UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

IMPLEMENTATION OF KANBAN SYSTEMS THROUGH AUTO SCHEDULING TOOLS AT DIE BOND PROCESS

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MARIATI BINTI SABAH

A thesis submitted
in fulfillment of the requirements for the degree of Master of Manufacturing Engineering (Manufacturing System Engineering)

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I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Manufacturing Engineering(Manufacturing System Engineering)

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DEDICATION

I dedicate my dissertation work to my family and many friends. A special feeling of gratitude to my loving parents, Mr Sabah and Mrs Sahara whose words of encouragement and push me to went through all the challenges along the way to complete my Master. Not to forget, this dedication is to my lovely husband Muhammad 'Afif Jufri who is always be by my side through ups and down.

I also dedicate this dissertation to my friends and working colleagues who havesupported me throughout the process. I will always appreciate all they have done,especially Mr Kalai for helping me develop my skills and knowledge in Planning, Arba'ayah for the many hours helping me in the formatting and idea to complete this project.

I dedicate this work and give special thanks to my supervisor Prof Adi Saptari for his willingness to guide me and brainstorm together in developing the project with good input and results. In a nut shell, all of them are the key person and backbone for my great achievement in this project.

ABSTRACT

Nowadays, many manufacturers are now critically evaluating their processes to determine their effectiveness in bringing maximum value to customers where the techniques can give greatly minimize delays, reduce costs, and improve quality. Lean manufacturing is more than a set of tools and techniques and has been widely adopted by many production companies when combined and matured, allow to reduce and eliminate the waste from a company. It can be a continuously look for ways to improve processes and being used in Production Planning. Production planning and scheduling becomes very important part of production management because companies have to react to dynamic market conditions and rising customers' requirements for shorter delivery times, lower prices and better quality and services.

The company under study facing the problems of not meeting the parameters production which is under the target, among other parameters such as productive time and target ratio. The study investigated the causes of the problem through statistical analysis of the current achievement. It was found among the problem was human errors and transferring data among the department. This make miscommunication between departments. Kanban system approach was use to solve this problem, at the same time it combined with auto scheduling to eliminate miscommunication among the department on the production target between the supplier and user between two department.

This Kanban System improved by integrating the Auto Scheduling tools for better Production planning. This can be shown by the increasing of productive time, eliminating miscommunication in the target. The objective of this study is to highlight the Kanban system implementation together with the Auto Scheduling have improved the manufacturing system as well as achieved "Just In Time" practice.

ABSTRAK

Pada masa kini, banyak pengeluar kini kritikal menilai proses mereka untuk menentukan keberkesanannya dalam membawa nilai maksimum kepada pelanggan di mana teknik yang digunakan boleh memberikan banyak pengurangan kelewatan, mengurangkan kos, dan meningkatkan kualiti. Pembuatan Lean adalah lebih daripada satu set alat dan teknik dan telah digunakan secara meluas oleh syarikat-syarikat pengeluaran dimana apabila digabungkan dan matang, akan membolehkan anda untuk mengurangkan dan kemudian menghapuskan sisa dari sebuah syarikat. Ia boleh menjadi satu secara berterusan untuk melihat cara-cara untuk penambah baikkan proses dan digunakan dalam Perancangan Pengeluaran. Perancangan pengeluaran dan penjadualan menjadi bahagian yang sangat penting dalam pengurusan pengeluaran kerana syarikat-syarikat perlu bertindak balas terhadap keadaan dinamik pasaran dan memenuhi keperluan pelanggan yang semakin meningkat dengan masa penghantaran yang lebih pendek, harga yang lebih rendah dan kualiti dan perkhidmatan yang lebih baik.

Syarikat yang terlibat dalam pengkajian ini mengalami masalah di mana ianya tidak dapat memenuhi pengeluaran parameter iaitu dibawah sasaran, dan antaranya adalah masa produktif dan nisbah sasaran. Pengkajian ini menyiasat punca-punca masalah melalui analisis statistik daripada pencapaian semasa. Ianya mendapati antara masalah itu adalah kesilapan manusia dan pemindahan data di antara jabatan. Ini menimbulkan salah faham diantara kedua-dua jabatan. Pendekatan Kanban Sistem digunakan untuk menyelesaikan masalah ini, dan dalam masa yang sama ianya digabungkan dengan Penjadualan Auto untuk menghapuskan salah faham antara jabatan kepada pengeluaran sasaran diantara pembekal dan pengguna antara dua jabatan.

Kanban Sistem ini diperbaiki dengan mengintegrasikan alat Penjadualan Auto untuk perancangan Pengeluaran yang lebih baik. Ini dapat dilihat dengan peningkatan masa produktif, penghapusan salah faham dalam sasaran diberikan. Objektif pengkajian ini adalah untuk menyerlahkan pelaksanaan Kanban Sistem bersama-sama dengan Penjadualan Auto telah menambah baik sistem pembuatan serta mencapai amalan "Tepat Pada Masanya'.

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LIST OF ABBREVIATIONS

DB	-	Die Bond
FOL	-	Front of Line
EOL	-	End of Line
WIP	-	Work In Progress
JIT	-	Just In Time
TCR	-	Target Cost Roadmap
PR	-	Productive
SB	-	Standby
UD	-	Unscheduled Downtime
SD	-	Scheduled Downtime
EN	-	Engineering
OEE	-	Overall Equipment Effectiveness
BE	-	Back End
FE	-	Front End
PA	-	Pre Assembly
CLIP	-	Confirm Line Item Performance

CHAPTER 1

INTRODUCTION

1.0 Background

Previously, traditional manufacturing uses 'push' system which means they run the process in mass production. The consequences of this type of production it builds bulky production or huge inventory of product. This approach may cause exceeding the demand requested that might cause over-processing and over-production. This push concept works by pushing all the materials from one location to other location but this creates big problem for people on the floor in dealing with huge WIP inventories, unsynchronized production processes and producing non-required products.

In this era, a rapid semiconductor industries compete among each other in order to determine their effectiveness in bringing maximum value to customers by reducing cost, eliminate waste and increase their profit. The concept of Lean manufacturing is now introduced to industries. This concept has brought manufacturing control systems. It introduces a systematic approach to identify and eliminate waste through continuous improvementflows the product at the pull of the customers in pursuit of perfection. Lean manufacturing is a philosophy to provide better quality of products with lower cost and on time with lesser efforts.

Modi (2014) defined that Lean Manufacturing is defined as a philosophy based on Toyota production system and other Japanese Management Practices that strives to shorten the time line between the customer order and the shipment of the final product by consistent elimination of waste. There are many tools in Lean Manufacturing such as Kaizen, Jidoka, 5S, Standardization of work, Gemba, Total Productive maintenance, Value Stream Mapping, JIT (Just In Time) and etc.

One of the well-known tools in Lean is Kanban system. It is practical; it synchronizes all manufacturing activities entire manufacturing with customer demands. It helps to improve the company's productivity and at the same time it saves cost by eliminating over production, developing flexible work stations, reducing wastes and scrapes, minimizing the waiting times and logistics costs; thus reducing the inventory stock levels and overhead costs. The Kanban system requires production only when the demand of products is available. Surendra et al. (1999) stated that Kanban (kahn-bahn) is a Japanese word; when translated it literally means "visible record" or "visible part". Generally, it refers to a signal of some kind; thus in manufacturing, it refers to Kanban cards.

The Kanban system is based on customer demand; it pulls the part from the supplier. The customer can be an actual consumer of a finished product (external) or it can be also the production personnel at the succeeding station in a manufacturing facility (internal). Likewise, the supplier could be the person at the preceding station in a manufacturing facility. The premise of Kanban is that material will not be produced or moved until a customer sends the signal to do so. These tools are used to visualize abnormality and assist production associate to work according to takt time. Just-in-Time (JIT) (Ohno 1982) is a well-known philosophy of pull production. The objective of JIT is to minimize the waste by producing items only when needed (Groenevelt 1993), where

Kanban plays a critical role in the implementation of JIT. According to Monden (1983), the conditions for Kanban to work well are: a stable product mix, short setups, proper machine layout, job standardization, improvement and automation.

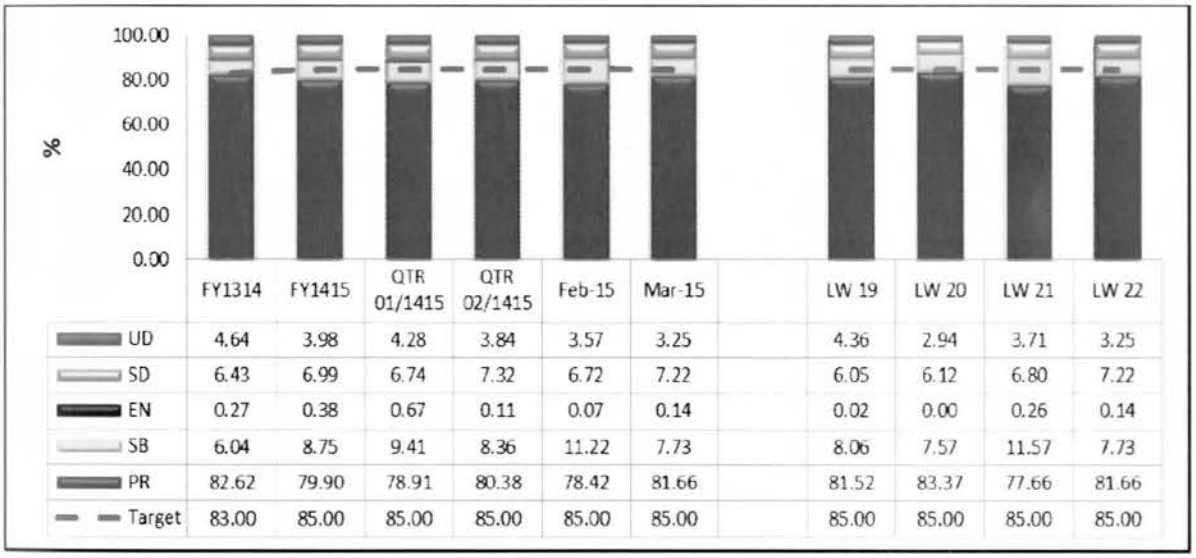
Kanban System is also known as a pull system. A pull system makes decisions based on the most updated information, such as current shop floor conditions, incoming job arrival times and updated demand information. When making present decisions, it simply uses present information, and the feedback can be used for closed-loop control (Spearman and Zazanis 1992). When making future decisions, it does not use forecast but regards the future as present and uses the most updated information. In order to have an efficient pull system in Production Planning, scheduling is one of the useful approach and tools to be apply. Scheduling is the action of manufacturing products from components or raw materials to realize the planning level decisions by limited resources at a certain time.

In order to optimize the profit at a certain time, scheduling has to satisfy the demand (i.e., production quantity and sojourn time) from the planning level. In the optimization models of a scheduling problem, the planned demand is reflected in the objective function, components or raw materials are the work-in-process (WIP), and resources are captured by the constraints. Based on Blackstone et al. (1982), the definition of dispatching is defined as follows.

1.1 Problem Statement

Manufacturing semiconductor industrieschallengemany disturbances whether internal or external that might cause hiccups and jerk in running the production line. Typically the types of disturbance during running production are like Idling/Waiting

(Standby time), Scheduled and Unscheduled downtime, Inventory or Work in Process (WIP), Processing waste, Transportation, Motion and Making defective products and etc. Based on information of the previous running production at Quarter 1 and Quarter 2 at Die Bond process, (refer Figure 1.0) the OEE (overall Equipment Efficiency) identified as PR (Productive time) shows average 79% not even meeting TCR target 83% at Die Bond process. This can be seen when the standby time (SB) is high, more than 5% due to waiting wafer and material from supplier and it can also happened during break time waiting for operator. Moreover, scheduled downtime (SD) is also high, more than 5% due to conversion and frequent change of lot. All of these disturbances are called as 'waste' and essentially this is anything that the customer is not willing to pay for.



	FY1314	FY1415	QTR 01/1415	QTR 02/1415	Feb-15	Mar-15	LW 19	LW 20	LW 21	LW 22
UD	4.64	3.98	4.28	3.84	3.57	3.25	4.36	2.94	3.71	3.25
SD	6.43	6.99	6.74	7.32	6.72	7.22	6.05	6.12	6.80	7.22
EN	0.27	0.38	0.67	0.11	0.07	0.14	0.02	0.00	0.26	0.14
SB	6.04	8.75	9.41	8.36	11.22	7.73	8.06	7.57	11.57	7.73
PR	82.62	79.90	78.91	80.38	78.42	81.66	81.52	83.37	77.66	81.66
Target	83.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00

Figure 1.0: OEE PR at Die Bond for Q1 and Q2 FY1415

To be competitive, the company needs to improve the overall efficiencies to the level of competitive, this translate to Target more than 90%. Therefore, it is necessary to study this problem and introduced a solution that may achieve the target.

1.2 Aim and Objectives

The purpose of the project is to study the effectiveness of Lean Techniques in manufacturingsemiconductor industry through automation system. The objectives are:-

i. To investigate the problems occur at Die Bond planning process.

ii. To design Kanban System in order to improve line stability.

iii. To develop Auto Scheduling tools for systematic and eliminate the mistakes and human error as well as shorten the time for Die Bond planning.

1.3 Scope

This study conducted at Production Line which is at Assembly Front of Line (FOL), Infineon Technologies. The tool applied at Die Bond process which the first process in manufactured the units.

The customer in this project refers to the station of the Die bond process, and the supplier was the sawing process.

This project applies Kanban System in order to emphasized minimum level of inventory by producing only what is needed. It ensures the supply of the right product, at the right time, in the right quantity and at the right place.

1.4 Significance of Study

The purpose of this study is to reduce the lead time (standby time) from one process to next process and increase the productivity. Moreover, the implementation of this Kanban System applied Lean Techniques and shows that this systematic and efficient tool to sustain the line stability in Manufacturing Industry. On top of it, the achievement in shortens the lead time (less standbys) and improvement of OEE increase the machine

performance and productivity thus will fulfil the customer requirement to get their part at the right time.

1.5 Organization of the thesis

This project paper consists of five chapters, namely introduction, literature review, methodology, results and discussion and conclusion.

In the first chapter, it discusses a brief introduction on the background of semiconductor manufacturing industry competition, current tools used in manufacturing and also discusses and the problem statement. The main objectives of this study are discussed and the significance of this study is also introduced.

Chapter 2 focuses on the literature of the variables in this project. It discusses manufacturing processes in semiconductor industries, current techniques uses in production planning processes.

Chapter 3 discusses the methods used to conduct this research. It starts with the identifying the problems in die bond processes. Then it discusses the method of applying Kanban, and lastly it introduces the solution or recommendation to improve the productivity.

Chapter 4 presents the results and discussion. In this chapter, the data collected are analyzed to show more detail on the problems. It also deliberates the Kanban model development to eliminate and reduce the wasted, more specific is how to solve the problem encountered.

Chapter 5 is the last chapter, which concludes this study with key findings of the results obtained. Besides that, the contributions and limitations in this research are also discussed.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In Infineon Technologies produces chips and focuses on the three central challenges facing modern society: Energy Efficiency, Mobility and Security and offers semiconductors and system solutions for automotive and industrial electronics and chip card and security applications. Infineon Technologies Malacca is one of the biggest production plants for Semiconductor Industry which is called as Back End operations. The company processes semiconductor from Front (raw material) to Back (End Process) until ship the lots to customer.

Basically, the process startswith receiving the demand requested from customer and releasing wafers from Front End (FE) whether from Regensburg, Villach and Wuxi. All of these wafers will be sawn at Pre Assembly process. Production area in Infineon is divided into 4 areas which are Pre Assembly, this is a supplier which does a sawing process to saw the wafers release from Die Bank, Assembly Front Of Line (FOL), End Of Line (EOL) and Test. Figure 2.0 shows a diagram of the first process flow at Assembly FOL is start from Die Bond process, then continue to Wire bond process and lastly at FAV (FOL Autovision).

Figure 2.0: Front Of Line process flow

At this process, wafer that already sawn will be send by Pre Assembly to Die Bond to do the die attach to the leadframe in strip to strip form. Next, the frame already bonded with die will send to second process which is Wire Bond process. During this stage, aluminium and copper wire was bonded on the die. And then, the lots will be sent to FAV (FOL Autovision) process to check on the quality of bonded leadframe and punch the reject automatically.

Then the End Of Line process are Molding which the frame form units was molded according to their compound type like CEL, KMC, MP and EME. Figure 2.1 shows the diagram of End of Line processes.

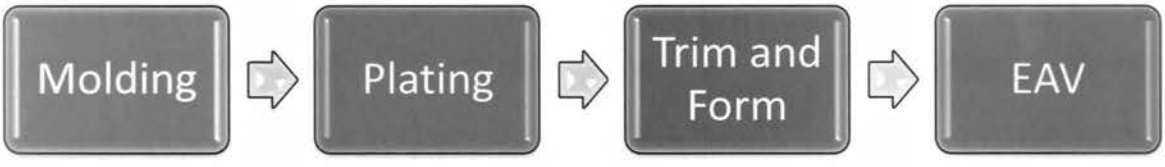


Figure 2.1: End Of Line process flow

After the Molding process, the lots will be ship to subcontractor plating to do the plating and send back the lots to Infineon after 0.8 days. Once reached the lots at EOL area, the frame form lots will going through Trim and Form process to cut the frame into singulated units. And the last process at EOL will be EAV (EOL Autovision) where during this process, the singulated units will going through the vision process to check the reject along the process from Molding, Plating and Trim and Form. Figure 2.2 shows the final

processes. At the end process, the product will be tested before it ships the good units to the customers.

Figure 2.2: Testing process flow

All along the process supply chain reaction, there will be some hiccups and jerk in the production linethat might cause a delaying time to finish the goods. There are many factors that cause a delaying in lead time along the process such as overproduction, means making more product than what is required and making it earlier, standby time (waiting material), scheduled down time (change lot/conversion), and unscheduled downtime. Lead time is the waiting time the client needs to spend for a product delivered to site or service start. From another general point of view, this term refers to the time required for carrying out a particular operation or set of operations. Its measurement begins when all the requirements for a given operation are met (for example: materials, information) and all effects of that operation have been obtained. This term is also known as THROUGHPUT TIME. Lead time categorize into 3 types which are:-

1. Supply Lead Time - The time elapsing between issuing a raw materials order and receiving it from the warehouse.
2. Production Lead Time - The time elapsing between the issue of a production order, raw material delivery from the warehouse for that order, and end product delivery to the warehouse.

3. Inventory Lead Time - The time elapsing between storing a material and picking it up. It is also known as "stock turnover time".

A key variable related to lead time is to customer service, inventory level and cost. And this lead time is the indicator for measuring all sub-processes in production, warehouses and transportation with respect to customer needs.

2.1 Techniques in Production Planning

Production planning and scheduling becomes very important part of production management because companies have to react to dynamic market conditions and rising customers' requirements for shorter delivery times, lower prices and better quality and services. To plan many sophisticated methods and approaches can be applied to produce more efficient and thus meet growing customers' requirements. The tools currently used by manufacturing company are Lean Tools and approach to improve and stabilize their productivity. Figure 2.3 shows the approach of Lean Tools in manufacturing industry.

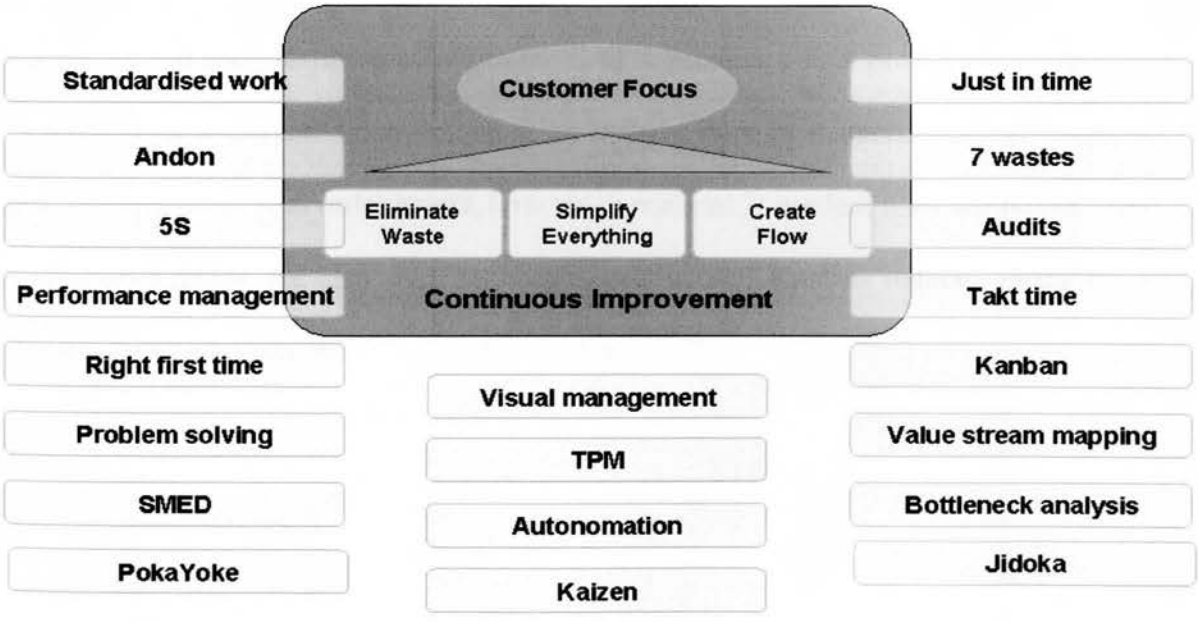


Figure 2.3: Lean tools and techniques: