Digital Transformation Journey for Manufacturing

PTC Korea
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Agenda

1. Manufacturing trend
2. Transformation Approach
3. PTC Smart Factory Solution
Manufacturing transformation

Manufacturing companies are undergoing digital transformation by adopting ICT technology proactively into their business model development and business process improvement.

Industry

| Traditional Manufacturing & Business | ICT technology |

Transformation enabler

Types of new opportunity

- Enable new business models
- Transform business processes
A wave of transformation is coming to manufacturing

33% (majority) of IoT economic value will come from the “Factories” setting

McKinsey Global Institute
# Manufacturing Journeys of Transformation

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Manufacturing</th>
<th>Service</th>
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<tbody>
<tr>
<td>Drive business results and continuous innovation by transforming your engineering practices and product designs</td>
<td>Continuously improve your operational performance and flexibility through digital manufacturing, real-time intelligence and predictive analytics</td>
<td>Generate unprecedented value for your customers and your organization by redefining the entire service model</td>
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Smart Factory POV

- Product Lifecycle Perspective – Closed loop process for entire product lifecycle connecting dots among value chains.
- Domain Integration Perspective – IT & OT integration by “wrap & extend” methodology

Digital Thread Completion – Closed Loop Process
(engineering, sourcing, manufacturing, quality, service, …)
IOT adoption for closed loop process in manufacturing

51% MAKING INVESTMENT IN IIoT IN NEXT 12 MONTHS
SOURCE: LNS RESEARCH, 2016

75% EVENTUALLY EXPECTING TO INVEST IN IIoT
SOURCE: LNS RESEARCH, 2016

45% EVALUATING AND/OR INVESTING IN IoT PILOTS
SOURCE: ARC, 2015
The manufacturing opportunity – With IoT

“Rip and replace” gives way to “wrap and extend”
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 factory**
- “Linking 130 factories at home and abroad by 2020”
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Three stages of transformation

Continuously improve your operational performance and flexibility through digital manufacturing, real-time intelligence and predictive analytics.
Stage one: Understand

Make decisions quickly by connecting and unifying different sources and structures of internal and external data in real-time

- Decreased unplanned downtime
- Improved throughput
- Improved maintenance efficiency
- Higher workforce efficiency
Stage two: Advance

Streamline your operations and continuously innovate through digital processes, predictive analytics and a guided workforce.

- Increased speed and flexibility
- Increased workforce efficiency
- Optimized maintenance
- Improved quality
Stage Three: Outperform

- Optimized enterprise-wide operations
- Lowered manufacturing costs
- Optimized production, maintenance and energy balancing.

Achieve optimal execution through continuous, closed-loop process improvement and adaptive operations.
Your roadmap: the Manufacturing Transformation Journey

**How to get there**

- **Closed-Loop Improvement**
  - Combine engineering, manufacturing, quality and service data into a unified digital thread
  - Enable physical-digital closed-loop processes to constantly improve and adjust operations
  - Implement consistent KPIs and corporate-wide performance benchmarking to identify and implement best practices

- **Digital Processes**
  - Digitally design your manufacturing process and quality plans
  - Apply predictive analysis to machine health and quality processes
  - Employ intuitive, in-context 3D and augmented reality to guide workers
  - Incorporate smart, connected tools for in-process quality validation

- **Performance Benchmarking**

- **Synchronized Resourcing**

- **Rapid Change Implementation**

- **AR-Guided Workers**

- **Rapid Innovation**

- **Predictive Analytics**
  - Real-Time Performance Visibility
  - Real-Time Issue Identification
  - Task-Based Interfaces

- **Understand**
  - Make decisions quickly by connecting and unifying different sources and structures of internal and external data in real-time

- **Advance**
  - Streamline your operations and continuously innovate through predictive analytics, digital processes, and a guided workforce

- **Outperform**
  - Achieve optimal execution through continuous, closed-loop process improvement and adaptive operations

**Results**

- Optimized enterprise-wide operations
  - Near-perfect quality
  - Lowered global manufacturing costs
  - Optimized production, maintenance, and energy balancing

- Increased speed and flexibility
- Increased workforce efficiency
- Optimized maintenance planning and execution
- Improved quality

**Today**

- Decreased unplanned downtime
- Improved throughput
- Improved maintenance efficiency
- Higher worker productivity
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PTC strategy:

Fundamentally the PHYSICAL and DIGITAL worlds have converged
PTC strategy:

DIGITAL
Proven Mfg enterprise capabilities

Digital Process Planning
Illustrations
Additive Mfg

PHYSICAL
Complete IIoT Platform for the factory

CONNECT
kepware®
ANALYZE
thingworx®
BUILD
thingworx®
EXPERIENCE
vuforia
Purpose Built and Comprehensive IoT Platform

CONNECT
- Industrial Protocol Drivers (Kepware)
- Device Cloud Connector SDK
- Industrial-to-Application Thing Modeling (Kepware Integration)

ANALYZE
- ThingWatcher
- ThingPredictor
- ThingOptimizer
- Analytics Builder

BUILD
- UI Builder for Web, Mobile, AR
- Visual Application Modeling
- Run-time Services
- Edge Intelligence

MANAGE
- Visual Alert & Rules Management
- Asset Provisioning & Management
- Software & Content Management

EXPERIENCE
- Leverage rich 3D animation and IoT data for experience creation
- Compelling visualization for web, mobile and AR
- ThingMarks for unique AR experiences for each associated device

SCALE
- Enterprise-ready Deployment Architecture
- Millions of connected devices

SECURE
- Advanced Device Identity and Authentication
- Platform-Wide Identity Management
PTC smart factory solution

A suite of role-based IoT applications for the factory to enable the customers to realize the Manufacturing Journey outcome

- **Controls Engineer**
  - Industrial connectivity monitoring
- **Plant Manager**
  - Operational intelligence
- **Maintenance**
  - Asset performance
  - Real-time monitoring
  - 2D, 3D, mobile, augmented reality experiences
- **Quality**
  - Operator efficiency
  - Anomaly detection & predictions
  - 3D / AR instructions delivery
- **Operator**
  - Process, quality & maintenance 3D / AR authoring
- **Maintenance, Process & Quality Planners**

PTC manufacturing extensions to make the platform quicker and easier to adopt for factory use cases
PTC smart factory solution - for Controls Engineer

CAPABILITIES
- Real-time visibility of OPC server status
- Instant notification of device connectivity errors
- Easily trend tags in minutes
- Set alarms and issue text and email notifications
- Web enabled, no client software install required

BENEFITS
- Fast & flexible
- Proactive issue identification
- Reduced unplanned downtime
- More reliable data collection
PTC smart factory solution - for plant managers

**CAPABILITIES**

- Unified connectivity to assets, sensors and systems
- Real-time visibility into performance and issues, for rapid problem resolution
- Drill down into underlying data for root cause analysis
- Role-based delivery for better and faster decision making

**BENEFITS**

- Increased efficiency
- Increased throughput
- Improved quality
- Increased responsiveness

- Normalized manufacturing KPIs
- 360 view into operations, including historical trending
- Connectivity to heterogeneous equipment and systems from different vendors, with variations across plants
PTC smart factory solution - for maintenance

CAPABILITIES
- Predictive Maintenance
- Predictive Quality
- Auto-detect normal state pattern
- Real-time anomaly detection
- Predict Outcomes

BENEFITS
- Reduced downtime
- Optimized maintenance planning & execution
- Improved quality
- Reduced scrap and rework
PTC smart factory solution - operator & quality control

CAPABILITIES

- Bi-directional integrations
- 3D & augmented reality delivery
- Automated and manual data capture to build quality genealogy
- Support for smart tools
- Real-time quality check to error proof execution

BENEFITS

- Improved operator productivity
- Improved quality
- Higher value from existing systems
- Higher IT flexibility per work cell

One unified screen for the operator with contextual, order specific, up-to-date information from all sources

People (operator):
- Single interface
- Role-based

Mfg systems (ERP/MES):
- Work orders
- Operations, parts, resources
- Competencies check
- Parts / resources availability
- Operation clocking

PLM / MPM / CAD:
- 2D / 3D
- Part and process plan details
- Standard operating procedures
- Augmented Reality

Quality / data capture:
- Traceability, genealogy
- Operator feedback

Industrial tools:
- Torque, angle, battery life, ...
- Position and orientation
- Program download (NC, CMM)
Augmented reality guided workers

CAPABILITIES
• Contextual delivery
• Visual delivery for 3D, machine, performance and business data
• Guided, step-by-step instructions
• Real-time process and quality validation for error-proof execution
• Walk the plant augmented reality experience
• Supports for multiple devices and platforms

• Step-by-step guided instructions
• Real-time quality validation

• Augmented real-time KPIs for a “virtual walk the plant” experience

BENEFITS
| Improved operator productivity | Improved quality | Improved maintenance | Improved training |
3D / AR instructions authoring

CAPABILITIES

- Digital Process Planning
- 3D Instructions
- 3D Illustrations
- A/R Experience
- Create & Update
- Change Control

BENEFITS

- Improved Eng. & Mfg. collaboration
- Increased production quality and performance
- Shorten time to production
- Reduce development cost

One digital process plan; flexible and associative instructions options:

- 3D animations
- 3D illustrations
- AR experience

A single source of digital mfg processes, under change control
PTC is the Clear Market Leader With 18% Market Share

PTC 18%
Telit (ILS) 4%
IControl networks 4%
Arrayant 3%
Samsung Smartthings 3%
IBM IoT Foundation 2%
BlackBerry 2%
Ayla Networks 2%
Zebra Technologies 2%
Prosyst 2%
Etherios 2%
Pubnub 2%
General Electric 1%
Amazon (2lmentry) 1%
Other 49%

Source: IoT Analytics

Total market size 2015: $298M

IOT Platforms Vendor Benchmarks 2016

Source: Lux Research, Inc.

Technology Platforms for the Internet of Things (IoT)

PTC 27%
Telit (ILS) 4%
Cumulocity 7%
Gemalto-SensorLogic 5%
LogMein-Xively 3%
Arrayant 2%
Amazon (2lmentry) 2%
Zebra Technologies 2%
ABO Data 2%
Bosch Software Innovations 1%
Autodesk – SeeControl 1%
Other 36%

Source: BCC Research

Source: Experton Market Insight