REDUCTION OF YIELD LOSS FOR TAPING PROCESS IN SEMICONDUCTOR INDUSTRY USING TRIZ

NG MAY LING

B051310133

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2017

REDUCTION OF YIELD LOSS FOR TAPING PROCESS IN SEMICONDUCTOR INDUSTRY USING TRIZ

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

NG MAY LING
B051310133
931007085226

FACULTY OF MANUFACTURING ENGINEERING
2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **REDUCTION OF YIELD LOSS FOR TAPING PROCESS IN SEMICONDUCTOR INDUSTRY USING TRIZ**

SESI PENGAJIAN: **2016/2017 Semester 2**

Saya **NG MAY LING (931007-08-5226)**

mengaku membenarkan Laporan Projek Sarjana Muda (PSM) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysiasebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh:

Alamat Tetap:

73, Taman Ringlet, 39200 Ringlet,

Cameron Highlands,

Pahang.

Tarikh: _____

Cop Rasmi:

Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
Hang Tuah Jaya, 76100 Durian Tunggal Melaka, Malaysia

Tel : 06-331 6019 Faks : 06-331 6411

FAKULTI KEJURUTERAAN PEMBUATAN

MS ISO 9001:2000 REG NO.AR 3543

Rujukan Kami (Our Ref) :
Rujukan Tuan (Your Ref):

Pustakawan
Perpustakaan UTeM
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya,
75450, Melaka

13 June 2017

Saudara,

PENGKELASAN LAPORAN PSM SEBAGAI SULIT/TERHAD LAPORAN PROJEK SARJANA MUDA KEJURUTERAAN PEMBUATAN (MANUFACTURING MANAGEMENT): NG MAY LING

Sukacita dimaklumkan bahawa Laporan PSM yang tersebut di atas bertajuk **"REDUCTION OF YIELD LOSS FOR TAPING PROCESS IN SEMICONDUCTOR INDUSTRY USING TRIZ"** mohon dikelaskan sebagai *SULIT / TERHAD untuk tempoh LIMA tahun dari tarikh surat ini.

2. Hal ini adalah kerana IANYA MERUPAKAN PROJEK YANG DITAJA OLEH SYARIKAT LUAR DAN HASIL KAJIANNYA ADALAH SULIT.

Sekian dimaklumkan. Terima kasih.

Yang benar,

_____

Tandatangan dan Cop Penyelia

* Potong yang tidak berkenaan

NOTA: BORANG INI HANYA DIISI JIKA DIKLASIFIKASIKAN SEBAGAI SULIT DAN TERHAD. JIKA LAPORAN DIKELASKAN SEBAGAI **TIDAK TERHAD**, MAKA BORANG INI **TIDAK PERLU DISERTAKAN** DALAM LAPORAN PSM.

DECLARATION

I hereby, declared this report entitled "REDUCTION OF YIELD LOSS FOR TAPING PROCESS IN SEMICONDUCTOR INDUSTRY USING TRIZ" is the results of my own research except as cited in references.

Signature : ……..

Author's Name : NG MAY LING

Date :

APPROVAL

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

……

(PROFESSOR DR. CHONG KUAN ENG)

ABSTRAK

Dalam persekitaran perniagaan yang berdaya siang, kehilangan hasil dalam industri pembuatan semikonduktor adalah berdasarkan kepada banyak faktor. Kehilangan hasil boleh diperhatikan dengan jelas dan cabaran adalah perlu mengenal pasti punca kehilangan hasil dengan cepat. Setelah punca yang paling kritikal diselesaikan, produktiviti dan kualiti pembuatan dalam industri pembuatan semikonduktor boleh dipertingkatkan dan kesan kerugian hasil boleh dikurangkan. Pada masa ini, syarikat tersebut mendapati bahawa terdapat kehilangan hasil yang tinggi pada 'X' Package selepas proses ujian dalam proses 'taping'. Oleh itu, tujuan kajian ini adalah untuk mengurangkan kehilangan hasil kerana untuk meningkatkan kecekapan peralantan secara keseluruhan (OEE) dengan mengenal pasti punca kepada kehilangan hasil dalam industri semikonduktor yang terletak di Melaka. Data untuk proses 'taping' telah dikumpul. Jenis-jenis punca yang menyebabkan kehilangan hasil telah dikenalpasti dengan menggunakan carta Pareto. Ishikawa rajah digunakan untuk mengenal pasti punca kecacatan yang ketara. Selapas mengenal pasti punca, keadah Theory of Inventive Problem Solving (TRIZ) telah digunakan untuk mencadangkan penyelesaian yang boleh dilaksanakan untik syarikat tersebut bagi peningkatan kualiti hasil. Sebanyak 3 penyelesaian telah dicadangkan untuk mengurangkan hasil, namun hanya 2 penyelesaian telah dilaksnakan dan diuji. Keputusan uji kaji tersebut menunjukkan kehilangan hasil telah dikurangkan 1.14% dan OEE telah ditingkatkan sebanyak 0.37%. Menurut status kos setiap unit dalam industri, dengan meningkatkan OEE sebanyak 0.37% boleh meningkatkan profit industri sebanyak MYR 754,138 setahun. Justeru, pengurangan kehilangan hasil boleh membawa keuntungan yang tinggi kepada syarikat tersebut.

ABSTRACT

Yield loss in the semiconductor industry varies based on many factors. The yield loss is distinctly observable and the significant challenge is to quickly identify the root causes. Once the most critical causes are resolved, the productivity and manufacturing quality can be improved as the impact of the yield loss is reduced. Currently, the case company discovered that there is high yield loss for 'X' product package on the taper machines after the testing process for the taping process. Therefore, the aim of this study is to reduce the yield loss as to improve the Overall Equipment Effectiveness (OEE) by identifying the root cause of yield loss in a semiconductor industry located at Melaka. The real time data for taping process in the case company was collected. The type of defect that causes yield loss was identified by using Pareto chart. Ishikawa diagram was used to identify the root causes of the significant defects. After identifying the root causes, Theory of Inventive Problem Solving (TRIZ) methodology was applied to propose feasible solutions to the case company for quality yield improvement. There are total three solutions proposed to reduce the yield loss but only two of the solutions were implemented for the case company. The pilot run was carried out to determine the effects and impacts of the proposed solutions implemented in the case company. Based on the results, the yield loss was reduced about 1.14% and OEE was improved about 0.37%. According to the case company's cost per piece, by increasing 0.37% in OEE enables the case company to gain a total yearly profit of MYR 754,138. Hence, the reduction of yield loss can bring high profitability to the company.

DEDICATION

I would like to dedicate my thesis to my beloved family members, supervisor and friends. Thank you for the unconditional loves and supports.

ACKNOWLEDGEMENT

Firstly, my heartfelt thanks go to my supervisor, Professor Dr. Chong Kuan Eng for his insight in guiding me and sharing his knowledge during the duration of my final year project. He was generous enough to share the necessary information and provided me with the required study materials to further comprehend the project. He was kindness and willingness to share his experiences and guiding me in this report.

I would like to dedicate my appreciation and I am truly indebted to my industry supervisor, Mr. Alan Ng Kam Choi. He was patience to explain the theories behind why and what certain process are carried out in the industry. I would also like to express my gratitude towards all the engineers, technicians and staff members in the case company for being helpful and approachable at all times.

Finally, I am truly grateful and thank my beloved family members and friends who are involved directly and indirectly in helping me out during my final year project.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

.

LIST OF ABBREVIATIONS

A	-	Availability
FMEA	-	Failure Mode and Effect Analysis
FTA	-	Fault Tree Analysis
FYP 1	-	Final Year Project 1
FYP 2	-	Final Year Project 2
LCL	-	Lower Control Limit
LSL	-	Lower Specification Limit
OEE	-	Overall Equipment Effectiveness
P	-	Performance
PM	-	Preventive Maintenance
Q	-	Quality
QFD	-	Quality Function Deployment
SPC	-	Statistical Process Control
TPM	-	Total Productive Maintenance
TRIZ	-	Theory of Inventive Problem Solving
UCL	-	Upper Control Limit
USL	-	Upper Specification Limit

LIST OF SYMBOLS

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

CHAPTER 1
INTRODUCTION

In chapter 1, the background of the study and company's history is briefly described. The issues of yield loss after testing although process sustaining is continuously implemented in the case company are presented in the problem statement. All the objectives and scope are determined to accomplish this study. In the end of chapter 1, the significance of study and organization of report is presented.

1.1 Background of Study

Semiconductor manufacturing industries act as the most demanding business within the manufacturing industries due to the complication of the production processes and continuously achieving high quality product. The semiconductor manufacturing industries are facing a big challenge to stay in the global economy where customers have higher expectation on quality and competition is strong. The semiconductor manufacturing industries have undergone tremendous changes which included product and process technologies, behaviour of the competitor, divergence in the management method, perspective of the customer and supplier. In general, productivity can define as a measure of production efficiency which is to transform the input to output. Thus, it is critical to meet the customer's satisfaction and demand on developing the levels of productivity. For the purpose to survive in the competitive environment, all the manufacturing industries are forced to implement production improvement programs in order to improve the quality and productivity (Chandurkar, 2015). The main intention is cost as yield loss can cause enormous bottom line impact particularly for high volume products (Bohna and Terwieschb, 1999)

The semiconductor manufacturing industries get to hunt for the chance to improve yields continually in the modern technologies era. Obviously, manufacturing industries will face fluctuations in product quality or a random event that may cause the failures happen when the process has become more complex (Rokach and Hutter, 2012). For this reason, manufacturing industries have to ensure the process stability and process capability are in control so that the products produced within the specification limits thus achieved high quality yield. Process capability indices, C_p and C_{pk} are used to provide a numerical measure that can indicate whether a process is capable and ensure products meet the quality requirement (Pearn et al., 2006).

Any manufacturing industries are focusing on the defect issues and trying to minimize the defects that may happen in the manufacturing processes (Rokach and Hutter, 2012). The number of the failures increased when the number of lot size increased and it's become important to identify the root cause of these failures as to reduce yield loss (Antony, 2006). However, it is a very challenging problem to identify the root causes especially for a multistage manufacturing process. The root cause analysis process is used to classify and investigate the root cause events with quality, reliability and production impact (Wirawan and Desiana, 2014).

Overall Equipment Efficiency (OEE) is a methodology for the performance measurement to show the effectiveness of a machine which consists of three parameters known as availability, performance and quality (Dogra et al., 2011). OEE is used to calculate the product availability, performance efficiency of a process and the quality losses (Nakajima, 1988). The parameter used to calculate the OEE value is based on the basic definitions and methods.

1.2 Case company's background

This study is carried out in a semiconductor manufacturing company located at Melaka which offer semiconductor solutions to a better future by making life safer, easier and greener with technology that aims to consume less, achieves more and is approachable to everyone. There are four main divisions which are industrial power control, automotive, chip card and security and lastly power management and multimarket in the case company.

The case company started its operation in the year 1973 and become the largest backend manufacturing site which is focusing on assembly and testing facilities. The total building area of the case company is around 123500 m^2. This brilliant achievement from the company had contributed to Malaysia's economic growth in The Historic State. The excellent performance of the case company's operation assures success in today's competitive business environment. The case company also made the company as one of the Melaka's largest employers with a committed manpower of more than 8200.

There are four main segments from this company which is discrete segment, power segment, logic segment and sensor segment. This study focused on the discrete segment which is mainly produced automobile product such as a transistor and integrated circuits. Varieties of packages have been produced in the discrete segment. However, this study is focusing on taping process of 'X' product package. A total of 7 unit taper machines are available in the production line and used to tape the 'X' product package after testing. Only the good testing units will be tape and proceed to the next step and defect units will be scrapped.

1.3 Problem Statement

Yield loss is one of the key items in manufacturing company because it is one of the contributions for overall production cost. Overall production cost will increase if yield loss is transpired along the processes. The current problem found in the production line is the taper machines are encountering high yield loss (approximately 5.7%) after testing although process sustaining is continuously implemented. High yield loss is significant in a high volume manufacturing industries and it also means that low quality yield of the products. When the quality yield is low, it indicates the yield loss is high which resulted in low OEE. The yield loss is caused by different type of defects in taper machines. However, the root causes of defects that responsible for the yield loss are needed to be determined. It is important to determine and address the root causes of the defects by using a suitable approach in order to reduce the yield loss. Thus, the case company planned to identify all the potential root causes to reduce the yield loss as to improve OEE and profitability.

1.4 Objectives

The main purpose of this study is to improve the quality yield as to improve OEE for taping process by reducing defects that contributed to the yield loss. The objectives that need to be accomplished in this study include:

a) To study the 'X' product package manufacturing process.
b) To identify the primary defects that can contribute to yield loss.
c) To determine the root cause of defects for taping process.
d) To propose and implement the corrective actions for respective defects based on the root causes.

1.5 Scope of Study

This study concentrates on the yield loss for taping process for 'X' product package. The study is carrying out on the taper machine which is situated at the discrete segment. The data is based on 7 unit taper machines from financial year of 2015/2016. Based 12 log weeks data, the primary defects that contribute to yield loss for taping process can be identified by plotting Pareto chart using Microsoft Excel. This study focused on the quality parameter in improving OEE in the taping process. The machine performance and equipment availability are not considered in this project.

1.6 Significance of Study

The goal of the study is to improve the quality yield of taping by reducing yield loss in order to increase OEE, profitability and satisfy customer requirement. Through this study, the root causes that contribute to the yield loss can be determined by analyzing the collected data. Hence, corrective actions can be identified to solve the problem. By solving the problem, the company can obtain a better taping performance meanwhile gaining more profit due to no additional costs are needed for scrapping the defective units. Furthermore,

this study also helps to minimize the causes that leading to quality issues and ensure the provided solutions can bring potential benefits for the case company.

1.7 Organization

There are five chapters are presented in this report.

Chapter 1 starts with the short overview of introducing the study's background and company's history. It is continued by the problem statement facing by the case company. The objective to be achieved in this study is stated. Finally, this chapter also includes scope and the significant of the study.

Chapter 2 covers the literature review of the study which shows the prior research related to this study. It encompasses the basic theories of quality, Statistical Process Capacity (SPC), Overall Equipment Effectiveness (OEE) and the overview of yield based on the previous studies such as journals, books, articles, theses, internets and other resources. In the end of this chapter is the summary of all the published works.

Chapter 3 presents the overview of the research methodology of the study. It describes the appropriate procedural information on the data collection and interpretation approach in order to accomplish the goals of the study.

Chapter 4 analyzes the collected data by using different type of tools and discusses about the result. The real-time data is collected from the case company then evaluated and discussed further in details. The quality tools such as Pareto chart and Ishikawa diagram are used to identify the causes that contributed to the yield loss. There are also some recommended solutions to reduce the yield loss is presented at the end of this chapter.

The finding in this study and relative information based on the previous chapter is concluded in Chapter 5. Finally, recommended actions for the future improvement of the project are briefly discussed.

CHAPTER 2
LITERATURE REVIEW

2.1 Quality

Quality can define in many ways and the definition has changed over time. In a simple way, quality knows as a product with its typical characteristics is conformance to the customer requirements (Irechukwu, 2009). Quality defines as fitness for purpose or use which is driven by customer satisfaction. This definition according to Dr. Joseph Juran (1998), is a product or service as the compatibility in term of features, availability, safety, and conformity. He believes that about 80 percent of the defects are management controllable. Therefore, he defines quality management in the terms of trilogy which contain quality planning, quality control and quality improvement (William and Sum, 2014).

Another important definition for quality is the quality is proportional to variability. The father of quality, Deming mentioned that by distinguishing the special and random causes of variation can reduce the variation in output (Hopp and Spearman, 2001). By the way of explanation, quality and variability are intimately linked because as the quality increased and the variability will be decreased (McCabe 1998). The relationship between variability and quality is closely related to the cost.

The final two perspectives on quality are the customer's perspective and customer's perspective which dependent on each other as shown in Figure 1.1 (Russell and Taylor, 2011). The product design is customer-motivated but it can't proceed without the participation of the production process. If a product is designed without thinking how it will be produced then the production process is impossible to meet the specifications of the design. The final determination of quality is the fitness for consumer use that got from the