Implementing Adaptive Test

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2006 KGD Packaging & Test Workshop
Sept. .10-13, 2006
Napa, California

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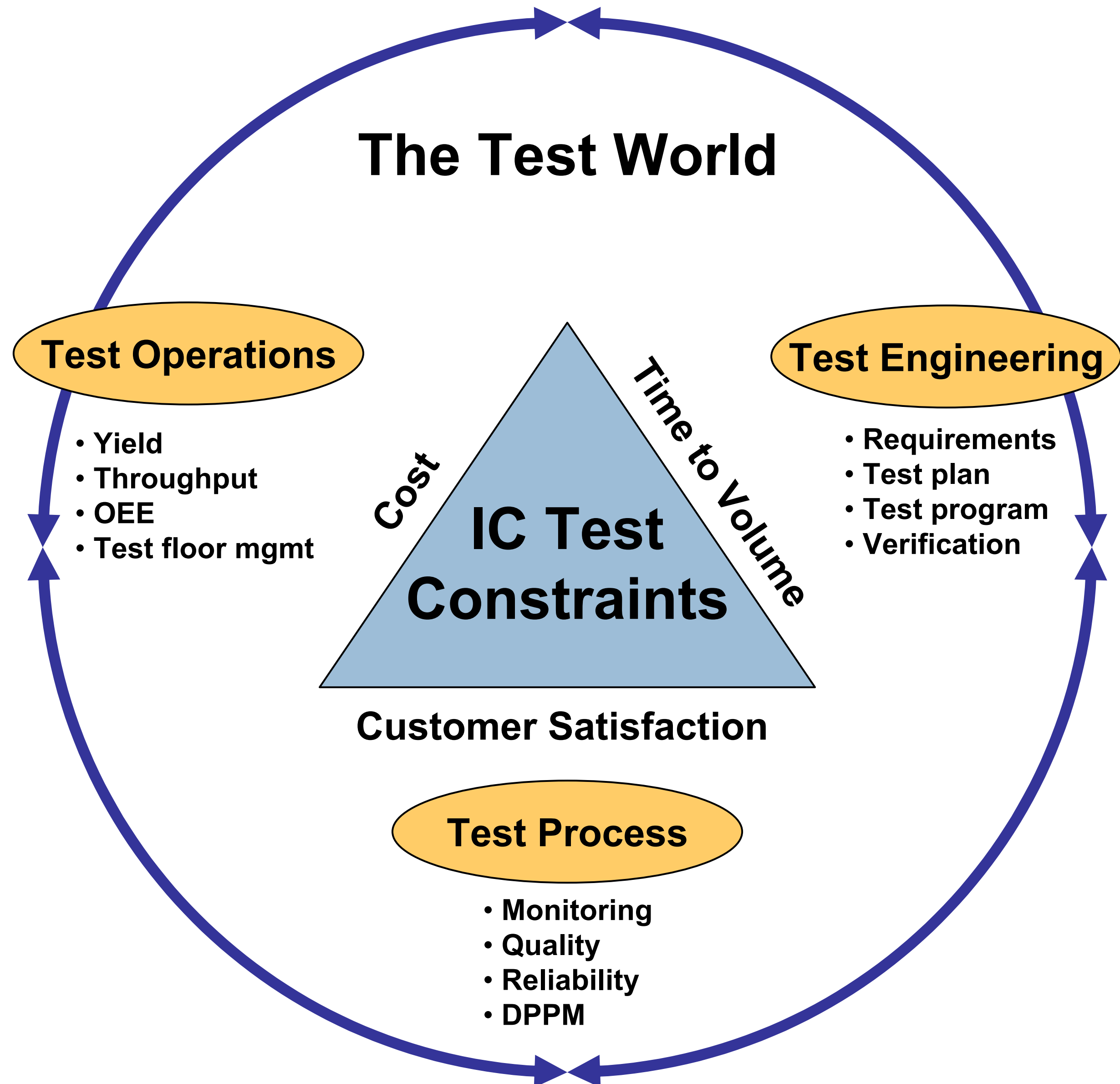
Test Management Solutions (TMS)

An emerging industry term for test improvement



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How Can Testing Improve?

- Testing is a complex process
  - The process is typically out of control
  - Test cost is increasing each year
- Each step in the testing chain is independent
  - The chain must be monitored
  - The process must be measured
  - The process can be improved
  - **The process can be adaptive**

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What is Adaptive Test?

- Adaptive test is a term used to describe a system that learns test process parameters and adapts the test flow to optimize the tests performed on each wafer die or packaged part.
  - Each die or IC has a unique test suite
  - Adaptive test can ADD or REMOVE tests
- Adaptive test involves:
  - Test Engineering
  - Test Operations
  - Test Process

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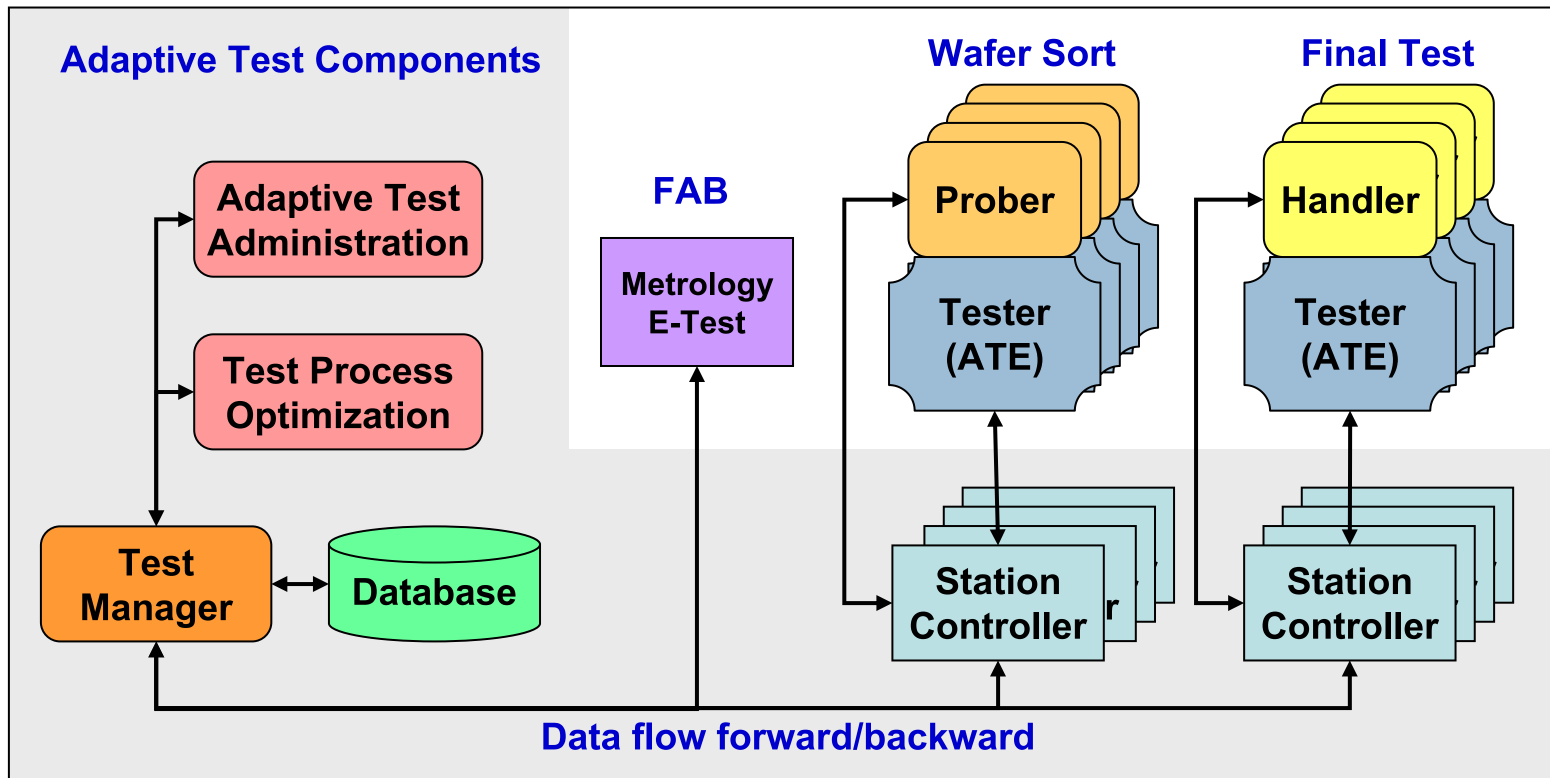
Adaptive Test System



Typical adaptive test system for IDM and Fabless applications

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Data Flow and Control

- Data flow is forward and backward
  - Fab >> Wafer Probe >> Final Test
  - Final Test >> Wafer Probe >> Fab
- Test Manager
  - Processes test and performance data
  - Uploads the product recipe to each station controller
- Station Controller
  - Controls the Prober or Handler
  - Controls the ATE and test flow
  - Continuously monitors critical test data
  - Makes quality decisions in real time

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Using Baseline Die

- Carefully choose baseline die
  - Based on each product type
  - Based on Lithography
  - Based on Geography

- Baseline die:
  - **Represent both the manufacturing and test processes of a given product**
  - Require more testing than other die and may include characterization or stress tests
  - Establish historical database
  - Monitor product quality and health
  - Used for adaptive test and reliability augmentation

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- Simulate the adaptive test scenario
  - Use historical data from 100% tested wafers and optionally packaged IC's
  - Verify baseline die accurately predict process issues
  - Create an adaptive test recipe (rule-set) for each product type
  - Verify results and check for test escapes
- Monitor production runs
  - Capture real time data with adaptive test off
  - Verify results from multiple test cells

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Ramping Up

- Validate the adaptive test flow
  - Using the ATE vendor off-line simulator
- Do a pilot production run
  - 1 to 3 test cells, 1 product type
  - First run the adaptive test flow
  - Second do 100% re-test
  - Correlate results
- Do a production run
  - 5 to 10 test cells, 2 to 3 product types
  - Monitor results
- Continue escalation

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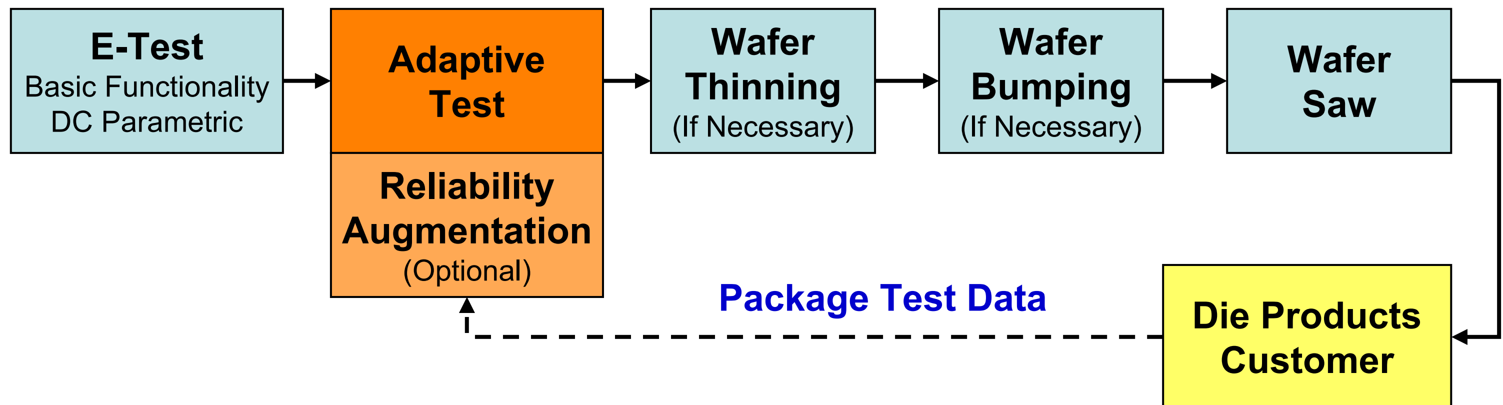
Does Adaptive Test Work with KGD?



- Adaptive test can be added to a typical KGD flow
- Reliability augmentation can be added as an inline alternative to burn-in
- Package test data can flow backward to the adaptive test process

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What are the Benefits for KGD?

- Adaptive test is up to 50% faster than full wafer test
- Increase reliability using inline reliability screening
- Reduce test escapes by up to 75%
- Reduce DPPM by up to 50%
- Increase Yield
  - Up to 4% based on traditional wafer test
  - KGD yield may be considerably higher
- Reduction of capital and operating expenditures

Above results are based on actual case studies at traditional wafer test.

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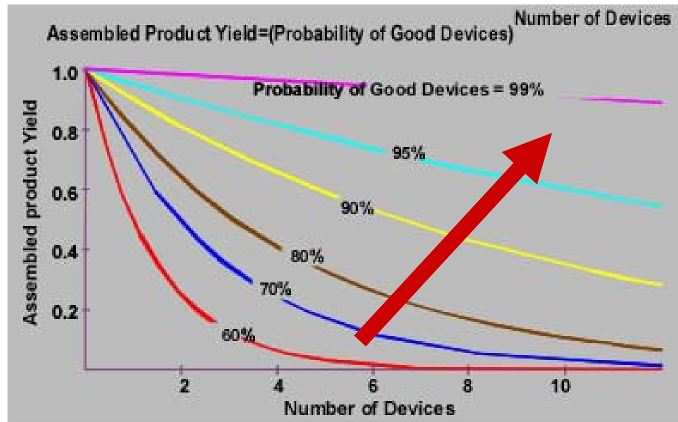
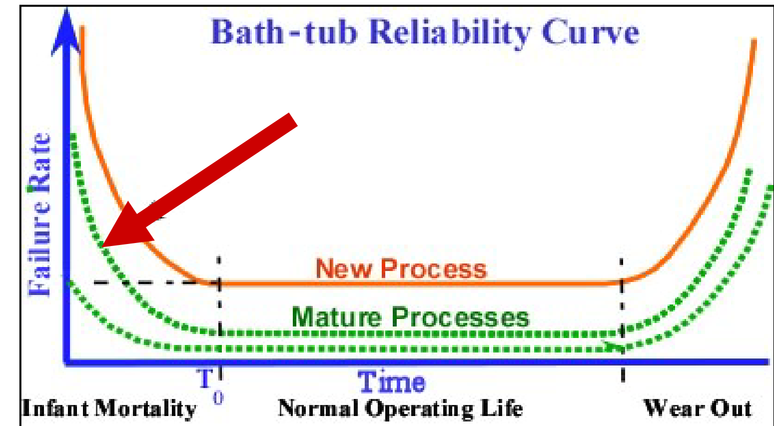
It Just Gets Better Over Time





- Adaptive test is a learned process
- As the product matures all the metrics improve:
  - Probability of good devices increases
  - Reliability augmentation pushes the bathtub curve down and to the left

Probably and bathtub curves courtesy of DPC website.

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Beyond Adaptive Test

- Once an adaptive test system is in place the infrastructure supports:
  - Outlier detection and removal
  - Inline QA testing
  - Optimization of retest (if used)
  - Reliability augmentation to reduce burn-in (if used)
  - Test floor management
  - Testing health indicators and OEE
  - Integration with other enterprise systems
  - Enhanced collaboration with KGD customers

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Biography

Jeff Bibbee is a 25-year veteran of semiconductor test and has the unique experience of working with digital, memory and mixed signal products. Throughout his career, Jeff pioneered many industry firsts. Jeff holds a BSEE and five patents. Jeff is currently an independent industry consultant working in all areas of test improvement.

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