Digital Workflow
Virtual Commissioning
TIA Portal Innovation Tour

siemens.com/tia
Digital Enterprise - our portfolio of solutions for the digital transformation

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<tbody>
<tr>
<td>Product design</td>
<td>Process and plant design</td>
<td>Engineering</td>
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Digital Enterprise Software Suite

- Industrial Communication
- Industrial Security
- Industry Services

Digital Enterprise Suite

TIA in the Digital Enterprise
## Horizontal and vertical TIA value chain

Use cases to experience digitalization with TIA Portal

| 1 | Automatic execution of engineering tasks |
| 2 | PLM integration to automation engineering |
| 3 | Efficient cloud based engineering       |
| 4 | Virtual commissioning                    |
| 5 | Integrated Energy Management             |
| 6 | Machine and plant security               |
| 7 | Data acquisition for Cloud Services      |
| 8 | Industrial Communication                 |
| 9 | Line integration                         |
| 10| Integrated engineering of kinematics     |
| 11| Virtual training                         |
| 12| Automation planning                      |
| 13| Collaborative automation design          |
| 14| Edge computing                           |
| 15| RFID-enabled supply chain management     |
| 16| Analysis of drive data                   |

### Third party applications

Cloud-based, open IoT operating system: MindSphere

### Collaboration platform: Teamcenter

- Product design
- Production planning
- Production engineering
- Production execution
- Services

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Reference Videos

**Reference Video**
https://www.youtube.com/watch?v=UhuJS6CAWhs

**Reference Story**

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**Reference Video**
https://www.youtube.com/watch?v=8Qo9CRp659k

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Reference Story
Virtual commissioning lowers the risks for real commissioning

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

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 more cost effective it is for the organization. (...)«

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
Virtual commissioning permits working in parallel and thus a shorter time to market.
Virtual commissioning is beneficial for us as we are able to test the machine prior to actual commissioning!«
The virtual environment is dependent upon the respective issue under investigation

Logic of PLC and HMI control components

Interaction between mechanical and automation system

Interaction of multiple components in a cell, plant or line
The Siemens portfolio offers solution scenarios for virtual commissioning for all analysis stages.

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

**Digitization readiness**

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

**Workflow level**

Validation of automation logic and component behavior of a machine

VC for controllers and HMI

VC for machines

VC for production cells, line or factory

Validation of interaction between various components within a line, plant or cell
SIMATIC PLCSIM Advanced is the virtual controller of SIMATIC S7-1500

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

Benefit – Comprehensive simulation of control functionality
## New features of the PLCSIM Advanced V2.0

**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...

**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
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

Overview of licensing concept
• PLCSIM Advanced can be upgraded to the latest version
• One license activates PLCSIM Advanced instances on your PC

License options
• Floating License
• Trial – 21-day trial available for download https://support.industry.siemens.com/cs/de/de/view/109745647
»The customer receives all aspects of virtual commissioning from a single source – mechanical concept, automation, and even the physical behavior pattern.«
The Siemens portfolio offers solution scenarios for virtual commissioning for all analysis stages.

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

Complexity and planning reliability:
- 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)

Workflow level:
- VC for controllers and HMI
- VC for machines
- VC for production cells, line or factory

Validation of interaction between various components within a line, plant or cell:
Line builder, end user, SI
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
SIMATIC Machine Simulator in combination with NX MCD enables virtual commissioning for machines

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
Virtual commissioning with two PLCSIM Advanced instances and Crosslink

Live demonstration

Virtual Commissioning by basic behavior modeling with SIMATIC S7-PLCSIM Advanced

»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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<td>OEM</td>
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<td>- TECNOMATIX Process Simulate</td>
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Complexity and planning reliability

Workflow level

VC for controllers and HMI

VC for machines

VC for production cells, line or factory
Cell validation – Virtual commissioning with the assistance of »Process Simulate«

Capabilities
• Validation of mechanical processes
• Verification of the PLC code, robot program and HMI
• Checking of safety interlock
• Implementation of system diagnostics

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

Example of "Process Simulate"
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
Singapore Digitalization Demo Room

Looking for the value add and finding #siemens solutions in #digitalization around #TIA and #simatic where #tiaportal connects you to the #future of Automation

Today MM Electrical Merchandising was visiting us in our Singapore office. Together with Bernd Lieberth we could present f.e. the concept for a Digital Twin based on our demo-machine.

Thanks to APS Industrial and especially Rupert Blatch and Kevin Toohey from MM Electrical for being our guest, see you soon!

Thanks for listening

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