Faculty of Mechanical and Manufacturing Engineering Technology

LEAN SIX SIGMA FOR PROCESS IMPROVEMENT: CASE STUDY AT A MANUFACTURING COMPANY

LEE HUI KEAN

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

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

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

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Sesi Pengajian: 2019/2020 Semester 1

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DECLARATION

I hereby, declared this report entitled LEAN SIX SIGMA FOR PROCESS IMPROVEMENT: CASE STUDY AT A MANUFACTURING COMPANY is the results of my own research except as cited in references.

Signature: ……………………………………
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Date:

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours. The member of the supervisory is as follow:

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Supervisor : Ts. Dr. Rohana Binti Abdullah

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ABSTRACT

The defective product that contribute to the product quality problem is the main issue of this study. While, this paper aims to deploy Lean Six Sigma framework to facilitate the reduction of defective products and improve the process variation for moulding process. This study is carried out on the moulding process of Konica Minolta Business Solutions (M) Sdn Bhd. There are a bundle number of defects are identified on the parts that may affect the productivity of firm. The integration of Lean and Six Sigma will apply to reduce quality defects and process variation with DMAIC methodology. An overview of this thesis are drafted by using problem definition, project charter, process flow chart and line graph of occurrence number of defective products. Furthermore, data were collected on all possible defective product. In this paper, the root causes responsible for the occurrence of defect types on mould products are analysed. For that, the historical records of the occurrence number of defect type from December of 2018 until May of 2019 were analysed, leading to the identification of flash and gate flash defects as the main factor responsible for product quality problem in moulding department. Other than that, investigation of a cause-and-effect diagram is carried out. This leads to the potential sources responsible for flash and gate flash are listed out according to the four main factors. While, an improvement plan is investigated to develop a solution for the main issues. The critical defects is identified and solution that responsible to the cause is discussed. The outcome of this study is to propose an improvement plan to reduce the quality defects and improve the variation of moulding process. A suggestion is proposed on future research which are the Lean Six Sigma framework could be implemented on other production line.

ABSTRAK

Produk bercacatan yang menyumbang kepada masalah kualiti produk adalah isu utama dalam kajian ini. Sementara itu, tesis ini bertujuan untuk menggurangkan produk yang cacat dan menambahbaikkan variasi proses pembentukan dengan menggunakan kerangka "Lean Six Sigma". Kajian ini dijalankan dalam proses pembentukan kilang Konica Minolta Business Solutions (M) Sdn Bhd. Terdapat sepuluh jenis cacat yang dikenalpasti dalm produk yang akan menjejaskan produktiviti kilang. Integrasi "Lean" dan "Six Sigma" akan digunakan bersama-sama dengan metodologi "DMAIC" untuk mengurangkan kecacatan produk dan variasi proses. Gambaran keseluruhan kajian ini dinyata dengan menggunakan definisi masalah, piagam projek, carta aliran proses dan graf garis yang berkaitan dengan bilangan produk yang cacat. Selain itu, data yang berkaitan dengan produk yang mungkin cacat akan dikumpulkan. Dalam kajian ini, punca akar yang menyebabkan pelbagai jenis kecacatan berlakunya pada produk acuan akan dianalisis. Untuk itu, rekod sejarah mengenai jenis kejadian cacat dari Disember 2018 hingga Mei 2019 dianalisis, ini membawa kepada pengenalpastian kecacatan "burr" dan "gate burr" sebagai faktor utama yang bertanggungjawab terhadap masalah kualiti produk di jabatan pembentukan. Selain daripada itu, analisis untuk rajah "cause-and-effect" akan dijalankan. Ini membawa kepada sumber-sumber yang berpotensi menyebabkan "burr" dan "gate burr" akan disenaraikan mengikut empat faktor utama. Walaupun, pelan pembaikan dianalisis untuk mengeluarkan penyelesaian bagi isu-isu utama. Kecacatan produk yang kritical akan dikenalpasti dan penyelesaiaan yang berhubung dengan punca kecacatan akan dibincangkan. Hasil kajian ini adalah untuk mencadangkan pelan peningkatan yang lestari bagi mengurangkan kecacatan produk dam menambahbaikkan variasi proses pembentukan. Cadangan dicadangkan pada penyelidikan masa depan iaitu rangka kerja "Lean Six Sigma" boleh dilaksanakan pada barisan pengeluaran lain.

DEDICATION

This study is humbly dedicated to all my valuable treasures:

To my beloved mother and father

Mr. Lee Thiam Teik

Mrs. Lo Yet Lee

For my supportive sibling

Lee Hui Ting

Thank you for love, sacrifices and always there in my every stop of life

For my respected surpervisor

Ts. Dr. Rohana Binti Abdullah

For all UTeM lecturers, Konica Minolta Business Solutions (M) Sdn Bhd, project team members and my treasured friends

Who give me strength and faith to overcome all difficulties

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Particularly, special thanks to all my peers, beloved parents and sibling for their moral support in completing this bachelor degree project. While, very appreciate about Konica Minolta Company for giving me the opportunity to carry out this study in moulding department. Lastly, thank you to everyone who had been to the crucial parts of realization of this project.

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C_p	-	Capability Ratio
C_{pk}	-	Process Capability Index

LIST OF ABBREVIATIONS

5S	Seiki, Seiton, Seiso, Seiketsu, Shitkesu
DMADV	Define, Measure, Analyse, Design, Verify
DMAIC	Define, Measure, Analyse, Improve, Control
DoE	Design of Experiments
DPMO	defects per million opportunity
DPU	Defect Per Unit
GE	General Electric
IoT	Internet of Things
IR 4.0	Forth Industrial Revolution
JIT	Just In Time
KMBS	Konica Minolta Business Solutions (M) Sdn Bhd
LCL	Lower Control Limit
MIT	Massachusetts Institute of Technology
M-Karte	Manufacturing Karte
OEE	Overall Equipment Effectiveness
PDCA	Plan-Do-Check-Act
QC	Quality Control
QFD	Quality Function Deployment
RPN	risk priority number
SIPOC	supplier-input-process-output-customer
SMED	Single-Minute Exchange of Die
SOP	standard operation procedure
SPC	Statistical Process Control
TPS	Toyota Production System
TQM	Total Quality Management
UCL	Upper Control Limit
UTeM	Universiti Teknikal Malaysia Melaka
VSM	Value Stream Mapping
WIP	Work In Process

CHAPTER 1

INTRODUCTION

This chapter provided the rationale and an overview of this study. The chapter starts off by briefly outline the company profile and the theory background under subtopic of project background. Furthermore, the study's problem statement is investigated on the next subtopic. This is followed by discussing the objectives. Then, this is continued by stating the scope and limitation for this study. The thesis framework was conducted is provided.

1.1 Project Background

This study will carry out in a printer manufacturing industry which is Konica Minolta Business Solutions (M) Sdn Bhd (KMBS). This company aims to contribute to a global community by creating ever greater value and excellence. After than that, philosophy of this company is to declare the ideas that is shared by more than 40 000 people around the world. The production of KMBS are office printing, industrial printing, production printing and innovative technologies. In order to connect and transform the business of KMBS in the wave of digital innovation, this company is refining a new workplace.

Furthermore, this manufacturing company is implementing the fourth Industrial Revolution (IR 4.0) strategies by using Manufacturing Karte (M-Karte). M-Karte is a system that collecting, storing, visualising various data in the production floor using Internet of Things (IoT). Moreover, M-Karte is a licensed product of KMBS. This system is applied at mould factories, production plants and maintenance areas of KMBS.

In recent decades, the manufacturing industry has undergone evolutionary changes and the economic challenges have shifted production from West to East. Standardization and interchangeability have helped developing countries earn their manufacturing share because of lower labour costs. The outdated manufacturing system of a production will cause the industry lose business due to overproduction costs and uncertain production delivery times. Hence, the company need to develop and deliver perfect solutions, products and services to promote the "Zero Defect" and first time right production philosophy to achieve business excellence in the manufacturing industry.

Apart from this, the integration of environmental protection can also be promoted in all activities of company such as design and production, as well as training, motivating and involving all staff in the effort towards excellence. Usually, the policy of a manufacturing company in the market is conducted mainly along the following lines such as increase the quality of product, minimize the variation of the manufacturing process, concentrate on defective product and solve the problem, optimizing natural resource consumption, better waste management, prevent any rework process and satisfy the customers' requirement.

Therefore, a way of letting an organization to execute its policy and objectives is implementing of the Lean management paradigm. This model along with the various methodologies associated with it, allows an organization to focus on rationalization of its resources, problems that appear in the products and the elimination of non-value-added activities. Thus, an increase in production flexibility as well as in product quality can be verified with the elimination of waste.

On the other hands, the aim of Lean methodology is to create effective and efficient processes for adding value while sharing information. Similarly, the implementation of Lean on the manufacturing systems allows a company to attend in a competitive way towards the demand of the customers, reduce the production costs at the same time and increase the product quality. According to Cabrita et al. (2015), most of the applications and case studies in manufacturing field are descriptions of how companies have adopted, created, and implemented Lean principles in their organizations. This is because Lean Manufacturing can focus on reducing the production cycle time in order to become more responsive to customer demand while using fewer resources and improving quality and processes of products. By this way, the objectives of manufacturing industry can be achieved since production costs is reduced, productivity increased and highly profitable and flexible production capability which overall increase the operational efficiency.

Moreover besides, Jadhav et al. (2015) quoted that the Lean Manufacturing is the industrial management paradigm in this manufacturing industry. Elimination of work losses, especially any activity in the process that consume resources but does not create any values is the main purpose of Lean Manufacturing. In this way, the theory and tools of Lean Manufacturing have proven to engage all workers effectively in improvement activities (Torres and Gati, 2009).

Other than Lean principle, Six Sigma is another influential process improvement methodology in manufacturing sector. This model has been well recognized as a powerful business strategy and an imperative for achieving and sustaining excellence in operational and service. According to Antony et al. (2017) as cited in Panda et al. (2016), operational excellence through continuous process improvements is the aims of Six Sigma methodology and has been successfully implemented worldwide for over 30 years. This systematic methodology producing significant improvements to the 25 profitability of many large and small organizations (Zhang et al., 2016 as cited in Treichler 2005).

Similarly, Zhang et al. (2016) quoted that Six Sigma can help the manufacturing industry identify the root causes of process variations and improve product quality through the use of various statistical tools. Six Sigma focuses primarily on the elimination of process variations and defects in the business process so that can improve the throughput.

On the other words, Six Sigma has two approaches which are DMAIC (D-Define, M-Measure, A-Analyse, I-Improve, C-Control) and DMADV (D-Define, M-Measure, A-Analyse, D-Design, V-Verify). DMAIC is applicable to an existing product or process to be improved while DMADV is applicable to a new products or processes, to be designed and implemented in a manner that will provide a Six Sigma performance.

Furthermore, Lean and Six Sigma are traditionally practiced separately, but have been implemented together in some manufacturing organizations in recent years, this integrated approach is called “Lean Six Sigma” (Zhang et al., 2016). The mounting trend and concern of competition in the manufacturing industry led to the approach of searching better ways of doing things in the management purview.

In this fierce competition industry environment, Lean Six Sigma is an essential methodology for ensuring that the contemporary organization acquires and retains a competitive advantage. Meanwhile, Alhuraish et al. (2017) as cited in Pfeffer (2010) mentioned that a competitive advantage is achieved when the organization maintains practices consistent with sustainable development strategies and, as such, process variations and implement practices that are environmentally and socially responsible. Moreover, Lean Six Sigma is the combination of applying Lean techniques to increase production rate and reduce waste and applying Six Sigma processes to improve quality.

After that, Do Rosário Cabrita et al. (2015) as cited in Assarlind et al. (2013) demonstrated that both Lean and Six Sigma approaches together are proven methodologies that increase efficiency, effectiveness and quality, resulting in continuous improvement to improve process variation. In addition, Hill et al. (2017) stated that the intention of Lean Six Sigma in a manufacturing industry is to drive the process improvements through adopting the key features of both Lean and Six Sigma by combining these features into a single approach towards process performance enhancement.

Moreover, methodologies of Lean and Six Sigma have certain unique benefits respectively since they have different principles and characteristics. Therefore, Lean approach is helping the firm to reduce all kinds of wastes effectively develop and maintain standardised processes and improve the processes continuously while Six Sigma methodology is helping the firm to remove bottlenecks efficiently, enhance resource consumption, reduce process variations and product defects.

There is no perfect plan in the world although though Lean and Six Sigma are the essential methodologies. At the same time, the implementation of Lean and Six Sigma have also the similarities and differences in the challenges that have been observed. The common challenges include resistance to change, lack of understanding of the intention for implementation, lack of resources and misalignment of project and organizational objectives (Lee and Chang, 2010; Snee, 2010). However, Aboelmaged (2010) quoted that the differences are Lean implementation faces more issues of cultural change and lack of employee involvement and empowerment and Six Sigma implementation faces more issues of various belt systems standards, the difficulty of collecting quality data and the lack of interactions and connections between different tools and solutions in one project.

On the other hand, the claim that lean and Six Sigma have a complementary relationship that is widely accepted today and more companies are developing Lean Six Sigma methodology, especially after the proven capability of Lean and Six Sigma in leading companies like General Electric (GE) and Toyota. Likewise, Lean Six Sigma in a manufacturing firm can be described as a methodology in a manufacturing that focuses on the eliminating waste and process variation. This approach follows the DMAIC structure in order to achieve customer satisfaction with regards to product quality, delivery time and cost of product. It should be emphasized that this is not only an approach to solving manufacturing problems, but also business processes.