UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

PRODUCTIVITY IMPROVEMENT FOR VISUAL INSPECTION USING LEAN CONCEPT: A CASE STUDY AT FRONT OF LINE PROCESS

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PRODUCTIVITY IMPROVEMENT FOR VISUAL INSPECTION USING LEAN CONCEPT: A CASE STUDY AT FRONT OF LINE PROCESS

NOEL FRANCISCO A/L AUGUSTINE

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

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

DECLARATION

I declare that this thesis entitle "Productivity improvement for Visual Inspection using Lean Concept: A Case Study at Front of Line process" is the result of my own research except as cited in the reference. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : NOEL FRANCISCO

Date : 08 AUG 2016

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality as a partial fulfilment of Master of Manufacturing Engineering (Manufacturing Systems).

Signature : .....

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DEDICATION

To my beloved wife Kavitha Thevi, children and parents

ABSTRACT

Nowadays, semiconductor manufacturing companies aim for higher productivity with short lead time that will maximize the profit to the organization for their survival. This project is conducted at Infineon Technologies (M) Sdn. Bhd. especially at Front of Line area that focusing on quality performance of visual inspection for die bond and wire bond processes. There are redundant quality visual inspection activities between Production operators and Process Control operators. Here, the production operators whom operate the machines while Process Control operators whom conducting quality surveillance checks perform similar quality visual inspection. Furthermore, there is inconsistent duration of visual inspection activities although the standard work instruction has been provided. Therefore, the aim of the project is to improve the productivity of visual inspection process through elimination of non-value activities at Dpak package Front of Line process by 50%. There are three objectives defined for this project; (i) to identify the NVA and NVA but necessary activities using time study, (ii) to determine root cause of NVA and NVA but necessary and perform simulation with proposed action and (iii) to validate the proposed solutions through implementation of actions for improvement. Time study and brainstorming has been used in order to achieve objective one. Then, the root causes of the NVA and NVA but necessary had been determined using 5 Why's tool. Actions for improvement were proposed and simulated. Finally, the proposed actions for improvement are validated by reduction of total time taken for visual inspection activities. As a result, the total time of visual inspection activities has been reduced for 50% to 70% in which before improvement, total 40% of the total time caused by NVA and NVA but necessary activities. In conclusion, eliminating NVA and NVA but necessary activities can increase productivity by reduction of process time.

ABSTRAK

Pada masa kini, syarikat semikonduktor mensasarkan produktiviti yang lebih tinggi dengan jangka masa yang pendek yang memaksimumkan keuntungan untuk kelangsungan hidup mereka. Projek ini dijalankan di Infineon Technologies Sdn. Bhd. memberi tumpuan di kawasan "Front of line" yang melakukan pemeriksaan visual kualiti pada proses "die bonding dan wire bonding". Terdapat aktiviti berlebihan untuk pemeriksaan visual kualiti di antara operator Pengeluaran dan operator Kawalan Proses. Di sini, operator pengeluaran mengendalikan mesin manakala operator Kawalan Proses yang menjalankan pemeriksaan pengawasan kualiti melakukan pemeriksaan visual kualiti yang sama. Tambahan pula, operator juga melaksanakan aktiviti pemeriksaan visual dengan masa yang tidak konsisten walaupun terdapat arahan kerja. Oleh itu, tujuan projek ini adalah untuk meningkatkan produktiviti proses pemeriksaan visual melalui penghapusan aktiviti "NVA" untuk "package Dpak" di proses "Front of Line" sebanyak 50%. Terdapat tiga objektif yang ditetapkan untuk projek ini; (i) mengenal pasti aktiviti "NVA" dan "NVA but necessary" dengan menggunakan kajian masa, (ii) menentukan punca NVA dan melaksanakan simulasi dengan tindakan yang dicadangkan dan (iii) mengesahkan penyelesaian yang dicadangkan dan melaksanakan tindakan penambahbaikan. Kajian masa dan aktiviti 'brainstorming' telah digunakan dalam usaha mencapai objektif pertama. Kemudian, punca 'NVA' dan 'NVA but neccesary' telah ditentukan dengan menggunakan kaedah '5 Why's'. Penambahbaikan telah dicadangkan dan disimulasikan. Akhirnya, tindakan yang dicadangkan untuk penambahbaikan disahkan dengan pengurangan jumlah masa yang diambil untuk aktiviti pemeriksaan visual. Hasilnya, jumlah masa aktiviti pemeriksaan visual telah dikurangkan sebanyak 50 % ke 70 % di mana sebelum penambahbaikan, 40 % daripada jumlah masa disebabkan oleh aktiviti 'NVA' dan 'NVA but necessary'. Kesimpulannya, penhapusan aktiviti 'NVA' dan 'NVA but necessary' diperlukan untuk meningkatkan produktiviti dengan pengurangan masa proses.

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AQL	-	Acceptance Quality Level
CI	-	Continuous Improvement
DDM	-	Deviation and Decision Management
EAV	-	End of Line Auto Vision
EOL	-	End Of Line
ESH	-	Environment, Safety and Health
FAV	-	Front of Line Auto Vision
FOL	-	Front Of Line
LM	-	Lean Manufacturing
LTPD	-	Lot Tolerance Percentage Defective
NVA	-	Non Value Added
OC	-	Operating Characteristic
OJTI	-	On Job Training Instructions
PC	-	Process Control
PPAP	-	Production Part Approval Process
QC	-	Quality Control
TPS	-	Total Production System
TQC	-	Total Quality Control

CHAPTER 1

INTRODUCTION

This chapter comprises the background of the study, problem statement, aim and objectives, scope of the study, and background of Company Infineon Sdn. Bhd. The importance and the expected outcomes of this study are also presented at the end of this chapter.

1.1 Factory Background

Infineon Technologies (Malaysia) Sdn. Bhd. is one of the largest semiconductor manufacturing sites for Discrete Semiconductors, Power Semiconductors, Logic and Sensor Products as can be seen in Figure 1.1. It was established in 1973 and has become one of the largest backend manufacturing sites of Infineon with total investment of RM6 billion in Malaysia. It has become one of the important economy growths for the state of Melaka. Total number of employees working in Infineon Melaka already exceeded 7000 employees.

Infineon headquarters is situated in Villach Germany and is the world leader in semiconductor products offering products to industries such as Automotive, Multimarket and Industrial products.

Main customers are Bosch, Continental, Omron, Delphi and other automotive customers.

Figure 1.1: Infineon Melaka site

1.2 Core Business

Infineon Melaka is divided into four segments which is Power Product, Sensor, Logic and Discrete products. Power product provides the highest volume of product compare to other segment. Main packages from Power Segment are LPL, Dpak, Fullpack and SS08. Each of the products is processed at different blocks within the Power Segment.

1.3 Process Flow

Basically, in Infineon Manufacturing process the production is split into three main processes which is Front of Line process (FOL) as shown at Figure 1.2, End of Line process (EOL) as shown at Figure 1.3 and Testing process as shown at Figure 1.4.

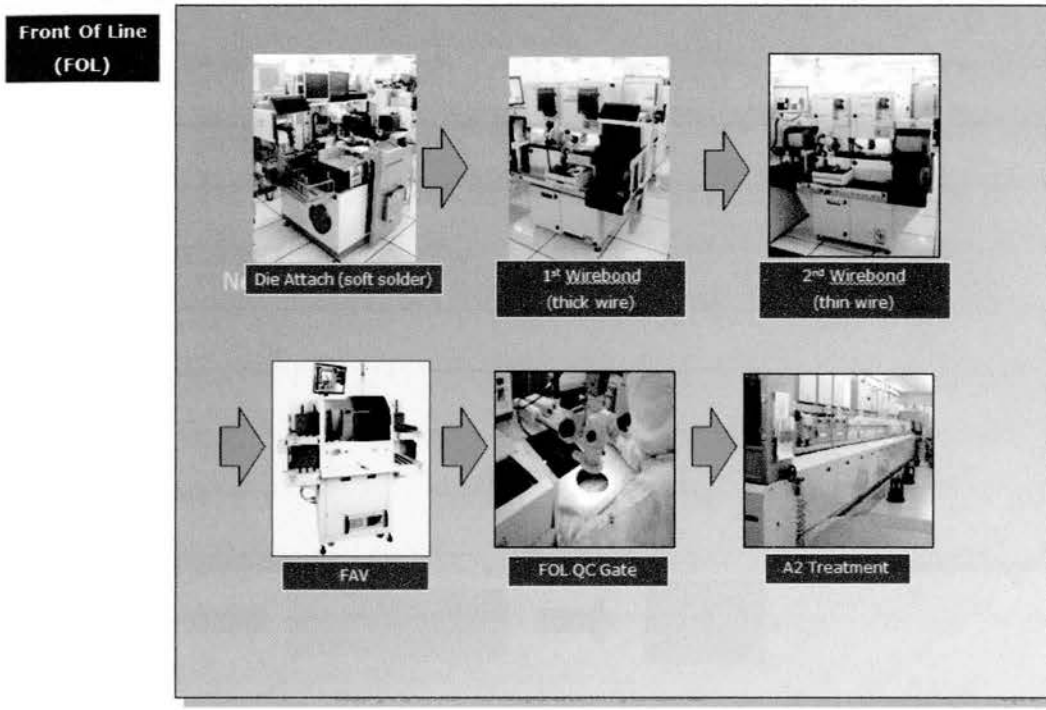

Figure 1.2: Front of line processes

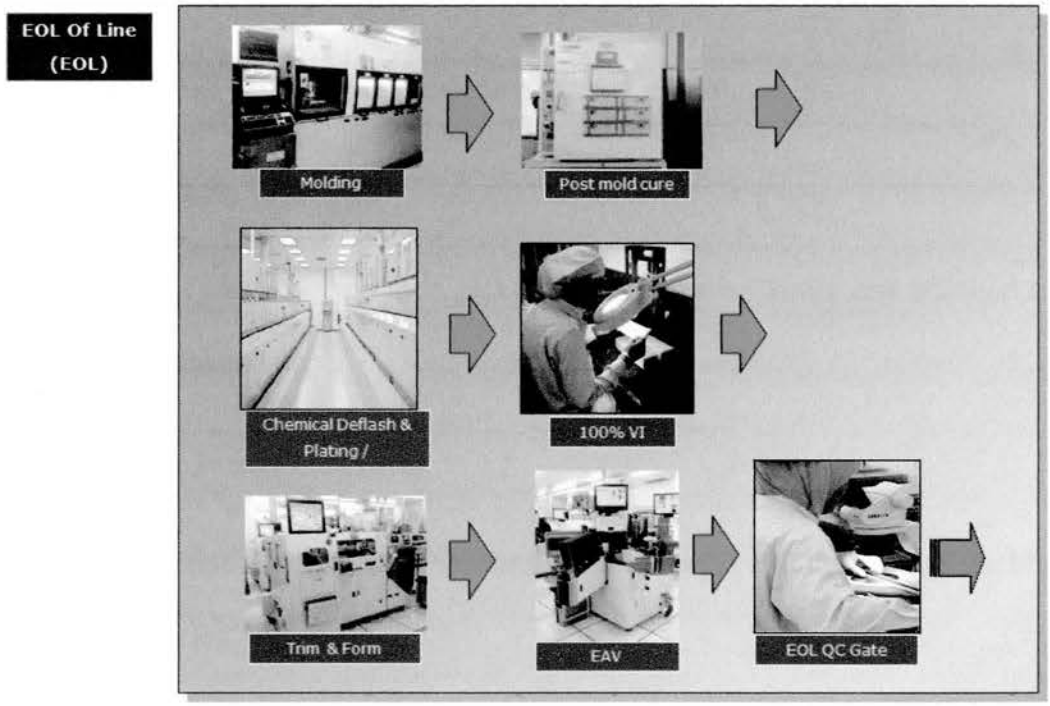

Figure 1.3: End of line processes

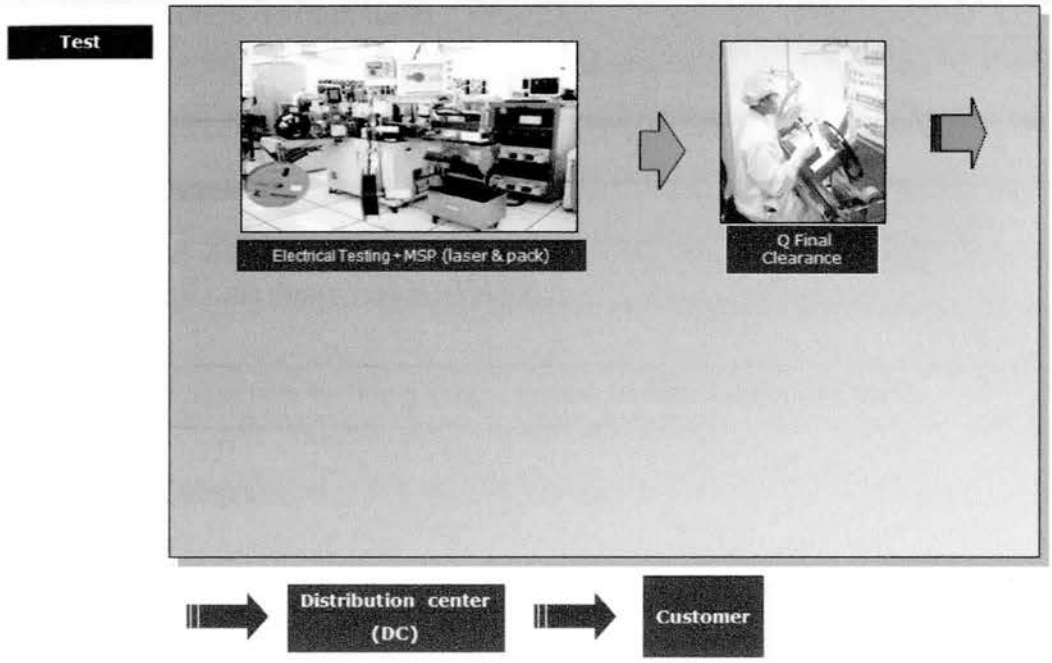

Figure 1.4: Testing processes

The Front of Line (FOL) process can be generally breakdown into:

i. Die Attach

Process whereby the die is pick-up from the sawn wafer and attached to the lead frame die paddle.

ii. 1st Wire Bond (thick wire)

Connection of thick wire between the lead frame and the die top for high current application.

iii. 2nd Wire Bond (thin wire)

Connection of thin wire between the leadframe and the die top for low current application.

iv. Front of Line Auto Vision (FAV)

Auto inspection by using vision system to detect defective parts.

v. FOL QC gate

QC buy-off based on sampling size.

vi. A2 treatment

Good adhesion between the mold compound and die pad to avoid delamination.

The end of Line (EOL) processes can be breakdown into:

vii. Mold

To encapsulate the bare die with mold compound

viii. Post Mold Cure

To bake the mold compound and to remove moisture

ix. Plating

To plate the lead and heatsink with tin material

x. 100% Visual Inspection

To perform 100% optical check on the product after return from plating process

xi. Trim and Form

To segregate the product from a frame form to singulated units.

xii. End of line Auto Vision (EAV)

Auto inspection by using vision system to detect defective parts.

xiii. EOL QC gate

QC buy-off based on sampling size.

The testing process can be breakdown into:

xiv. Testing and Mark Scan Pack

To electrical test the unit, mark and pack the units into reel or tube form

xv. Quality Final Clearance

To inspect and buy-off the products before ship to distribution centre and customer

1.4 Die Attach Process

Die attach is a process of attaching a semiconductor die onto the lead frame die paddle as shown in Figure 1.5. The die attaching process begins with picking up the sawn die from the wafer and attaching it on the die paddle which has been dispensed with solder or epoxy glue. Frank and Ronald (2004) describes die attach process as affixing silicon die or chips on the lead frame with adhesive or solder in the form of paste. The bonding is normally between the backside metallization of the die and metal surface of the paddle.