IBM High Tech MES Solution (View series)

Overview and “What’s the next CIM approach”

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Business Experience

- Global IBM Production Solution Leader, IBM Corp.
- Manager of MES Solution Service, IBM Japan Service Co. Ltd.
- Project Manager of CIM Project for 300mm Semiconductor Fab in worldwide (Taiwan, US, ..)
- IT Architect in SiView Standard Development
- IBM Japan Yasu Plant Information Systems

Educational Background

- B.S. of Mathematics, Osaka University (1985)
Agenda

- Target Industry of IBM View series
- Coverage of IBM View series
- Overview of IBM View series
  - Characteristics of IBM View series
  - SiView Standard, AsmView
  - LCDView, WaferView, GlassView, SolarView
  - SOA Enablement - Sense and Respond (SaR) Framework
- Next CIM Approach
  - Business Environment and next CIM system
  - Approach to Business Objectives
- Summary
Target Industry of IBM View series

Global Semiconductor, FPD, and photovoltaic market by application

- Semiconductor and FPD industries are both large and growing.
- Photovoltaic industry is emerging.

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<tr>
<td><strong>$309B</strong>&lt;sup&gt;1&lt;/sup&gt; (2009, 2007-2012 <strong>CAGR 4.9%</strong>)&lt;br&gt; Data processing $116B&lt;br&gt; Automotive $24B</td>
<td><strong>$125B</strong>&lt;sup&gt;2&lt;/sup&gt; (2009, 2007-2012 <strong>CAGR 4.0%</strong>)&lt;br&gt; TV $62B&lt;br&gt; Cellular Phone $10B</td>
<td><strong>$28B</strong>&lt;sup&gt;3&lt;/sup&gt; (2010, 2006-2010 <strong>CAGR 38.3%</strong>)&lt;br&gt; Crystalline Si $20B&lt;br&gt; Thin Film $5B</td>
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<td><strong>$24B</strong>&lt;sup&gt;2&lt;/sup&gt; Industrial&lt;br&gt; Aerospace</td>
<td><strong>Note PC $12B</strong>&lt;br&gt; Others</td>
<td><strong>Others $3B</strong></td>
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<td><strong>PC Monitor $24B</strong>&lt;br&gt; Others</td>
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<td><strong>$77B</strong>&lt;sup&gt;2&lt;/sup&gt; Communications</td>
<td><strong>TV $127.4B</strong>&lt;br&gt; Others</td>
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<td><strong>$132.5B</strong>&lt;br&gt; Others</td>
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<td><strong>$348.7B</strong></td>
<td><strong>$629B</strong>&lt;br&gt; Others</td>
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1: Gartner 5/28/08 G00158470

2: Fuji Chimera FPD Research 2007

3: Fuji-Keizai Photovoltaic Research 2007

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## Coverage of IBM View series

IBM provides proven MES solution for each industry from material to final product

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<td>GlassView for Glass maker</td>
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<td>AsmView for SAT</td>
<td>LCDView for TFT Array, Cell</td>
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<td>LCDView for Color Filter</td>
<td>LCDView for Module</td>
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<td>WaferView for Silicon Wafer Maker</td>
<td>Material Maker / Parts</td>
<td>SolarView for Cell</td>
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Characteristics of IBM View series

- **Rapid Start-up of Factory**
  MES solution specialized for the industry with *proven operation scenario*
  Delivery Excellence in system integration service by MES experts - *100% successful in-time delivery* record
  IBM One team operation in delivery of HW, SW, Application.

- **Full scope integration in full automation mode**

- **High Availability and Scalability (HAS) System Design**
  *24 Hr x 7 Days Always Available System* by Non-stop system maintenance and upgrade
  *Scalability* to handle tremendous amount of transaction at “Giga-Fab”
  IBM 24 hours total support (24 hr Help Desk, HW, SW, Application)

- **Compliance with Industry & IT Standard**

- **Continuous enhancement to meet requirements from End User Community**

- **On-Demand operation scenario on SOA - Sense and Respond (SaR) framework**
  Lean Production – *KAIZEN* (Continuous Productivity Improvement) by *BPM Automation*

- **Virtual Factory Integration (Enterprise MES) beyond country and company**
  End-to-End Production Control and Quality Traceability
  On-Demand collaborative operation scenario between factories and companies at SOA platform (SaR)

- **World Wide Support**
SiView Standard  An automated MES for Semiconductor with full scope integration

A reliable and extensible MES solution based on SiView Standard to meet the quality and short time requirements of your semiconductor business.

**SiView Standard**

- Specification Manager
- Material Manager
- Scheduler
- Reporting
- Floor Monitor
- SPC
- Automation Manager
- Floor Data

**Interface for Tools (SECS/GEM) and Transfer System**

- Process Tool
- Metrology Tool
- Tester
- AMHS
- ARHS

**Interface for Enterprise system**

- Portal Site
- ERP
- SCM
- PLM

**Interface for peripheral system**

- RMS
- RTD
- Yield Mgmt
- PM
- APC
- FDC

**Notations**

- SCM: Supply Chain Management
- ERP: Enterprise Resource Planning
- MES: Manufacturing Execution System
- RMS: Recipe Management System
- APC: Advanced Process Control
- FDC: Fault Detection and Classification
- AMHS: Automated Material Handling System
- ARHS: Automated Reticle Handling System
IBM Semiconductor factory integration architecture

SiView Standard provides proven integration scenario in full automation mode.

Enterprise (Division) Layer
- CRM
- ERP
- Costing
- SCM
- EAM
- PLM
- Design System
- Portal
- Partner gateway

Layer
- SaR F/W b/w Fabs
- Enterprise Level Bus (ESB / MQ)

E-MES (Enterprise MES)
- RTD
- RTS

Yield Mgmt / KPI
- DWH
- DFM
- TDS
- Reporting
- YMS
- Local DWH

Fab Control Layer
- RosettaNet
- Dashboard Monitor
- AMS
- Sense and Respond (Fab Level Bus (ESB / MQ))

Scheduling and Dispatch
- WIP Balancing
- Scheduling Simulation

Process Control / OEE
- SPC
- APC
- FDC
- PLY
- ILT
- PMS
- APC/FDC Backbone (MQ)

Mfg Execution Layer
- WSDL
- CORBA
- MES (SiView)
- Floor Logistics
- Defect. Data
- Process Data

Equipment I/F Layer
- AMHS IF
- EI
- RMS
- EDA
- Tester Automation
- Test Result

IBM Production Solution
- AMHS ARMS
- Stocker
- OHT
- MCS

RosettaNet

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SiView provides full automation by integration with Tools, Automated Material Handling System and advanced system for QTAT, OEE.

**Tool Integration**
- Process
  - Batch
  - Single Recipe
  - Multiple Recipe
- Metrology
- Internal Buffer
  - Furnace
  - Wet Bench
- Inline Photo
- Multiple Chamber
- Wafer Sorter

**AMHS, ARHS Integration**
- FOUP Stocker
- Reticle Pod Stocker
- Bare Reticle Stocker
- FOUP OHT-OHV
- ReticlePod OHT-OHV

**Advanced System Integration**
- RTD
- APC
- FDC
- EES
- RMS
- PM
- Yield Mgmt

Addition to tool integration and AMHS integration, RTD for QTAT operation and APC/FDC integration for real time wafer level process control in Full Automation.

In order to realize full automation, all these components need to be integrated.

SiView provides Standard Interface and proven full automation scenario based on the role model of CIM component.

SiView provides total solution by collaboration between each CIM components.

300mm MES
SiView Standard

SiView Standard Interface
Major MCS vendor x 3
AMHS S/W vendor x 2

300mm tool connection experience
(more than 80 types)
SiView HAS (High Availability and Scalability) feature provides:

- High Availability (Non-Stop 24x7 operation)
- Non-stop upgrade of application code in case of urgent changes by multiple appl. Servers
- High Scalability to support High Volume Production (Giga-Fab)

**Clients**

**TX Dispatcher**

**Multiple MM Server Processes**

**Database**

- MM 1 TX thread
- MM 2 TX thread
- MM 3 TX thread
- MM 4 TX thread
- MM 5 TX thread

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On-Demand operation scenario on SOA - Sense and Respond (SaR) framework

On Demand FAB has adaptive manufacturing capability by monitoring changes in manufacturing and business, and taking corresponding actions for detected situation.

Enterprise Systems

Enterprise Service Bus

Plan

Result Status

Business Process

Know-How

Knowledge Management

Business Rules

FAB Dashboard

SaR Framework

Factory Control Systems (MES, ..)

Event (e.g. Hot Lot)

- Alert
- Change Notice

- KPI Report
- Alert
- Change Notice
- Action Request

- Recovery
- Adjustment

Lean Production – KAIZEN by BPM Automation

• Exception Handling scenario
• Intelligent Logistics scenario (SLM)
• OCAP (Standardization Engineer workflow) ..
SaR Framework Architecture

Situation Detection & Event Notification

Enterprise Systems
- DB2
- MQ
- E-mail/James
- MM Event Log

SiView
- DB Trigger
- Event Emitter
- Watchdog
- Event Emitter
- Event Emitter
- Event Emitter

Plant Floor
Action Execution

Sense

Respond

WebSphere Process Server (J2EE / Web Services)

Event-Service Container
- Human Task Manager

DB Façade Code Generator
- SiView Proxy Code Generator

DB Connector
- MQ Connector
- E-mail Connector
- SiView Proxy (core)
- SiView Proxy (customize)

Log
Development Cycle: Reference Case (Japan)

1-2 months of development cycle for a scenario

- **Requirement**
  - Initial requirement assessment
  - Use case analysis
  - Assessment of front-end requirements

- **Design and Prototyping**
  - Identify required Web services
  - Macro/Micro design
  - Test cases
  - Prototyping
  - User reviews

- **Development and Testing**
  - Redesign prototype based on performance
  - Development
  - Unit test
  - Integration test
  - Acceptance test

- **Deployment and Monitoring**
  - Deploy to production
  - Monitor business performance

**Experts who know the SiView application, semiconductor business scenarios, and system infrastructure all support best practice design.**

- **Feedback**
  - 35%
  - 5%
  - 60%

- **Achievements of a customer**
  - Released over 20 scenarios in a year
  - Exception handling
  - Automated setting up
  - Sense and respond to WIP holds
  - Productivity up
  - Transport efficiency
  - Quality control

- **Develop**
  - business process scenarios on GUI of WID.
  - Replacing business processes without stopping service in production.
  - SiView Proxy Generator enables applying new and updated SiView services

**Agile optimization of business processes**

Enables BPM Automation and Multi-skilled workers in Automation for Best Practices Manufacturing
Vision of Virtual Factory Integration (Enterprise MES)

- Creation of an extended, virtual enterprise by using open standards
- SOA positioned as a key enabler of internal processes and external connections
- Operational processes are assembled from reusable services
- Maximized business flexibility and collaboration
Enterprise MES : Reference Case (IBM)

End to End WIP/Inventory Traceability by Wafer including in transit status

Customer-Supplier Collaboration (Portal)

Common Interface (RosettaNet)

Enterprise MES Scenario (SOA)

Spec. BOM

WIP mgmt

End to End Traceability

Dispatch to Next Factory

Lot Release

Lot start

Lot Progress Defect

Lot Comp Transit

Lot Release

Lot Progress Defect

Lot Comp Transit

MES (SiView, Inhouse)

MES (ASMView)

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MES (Inhouse)
Enterprise MES achievement in IBM

One interface to Enterprise Systems and one view of all work-in-process enables:
  - Enterprise-wide build plan from single view of supply vs demand
  - Single view to customer of all WIP
  - Simplified system integration

Integration architecture enables limitless extension up/down/across the supply network, quickly and seamlessly extending the scope of the business.

- Semiconductor Mfg can easily be integrated ‘upward’ to include card/panel/box, etc.
- No limit on applicability to various types of Mfg business integration and vendor mgt, at both Stage and Level of Assembly.

Conversion of Singapore BAT site from IBM to Amkor ownership took four (4) hours to execution, with zero impact to operational business!

New Mfg assets can be brought on board in weeks/months, not years, at proportional cost and risk!
AsmView  MES for Semiconductor Back-end Manufacturing  (Wafer test– Assembly – Module Test)

AsmView inherits SiView Standard object class and adds AsmView extension (object model and operation scenario required for Semiconductor Back-end Manufacturing).

(Example of AsmView Extension)

- High-end product support
  - BIB (Burn In Board) management, Part Serial ID management, BOM Serial ID management
- Test Operation support
  - Speed Sort capability, Probe card/Socket management, Tester I/F (Non-SECS protocol)
Application Component of LCDView, WaferView, GlassView, SolarView

Optional System or External System
- ERP/SCM
- EDA
- YMS
- DWH
- Scheduler Simulator
- APC
- EES

LCDView

Performance History system (HIS)
- RMS
- Report
- Summary Table
- Web Floor Monitoring System (WFM)
- Statistical Process Control (SPC)
- Preventive Maintenance System (PMS)

Products and Process Tracking System (PPT)
- MES Online Engine
  - Inline Equipment I/F (BCIF)
  - Equipment I/F (TCS)
  - AMHS I/F
  - Dispatching Control System (DCS)

- User Client (OPI & BRClient)
- Master System (BRM)

Inline Equipment
- Process / Measurement / Testing / Repair Equipment
- MCS or Transportation Equipment

Web Floor Monitoring System (WFM)
- Statistical Process Control (SPC)
- Preventive Maintenance System (PMS)
System Architecture of LCDView, WaferView, GlassView, SolarView

Active DB Server
- DB Server
- DB/2
- AIX / HACMP

Standby DB Server
- DB Server
- DB/2
- AIX / HACMP

Historical Server
- HI S Server
- MQ/CAE
- AIX/HACMP

High Availability Database
- Enterprise Storage Server

#1 Server
- Production Online Server
  - TFT/CF LCD/LCM
- WebSphere MQ
- AIX

#2 Server
- Production Online Server
  - TFT/CF LCD/LCM
- WebSphere MQ
- AIX

# n Server
- Production Online Server
  - TFT/CF LCD/LCM
- WebSphere MQ
- AIX

MQ Cluster
- BRM
- DCS

User Client
- OPI
- BRM Client
- Web Client

TCS/BCIF
- SmartTCS (XML)
- VTAP
- Windows Server

Load balancer
- EQP

AMHS I/F
- G/W
- SECS Driver
- 2000 Server or AIX

Note:
1. Online Server is scalable horizontally and vertically.
2. TCS and AMHS I/F are supported both of AIX and Windows.

MQ is used as Message Bus for MES
SolarView Characteristics

- Packaging the basic function required for Solar panel manufacturing by inheritance from LCDView which is proven MES solution at LCD panel manufacturing lines.

1. Inherit the basic function from Proven MES Solution: LCDView

   LCDView
   
   Simplify Component
   
   SolarView
   
   Silicon wafer base mfg lot tracking
   In production
   
   Thin Film/CIGS mfg sheet level tracking
   Project on going

2. Equipment/MHS interface (mainly for data collection)

   < Equipment, MHS >
   
   HSMS
   MES interface
   PLC
   
   Application Server
   External System Interface
   BRM, PPT, WFM, SPC, etc.
   DB2 / MQ / AIX

3. Interface with Enterprise Application

   < MES >
   
   MES
   Application Server
   DB Server
   PPT DB
   HIS DB
   USR DB
   
   *) Application Server can be multiplexed with multiple servers.

   High Availability System
   Scalable from PC server (linux) to UNIX servers

   E2E Traceability & Global SCM capability
   (Global PSI, Parts Inventory Optimization)

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Business Environment and Next generation CIM

BPR
Time-to-market
- e-Business
  - Focus Biz

Large scale MFG & Virtualization
Time-to-volume & Time-for-profit
- M&A, Global Technical Alliance
- Giant Investment & QTAT Approach

Global Std (Open)
Time-to-compliance
- CSR
- Traceability & Audit function

Virtual CIM
Business Objects Definition and those Automated control
  - Facility, Quality & IT
  - Integrated Process Control

On Demand CIM
BPM Automation for personalized OCAP ops
- Human Intensive Business Process

Event Driven CIM
On Demand Event Process, to Optimize BPM as MFG Know-how
- On Demand Control using Embedded ABC Mgt
Approach to Business Objectives

Business Scalability by Virtual Integration

Global SCM
- Single SM (Spec. Mgmt)
- Virtual & Vertical MFG Integration

Global Optimization

Business Efficiency by On-Demand CIM

BPM Asset Mgmt
- Business Process Optimization
- Engineer Activity Improvement

Enterprise Asset Mgmt

Global Optimization

Business Quality by Event-Driven CIM

Contract Mgmt by Asset
- Spare Parts Mgmt
- Remote Maint.

BCP Asset Mgmt

Enterprise Quality

Local Optimization

Site Manager/CIO View

Global

Local

Approach to Business Objectives

Enterprise View Mgmt
- Non-Stop Production
- Flexible Fab

FAB Operation Optimization

BPM Automation
- Responsive Scenario (Sense and Respond)

Work Mgmt
- Predictive Preventive Maintenance

Biz Quality

Speed

Efficiency

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1. The next IT is the Event Driven World and we must transform the LOB into the On-demand Business.

   Biz Scalability by Virtual Integration → Biz Efficiency by On-Demand CIM → Biz Quality by Event-Driven CIM

2. The key factor of success is the integration between Business Process Automation and enterprise wide CIM.

3. It is the time for us to clear our CIM Road-Map to contribute the LOB.
   - Step1. How to build the On Demand and Enterprise Level CIM
   - Step2. How to promote the lean manufacturing (BPMA) toward to the company wide operation.
   - Step3. Consider Enterprise Assets Management and its efficient operation
   - Step4. Appeal CSR [Time to Compliance] in Event driven world
Q&A