New generation Probe card Metrology Qualification Methodology

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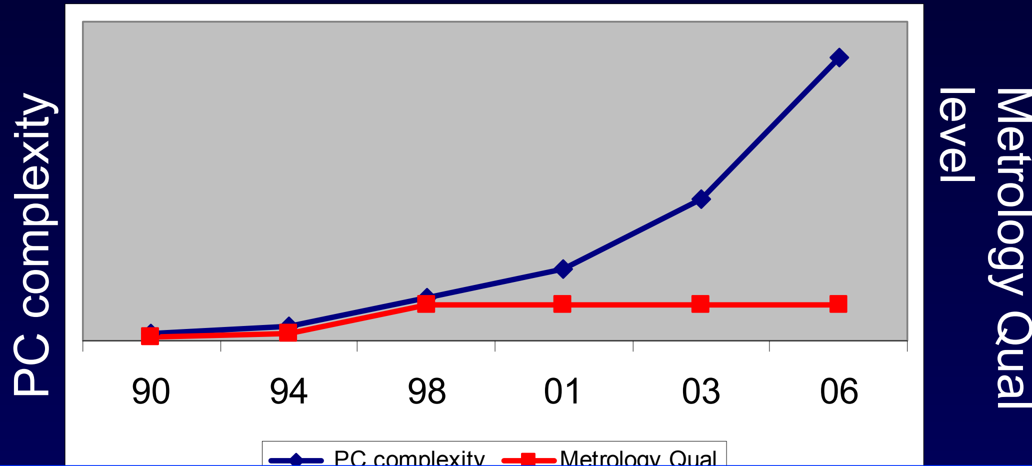
Agenda

- Environment overview
- Operational sequence
- Repair objective
- Effective metrology
- Qualification method
- Summary
- Acknowledgments

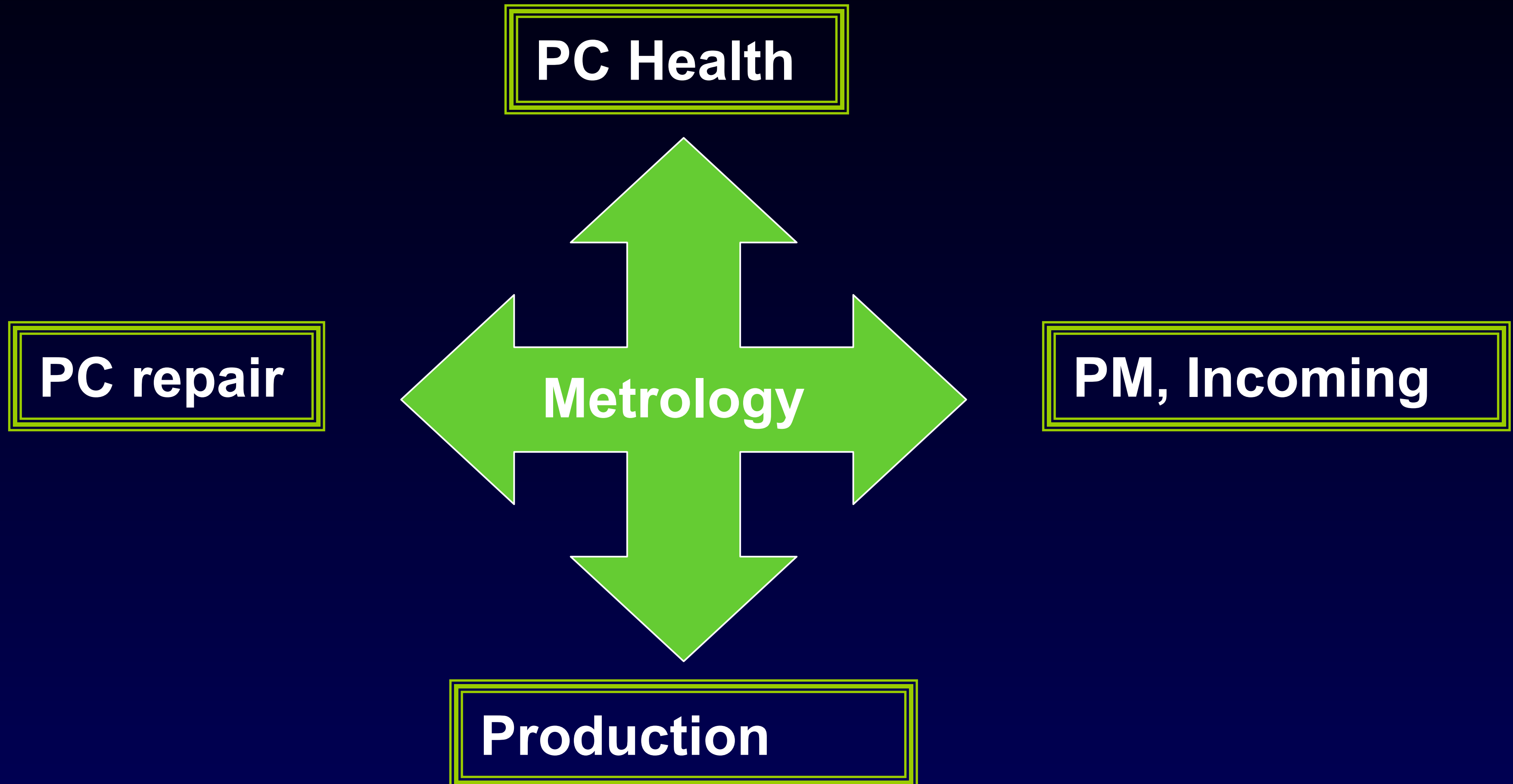
Probe Card (PC) Environment Overview

- **Probe card cost has grown significantly in recent years**
- **Main cost of ownership are availability and effective utilization**
- **Probe card complexity growth challenge PCR environment and metrology**
  - **Probe count, probe design, pitch**
- **Metrology qualification hasn't developed at the same pace**



Metrology qual method needs major improvement

PC Operational Sequence



Metrology is the center of probe card operational philosophy

Probe Card Repair Objective

- Maximize PC Availability/Utilization
  - To minimize inventory/buffer
  - To reduce PC validation time on tester
- Metrology test results are used for probes X,Y,Z adjustment
  - Efficient repair/PM increases MTBF and decreases MTTR
  - Indication for PC health

Effective PC repair is critical for today's wafer test technology

Effective Metrology

Safe

- Injury free environment for user
- Damage free environment for PC

Repeatable

- Sufficient precision in order to meet the P/T spec

Reliable

- Maintain precision and calibration over time
- Minimize test outliers

Independent

- Provides all necessary features for PC repair e.g. cleaning module, microscope, etc..

Correlative

- Reflects actual test process

Effective metrology is a key for efficient PC operation

Safety

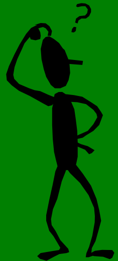
Make ergonomic and safety machine per SEMI S2 &S8 standard. Damage free environment for PC

MCA

GR&R- comprehensive MCA study that will capture production environment variations

HVM

High Volume Manufacturing readiness: training, documentation, copy exactly systems



SPC

Excursion prevention systems – comprehensive SPC program including the PC supplier

Metrology correlation

Metrology/Test correlation – identify failure characteristics

Safety

Objective

- Injury free environment for the user
- Damage free environment for PC

Motivation

- Avoid injury to operator
- Avoid PC damage => unnecessary expense

Procedure

- SEMI S2 &S8 certification by the tool supplier
- Subjective Ergo evaluation by the customer
- Detail evaluation of the options for PC damage and develop correction items
  - Cleanliness, crashing

MCA

Objective:

- **Metrology capability analysis**
- **Simulate day to day work**

Motivation:

- **Ensure system ability to provide test result during normal operations**

Procedure:

- **Check metrology repeatability for undisturbed batch**
- **Check metrology reproducibility- induce all day to day errors/disturbances**
- **Repeat on several PCs to cover PC to PC variation**
- **Repeat per PC technology**

SPC Program

Objective:

- **Excursion prevention systems**

Motivation

- **Prevent metrology from going out of control**
  - **Affects PC repair quality**
- **Monitor PC supplier quality and outgoing tests**

Procedure

- **Define local monitoring procedure**
- **Develop automated system**
- **Perform correlation study with PC supplier**
- **Implement preventive action to avoid incoming failure**

Metrology/Test Correlation

Objective:

- **Identify failure characteristics**
- **Metrology to Simulate the test process**

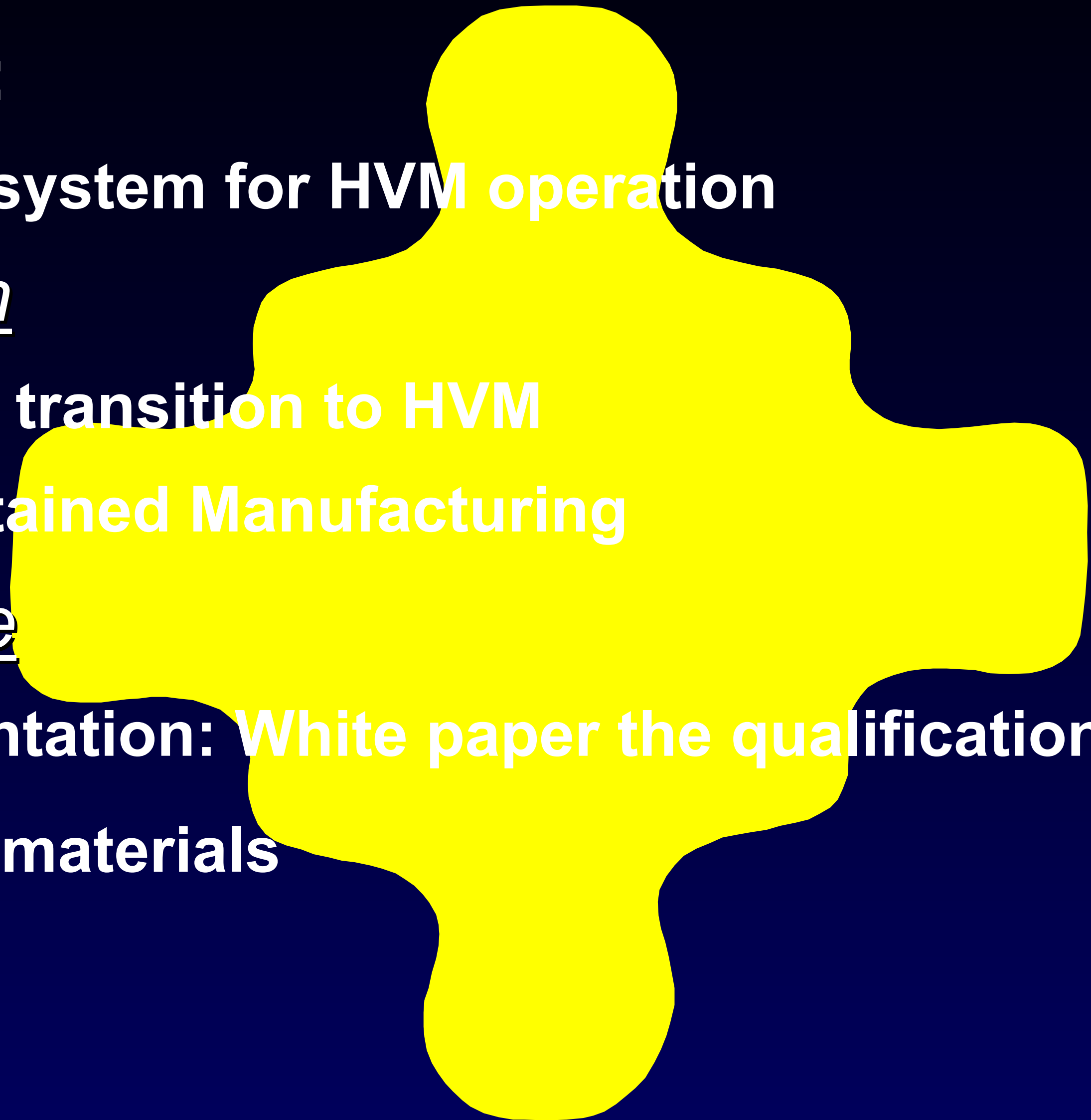
Motivation

- **Correlative metrology will make PC repair more efficient**

Procedure

- **Mother Board Design that emulates PC docking**
- **Test module accuracy study**
- **Scrub correlation**
  - **Metrology vs. Actual**

HVM Readiness



Objective:

- **Prepare system for HVM operation**

Motivation

- **Flawless transition to HVM**
- **Self Sustained Manufacturing**

Procedure

- **Documentation: White paper the qualification**
- **Training materials**

Summary

- Probe card price and complexity has risen significantly
- PC metrology qualification methodology is lagging behind technology development
- PC Metrology is a key entity in the PC environment
- Qualification Methodology has shown benefit for effective metrology

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Backup

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Terminology

- Metrology- probe card metrology
- PCR - Probe Card Repair
- Qual – qualification
- PC – Probe Card
- PM – Preventive Maintenance
- Incoming – new PC acceptance
- HVM – high volume manufacturing