UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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TOOL FOR QRM IMPLEMENTATION IN JOB SHOP ENVIRONMENT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) (Hons.)

by

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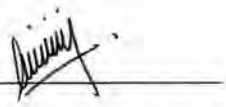
Signature : 

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons). The member of the supervisory is as follow:

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ABSTRACT

Lean Manufacturing philosophy is the most common used philosophy where the main idea is reducing cost, improving quality and reducing product cycles time which leads to fast delivery. However, lean will only be more successful in producing high mix volume characteristic in an assembly line when there is a stable demand from customer in the production line. Quick Response Manufacturing (QRM) is a new approach where the main concept is to focus in reducing lead time throughout the enterprise and provides organizations in competing advantages. QRM consider as a new philosophy but is an effective strategy for job shop environment where it capable in producing high mix production and low volume demand from customer. This project is carried out in a case company that produces mainly precision components. The company produces over 160 product families where each of the products has different process routes and times. This company is considered being a job shop environment company where it is confronted with consistently long Work-In-Process which leads to poor on-time delivery to their customer. In order to cope with this problem, a tool for automated generates number of POLCA cards will be developed accordingly to the current situation. This tool will helps in calculating the number of POLCA cards needed automatically which ease human work and time and can be easily converted for implementation in other job shop environment industries. POLCA system can be applied into the entire virtual cell where the receive jobs are group together according to same demand of volume and similarity in process. As a result, the lead time and poor on-time delivery can be solved.

ABSTRAK

"Lean Manufacturing" adalah falsafah yang biasa digunakan di mana idea utama adalah mengurangkan kos, meningkatkan kualiti dan mengurangkan kitaran produk masa yang akan mengakibatkan penghantaran barangan kepada pelanggan dengan cepat. Walau bagaimanapun, "Lean Manufacturing" ini hanya akan lebih berkesan digunakan untuk penghasilan ciri pencampuran yang rendah dalam barisan pemasangan apabila terdapat permintaan yang stabil dari pelanggan selaras dengan pengeluaran. "Quick Response Manufacturing" (QRM) adalah satu pendekatan baru di mana konsep utama lebih kepada memberi tumpuan dalam mengurangkan masa yang akhirnya membawa dalam perusahaan itu dan menyediakan organisasi dalam kelebihan bersaing. QRM dianggap sebagai satu falsafah baru tetapi merupakan strategi yang berkesan untuk persekitaran kilang yang menghasilkan pengeluaran campuran tinggi dan permintaan kelantangan rendah daripada pelanggan. Projek ini dijalankan di sebuah syarikat yang menghasilkan komponen yang berbeza-beza. Syarikat ini mengeluarkan lebih daripada 160 keluarga produk di mana setiap produk mempunyai laluan proses yang berbeza dan masa yang berlainan. Kerja Dalam Proses yang lama menyebabkan kelewatan penghantaran produk dalam masa yang tertentu kepada pelanggan mereka. Dalam usaha untuk menangani masalah ini, satu sistem dicipta untuk menjana nombor kad POLCA secara automatik. Sistem ini akan dapat membantu dalam pengiraan jumlah kad yang diperlukan secara automatik yang akan memudahkan kerja dan masa manusia secara tidak langsung. Sistem POLCA boleh digunakan ke seluruh sel jabatan di mana menerima pekerjaan adalah kumpulan bersama-sama mengikut permintaan sama jumlah dan persamaan dalam proses. Hasilnya, masa yang lama untuk produk diproseskan dan masa yang lambat untuk penghantaran produk kepada pelanggan dapat diselesaikan.

DEDICATION

On behalf of this, I would like to dedicate this report to my supervisor in giving the guidance and right advice during the development period of final year project. Besides, I would also dedicate this to my families and friends for their support and advice given during this period as well.

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CHAPTER 1
INTRODUCTION

In the globalization era where every product has to be in high quality and low in cost, each and every manufacturer industries tends to compete with each other to gain more demand from the customer. Manufacturer sector not only compete with each other to have more sales, they eventually have to accept the challenges from the customer in producing more complex, unique design as well as varieties product according to customer demands. Hence, in order to achieve the following requirements, most of the manufacturing sectors will implement some philosophy that are suitable to be used for their company and choose to use more advance machine which are capable to achieve customer requirement on specific products.

1.1 Background of Study

In manufacturing sector, there are multiples techniques and tools in helping for continuous improvement such as the commonly used, Lean Manufacturing philosophy, most common term in describing the Toyota Production System (TPS) that were introduced first in Japan. Lean Manufacturing philosophy was introduced by engineers Taiichi Ohno and Shigeo Shingo from Japan in 1950. The main idea of lean manufacturing is to reduce the costs, improve quality as well as reduce the product cycle times. Lean is considered successful when producing a high mix volume characteristic in an assembly line when there is a stable demand from customer in production line. In the publication of The Machine that Changed the World, it started the dispersion of particular lean manufacturing practices exploit by the utmost competitive auto manufacturers in the world (Womack and Jones, 1996).

Another approach will be the Quick Response Manufacturing (QRM) where it been introduced mainly focusing in reducing the lead time throughout the enterprise and provide organizations in competing advantages. QRM approach considered being a new philosophy and there are a few user implement QRM method in their manufacturing sector. QRM consider being an effective strategy for the manufacturing sector in job shop environment especially when they are competing with Make-to-Order (MTO) environment as well as Engineering-to-Order (ETO) environment basis (Rajan Suri, 1998)

Paired-cell Overlapping Loops of Cards with Authorization (POLCA), one of the mechanisms that were developed as a part of QRM strategy that overcomes the limitation of the pull system for high variety and/or customized product environment (Rajan Suri, 1998). POLCA is able to help in manipulating the flow and inventory in manufacturing sector. POLCA is an important system that is designed to work within the QRM where it acts as a capacity signal that when a job is done, a signal will be triggered and notifies the previous cell to send another job into the current cell.

POLCA differentiates the job floor into flexibility and multidisciplinary staffed work cell where it only makes semi-finished products for receiving work cell which it contain a free capacity. POLCA cards are used for assuring the free capacity in the work cell where it circulate within the work cell and trigger the signal when there is room available for further processing. Hence, with the help of this POLCA system, the size of the system and type of product being made is considered to be at the maximum robust and the late deliveries can be improved as well.

This project is carried out in a case company that produce mainly precision components in a job shop environment. The company involved different type of processes such as milling, turning, grinding, profile grinding, wire cutting, EDM, welding, laser marking and tapping. The company produces over 160 product families where each of the products has different process routes and process time. Hence, this case company is categorized into high mix production and low volume demand from customer. Once the order is received from customer, the case company will quote a price for the product and re-send to customer for their agreement on the price. Once the quotation has been confirmed, the case company will proceed to draw the product layout and plan for the process flow. A job order will be created

together with the product layout and send to the production line for producing the product according to the created process flow. If the part‟s drawing that was created involved the CNC machining operation, the part will send to the programming first before proceeding to the production line. After completing entire process, the final products will be inspected before shipping to customer. Figure 1.1 shows the overall process flow of the company from receiving order to shipping and Figure 1.2 shows the overall layout of the production line in the case company.

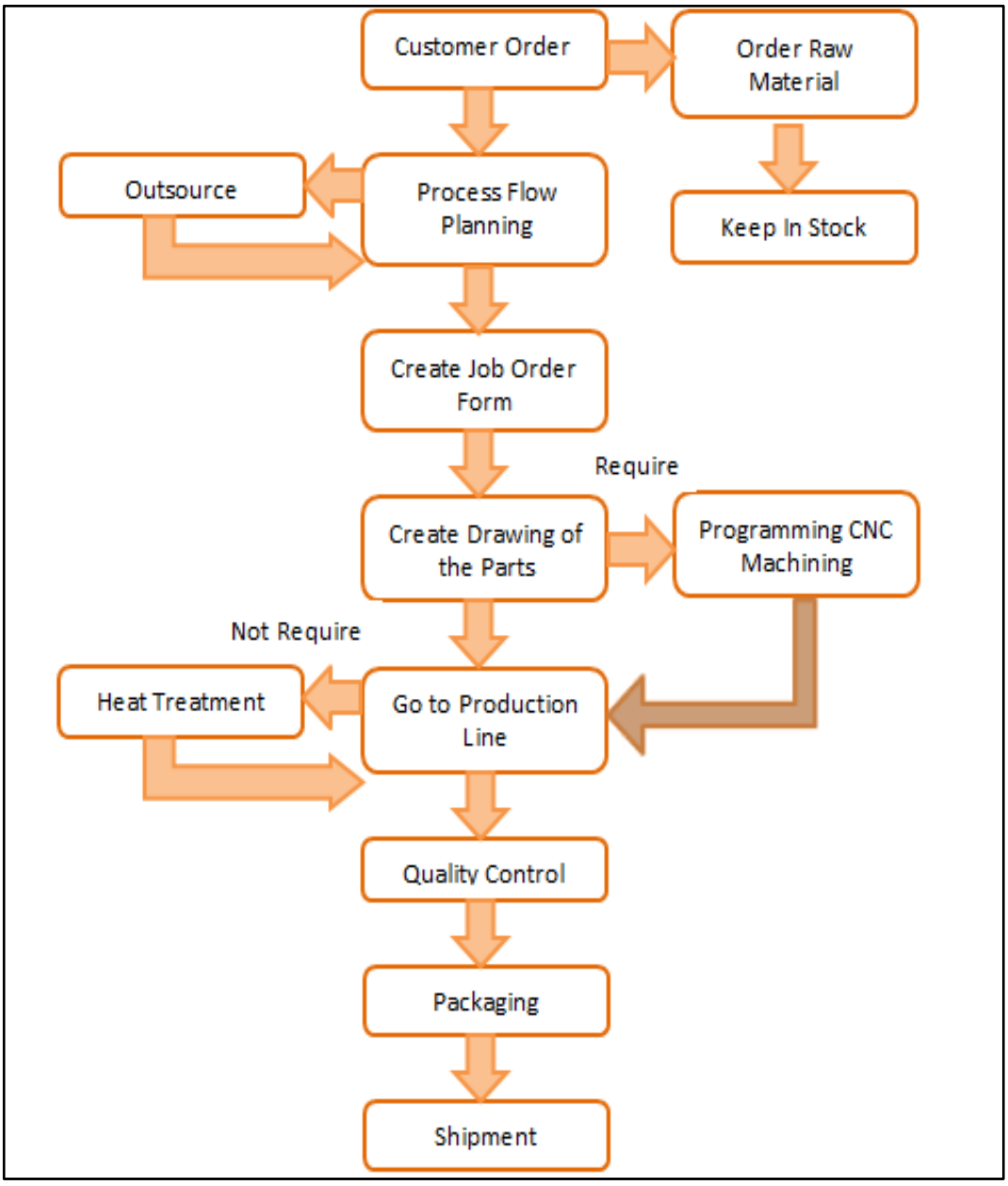

Figure 1.1: Overall process flow of the case company.

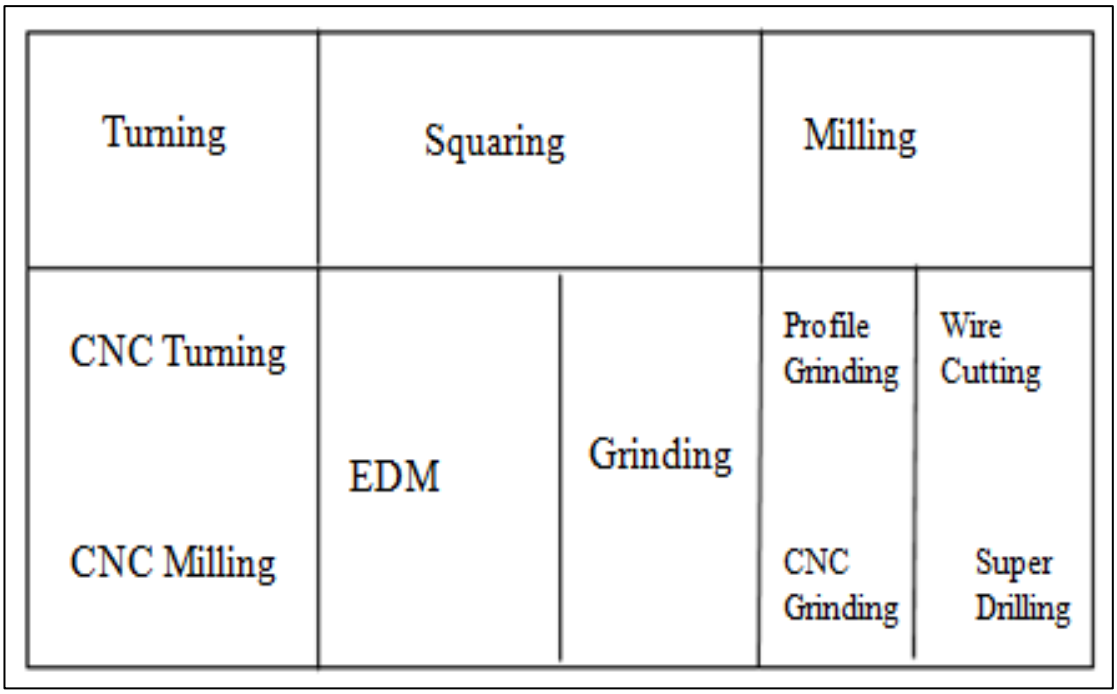

Figure 1.2: Layout of the production line in the case company.

1.2 Problem Statement

This project is conducted in a case company where the high precision components and other products are manufactured in a job shop environment. This company deals with high mix production and low volume demands. Hence, the lead time and speed act as a key performance indicator to this company as the longer the lead time and slower the speed will eventually leads to unsatisfied customer.

The manager from the company mentioned that the main problem of this company is the late deliveries of the finished product to the customer. It is estimated approximately 30 percent of the product experience late deliveries to the customer. This is due to the unknown utilization of the machine and the long Work-In-Process (WIP) of the product. Moreover, On Time Delivery (OTD) to customer has always been a problem for this company because there is a lack in the system to survey the entire department processes since the system only able to track which product is in which department but not actually processing it.

1.3 Objectives

The main objectives in this project are:

a) To develop a POLCA tool to generate the number of POLCA cards.
b) To develop a simulation model for a job shop environment.
c) To compare the throughput performance and total Machine Cycle Time (MCT) in Job shop environment using the POLCA tool and simulation model.

1.4 Scope

The data collected are based on the historical data from the company where it is retrieve from the ERP system that uses to track the product processes. A total of 3 days data will be collected and be used in the simulation method for testing the automated POLCA cards tool that focused in the whole production flow. This project does not involve the cost and quality of the product as well as the management of the company.

1.5 Importance of Study

The main purpose of this project is to develop an automated POLCA cards tool system to help in generating the number of POLCA cards required for the whole process departments. With the aids of the POLCA cards, the Machine Cycle Time (MCT) for the overall process at the job shop environment can be reduced. This automated POLCA cards tool not only gives advantages into solving the late deliveries issues but it also help in improving the smoothness of the work floor of the company by calculating the number of POLCA cards needed automatically. Automated POLCA cards tool also proven that it is applicant into the job shop environment by using simulation method where it eventually increases the customer satisfaction and reduces the cost of product.

1.6 Organization of the Report

This report is organized as the following outline. Chapter 1 is about introducing the background of study, problem statement, objectives, scope and the important of study. Chapter 2 is about the literature review of the related topic while chapter 3 present about the methodology used in the topic and Chapter 4 is about the model development. Chapter 5 provides details about result and discussion. Last but not least, Chapter 6 is the conclusion for the overall project.

CHAPTER 2
LITERATURE REVIEW

In this chapter, there is a collection of the searched information from journals, articles, books and other resources that related to the topic. In this case, Quick Response Manufacturing (QRM) to be implemented in the job shop environment will be concise in here together with the evidence in supporting the next chapter. Moreover, the background of Lean Manufacturing, concepts of QRM, POLCA, difference between QRM and Lean Manufacturing, and difference between POLCA and KANBAN will be illustrated in this chapter as well.

2.1 Lean Manufacturing

Lean manufacturing is a popular philosophy that is being implemented in almost every manufacturing sector, even in office operations. The aim of Lean Manufacturing is to respond quickly to customer demand by waste reduction and also producing the products or services at the lowest cost. Based on the book „The Machine that Changed the World" by Womack et al. in 1990, Lean Manufacturing is a conceptual framework that are popular in many Western and Japanese automotive industries. Through this book, it stated that the spread of the Lean Manufacturing practices was established by the most competitive automotive industries and it is seen as a counter-intuitive alternative to a traditional Fordist manufacturing mode (Womack and Jones, 1996). In addition, Oliver et al agree on the interest of lean production is mainly founded on empirical proof suggest that it increases the company's competitiveness (Oliver et al., 1996).

Although in the primary goal for Lean Manufacturing, by introducing any lean production is to upsurge the throughput, reducing the lead time and cost as well as improving the quality etc. however, Ahlstrom and Karlsson (1996) states that it is not always easy to prove that the application of lean production due to the decrease in throughput because this is strongly opposed to the traditional management accounting systems under the early implementation phase.

Lean manufacturing production program only suitable to be implementing and is consider being successful if only there is a stable demand in assembly production line when producing a high volume characteristic. Current concept of Lean Manufacturing can be outlined to Toyota Production System (TPS), founded by Japanese engineering Taiichi Ohno and Shigeo Shingo in 1977. However, according to Masson et al (2007), TPS perform finest especially for low mix and high volume demand background and are supported by Stump and Bardurdeen (2009) claiming that Lean Principles such as Just-In Time and Production leveling are very hard to be applied into high-level mass customization environment. When the customers have high expectation in high variety and custom engineered products and is ordered in low volume with unstable demand, it is not that simple to implement the lean production program into the demand.

2.1.1 Lean Tools and Technique

In Lean Manufacturing, there are couples of tools and technique in helping to accomplish the goal in Lean Manufacturing which are 5S, Kanban, Value Stream Mapping, Poka-Yoke etc. Even though there is much dissimilar kind of tools and techniques, there is one objective where each of the tools and techniques aims to improve the production.

2.1.1.1 5S

5S method is considered to be one of the basic principles in lean production to improve quality, reduce cost, reliable delivery etc. in order to maximize the efficiency in the workplace and also having the probability of product diversification. By implementing the 5S method the formation of habits of cleanliness and