LEAN MANUFACTURING AND OEE OPTIMIZATION OF SEMICONDUCTOR INDUSTRY THROUGH SCHEDULED DOWNTIME REDUCTION AT TESTING PROCESS

HO CHEE HUAY

Master of Manufacturing Engineering
(Manufacturing System Engineering)

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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in fulfillment of the requirements for the Master of Manufacturing Engineering
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Supervisor Name : Profesor Madya Dr. Mohd Rizal bin Salleh

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DEDICATION

To my beloved God, Family and Friends

ABSTRACT

Semiconductor Manufacturing Industry such as Infineon Technologies Company often looks for ways to improve their production and management processes in order to remain competitive in the market. This calls for ways to reduce production cost, enhance productivity and improve product quality. The aim is to utilize all the available resources efficiently and effectively in order to provide their customers with high quality products at a low price. Aimed at these motives, several improvement strategies and tools had been proposed to satisfy the organization's needs. Such initiatives include optimizing the Overall Equipment Effectiveness (OEE), lean manufacturing and others. Machine performance is one of the critical factors which reflects productivity capability and often is measured by OEE. A steep production demand ramp-up in year 2015 threatened a potentially huge investment for Microflex machines in Infineon. The objective of the study is to optimize OEE loss of scheduled downtime by reducing change lot duration in order to improve the OEE of MicroFlex machines. DMAIC is one of the adopted systematic approaches to identify the gaps. The biggest challenge is the high complexity of OEE losses that comes from multi-dimensional influencing factors. Several ideas were transformed into holistic and realistic approaches. With zero defect quality in mind, it has never been compromising in quality in the course of action to improve OEE. The most important criteria to an OEE improvement project is to have tracking system categorized its OEE factors and sources of loss in a manner that allow continuous focus on specific correlation of equipment performance. Many lean tools are applied in the report such as Kaizen, SMED, MOST Technique, PDCA, SIPOC and others. Several hypotheses are made to seek on the potential improvement plans for change lot time reduction. Each of the hypotheses are verified in the pilot run and justified based on the time study simulation. The overall improvement activities introduced in the study are manufacturing wastes elimination, SMED concept converting the internal activity to external activity and others. Last but not least, the study has successful optimized the scheduled downtime through change lot time reduction after implementation of improvement activities. The results are positive which the scheduled downtime is reduced from 4.1% to 2.9%. Also, the change lot time has shortening from 12.9 minutes to 7.43 minutes.

ABSTRAK

Industri pembuatan semikonducktor seperti Infineon Technologies Syarikat sering mencari cara untuk meningkatkan proses pengeluaran dan pengurusan mereka untuk terus berdaya saing dalam pasaran. Ini memerlukan cara-cara untuk mengurangkan kos pengeluaran serta meningkatkan produktiviti dan kualiti produk. Tujuannya adalah untuk menggunakan segala sumber yang sedia ada dengan cekap dan berkesan untuk memberikan pelanggan mereka produk-produk yang berkualiti tinggi pada harga yang rendah. Beberapa strategi peningkatan dan teknik telah dicadangkan untuk memenuhi keperluan organisasi. Inisiatif tersebut termasuk mengoptimumkan Keberkesanan Keseluruhan Equipment (OEE), pembuatan lean dan lain-lain. Prestasi mesin adalah salah satu faktor kritikal yang mencerminkan keupayaan produktiviti dan sering diukur dengan OEE. Dengan adanya permintaan yan tinggi untuk pengeluaran pada tahun 2015, ia telah mengancam pelaburan yang berpotensi besar untuk membeli mesin Microflex di Infineon. Objektif kajian ini adalah untuk mengoptimumkan dan meningkatkan OEE mesin MicroFlex dengan mengurangkan masa pertukaran lot yang agak tinggi. DMAIC adalah salah satu cara yang sistematik digunakan untuk mengenal pasti dan menyelesaikan punca masalah. Kriteria yang paling penting untuk meningkatkan OEE adalah mempunyai sistem pengesanan yang dapat melaksanakan analisis dengan mengkategorikan semua faktor yang terlibat. Cara-cara yang telah digunakan dalam kajian ini adalah seperti "Kaizen", "SMED","MOST" dan lain-lain. Selain itu, beberapa hipotesis telah dicadangkan sebagai pelan penambahbaikan masa untuk penukaran lot. Akhir sekali, kajian ini telah berjaya mengoptimumkan OEE daripada 4.1% ke 2.9% dan tempoh masa untuk penukaran lot dikurangkan daripada 12.9 minit ke 7.43 minit.

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%	-	Percentage
BE	-	Back End
CL	-	Control Limit
D	-	Defects
DN	-	Downtime
EN	-	Engineering
EOL	-	End Of Line
FE	-	Front End
h	-	Hour
I	-	Inventory
ITFM	-	Infineon Total Fab Monitoring
LCL	-	Lower Control Limit
M	-	Motion
Mins	-	Minutes
MOST	-	Maynard Operation Sequence
NS	-	Non-Scheduled Time
NVA	-	Non Value Added
OD	-	Over Production
OEE	-	Overall Equipment Effectiveness
OP	-	Over Processing
OT	-	Operation Time

OVA	-	Operation Value Added
PDCA	-	Plan Do Check Act
PR	-	Production Run
s	-	Second
SB	-	Standby
SD	-	Scheduled Downtime
SDS	-	Setup time
SIPOC	-	Supplier, Inputs, Process, Outputs, Customers
S.M.A.R.T	-	Specific, Measurable, Assignable, Realistic, Timing
SMED	-	Single Minute Exchange of Dies
T	-	Transportation
TPM	-	Total Productive Maintenance
TT	-	Total Time
UCL	-	Upper Control Limit
UD	-	Unscheduled Downtime
UDW	-	Undefined Waiting
UPH	-	Unit Per Hour
VA	-	Value Added
W	-	Waiting

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CHAPTER 1

INTRODUCTION

1.0 Background

The semiconductor manufacturing industry is mainly one of the high exports contributor in Malaysia. Generally, there are many types of products produced such as security identity card, transistor, automotive chips, chip card and others. Most of the products are integrated for application in car's system. The applications are such as air bag system, braking control system, steering control system and others. Nevertheless, semiconductor manufacturing is one of the economical demanded businesses in the global market. As of today, the growth of car demand in the global market is increasing tremendously. The car demand increase is proportional to the semiconductor products' demand volume. Therefore, the productivity of the semiconductor manufacturing industry plays an important role to fulfill the market demands and their customers.

The process of semiconductor manufacturing company is classified into Front End (FE) processs and Back End (BE) process manufacturing. The front end processes are mostly related to produce the wafer probing and wafer fabrication. The back end processes includes processes such as wafer saw, die bond, wire bond, molding, trim/form, testing, marking, scanning and packing. Testing process is to test the functional property of the products before deliver to customer in order to achieve the zero defects commitment.

Thus, Overall Equipment Effectiveness (OEE) is the key factor to achieve higher productivity which avoid additional investment cost incur. Of course, the ideal OEE should

be 100% but it is rather impossible as there are many OEE loss factors. One of the OEE loss factors is the scheduled downtime. This study is to analyze and improve the issue of high scheduled downtime due to longer change lot duration in the industrial manufacturing.

In general, a change lot is defined as the elapsed time between the last productivity of product A leaving the machine until the first good product B is produced (Dirk Van Goubergen et al., 2002). The desired is to reduce this time so that the machines will have more productive time to produce more parts. Change lot time includes the run down, set up and run up of the machine, in which set up is defined as the time required to prepare the machine for product B and is performed when the machine is idling. In this report, the term set up reduction and change lot reduction are used frequently. Set up refers to the downtime of the machine and Change lot means the entire process that is occurring during production from product A to product B.

Setup reduction was basically defined by a Japanese engineer named Shiegeo Shingo who implemented Single Minute Exchange of Dies (SMED) methodology. Another great methodology from Shingo is about his observations that concluded that setup operations needed to be distinguished of its internal and external operations. In which, internal operations are performed while the machine is running whereas external operation performed when the machine is not productive (Shingo, 1985).

Competing against today's global market, companies have been forced to look at ways to boost productivity and diversify their product lines while still maintaining short lead time which still producing high quality products. Toyota's Just-In-Time (JIT) was one of the common principles adopted by many companies which aim to reduce inventory and lead time. In fact, during setup implies essential lost times where the company is not