Integration of control, manufacturing and enterprise systems

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Outline of talk

The broad picture
  ➢ ISA-95
Integration between PCS, MES and ERP
  ➢ General comments
  ➢ Experience from SABIC – the new polyethylene plant on Teesside
Discussion on future research directions
The Broad Picture

“The computer-integrated manufacturing (CIM) pyramid of the 1980s has crumbled to make way for .... better models for manufacturing information technology in the 2000s.” – Keith Unger, InTech, 03 October 2001

The broad picture – ISA-95

- Planning
- Scheduling
- Optimization
- Advanced process control
- Regulatory control
- Control valves, sensors, hardware
- Enterprise resource planning, ERP
- Manufacturing execution system, MES
- Process control system, PCS

ISA-95
Enterprise Control System Integration

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The broad picture – ISA-95

<table>
<thead>
<tr>
<th>ERP</th>
<th>Enterprise Performance Reporting</th>
<th>Human Resource Management</th>
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<tbody>
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<td>Demand Planning</td>
<td>Supply Chain</td>
<td>Production Planning</td>
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<td>Sales &amp; Distribution</td>
<td>Material Management</td>
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<td>Scheduling</td>
<td>Process Optimization</td>
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<td>Asset Monitoring</td>
<td>Production Execution</td>
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<td>Material Management</td>
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<td>Production History</td>
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<th>Process Control</th>
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<td>Real-Time SPC</td>
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<td>Real-Time Control</td>
<td>Real-Time Monitoring</td>
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Adapted from: Sham Afzalpurkar CEO, Performix Inc., 2006 ASUG Annual Conference

Integration between PCS, MES and ERP
Control systems have evolved to manage the present

- Advanced control uses historic data to make deterministic predictions of the future...
  - ...but only to decide what to do straight away
- (Real-time) optimisation is used to drive to a deterministic ideal for a instant in time
  - Irrespective of the consequence over time
  - Without any regard for inherent uncertainty

- Scheduling is generally about managing deviations and opportunities
  - Establishing the theoretical ideal is the least of the challenges
- Planning is inherently about managing risk and uncertainty
  - The hierarchical translation of planning outcomes inevitably loses all information about the original intent

Leaders in our industry use technology to

- Monitor everything that might be important in real-time
  - Displaying what matters, to those who need to know, when they need to know it, at all levels in the organisation
- Ensure planning, reporting and improvements are driven through a common, coherent information framework
  - No value disappears between the cracks of inconsistency
Business Control Hierarchy

Risk Management
- Coping with an uncertain World
  - Prices & markets
  - Supply and demand uncertainty
  - Plant availability

Agility Management
- Responding to fluctuations and deviations
  - Alternate production and supply routes
  - Spot opportunities
  - Responsiveness & flexibility

Performance Management
- Knowing what’s happening and what’s possible
  - Identifying deviations (in production performance, supply/demand patterns etc)
  - Validation of planning models and assumptions
  - Driving continuous improvement

Conformance Management
- Doing what’s wanted or expected
  - Staying on spec (quality control)
  - Minimising costs (constraint control)
  - Pushing appropriate limits (real-time optimisation)

Conservation Management
- Keeping the process running
  - Basic regulatory control (closed-loop)
  - Conservation of mass and energy

Enterprise resource planning, ERP
Manufacturing execution system, MES
Process control system, PCS

Competitive Advantage......

Formula 1 10-15 years ago
- Technology was primary source of competitive advantage
- Focus on automation
  - Traction control
  - Active suspension
  - Automatic transmission
  - Launch control
  - Intelligent braking
  - Fly-by-wire
„…Requires Technological Advantage…“

Formula 1 today:
- Automation is an enabler
  - No longer differentiates
- Technology remains a source of competitive advantage
  - Emphasis now on real-time decision support
  - No longer need to wait until the end of the race to understand what happened

So what have we done on Teesside?

Risk
- SAP ERP Planning System
- MES
- ERP
- Manufacturing Execution System
- LIMS
- Plant Control
- Process Measurements
- MES
- SAP ERP Planning System
- MES

Performance
- MES
- ERP
- Manufacturing Execution System
- LIMS
- Plant Control
- Process Measurements
- MES
- SAP ERP Planning System
- MES

Agility
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Conformance
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Conservation
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- SAP ERP Planning System
- MES
## Learning & Challenges

- **Integration of different layers**
  - How to retain the core message, ensure coherence and prevent inconsistency
- **Treatment of time**
  - Immediate and instantaneous at plant level
  - Integral and multi-versioned at business level
- **Fit with existing business models**
  - Comparing apples with apples (consistency vs accuracy)
  - Incremental change across entire business
- **Management of Information**
  - Data structures
  - Visualisation
  - Maintenance

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**END**