S is a program which develops self-pride, regard for others, and team working among the employees by solving the organization growth problems with collective effort. It also develops a sense of utilization and systematic organization for the efficient results from the workplace and acts as a key for the survival of the company in the competitive world, Mendes-de-Toledo, and Andde-Farias-Filho (2001).

A lean material supply chain can be kept in a position with the help of 5S, Bullington (2003). A systematic methodology and specific lean thinking tools like 5S are suggested to identify value and to eliminate non-value adding processes, Folinas and Ngosa (2013). 5S not only simplifies the work environment and reduce the wastage but also contributes towards safety enhancement at the workplace (Krajewski et al., 2007; Korkut et al., 2009).

It helps in providing order and discipline at the organization with the supervision on even the smallest details of the company, Erdal (2007). Ho et al. (1995) have stated that 5S requires total employee involvement (TEI) at each level of the organization for obtaining significant enhancement in organizational performance. Further, 5S calls upon strong commitment from top to bottom management to bring quality and continuous improvement in an organization, Liker (2004).

Figure 2.1: 5S explanation, Hines and Taylor (2000).

2.1.2.2 Gemba

Gemba (現場) also spelled "genba" is the Japanese term for "actual place" often used in business to identify the place where the value is created. The term is used to stress that improvements require direct observation of current conditions where work is done. In a manufacturing environment, a Gemba Walk is the action of walking around the shop-floor while having as main objective the identification of problems and improvement ideas aimed to address these latter problems.

Although the Gemba Walk seems to be a well-known practice in the lean ecosystem, only a few have shared insights about it, especially how companies actually make it a reality in their own settings and how it is adapted to transform their business culture. Furthermore, there is a lack of common understanding of what Gemba Walk is and how this practice could be deployed. What the evidence has reflected so far, is that the Gemba Walk strength relies not only "to go and see where the action takes place" to find problems, but it is also key to coach and ensure leaders interact successfully with