Bridging the Digital & Physical Worlds: IoT & Model-Based Approaches in Manufacturing

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Customer requirements, business initiatives / strategy, concept development

Manufacturing / Service planning, execution; after-market activities

Plan

Requirements Management
System Architecture

Test

Validation
Verification

Develop

Software
Electrical
Mechanical
Extended Systems Engineering “V”

Customer requirements, business initiatives / strategy, concept development

Manufacturing / Service planning, execution; after-market activities

Plan

Requirements Management

System Architecture

Software

Electrical

Mechanical

Manufacturing

Service

Develop

Test

Validation

Verification
A holistic, multi-disciplinary and collaborative approach to designing and maintaining complex systems throughout the systems lifecycle.
Evolving MBSE Use Cases

Source: John Watson

To measure MBSE effectiveness we need to understand the context of how it is used.
Understand

Make better engineering decisions and designs using real-world data

Outperform

Grow your market share and profitability though continuous innovation on evergreen products

Advance

Achieve new levels of innovation and business results by incorporating IoT technologies into your design practices
PLE integration across Modeling and PLM

PTC Integrity Modeler

REST/OSLC Links

PTC Integrity Lifecycle Manager

System Model (SysML)

PTC Windchill
MBSE to PLM Selection of Parts

- Review and confirm the items selected for export.
- Drag and drop additional items from standard Modeler Browsers.
- Structure can be expanded/collapsed.
- Items can be marked as included/excluded for export.

Items can be defined as Windchill PDMLink End Items or Configurable Modules.
Export of MBSE Variability to PLM

If the included Blocks/Block Properties have related variability items, they are automatically included in step 2 of the Exporter.

Structure can be expanded/collapsed. Items can be marked as included/excluded for export.

Review and confirm the variability items selected for export.
Options, Choices and Option Set are created.

Parts, Part Structure and Variability Expressions are created.
Browse Modeler data and select items.

View details and existing traces for selected item.

Select items on both sides and click Apply to create new trace links.
MANUFACTURING TRANSFORMATION

Continuously improve your operational performance and flexibility
MANUFACTURING

OUTPERFORM
- Synchronized Operations
- Performance Benchmarking
- Supplier Visibility
- Closed-Loop Digital Thread

ADVANCE
- AR Enabled Operations
- Digital Processes
- Agile Innovation

UNDERSTAND
- Real-Time Issue Identification
- Unified Connectivity
- Role-Based Intelligence

TODAY
STAGE ONE: UNDERSTAND

- Enhance existing infrastructure with smart sensors and modern technologies
- Simplify data in up-to-the-minute role-based views of operational performance
- Broadcast real-time alerts about assets and performance anomalies
- Connect diverse and disparate assets, sensors, business systems and external data sources in real time

- Improve information quality & reliability
- Decreased unplanned downtime
- Increase operator efficiency
- Improve maintenance efficiency
- Improve product quality
STAGE TWO: ADVANCE

- Utilize agile methodologies to rapidly create & continuously evolve manufacturing applications
- Digitally design your manufacturing processes & quality plans
- Employ intuitive, in-context 3D and augmented reality to guide workers
- Apply predictive analytics to machine health and quality processes

• Accelerate continuous improvement
• Increased speed and flexibility
• Increased workforce efficiency
• Improved product quality
• Optimized maintenance processes
STAGE THREE: OUTPERFORM

- Deploy physical-digital closed-loop processes to drive continuous improvement
- Implement consistent KPIs and operations-wide performance benchmarking to identify and implement best practices
- Synchronize resources to ensure flawless execution of production
- Obtain supplier production visibility to gain early status into performance and quality

- Improve and perfect production processes
- Improve profitability
- Reduce unplanned downtime
- Shorten lead times
- Improve agility and responsiveness
Transform your performance by giving your operations teams unprecedented capabilities to see, understand and act in real time. ThingWorx manufacturing apps accelerate your time-to-value and offer unmatched flexibility.

**ThingWorx Production Advisor**
- **Plant Manager**
  - **Optimize Production Performance**
    - Real-time monitoring of production status and critical KPI’s. Detect and react instantly to production schedule and quality issues.

**ThingWorx Asset Advisor**
- **Maintenance**
  - **Reduce unplanned downtime**
    - Real-time monitoring of the status and health of critical production assets. Detect anomalies to identify potential issues that could result in unplanned downtime.

**ThingWorx Controls Advisor**
- **Controls Engineer**
  - **Ensure OT Network Data Quality**
    - Unified real-time monitoring of all connected end points and related data elements on the OT system network. Rapidly and flexibly trend data to troubleshoot issues.
CONNECT

MODEL-DRIVEN IOT

- IoT system architecture design for complex systems
- Systems flow-down to IoT software modeling
- Automated IoT code generation for ThingWorx
- Edge-device to Cloud and Edge-device to Edge-device

PTC MBSE
Manufacturing processes, quality plans, and work instructions are defined and delivered digitally

- Accelerates time-to-volume production through the digital validation of manufacturing processes
- Improves operator efficiency through delivery of 3D/AR work instructions and in-process quality validation
- Improves product quality by defining control characteristics and validation requirements from the 3D models
- Accelerates change propagation with associative engineering and manufacturing change management

PTC Solutions:
- ThingWorx Platform
- Windchill MPMLink

Customers:
Import Creo NC process plan
Immersive factory experiences improve training, work instructions, quality validation, maintenance execution, and operations monitoring by layering digital information onto the user’s physical world.

- Increases **workforce efficiency** and flexibility by delivering easy-to-consume, guided instructions.
- Dramatically **improves training** speed and outcomes through cognitively rich digital / physical user experiences.
- **Improves quality** assurance through use of AR as a quality-control visual validation technique.
- **Improves safety** by making workers aware of in-context safety risks.

**PTC Solutions:**
- ThingWorx Studio and ThingWorx View
- MPMLink

**Customers:**

Solar Turbines
A Caterpillar Company
What if you could create and use augmented reality experiences in less than a minute? … with your engineering data?
CLOSED-LOOP DIGITAL THREAD

Physical manufacturing processes are compared with digital models to identify opportunities for continuous improvement.

- Uses closed-loop feedback from production to identify product design improvements
- Identifies manufacturing process and quality improvements based on production outcomes
- Continuously assesses gaps between the physical/digital realities to improve and perfect production processes

PTC Solutions:
- ThingWorx Platform (Connectivity, Foundation, analytics)
- MPMLink
- Q3 – Kinex for Manufacturing

Customers:
IN THE WORDS OF LEADING MANUFACTURERS

GE Brilliant Factory

- “Get Connected, Get Insights, Get Optimized”
- 530 plants in total. 75 in 2016

Airbus Factory of the Future

- “Future digital technology will be introduced everywhere in the factory”

DENSO “Dantotsu” Factories

- “Linking 130 factories at home and abroad by 2020”
Questions and Answers

Thanks for your attention!
CUSTOMER STORIES
CNB STREAMLINES MANUFACTURING WITH DIGITAL PROCESS PLANNING

“The PTC Manufacturing Process Management solution helps streamline our R&D and manufacturing processes.”
“PTC has delivered a solution that is in line with the vision we have for improving our product development and manufacturing processes.”

CNB
GE TRANSPORTATION, GROVE CITY

10 to 20% reduction in unplanned downtime
A GLOBAL FOOD LEADER INCREASES PRODUCTIVITY

5 to 8% improvement in productivity
Leading aircraft manufacturer with €40 billion in revenue and 55,000 employees
SOLAR TURBINE
Enabling Timely Data Driven Decisions
- Rapid Time to Value with 6 weeks IoT sprints
### Predictive Maintenance to Reduce Unplanned Downtime

Predicting alarms 24 hours in advance, with a 91% accuracy.
“I will show the tool to my team and use it every time we have support calls regarding data collection”

- Benoit Lapensee, Director of MES