Closed-loop Industrial IoT: giving the model-based ecosystem a reality check
Industry Challenges

How to avoid poor program performance and cope with increasing product complexity?

How to remain competitive within global competition while overcoming cost & schedule challenges?

How to reduce the growing backlog but mitigate the increased risk throughout the supply chain?
Combining the real world with the virtual world
Integrating and digitalizing of the entire value chain
This is accomplished by creating a holistic virtual representation of the value chain: the Digital Twin
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Traditional hierarchical structures lack interconnectivity.

- **ERP**
  - Data exchange is often limited to file converting and basic I/O

- **PLM**
  - Connectivity to different layers is limited or not intended

- **MES/MOM**
  - Constraints for flexible design and web applications

- **SCADA/HMI**
  - Limited computing power for high-frequency process evaluation

- **Automation Systems**
Cloud based open IoT Platforms breaks silos, enables vertical and horizontal integration to generate smart data

- Commercial and logistics data
- Product/process master data
- Quality and process data
- OEE and monitoring data
- Machine data
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Realizing the Vision: Siemens Lean Digital Factory Approach

Streamline PLM
Digital twin product, digital twin production, digital twin data

End 2 End
Cyber-physical systems, self learning systems, digital consistency, flexibility

IoT operating system
Cloud computing, tracking and tracing, analytics, artificial intelligence

Disruptive technology
Additive manufacturing, automated guided vehicle, robotic, virtual reality, augmented reality

People and methods
Digital mindset, flexible collaboration, digital guidance, automated administrative process
Realizing the Vision: Siemens Lean Digital Factory Approach

**Value:** Market-driven business value definitions

**Solution:** Process-centric solution definition

**Adoption:** Continuous monitoring and refinement

**Validation:** technology alignment, time-to-value prioritization, gap assessment/improvement
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Holistic IIoT: Begin with a process-centric approach
Holistic IIoT: Identify starting points with near term, realizable value

Planning & Governance
- Program Management
- Product Cost Management

Quality
- Advanced Quality Planning
- Inspections

Product Development
- Product Configuration Management
- Electrical Design Data Management
- Mechanical Design Management
- PCB Design Management
- Failure Mode Effects Criticality Analysis (FMECA)

Industrial Engineering
- Manufacturing Configuration Management
- Manufacturing Resource Management
- Part Fabrication & NC Program Mgt
- Manufacturing Process Simulation
- Manufacturing Assembly Process Planning
- PCB Manufacturing Assembly & Test
- Robotics Planning & Simulation

Production Engineering
- Manufacturing Execution Concept Planning
- Line Design
- Collaborative Automation Design
- Automation Engineering
- Supplier Manufacturing Collaboration
- Value Stream Analysis
- Virtual Commissioning
- Ergonomics Simulation
- Plant Simulation

Logistics
- Logistics Planning & production Flow Simulation
- Supplier Sourcing & Vendor Mgt
- Incoming Goods & Supplier Quality Mgt
- Plant Logistics Management
- Plant Operation & Maintenance

Production Operations
- Production Planning & Scheduling
- Production Order Execution
- Defect Tracking & Non-Conformance Mgt
- Shop Floor Quality Execution & Statistical Process Control
- Plant Asset Management
- Motion Control of Machining
- View Service Performance

Service Operations / Execution
- Service Planning
- Create Service Work Order and Schedule
- Execute Work Order
- In Service Asset Management / Tracking
- Collect Service Execution Data
- Track Service Non-Conformity and address local issue
- Escalate Non-Conformity
- Raise Service Issues

Use case 1: Preventative, Predictive, Prescriptive Maintenance

Use case 2: Asset monitoring, location, preventative, predictive, prescriptive services, etc.
Holistic IIoT: Close the interoperability loop to maximize ecosystem value

Example MindSphere Use Cases (Apps)

1. Predictive timing, costing, etc.
2. Predictive control planning
3. Closed loop energy, HVAC, etc.
4. Closed loop material, logistics flow, etc.
5. Predictive throughput / bottleneck
6. Closed loop safety / ergonomic DOE
7. Closed loop programming, generative process
8. Asset Performance/Condition Monitoring, Location, Analytics
9. Closed loop vendor/supply chain quality analysis
10. Closed loop root cause analysis
11. Closed loop simulation, DoE, prediction
12. Preventive, Predictive, Prescriptive, Maintenance
13. Closed loop commissioning / programming
14. Remote mitigation / execution
15. Asset monitoring, location, predictive, prescriptive, etc.
Path to Closed Loop, Model Based Ecosystem

Solution Package

Connect & Monitor
- Connect assets for remote transparency
- Collect data for use in apps or processes
- Reduce downtime, improve customer experience

Digitalize & Transform
- Interconnection across systems, devices, applications and services
- Heterogeneous ensemble deep learning modelling
- Business transformation
- New products, apps, new markets, product as services

Self-Optimizing Systems
- Intelligent/Expert Systems

System of Systems
- Deep Learning

Digital Twin
- Artificial Intelligence (AI)

Augmented Reality
- Virtual Reality

Energy
- Consumption Optimization

Usage
- Transparency

Maintenance
- Predictive, Prescriptive

Asset Management
- Condition Monitoring
- Asset Performance Management

Digital Transformation

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