

e-Diagnostics Motivation & Benefits

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October 19, 2000

Improve Equipment Productivity

| Year Technology Node Wafer Diameter | 1999 180 nm 200 mm | 2002 130 nm 300 mm | 2005 100 nm 300 mm | 2008 70 nm 300 mm | 2011 50 nm 300 mm | 2014 35 nm 450 mm |
|--|--------------------------|--------------------------|--------------------------|-------------------------|-------------------------|-------------------------|
| Bottleneck production equipment OEE [3] (SEMI E79) | 75% | 81% | 89% | 91% | 92% | 92% |
| Average production equipment OEE [3] (SEMI E79) | 55% | 65% | 71% | 78% | 80% | 82% |
| % Capital equipment reused from one process node to next | > 70% | > 0% | > 80% | > 80% | > 80% | >20% |
| Production equipment lead time (months from order to full throughput capability) [5] | < 9 months | < 8 months | < 7 months | < 6 months | < 5 months | <5 months |
| Process equipment availability [6] (SEMI E10) | > 85% | > 90% | > 93% | > 95% | > 95% | > 95% |
| Metrology equipment availability [6] (SEMI E10) | > 90% | >95% | >95% | >98% | >98% | >98% |
| % of equipment to factory systems interface standards defined [2] | 75% | 100% | 100% | 100% | 80% | 100% |
| % conformance: equipment to factory systems interface standards [2] | 300 mm 200 mm | 300 mm 300 mm | 300 mm 300 mm | 300 mm 300 mm | 450 mm 300 mm | 450 mm 450 mm |

SOURCE: 1999 ITRS

- **Equipment productivity (availability and overall effectiveness) are not meeting roadmap targets. Need to update tables with actuals + gaps and drive improvements through potential solutions**
- **300mm software interface standards are defined, but industry implementation is not meeting expectations**

INTERNATIONAL
SEMATECH

What is it? Why do it?

A method for gathering diagnostics information, process data and making it available to the equipment suppliers

Enhance supplier knowledge database

Reduce time to detect and diagnose problems

Improve existing and future products

Enable two way communications to field service staff

Proactive and predictive maintenance

Promote e-Business solutions

Standard OEE engine across fabs

e-Supply chain management

e-Documentation

e-Collaboration

Provides standard way to interface third party

Deliverables & Benefits

- 1. Collect data, calculate OEE elements, and populate database**
- 2. Robust security model to control data access**
- 3. Build knowledge database and expert systems**
- 4. Enable real time two-way communication between supplier and fab**
- 5. Provide predictive maintenance and tool performance modeling**

Idea Flow

- **Collect the data at the fab, authenticate, standardize, filter, and store in database**
- **Allows approved data accessibility by equipment supplier**
- **Supplier "investigates" the data from all fabs and uses the results to improve diagnostic capability and enhance product development**
- **Equipment suppliers should develop/acquire data mining and expert system software**
- **Equipment supplier can now provide better service at lower cost, develop more robust equipment and better**

e-Diagnostics Scenario

On the fab side...

SECS
Trace &
Event
Data

Tool state
& chamber
status

Tool
Log
Data

Set up
parms
etc.

MES
Data

Next lot,
tool up/ down

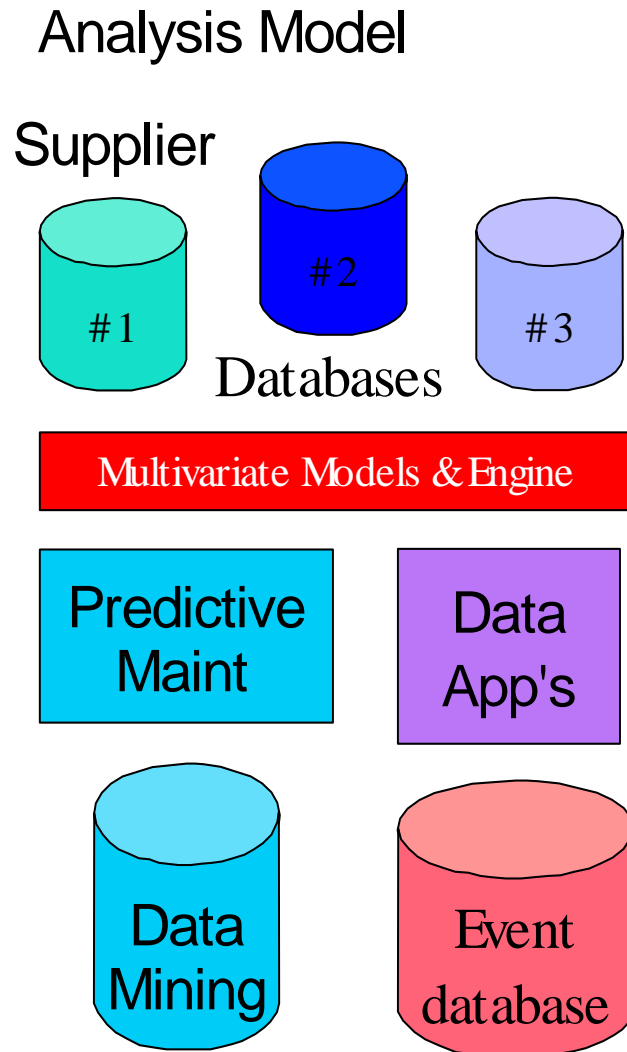
RbR
Data

RbR calcs

Actions

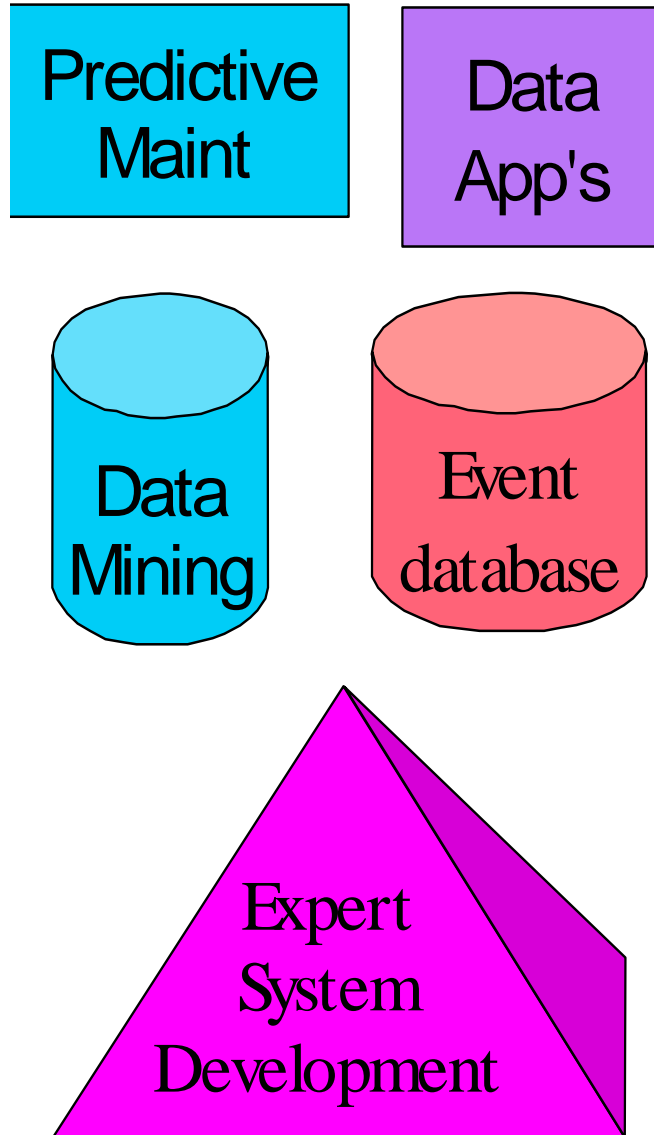
Message Authentication
& Standardization
Data Security
RTPC & FDC
Database Population

e-Diagnostics Scenario



- Data from each IC fab is stored in its own database
- Multivariate models are used to detect process variations
- Tool optimization software predicts necessary maintenance and outlines the cost (pts of yield)
- Data mining looks for patterns of success or failure and provides models
- Data application server provides all this data to the users via PC, palm-pilot etc

At the equipment supplier...



- All event, tool maintenance log and multivariate summaries are stored
- Develop expert systems to guide field support staff
- Supplier's staff tunes predictive maintenance models through interaction with fab personnel
- Developers use results to fine tune new and existing products and process recipes

Rewards

- **Standard methods for comparing like tools of same or different manufacturers**
- **Implementation of standard messaging techniques and data structures will facilitate RTPC, FDC, APC, and CIM framework connections**
- **More aggressive continuous improvement cycle for legacy equipment and faster product development for new tools**
- **Expansion of knowledge base at equipment supplier will result in faster diagnostics via "smarter" field service**

Motivation for Commonality

- **Common methods are vital to provide a common framework for third party application developers**
- **Parsing messages from any process tool**
- **Plug in data acquisition applications**
- **Plug in FDC applications**
- **Predictive maintenance applications**
- **Process tool yield modeling**
- **Common data structures facilitate other projects**
- **APC**
- **Tool status (down for maintenance etc)**
- **Data exchange from MES etc**
- **OEE**

Summary

- **e-Diagnostics offers a standardized way to:**
 - Get tool data back to the equipment suppliers
 - Reduce mean time to detect failures
 - Reduce problem diagnostics time
 - Provide for uniform OEE calculations
 - Allow suppliers to build knowledge databases
 - Provide assistance to field service personnel
 - Lower operational cost of maintenance