Increasing Yield with SmartFactory Rx & PI System

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Agenda

• Introduction
  • Applied Materials Pharma: SmartFactory Rx
  • Janssen Vacaville

• Challenges with Yield

• Looking to Semi-Conductor Manufacturing

• Janssen’s Project with Applied

• Partnering for the Future
Applied Materials:
Our innovations **make possible**
the technology shaping the future
Applied is At the Foundation of Emerging Trends

VR / AR
OLED

IoT
Sensors and Cameras

Big Data
High Performance Memory and Storage

AI/ML
High Performance Computing

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SmartFactory Rx
A synergistic suite of software solutions – unparalleled

Analytics & Control
Real-time monitoring & closed loop control

Knowledge Management
Manage Knowledge with emphasis on human factors in engineering

Operations Productivity
Planning & scheduling

Advanced Maintenance
Determines best time for service
Smart Manufacturing Vision with Industry 4.0
Leveraging a rich and growing algorithmic base

**Big Data Infrastructure**
- Hadoop-based systems
- Big Data migration systems (RDBMS + BD)
- On-line (analysis) and off-line solution components

**Enhanced Analytics**
- Data quality enhancement methods
- Next Generation FDC (NG-FDC, auto feature recognition and parameterization)
- Trace data auto analysis
- Yield excursion analysis
- Wafer topography analysis
- Digital thread
- Crawlers

**Predictive Analytics**
- R2R Control / MPC
- Predictive Maintenance (PdM)
- Virtual Metrology (VM)
- Virtual Sensing / Advanced sensors
- MTTR Reduction with VM+R2R
- Predictive Scheduling
- Yield Prediction (YP)
- YP with feedback to control and scheduling

**Cloud Computing**
- Cloud-based analytics capability with data partitioning / IP security guarantees
- Interface to fab-level capabilities
- 3rd party participation mechanism

**Digital Twin**
- Real-time Scheduling/Dispatch for rule-based digital-twin
- Equipment and process modeling and simulation
- System modeling and simulation
- Integration to supply chain
- Real-time simulation update for digital twin realization
- Play forward capability at all levels

**Prescriptive Analytics**
- State-based modeling such as HMM

**Integration**
- Data aggregation methods
- Vertical integration from sensor through ERP
- Horizontal integration across the fab at SCADA and MES levels
- Supply chain integration and optimization

Algorithm roadmap to support move from reaction, to prediction to prescription, leveraging CPC
Janssen Vacaville: Transforming Our World Delivering affordable medicines to anyone, anywhere, any day
Janssen’s Challenge
Semiconductor to Pharma
Quality, Efficiency, Lower Costs

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<thead>
<tr>
<th></th>
<th>OEE</th>
<th>10% - 60% (Low)</th>
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<tbody>
<tr>
<td>80% - 90% (High)</td>
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<tr>
<td>5σ – 6σ (High)</td>
<td>Process Capability</td>
<td>2σ – 3σ (Low)</td>
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<td>5 – 10 Days</td>
<td>Production Lead Time</td>
<td>120 – 180 Days</td>
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<tr>
<td>5 – 50 Days</td>
<td>FG Inventory</td>
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<tr>
<td>Low</td>
<td>Direct / Indirect Labor Ratio</td>
<td>High</td>
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- **OEE**: 5s – 6s (High), 2s – 3s (Low)
- **Process Capability**: 5 – 10 Days, 120 – 180 Days
- **Production Lead Time**: 5 – 50 Days, 60 – 90 Days
- **FG Inventory**: Low
- **Direct / Indirect Labor Ratio**: High
Business Challenge

- Need to increase yield on Press
- Minimal data integration: Process environmental, LIMS, CQA, maintenance

Solution

- Integrate data contributing for yield
- Strategy for managing process and maintenance interaction
- Analytics to monitor, control, and improve process understanding
- Both MVA and UVA statistical process control methods to reduce tablet scrap
- Operator Dashboard: Green means GOOD!
- Prescriptive corrective action

Results

- Deliver actionable insights to shop floor
- Improve process robustness
- Workflows in place to increase yield
- Minimize process variability with run to run control

Yield Improvement
Estimated 1.5% year 1

Results

Cluster of increased scrap

Revenue Opportunity
$1M to $10M*/year

Batch/Plant (Value)

Yield Improvement
Estimated 1.5% year 1
Getting started

- Minimal end to end electronic data to support analysis
  1. Integrate
  2. Run 40 batches
  3. Model/Analyze
  4. Prescriptive Action
- Mechanistic modelling approach
  - Process expert driven modelling
  - Identify optimum settings for monitoring process health
Process, Granulation & Environmental Data

Maintenance Data

Press Data

LIMS

UVA/MVA Models Granulation

UVA/MVA Models Compression

UVA model of LOD

Process Health

Yield of Press
Creating windows of analysis using PI Event Frames

- Upstream process health critical at understanding press performance
Mechanistic Hybrid Modelling Example: Granulator

Contributors to outlier
Dashboard to reduce operator error

Dashboard on the shop floor, **Green** means good - *don’t touch it*
Delivering Prescriptive Action for Maximum Yield

Model Process Health

Identify scrap contributors

Store contributors

Notify setup parameters
Janssen, Applied & OSIsoft: Partnering for success

- Integrate Equipment to PI
- Expand PI AF to new Equipment
- Expanding SmartFactory Rx to other equipment
Expanding SmartFactory Rx

• Analytics on all granulation and tablet presses
• Maintenance predictions on tooling
• Optimize site scheduling practices
  • Realtime scheduling
Questions

Please wait for the **microphone** before asking your questions

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