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Effective Integration of Advanced Probe Card Technologies from Development to Production Test Floors

Norman Armendariz
norm@ti.com
James Tong
jtong@ti.com
MAKE TEST INFRASTRUCTURE

AGENDA

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- INTEGRATION APPROACH
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- PET FISH “PROBE” MODEL
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INTRODUCTION

- TI and sub-con test floors use a variety of probe card technologies ranging from cantilever to advanced MEMs on wafers with an array of probe test requirements.
- Each new device exhibits increased functionality, which requires increased test capability and a decrease in the cost of test or COO-cost of ownership. *“cheaper, faster, better,”...what else is new?*

PROBLEM STATEMENT

- But, increasingly shorter and complex product cycles also shorten the time to design, develop, characterize and introduce wafer-level probe card technologies into test floors and "Qualify" as "Production Worthy."
- So, how does one go about getting probe card technology quickly into production without incurring significant evaluation costs in as non-intrusive and/or as non-disruptive manner to production?

INTEGRATION APPROACH

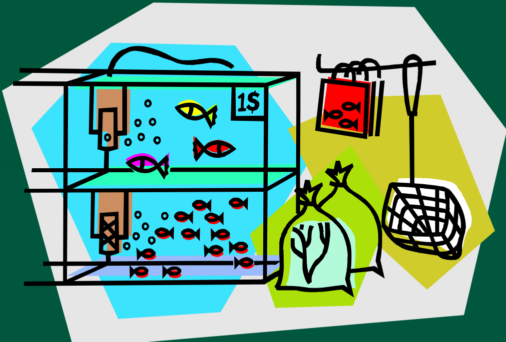
Perform a focused integration process that reduces the qualification time, yet increases the success-rate of introducing probe card technologies into test floors. Composed of 2 key steps:

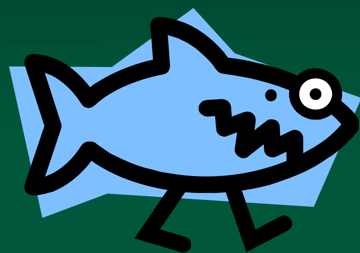
1. Technology Qualification- A few wafers and probe cards
2. Production Qualification- A lot more wafers and more production exposure

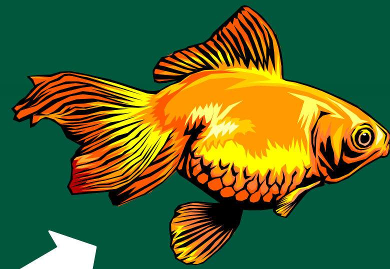
"Similar to bringing a pet fish home from the pet store"

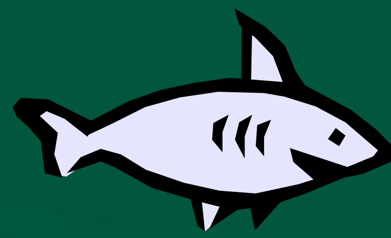
1-PET FISH INTEGRATION
Probe Technology "Fish" Qualification

"PET SHOP"
PROBE CARD /
ATE INDUSTRY

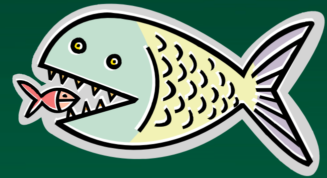








"PET FISH"
PROBE CARD
TECHNOLOGIES



COST / PERFORMANCE
COO ?

TEST CELL / FLOOR
INFRASTRUCTURE ISSUES ?

ISMI Probe COO Model

Breakdown of Probe Related Test Costs

$180,000
$160,000
$140,000
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$-

INTERNATIONAL SEMATECH
ISMI
MANUFACTURING INITIATIVE

OK?

- "Probing" yield loss
- Multi-DUT related test time cost
- Wafer inspection
- Reprobe
- Test cell set-up
- Online cleaning
- Offline maintenance
- Refurbishment
- Rebuild/replacement
- Total initial investment

2-PET FISH INTEGRATION
Production “Aquarium” Qualification

EWR-ENGR
WORK REQUEST
“BAG”

Test Prgm

RTP
RELEASE
TO PROD

“PROBE FISH”

Contamination

Set-up

“TEST FLOOR”

PROBE CARD INTEGRATION PROCESS:
(2 Steps Each with 4 Compliance Levels)

Technology - Production QUALIFICATION	
PASSES Category	Meets required CTF-Critical To Function parameters. Passes qualification category for the particular probe requirements envelope or node intended. e.g. 70 um, x32/x64 multi-site enablement
PASSES Category	Meets most CTF-Critical To Function parameters. Passes qualification step. However, contingent on additional data, data analysis either on-line or off-line to resolve.
DOES NOT QUALIFY	Does not meet most CTF-critical to function parameters. Does not pass qualification category. Not considered a show-stopper; however, ARs required to be resolved
DOES NOT QUALIFY	Does not meet required CTF-critical to function parameters. Does not pass qualification category. Considered a show-stopper, significant work required to resolve.

CTF Critical-to-Function Qualification Areas

DEVICE 11/7/2007	PROBE CARD QUALIFICATION CTF-AREAS / PARAMETERS	TECHNOLOGY QUALIFICATION	PRODUCTION QUALIFICATION
ITEMS HIGHLIGHTED IN RED, CONSIDERED MUST HAVES	LEGEND	PASSES Qualification Category	Meets required CTF-Critical To Function parameters. Passes qualification category for the particular probe requirements envelope or node intended. e.g. 70 um, x32/x64 multi-site, C014 enablement
		PASSES Qualification Category	Meets most CTF-Critical To Function parameters. Passes qualfication step. However, contingent on additional data, data analysis either on-line or off-line to resolve.
		DOES NOT QUALIFY	Does not meet most CTF-critical to function parameters. Does not pass qualification category. Not considered a show-stopper; however, ARs required to be resolved
		DOES NOT QUALIFY	Does not meet required CTF-critical to function parameters. Does not pass qualification category. Considered a show-stopper, significant work required to resolve.

ITEM#	CTF AREA	CTF PARAMETER	TECH QUAL CATEGORY	PROD QUAL CATEGORY	STATUS- ACTIONS REQUIRED	OWNER(s)
1	PHYSICAL	•Pitch	60um	60um		JT
2		•Pincounts	1216	1216	152 probes/die x 8 DUTs	JT
3		•Multi-site	8	8	Skip 1 row and 1 column with 2by4 layout	JT
4		•Planarity	25um	25um		
5		•Maximum Overdrive	75um	60um	FFI Spec is max 75um but restriction to current release process spec of 60um	JT
6		•Probe Working Area	Pass	Pass		JT
7		•Component Area	Pass	Pass		JT
8		•PCB Mfgr/Functionable	Pass	Pass	PCB design worked right of the box	JT
9	DESIGN PROCESS	•PCB Design Make Flow	Pass	Pass	Design took too long to complete	FFI/MTI
10		•Routing Die Design	Pass	Pass	Site remapping due to FFI PCB Design optimization	FFI/MTI
11		•Probe Design	Pass	Pass	Inadequate tip pre-condition at time zero	FFI
12	MANUFACTURING	•Capacity	Pass	Pass	Delivery of 1st article was delayed numerous time due to PCB design. Lead time: Re-order 6wks.	
13		•Leadtime	Pass	Pass		
14		•Delivery	Pass	Pass		
15	SUSTAINABILITY	•PC Analyzer	Pass	Pass	No RASP x1 mother board in FFI-TSC	
16		•Repairability	Pass	Pass	FFI-TSC had demonstrated numerous time on quick turn repair.	
17		•On-Site Support	Pass	Pass	Limited FSE and is a concern on ramp production situation	

- PHYSICAL
- DESIGN PROCESS
- MANUFACTURING
- SUSTAINABILITY
- TEST PERFORMANCE
- RELIABILITY
- TEST OPERATIONS
- FUTURE APPLICABLITY
- COST OF OWNERSHIP
- OVERALL ASSESSMENT

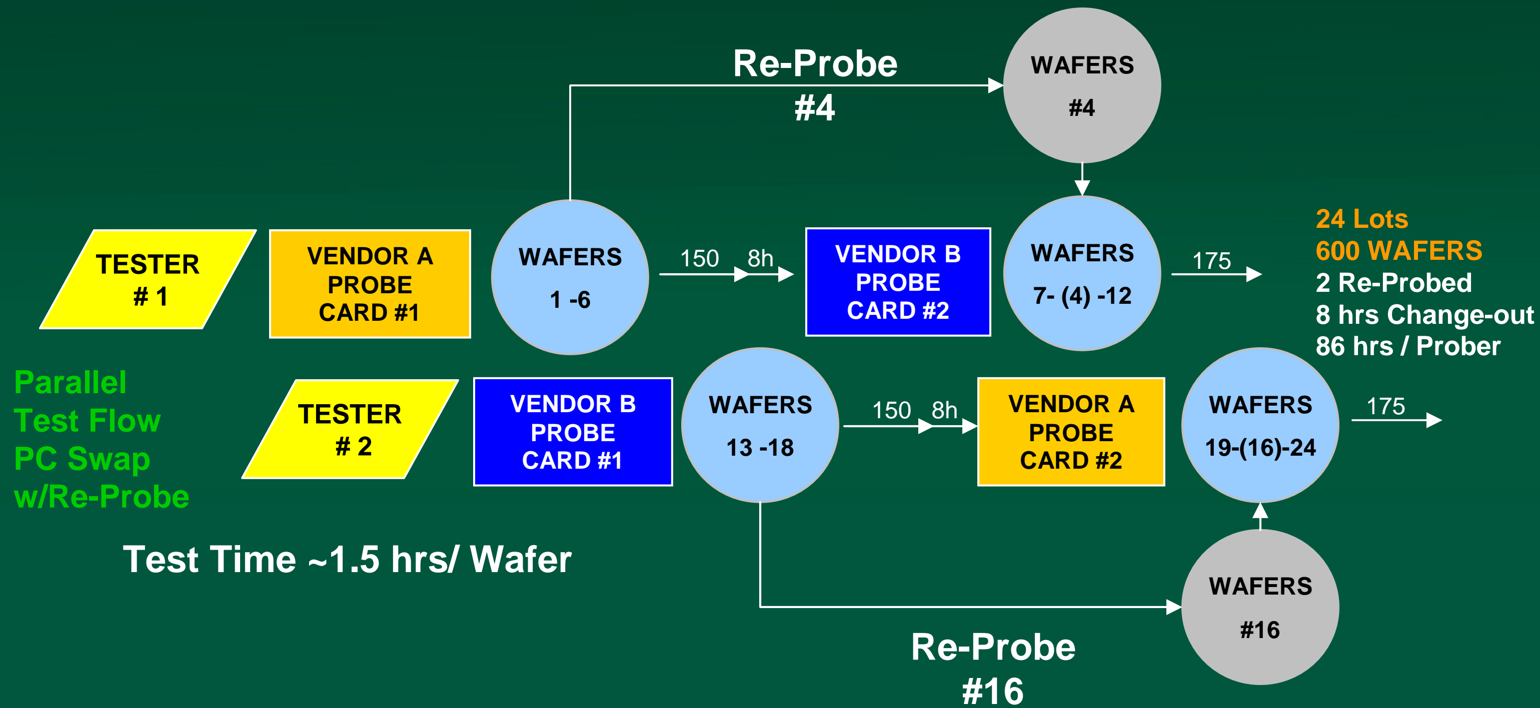
Qualification Team Structure:

EXAMPLE: FOR A DUAL COMPARATIVE QUALIFICATION

	PROBE Vendor A				PROBE Vendor B	
			Busn Unit Pgm Mgr			
		Subcon Mgr	Busn Unit TEST Mgr	Test Floor Mgr		
POC-Point of Contacts	PC1 Mgr	Subcon Ops	PROBE MGR / TEST ENGR	Planning Mgr	PC2 Mgr	Prober Mgr
On-Site Tech Trans Engrs / Techs / Opers	PC1 Engr	Probe Engr A	PROBER E	Probe Engr B	PC2 Engr	Prober Engr
	PC A Subcon		Subcon Engr		PC B Tech	Prober Engr
	PC A SubCon		Subcon Engr		PC B Tech	Prober Tech
			Subcon Tech			

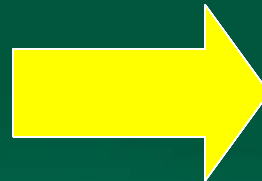
LEGEND

TEST FLOW FOR PRODUCTION QUALIFICATION-RTP



Input Variables:

- Probe Card to Probe Card
- Tester/Prober to Tester/Prober
- Wafer to Wafer (Re-probe)



Output Variables:

- CRes (Std Dev)
- Yield
- Re-Probe Rate
- Planarity/Alignment
- Tip Diameter
- TPT
- Scrub / UBM Damage

Example: Effect of Downtime

CResMax_1 Stdev (Ohms) PC#01

ENCOUNTERED A PROBE PROCESS ISSUE DURING PRODUCTION THAT AFFECTED PROBE CARD PERFORMANCE AS A RESULT OF AN INTERRUPTION

KEY MESSAGE

- The probe technology may appear to work from the outset, but need the production time to expose the technology to various use conditions.

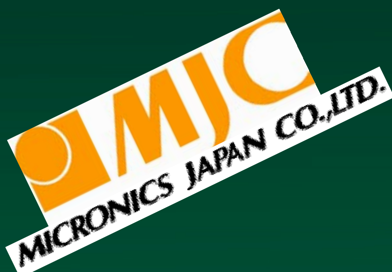
- A high number of TDs not necessarily required, but by designing evaluation DOEs for multiple set-ups, change-outs, test program checks, etc., the production issues are given more opportunity to appear and resolve earlier.

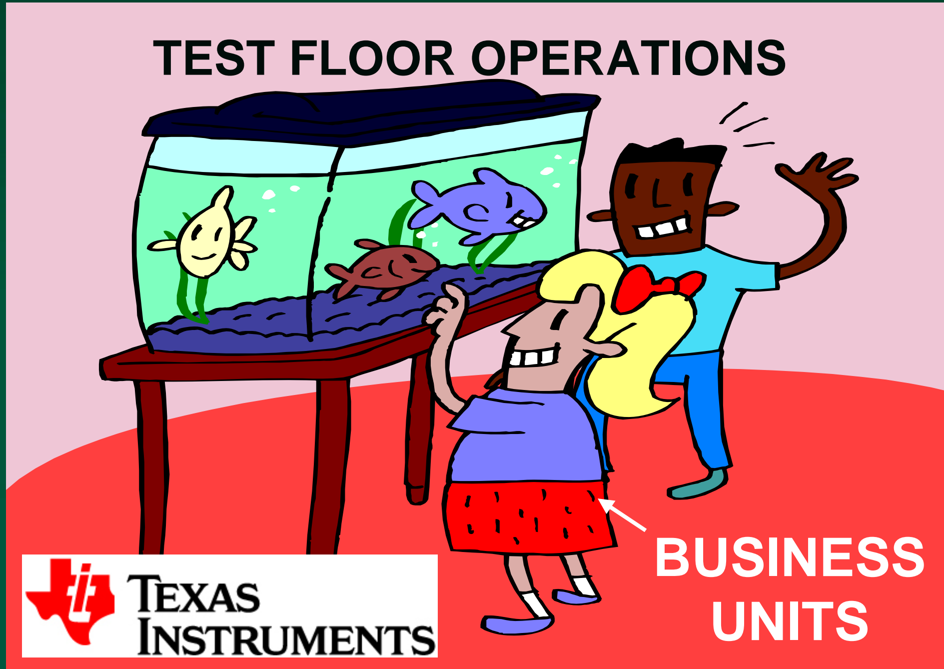
KEY LEARNINGS

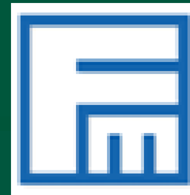
- Project management CPM-critical path methodology proved critical to success: Key obstacles identified ahead of time to still meet major milestones.
- Cross-matrixed organizational structure formed across TI, vendors and sub-cons covers key personnel and technology requirements with roles / responsibilities clearly defined.
- Both on-site (TI-Dallas) and off-site (Sub-con) training provided by TI and vendors for both engineering and operators facilitates probe technology integration.

A Test Plan is CRITICAL

ACKNOWLEDGEMENTS







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