OPTIMIZING THE CHANGEOVER OF PACKAGING MACHINE BY IMPLEMENTING SINGLE MINUTE EXCHANGE OF DIES IN TEXTILE MANUFACTURING INDUSTRY

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A thesis submitted in fulfillment of the requirements for the degree of Master of Manufacturing Engineering (Industrial Engineering)

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DECLARATION

I declare that this thesis entitled "Optimizing the Changeover of Packaging Machine by Implementing Single Minute Exchange of Dies in Textile Manufacturing Industry" 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 : MOHAMAD MUZAMMIR BIN ROSLI

Date : 30/9/2016

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Manufacturing Engineering (Industrial Engineering).

Signature   :

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DEDICATION

I dedicated this thesis tp my parents. I hope that this achievement will complete the dream

that they had for me all those many years ago when they chose to give me the best

education they could.

ABSTRACT

Today, the majority of firms, particularly in the manufacturing domain, are espousing flexibility with regard to manufacturing an array of products. The aim is to meet consumers' requirements so as to remain competitive and afloat in the industry. This can be done by ensuring a swift changeover of the machinery in such a way that the flexibility of response to demand stays unaffected. A textile firm in Melaka, Malaysia has adopted this approach. To achieve this objective, Single Minute Exchange of Dies (SMED) was deployed to enhance the changeover time of its packaging machine. It was noted that the key issue was the absence of lean thinking by workers, which caused much waste in the changeover process, and in turn the changeover time. By deploying SMED, some waste can be decreased or totally eradicated. The SMED framework involved determining the present changeover process, segregating internal and external tasks, converting maximum internal tasks into external ones, and streamlining all changeover tasks. It was observed that all tasks that are part of this procedure were accomplished internally. On analysis, it was ascertained that one of these tasks had the potential to be accomplished externally, and this task was preparation of new base and receiver. Few of the tasks in the changeover process were removed by enhancing the correlation between the operator and technician in charge of the machine. These tasks were changeover preparation, emptying pins from bowl feeder, putting new pins, and preparing for next run. A new jig was devised and fabricated, aiming at replacing the present jig which can only be utilised by one kind or size of packaging box. This jig intended to get rid of the need to prepare other base when various kinds or sizes of pins require to be packaged. To upgrade the improvements, other lean tools were recommended, including 5S and andon. 5S was recommended to enhance the task of preparing base and receiver by installing an indicator or label for quick identification by the technician. Andon was recommended to enhance the correlation between labourers and inform the technicians regarding the changeover. By means of all these enhancements, a new changeover process which is much easier and time saving was produced. It was observed that with the new process, the total changeover time consumed was 9.5 minutes as against 32.1 minutes for the original changeover time, indicating a saving of around 70 percent. To conclude, this study showed that SMED remains one of the most robust and effective tools which can be utilised to attain a swift changeover that is essential for this firm for making flexibility as one of its strong areas.

ABSTRAK

Masakini, kebanyakan syarikat, terutamanya dalam bidang pembuatan, sedang menuju ke arah fleksibiliti dengan mengambil kira kepada penghasilan pelbagai produk. Tujuannya adalah untuk memenuhi keperluan pengguna dan juga untuk kekal bersaing dan bertahan di dalam industri. Ini boleh dicapai dengan memastikan pertukaran pantas pada mesin supaya tindak balas fleksibiliti kepada permintaan tidak terjejas. Sebuah syarikat tekstil di Melaka, Malaysia telah menerapkan pendekatan ini. Untuk mencapai objektif tersebut, Single Minute Exchange of Dies (SMED) telah dilaksanakan untuk menambah baik masa pertukaran mesin pembungkusan. Ianya telah diberitahu bahawa isu utama adalah ketiadaan pemikiran lean oleh pekerja, dimana telah menghasilkan banyak pembaziran di dalam proses pertukaran dan seterusnya masa pertukaran. Dengan menggunakan SMED, beberapa pembaziran boleh dikurangkan atau dihapuskan. Rangkakerja SMED yang telah digunakan dalam kajian ini terdiri daripada mengenal pasti tatacara pertukaran semasa, mengasingkan tugasan dalaman dan luaran, menukar sebanyak mungkin tugasan dalaman kepada tugasan luaran, dan akhir sekali menyelaraskan semua tugasan pertukaran. Setelah diperhatikan, semua tugasan yang terlibat di dalam pertukaran tersebut telah dibuat secara dalaman. Pada analisis, telah dipastikan bahawa satu daripada tugasan tersebut mempunyai potensi untuk dibuat secara luaran, dan tugasan ini adalah menyediakan tapak dan penerima. Beberapa tugasan di dalam tatacara pertukaran ini juga telah dihapuskan dengan memperbaiki hubung kait antara pengendali dan juga juruteknik yang bertugas pada mesin tersebut. Tugasan-tugasan tersebut adalah penyediaan untuk pertukaran, mengosongkan pin, meletakkan pin baru, dan persediaan untuk penghasilan seterusnya. Satu tapak baru juga telah direka dan dihasilkan, yang bertujuan untuk menggantikan tapak sedia ada yang hanya boleh digunakan oleh satu jenis atau saiz kotak pembungkus sahaja. Tapak ini bertujuan untuk menyingkirkan keperluan menyediakan tapak yang lain apabila jenis dan saiz pin yang berlainan perlu dibungkus. Untuk mengukuhkan lagi penambahbaikan tersebut, alat lean yang lain juga telah dicadangkan, termasuk 5S dan andon. 5S dicadangkan untuk memperbaiki aktiviti penyediaan tapak dan penerima dengan memasang label atau penunjuk untuk mencepatkan proses pengenalpastian oleh juruteknik. Andon pula dicadangkan untuk meningkatkan hubung kait antara pekerja dan digunakan untuk memberitahu juruteknik mengenai pertukaran. Melalui semua penambahbaikan tersebut, satu tatacara pertukaran baru yang lebih ringkas dan mengambil masa yang lebih pendek telah dihasilkan. Setelah diperhatikan dengan proses yang baru, jumlah masa pertukaran yang diambil hanyalah 9.5 minit dibandingkan dengan 32.1 minit untuk pertukaran asal, menunjukkan pengurangan kira-kira 70 peratus. Konklusinya, kajian ini telah menunjukkan bahawa SMED masih lagi satu alat yang teguh dan berkesan yang boleh digunakan untuk mencapai pertukaran pantas yang mana sangat penting untuk syarikat ini bagi menjadikan fleksibiliti sebagai salah satu daripada kekuatan mereka.

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JIT   -   Just-in-time

LM   -   Lean manufacturing

M1   -   Machine 1

OEE   -   Overall Equipment Effectiveness

SMED   -   Single Minute Exchange of Dies

TPM   -   Total preventive maintenance

TPS   -   Toyota Production System

VSM   -   Value stream mapping

WIP   -   Work in process

CHAPTER 1

INTRODUCTION

This chapter is about the introduction, motivation of study, problem statement, objectives and scopes of the project. The motivation of study is focusing in reducing changeover time in the manufacturing in industry. Besides, the problem statement, objectives, and scopes are discussed in the sub header provided.

1.1 Motivation of Study

Due to high market demand in flexibility and competitiveness, many manufactures are trying to decrease their machine down time (Pawar et al., 2014). Changeover time includes the time elapsed from last good piece to first good piece and this setup change time could contribute in increasing machine down time and according to Esa et al. (2015), high changeover time can be considered as waste to the company. It is very important for the company to take action in reducing the changeover time in order to increase the machine productive time that would lead to increasing the productivity of the company. Productivity performance also can be improved by reducing the production lead time and also production waste. (Azizi, 2015).

Industries are producing variety of products to fulfill the customer requirement that getting higher from day to day and they are bound to produce the same in low cost, shorter

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delivery time and without detriment to quality (Lingayat et al., 2015). To respond to these demands, business need to increase productivity and efficiency and this can be achieved through lead time and set-up time reduction (Eriksson, 2007).

Due to globalization and current scenario in the market, companies need to increase their production and also their product flexibility and these would cause them to produce their products in small batches size (Gaikwad et al., 2015). For this reason, it is important that changeovers are quick, so that flexibility of respond to demand is not affected (Mcintosh et al., 2007). The need of shorter changeover isn't new; the time spent between in the production of the last product of a series and producing the first product of the new series, has always been considered as waste or added cost (Van Goubergen and Van Landeghem, 2002).

1.2 Problem Statement

In today market, individualization of products is the reaction from the manufacturing industry to the changing customer wishes and demand, as well as to market saturation and because of this development, the diversity of variants will increase in the future (Götz et al., 2016). According to Berger (2012), his research shown that product variety has increased more than doubled between 1997 and 2012, while the number of raw materials and components increased only to a lesser extent. Figure 1.1 below shows the increase in variety of products.
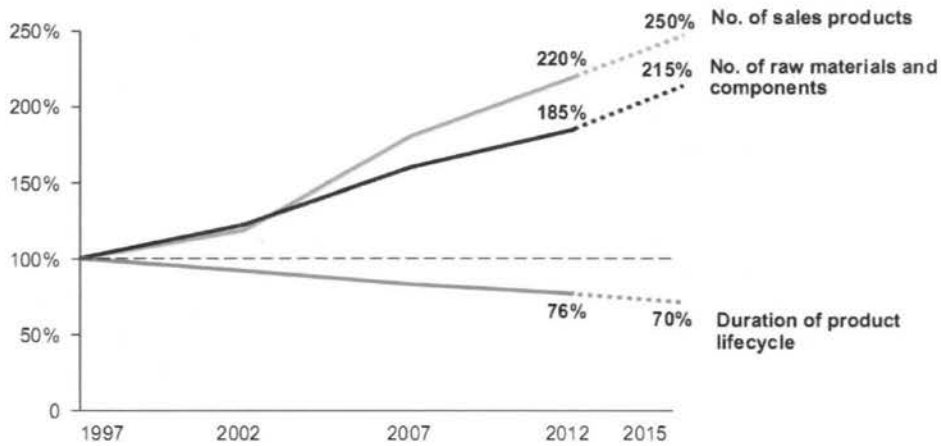
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Figure 1.1: Increment of product variety across all industries (Berger, 2012)

In order to reduce the changeover time for higher flexibility and to fulfill demand for variety of products, the most popular and effective tools is single minute exchange of dies (SMED) introduced by Shigeo Shingo in 1985. According to Braglia et al. (2016), SMED provides a rapid and efficient way of converting a manufacturing processes when product changes. In summary, this method represents the key to decrease the batch size and thereby improving material flows. Moxham and Greatbanks (2001) claimed that the adoption in SMED allowing companies to understand where they currently stand in setting up a process. The measurement indicator of setup performance is important for measuring and monitoring the improvement of the setup process. SMED also has proven to allow many benefits for manufacturers, increasing productivity up to 70% (Faccio, 2013).

This study will be conducted in a textile manufacturing industry in Malacca, Malaysia. In order to fulfill the variety in product demands and redcution of batch size, the packaging machine (M1) in this company as shown in Figure 1.2 have to undergo frequent changeovers and this machine need to be stopped during the changeover.

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Figure 1.2 Packaging machine (M1)

This machine is packaging different models of pin and each model uses different types of base and receiver. The current changeover takes about 32 minutes and time for each activites are shown in Figure 1.3. The changeover time for this machine is high and to make it worse, usually this machine need to go through changeover at least 3 times per day meaning more time will be wasted in the changeover procedure. This problems will reduce the machine utilization and lowering the productivity of this company.
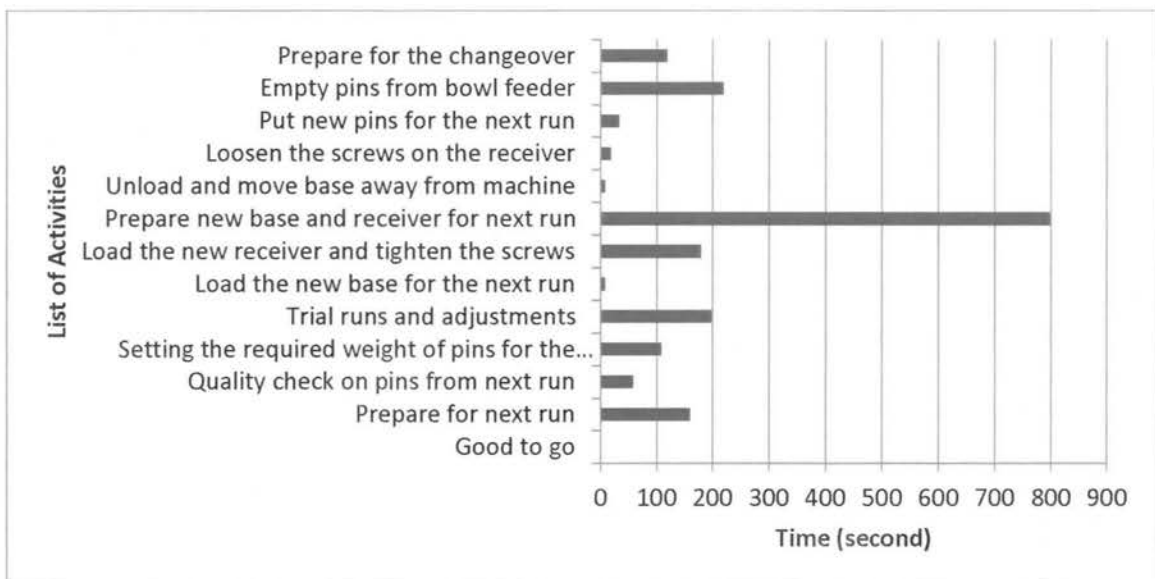

Figure 1.3: Current changeover chart for M1

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From the figure above, preparing new base and receiver for next run is the activity that consuming the highest time which is 800 seconds in this changeover procedure. This is due to trial and error system that has been used by the technician in preparing base and receiver without using any indicator such as labelling to help the technician retrieving the base and receiver.

1.3 Objectives of the Study

The objectives of this study are as follows:

a) To study current changeover process of packaging machine

b) To analyze and simplify certain steps in the changeover process by designing and fabricating jig and creating standard

c) To implement new jig and changeover process for packaging machine

1.4 Scopes of the Study

This study focuses only on a packaging machine (M1) at the textile manufacturing industry. This machine is packaging many types of safety pins that will be delivered to customers. The reason why the researcher is not doing study at other machine is because of some constraints that could not be avoided. The main constraint that affected this study is time. Researcher have only about 7 months to finish this project so it is quite difficult to focus on more than one machine and it is impossible to finish it in the given time.

This study is also about reducing changeover time on the machine by implementing Single Minutes Exchange Dies (SMED). Researcher used SMED as the main method on this

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study based on the previous research papers and journals that has been analyzed. Most of research papers that discussed about reducing changeover time used SMED as their method and succeed in achieving their objectives. The other reason SMED has been chosen was because of lower cost in implementing it. SMED is focusing more on the activities itself by converting, simplifying and streamlining them without the need of spending too much money on it.

Lastly, this study is only focused on six different packaging boxes. There are more than ten types of packaging boxes that have been packaged at this company but only six of them were packaged at the packaging machine and remaining boxes were packaged manually by operator. Because of this study is only focused on the packaging machine, so the researcher only capable of analyzing these six packaging boxes for this project.

CHAPTER 2

LITERATURE REVIEW

This chapter is about the review study from the previous research by other researchers. This study is about the implementation of SMED in order to reduce the changeover time while increasing the productivity. The objectives of this chapter is to understand more about the previous study that related to this paper that can be used to support this study in order to come out with the best conclusion for this paper. The sources of literature are taken from journals and books that related to this study.

2.1 Changeover of Machine

Changeover operation is to change the manufacturing conditions from those for producing a certain product to those for producing a different product, including stopping the present job and preparing the conditions for start of the next job (Shirahama, 2001).

There are a number of separated tasks in a changeover operation. Some can be carried when the machine or process is stopped though some can still be carried out even when the machine is still running. Shingo (1985) named these processes as internal and external.

A definition of internal and external activities according to Rubrich and Watson (2004) is that:

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