Industry 4.0
From integrated engineering to integrated operation
- discover the potential of digitization
Chris Vains, Siemens Ltd
Influencing Regeneration, Recovery and Reinvention

**Industry 4.0 introduction**

RAMI 4.0 setting Standards

Digitalisation: Next level of productivity

Our Vision

Use Cases
Industry 4.0 – the Fourth Industrial Revolution

From the computer to the production line, new technologies are shrinking the time between virtual planning and manufacturing.

► As information generated in the virtual world flows into real manufacturing processes, new production environments will emerge.

► Design and manufacturing processes are changing – how we service equipment will also change.

► Next steps require collaboration between major industrial companies, academic research institutes, and governments.
March 2016: ‘Together instead of alone’

The U.S. and Germany are seeking joint standards for digital networking, "Handelsblatt" writes. The German "Platform Industrie 4.0" and the U.S. "Industrial Internet Consortium IIC" are looking to cooperate in order to prevent major players such as Google and Cisco from manipulating the industry to suit their needs. One of the pioneers in Industrie 4.0 is Siemens, which has commented in group circles that "this is in our interest." "Island solutions are not in the interest of the German industry."

Siemens CEO Joe Kaeser had always stressed that global solutions are needed.
How Platform Industry 4.0 meets the Industrial Internet Consortium

http://www.plattform-i40.de/i40/Redaktion/EN/PressReleases/2016/2016-03-02-kooperation-iic.html;jsessionid=0E7640468A0A532041EBE17358BB0DDF
From well-structured automation …
… to flexible and self-organizing automation

- I4.0 connects / merges production with information and communications technology
- I4.0 links customer data to machine data
- Machines communicate with machines
- Components and machines autonomously manage production in a flexible, efficient, and resource-saving manner

Source: Presentation from Dr.-Ing. Peter Adolphs on Reference Architectural Model Industrie 4.0 RAMI 4.0
Security as a Precondition and Enabler

- Security by design
- The basis of all Industrie 4.0 applications
Prerequisites

- Defining communication structures
- Development of a common language with its own signs, alphabet, vocabulary, syntax, grammar, semantics, pragmatics, and culture

Source: Presentation from Dr.-Ing. Peter Adolphs on Reference Architectural Model Industrie 4.0 RAMI 4.0
Influencing Regeneration, Recovery and Reinvention

Industry 4.0 introduction

**RAMI 4.0 setting Standards**

Digitalisation: Next level of productivity

Our Vision

Use Cases
RAMI 4.0 – The Reference Architectural Model for Industrie 4.0

RAMI 4.0 is a three-dimensional map showing how to approach the issue of Industrie 4.0 in a structured manner.

RAMI 4.0 ensures that all participants involved in Industrie 4.0 communication understand each other.
Axis 1 – Hierarchy: The Factory

The Old World: Industrie 3.0
- Hardware-based structure
- Functions are bound to hardware
- Hierarchy-based communication
- Product is isolated

The New World: Industrie 4.0
- Flexible systems and machines
- Functions are distributed throughout the network
- Participants interact across hierarchy levels
- Communication among all participants
- Product is part of the network

Source: Presentation from Dr.-Ing. Peter Adolphs on Reference Architectural Model Industrie 4.0 RAMI 4.0
Axis 2 – Architecture

- Business: Organisation and Business Processes
- Functional: Functions of the Asset
- Information: Necessary Data
- Communication: Access to Information
- Integration: Transition from Real to Digital World
- Asset: Physical Object in the Real World

Source: Presentation from Dr.-Ing. Peter Adolphs on Reference Architectural Model Industrie 4.0 RAMI 4.0
Axis 3 – Product Life Cycle

The Product: From the First Idea to the Scrapyard

Development
Development
Construction Plan:
Construction
Computer Simulation
Prototype

Maintenance
Usage
Type

Production
Production
Maintenance
Usage
Instance

Construction Plan:
Software Updates
Instruction Manual
Maintenance Cycles
...

Production:
Product
Data
Serial Number
...

Facility
Management:
Usage
Service
Maintenance
Recycling
Scraping
...

Source: Presentation from Dr.-Ing. Peter Adolphs on Reference Architectural Model Industrie 4.0 RAMI 4.0

© Siemens AG 2016 Unrestricted
Reference Architectural Model Industrie 4.0 (RAMI 4.0)

A Solution Space with a Coordinate System for Industrie 4.0

Source: Presentation from Dr.-Ing. Peter Adolphs on Reference Architectural Model Industrie 4.0 RAMI 4.0
Influencing Regeneration, Recovery and Reinvention

Industry 4.0 introduction
RAMI 4.0 setting Standards

**Digitalisation: Next level of productivity**
Our Vision
Use Cases
Process Industries needs to face market dynamics that require increasing flexibility, faster market readiness and improved productivity.

### Key Drivers and Specifics

**Time to market**
- From idea to production
- Ramp-up of plant

**Flexibility**
- Individualized products / quantities
- Different feedstock

**Output**
- Demanded product / quantity
- Increased productivity

**Costs**
- Resource efficiency
- Operational excellence

- Long plant lifecycles (> 40 years) with highly fragmented data landscape
- Continuous, safe and reliable operations
- Need to address different feedstock, markets and quantities
- Lack of operators and “digital natives” as next generation
Digitalization is next level to yield productivity within Process Industries

Process Industries → Electrification, Automation and Digitalization as levers to increase productivity

**Technological driver**
- Computing power
- Communication
- New sensors
- Virtualization
- Cloud computing
- Simulation
- …

**Digital Enterprise**
Integrated Engineering and Integrated Operations

**Different initiatives, e.g.,**
- Industrie 4.0
- Industrial Internet Consortium (IIC)
- Made in China 2025
- …

**TIA@Process Industry**
Perfect interaction of all components along the life cycle

**TIP@Process Industry**
Electrical power wherever and whenever

**Next level of productivity**
Experienced partner for Automation and Electrification
Pioneer for Digitalization in industry
Siemens enables Digitalization both in Process Industries and Discrete Industries as basis to create a Digital Enterprise

Digitalization → Different forms in industries

Digital Enterprise

**Process Industries**

- Product design
- Process & plant design
- Engineering & commissioning
- Operation

**Hybrid Industries**

- Services
- Production planning
- Production engineering
- Production

**Discrete Industries**

- Services
- Product design
- Production
Siemens portfolio for Digital Enterprise covers complete lifecycle

Digital Enterprise

Process Industries
- Product design
- Process & plant design
- Engineering & commissioning
- Operation
- Services

Hybrid Industries
- Product design
- Production planning
- Production engineering
- Production
- Services

Discrete Industries
- Product design
- Production planning
- Production engineering
- Production
- Services

Digitalization ➔ Different forms in industries

- COMOS
- COMOS
- Teamcenter
- NX
- Tecnomatix
- MCD
- Data Driven Services / XHQ / ASM
- Manufacturing Execution Systems
- SIMATIC IT
- SINUMERIK Integrate
- PIA Selector
- Automation / Instrumentation and Drives Portfolio
- TIA Portal
- Automation / Drives Portfolio
- Communication / Security
- Communication / Security
- TIA: Totally Integrated Automation
Siemens enables Digitalization both in Process Industries and Discrete Industries as basis to create a Digital Enterprise.

Digitalization → Different forms in industries

Digital Enterprise

Process Industries
- Product design
- Process & plant design
- Engineering & commissioning
- Operation
Services

Hybrid Industries
- Product design
- Production planning
- Production engineering
- Production
Services

Discrete Industries
- Product design
- Production planning
- Production engineering
- Production
Services
Already today, customer plan Digitalization steps to address key challenges of their industries

Digitalization in Process Industries → Customer examples

**Chemicals**

**Seasonal production**

**Today:** • Plant in one location over entire life cycle

**Vision:** • Jan-Apr: Operation integrated w/ 20 modules
• Apr-Jun: Transport to different locations / Service
• Jun-Nov: Immediate operation w/o any delay

**Challenges:** • Highly automated modules with self-diagnostic functionality
• Remote maintenance and control
• Standardized modules

**Oil and Gas**

**Virtual global oil field (VOF)**

**Today:** • Different upstream technologies (platform, FPSO, SSM) working independently

**Vision:** • Autonomous sub-sea modules spread world-wide combined to one virtual oil / gas field
• Central performance control
• Maintenance via central remote control hubs

**Challenges:** • Manage continuous autonomous automation in deep sea
• Central control VOF based on economical pre-sets
Digital Enterprise for Process Industries through Integrated Engineering and Integrated Operations

Integration Engineering optimizes engineering and life cycle management …

- Integrated engineering tools
- Simulation
- Common data model

… Integrated Operations improves productivity and flexibility

Product design | Process & plant design | Engineering & commissioning | Operation | Service

© Siemens AG 2016 Unrestricted
Influencing Regeneration, Recovery and Reinvention

Industry 4.0 introduction
RAMI 4.0 setting Standards
Digitalisation: Next level of productivity

Our Vision

Use Cases
Integrated Engineering addresses further integration along the life cycle, simulation and augmented reality based on a common data model.

### Integrated Engineering

#### Today

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3D</strong></td>
<td>Integrated Engineering across all disciplines; engineering tools interlinked with automation and field devices, e.g., instrumentation and analytics</td>
</tr>
<tr>
<td><strong>Automation</strong></td>
<td>Simulation and 3D visualization enable e.g., authoring, virtual commissioning or operator training and assist maintenance</td>
</tr>
<tr>
<td><strong>Digital twin</strong></td>
<td>Digital twin of real plant in “as-is” quality integrating plant and process data based on common data model</td>
</tr>
</tbody>
</table>

#### Vision

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased level of integration and interoperability</strong></td>
<td>Increased level of integration and interoperability of engineering tools with automation and field level across all workflows and disciplines</td>
</tr>
<tr>
<td><strong>3D application</strong></td>
<td>Increasing importance of 3D application and strong combination with 2D.</td>
</tr>
<tr>
<td><strong>Augmented reality</strong></td>
<td>Augmented reality in plant supports operators</td>
</tr>
<tr>
<td><strong>Open architectures and interfaces</strong></td>
<td>Open architectures and interfaces for new ways of collaboration (software deployment platforms, collaborative engineering)</td>
</tr>
</tbody>
</table>

### Product design | Process & plant design | Engineering & commissioning | Operation | Service
A common data model is enriched along the life cycle and ensures consistency during all workflows.

Integrated Engineering with Siemens → Common data model

- Plant hierarchy
- Mass-/ energy balance
- Process flow diagram
- Simulation model
- ...

- P&ID
- Electricals
- Instrumentation
- Piping
- Automation
- ...

- As built documentation
- KPIs and alarms
- ...

- Maintenance data (MRO)

One common data models along the life cycle to integrate plant and process data

Product design  Process & plant design  Engineering & commissioning  Operation  Service
Integrated data from all levels to provide decision support, optimize productivity and enable new control concepts

Integrated Operations with Siemens → Today and future vision

**Integrated Operations**

**Today**

- Increased **productivity** and **decision support** through increased transparency, analytics and services
- **Advanced control** with scalability, remote access, interoperability with COMOS and proven security
- **Simple integration** of field level (libraries, connectivity) and **increasing intelligence**
- **Reliable connectivity** as backbone for integration as well as remote operations and services

**Vision**

- **Optimization** through real-time (cloud-enabled) data analysis and advanced tools / services and **simulation**
- **Modularization** and **virtualization** through highly scalable controls, optimized interoperability and open interfaces
- **Digitalization of field level** with full and easy (“plug’n’produce”) integration and embedded intelligence
- **Full interoperability** and advanced remote operations and services through seamless connectivity
Data analytic services help to increase performance based on enhanced transparency and understanding of one's own processes

Integrated Operations with Siemens → Cloud enabled services

Data analytics

**Data collection**
- Right data available in right form (e.g., by PCS 7, XHQ)

**Plant security services**
- Secure connection for data integrity / confidentiality
- Holistic security offering for industrial plants

**Plant analytics services**
Plant and asset optimization (Asset, Energy, Process Data Analytics)

**Control Performance Analytics Service**
Higher control loop performance for optimal resource efficiency

**Vision**
- Process Event Analytics to optimize alarm strategy
- Dynamic Process Optimization with set point values and defined but dynamic efficiency criteria

Plant cloud services 1)

- Cloud for industry with open application interface for individual applications
- Open standard (OPC) and plug&play connection
- Optional cloud infrastructure

1) Currently just for pilot customers
Integrated data from all levels to provide decision support, optimize productivity and enable new control concepts

Integrated Operations with Siemens → Next level of control

Today and tomorrow

**SIMATIC PCS 7**
- **Scalable DCS system** with integrated **security** and **simulation**
- **Common plant model and integration** through **bi-directional interfaces** to COMOS, SIMIT and SIMATIC IT and connectivity to enterprise analytic systems (e.g., XHQ) and cloud
- **Operators support** with technology driven workflow, **multiuser** engineering, easy visualization (**web-based**, KPI-driven) and **mobile devices**
- **Process optimization** with **Advanced Process Control**

**MES System**
- **SIMATIC IT as interface between enterprise and plant** operations (detailed planning, scheduling, quality control, reporting)
- **Electronic batch recording** for **paperless manufacturing**

**One historian** for DCS, SCADA and MES

Our vision

**Common plant model**
- **Modularization**
- **Virtualization**
- **High scalability**

**Remote operations**
- **Interoperability**

**Application**
- **Content**
- **Services**
- "...

**Technology:**
- 🟦 **Hardware**
- 🟦 **Software**
New ways of getting process information and improved integration of field level are basis for transparency and optimization

Integrated Operations with Siemens → Digitalization of field level

<table>
<thead>
<tr>
<th>Today</th>
<th>Our vision</th>
</tr>
</thead>
</table>
| **Gather information** | Use of gathered information (partially <1% used), e.g., with ASM, XHQ  
  - Transparency with **KPIs and dashboards**  
  - **Maintenance, reliability, accuracy**  
  - Optimized processes with **analytics** |
| SITRANS FC430 | **Grid of (basic) sensors, smart sensors** and virtual / **soft sensors** (big data approach)  
  - Control in the field and modular plants  
  - Distributed high performance transmitter style analyzers in all rough environments |
| **Evaluate information** | **Transparency** on process and field conditions  
  - Advanced **analytics, real-time** process optimization  
  - **Smart grids** (field, control) automatically react on changes in process or field conditions |
| Analyzer System Manager | **Digital twin of sensors**  
  - Seamless integration: “**Plug’n’produce**”  
  - Sensor grids with **IP-based communication, devices as I/O node** |
| **Simple integration** | **Product libraries** integrated in COMOS and PCS 7, 2D/3D and simulation models  
  - Easy **integration in automation**  
  - **Connectivity** other devices or grids |
| SITRANS FC410 3D-Rendering | 1) TDLS = Tunable Diode Laser Spectrometer  
  © Siemens AG 2016 Unrestricted
Connectivity will be key to enable Digitalization of Process Industries

Integrated Operations with Siemens → Reliable connectivity

Future challenges in industry

Vertical integration and remote operations enabled by industrial identification and high performance, reliable communication
- IP based communication
- Profinet / OPC UA with various diagnostic functions
- Ubiquitous connectivity (WAN, WLAN, LAN, wireless fieldbuses, RFID)

Domain specific data transfer (realtime, security, safety)

Comprehensive security enabled by embedded security and solutions for network and plant security

Our vision

- Increased usage of plug’n’play components and on-demand networks
- Easier and automated (self-)configuration
- Real-time communication with higher robustness, bandwidth and reliability
Siemens’ portfolio seamlessly connects design, engineering, commissioning, operation and service

Digitalization in Process Industries → PD PA portfolio

<table>
<thead>
<tr>
<th>Optimization through Digitalization</th>
<th>Automation and Engineering</th>
<th>Process Instrumentation</th>
<th>Process Analytics</th>
<th>Industrial Communication</th>
<th>Integrated Drive Systems</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMOS</td>
<td>Automation Solutions</td>
<td>SIMATIC PCS 7</td>
<td>Automation Solutions</td>
<td>XHO</td>
<td>SIMATIC IT / eBR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SIMATIC IT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SITRANS Library</td>
<td></td>
<td></td>
<td>SITRANS Library</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PIA Lifecycle Portal incl. COMOS Interface</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analytic Solutions / Analytic System Houses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analyzer System Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SIMATIC Net / Scalance / RuggedCom</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SINEMA Server Network Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drives</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gears</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Value added Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Life Cycle Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data Driven Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering and Consulting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product design</th>
<th>Process &amp; plant design</th>
<th>Engineering &amp; commissioning</th>
<th>Operation</th>
<th>Service</th>
</tr>
</thead>
</table>

© Siemens AG 2016 Unrestricted
Siemens PD Process Automation with comprehensive portfolio to drive Digitalization

Digitalization in Process Industries → PD PA portfolio today and in the future

**PD Process Automation portfolio**

**Engineering Management Level**
- COMOS Plant Engineering
- SIMIT Simulation
- XHQ Operations Intelligence
- MES Solutions Pharma

**Operation and Control Level**
- SIMATIC PCS 7 Process Control System
- Power Supplies
- SIMATIC S7-400

**Field Level**
- Analytical Products and Solutions
- Process Instrumentation
- Industrial Identification
- Industrial Communication

**Technology:**
- Hardware
- Software

**Our vision**

**Engineering Management Level**
- Seamless horizontal integration
- Optimization through full transparency and analytics

**Operation and Control Level**
- Advanced control enabling modularization, virtual control and remote operations
- System integrated diagnostics & maintenance

**Field Level**
- Enhanced embedded functionality
  - Fully included in “as-is” digital twin based on digital connectivity
  - Soft / virtualized and smart sensors

- On-demand networks, real-time communication, easy configuration, RFID and NextGen code reading for Digitalization
Influencing Regeneration, Recovery and Reinvention

- Industry 4.0 introduction
- RAMI 4.0 setting Standards
- Digitalisation: Next level of productivity
- Our Vision
- Use Cases
Key use cases of Digitalization can already be addressed today

Digitalization in Process Industries → Todays use cases

**Integrated Engineering** optimizes engineering and life cycle management …

- Integrated Engineering
- Asset Performance Management
- Simulation and Virtual Commissioning
- Simulation and Virtual Reality
- Specification Management

… **Integrated Operations** improves productivity and flexibility

- Process Optimization
- Flexible Production
- Paperless Manufacturing
- Real Time Production Release
- Smart Water Management System
- Industrial Security
- Plant and Process Simulation
Siemens has a broad scope of offerings

Digitalization → Detailed Framework enabled by Siemens (Examples)

**Management & enterprise level**
- ERP, SRM, SCM, CRM, EAM, …
- Enterprise Manufacturing Intelligence
- Operational Efficiency
- Asset (Performance) Management
- MES
- Production Mgmt., Quality Exec., LIMS

**Operator & control level**
- Remote Operation
- Controls & HMI
- Batch
- DCS
- SIS (Safety instrum. system)
- HMI
- PLC
- Embedded APC
- APC (Adv. Process Control)
- Historian

**Field level**
- Instrumentation / Drive Engr. & Config.
- Instruments with embedded analytics
- Instrumentation & Drives / Actuators
- Communication Protocols / Platform

**Laboratory Automation**
- Molecular Design
- Specification / Recipe Mgmt.
- Lab Info. Mgmt. Sys. (LIMS)
- Process Design & Simulation
- Plant Design & Engineering
- 2D-Engineering
- 3D-Engineering
- Plant Lifecycle Data Management & Documentation
- Virtual Commissioning, Operator Training & Simulation
- Automation Engineering

**Siemens CLOUD for Industry**

- Siemens PLM Analytics
- Customer Analytics
- 3rd party Analytics
- Big Data Services (Public / private)

**Product design**
- Process & plant design
- Engineering & commissioning
- Operation
- Service

© Siemens AG 2016 Unrestricted
Integrated Engineering guarantees consistency between digital twin and “as-is” plant

A Use Case → Integrated Engineering

Integrated Engineering...

Seamless integration of engineering disciplines, steps and tools
Bi-directional transfer between engineering tools and hardware configuration and type-based generation of control functions

...enabled by Siemens offerings

1. COMOS – Integrated planning framework
   - Interfaces to PCS 7, instrumentation, analytics and simulation tools
   - Integrated maintenance with ERP-interface
   - “As-is” documentation

2. SIMATIC PCS 7 – Scalable DCS system
   - Bi-directional interface to SIMIT and COMOS
   - SITRANS Library (specific faceplates, function blocks)

3. SIMIT – Simulation tool for plant behavior

4. COMOS Walkinside – 3D visualization

5. SIMATIC PDM & Maintenance station

Key portfolio elements

1. Plant design & engineering
2. Distributed Control System
3. Plant simulation
4. 3D visualization
5. Device and asset management

Chemical plant

© Siemens AG 2016 Unrestricted
COMOS, XHQ and PCS 7 support Asset Performance Management to gain reliability improvements

Use Case → Asset Performance Management

Asset Performance Management...

Support reliability improvements, i.e., to reduce unplanned shutdowns, maintenance costs and time for start-up after shutdowns or maintenance

Key portfolio elements

1. Critical assets
2. Maintenance and turnaround strategy
3. Support system to control critical assets
4. Optimized use of assets
5. Root cause analysis and captured know-how

...enabled by Siemens offerings

1. Support – Information on Siemens assets; as-is information out of COMOS
2. SIMATIC IT PCS 7 Asset Mgmt. / COMOS – Capture information
   XHQ – Information dashboard
   Remote-Diagnostic-Services
   Siemens Cloud for Industry – Infrastructure for cloud applications / services
3. Control Performance Analytics Service – Control / optimization of controllers as a service
4. Walkinside – 3D visualization / virtual reality
Increase transparency and support decisions through combination of multiple data points into meaningful information

**B Use Case → Asset Performance Management**

**Data dimensions around assets**

**Challenges**
- Holistic Asset Performance Management across fleet
- Reduce unplanned outages and maintenance costs
- Optimize asset lifecycle
- Improve safety and reliability

**Value Proposition**
- XHQ for
  - Descriptive analytics for asset conditions
  - Predictive analytics for anomalies and early warning
  - Prescriptive analytics for decision support

**XHQ solution examples today**

**Solutions at Oil&Gas customers**
Enhanced asset diagnostics, preventive maintenance and continuous asset health monitoring for 200 sites (globally)

Automated asset surveillance and asset performance monitoring, incl.,
- Predictive and real time monitoring
- Calculated indicators and reliability metrics
- Early indicators
Keep your commissioning schedule despite delays on site

Use Case → Simulation and Virtual Commissioning: EME Maschinenfabrik Clasen GmbH

Initial situation

Batch House

Furnace

Challenges

- Customized equipment and automation functions
- Limited time between erection and commercial operation
- Delays on site
- Customer request training parallel to erection

Value Proposition

- Scalable process simulation
- Hardware emulation
- Operator training system

Actual status

Siemens Offering

- SIMIT: Control Module Types (CMTs) for bulk engineering
- Additional service offering: Operator Training System

Potential 1st step

Example: Mixer

COMOS
Pre-configuration of CMT

PCS 7
Configuration

CMT

Example: Mixer

Scope at EME

Customer Benefits

- Reduced debugging time
- Reduced on site commissioning time
- Compensation of project delays

CMT: Control Module Types

© Siemens AG 2016 Unrestricted
COMOS Walkinside enables virtual training in a safe environment

Use Case → Simulation and Virtual Reality: *Total*

**Initial situation**

- **Challenges**
  - Increasing shortage in experienced personnel
  - Need for increased *asset uptime* and *safe* operation
  - Need for *up-to-date* plant information

**Value Proposition**

- Efficient and safe operator trainings:
  - *before* real plant operation
  - Based on *real-life scenarios*

**Actual status**

- *Virtual training* in the life-like virtual environment improves personal safety
- *Remote instruction* reduces costs for asset-related training through efficient collaboration for project stakeholders
  - Faster *time to first oil*
  - *Enhanced ROI* - increased efficiency, safety and asset uptime, lowered risk

Example TOTAL E&P, France
Training based on COMOS Walkinside

CMT: Control Module Types
© Siemens AG 2016 Unrestricted
**Process and Operation Optimization**

Optimization of **plant operations and processes** enabled by

- Better **support for operators**
- Improved **process control**
- **Remote operation** of plants

**Key portfolio elements**

1. **Unburden the operator**
   - a. **Alarm Management and HMI+**
   - b. **„Safe Operation Support“ functions**
   - c. **Advanced Process Control (APC)**, e.g., for
     - Embedded Model Predictive Control
     - Control Performance Monitor and PID Tuner
   - d. **Remote Operation**
     - via web server / web clients

2. **Good closed loop control performance**

**SIMATIC PCS 7**

- a. **Control Performance Analytics**
  - Control / optimization of controllers as a service
Embedded APC enables stable and optimized control loops in a glass furnace

**Use Case**

**Process and Operations Optimization:** *Embedded APC in a glass furnace*

### Initial situation

**Demo model:** Gas and temperature control of furnace

**Challenges**
- External impacts on P&ID loops e.g.,
  - fluctuating gas quality
  - continuity in batch supply
  - other control loops
- Many product changes
- Operational cost
- Operator experience / know-how

### Predict control needs and optimize operation

**Value Proposition**
- Stable and optimized control loops
- Faster product changes
- Optimized operational cost

**Siemens offering**
- DCS with embedded APC with easy to handle configuration tools
- Configuration service and training
- Web-based control performance monitoring and tuning

---

**In Piloting**

Model to optimize furnace control

**Gained model accuracy**

- Prediction embedded APC (simple model) [Accuracy: 57%]
- Real control data [Accuracy: 42%]

**Demo model:** Gas and temperature control of furnace

**Gained model accuracy**

- Prediction embedded APC (simple model) [Accuracy: 57%]
- Real control data [Accuracy: 42%]

**Value Proposition**
- Stable and optimized control loops
- Faster product changes
- Optimized operational cost

**Siemens offering**
- DCS with embedded APC with easy to handle configuration tools
- Configuration service and training
- Web-based control performance monitoring and tuning
Remote control of plants increases efficiency through joint operator taskforces and operation know-how

**Use Case → Process and Operations Optimization: Linde**

### Initial situation

**Today**
- Separated control rooms
- Separated operator taskforces
- Separated operation know-how

**Local OS clients in local control room**

**Challenges**
- Sharing of responsibility and know-how
- IT Security
- Stability of connection, including fallback strategies

**Value Proposition**
- Operator load balancing
- Remote support in critical situations
- Use of process / plant unit specialists across plants

### Improvements through remote control

**Remote control**
- One remote operation center
- Joint operator taskforces and operation know-how

**Remote clients in Remote Operation Center**

**Example Linde**
- 8 Remote Operation Centers for >>100 plants in ~60 countries worldwide

OS: Operator System

© Siemens AG 2016 Unrestricted
Enterprise Operations Intelligence helps standardizing processes and creating transparency

Use Case → Process and Operations Optimization: Transparency (continuous)

Gaining process transparency…

Monitor and improve performance with
- Seamless integration of data from operations, business and supply chain
- Meaningful KPI's and metrics for all core and support processes
  → Empower decision efficiency
  → See operations in new ways to grow to your top line

…enabled by Siemens offerings

Key portfolio elements
1. Dashboard: Enterprise wide transparency
2. KPI: Drive collaboration with data visibility at all levels

XHQ Operations Intelligence
- Turning data into actionable decisions

MI: Manufacturing Intelligence System
© Siemens AG 2016 Unrestricted
Increase transparency and support decisions through combination of multiple data points into meaningful information.

**Use Case → Process and Operations Optimization (Transparency):** Global oil companies

**Data dimensions around assets**

**Challenges**
- Holistic Asset Performance Management across fleet
- Reduce unplanned outages and maintenance costs
- Optimize asset lifecycle
- Improve safety and reliability

**Value Proposition**
XHQ for
- Descriptive analytics for asset conditions
- Predictive analytics for anomalies and early warning
- Prescriptive analytics for decision support

**XHQ solution examples today**

**Solutions at Oil&Gas customers**
- Enhanced asset diagnostics, preventive maintenance and continuous asset health monitoring for > 200 sites (globally)
- Automated asset surveillance and asset performance monitoring, incl.
  - Predictive and real-time monitoring
  - Calculated indicators and reliability metrics
  - Early indicators
Use Case → Plant Security Services

Initial situation at customer

Attacks and infections can seriously damage health, safety, environment and availability of plants

Challenges
Different weighing of security threats through differing priorities in plant:
- Protection and improved ROI
- Secure, productive infrastructure and applications
- Max. availability, failure-free operation

Value Proposition
- Continuous protection of plant to reduce risk and maintain production availability
- Fixed, calculable costs for system security

Siemens Plant Security Services

- Plant Security Service: Support for risk-based, customized security solution following 3 phases for long-term protection
- SIMATIC PCS 7 with included security

Manage
Comprehensive security through monitoring and pro-active protection

Implement
Risk mitigation through implementation of security measures

Assess
Evaluation of current security status

Risk Identification
Risk Classification
Mitigation Design
Mitigation Implementation
Mitigation Operation
Risk Management
Assess
Global program to ensure comprehensive industrial security program at more than 600 production site of Linde Gas

**Initial situation**
- World leading supplier of industrial, process and specialty gases
- Serves nearly every industry; more than 100 countries

**Challenges**
- Different maturity level for industrial security at Linde Gas
- Need for holistic implementation concept

**Value Proposition**
- **Global roll out** to achieve a higher maturity level for Industrial Security
- Cost effective and optimal strategy to deploy on all platforms globally (non-vendor specific)

**Actual status**

**Comprehensive industrial security program:**
- >600 production sites
- All remote operation centers
- Support of pilot implementation (Germany, Asia Pacific)
Largest standalone Industrial Security Service project realized at Sinopec Qingdao Refinery based on secure PCS 7 solution

Use Case → Plant Security Services: Sinopec Qingdao Refinery

Initial situation

Sinopec Qingdao Refinery

Challenges
- Operations without disturbances:
  - Protect against all kind of disturbing viruses
- Smooth implementation

Value Proposition
- Continuous protection of plant: reduce risk and maintain production availability

Actual status

Largest standalone Industrial Security Services project worldwide and blueprint for Chinese Petrochemical customers

Secure PCS 7 solution
- DMZ
- Firewall
- Antivirus
- Patchmanagement
- User Management
- System hardening
- Implementation

Customer benefits
- 2 weeks implementation during downtime of plant
- Zero incidents or infections after the project: 18 month of safe operation
Digitalization impacts business models, value creation processes and products.
Digital Enterprise

Only a holistic approach improving all processes along the whole value add chain will help to fulfill all requirements of the digital enterprise.

Requirements

- Reducing the time to market
- Enhancing flexibility
- Increasing quality
- Increasing efficiency

Value Chain

1. Product design
2. Production planning
3. Production engineering
4. Production execution
5. Services

Digital Enterprise