IEEE SW Test Workshop
Semiconductor Wafer Test Workshop

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Probe Card Cost Drivers from Architecture to Zero Defects

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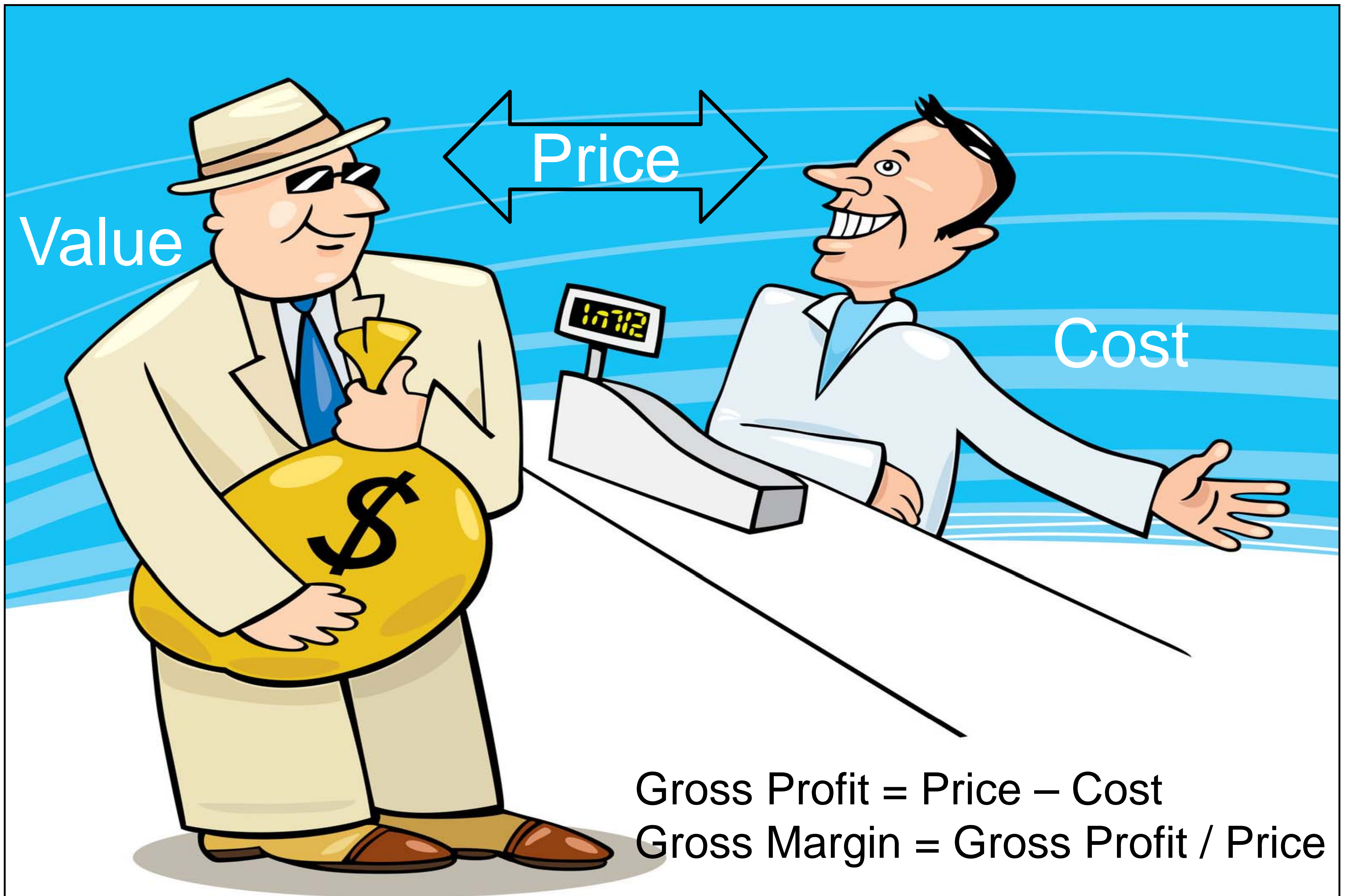
Overview

- Cost, Price, & Cost Drivers
- Serial Processing – Drilling Example
- NRE
- Advanced Process Technology
- Profitless Prosperity
- Cost Savings
- Summary

Note: price/cost examples are approximate and from multiple vendors not necessarily those identified or shown.


Price
Value
Cost
Gross Profit = Price – Cost
Gross Margin = Gross Profit / Price

Vertical Probe Head

Printed Circuit Board

BGA (Solder Attach)

Space Transformer

Upper Guide Plate

Spacer

Lower Guide Plate

MicroProbe Apollo

Probes

Machine Shop
Cost Drivers

Programming
Material
Setup Time
Run Time
Inspection
Yield

Drill Time

Time, hours

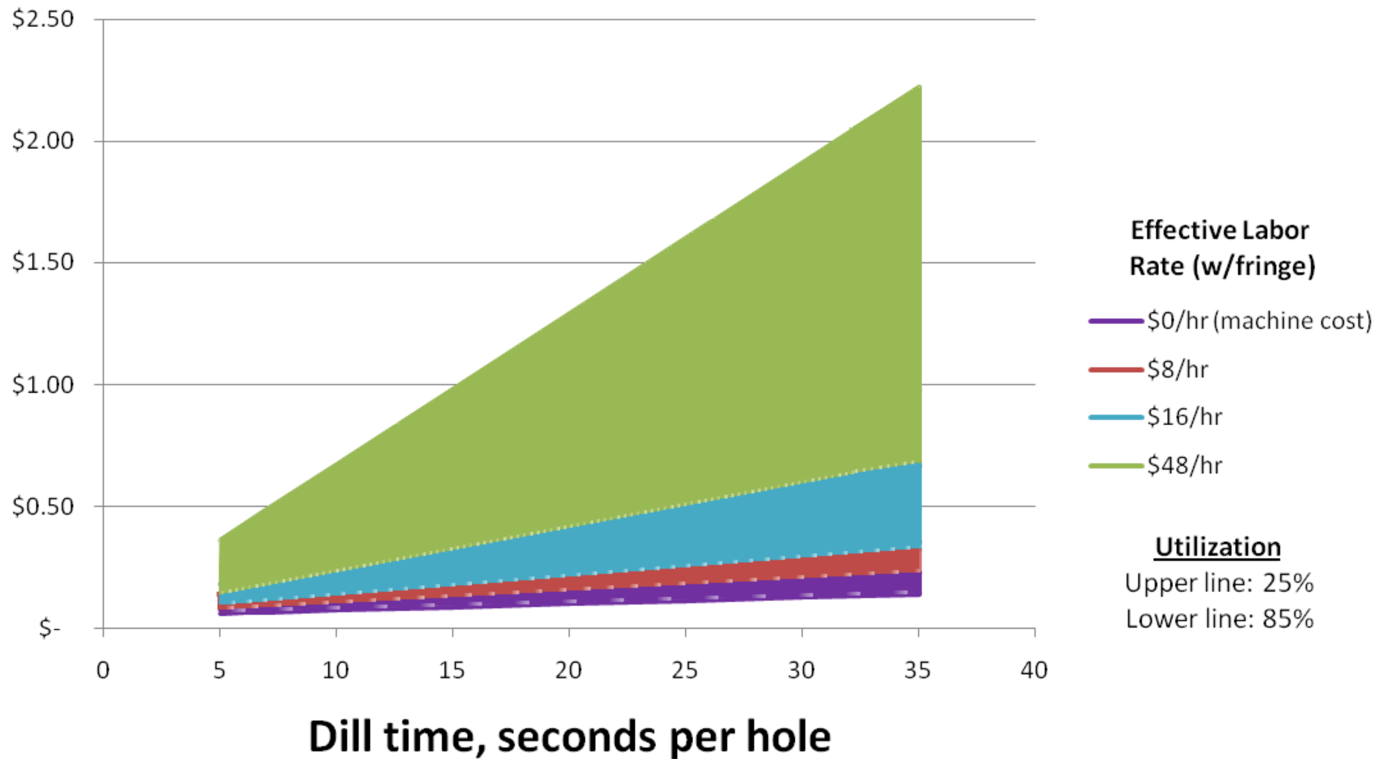
Hole Count (non-flipped)

Hole Count	500	1,000	2,000	4,000	8,000	10,000

Seconds per hole: 5, 6, 7, 10, 15, 20, 25, 30, 35

Don't bother… "Ferrari"

Cost Per Drill Hole



Machine Cost	$300,000
Annual Maintenance	7%
Useful Life	7 years
Total Cost	$447,000
Facilities Annual Cost	$35,000
Total Annual Cost	$68,857

Machine Cost		
25% utilization	$31.44	/hr
85% utilization	$9.25	/hr
Tooling per hole	$ 0.05	

Don't bother…

"Ferrari"

Make vs. Buy

Utilization
Lead Time
Quality
Fixed vs. Variable Cost
Cost (Make) vs. Price (Buy)

Non Recurring ~~Engineering~~ Expense

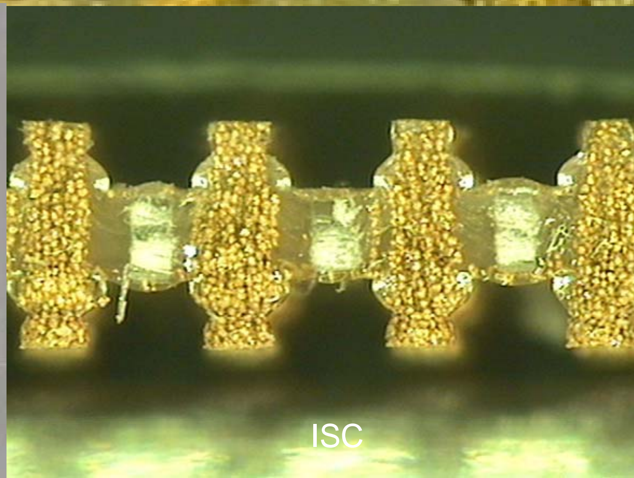
Architecture	Design	Tester	Customer
R&D	NRE	NRE	NRE
Design Input	X		X
Probes			?
Guide Plates	X		
Space Transformer	X		
Interposer	?		
PCB Design	X (External?)	X	?
PCB Fab	External	?	?
Mechanical H/W	?	X	?
Electronics	?	?	?
Metrology	X	X	?
Packaging		X	?

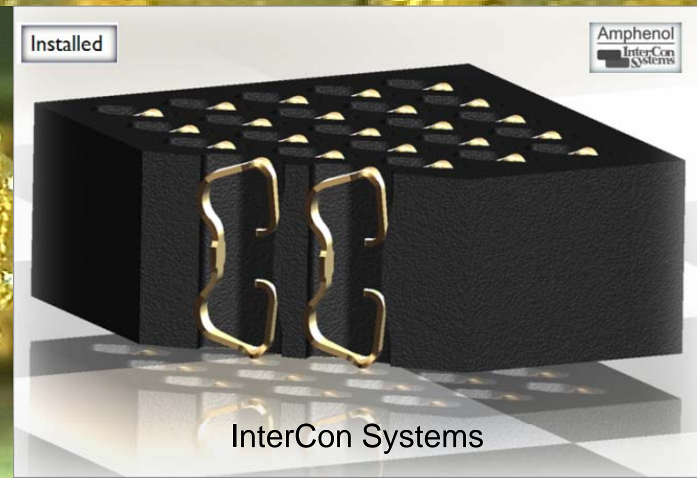
Outgoing Metrology

Interposers

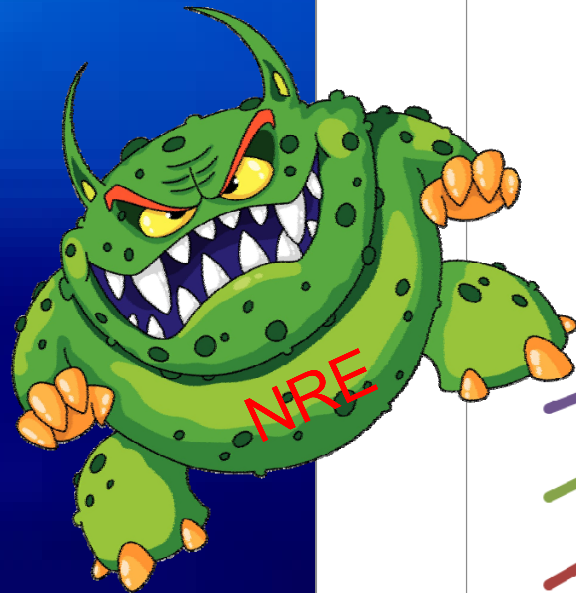
ISC

		Spring Pin	Elastomeric	Molded Frame
Small Area	NRE	$.5 - 1 K	$2 - 3 K	$20 - 30 K
	$ / contact	$1 - 10	$.50 - .60	< $.20 - .40
Large Area (1/4 wafer +)	NRE		$10 - 15 K	$100 - 150 K
	$ / contact		$.40 - . 50	< $.10 - .20





Space Transformers



$25,000

$0

0 50 100 150 200

Total Via Count (K)

Sequential Punch

Material & Processing

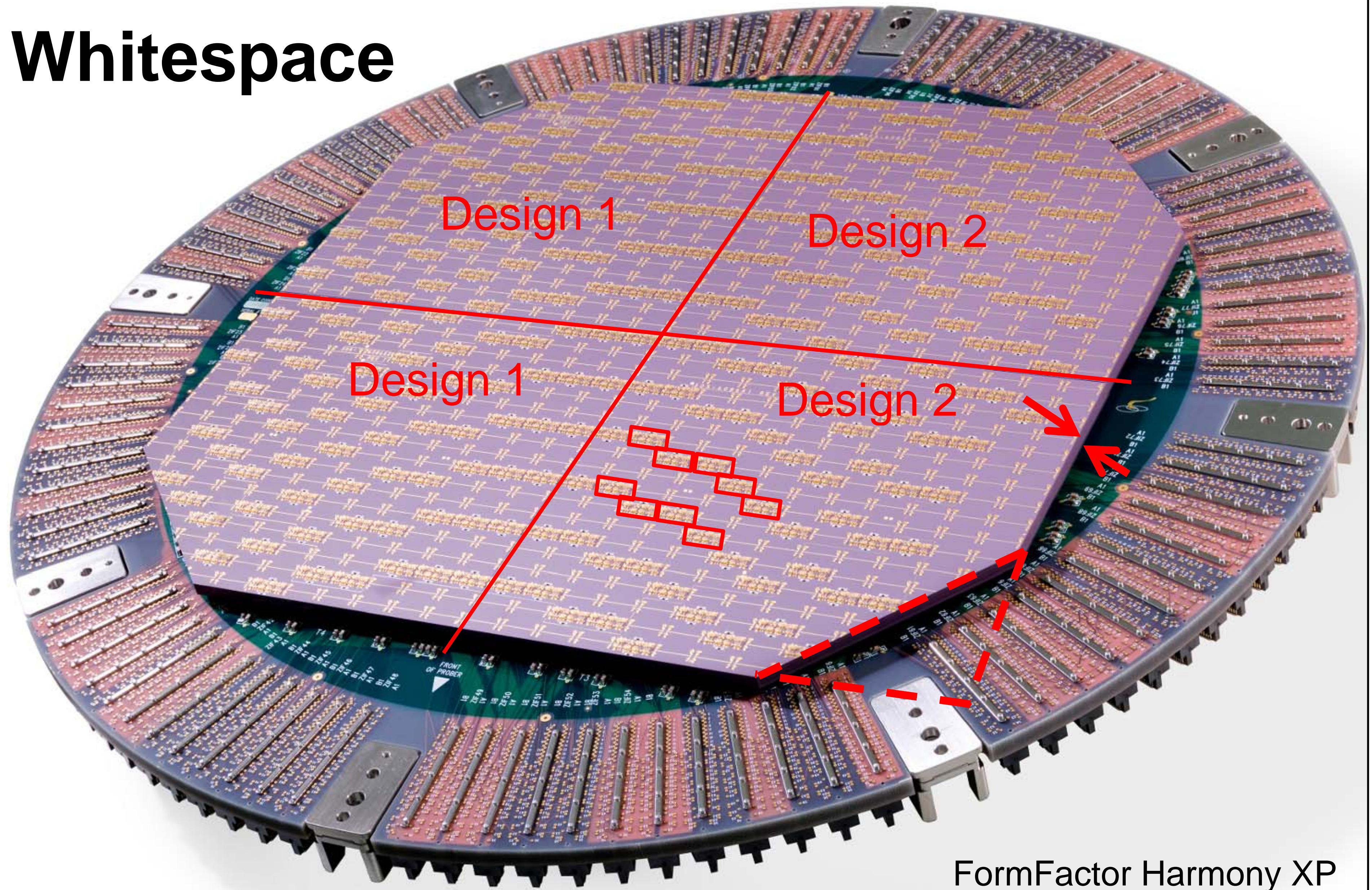
- 10 layer
- 15 layer
- 20 layer
- 25 layer
- 50 mm sq.
- 75 mm sq.
- 100 mm sq.
- 125 mm sq.
- 165 mm sq.

Advanced Process Technology

Cost Drivers

- Process Steps
- Masks
- Substrates
  - Material
  - Active Area
- Yield
  - Defect Density
  - Layers
- Equipment
- Rework / Repair

Whitespace



FormFactor Harmony XP

Solution

FormFactor Smart Matrix

Ten Year Profitability

Ten Year Net Profit / Revenue

30.0%
20.0%
10.0%
0.0%
-10.0%
-20.0%
-30.0%

0% 5% 10% 15% 20% 25% 30% 35%

QCOM
INTC
AAPL
TXN
KLAC
IBM
CSCO
S&P 500
AMAT
LRCX
A
MJC*
ATE
HPQ
JEM*
IT (72)
CSCD
MU
VRGY
TER
FORM
AEHR
LTXC

Ten Year R&D Spending / Revenue

FORM – 9 years; MJC – 5 years; JEM- 5 years; VRGY - 7 years

Costs Savings

STANDARDS

Input Data Formats
Probe Depth
Testhead Configurations
Specifications

Summary

- **Understand true cost of architectures**
  - Beware of NRE
  - New architectures needed for cost reductions
- **Maintain sufficient Gross Margin**
  - Company health
  - Funding for R&D
- **Honest supplier – customer partnerships**

Acknowledgments

- Amphenol InterCon Systems
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Thank You!

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