VLSI Testing
積體電路測試

Introduction

Professor James Chien-Mo Li 李建模

Lab. of Dependable Systems

Graduate Institute of Electronics Engineering
National Taiwan University

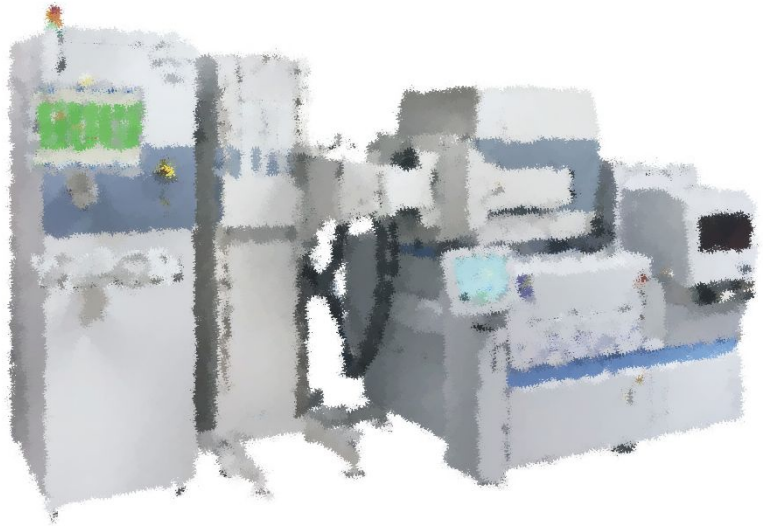
“Testing is a skill.

While this may come as a surprise to some people it is a simple fact.”

(Graham Fewster)

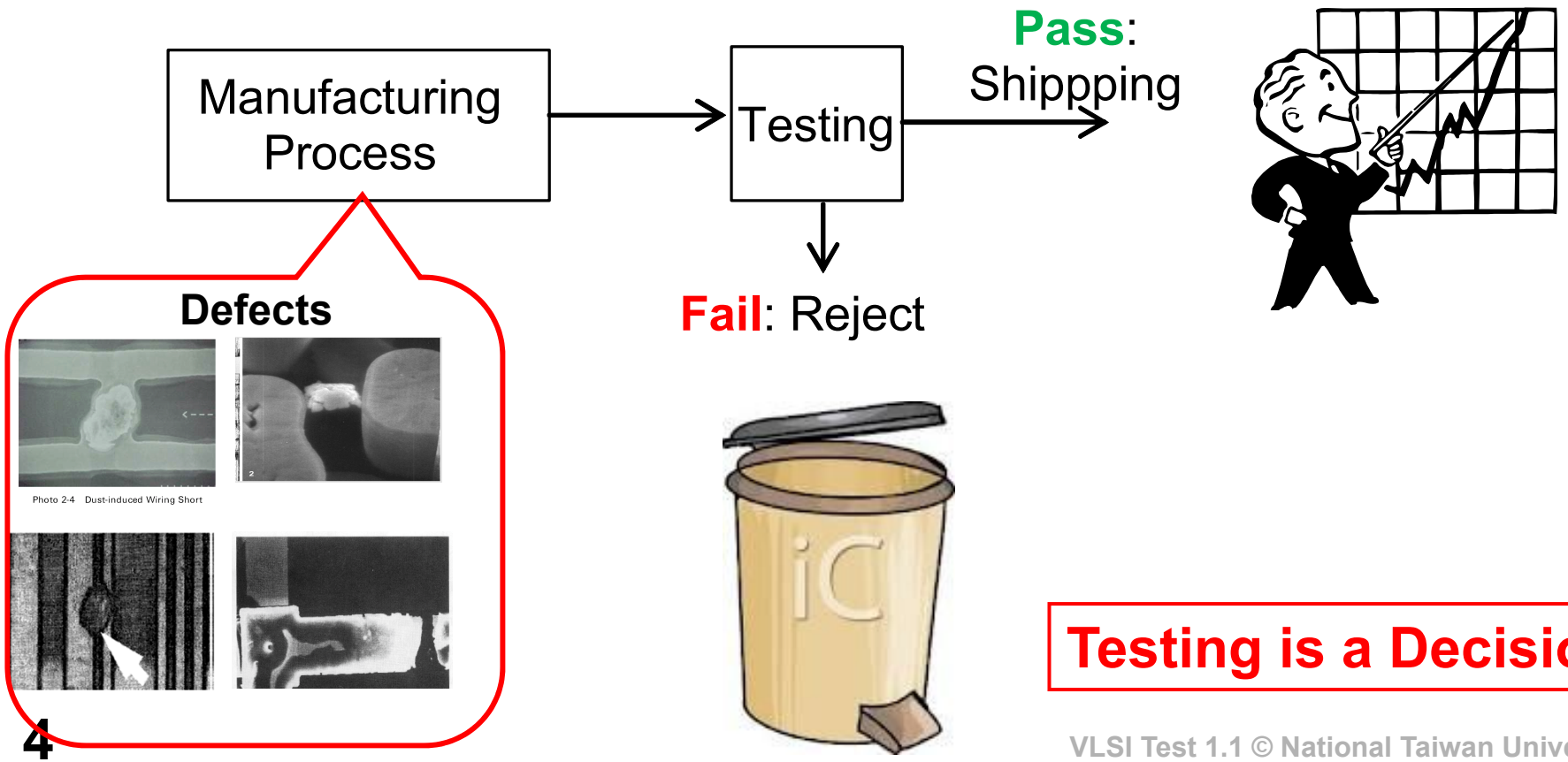
Outline

- Introduction
  - What is Testing
  - Why is Testing Important
- Types of Testing
- Test Quality
- Test Economics
- Important Issues in Testing
- Conclusion



What is Testing?

- *Testing* is process of determining whether a piece of hardware
  - Functioning correctly (PASS) or defective (FAIL)
- Why do we need to test Integrated Circuit (IC)?
  - Because *defects* occur in manufacturing process



Testing is a Decision

Four Possible Outcomes

- True pass and true reject are correct decision
- *Test escapes* = defective chips that pass test
  - also known as (aka.) *under-testing*
- *Yield loss* = good chips that fail the tests
  - aka. *overkill*, *over-testing*
- Goal of good testing: reduce both test escape and yield loss
  - Trade off between test cost and test quality
    - Quality test reduces test escape but increases yield loss
    - Low cost test reduces yield loss but increase test escape

	Good IC	Defective IC
Pass tests	True PASS	Test Escapes (less is better)
Fail tests	Yield Loss (less is better)	True Reject

Quiz

Q: Which of following is NOT IC testing?

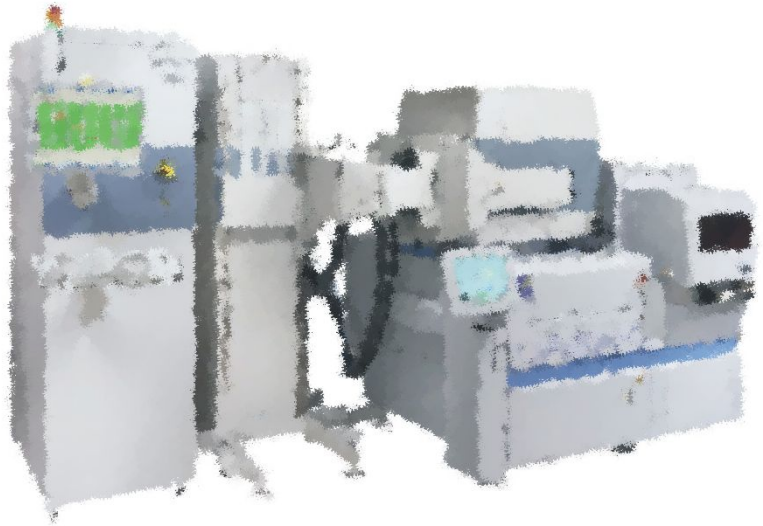
A: Run SPICE simulation on amplifier design to check if output is correctly amplified

B: Apply analog signal to an ADC IC and check if output is correctly digitized

C: Apply two numbers to an adder IC and check if output number is correctly added

Outline

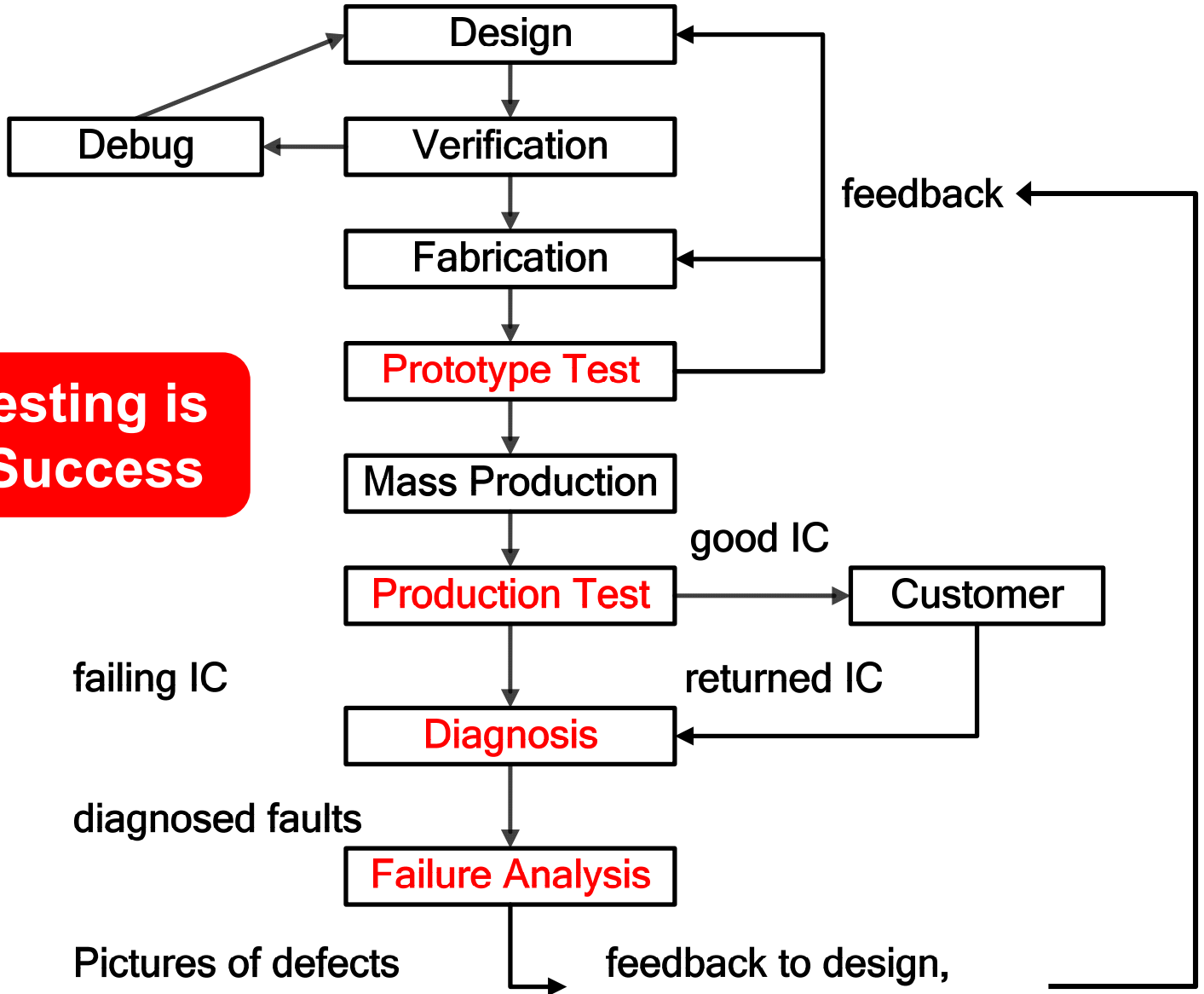
- **Introduction**
  - **What is Testing?**
  - **Why is Testing Important?**
- Types of Testing
- Test Quality
- Test Economics
- Issues in Testing
- Conclusion



Why is Testing Important?

- 1. Guarantee IC quality
  - Reduces test escapes
  - Not only functionally correct but also reliable IC
- 2. Shorten Time to Market
  - Prototype testing to debug silicon
  - Improve efficiency of production test
  - Diagnose defective IC to improve yield
- 3. Enhance Profit
  - Reduce test cost
  - Fix defective chips if possible (like memory)
  - Reduce yield loss

Stages of IC Product



Good Testing is Key to Success

Testing is Everyone's Responsibility

Fabrication
Yield improvement
Systematic defect diag.

Physical Failure Analysis
Diagnosis

Test Engineer
Test cost reduction
Test quality assurance

Test Service
ATE maintenance
Test data analysis

EDA
Auto.Test Pat. Gen.
Fault simulation

Design
Design for testability
Built-in self test

Reliability
Burn-in
Accelerated life test

Summary

- Testing is decision: whether IC is PASS or FAIL
- Good testing requires low
  - Test escapes = defective chips that pass test
  - Yield loss = good chips that fail the tests
- Test is key to success of IC product
  - Guarantee quality
  - Shorten time to market
  - Enhance profit
- Testing is everybody's responsibility
  - Designer, manufacturer, test engineer, EDA ….