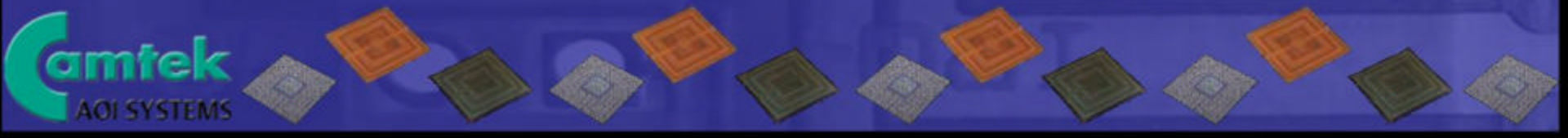
IPC Technical Conference

Yield Enhancement in BGA Substrate Manufacturing and IC Packaging



Agenda

- Difference between AOI and AFI.
- The Challenge in AFI.
- Design elements in the Inspection.
- Typical defects.
- The 3rd Dimension- BGA Substrates for FC with CB.
- The Challenge in Technology and DI.

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What is AFI

- Definition of HDI.
- AFI – Automated Final Inspection.
- How is it done today.
- Why is it not implemented in the PCB Market, final inspection.

Interconnect – Surface Defects

- In Process.
- Strive to isolate Cu and laminate.
- DRC and CAM – Interconnect.
- No attempt to identify Surface.
- Ignore surface anomalies.
- Final or Pre-Assembly.
- Inspection of Interconnect Pads.
- Flaws in Gold, OSP, SM, plating, Balls and Bumps.
- Flaws that may pass assembly, but fail in service life.

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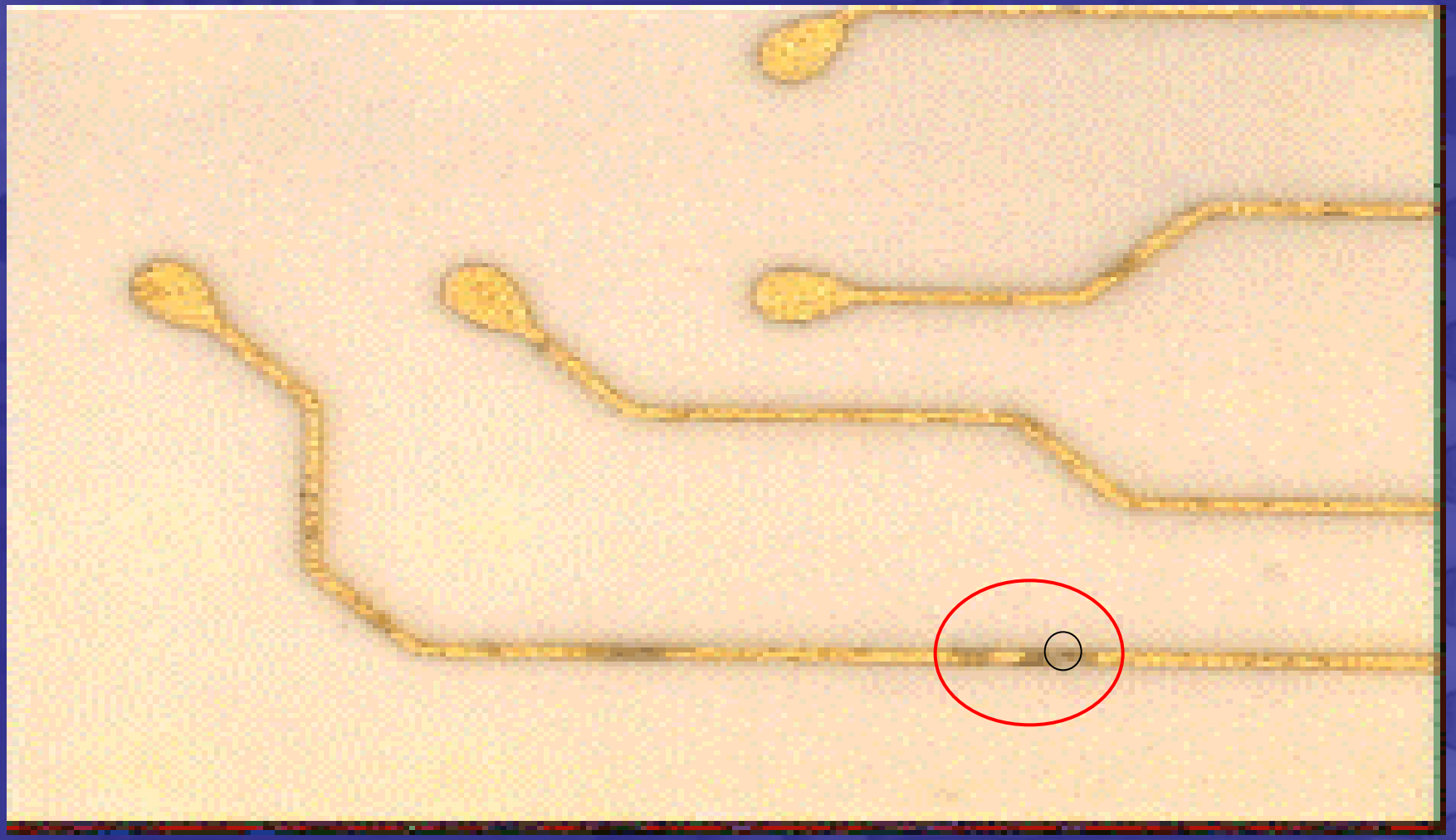
Interconnect – Surface Defects



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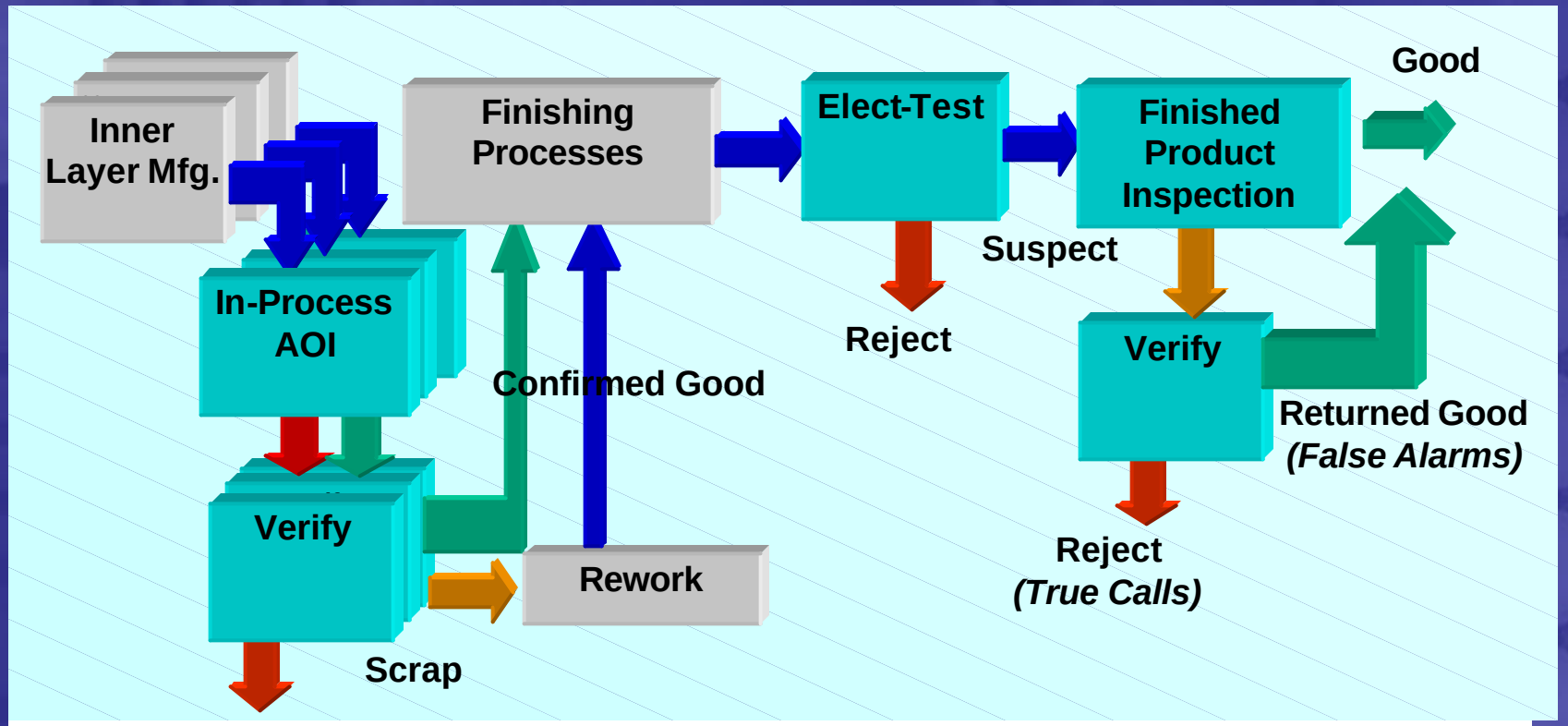
Inspection through Process



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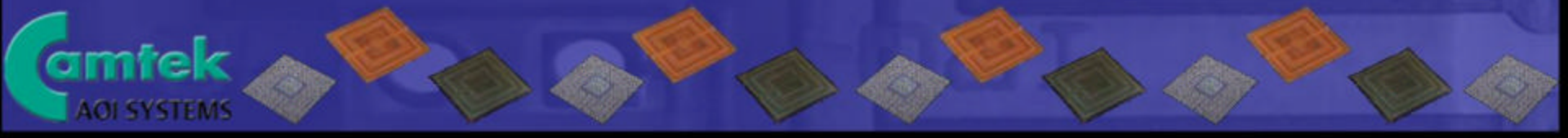
The Unique Challenge of AFI

- AFI looks for interconnect surface defects, resulting from process or handling issues.
- Correlating the Type, Size, Design Location and extent on the interconnect reliability. Not Obvious.

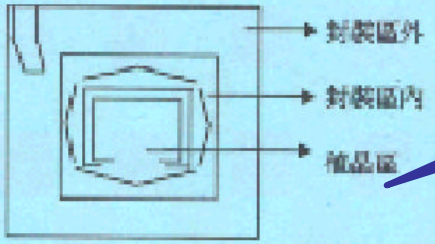


The Unique Challenge of AFI (2)

- The Inspection needs to differentiate all surface defects from their background.
- The need for Intelligence that would qualify their significance according to a pre set customer spec.

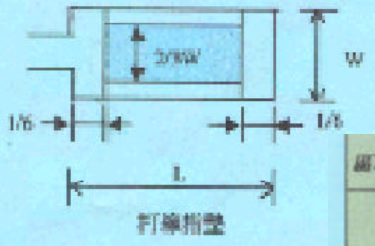
Customer Criteria

1.植晶區 (電力環以內區域，圖示如下)：



Where to look?

2.打線區定義（未特別規定時，皆依此規範檢驗）：



區域	異常項目	代號	判定標準	Photo
	AOI前製程檢驗)		不允收	

區域	異常項目	代號	判定標準	Photo
	變色污染		金手指重要區：不允收 電力環重要區：1.不可大於2*2mil，電力環單邊以一顆爲限 2.電力環4個角落非重要區不管	
		45	電力環重要區：1.不可大於2*2mil，電力環單邊以一顆爲限 2.電力環4個角落非重要區不管 solder pad：不可大於面積的5% 導膠口：不可大於面積100mil*100mil	

What to detect?

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The heart of things

- **Problem** - Subjective judgment due to uncertainty in defect reporting, due to non-deterministic defect description in specs and variety of defects.
- **The Ideal** – The Inspection tool should effectively , implement qualities criteria, and replace human decision.

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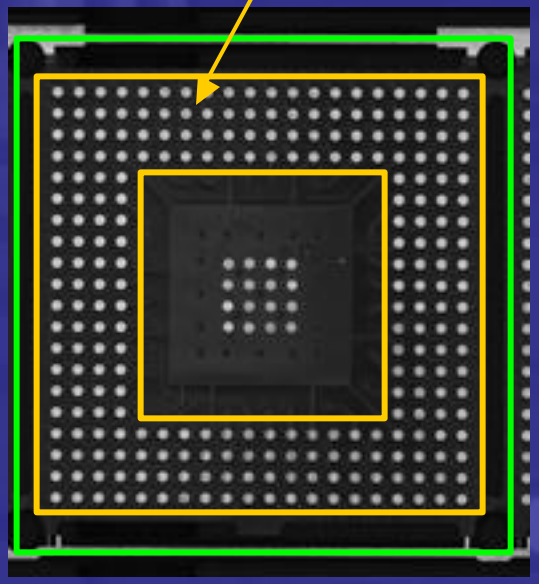
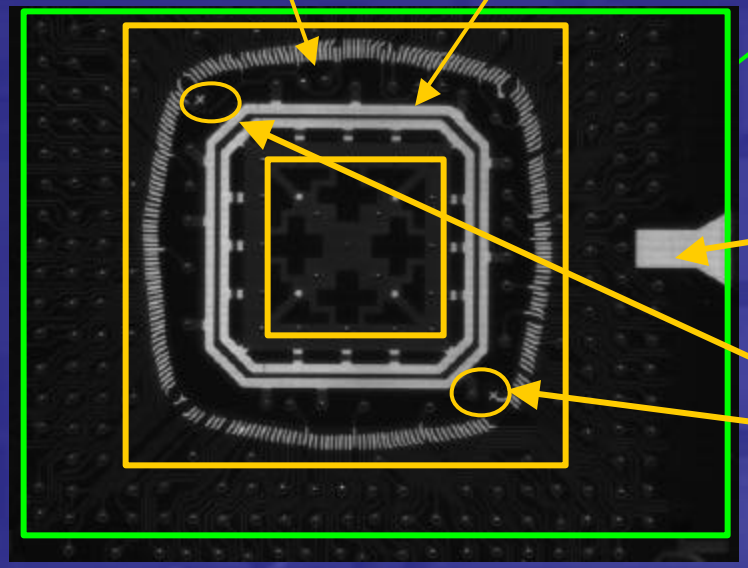
Design Elements of Inspection





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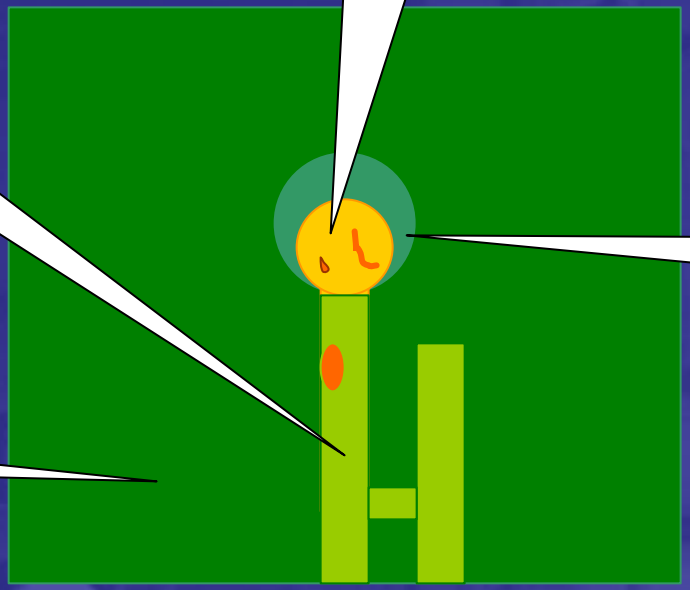
Different Areas of Inspection



Gold (Au) Pad
[area C]

Solder Mask on Cu
[area B]

Laminate
[area D]

Solder Mask on GE
[area A]

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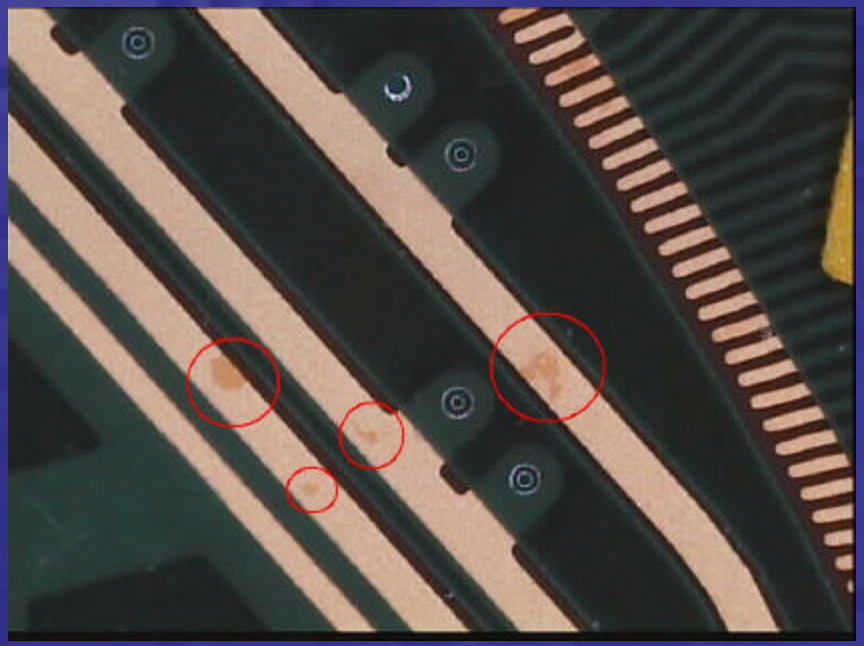
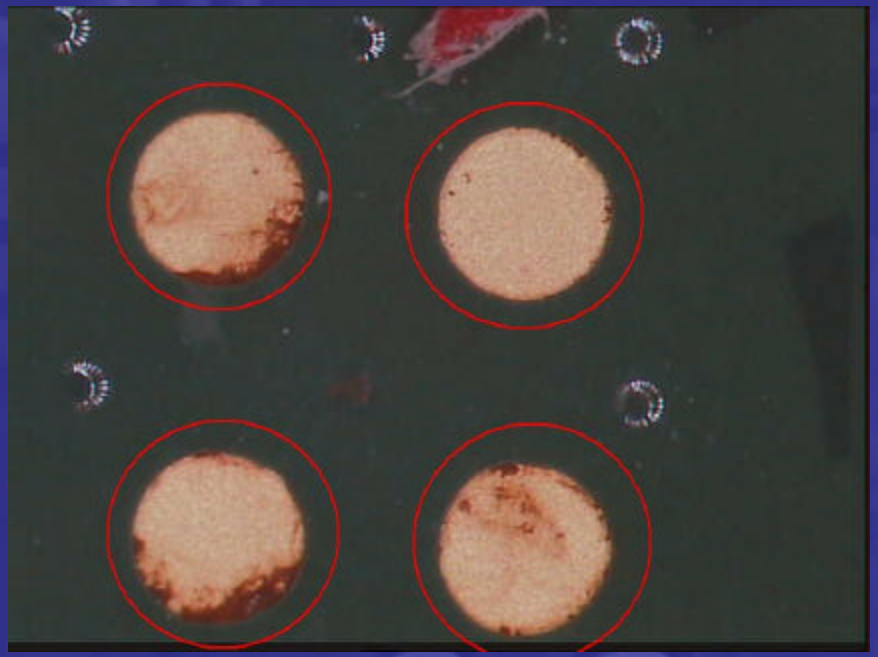
Discoloration



Contamination and Foreign Materials



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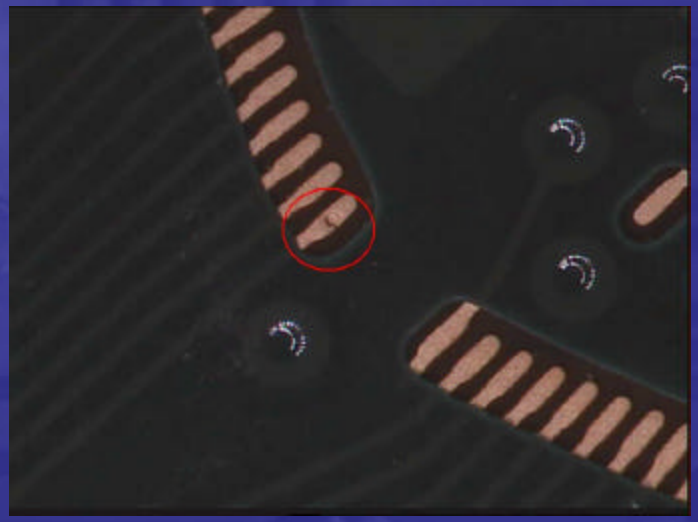
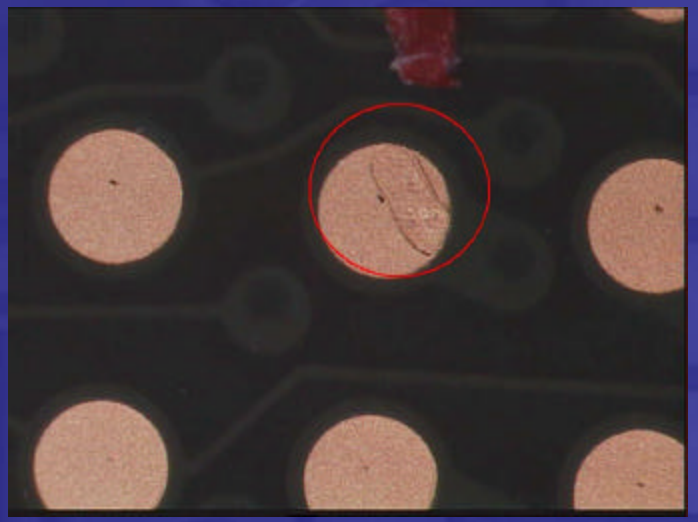
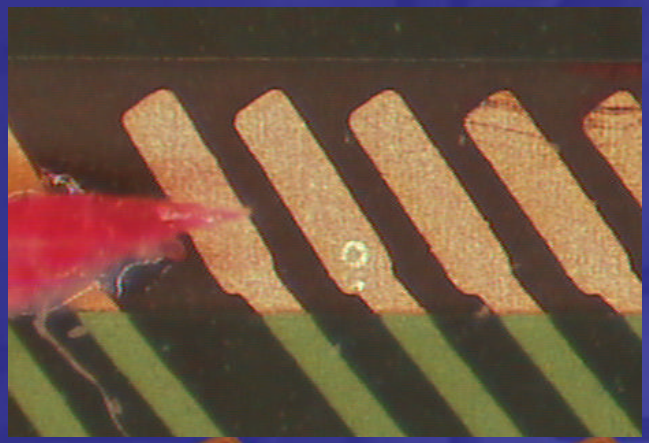
Dish-down and Dents







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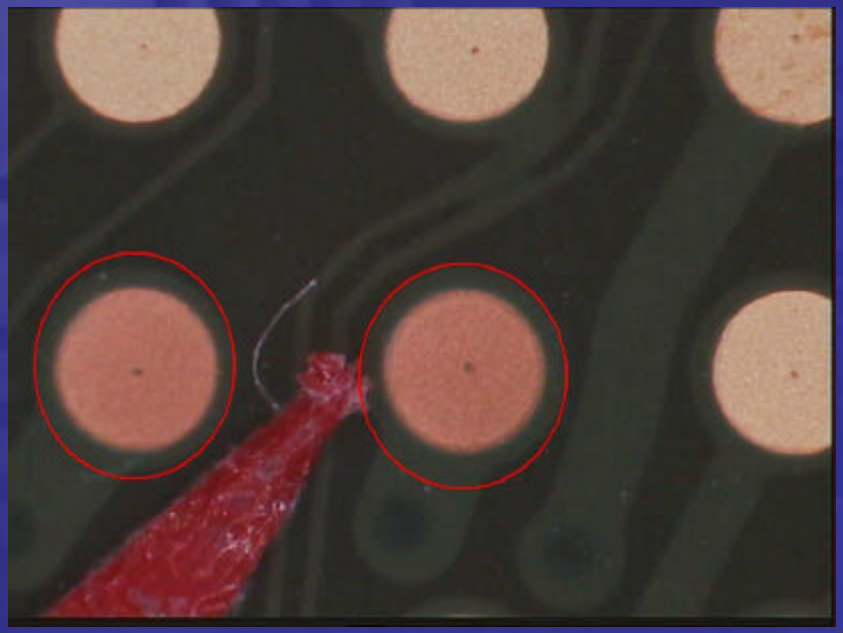
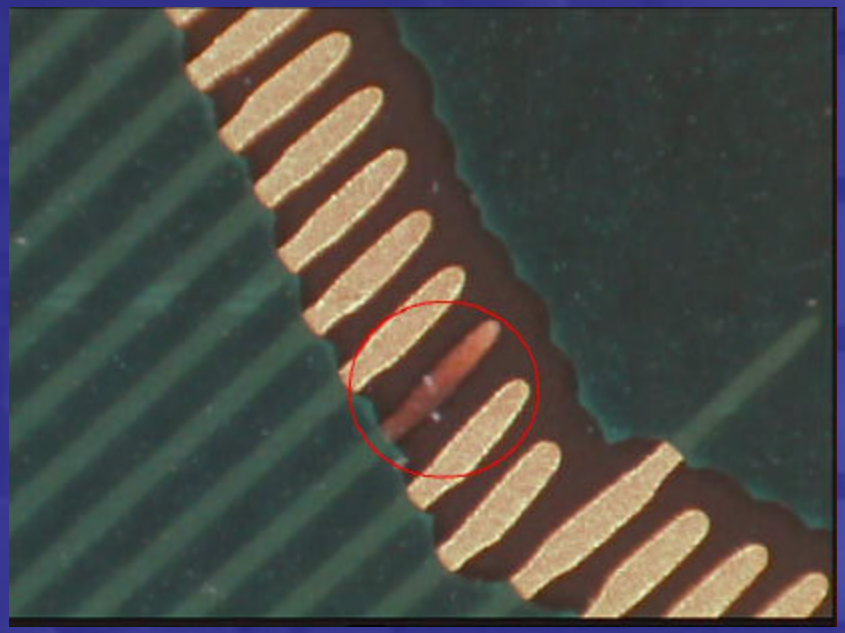
Bare Copper / Skip Plating





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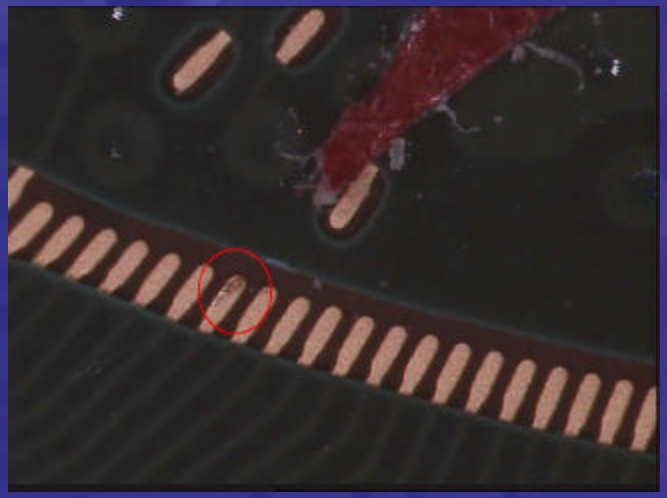
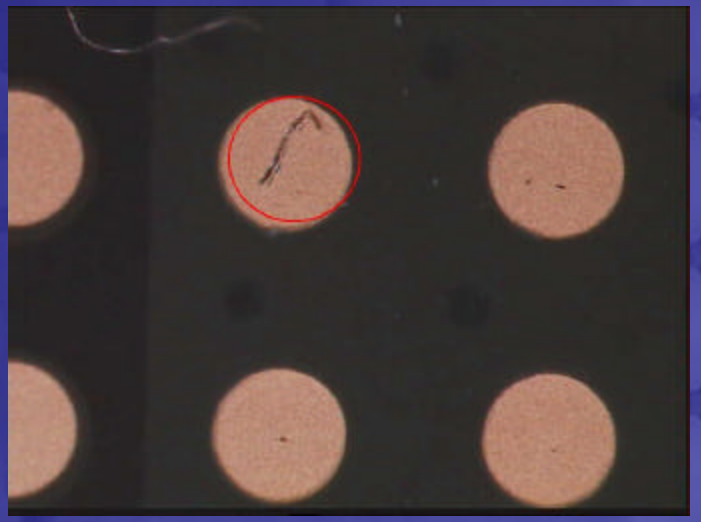
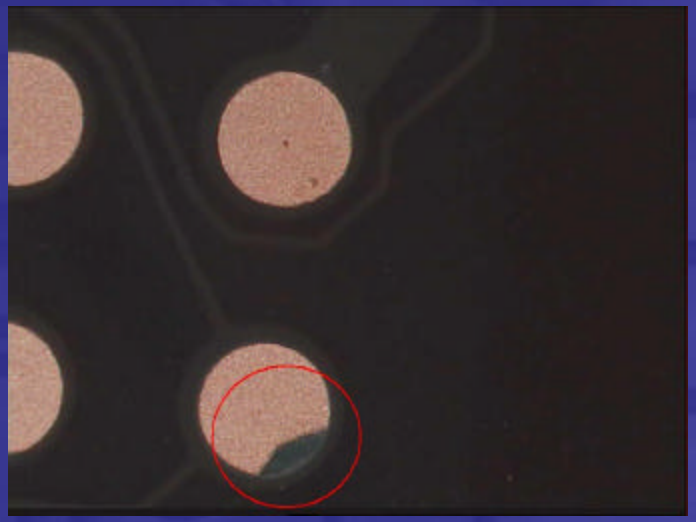
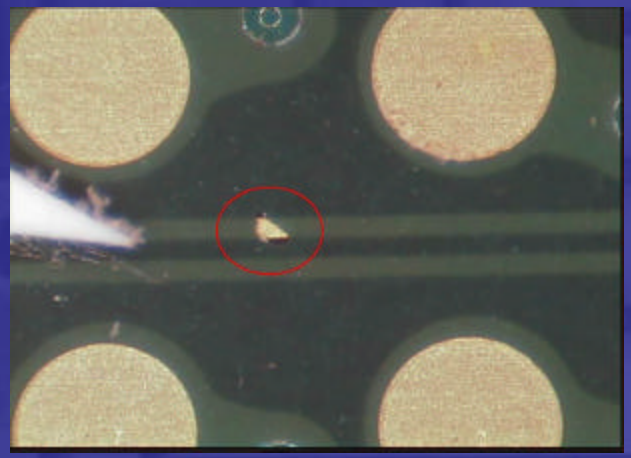
Scratches on Gold and SM





Solder Mask violations and Solder Mask peeling





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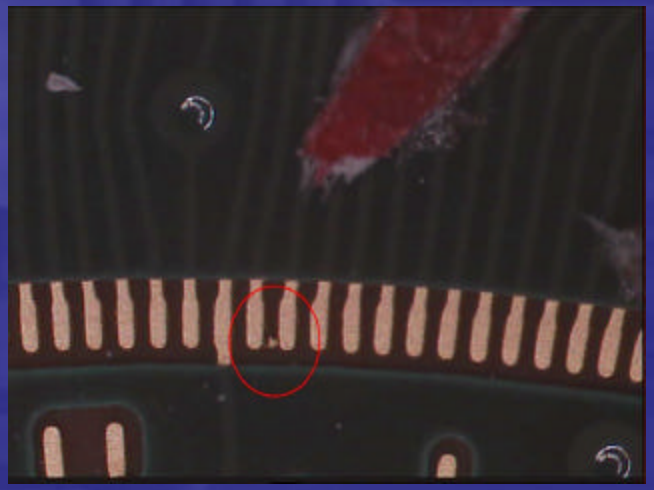
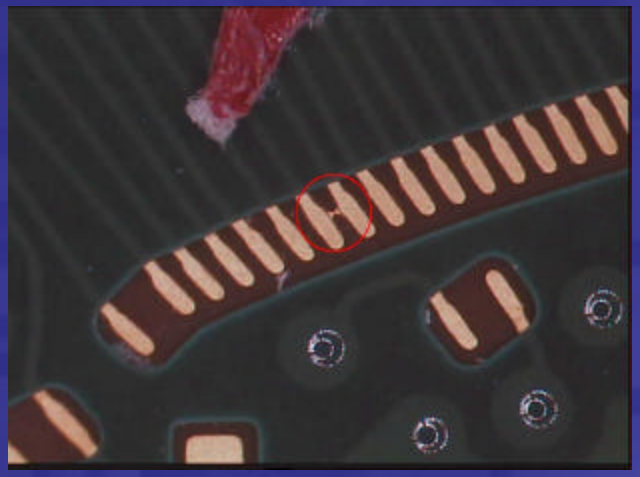
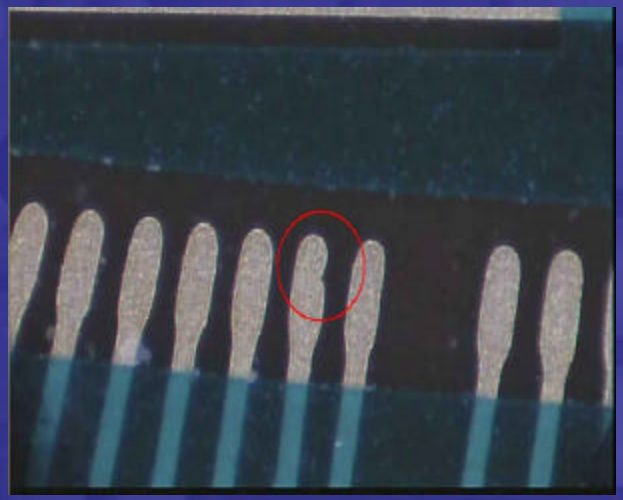
Extra Copper/Gold and Shape violations







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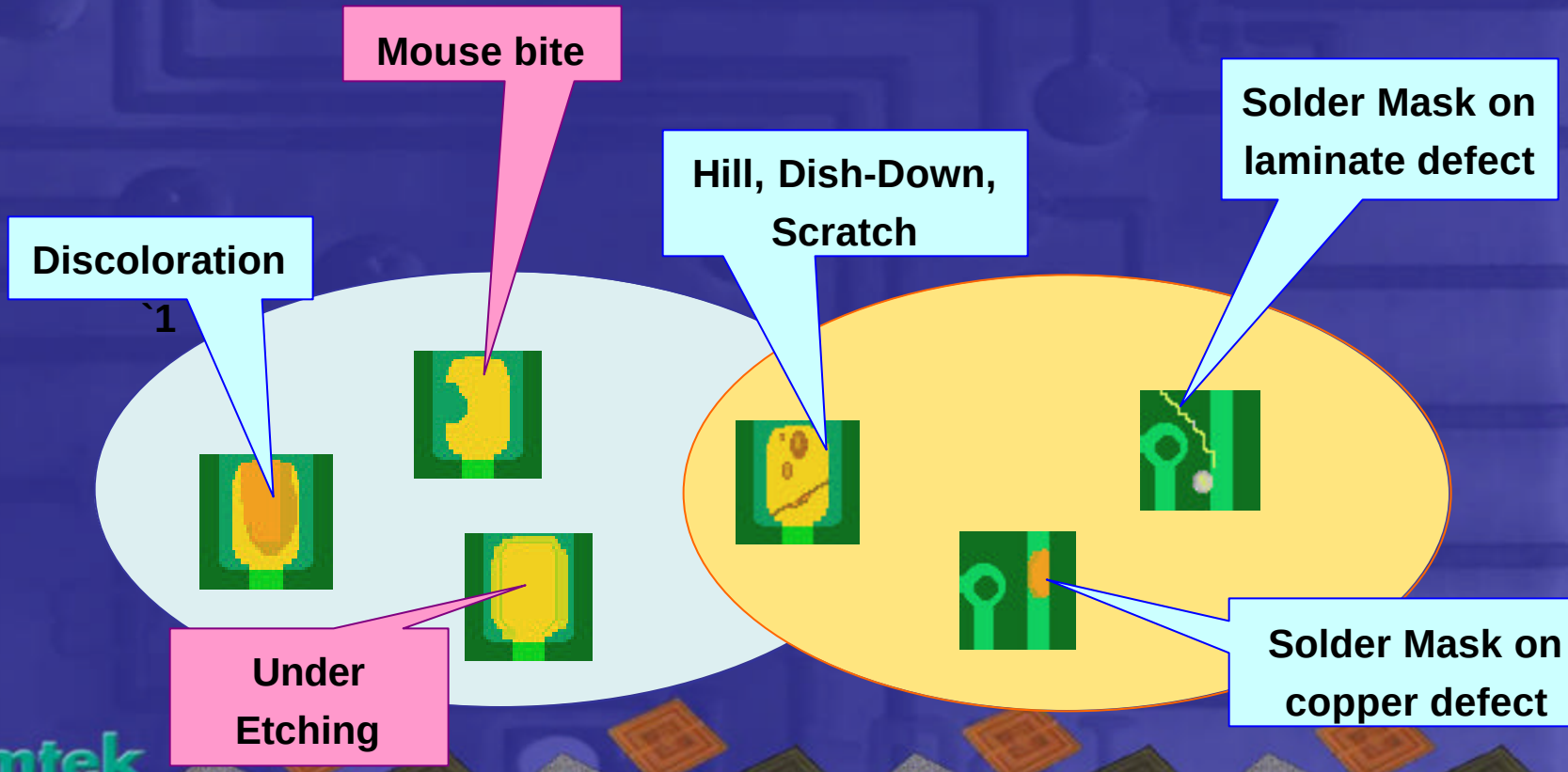
Sorting AFI Defects

Pegasus provides defects Auto Classification capability and SPC analysis



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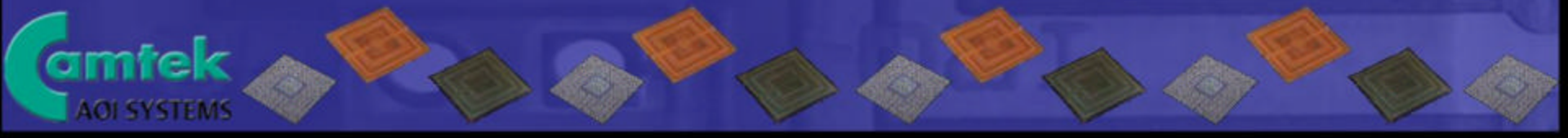
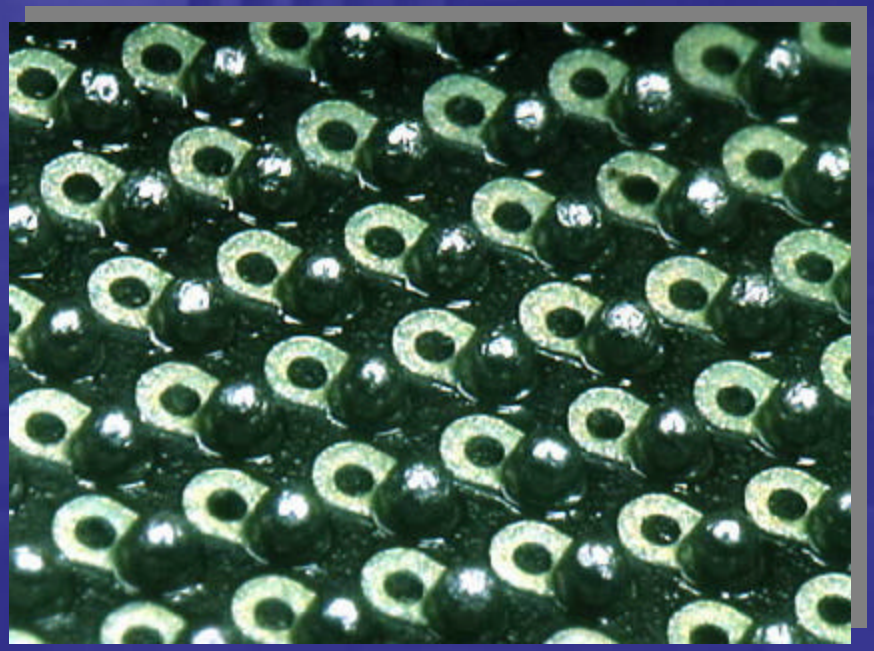
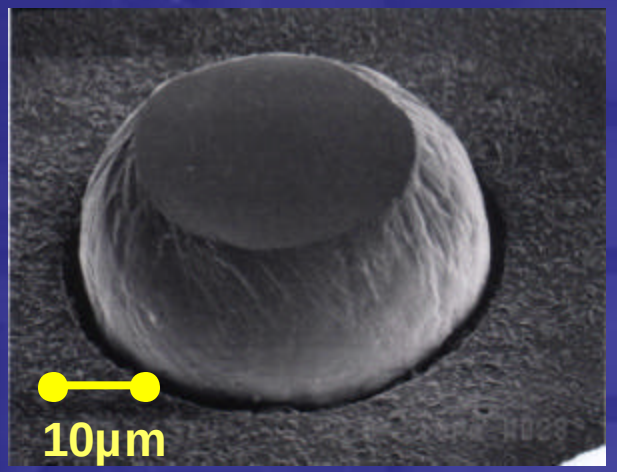
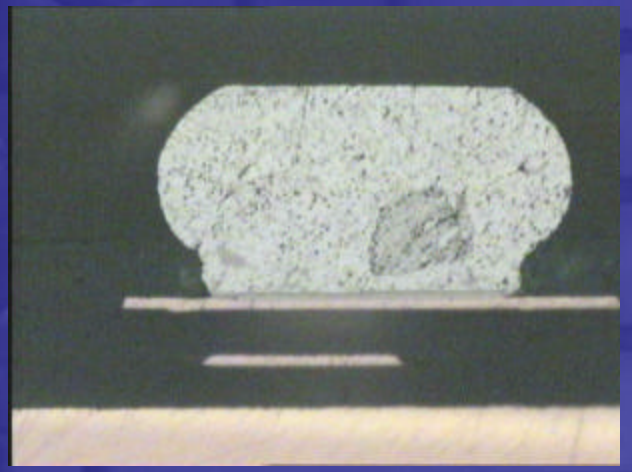
The Third (3rd) Dimension of Flip-Chip



Bumps on Substrates

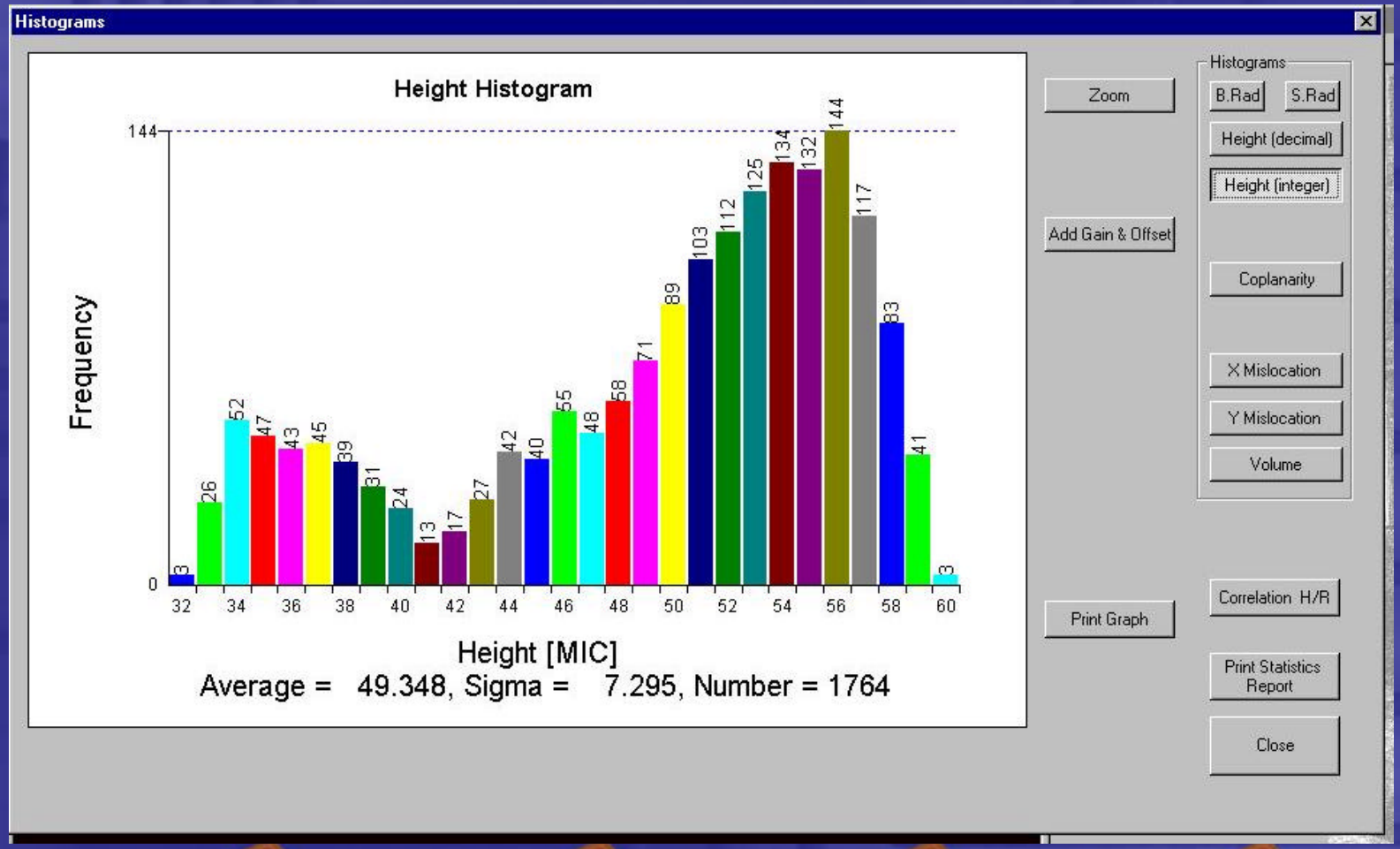






Flattened Solder Bump

SPC - Bumps Height Metrology



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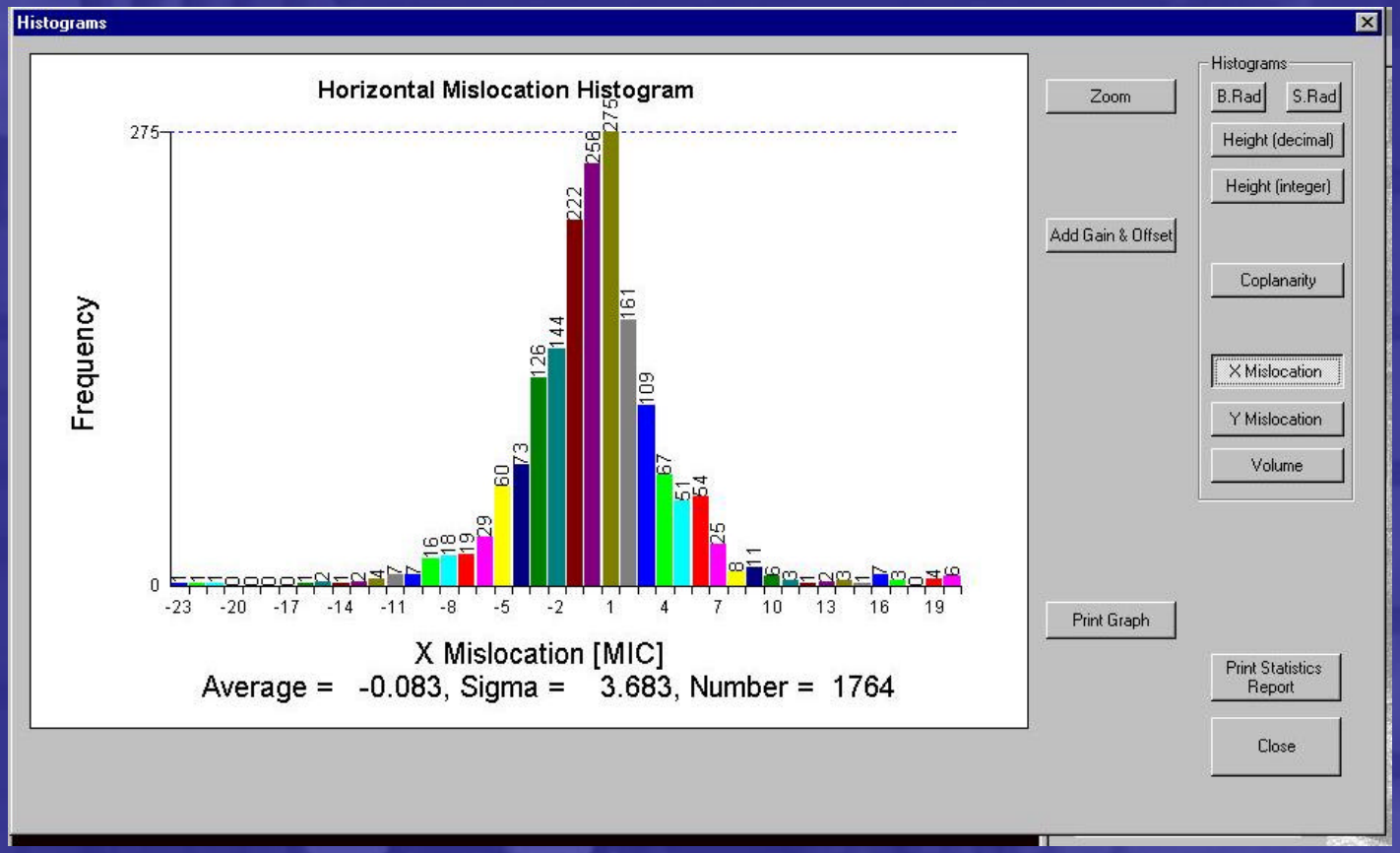
SPC - Wrong Location in X axes



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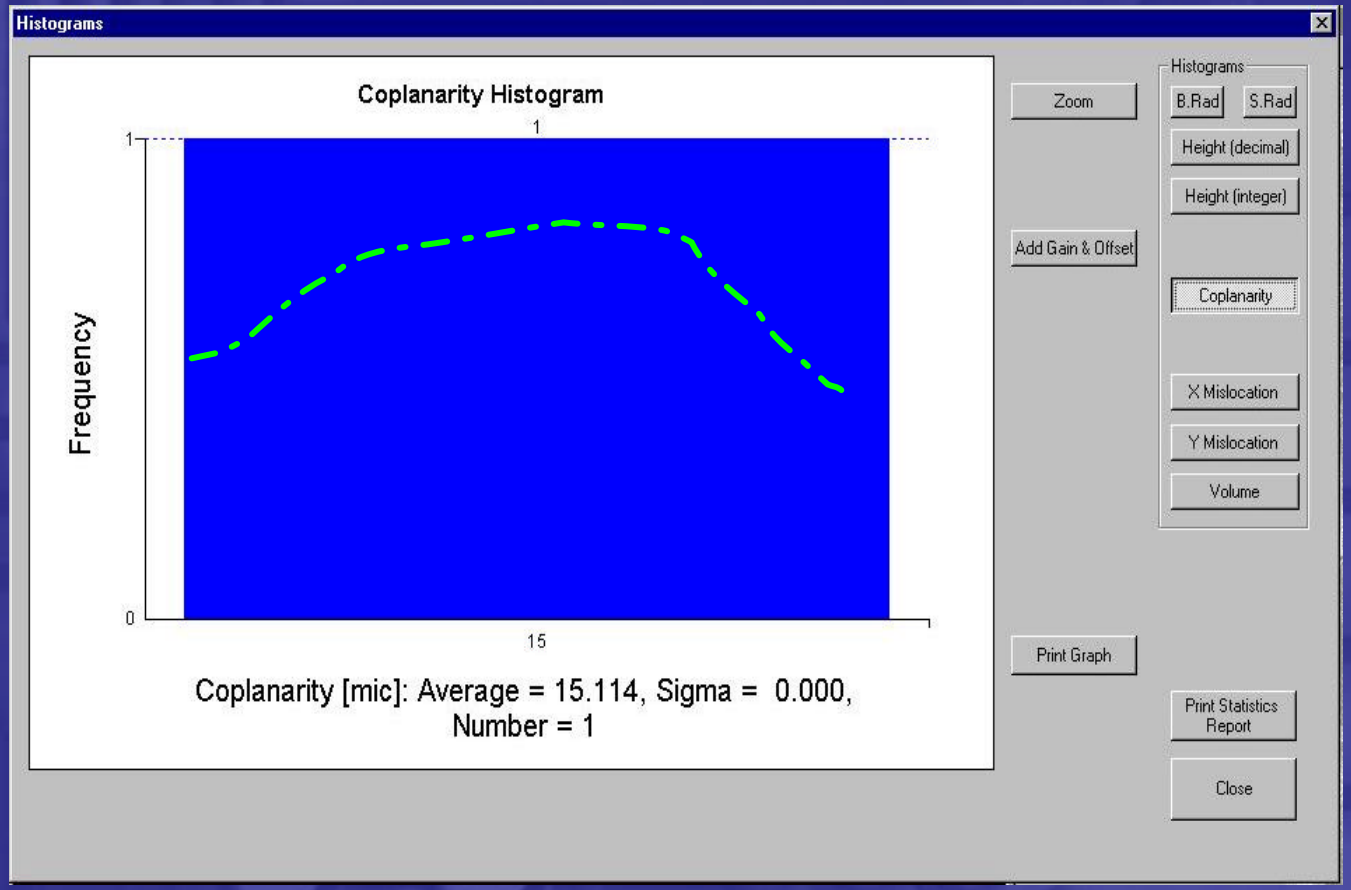
SPC - Bumps Co-Planarity



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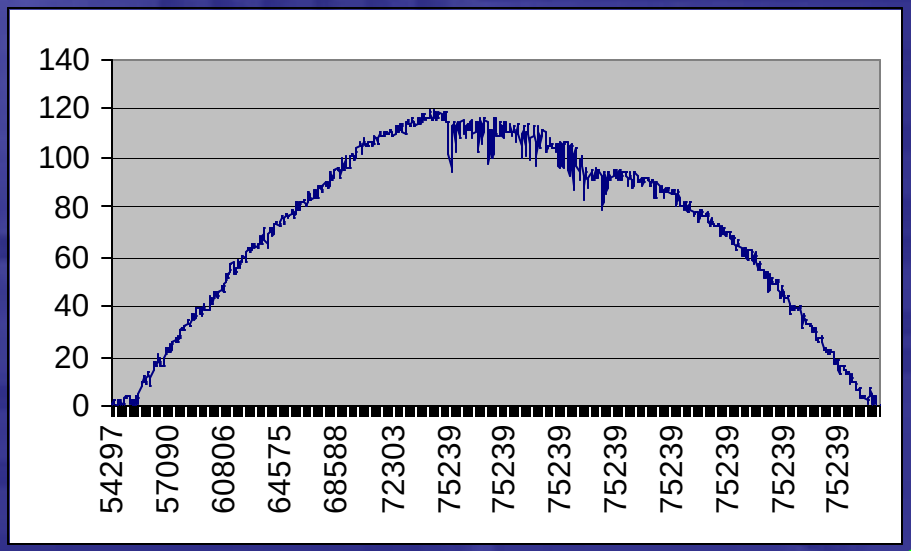
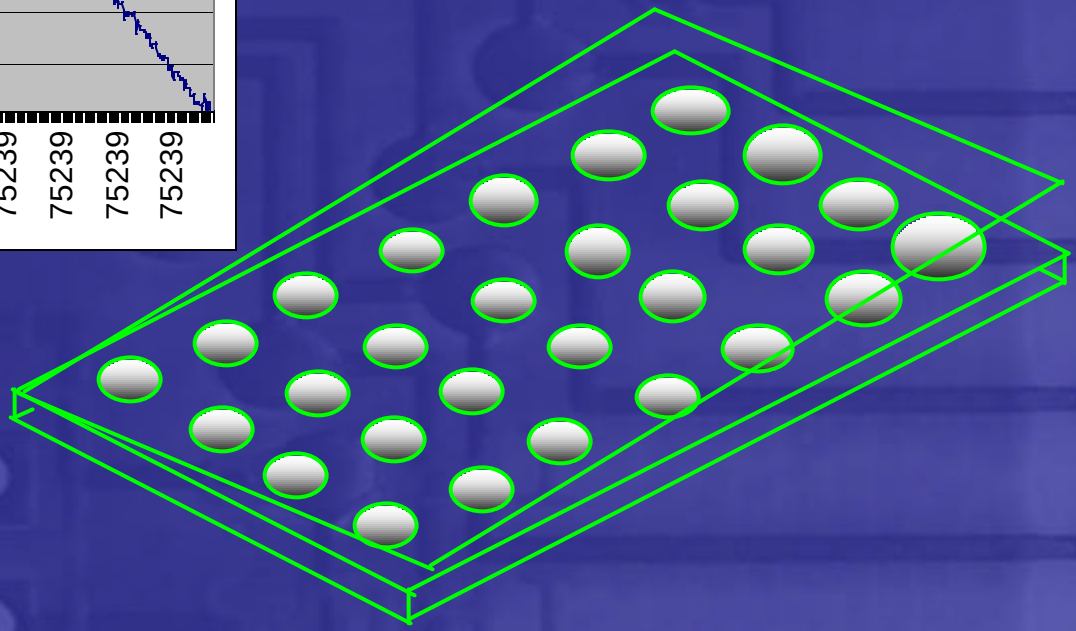
SPC - Substrate Warpage





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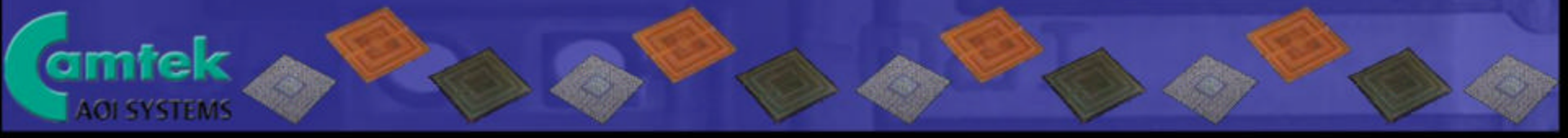
The challenge in the Technology



The Trade Off between Detection -- False Alarm

$$DI = \left[1 - \frac{FA}{TC}\right]\left[1 - \frac{MD}{KD}\right]$$

DI – Detection Index
FA – Number of False Alarm Calls.
TC – Total number of calls.
MD – Number of Missed Defects.
KD – Number of Known Defects.

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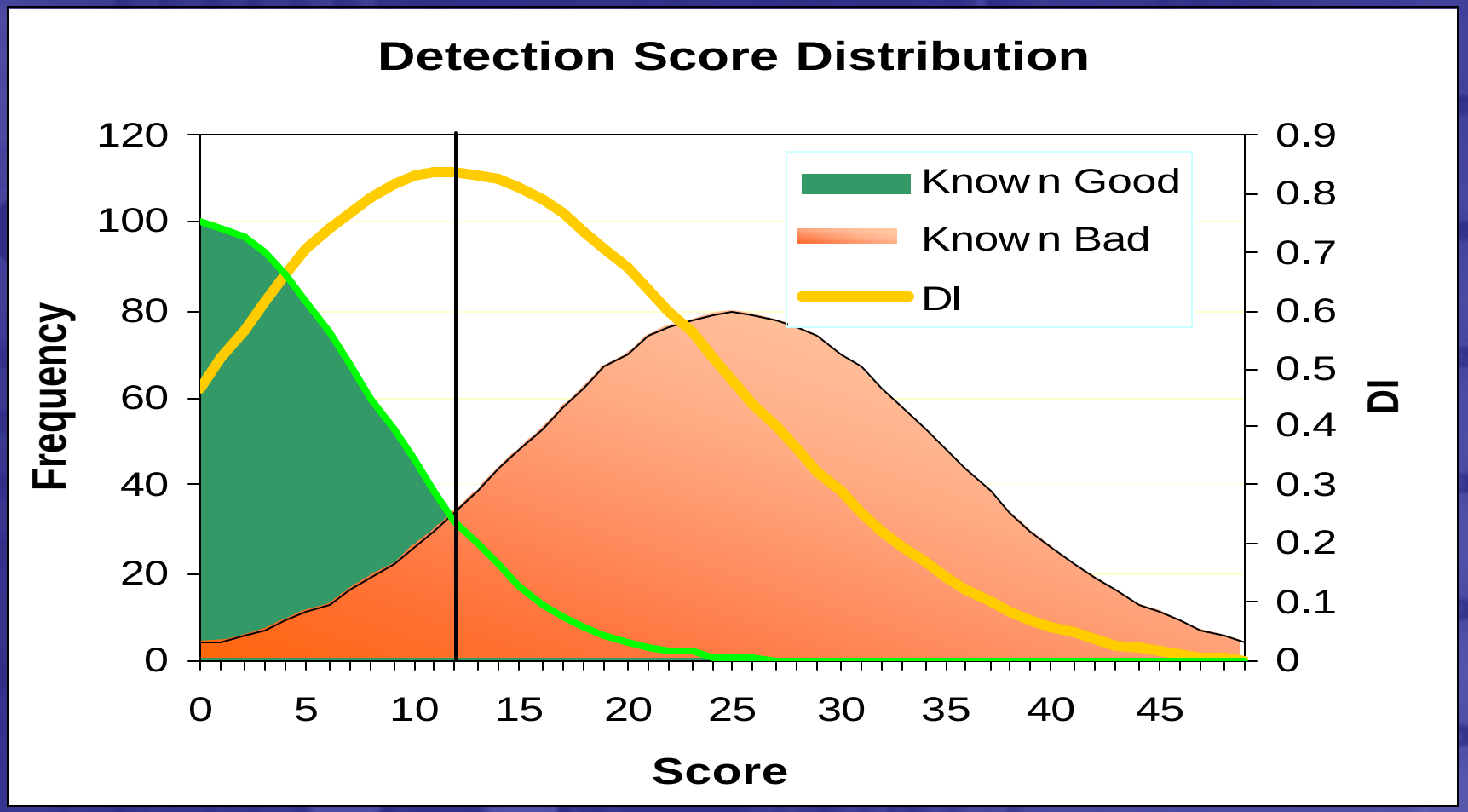
Detection Score Distribution



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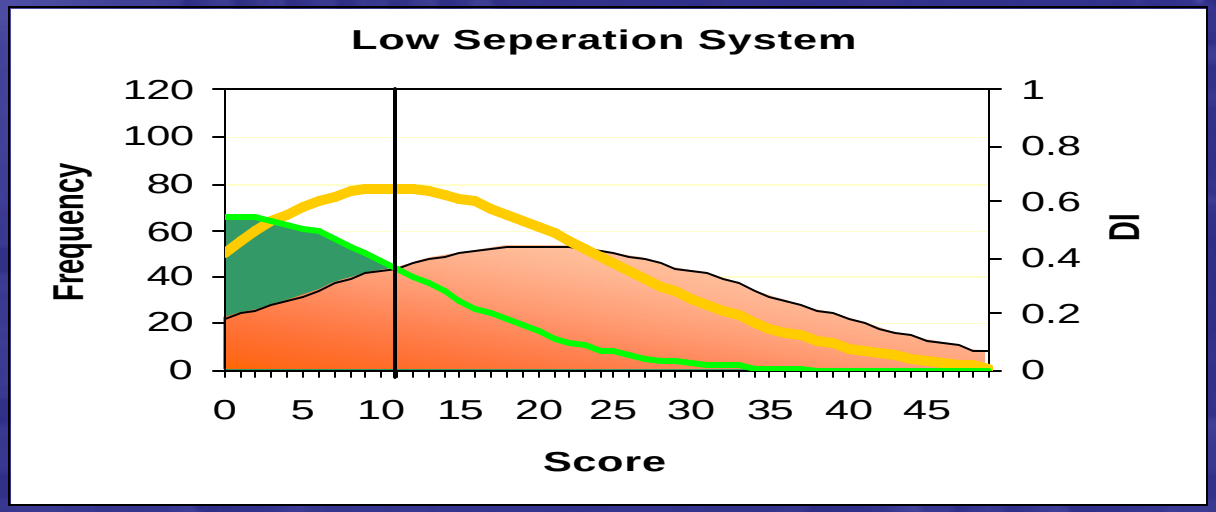
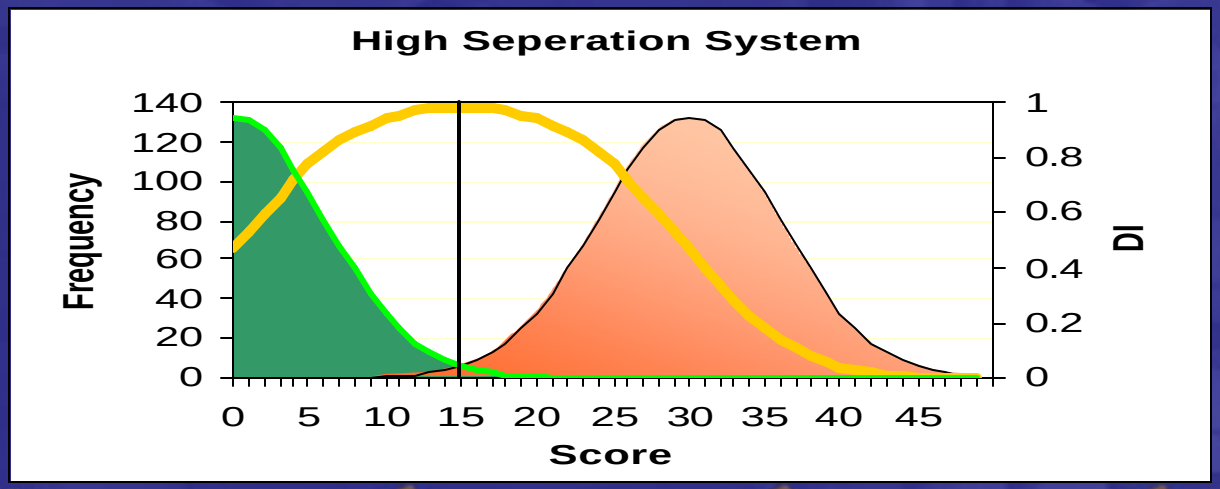
Low - High Separation System





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Thank You!

Yossi Pinhassi

Udi Efrat

Moti Yanuka