# *New Tools for Probing Process Management*

*Cary Kiest*
*Electroglas, Inc.*

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# Presentation Overview

- Probing Process Management
  - Background
  - Today's Tools
  - Motivation
- An Inline Probing Process Management System
  - Requirements
  - System Elements
  - Validation
  - Practical Considerations
- Conclusions

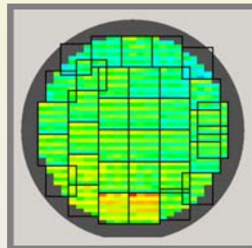
# *Probing Process Management*

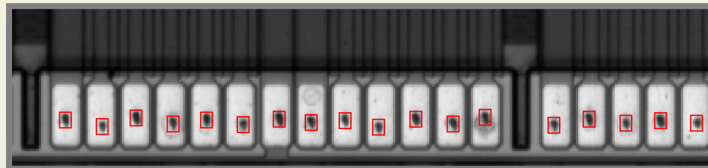
# Background

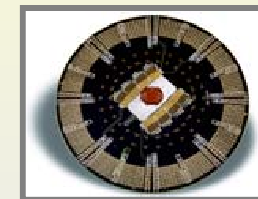
- Technology Trends
  - Test Cell Efficiency (Throughput):
    - Test time per wafer is falling in many applications
    - More Parallel Test
    - BIST on whole wafer
    - Faster Testers
  - Cost of Downtime is increasing:
    - Higher cost testers
    - Higher cost probe cards
- Impact
  - Test Cell Efficiency and Cost of Ownership are key measures

# Background

- Technology Trends
  - Fine Pitch Probing:
    - I/O larger than circuitry on IC's drives need for smaller pads
    - Lithographic probe cards improve probe card accuracy
    - 25ɥm bonders means probing is only barrier to smaller pad
- Impact:
  - Greater emphasis on PTPA and prober control
  - Thermal stability has become vital
  - Many probers are on the verge of not being capable for new probe cards







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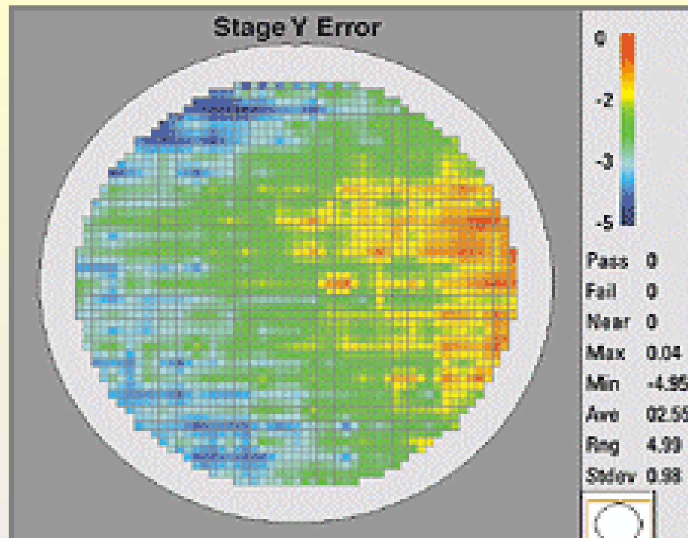
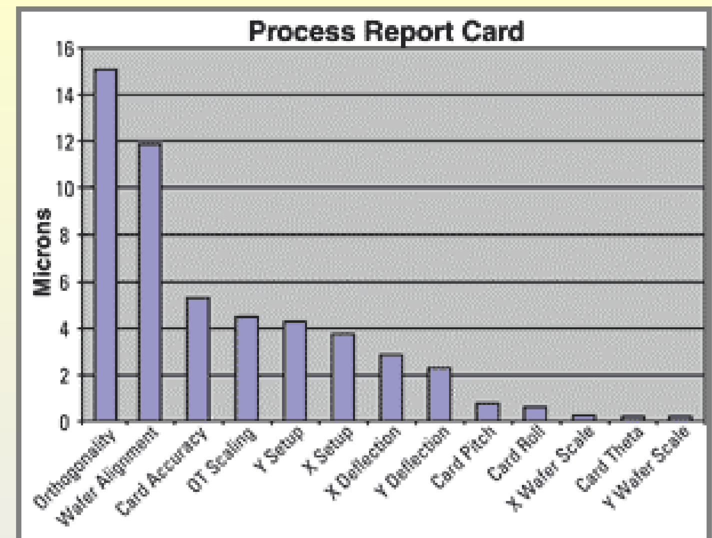
# *Probing Process Management*

- Definitions
  - Process management is the control and improvement of business processes through understanding, measuring, innovating, and managing how work gets done to accomplish organizational goals
  - Applied to wafer test, we aim to offer process characterization and understanding that facilitate improvement through reduced costs and less waste (higher yield)

# Probing Process Management

- Today's Tools
  - waferWoRx Probing Process Analysis:
    - Enables automated root cause analysis for rapid corrective action, yield optimization and control
    - Helps users differentiate between prober and probe card issues
    - Eliminates need for wasteful trial-and-error problem solving

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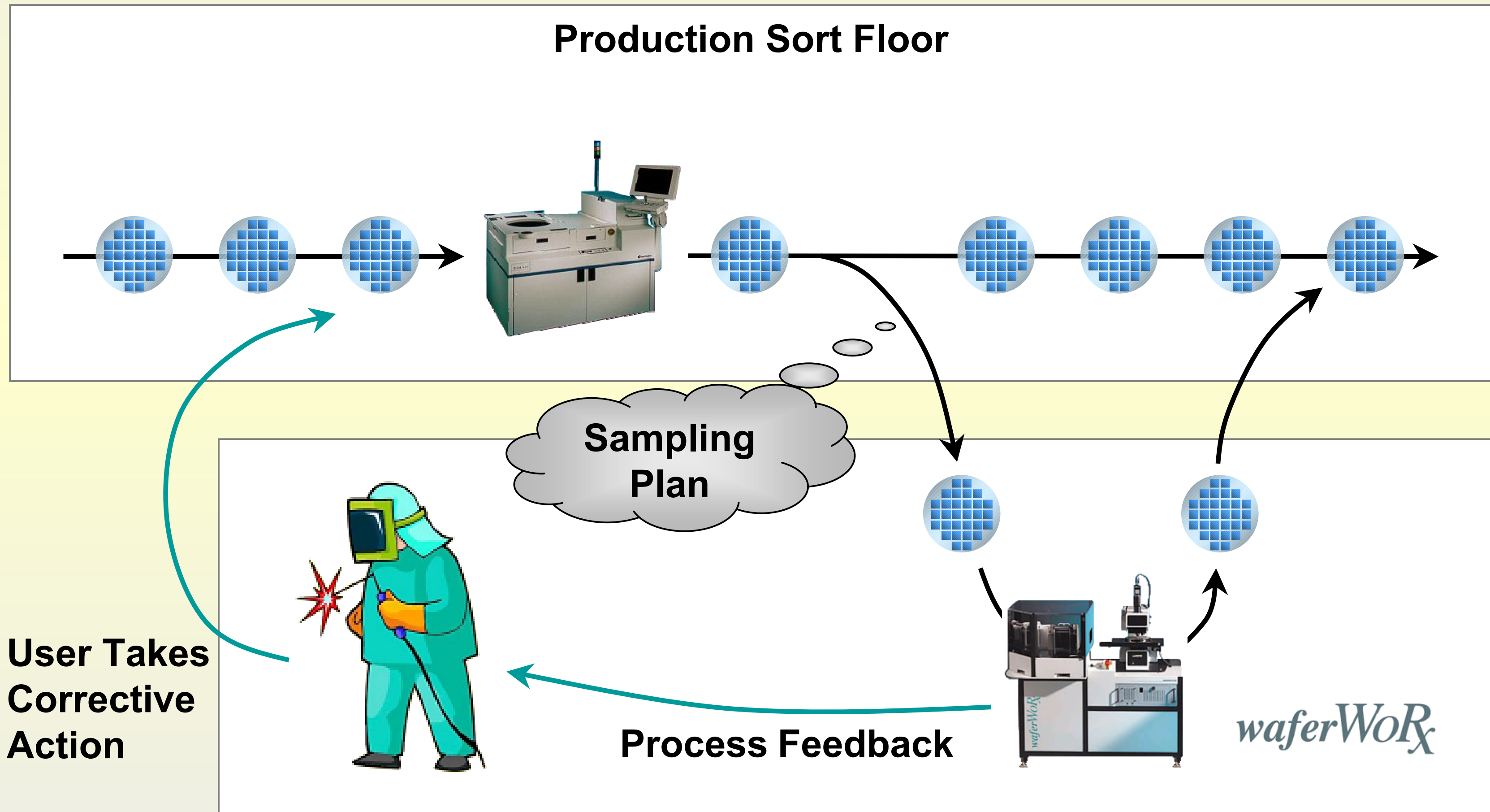
# Probing Process Management

- Product and Data Flow with Today's Tools



# Probing Process Management

- Objectives for New Inline Tools
  - Leverage waferWoRx analysis capability
  - Increase Test Floor Coverage
    - Analyze more wafers from more test cells
    - Catch and correct process deviations earlier
  - Expand Test Cell Performance Characterization
    - Track performance history for each test cell
    - Automate analysis operation
    - Show trends and predict future events
  - Deliver Process Management Information
    - Fast feedback response
    - Format results for quick, accurate interpretation
    - Make results available at all beneficial locations

# Motivation

- Why Do This Inline?
  - Get as Close as You Can to the Probing Process:
    - Faster problem detection
    - Faster problem correction
  - Kill Two (or more) Birds With One Stone:
    - Detect and classify other wafer defects
    - Detect and classify other probing problems (PMI)
    - Automate wafer map updates
  - Share procurement justification across multiple benefits

# *An Inline Probing Process Management System*

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# *Inline System Requirements*

- Accurate Probing Process Analysis
  - As throughput increases, output validity must be maintained
- Cost Effective Deployment
  - Maximize Test Floor Coverage
    - High throughput is key
    - Track multiple test cells
  - Minimize Ongoing COO
    - Reliability
    - Fast and Easy Setup
- Process Data Delivery
  - Easy to Access and Understand
  - Zero in on Priority Events Quickly

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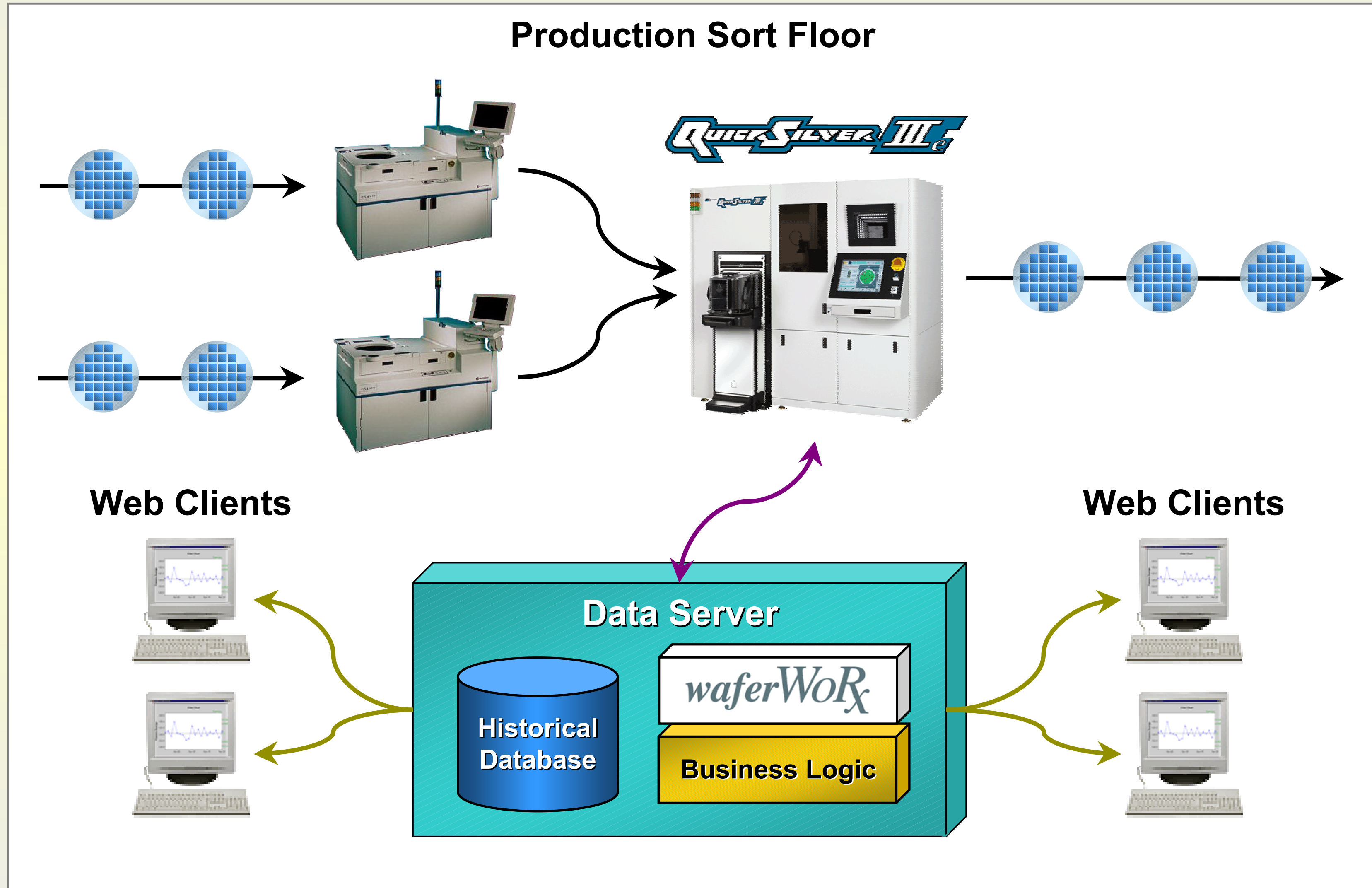
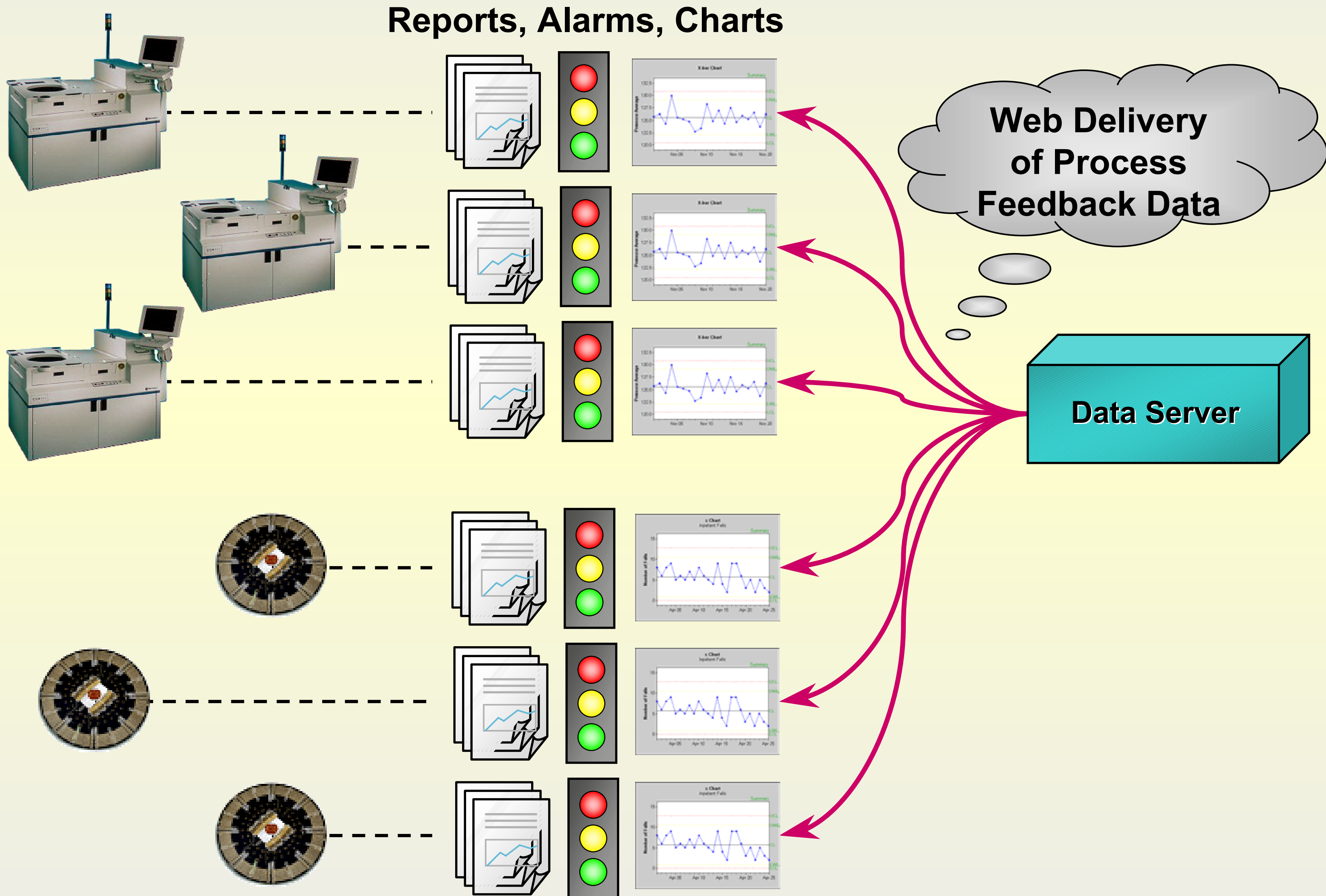
# *Inline System Elements*

| Element | Contribution |
| --- | --- |
| *waferWoRx Software* | **Established Standard for Probing Process Root Cause Analysis** |
| *QuickSilver* | **High Throughput Metrology and Inspection, 300mm Capability, Production Floor Networking** |
| *Data Server* | **Historical Database, SPC Analysis, Business Logic, Analysis Drill-Down, Web Server** |
| *Web Browsers* | **Fast, Easy Data Delivery, Leverages Existing PC / Workstation Investment, Minimal Learning Curve** |

# Inline System Overview



# Process Data Delivery

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# Probe Mark Metrology Accuracy

- Can Data From QuickSilver Be Used?
  - QuickSilver tool must supply 46 parameters for each scrub mark with comparable accuracy to waferWoRx
- Validation Study:
  - Measure same probed wafer on waferWoRx and QuickSilver systems
  - Focus on Repeatability and Reproducibility
  - Run PMI results from both tools through waferWoRx analysis algorithms
  - Compare results (Report Card format)

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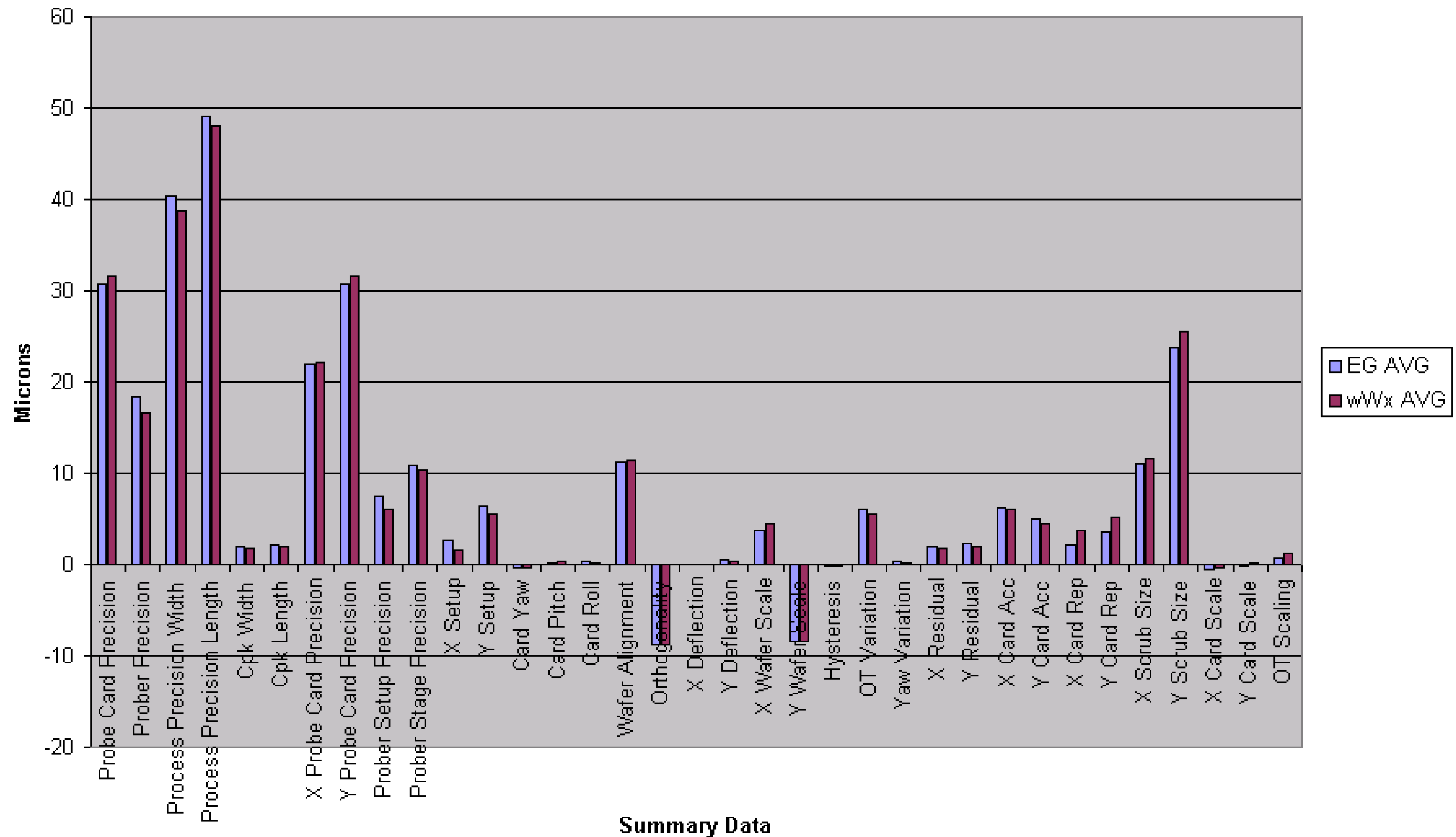
# Probe Mark Metrology Accuracy

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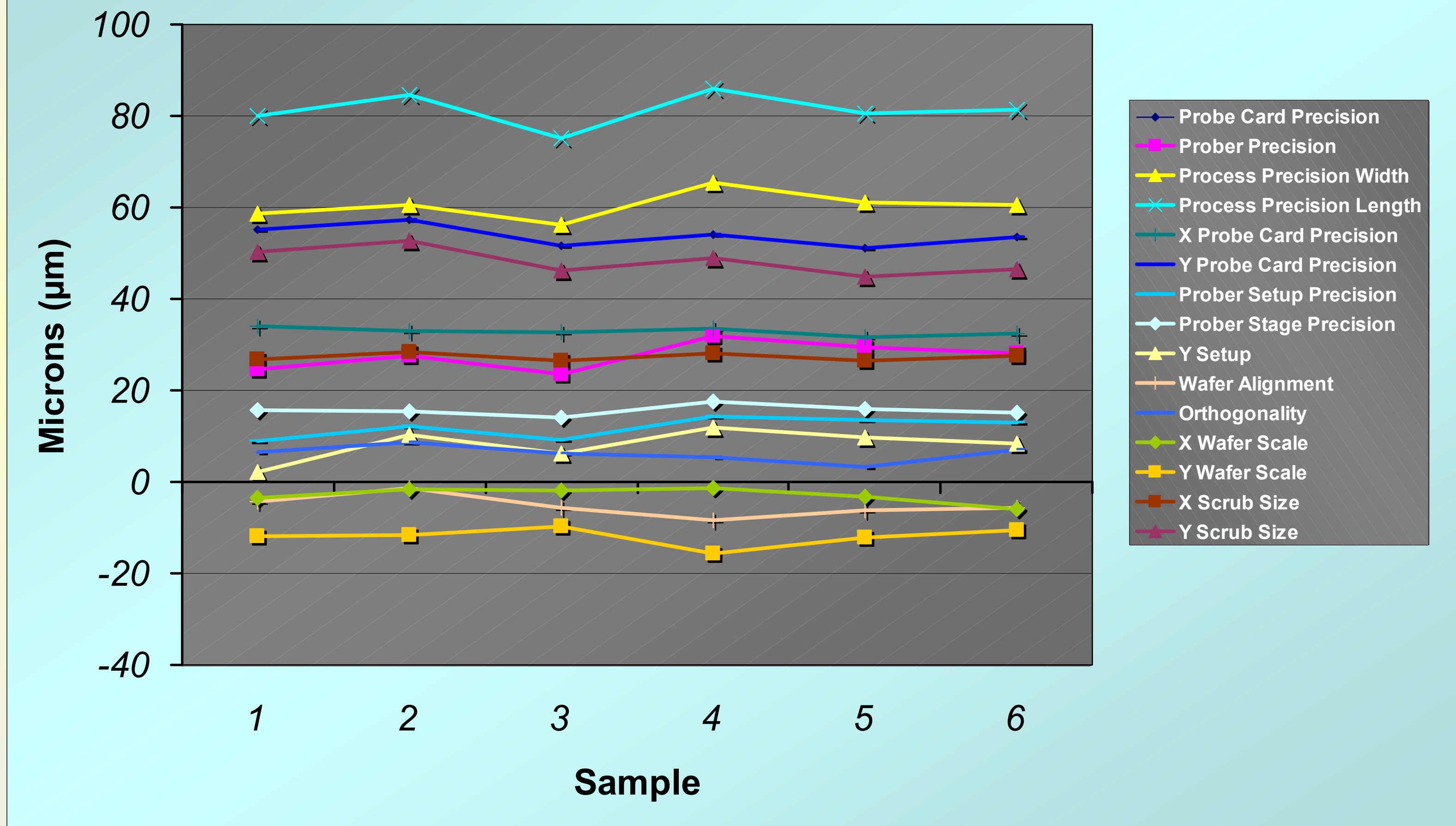
# Probing Process Variation

- What Trends Can We Expect?
  - Gradual Process Variations
    - PTPA drift
    - Probe card lifecycle; cleaning, wear, repairs
  - Abrupt Events
    - Equipment failure
    - User intervention
    - Fab lot issues
- Validation Study:
  - Manually trend data from existing, installed waferWoRx tool:
    - Wafers must come from same prober and probe card

# Probing Process Variation

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# Practical Considerations

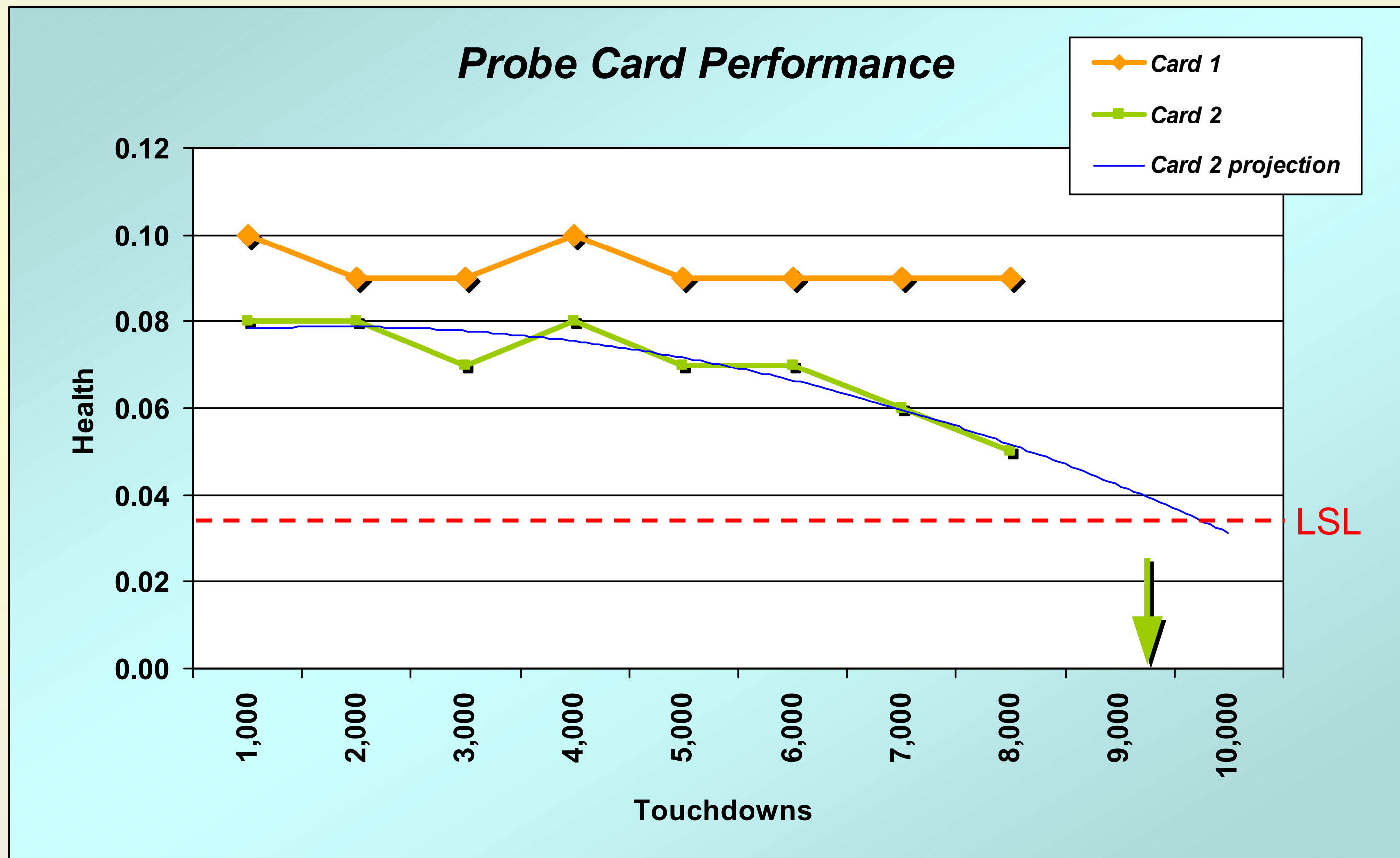
- Wafer Tracking
  - System needs to know which prober and probe card were used on each wafer analyzed:
    - Can be obtained through test floor network – more desirable
    - Can be entered manually by operators – less desirable

# Practical Considerations

- Lag Time
  - Process control benefit decreases as Lag Time Increases
    - Problems persist while test cell impacts yield
    - Sub optimal scheduling of probe card repair increases cost
    - Slower time-to-data adds delay to setup validation
  - Ways to reduce effects of Lag Time
    - Measure probe marks immediately after they're created
    - Measure and analyze them quickly
    - Allow (and prompt for) job priority scheduling

# Practical Considerations

- Prober Networking and Trend Prediction

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# Practical Considerations

- In-Situ PMI Analysis
  - Best way to defeat lag time is to monitor while probing:
    - Cannot reduce test cell throughput – too costly
    - How to do this on a prober without affecting wafer throughput?  No easy solution
  - Next best way is to monitor immediately downstream from test cell:
    - Must be on production floor
    - Minimize operator workload

# *Conclusions*

# Conclusions

- The need for probing process control continues to escalate
- Inline probing process analysis is feasible:
  - It leverages proven tools
  - It can be combined with inspection for added value
- Benefits:
  - Data when you need it where you need it
  - Higher test cell utilization
  - Higher yield

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