Digitalization in Process Industries
Agenda

• Digitalization: Next level of productivity 3
• Our vision 13
• Use cases 23
Process Industries needs to face market dynamics that require increasing flexibility, faster market readiness and improved productivity.

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
- …

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

**Digital Enterprise**
- Integrated Engineering and Integrated Operations

**Electrification**
- Electrical power wherever and whenever

**Automation**
- Perfect interaction of all components along the life cycle

**TIA@Process Industry**
- Experienced partner for Automation and Electrification

**TIP@Process Industry**
- Pioneer for Digitalization in industry

**Time**
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

- Production planning
- Services

Discrete Industries

- Production engineering
- Production
- Services
Siemens portfolio for Digital Enterprise covers complete lifecycle

Digitalization → Different forms in industries
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

**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

**Food and Beverage**

**Virtual production network**

**Today:** • Product plants with own recipe management and individual automation

**Vision:** • Distributed plants with standardized automation
  • Remote control
  • Recipes and production plan managed centrally

**Challenges:** • Standardized and modular plant design
  • Flexible and scalable automation concept
  • Integrated IT for remote planning / control and transparent KPIs
Already today, customer plan Digitalization steps to address key challenges of their industries

Digitalization in Process Industries → Customer examples

**Pharma**

**Personalized medicine**

**Today:**
- Generic drugs produced in large quantities

**Vision:**
- Small, personalized, quantities of drugs (batch)
  - Disposable production units (i.e., infusion bags)

**Challenges:**
- Standardized modules for decentral production
- Flexible automation and central recipe mgmt.
- Sensor / actor technologies (i.e., disposable micro technology)

**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

Presentation Instruction:
Choose 2 Examples most relevant for your purpose from page 9.
Siemens realizes Digital Enterprise for Process Industries through Integrated Engineering and Integrated Operations

Digital Enterprise for Process Industries → Focus of Siemens

Integrated Engineering optimizes engineering and life cycle management …

Integrated engineering tools
Simulation
Common data model

Cloud-enabled services and analytics
Next generation of Control
Digitalization of field level
Reliable connectivity

… Integrated Operations improves productivity and flexibility

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

• Digitalization: Next level of productivity  3
• Our vision  13
• Use cases  23
Integrated Engineering addresses further integration along the life cycle, simulation and augmented reality based on a common data model.

**Integrated Engineering**

**Today**

- **Integrated Engineering** across all disciplines; engineering tools interlinked with **automation** and **field devices**, e.g., instrumentation and analytics
- **Simulation** and **3D visualization** enable e.g., authoring, **virtual commissioning** or **operator training** and assist **maintenance**
- **Digital twin** of real plant in “as-is” quality integrating **plant** and **process data** based on **common data model**

**Vision**

- **Increased level of integration** and **interoperability** of engineering tools with automation and field level across all workflows and disciplines
- **Increasing importance of 3D application** and strong **combination with 2D. Augmented reality** in plant supports operators
- **Open architectures** and **interfaces** for new ways of collaboration (software deployment platforms, collaborative engineering)
A common data model is enriched along the life cycle and ensures consistency during all workflows

Integrated Engineering with Siemens → Common data model

One common data model along the life cycle to integrate plant and process data
Integrated data from all levels to provide decision support, optimize productivity and enable new control concepts

### 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 analytical 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
 Agenda

- Digitalization: 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

- Mobile devices in Maintenance and Operations
- Process Optimization
- Flexible Production
- Paperless Manufacturing
- Real Time Production Release
- Smart Water Management System
- Industrial Security
- Plant and Process Simulation
## Agenda

### 3 Use cases

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Integrated Engineering guarantees consistency between digital twin and “as-is” plant

Use Case → 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

Integrated Engineering…

...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
DSM Nutritional Products AG reduced engineering time and cost by use of Integrated Engineering with COMOS

**Use Case → Integrated Engineering: DSM**

**Initial situation**

**Challenges**
- Co-operation between engineering disciplines with individual tools
- Data erosion during plant lifecycle
- Up-to-date documentation

**Value Proposition**
- Data-base oriented engineering (COMOS) incl. defined workflows and platform for global cooperation
- Seamless transfer of plant documentation
- Data transparency

**Actual status**

**Example DSM Sisseln**
- Reduced errors through data base and instantiation (higher data quality, single data input and data transparency through common platform)
- Reduction of engineering time
- Reduction of cost through automatisms
- Higher planning and budget reliability
- 15 – 25% cost savings in process and automation engineering
Standardized and consistent data exchange between engineering and SITRANS field devices reduces effort, failures and time

Initial situation

Challenges
- Collection of engineering data
- Data consistency

→ Today: High manual effort (multiple tools, missing harmonization)

Value Proposition
- Automatic proposal for matching SITRANS devices
- Instant delivery of all relevant device data with offering / on device request
- Consistent and up-to-date data in all planning stages

Actual status

COMOS and PIA Life Cycle Portal for SITRANS field devices

Seamless integration
- Shortlist in line with status of planning
- Device selection and updates

Engineering data
- Delivery of all relevant engineering data

Standardized data exchange
- Supports eCl@ss 9
- Own extension to wiring, 3D data and others to come

“All in all, advantages, like e.g., reduced engineering time, are much more decisive than 20 percent savings for the engineering software.”

Dr. Thomas Tauchnitz, Engineering Manager, Sanofi-Aventis Germany
## Agenda

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COMOS, XHQ and PCS 7 support Asset Performance Management to gain reliability improvements

B 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
3. Siemens Cloud for Industry – Infrastructure for cloud applications / services
4. Control Performance Analytics Service – Control / optimization of controllers as a service
5. Walkinside – 3D visualization / virtual reality

Chemical plant

Presentation Instruction:
Adapt with adequate Vertical Picture (see selection)
## Agenda

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Virtual commissioning to ensure reduce commissioning time and delays on site

Use Case → Simulation and Virtual Commissioning

Virtual commissioning...
Test and debug systems independently from situation on site, e.g., if equipment is supplied by multiple suppliers

→ Pre-check interfaces between trades
→ Minimize expensive trouble shooting on site

...enabled by Siemens systems

1 SIMIT – Simulation of processes and plant
   • Simple cause / effect matrix to complex processes
   • Virtual controller
   • Extendible to operator training system

2 SIMATIC PCS 7 – Scalable DCS
   • Bi-directional and pre-configured interface to SIMIT and S7 PLC
   • Bulk engineering
   • Standard libraries

3 Glass plant

Key portfolio elements

1 Plant / process simulation
2 Distributed Control System
3 Standardized libraries
4 Controls (PLC)

4 PCS 7 CPU or S7 PLC with interface to PCS 7
# Agenda

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3D visualization enables off-site training and improves maintenance efficiency

Use Case → Simulation and Virtual Reality

Powerful 3D visualization

3D visualization for more efficient project management
- Share up-to-date 3D models to improve communication
- Train in real-life scenarios w/ immersive Training Simulator (ITS)
- Effective simulate, plan and execute maintenance tasks

Key portfolio elements

1. 3D Design Review
2. 3D Immersive Operator Training
3. 3D Maintenance Planning & Simulation

...enabled by Siemens offerings

1. COMOS Walkinside – Builder
   Automatic creation of a complete 3D virtual model

2. COMOS Walkinside – Viewer
   Fast rendering of even the largest 3D CAD models

3. COMOS Walkinside – Immersive Training Simulator (ITS)
   for asset-related trainings through remote instruction

4. COMOS Walkinside – Server
   Highest visualization and navigation performance
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Effectively working with specifications reduces administrative work and costs for the management claims

**Use Case → Specification Management**

**Effectively working with specifications…**

Common infrastructure for specification management and product development
- Services day-to-day operational needs on both corporate and plant level
- Support strategic development of the overall material and product portfolio

**…enabled by Siemens offerings**

**SIMATIC IT R&D Suite – Specification Management**
- Develop and manage all specifications and formulas
- Include additional data (e.g., legal, quality)
- Powerful formula workbench to design and optimize formulas
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Unchain operators and maintenance staff and ensure product quality through Mobile Devices

Use Case → Mobile Devices in Maintenance and Operations

Improved mobility...

Seamless combination of central and local tasks through full system access from mobile platforms up to EX-zone 1
- Full process control information while executing tasks in the plant
- Local access to all information, e.g., quality management systems
- Tracking of tasks and reduced paper documents

Key portfolio elements
1. WLAN infrastructure and mobile devices
2. Access to process operation systems
3. Access to QM/LIMS system (quality-related tasks / data)
4. Access to maintenance systems (asset information)
5. Support for identification

...enabled by use of mobile devices

1. SCALANCE W – Reliable mobile communication via WLAN
2. SIMATIC PCS 7 – Operation from tablets and web (or RDP) clients
3. SIMATIC IT Unilab – LIMS guarantee product quality, identify improvements
4. COMOS Portable – Transfer of maintenance orders to mobile device
5. SIMATIC IDENT – Code reading system
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Improve Operator and Control Performance to optimize processes and operations

Use Case → Process and Operations Optimization: Operator and Control Performance

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.** Operator assistance (e.g., Process Diagnostics or Condition Monitoring)
   - **c.** Improved **process control**
   - **d.** **Remote operation**

2. **Good closed loop control performance**

...enabled by Siemens systems and services

1. **SIMATIC PCS 7**
   - **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. **Control Performance Analytics**
   - Control / optimization of controllers as a service
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

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

**Local OS clients in local control room**

**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
Automation and paperless manufacturing as basis for the future of pharmaceutical manufacturing

Use Case → Process and Operations Optimization: Top Ten European Manufacturer

**Initial situation**

- **Challenges**
  - Working with novel technologies incorporated in existing and new IT systems
  - Process robustness and visibility of process data
  - Continuous tableting process with focus on automation, analytics and informatics

- **Value Proposition**
  - User centered design
  - Reduced manual interventions and operator complexity
  - Optimized and secure operations
  - Reduced quality review time
  - Batch to batch consistency

**Actual status**

- **Teamcenter**
- **Integrated portfolio: Future of pharmaceutical manufacturing**
- **PCS 7**
- **SIPAT**
- **XHQ**
- **Preactor**
- **SIMATIC IT eBR**

**Strategic collaboration** for development of future manufacturing concept

- Develop and construct automated and paperless manufacturing concept for pharmaceutical production
- SIMATIC IT eBR, PCS 7 and SIPAT as core products
# Agenda

## Use cases

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Flexible production helps to optimize time to market

**Use Case → Flexible Production**

**Flexibility in production …**

Reduced time from design to production with
- Seamless integrated dataflow, paralyzed workstreams and integrated quality for design, engineering and simulation
- Close link between digital factory and real production
- Plant modularization

...enabled by Siemens offerings

1. **SIMATIC IT Interspec**
   - to define BOM, BOR, BOP
2. **COMOS**
   - digital engineering and simulation
3. **SIMATIC IT** and **Preactor**
   - link digital and real world for seamless integration of data flow
4. **Modularization**
5. **SIMATIC IT Unilab**
   - to guarantee product quality and reflect results for further improvements on design

---

**BOM:** Bill of materials  
**BOR:** Bill of resources  
**BOP:** Bill of processes

Frei verwendbar © Siemens AG 2015
New ways to stable Bioprocesses

**Use Case** → Flexible Production: Research consortium, top companies and institutes

### Initial situation

**Challenges**
- Batch release after quality control
- Fixed, predefined production parameters
- No continuous improvement processes
- Loss of complete batches

**Value Proposition**
- From batch to continuous production
- Quality verification (100%) for real time release
- Understanding linkage between parameters influencing product quality
- Closed process (less risk, safer)

### Actual status

**Stable bioprocess**
- High process safety
- Stable product quality
- Sustainable
- Environmental aspects

**Innovations**
- New, innovative process sensors
- Intelligent networks of sensors
- Process analytical technology (PAT)

---

**What happens in the Process?**

- Raw material entry
- Feed forward control
- Feed backward control
- Product outlet
## Agenda

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Integrating manual and automated operations to achieve “true paperless manufacturing”

**Use Case → Paperless Manufacturing**

**Paperless manufacturing...**

Manufacturing Operations Management (MOM) portfolio integrated with SIMATIC PCS 7:
  - Native integration with control layer
  - Single interface for process engineering, operations and review
  - Single point for review of alarms, events and reports

**Key portfolio elements**

1. **Manufacturing Execution System**
2. **DCS**
3. **Advanced Planning and Scheduling**
4. **Laboratory Information Mgmt. System**
5. **Industrial Identif.**

**...enabled by Siemens offerings**

1. **SIMATIC IT eBR – MES for regulated industries**
   with interfaces to ERP and automation systems and electronic work instructions and graphical workflow
2. **SIMATIC PCS 7 – Scalable DCS System**
   with standardised pharmaceutical specific libraries
3. **SIMATIC IT Preactor – Planning & Scheduling**
   real-time and advanced; with finite capacity scheduling
4. **SIMATIC IT Unilab – Maximized Lab Efficiency**
   with at-line, on-line and off-line quality checks
5. **SIMATIC RFID – Reader and Tags**
Paperless manufacturing helps to create a digital plant for personalized immunotherapies

Use Case → Paperless Manufacturing: Biotech

Initial situation

Challenges
- Complex manufacturing process with numerous parameters to track and record
- Information spread in different IT systems
- Time consuming manual data transfer between systems

Value Proposition
- Central access point for data
- Avoid manual data transfer
- Enable faster review
- Eliminate paper-based batch reports
- Provide intelligent guidance and planning throughout the process

Actual status

- Strategic collaboration
- Development and construction of automated and paperless manufacturing site
- Integration of all necessary process and production steps

Goal: Personalized medicine

“We are pleased to partner with Siemens on automating a specialized, proprietary manufacturing process for truly personalized medicine. Siemens’ world-class expertise in engineering and optimizing automatic manufacturing processes will be of great value in making personalized cancer treatment for patients available to all.”

Chief Executive Officer and Founder
## Agenda

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Real Time Product Release (RTPR) through increased process understanding

Use Case → Real Time Product Release

Real Time Product Release (RTPR)

Real time Product Release realized through introduction of Process Analytical Technology (PAT)
- Real-time measurement of Critical to Quality Attributes (CQA’s)
- Monitor and control CQA’s during complete production cycle
  → Faster release to the market (no end product quality testing required)
  → Expected quality level assured based on electronic data

Key portfolio elements
1. Process Analytical Technology
2. DCS
3. Laboratory Information Management

...enabled by Siemens offerings

1. SIMATIC SIPAT – Key enabler for RTPR
   - Integrated platform for real time PAT management
   - Spectral analyzers and chemometrical tools included

2. SIMATIC PCS 7 – Model Predictive Control (MPC)
   + classical closed control loop

3. SIMATIC IT Unilab – Laboratory Information Management System (LIMS)

PAT: Process Analytical Technology
CQA: Critical to Quality Attributes
RTR: real-time release
MPC: Model Predictive Control
Continuous Oral Solid Dosage (OSD) line with direct compression is leading reference for continuous manufacturing

Use Case → Real Time Product Release: *Top Ten Pharmaceutical Manufacturer*

### Initial situation

- **Challenges**
  - Continuous manufacturing for the first time
  - Coordination of assembled unit operations into continuous setup
  - Material tracking to link input materials to end products

### Value Proposition

- Realize continuous quality verification
- Enable real time product release
- Shorten time to market for existing products
- Right first time production
- Smaller footprint and reduced waste

### Actual status

**Leading reference for continuous manufacturing:**
Continuous solid dosage manufacturing area

**PAT enabled CENTRAL CONTROL SYSTEM:**
- SIMATIC SIPAT
- SIMATIC PCS 7

---

**Use Case** → Real Time Product Release: Top Ten Pharmaceutical Manufacturer

**Challenges**

- Continuous manufacturing for the first time
- Coordination of assembled unit operations into continuous setup
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**Leading reference for continuous manufacturing:**
Continuous solid dosage manufacturing area

**PAT enabled CENTRAL CONTROL SYSTEM:**
- SIMATIC SIPAT
- SIMATIC PCS 7
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Enhancing supply reliability and efficiency through a SMART Water Management System

Use Case → Smart Water Management System

SMART Water Management System

Intelligent analysis enabled through hydraulic modeling, data analytics and machine learning algorithms for
- Analysis and forecast of water consumption
- Water balance calculation
- Leak detection and localization
- Network forecast
- Optimization of operations

Key portfolio elements

1. Software Solutions
2. SCADA / DCS
3. Process Instrumentation
4. Communication

...enabled by Siemens offerings

1. SIWA Software Solutions
   - Optimized resource management
   - Reduced non revenue water

2. SIMATIC Automation Systems
   - Integration in the SIMATIC for command and control of water network

3. SCALANCE Communication
   - Maximum network transparency
   - Real time data transmission
## Use cases

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Global program to ensure comprehensive industrial security program at more than 600 production site of Linde Gas

Use Case → Plant Security Services: 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)
Thank you.