

**A TRIZ APPROACH TO REDUCE CYCLE TIME IN
SEMICONDUCTOR TEST PROCESS**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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A TRIZ APPROACH TO REDUCE CYCLE TIME IN SEMICONDUCTOR TEST PROCESS

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

by

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.....
(Project Supervisor)

ABSTRAK

Syarikat-syarikat sedang bertumpu mengenai cara membaiki dan mengurangkan masa kitaran pembuatan untuk meningkatkan keuntungan dan pemprosesan. Projek ini telah dijalankan di satu multinasional semikonduktor syarikat. Syarikat ini sedang mengalami dengan pemprosesan yang rendah kerana masa kitaran lot tertutup panjang dalam proses ujian. Dalam proses ujian, satu lot akan menjalani satu siri operasi iaitu operasi vision, ujian dan tapping, operasi 100% visual ujian dan operasi kualiti akhir pelepasan. Tujuan projek ini adalah mengurangkan masa kitaran operasi dalam proses ujian. Objektif adalah untuk mengenalpasti jenis operasi yang tidak mencapai dengan masa kitaran yang dirancangan, menyiasat masalah-masalah yang berkaitan dengan masa kitaran operasi dan menganalisis serta mencadangkan penyelesaian untuk mengurangkan masa kitaran operasi dalam proses ujian. Kaedah TRIZ telah digunakan dalam projek ini. Pertama, data masa kitaran 3 operasi telah diekstrakkan daripada sistem perolehan data dan dianalisis dengan carta bar untuk mengenalpasti jenis operasi yang tidak mencapai dengan masa kitaran yang dirancangan. Berdasarkan analisis data, hanya operasi vision, ujian dan tapping yang tidak mencapai dengan masa kitaran yang dirancangan. Kemudian, Sebab dan Akibat Analisis telah dijalankan untuk mengenalpasti punca-punca potensinya. Selepas itu, Pemangkasan telah digunakan untuk mengeluarkan semua punca-punca yang tidak ketara dan mengenalpasti punca-punca yang paling ketara. Akhirnya, Percanggahan Matriks telah digunakan atas punca-punca yang paling kritikal untuk mencadangkan penyelesaian dengan menggunakan konsep 40 Prinsip Berdaya Cipta. Sebanyak 4 penyelesaian telah dicadangkan, namun hanya 3 penyelesaian yang telah dilaksanakan untuk 1 mesin. Hasil ujikaji menunjukkan penyelesaian dapat mengurangkan masa kitaran operasi vision, ujian dan tapping sebanyak 14.63% dan meningkatkan OEE mesin ujian sebanyak 14.36%. Menurut status ekonomi syarikat, peningkatkan OEE sebanyak 14.36% membolehkan syarikat beruntung sebanyak RM 1,148,800 setahun. Ini juga boleh menurunkan kos penyelenggaraan dan pembaikan serta meningkatkan hasil produk yang membolehkan syarikat mencapai pemprosesan yang tinggi.

ABSTRACT

Companies are focusing on how to improve and reduce the manufacturing cycle time to increase the profit and throughput. This project was carried out in a multinational semiconductor company. The company is now experiencing with low throughput due to the long close lot cycle time in the test process. In the test process, a lot will undergo a series of operations which are vision, testing and taping operation, 100% visual testing operation and quality final clearance operation and the time taken is defined as close lot cycle time or lead time of the test process. The purpose for this project is to reduce cycle time of the operations in the test process. The objectives are to identify the type of the operations that are not meet with the planned cycle time, to investigate the problems related to the cycle time of the operations in the test process and to analyse and to propose the solutions to reduce the cycle time of the operations in the test process. TRIZ methodology was deployed in this project. First, cycle time data of the three operations was extracted from the data acquisition system and analysed with the bar chart to determine which type of the operations that are not meet with planned cycle time. Based on the data analysis, only vision, testing and taping operation are not meet with planned cycle time. Then, Cause and Effect analysis was conducted to determine its potential root causes. After that, Trimming was apply to remove all non-significant root causes and determine the most significant root causes. Lastly, Contradiction Matrix was used on the most critical root causes to propose solutions by implementing the 40 Inventive Principles concept. A total of 4 solutions were proposed but only 3 solutions were being implemented for pilot run on 1 machine. The result of pilot run showed that those solutions are able to reduce cycle time of the vision, testing and taping operation by 14.63% and increase the OEE of the testing machine by 14.36%. According to the cost estimation of the company, by increasing 14.36% in OEE allows the company earn around RM 1,148,800 in a year. Additionally, it help to reduce maintenance and repair cost and increase the yield of the products which allows the company to achieve high throughput.

DEDICATION

Only

my beloved father, Chiong Poh Huat

my appreciated mother, Thor Ay Pyng

my adored sister and brother, Chiong Li Xiang, Chiong Wei Hoe and Chiong Wei Jie
for giving me moral support, money, cooperation, encouragement and also understandings

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LIST OF ABBREVIATIONS AND SYMBOLS

ARIZ	-	Algorithm for Inventive Problem Solving
AV	-	Availability
CT	-	Cycle Time
CTE	-	Cycle Time Effectiveness
DMAIC	-	Define, Measure, Analyse, Improve, Control
FYP	-	Final Year Project
JIPM	-	Japan Institute of Plant Maintenance
OEE	-	Overall Equipment Effectiveness
OTE	-	Overall Throughput Effectiveness
PP	-	Performance
Q	-	Quality
RM	-	Ringgit Malaysia
TH	-	Throughput
TPM	-	Total Productive Maintenance
TRIZ	-	Theory of Inventive Problem Solving
WIP	-	Work In Progress
\$	-	United States Dollar
%	-	Percent

CHAPTER 1

INTRODUCTION

This chapter explains the overview of this project. First, it explains the background of study. Then, it proceeds with the problem statement of the project. It also deliberates the objectives, scope and limitations of the project. Lastly, it illustrates the significance of study and organization of dissertation regarding the project. All information is illustrated in detail.

1.1 Background Of Study

In the last decade, a significantly alter has gone through in the semiconductor industry (Chan et al., 2005). The technology in the semiconductor industry has been dramatically advancing and its manufacturing process is the most sophisticated manufacturing process compared with other industries.

In today's market competition between semiconductor industries is becoming fierce due to the advance of technology. The successful of any manufacturing industry highly rely on its performance to incorporate cost reduction and enhance productivity in its productions (Sharma and Shudhanshu, 2012). Semiconductor industries are being forced to focus on improving productivity by meeting the requirements of having shorter time to market, competitive pricing, stricter quality requirements, higher accuracy and reliable delivery in order to survive in the competitive market (Eswaramurthi and Mohanram, 2013).

There are many channels to evaluate the productivity of an industry. For instances, overall equipment effectiveness (OEE), process capability, cycle time and labour utilisation. The productivity of an industry highly rely on the efficiency and effectiveness. Efficiency reflect a performance level that describes a process that deploys the lowest amount of inputs

to transfer the greatest amount of output. Effectiveness is the degree to which objectives are accomplished and the extent to which targeted problems are solved.

The International Roadmap for Semiconductors 2006 Update has been emphasized the essential role of cycle time plays in the semiconductor industry (Semiconductor Industry Association, 2006). It states that there is a need for cycle time improvement to meet its target in order to avoid the declining of the industry's growth. Thus, cycle time is essential to the productivity of industries. Cycle time is influenced by operations variability. For example, it is affected by machine breakdown, waiting for operator, long changeover time and non-value added activities.

The machines used in the semiconductor industry is the most advanced and sophisticated compared with other industries. To ensure the high return of investment, these machines must always efficiency and effectiveness to make sure the manufacturing cycle time is short to meet the customer demand and incorporate with cost reduction. Relkar and Nandurkar (2012) mentioned that overall equipment effectiveness (OEE) is essential metric of performance measurement for equipment effectiveness. Total productive maintenance (TPM) activities have been proved to increase the productivity improvement dramatically for individual equipment, especially in the semiconductor industry (Huang et al., 2002). He mentions that TPM reduce machine breakdown to improve overall equipment effectiveness (OEE). The activities of TPM does improve the availability of the equipment and can reduce the need for further capital investment (Dogra et al., 2011).

This project is being carried out in a semiconductor industry in Malacca, Malaysia. The company is a multi-national company. It's headquarter is located in Germany. It has many locations of manufacturing and research development across the world.

1.2 Problem Statement

The case company is one of the most capital intensive industries with a high ratio of capital investment to revenue. The concept of time to market is of prime importance. The key to ensure a high return of investment is by shorting the cycle time for each lot to improve

the productivity, reduce the holding cost and shorten time to market. For a lot, it will undergo a series of process in this company such as assembly and test process.

Currently, this case company is facing long cycle time for the lots to be market out. This is because one of the process which is test process take a long cycle time for the lots to be process. In the test process, a lot will undergo a series of operations which are vision, testing and taping operation, 100% visual testing operation and quality final clearance operation and the time taken is defined as close lot cycle time or lead time of the test process. With the long close lot cycle time in the test process, the company is now dealing with low throughput which the number of finished products produced per unit of time is low thus cannot shipped on time to meet customer demand. Figure 1.1 shows a series of operations in the test process.

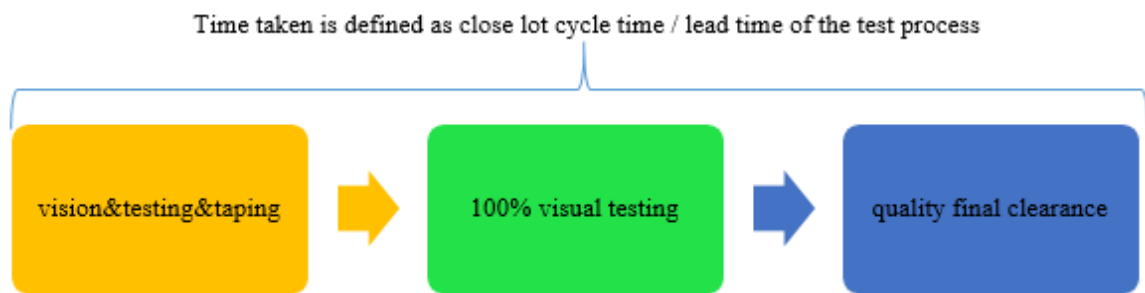


Figure 1.1: A series of operations in the test process.

There is a target of cycle time for the lots to be processed (which is 2.52 days) in the test process for reference purpose, however the cycle time of the operations always more than this target. One of the most significant source of variation towards long cycle time is the operations variability.

This project is motivated by the problem facing in the test process to shorten the cycle time of the operations so that their close lot cycle time is short to result a shorter time to market. Thus, the main purpose of this study is “How to reduce cycle time of the operations in the test process”.

1.3 Objectives

The purpose for this study is to reduce cycle time of the operations in the test process. The objectives are stated as below.

- i. To identify the type of the operations that do not meet with the planned cycle time.
- ii. To investigate the problems related to the cycle time of the operations in the test process.
- iii. To analyse and propose the solutions to reduce the cycle time of the operations in the test process.

1.4 Scopes And Limitation Of Study

In this study, the scope will be focus on the testing machines in the test process. The historical data from the data acquisition system is collected for analysis purpose. The limitation of study will be focus on the package Y. This project will be focus on the same lot size of 90,000 which is the average of the lot size and concentrate on the same type of lots which is fresh lot. This project does not include on the management of the company and quality and cost of the machine.

1.5 Significance Of Study

The importance of this study is to reduce the cycle time of the operations in the test process so that the close lot cycle time in test process is short to meet customer demand. This study assists to identify the root causes of long cycle time of the operations in the test process and propose solution to implement in order to solve it.

1.6 Organization Of Dissertation

The project will be organized as follows. Chapter 1 discusses the background of project, problem statement, objectives, scope and limitation and significance of study. Chapter 2 presents the overview of the related topic such as maintenance, Overall Equipment

Efficiency (OEE), Total Productive Maintenance (TPM), cycle time, cycle time reduction in different field of industries and the problem solving tools that has been utilised by other researchers to reduce cycle time. Chapter 3 illustrates the methodology used in this project. Chapter 4 describes the flow of the operations in the test process, the process of the selected operation in test process and discusses how the data being collected and analysed. Chapter 5 discusses the cycle time detractor and its root causes. The solutions to reduce cycle time will be discussed and proposed as well. Chapter 6 concludes the whole project and give recommendation for future research.