Improving SMED Process at Milling Area

Submitted in accordance with the requirement of the University Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Hons.)

by

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DECLARATION

I hereby, declared this report entitled “Improving SMED Process at Milling Area” is the results of my own research except as cited in reference.

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Date : 26 JUNE 2019

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering. The members of the supervisory committee are as follow:

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ABSTRACT

Rapid machine set-up plays an important part in minimizing the capacity of machine. When changeover duration is short, companies are able to respond quickly to the changing of customer demands and increase manufacturing flexibility. This study is about proposing Single Minute Exchange of Die (SMED) at the production department of Dormakaba Production Sdn. Bhd. focusing on reducing the time taken in changing fixtures in order to inprove the productivitiy of machine. The aim of this study are to study the changeover procedure of milling macine, identify the internal and external activities and propose a standard operation procedure of model changeover process. The main goal of this study is to reduce the time taken of changeover process by 30% where the current changeover of fixtures require extra time which up to 1 hour and 37 minutes. The methodology presented in the report showed the successful of SMED implementation in reducing the time taken for changing fixtures in milling machine. Current changeover process was observed by videotaping the whole process. Then, all the activities are then distinguish between internal and external. From all the data collected, a new changeover procedure had been proposed to the company. Through the implementation of SMED, a significant amount of time has been reduced to approximately 31 minutes. Therefore, it is found that an estimate of 67.87% time reduction is achieved. As a result, SMED methodology is an effective tool in reducing the set-up time.

ABSTRAK

Menukar ganti komponen-komponen mesin dalam masa yang singkat dan pantas merupakan aspek penting agar kemampuan mesin dapat dipertingkatkan secara maksimum. Kajian ini adalah mengenai cadangan Single Minute Exchange of Die (SMED) di jabatan pengeluaran Dormakaba Production Malaysia Sdn. Bhd. yang memberi tumpuan kepada mengurangkan masa yang diambil dalam menukar lekapan untuk meningkatkan produktiviti mesin. Tujuan kajian ini adalah untuk mengkaji prosedur pertukaran lekapan, mengenal pasti aktiviti dalaman dan luaran dan mencadangkan prosedur operasi piawai proses penukaran model. Matlamat utama kajian ini adalah untuk mengurangkan masa yang diambil proses pertukaran sebanyak 30% di mana perubahan masa lekapan semasa memerlukan masa tambahan sehingga 1 jam dan 37 minit. Metodologi yang dibentangkan dalam laporan ini menunjukkan kejayaan pelaksanaan SMED dalam mengurangkan masa yang diambil untuk menukar lekapan di mesin pengilangan. Proses perubahan masa kini diperhatikan dengan membuat video keseluruhan proses. Kemudian, semua aktiviti dibezakan antara dalaman dan luaran. Dari semua data yang dikumpulkan, prosedur pertukaran baru telah dicadangkan kepada syarikat. Melalui pelaksanaan SMED, sejumlah besar masa telah dikurangkan kepada kira-kira 31 minit. Oleh itu, didapati bahawa anggaran pengurangan masa 67.87% dicapai. Kesannya, metodologi SMED adalah alat yang berkesan dalam mengurangkan masa pertukaran lekapan.

DEDICATION

Dedicated to my parents, family and everyone who involved in this project. Thank you for your support and encouragement.

Adnan Bin Mohd Akib

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Fatin Amirah Bt Adnan

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SMED – Single Minute Exchange of Die

LPS – Lean Production System

SME – Small Medium Enterprise

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

Nowadays, the number one priority target in all production industries are to enhance level of productivity, the ability and efficiency. This is because competition in these days depends on time, production cost and the ability to sell in manufacturing field.

Ineffective production flow in manufacturing plant means that the production activities are not carried out smoothly. This will results in the production efficiency and delayed the delivery date of customer. Therefore, time has becomes one of the crucial fundamental in business performance variable. In this case, process of changing dies is one of the issues in the manufacturing industries that consuming time. Fast equipment set up is important in order to maximize the capability of machines. Back in the past few years, the industry only focused on marketing and customer demands. Lean production system gives the better result for industries to apply, however they had to use techniques from lean production system such as Single Minute Exchange Die, takt time, Kanban and others.

Single Minute Exchange of Die or setup time that can be counted in a single digit of minutes. It is one of the lean production methods used to reduce or eliminate waste in a manufacturing process. It provides a fast and efficient way to change the manufacturing process from running current products to running next product. This Japanese process-based innovative methodology will results in the reduction of lead time and thus lead to elimination of wastefulness during changeover activities. Rapid changeover is the key to reducing the production lot sizes and thus improving the flow. SMED is becoming more popular when

industries nowadays are looking for increasing demand for product variability, reduced product life cycles and reduce inventories significantly.

Based on the effort to success through Lean Production System (LPS), one study is conducted to one of the SME companies at Dormakaba Production Malaysia Sdn Bhd located in Melaka. Dormakaba has resulted in the merging of the famous brands of Dorma and Kaba, both of which are known for their expertise in the field of smart and secure access solutions to buildings. This study is about reducing the time lost in the changeover process of milling machine through the implementation of SMED. Longer changeover process of the tools significantly affected the productivity of the company. In order to maximize the productivity, a study had been carried out to identify the cause of the problem.

1.2 Problem Statement

This study is carried out at the milling area. The changeover of fixtures at the milling machine require extra time which up to 1 hour and 37 minutes to complete the process. A complicated changeover procedure will definitely increase the time taken especially involving with a fully mechanical machine where it require workers to be more details as it involves adjustment and resetting the machine. Most of the setting for mechanical type machine were done manually and usually the set-up or changeover activities are done based on the worker's experience.

The main problem for this company is wasting time during the changeover process. During the study, it is identified that the company does not have a standard changeover procedure. Setters who involved in the operations did not follow the desired sequence of changeover process. Table 1.2 shows the process of changing fixtures for milling machine in sequence. There are a few processes that took too much time to be completed. The process that take the longest time during the process of changing fixtures is to send sample parts to QA for inspection and audit which took 1800 seconds to complete. Second, it took 801 seconds to adjust the dimensions of the model. Third, it took 682 seconds for the operator to connect the hydraulic pipe to the fixtures. At the end of this project, methods and solutions will be carried out to reduce the current set-up time of milling machine at Dormakaba company.

Table 1.1 Procedure of changing fixture at milling machine

Step	**Procedure**	Time taken (seconds)
1	Wear safety glasses and ear plug	
2	Wires connected to fixtures and yellow box are removed	94
3	Scattered chips are cleaned from the fixtures and milling table	42
4	All screws are loosen from both side of the fixtures on milling table	147
5	Conveyor is removed away from the initial position	74
6	Fork is adjusted to the width of the fixture	49
7	The 1st initial fixture is taken down from the machine	14
8	The chips on the 1st initial fixture are cleaned	51
9	The 1st initial fixture is placed back to the wood pallet	63
10	The forklift is driven to the 2nd fixture and followed by taking it down from the machine	146
11	The chips on the 2nd initial fixture are cleaned	52
12	The 2nd initial fixture is placed back to the wood pallet and place it back to the fixture rack	80
13	4 screws are removed from the milling cutter	164
14	Replaced the used milling cutter with a new milling cutter	36
15	Lift up the cutter then installed 4 screws and tighten them	175
16	Surface table is cleaned	38
17	The subsequent fixtures are taken down from the rack and placed on the floor	60
18	The 1st subsequent fixture is cleaned	96
19	The 1st subsequent fixture is placed on the milling table	124
20	The 1st fixture is screwed on the milling table of the machine	211
21	The 2nd subsequent fixture is cleaned	87
22	The 2nd subsequent fixture is placed on the milling table	307
23	The 2nd fixture is screwed on the miling table of the machine	279
24	Wires are connected to the fixtures	682
25	Yellow cover is placed	17
26	The conveyor is placed back to its original position by using forklift	115
27	Bins that are ready to be milled were fetched by the forklift to the conveyor	41
28	The dimensions of the model are adjusted to its best	801
29	Sample parts are send to QA for inspection and audit	1800
	Total time taken	5845 sec

1.3 Objectives

The objectives of this study are as follows:

a) To differentiate the internal and external activities of current procedure
b) To propose standard Work Instruction Sheet for model change process
c) To reduce the changeover time by 30 percent

1.4 Scope

This project focuses on the techniques to implement SMED concept in Dormakaba Malaysia company that cast a variety of products which include milling process. In the report, techniques for reducing set-up time are briefly discussed and progress of applying the SMED technique are reported. The differences between internal and external activities that involved in the changeover process are emphasized. A methodology that shortens the changeover time is derived to help the manufacturer to improve the overall production line productivity. The improvement step that will be suggested would not be implemented without further evaluation by authorized personnel of the company. Therefore, the estimated time reduction is treated as the outcome in this study.

1.5 Significant Of Study

There are some potential benefits that can be gained by the users after the completion of this study.

- Able to develop and implement SMED.
- Able to develop a method and technique to apply SMED that can be applied by Small and Medium Enterprise companies (SME).
- This research could be able to be a reference by other SME companies.

1.6 Organization Of Report

Chapter 1 discusses the introduction of the research title. This chapter contains the background, problem statement, objectives and scope of study. It also covers the report structure to accomplish the study.

The literature review of the research problem is given in Chapter 2. In this chapter, the information and theoretical analysis which related to the research tittle is studied and summarized. The sources of the information are taken from journals, books articles internet and etc.

Next, chapter 3 describes the methodology that is used to conduct the study. it describes the overview of the research methods. The procedures and steps to perform SMED conceptual stages are also included in this chapter.

Chapter 4 emphasized on the implementation of SMED in actual process of the changeover. All data obtained are analysed and discussed. A comparison between current and new procedure of changeover process are presented.

Lastly, chapter 5 concludes all the result obtained from the study where the objectives of the study have been achieved.

1.7 Summary Of Introduction

The benefits of SMED can only be gained after a thoroughly analysis of set-up operations has been made. Moreover, the four conceptual stages of set-up need to be identified where effective techniques can be applied at every stage. Thus, leading to impressive reductions in time and improvements in productivity.

CHAPTER 2

LITERATURE REVIEW

2.1 The SMED Concept

The development of the SMED methodology took place in Hiroshima, Japan during the fifties (Shingo, 1985). However, SMED methodology was widely acknowledged in the seventies as part of the Toyota Production System. The definition of "Die" in SMED states that it is any part of equipment which is being replaced when new product will be processed on the same equipment (Agustin, 1996).

SMED which is also known as Quick Changover of Tools, can be applied in any industrial and machine. It is defined as the minimum amount of time necessary to change the type of production activity in less than ten minutes. Although not every changeover operation can be done in single digit minutes, a significant reduction of changeover time is still possible. SMED concept circulates widely in a high volume manufacturing in order to eliminate bottlenecks at changeover process.

2.2 Basic Elements of a Set-up and Changeocer Reduction

2.2.1 Definition of Set-up Time

Set-up time can be define as a total time taken when machine is not in operation (machine downtime) while model exchange for machine after first production finish until the second operation start for next process as shown in Figure 2.1 (Nasruldin and Hashim, 2012).

There are many type of products produced in operations and each have its own set-up method. Because of its unique setting and configuration, machine should stop before start to run next production. Change of tool took place while machine stop and each minute lost between production for previous product stop until next product took place is called waste. When machine stop for any production, setting for current machine must be change according to setting for nest production. Each operation that occurs for this stage is called set-up time.

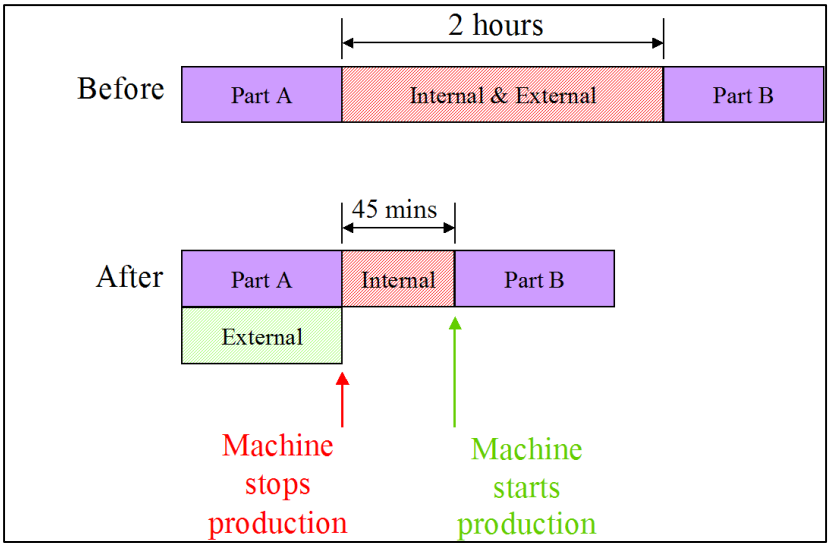

Figure 2.1 Set-up time

Usually, total time needed for preparing and change model or die should not take long time until one day or two to three hour. Every not needed task happen in set-up time and changing die is waste as it will lead to long set-up time.

Set-up process is a transformation of manufacturing model system from producing one product to another product, including stopping the current work for preparation for the next process except for the special case where certain product is produced at special machine or production line (Norzaimi *et al.*, 2015). Set-up is not referring to the changing of mold or other equipment and products, but the entire production of the previous stop production so that no defective products that have been issued for the next product. Van Goubergen and Van Landeghem (2002) defined that the set-up as time the final product (Part A) to leave the machine until the next product (Part B), which has produced good quality.

Reduction of set-up time always give attention to the reduction of downtime machine. Each time that happened during the time-consuming activities during downtime can increase the cost of production. In this case, the internal time is priceless and sign are very important to measure the operating efficiency, because time will pass and cannot be replaced for future use. Most manufacturing companies can take up to several hours or up to several days to perform the operations preparation and changing activities. Therefore, reduction of set-up time and waste disposal is not as easy as it looks and can get very expensive if it is counted in detail.

There are many methods of LPS that can be used to reduce set-up time and SMED is one of the methods that had been used and implemented by the manufacturing companies. This method will be described in greater detail in the next section.

2.2.2 Importance of Reducing the Set-up Time

According to Goubergen (2004), the need to reduce the set-up time has been known since years ago. Although the need to shorten the set-up time is not new, lately all types of industry more focused on the preparation for this. The need for a short set-up time is larger than it looks. Globalization of the market, product diversification and ongoing efforts to achieve better efficiency in existing production is the main factor that drives this phenomenon to continue to occur.

Reduction of set-up time has many advantages for instance, increasing the manufacturing systems and its capacity such as reducing lead times, reduced inventory levels and production costs. Typically, a short set-up time can be obtained if the overall lead times can be reduced. Short set-up time can reduce the losses and defects, thus enhancing the quality of a product. The next section will describes the importance in reducing the set-up time.

2.2.2.1 Reducing Lot Size and Inventory Cost

In the past, the increase of set-up time can be obtained through efficiency and large-scale production. Economic lot sizes has been presented to improve inventory control. Lot size of the economy has been regarded as a rational approach (Shigeo,1985).

Due to a change in the market and lack of available capital cost after World War II, most Japanese car makers realize the importance and the need to develop production Small Lot Size. They have to produce various types of cars and heavy vehicles in low quantities and low prices, to meet a small number of orders (Cusuinano, 1986).

Economic lot size is the number of identical products where these products should be produced to determine the cost of changes in production processes as compared with the same product but with different lot size. If the lot size is the same (unchanged) and can reduce setup time, machine utilization can be reduced and so the performance can be improved. Short set-up time can reduce the lot size and thus reduce inventory levels where existing products are delivered to customers more quickly. Therefore, this will cause a reduction in inventory costs and other costs. Inventory costs can be reduced to a smaller lot size and a reduction in set-up time by removing scraps, defects and restoration work. The relationshi between lot size and set-up time can be easily seen. This is because the shorter the time of preparation, the smaller lot sizes can be produced in good condition and able to follow the real order size.

By reducing the set-up, lot sizes and inventory levels can be reduced which will ease the operation. Use of standard fixture to produce a product on the machine is one approach to reduce set-up time.

2.2.3 Types of Set-up Activities

The changeover activities consist of all the tasks necessary to complete a changeover process. According to Shingo (1985), the main funtions of any set-up can be defined by four basic procedures.

a) Preparation, after process adjustment, checking of materials, tool, etc
   In this step, it involves locating all the parts and tools and ensuring that they are in the right position. This also includes putting tool away after the set up has been finished.
b) Mounting and removing blades, tools, parts, etc**.**
   This step includes removing old parts and tools after the previous operations and fixing the new tools for the next operation.