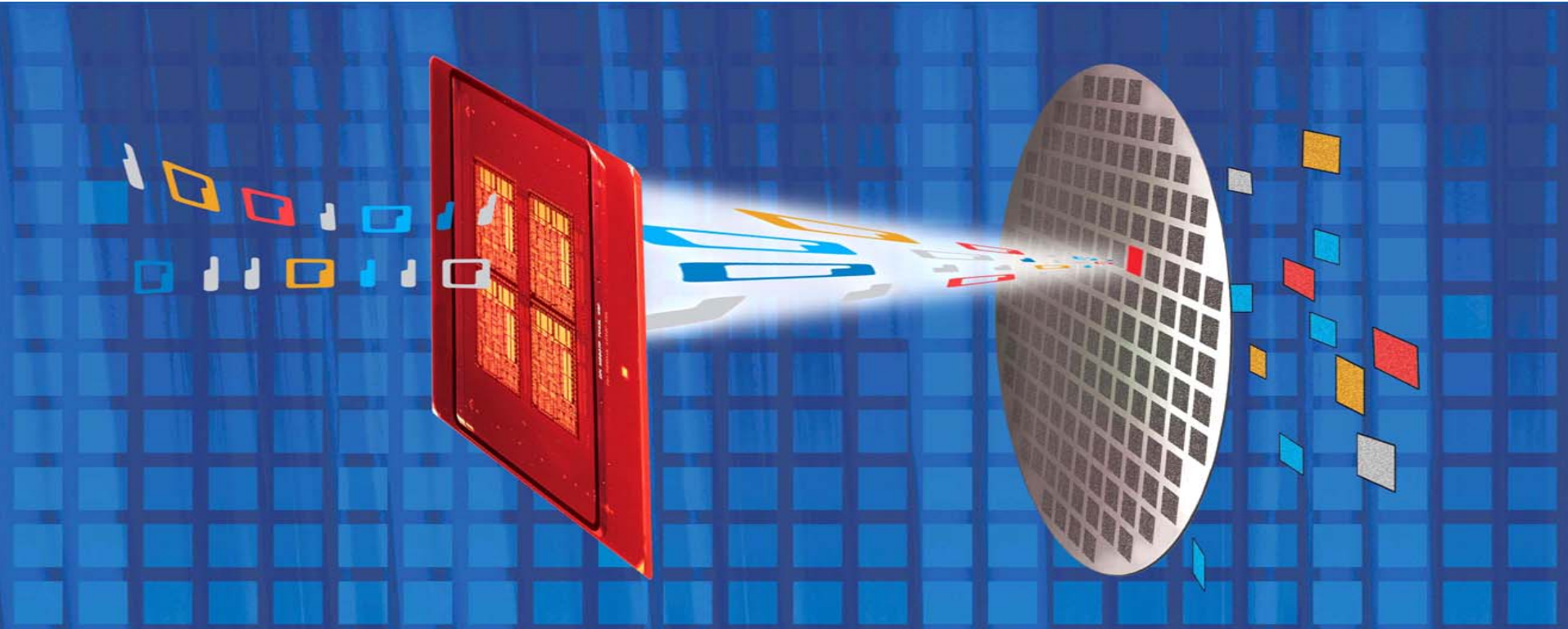


DuPont Photomasks Automation Review

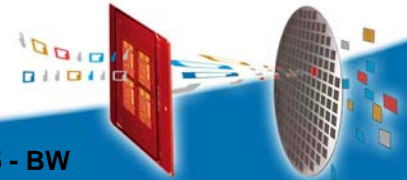
for
Sematech Mask Automation/
2005 ITRS Mask Meeting



DuPont Photomasks, Inc.
Perfectly Focused.

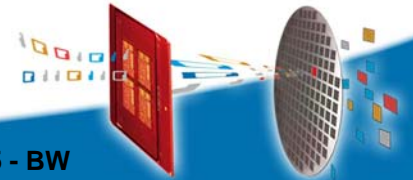
Outline

- Overview of Current Factory Automation Systems.
- Factory Automation Impacts.
- Issues and Potential Improvements Through Automation.
- Implementation Challenges and Opportunities.

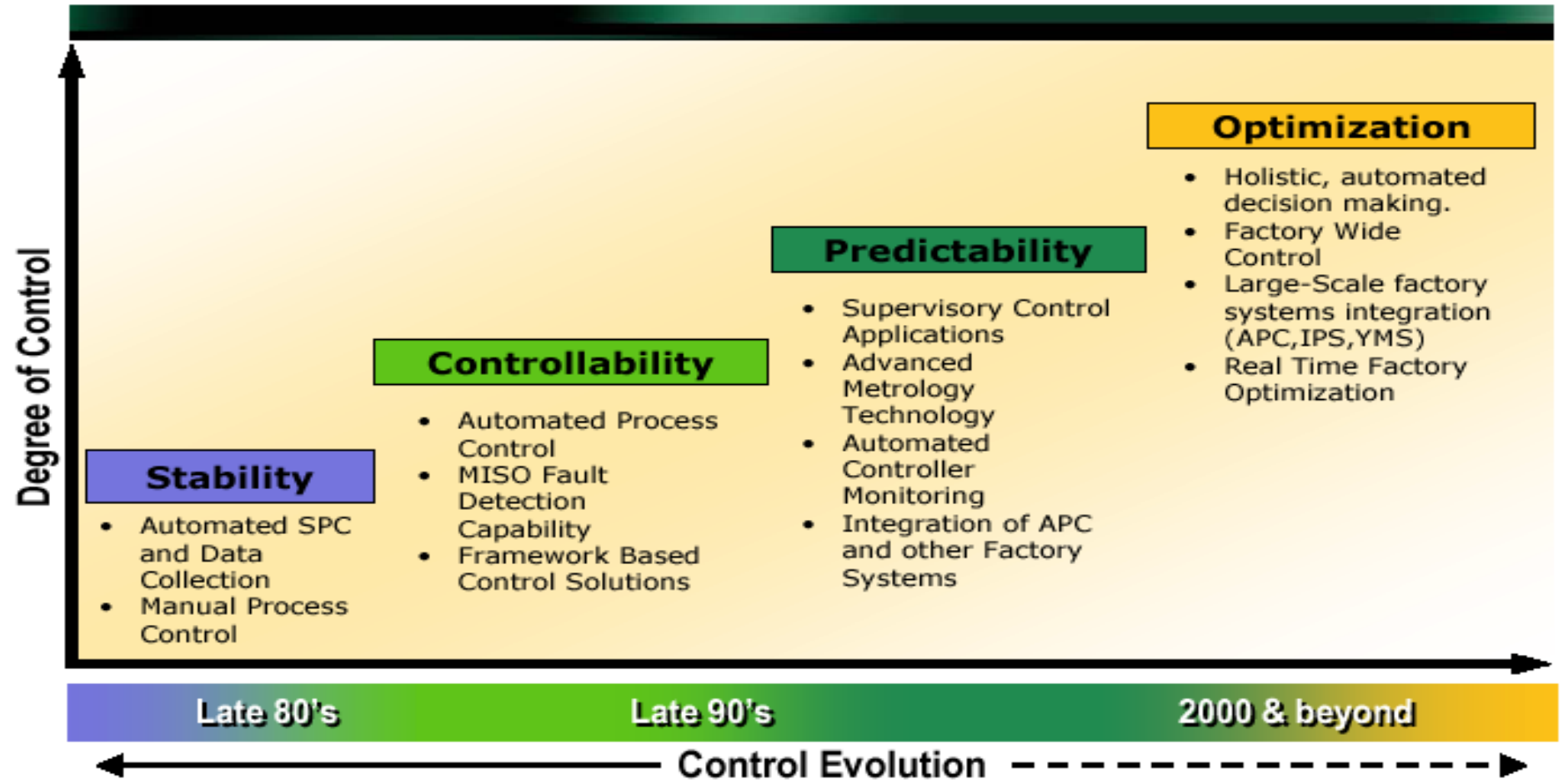


Current Factory Automation Systems

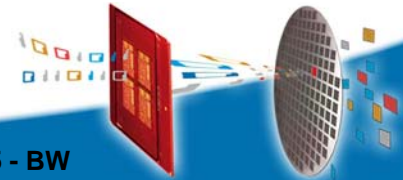
- Significant progress achieved over the past 3-4 years in understanding / implementation of factory automation.
- Recognize there are still many opportunities for improving existing systems and implementing more advanced automation.



Evolution of Automated Control

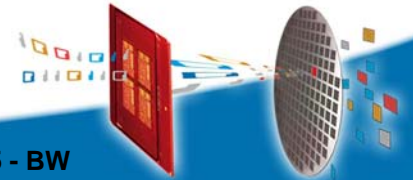


From AMD Presentation at 2004 Sematech AEC/APC Conference



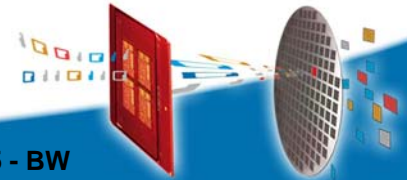
Current Factory Automation Systems

- Technical Planning / Data Preparation
- Manufacturing Execution System
- Material Handling
- Statistical Process Control
- Advanced Process Control (FDC / APC)
- Final Audit / Shipping



Current Factory Automation Systems: Tech Planning

- **Customer-Specific applications developed to align incoming data with standard format.**
- **Module-Specific applications developed to work with standard format.**
 - **Lithography**
 - **CD Metrology**
 - **Registration Metrology**
 - **Inspection**
 - **Audit**

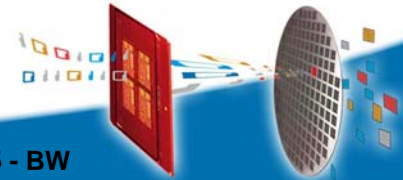
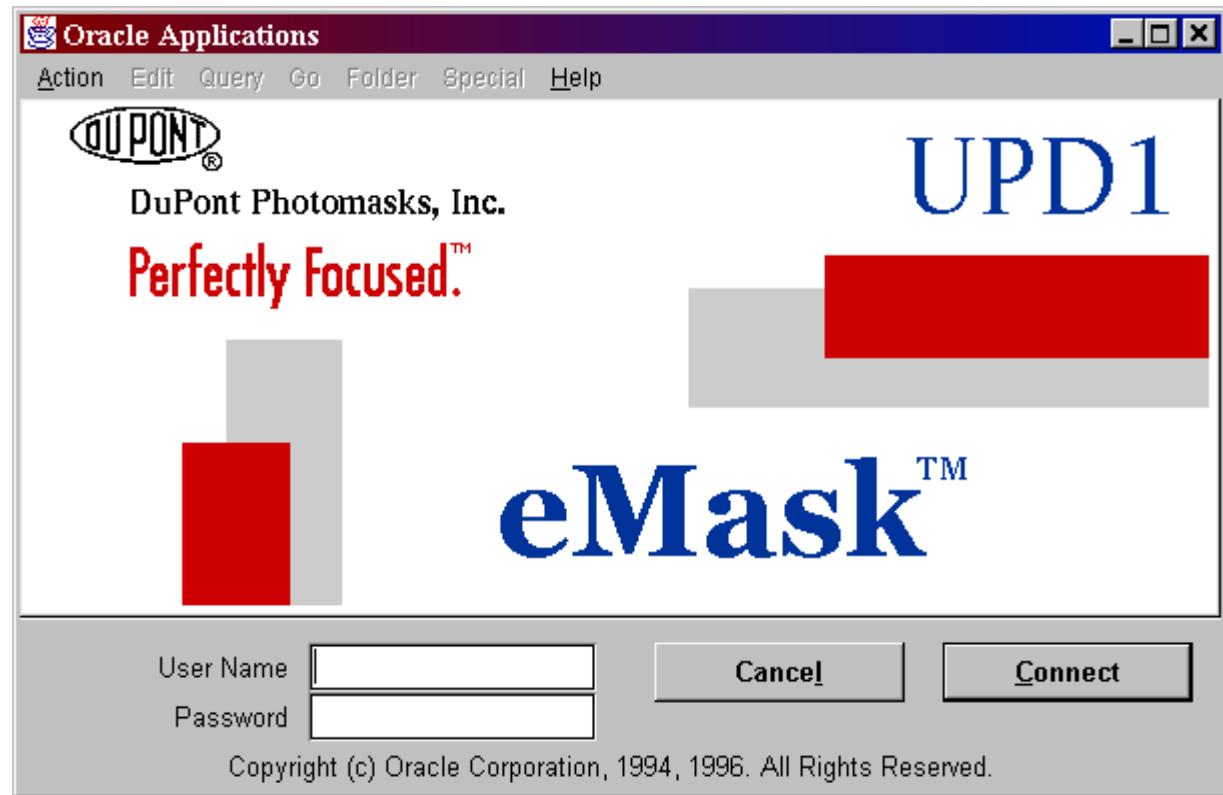




Current Factory Automation Systems: MES

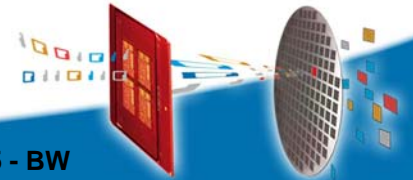
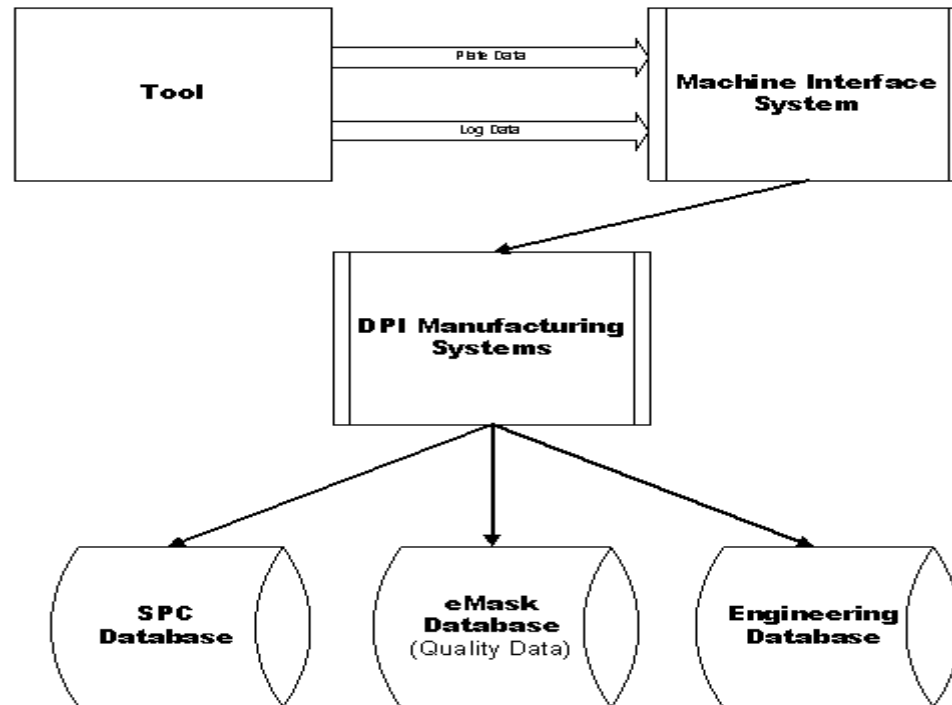
■ Global MES implemented

- Site-Based App.
- Regional Nodes
- Global Links



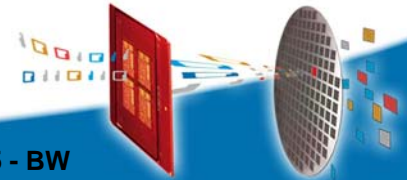
Current Factory Automation Systems: MES

- One-Way Machine Interfaces implemented to upload metrology data and selected equipment data to MES.



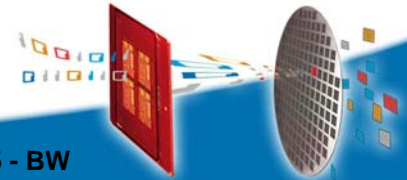
Current Factory Automation Systems: MES

- Allows seamless transfer of jobs between qualified manufacturing sites.
- Basic factory scheduling logic and business rules implemented to ensure product quality and delivery performance.
- Regional / Global MES databases allow improved data analysis and benchmarking.



Current Factory Automation Systems: Material Handling

- Advanced product lines utilize SMIF pods for write, process and etch modules.
- Robotic handling implemented on defect sensitive modules.
- Modules linked by robotic handling where practical.

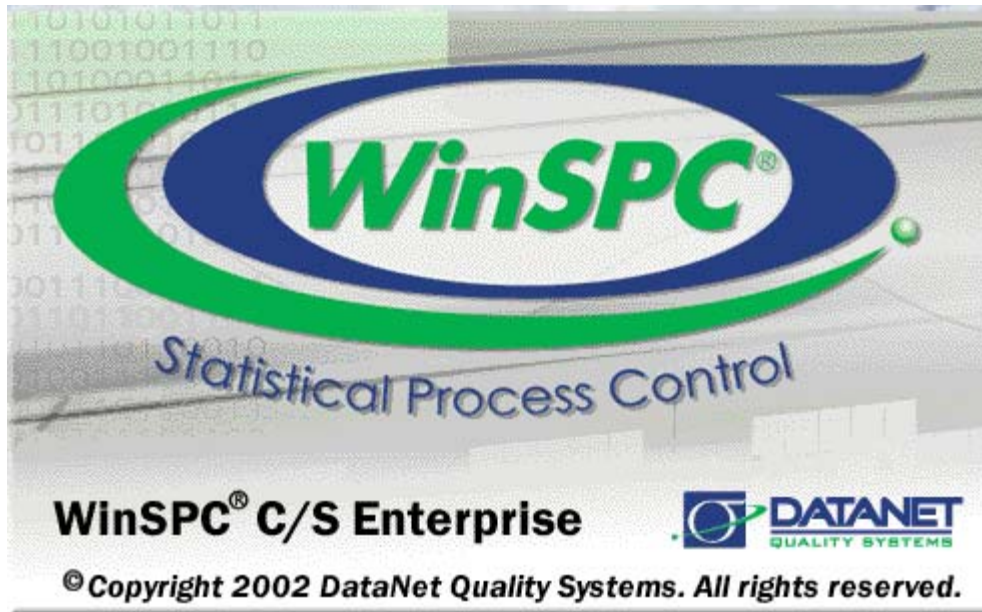


Current Factory Automation Systems: SPC

- Basic SPC Implementation through WinSPC application.
- Full automation of product data collection from MES database (CDs, Reg., Defects, etc.).

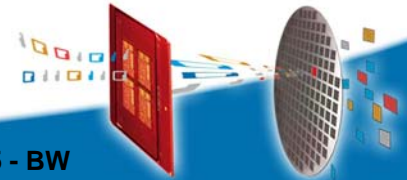
Data Collection

Manual
Semi-Auto
Auto



WINSPC Collection Plans

Gauge Control
Process Control
Product Results

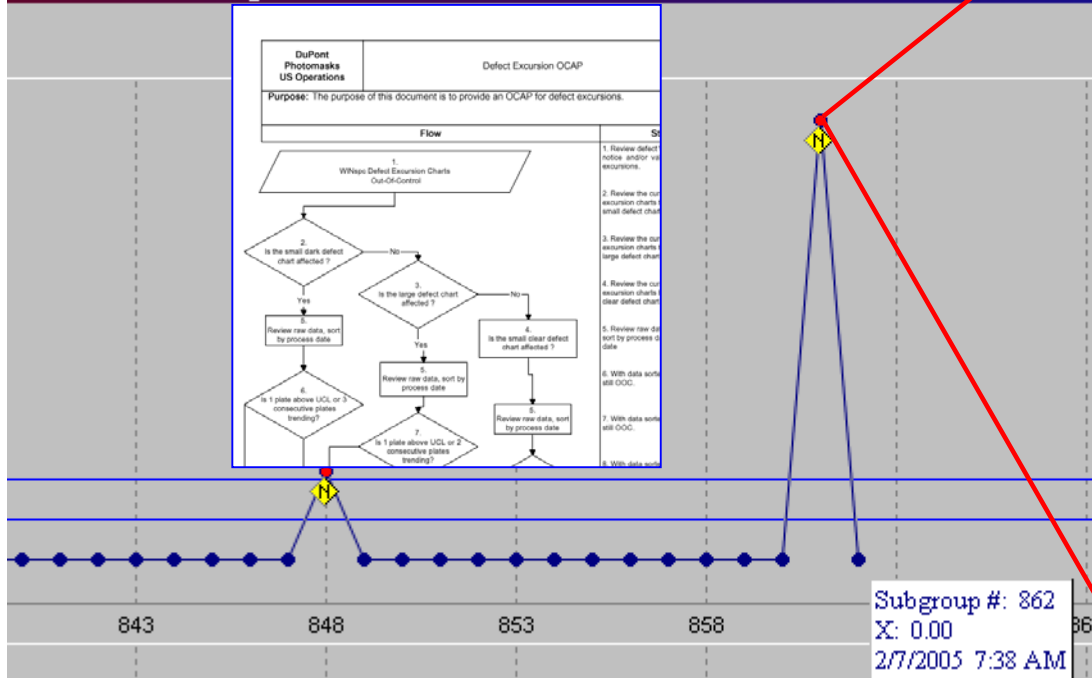
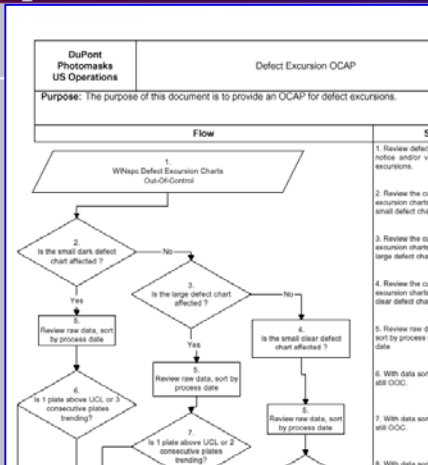


Current Factory Automation Systems: SPC

Subject: Mail From SPC

Parameter Large 90 on collection plan \Product Results\Percentile Defects\HOYA BINARY EAPSM 6025 APRX DRY ETCH has violated the control rule for a single point outside control limits. Follow instructions per OCAP RRMC-0036_OC1.

DRY ETCH.Large 90



Subgroup: **861** X MR

UCL: **0.90** **0.90**
CL: **0.45** **0.45**
LCL: **0.00** **0.00**

#	Data	Date	Time	User	Station
1	5.00	2/6/2005	8:11:59 PM	maskuser	Prspc02

Tag Name	Value
Bake Tool	NONE
Collection Plan Name	HOYA BINARY EAPSM 6025 APRX DRY
Develop Tool	PEBHP1#257
Etch Tool	VLRPM1#197

Violations: 1 pt beyond control limits

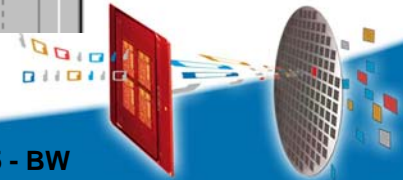
Assignable Cause:

Corrective Action: T1

Note: 344466-has 2-1c's. Missing and mis-shaped contacts...ss

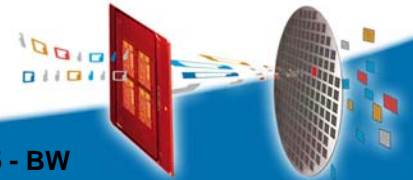
Exclude from calculations

Edit Tags OK Cancel Help



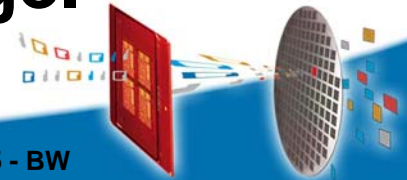
Current Factory Automation Systems: FDC / APC

- **Basic Fault Detection implemented on a limited set of equipment / parameters.**
- **Univariate control charts in use through WinSPC application.**
- **Establishing 2-Way MI's to enable automated recipe management and multivariate FDC.**
- **Manual & Semi-Automated Run-to-Run controllers implemented on selected systems as a pre-cursor to fully automated APC.**



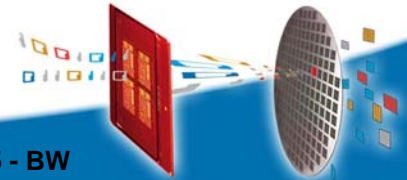
Current Factory Automation Systems: Final Audit

- Automation validates MES quality data vs. customer requirements during manufacturing and prior to product shipment.
- Automated eAudit & P10 package sends soft copy of customer-required data and CoC. (Inspection Maps, CD Data, Reg Data, etc.).
 - P10 Used Primarily for XML CoC's.
- 90% of audit packages are sent electronically.
- Transitioning to Customer Data Delivery (CDD) system to fully automate audit package.



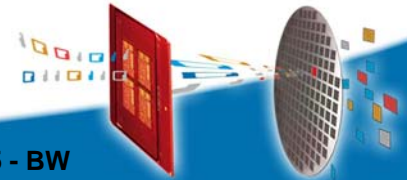
Factory Automation Impacts

- Significant cycle time reductions.
- Significant reductions in complaints & returns.
- Improved identification & response to process excursions.
- Improved process targeting & reduced variation.
- Global databases associated with automation systems have facilitated improvements in:
 - Data mining capabilities.
 - Report automation / feedback to MES.
 - Benchmarking between sites.



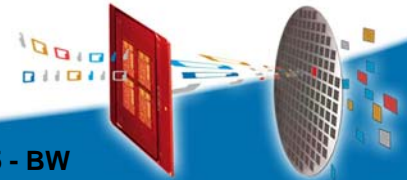
Issues to be Addressed w/Automation Improvements

- **Improved manufacturing line control.**
 - Integration of factory automation systems: MES, Equipment Tracking, Process Controls, etc.
 - Adaptive modeling and feedback to MES logic & business rules.
- **Improved process control / yield.**
 - Early detection and response to equipment excursions through multivariate FDC.
 - Process modeling and control through APC.



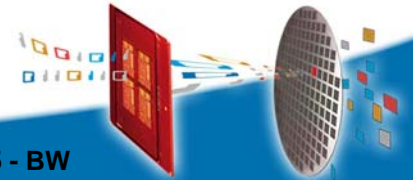
Implementation Challenges & Opportunities

- Understand product volume and mix interactions with automation systems.
- Integration of factory automation systems.
- Learn from customer's experience with automation successes and failures.
- Alignment of requirements / standards across customer base. (Interpretation of Standards).
- Implementation of automated recipe management, multivariate FDC & APC.



Summary

- Significant progress achieved over the Last 3-4 years in understanding / implementation of factory automation systems.
- Achieved improvements in global alignment of DPI automation systems and factory performance.
- Interested in learning more from wafer fab's experience with implementing factory automation systems.



Acknowledgements

- Thanks to the following individuals for contributions to this presentation:
 - Curt Jackson
 - Al Wong
 - Robert Bolger
 - Steve Erwin

