Digitalization in Food & Beverage

Siemens Vietnam
Automation Day 2019

Tran Trung Hieu

© Siemens AG 2017   Grand Mercure Hotel, Danang City, 31ˢᵗ of May   siemens.com

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1

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Digitalization changes everything

The next trillion dollars will be earned with data – for our customers and for our industries.

Michael Dell, founder of Dell Inc.

Digital is the main reason just over half of the companies on the Fortune 500 have disappeared since the year 2000.

Pierre Nanterme, CEO Accenture

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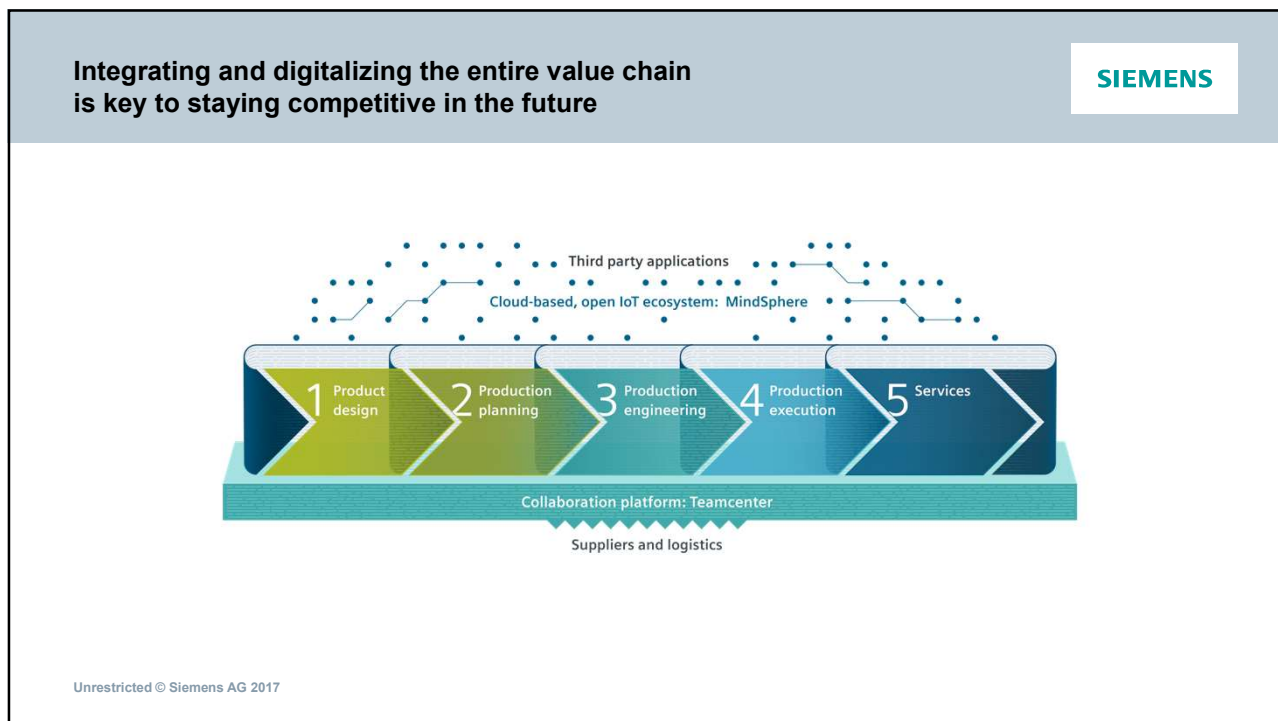Clothing, food, automotive

Mass customization

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„We have a very clear growth target. The result is that we want a system that can be retro-fitted quickly and can produce different variations, doing so in such large amounts that we can cater to the mass market."
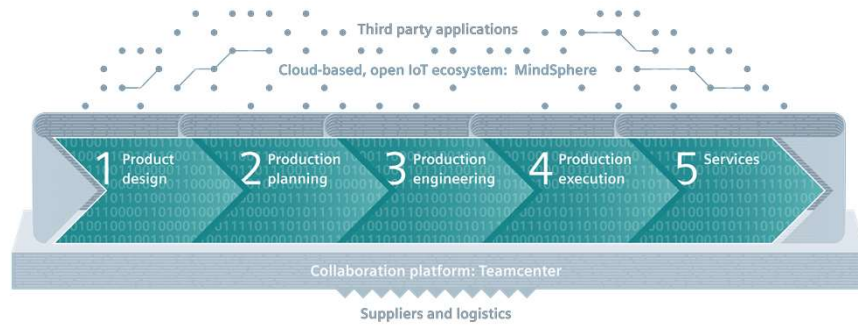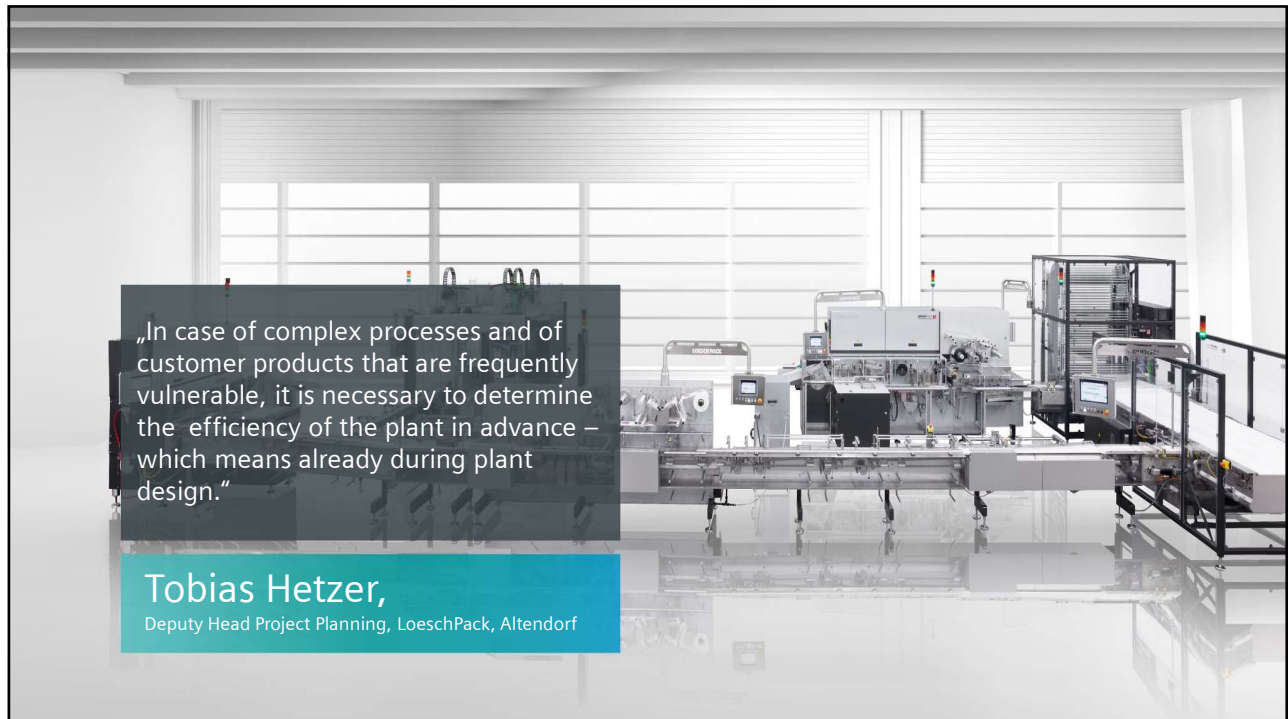
Dr. Martin Strampfer
Dr. Kurt Wolff GmbH & Co. Kg

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Integrating and digitalizing the entire value chain is key to staying competitive in the future

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Third party applications

Cloud-based, open IoT ecosystem: MindSphere

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

Collaboration platform: Teamcenter

Suppliers and logistics

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Integrating and digitalizing the entire value chain is key to staying competitive in the future

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Third party applications

Cloud-based, open IoT ecosystem: MindSphere

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

Collaboration platform: Teamcenter

Suppliers and logistics

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„In case of complex processes and of customer products that are frequently vulnerable, it is necessary to determine the efficiency of the plant in advance – which means already during plant design."

Tobias Hetzer,
Deputy Head Project Planning, LoeschPack, Altendorf

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Integrating technical domains into ONE data model

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Digital Twin of the product

Digital Twin of the production process
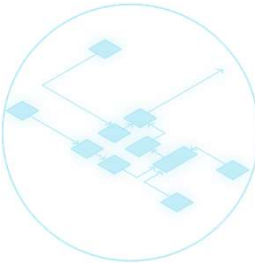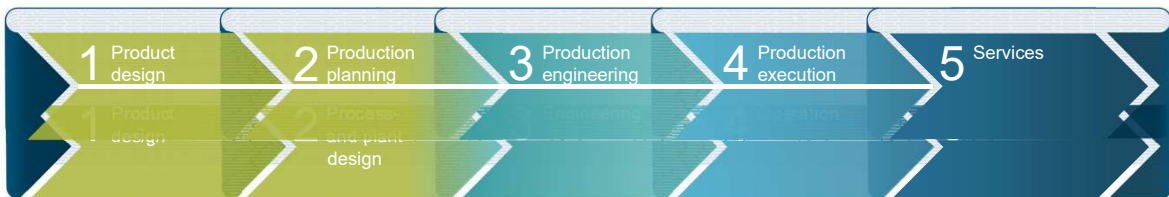
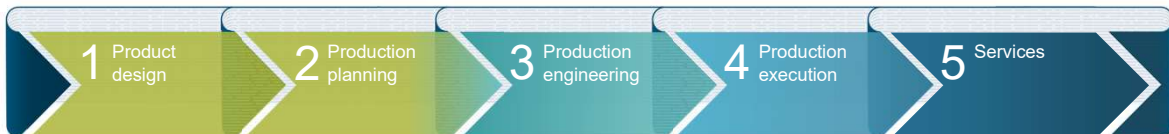**Digital Twin of the equipment**
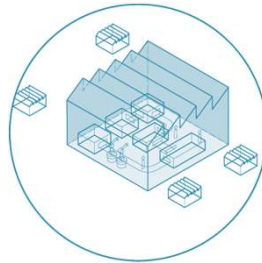
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Our holistic approach in Food & Beverage
Specific for process and discrete part of the digital enterprise

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1 Product design

2 Production planning

3 Production engineering

4 Production execution

5 Services

1 Product design

2 Process- and plant design

3 Engineering

4 Automation

5

Discrete value chain

1 Product design

2 Production planning

3 Production engineering

4 Production execution

5 Services

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Digitalization in Food & Beverage
Product Design

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

Formula Design
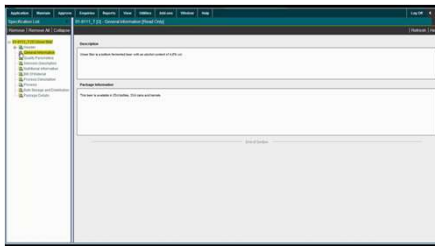
Package Design
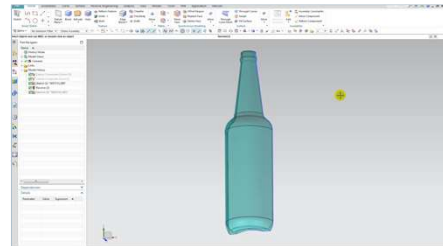
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Digitalization in Food & Beverage
Production Planning

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

Modeling the
production facility
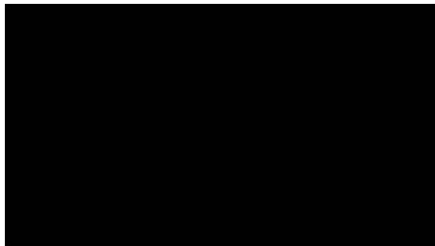
Planning the
filling & packaging line
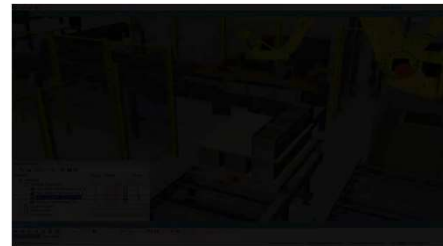
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Digitalization in Food & Beverage
Production Engineering

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

**Automation design
of the process**

Instrumentation
Integrated EI&C planning
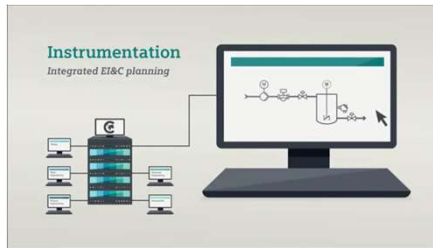
**Automation design
of the filling & packaging line**

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Production Execution

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

**Order download &
scheduling**
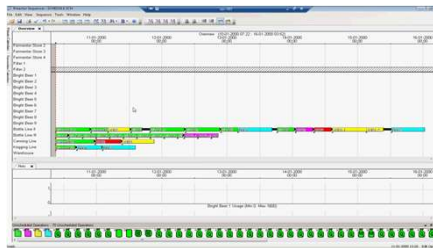
**Line management &
optimization**

Filling line 1
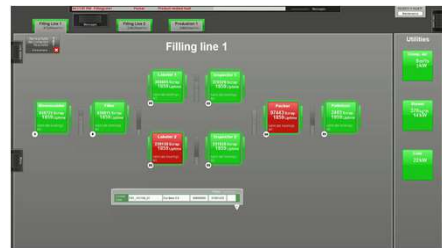
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Digitalization in Food & Beverage Service

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

Mindsphere
Energy Analytics
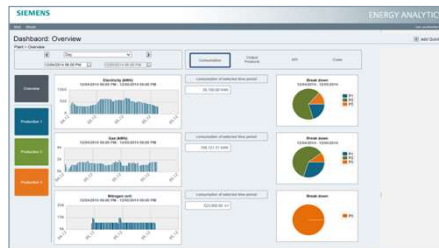
Mindsphere
Smart Condition Monitoring

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Digital Enterprise Suite –
Siemens' answer to customer requirements

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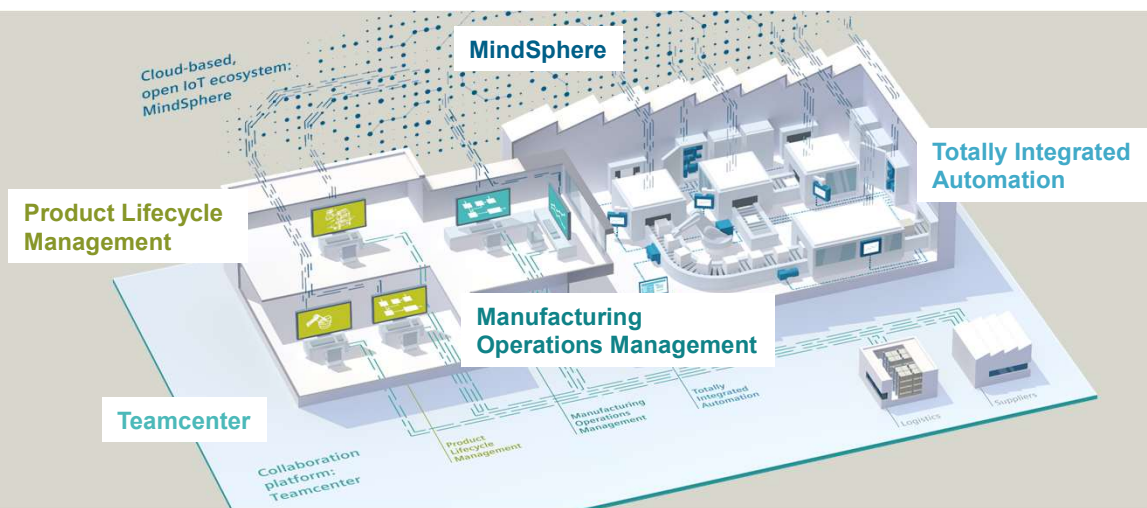
MindSphere

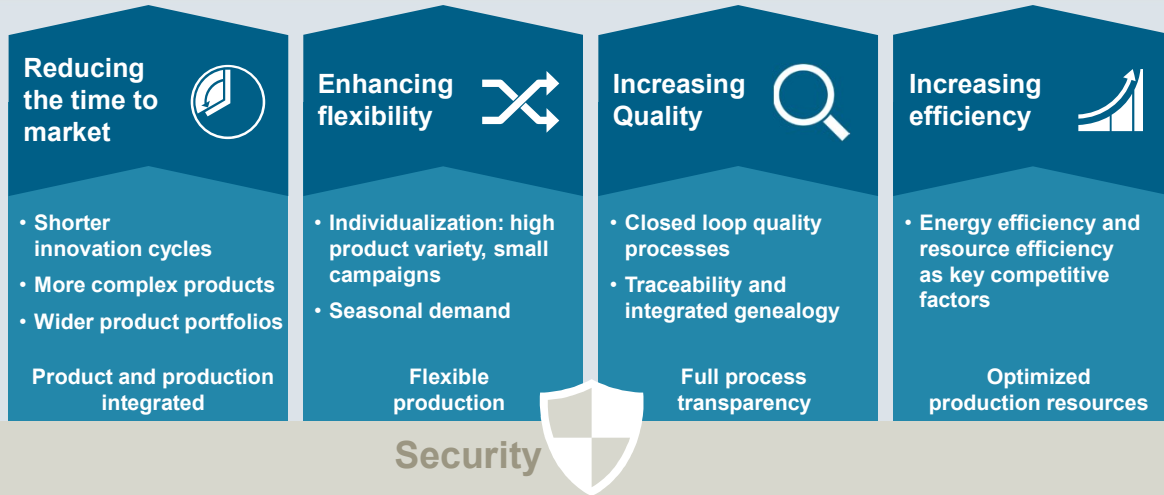Cloud-based, open IoT ecosystem: MindSphere

Totally Integrated Automation

Product Lifecycle Management

Manufacturing Operations Management

Teamcenter

Collaboration platform: Teamcenter

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Digital Workflow
Virtual Commissioning

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Virtual commissioning lowers the risks for real commissioning

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Without virtual commissioning
Unexpected problems increase

Time requirements

Personnel requirements

Materials requirements

And this for
international projects ...

= incalculable costs

With virtual commissioning
Problem scenarios are known

Best case: Cause of error
already eliminated

Solution strategies
already developed

Personnel are
trained accordingly

Replacement material is at
the ready

= calculable costs

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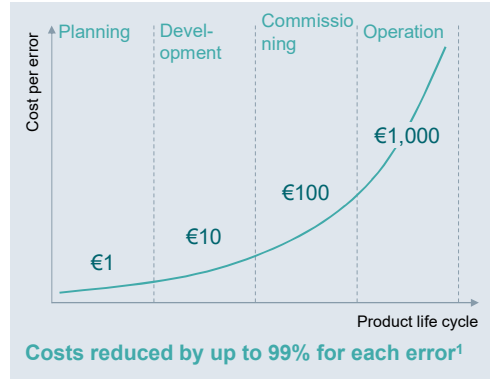## Simulation allows errors to be identified early in the product life cycle

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Six Sigma/
Quality rule
Rule of ten

»The rule of ten states that error-related costs for an unidentified error increase by a factor of 10 from one value-added level to the next. The earlier an error is identified and corrected, the cheaper this is for the organization. (…)«

Planning | Devel-opment | Commissio-ning | Operation

Cost per error

€1,000

€100

€10

€1

Product life cycle

Costs reduced by up to 99% for each error[1]

Conclusion – The quality of the engineering project must be increased as early as possible in the product life cycle!

1 This assumes that the error would otherwise not be detected until operation

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Virtual commissioning permits working in parallel and thus a shorter time to market

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Time-to-market

+ Shorter time-to-market

Engineering

VC

Production area

Concept | Mechanical construction | Automation | Mechanical design | Automation | Real commissioning | Production

Mechanical construction

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»Virtual commissioning is beneficial for us as we are able to test the machine prior to actual commissioning!«

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The virtual environment is dependent upon the respective issue under investigation

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Logic of PLC and HMI control components

Interaction between mechanical and automation system

Interaction of multiple components in a cell, plant or line

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The Siemens portfolio offers solution scenarios for virtual commissioning for all analysis stages

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Digitization readiness

Complexity and planning reliability

Validation of control logic, as well as visualization

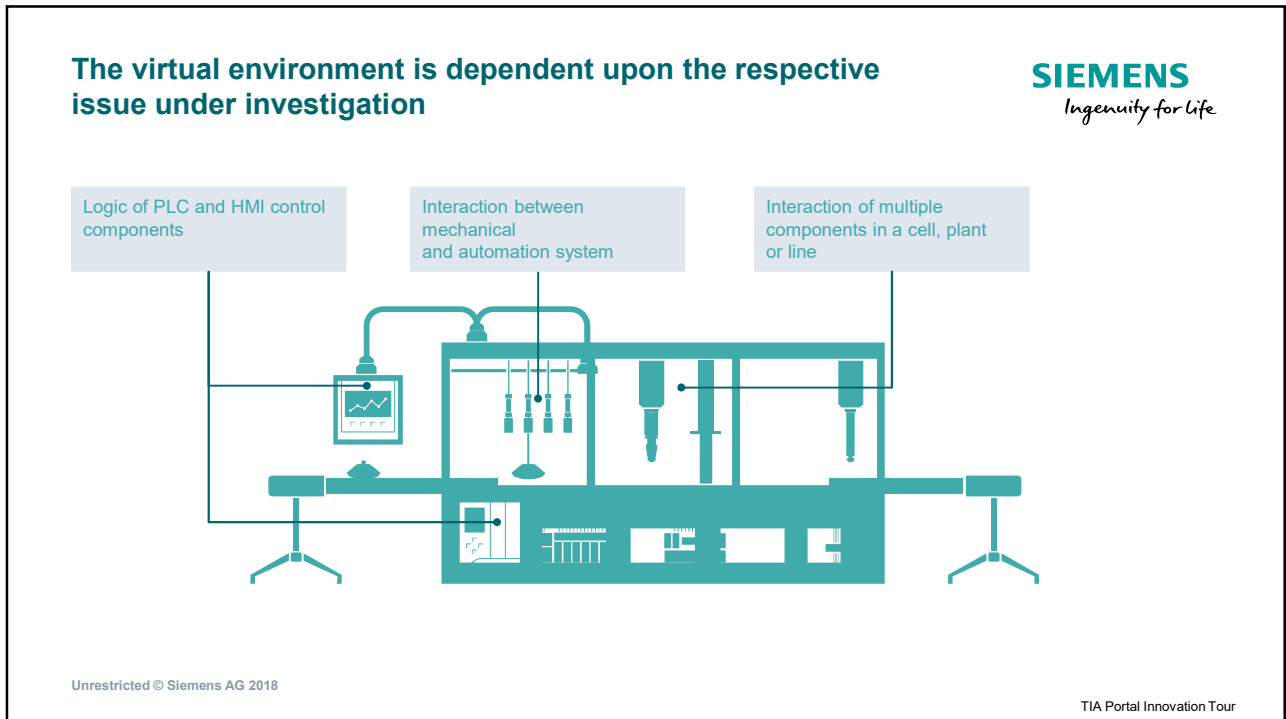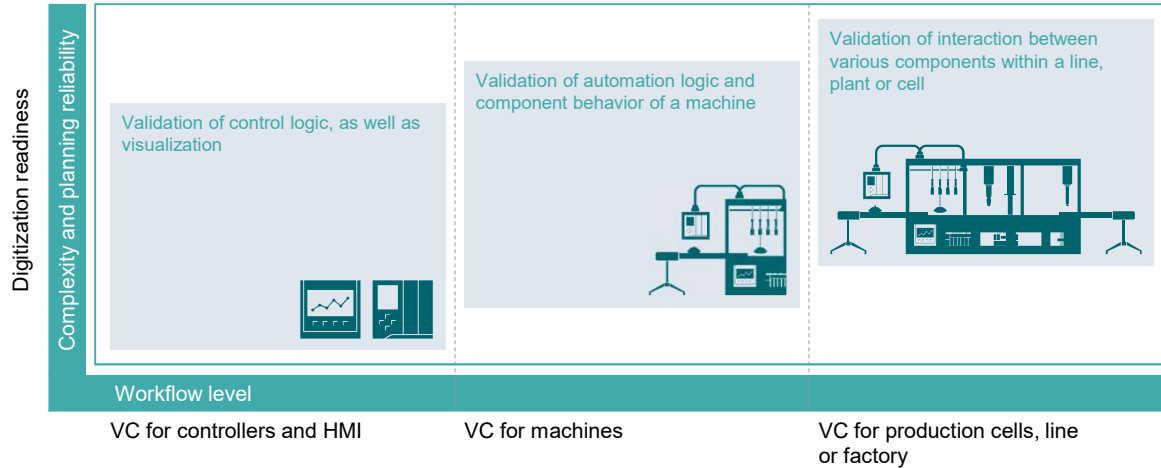Validation of automation logic and component behavior of a machine

Validation of interaction between various components within a line, plant or cell

Workflow level

VC for controllers and HMI

VC for machines

VC for production cells, line or factory

Digitization readiness

Complexity and planning reliability

Validation of control logic, as well as visualization
- PLCSIM
- PLCSIM Advanced
- TIA Portal HMI simulation

Validation of automation logic and component behavior of a machine

Validation of interaction between various components within a line, plant or cell

Workflow level

VC for controllers and HMI

VC for machines

VC for production cells, line or factory

SIMATIC PLCSIM Advanced is the virtual controller of SIMATIC S7-1500

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### A virtual control system ...

… for comprehensive simulation of functions, including communication, know-how protected blocks, safety and web server

Includes a documented public interface …

… for exchange of data (I/Os, bit memory, DBs, timers) with co-simulation or customer-specific test software in C/C++

Support of multiple and distributed instances …

… for simulation of multiple controllers on a PC/in the network

Data | API

S7 communication, OPC UA, Softbus
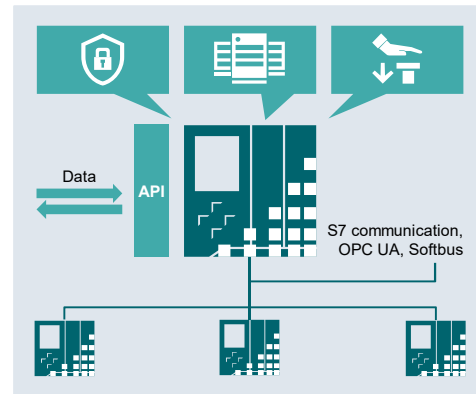
Benefit – Comprehensive simulation of control functionality

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New features of the PLCSIM Advanced V2.0

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Testing of spontaneously occurring errors ...

… through the support of acyclic services and alarms, such as …

- Process interrupts (OB40)
- Status interrupt (OB55)
- Update interrupt (OB56)
- Manufacturer-specific interrupt (OB57)
- Diagnostic interrupts (OB82)
- Removing/inserting (OB83)
- Rack failure (OB86)

Simulation of motion control applications ...

… for verification of the user program, including access to a consistent map of current process signals when calling cyclic OBs …

… through support for synchronization of process image partitions

Reliable testing...

… with improved deterministic response and performance…

... by decoupling from Windows Task Manager

Efficient working...

… due to higher usability such as …

- Parallel installation of PLCSIM and PLCSIM Advanced
- Expansions in the GUI, including auto-completion and new buttons for changing the operating state and memory reset

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Simulation of alarms via the API

Live demonstration

Testing and simulation of HMI projects
in conjunction with a SIMATIC controller and PLCSIM
https://support.industry.siemens.com/cs/de/en/view/109748099

PLCSIM Advanced
Co-simulation with API interface
https://support.industry.siemens.com/cs/de/en/view/109739660

S7UnitTest
Automated testing with SIMATIC S7-PLCSIM Advanced
https://support.industry.siemens.com/cs/de/en/view/109746405

Digitalization with TIA Portal
Virtual commissioning with SIMATIC and Simulink
https://support.industry.siemens.com/cs/de/en/view/109749187

PLCSIM Advanced V2.0 – License concept
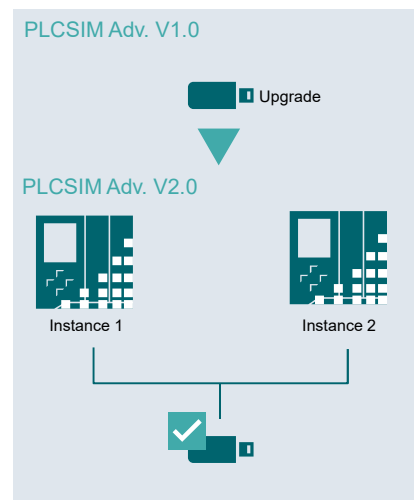
Overview of licensing concept

NEW

- PLCSIM Advanced can be upgraded to the latest version
- One license activates up to two PLCSIM Advanced instances on one PC

License options
- Floating License
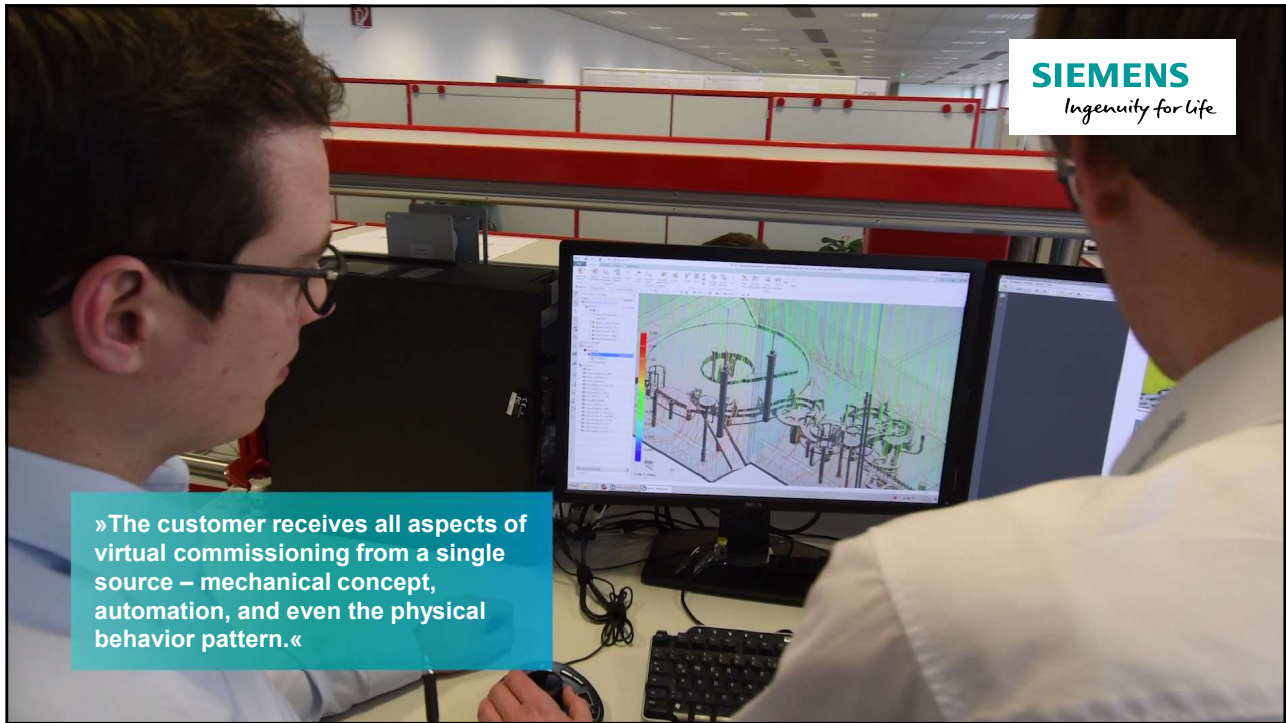- Trial – 21-day trial available for download
  https://support.industry.siemens.com/cs/de/de/view/109745647

PLCSIM Adv. V1.0

Upgrade

PLCSIM Adv. V2.0

Instance 1   Instance 2
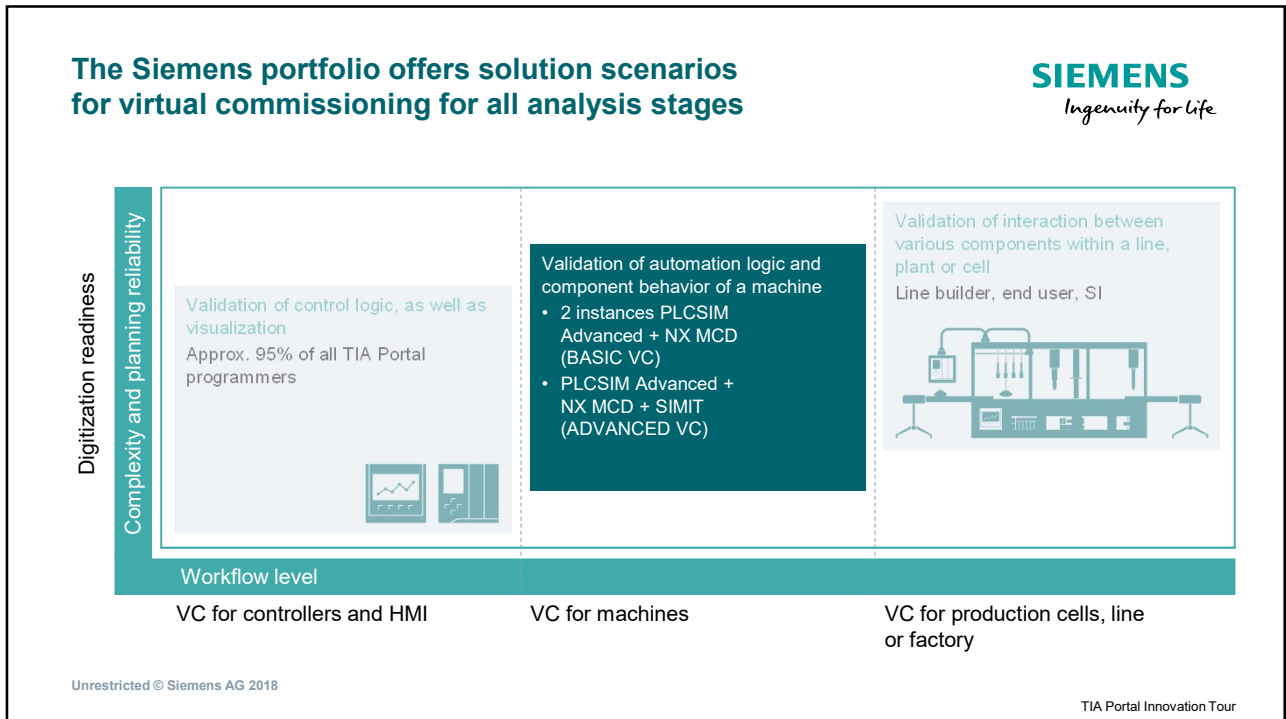
»The customer receives all aspects of virtual commissioning from a single source – mechanical concept, automation, and even the physical behavior pattern.«

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The Siemens portfolio offers solution scenarios for virtual commissioning for all analysis stages

Digitization readiness

Complexity and planning reliability

Validation of control logic, as well as visualization
Approx. 95% of all TIA Portal programmers

Validation of automation logic and component behavior of a machine
- 2 instances PLCSIM Advanced + NX MCD (BASIC VC)
- PLCSIM Advanced + NX MCD + SIMIT (ADVANCED VC)

Validation of interaction between various components within a line, plant or cell
Line builder, end user, SI

Workflow level

VC for controllers and HMI   VC for machines   VC for production cells, line or factory

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The virtual machine model is a combination of different simulation models

Virtual machine model = **Automation model**

Logic of the PLC program and visualization

+ **Electrical model and behavior pattern**

Active components (e.g. drives, valves) and behavior of peripherals

+ **Physical and kinematic model**

Mechanical components

Siemens offers
- One integrated software landscape
- Implemented interfaces to PLCSIM Advanced
- Presales and consulting support

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Depending of the requirement Siemens offers an applicative solution based on a bundle

Applicative approach for basic VC requirements based on PLCSIM Advanced

→ Enables cost effective start with virtual commissioning for SiL approaches based on application example

Advantages
- Only one PLCSIM Advanced license is required
- Connection of two instances is provided via application example
- Behavior modelling in familiar STEP 7 environment

Limitations
- No library for behavior modells available (customer has to spent engineering effort to create behavior modellsdependend of model complexity)
- Limited to SIMATIC S7-1500 applications
- STEP 7 behavior models can't be migrated to SIMIT

Product offering for advanced VC requirements based on SIMATIC Machine Simulator

→ Enables comprehensive and scalable virtual commissioning solutions for SiL and HiL approaches for basic to complex validation requirements

Advantages
- One comprehensive VC solution with presales and service support
- Libraries for behavior models are available
- Scalable and flexible solution due to scalability and interfaces of SIMIT

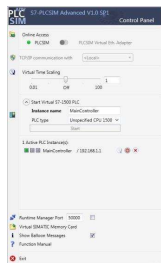**Planned release V1.0: June 2018**

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SIMATIC Machine Simulator in combination with NX MCD enables virtual commissioning for machines
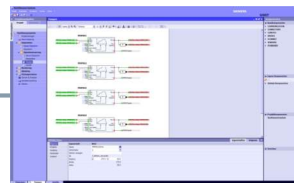
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1 Control emulation
with PLCSIM Advanced
- Interface of I/O scan to behavior model
- Output of motion position/speed
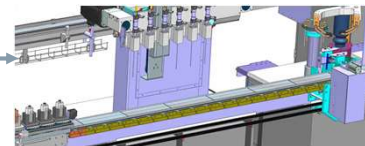- Time management
- Common startup/shutdown/ failure handling

2 Behavior model
with SIMIT
- Sensors
- Actuators
- Process features
- Temperature
- Pressure
- Hydraulics
- Pneumatic

3 Kinematic model
with NX MCD
- Motion
- Material flow
- Collision check

- Input/Output
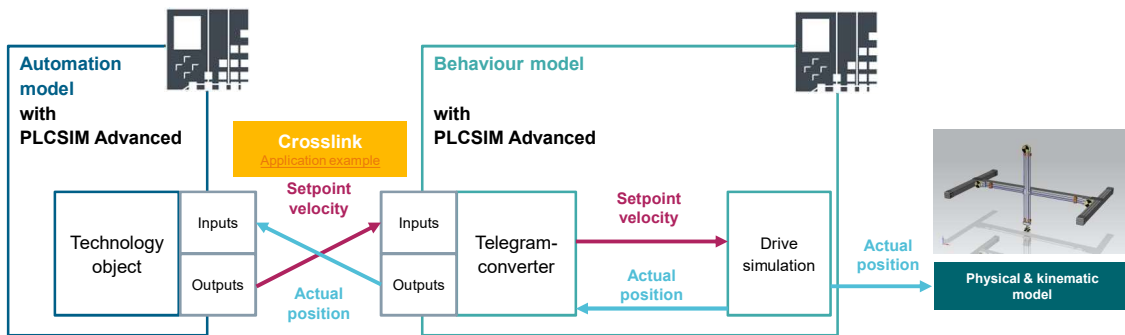- Axis position and speed

Position of axes

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Concept of basic behavior modelling with two PLCSIM Advanced instances

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Example: Validation of motion control functionality

Automation model
with
PLCSIM Advanced

Crosslink
Application example

Technology object

Inputs

Outputs

Setpoint velocity

Actual position

Behaviour model
with
PLCSIM Advanced

Inputs

Outputs

Telegram-converter

Setpoint velocity

Actual position

Drive simulation

Actual position

Physical & kinematic model

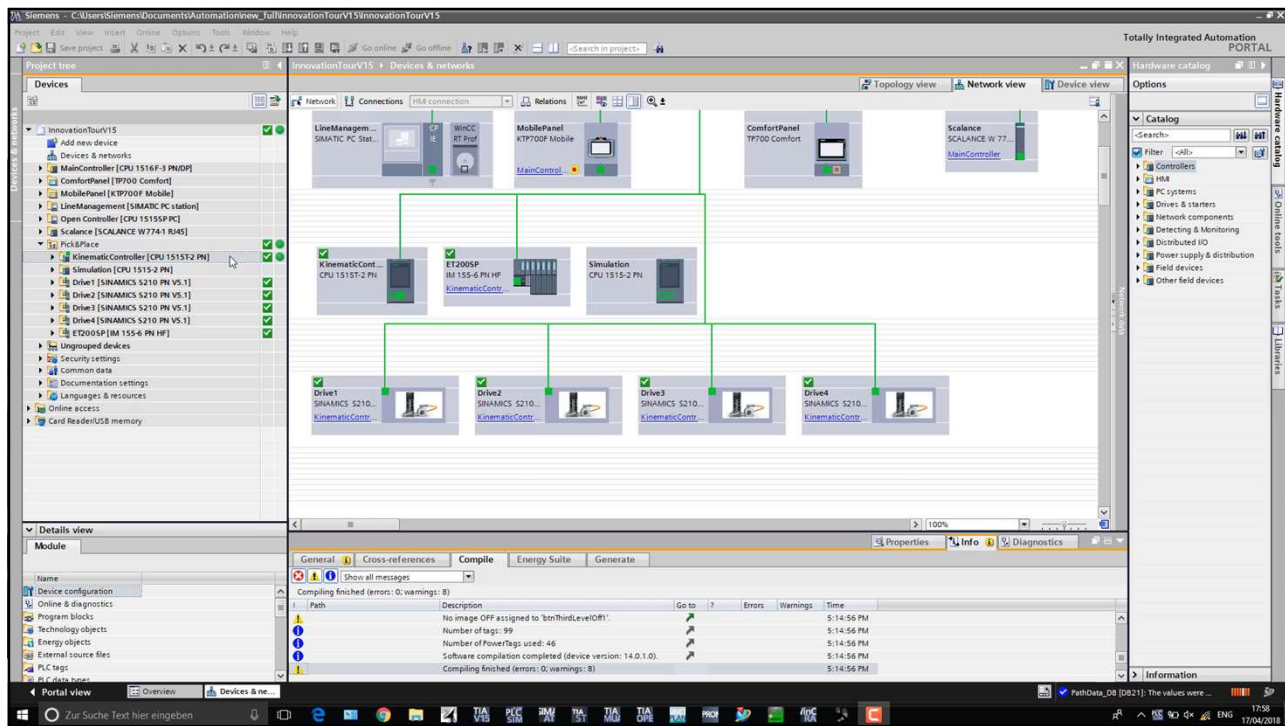- Contains original S7-1500 controller program w/o changes

- Logic of behavior modells must be created by customer **!**
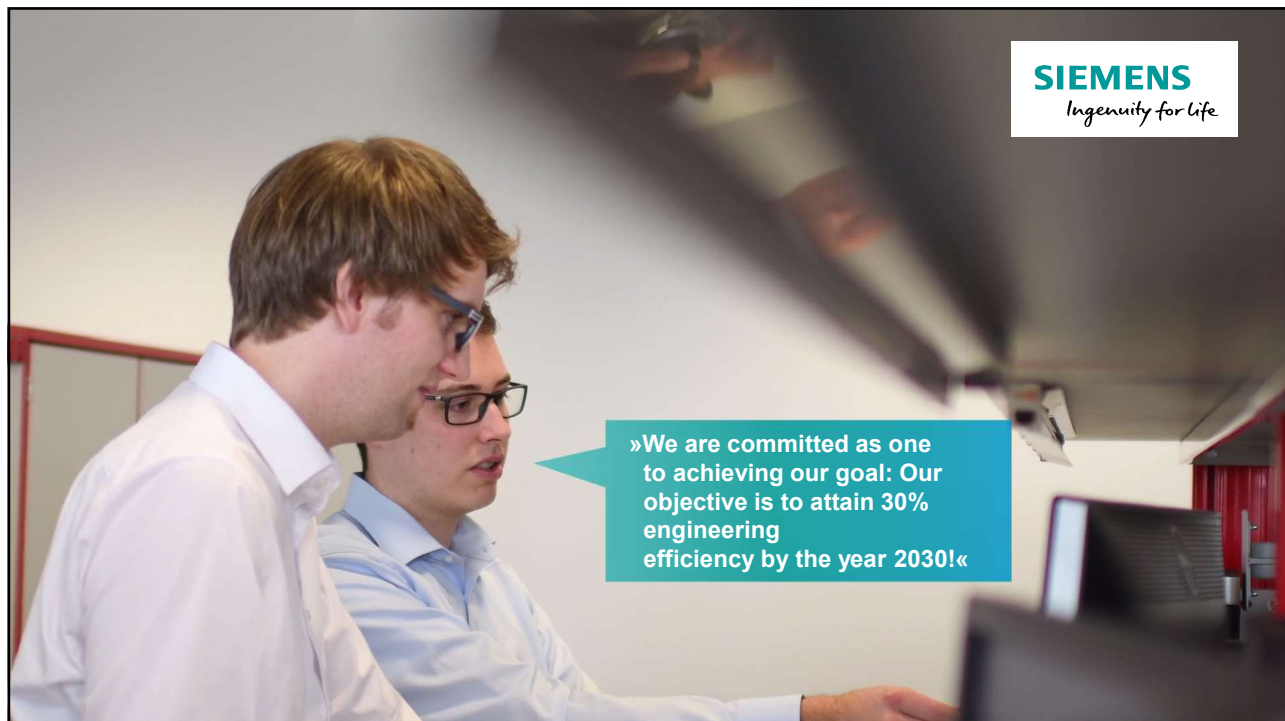
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»We are committed as one
to achieving our goal: Our
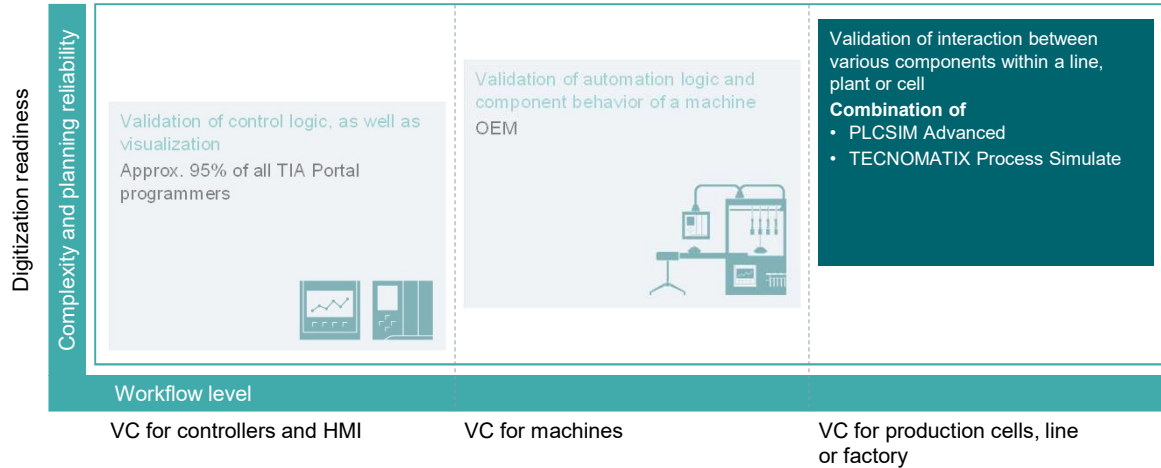objective is to attain 30%
engineering
efficiency by the year 2030!«

The Siemens portfolio offers solution scenarios for virtual commissioning for all analysis stages

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Digitization readiness

Complexity and planning reliability

Validation of control logic, as well as visualization
Approx. 95% of all TIA Portal programmers

Validation of automation logic and component behavior of a machine
OEM

Validation of interaction between various components within a line, plant or cell
Combination of
- PLCSIM Advanced
- TECNOMATIX Process Simulate

Workflow level

VC for controllers and HMI

VC for machines

VC for production cells, line or factory

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Cell validation –
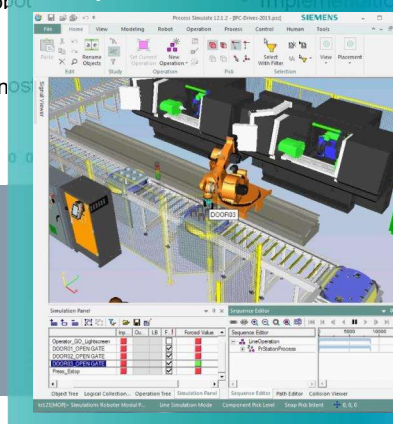## Virtual commissioning with the assistance of »Process Simulate«

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Capabilities
- Validation of mechanical processes
- Verification of the PLC code, robot program and HMIs
- Checking of safety interlock
- Implementation of system diagnosis

Key points
- Development of complete robot programs
- Implementation of »if-then« (potential errors)
- to cell construction

Example of "Process Simulate":

1 0 1 0 1 0 1 1 1 0 1 0 0

1 0 1 0 1 0 1 1 1 0 1 0 0 1 1 0 1

1 0 1 0 1 0 0

1 0 1 0 1 0

0 1 0 0 1 0 0 1 0 1 0

0 1 0 1 1 0 0 1 0 1

0 1 0 1 0 1 1 1 0 1

1 0 0 1

1 0 0 0 1

1 1 1 0 1

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Summary of digital workflow – Virtual commissioning

1 | High quality
… by optimizing the control project and machine functionality in a virtual environment

2 | Speed
… due to shorter commissioning times in the plant and parallel implementation of mechanical and automation engineering

3 | Minimize costs and risks
… through lower commissioning costs and fewer fault conditions in the actual plant

4 | Utmost flexibility
… by way of a »laboratory« for the development of alternative control concepts and the evaluation of changes to the machine during ongoing operation

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Team Innovation Tour

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