The Relevance of IoT and Big Data Analytics in Semiconductor Manufacturing

Duncan Lee
Intel Technology Sdn. Bhd.
Manufacturing IT Principal Engineer
Agenda

– Intel IOT Factory Story
– Why We Are Still Interested In The Internet Of Things
– Examples of New Cases Of Internet Of Things
– Signals Based Preventive Maintenance
– Analytics Tools
– Summary
IoT and The Intel Factory Story

80’s Factory
- No robotic material transport
- Run cards on wafer boxes
- Basic equipment standards
- Initial equipment control
- Initial manufacturing execution solution

90’s Factory
- Beginning robotic material transport (FAB)
- Automated statistical process control
- Improved equipment control
- Improved inventory control and tracking
- Improved equipment automation standards
- Integrated manufacturing execution solutions
- Planning and supply chain integration
- Improved decision making systems
IoT and The Intel Factory Story

Today’s Factory

- Pervasive robotic material transport (FAB)
- Pervasive equipment standardization
- Advanced manufacturing execution solutions
- Real-time excursion control
- Advanced process control & adjustment
- Predictive and Adaptive maintenance
- Advanced inventory control and tracking
- Advanced rapid decision making
- World class supply chain capabilities
- Big data repositories
- Quark integration with industrial equipment
Technology, process, and manufacturing challenges cause new data needs with associated analytics.

Each new “need” drives Intel Manufacturing IT to “lay new conduit” to extract new data, pipe it to real time systems, house it in large databases, and replicate it to offline data warehouses for decision support and analytics.

Building a connected end-to-end technology solution to address process technology needs... over and over again.
Intel’s IoT Factory: Highly Instrumented & Highly Connected

- Production Tool
  - Industry Standard Protocols
  - Temperature, pressure, vacuum, carrier ID, alarms etc...
  - RFID read for location and product check

- Desktop PC
  - Middleware Cluster

- Factory Application Clusters
  - Manufacturing Execution
  - Statistical Process Control
  - Excursion Protection
  - Yield Analysis
  - Advanced Process Control

- Data Storage
  - DSS DBs
  - Data Replication

- Web Cluster
  - Material Handling Control

- Automated Material Handling (FAB)

- Gateways to Supplement

OLTP = On Line Transaction Processing
DSS = Decision Support System
RFID = Radio Frequency Identification

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Why Are We Still Interested in the Internet of Things?

- With billions invested in semiconductor process equipment, the Internet of Things (IoT) is leveraged to:
  - Reduce capital cost
  - Increase quality
  - Improve time to market

Regardless of the industry, we all share these same challenges and goals.
New IoT Use Cases in the Intel Factory

IoT is used in the factory to:

1. Enable older, unconnected, and/or standalone tools to be connected and smarter
2. Enable external sensors to be connected where needed
3. Tap into internal machine sensors and circuits
4. Monitoring environmental conditions, i.e. temperature, humidity, power usage at a machine.
5. Tag important or high value items in the factory to enable “in-house” GPS
EXAMPLE OF IOT USE CASES
Enable Older, Unconnected Standalone Tools

Chemcab: Monitor chemical use and temperature

- Eliminate the need for humans to manually monitor and collect readings
- Reduce unexpected tool downtime when chemical empties faster than expected or chemical temperature fluctuates unexpectedly
Enable External Sensors
Self-healing frost alleviation in enclosed chamber

Humidity exposure and cold temperature during a process causes condensation. This situation is alleviated through constant monitoring of the humidity and temperature inside the chamber. Certain humidity and temperature will trigger dry air purge.
Tap into Internal Machine Sensors and Circuits
Preventive detection of potential oven coil failure

Analyzing the energy usage through monitoring relay performance to predict potential oven coil failure. This enables engineers to fix the faulty coils before causing a product excursion.
Signals Based Preventive Maintenance.
Data Analytics

Scenarios
- Predictive Maintenance
- Product Quality.

Data Analysis
- Various Data
- Within Machine
- Between Machines in Family
- Between Different Machines

Different Scenario, Different Analytics, Lots of Data Needed
Finding Correlations

Open Source Tools
Lots of mining tools available

Statistics, Machine Learning and Deep Learning
Summary

*Smart Factories continuously use IOT and edge (PCs etc.) enabled machines and Factory Data Analytics (statistics, spc, pcs, machine learning, deep learning) to improve factory operations and management.*
Learn More / Q&A

– Related White Papers:
  • Improving Manufacturing with Advanced Data Analytics
  • Joining IoT with Advanced Data Analytics to Improve Manufacturing Results
  • Integrating IoT Sensor Technology into the Enterprise
  • Broadening Access to Advanced Analytics in the Enterprise
  • Internet of Things (IoT) Delivers Business Value to Manufacturing
  • Collaborative Visual Data Analysis Enables Faster, Better Decisions
  • Using Big Data in Manufacturing at Intel’s Smart Factories
  • 2015-2016 Intel IT Performance Report
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