TECNOMAITX-Automation device Planning and commissioning

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TECNOMAITX-Automation device Planning and commissioning

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Digitalization changes everything

The next trillion dollars will be earned with data – for our customers and for our industries.对于我们的客户和我们的行业来说，我们将通过数据来赚取数万亿的美元

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 。自2000年以来，《财富》500强企业中有一半以上的企业消失，这其中的主要原因之一就是因为数字化。.

Pierre Nanterme, CEO Accenture

New business models in the internet age are disrupting complete markets
互联网时代的新商业模式正在改变整个市场

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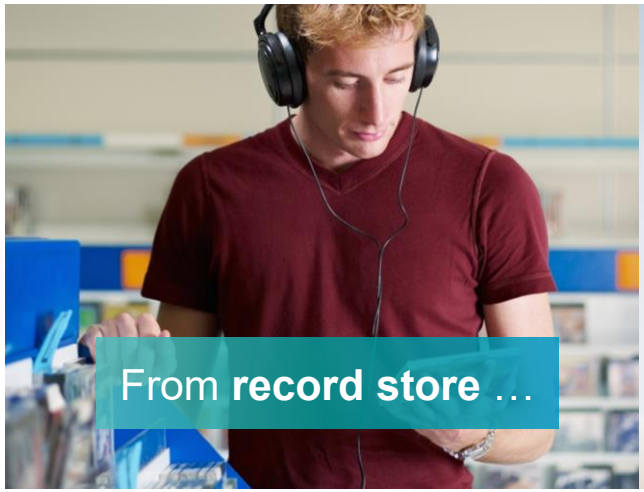

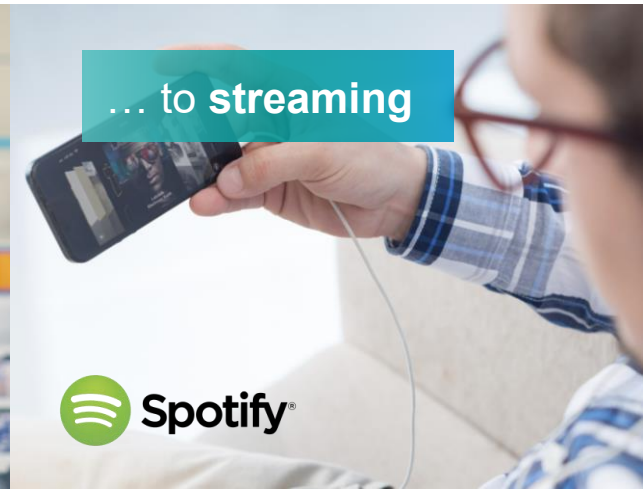

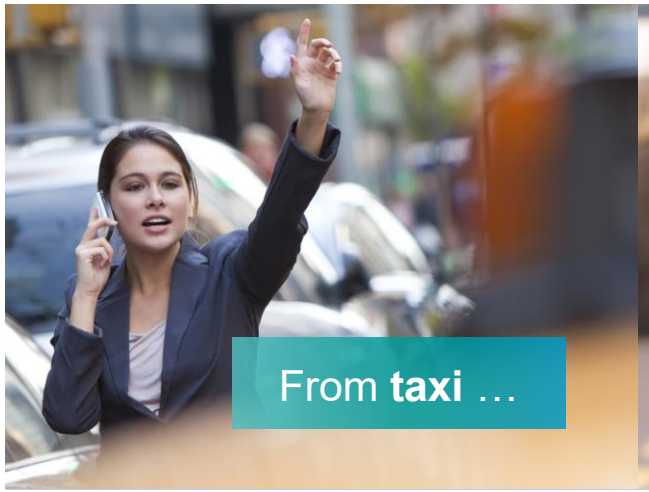

Our customers have essential requirements – throughout the manufacturing industry
客户在整个制造业都有基本要求：

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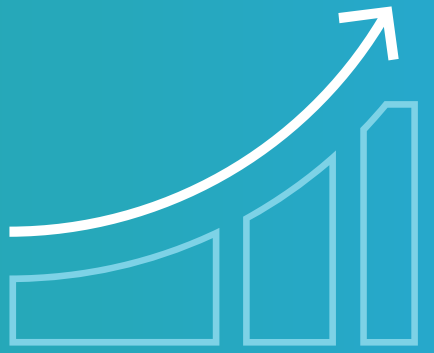
Speed

Flexibility

Quality

Efficiency



Security

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From Design to Simulation

Different phases of the machine or plant lifecycle…
机器设备或工厂生命周期的不同阶段…

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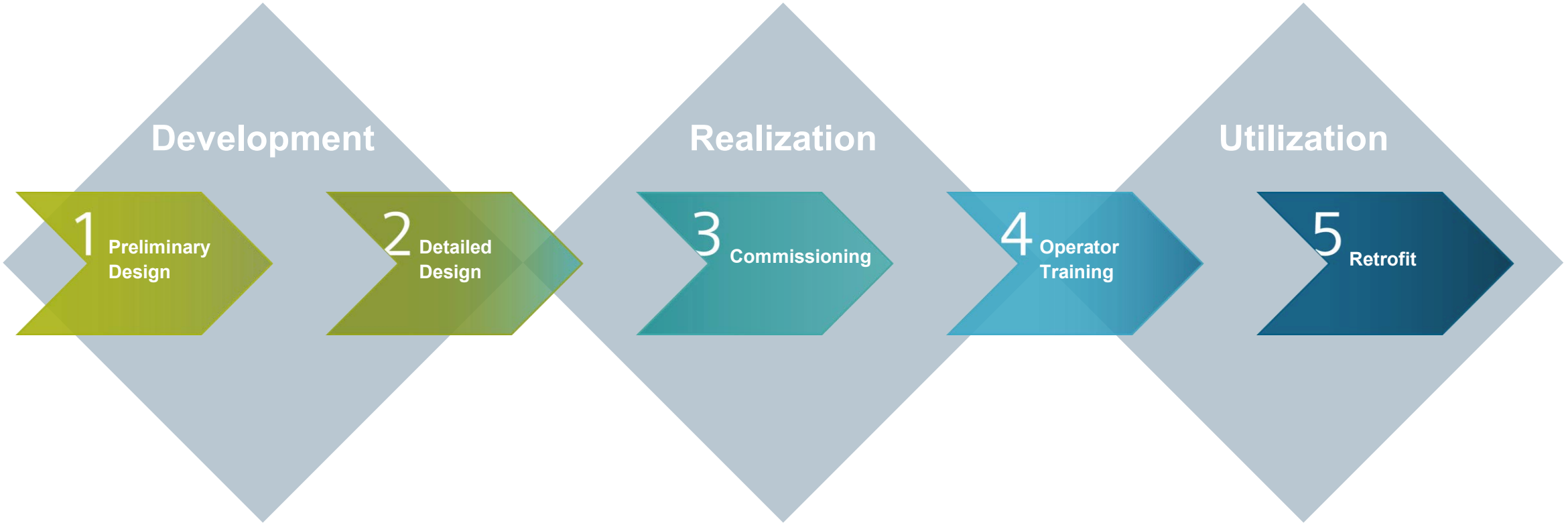

…use a common simulation model…
使用一个通用的仿真模型

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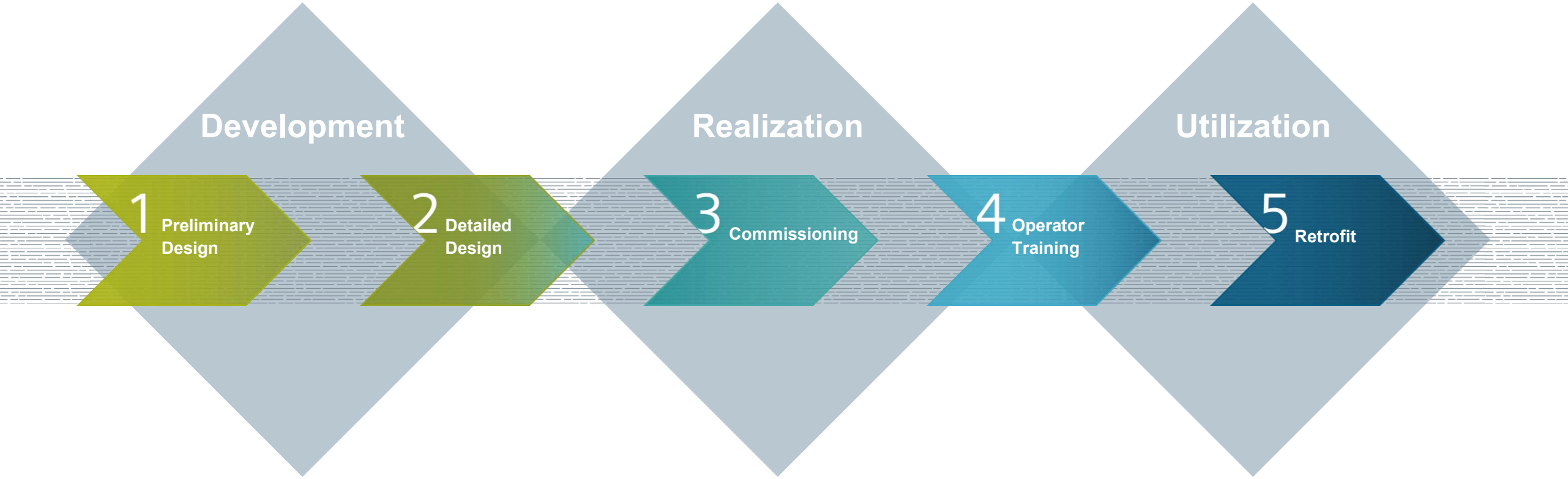

…to shorten development time and increase quality
来缩短开发周期并提升品质

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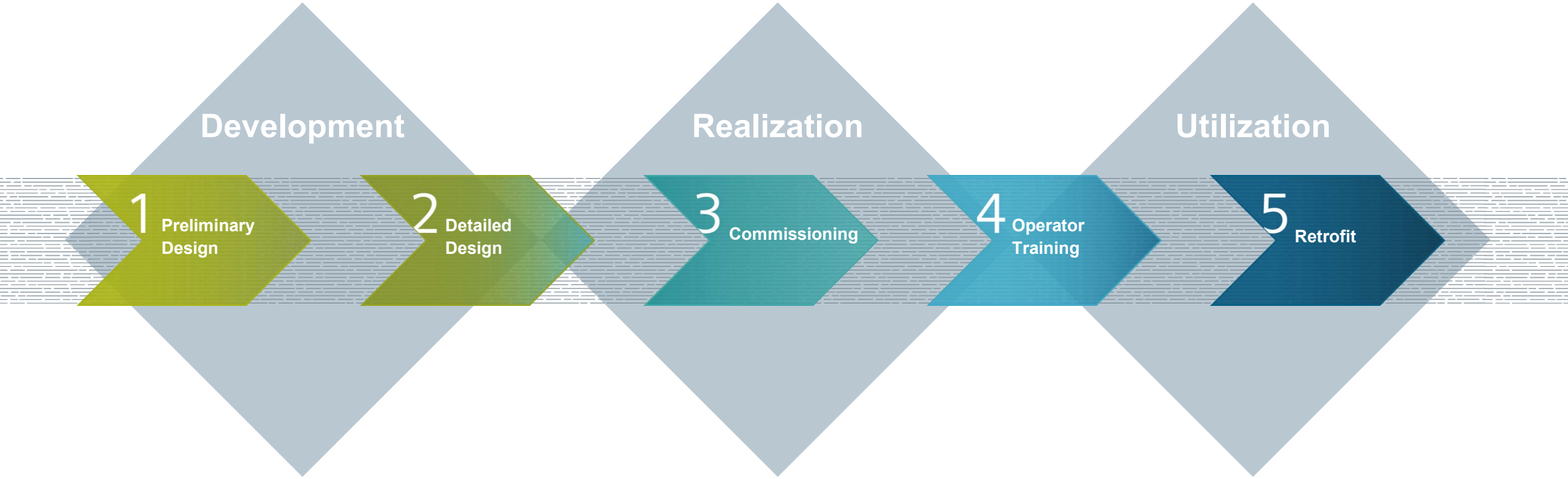

目前产品设计和产品制造- 瓶颈

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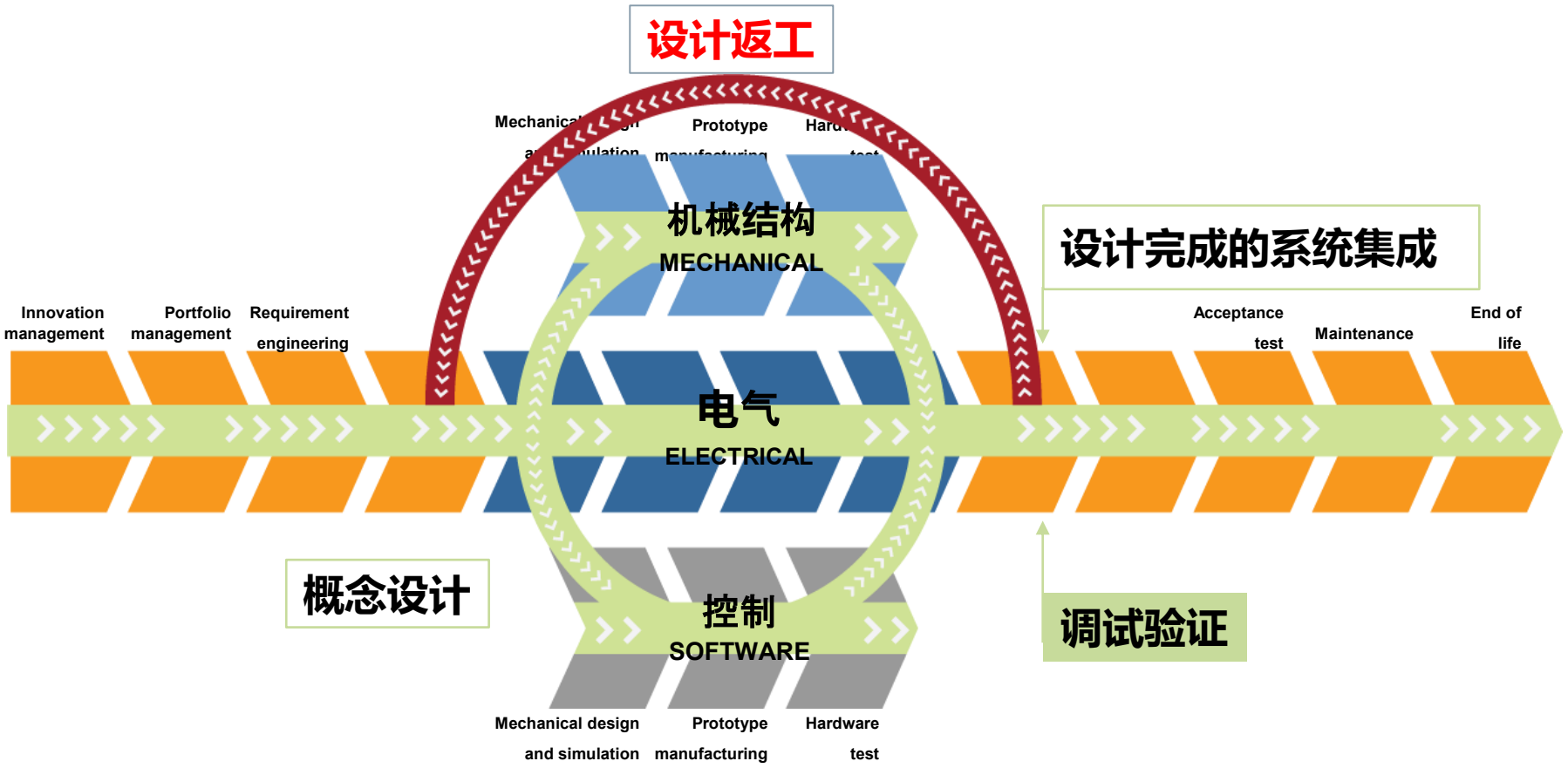

虚拟调试----评估机械和电气系统的匹配

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机械

- 机械运动
- 机器人程序
- 机械顺序
- 布局
- 干涉
- 循环时间

电气

- 输入/输出
- 逻辑
- 互锁
- HMI（人机界面）
- 诊断
- 安全

Process Simulate Robotics and Commissioning

提供一个集成环境来评估机械和电气系统的行为

Simulation at every level 各个层级的仿真

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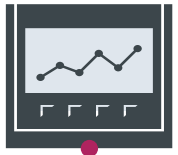
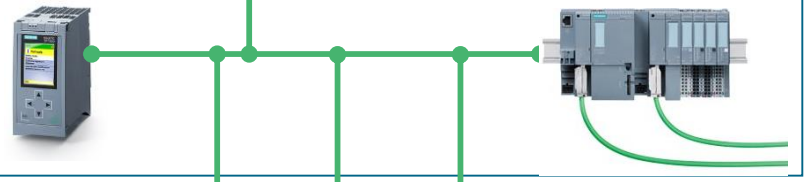
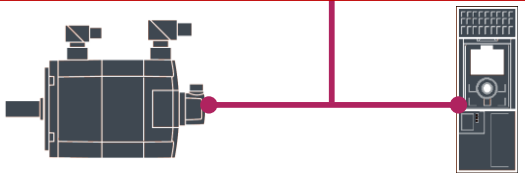
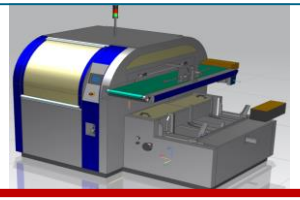
Real World		Virtual World	
HMI		Virtual HMI	
Controller		Virtual Controller	
Sensors & Actuators		Virtual Sensors & Actuators	
Machine Cell Plant		Virtual Machine Cell Plant	

西门子多层次的虚拟调试解决方案

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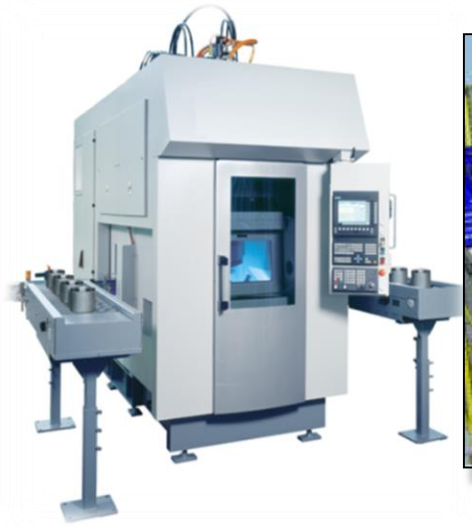
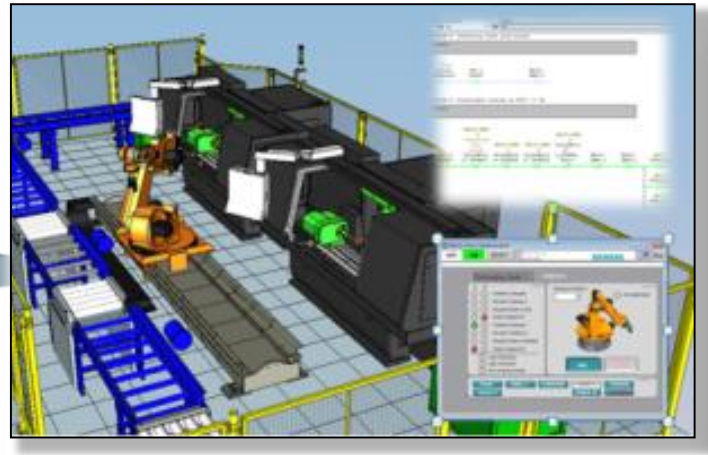
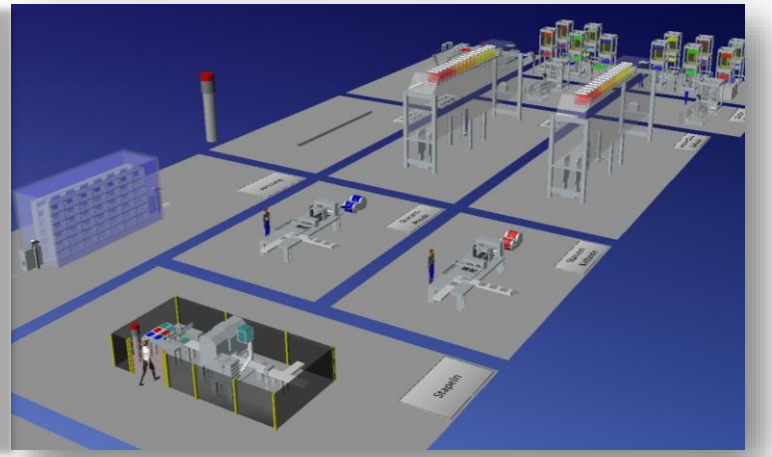
应用范围	应用领域	软件系统
产品研发	机电一体化产品：验证产品功能，是否存在问题，机电匹配	MCD
生产线/生产工位	设备运动机构、机器人等：干涉检查，动作逻辑，机电匹配，机器人时间信号	Process Simulate
工厂/自动化生产线	生产线的逻辑控制：输送系统的仿真、自动化物流系统的仿真	Plant Simulation







Integrated Production Systems Engineering

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Cell / Line Building

Teamcenter Manufacturing

Line Designer integrated in NX

Automation Designer integrated in NX

Totally Integrated Automation Portal

Process Simulate / Plant Simulation / PLCSIM Advanced

Teamcenter

Process planning

Line design

Mechanical design

Automation design

Automation engineering

Virtual commissioning

Reusable components within mechatronics library

Integrated engineering of mechanics and automation with change management

Generators and round-trip capabilities

Integrated simulation and integrated validation

Machine Building

NX / MCD integrated in NX

Automation Designer integrated in NX

Totally Integrated Automation Portal

MCD / PLCSIM Advanced

Controller and HMI Simulation

Replacement of hardware test setup

With SIMATIC S7- PLCSIM Advanced & WinCC

- using comprehensive simulation of controller functionality
- testing via TIA Portal tools. e.g. watchtables, simulated HMI / HMI runtime etc.

Automatic program code validation

With SIMATIC S7- PLCSIM Advanced, WinCC and test application

- using data exchange over API for automatic testing of function blocks
- testing via customer specific test application
- General test application „S7UnitTest“ for basic automated tests is provided via SIOS:

https://support.industry.siemens.com/cs/ww/de/view/109746405

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From Simulation to Virtual Commissioning

From simulation to Virtual Commissioning

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1 Preliminary Design
2 Detailed Design
3 Commissioning
4 Operator Training
5 Retrofit





Simulation	• Mechatronic concept • Tool Selection & Reachability • Material Flow Concept	• Mechanic, Electric, Automation Design • Toolpath and offline Programming • Line Design & Validation			
Software in the Loop	• Test of single plant parts and components • Preliminary tests and validation	• Detailed design validation • Performance analysis		• Training of shop floor-personnel • Upfront validation using virtual equipment • Shorter breakdown-times	• Validation of the changes of the plant

Virtual commissioning

Software in the loop

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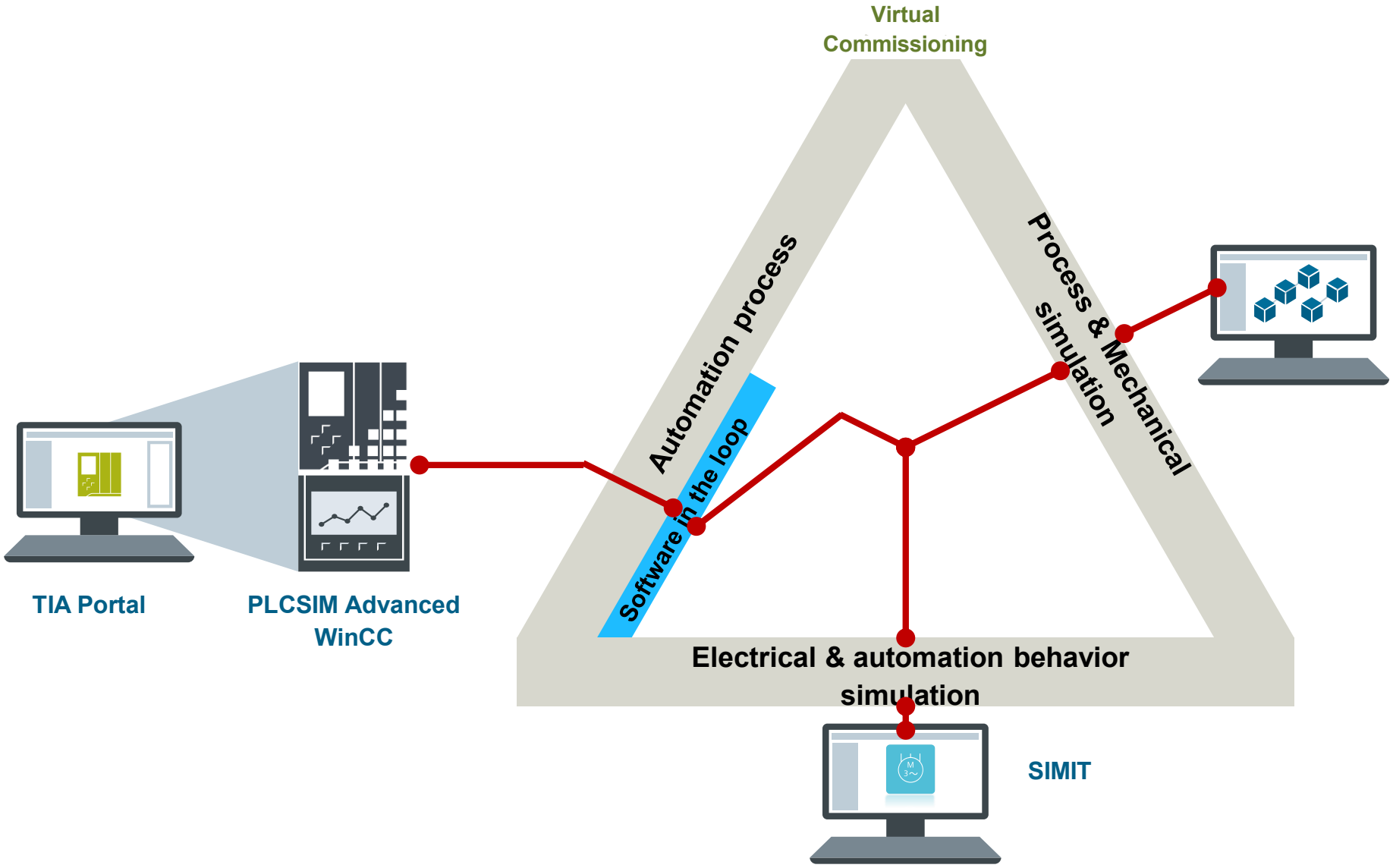

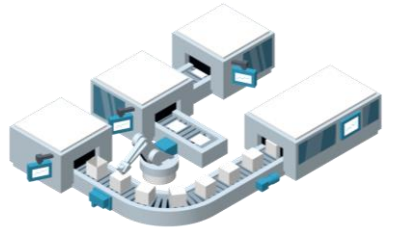

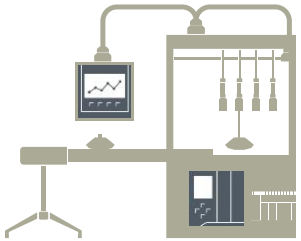

From simulation to Virtual Commissioning

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	1 Preliminary Design	2 Detailed Design	3 Commissioning	4 Operator Training	5 Retrofit
Simulation	• Mechatronic concept • Tool Selection & Reachability • Material Flow Concept	• Mechanic, Electric, Automation Design • Toolpath and offline Programming • Line Design & Validation			
Software in the Loop	• Test of single plant parts and components • Preliminary tests and validation	• Detailed design validation • Performance analysis		• Training of shop floor-personnel • Upfront validation using virtual equipment • Shorter breakdown-times	• Validation of the changes of the plant
Hardware in the Loop			• Cycle time validation • Mixed validation with hardware • Mixed validation with other plant parts		

Virtual commissioning

Hardware in the loop

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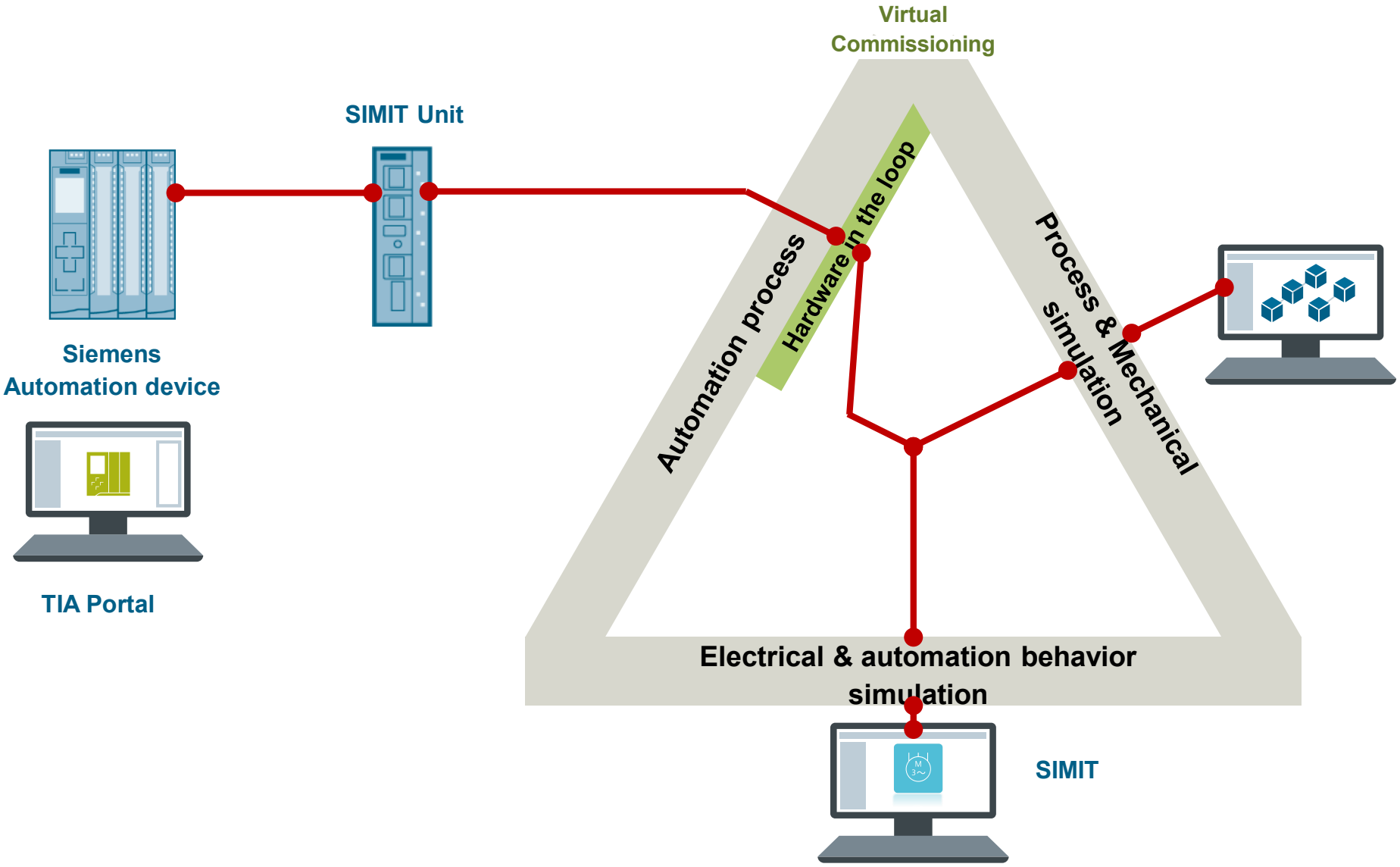

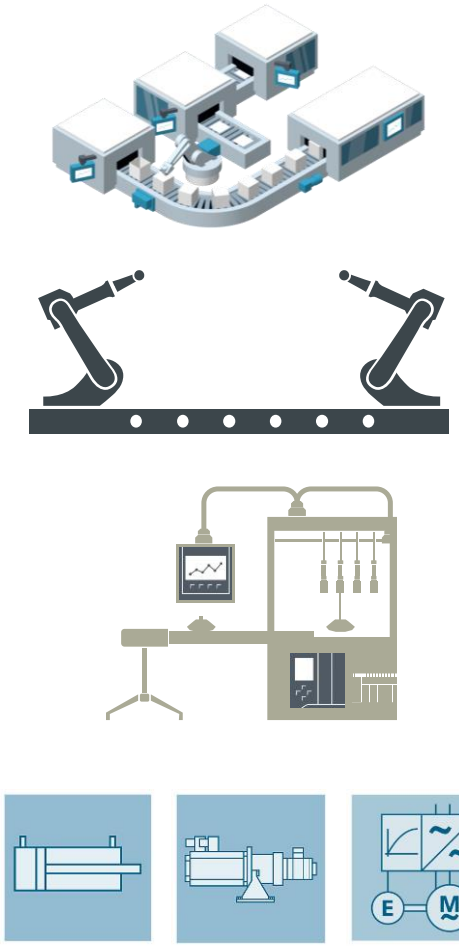

Virtual commissioning

Switching HiL ← → SiL

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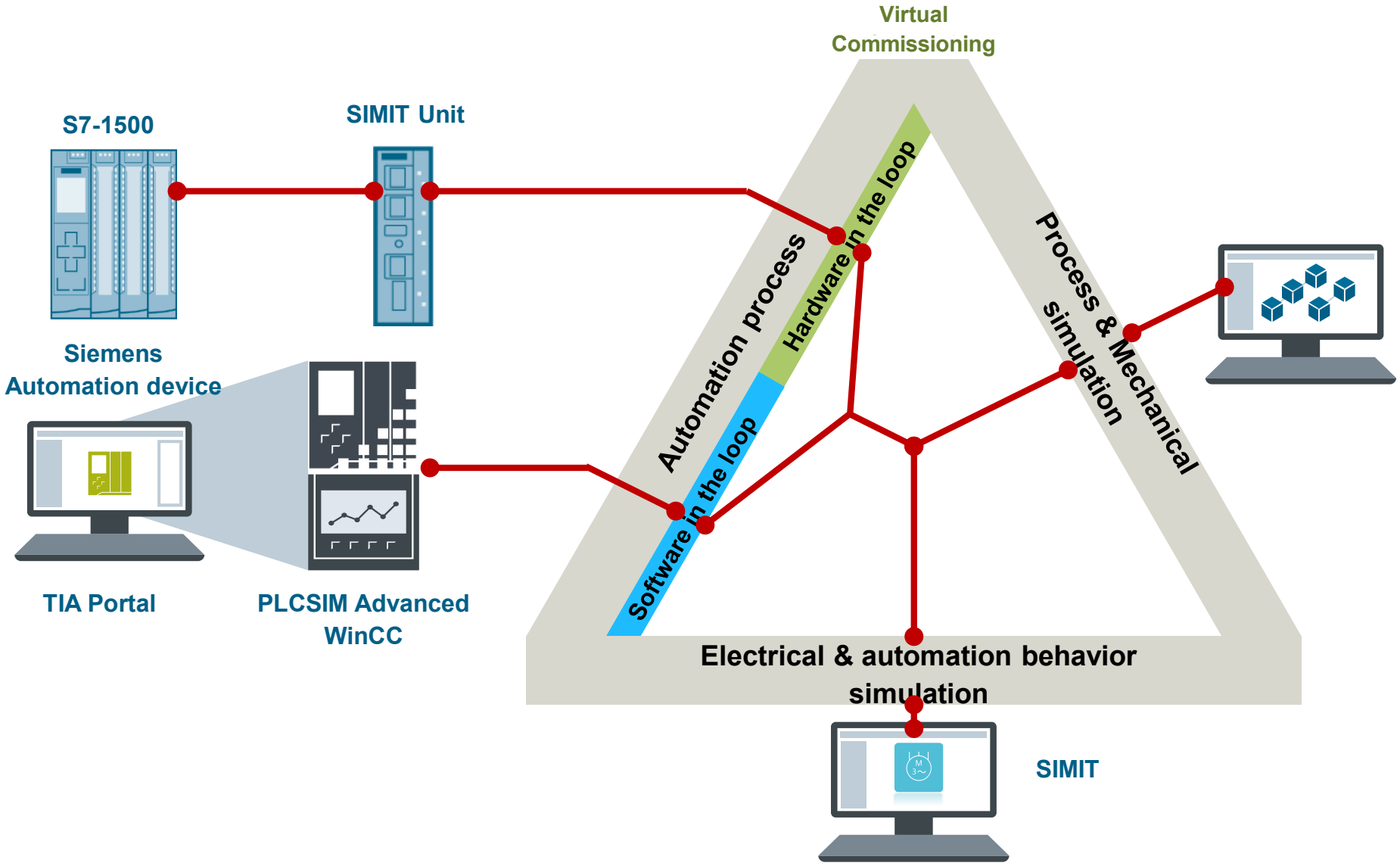

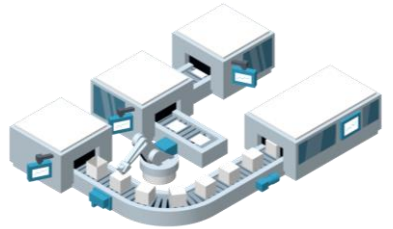

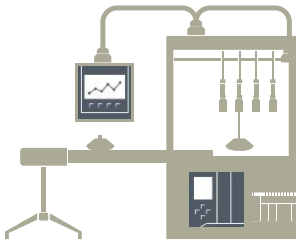

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Manufacturing machines, stations and lines simulation

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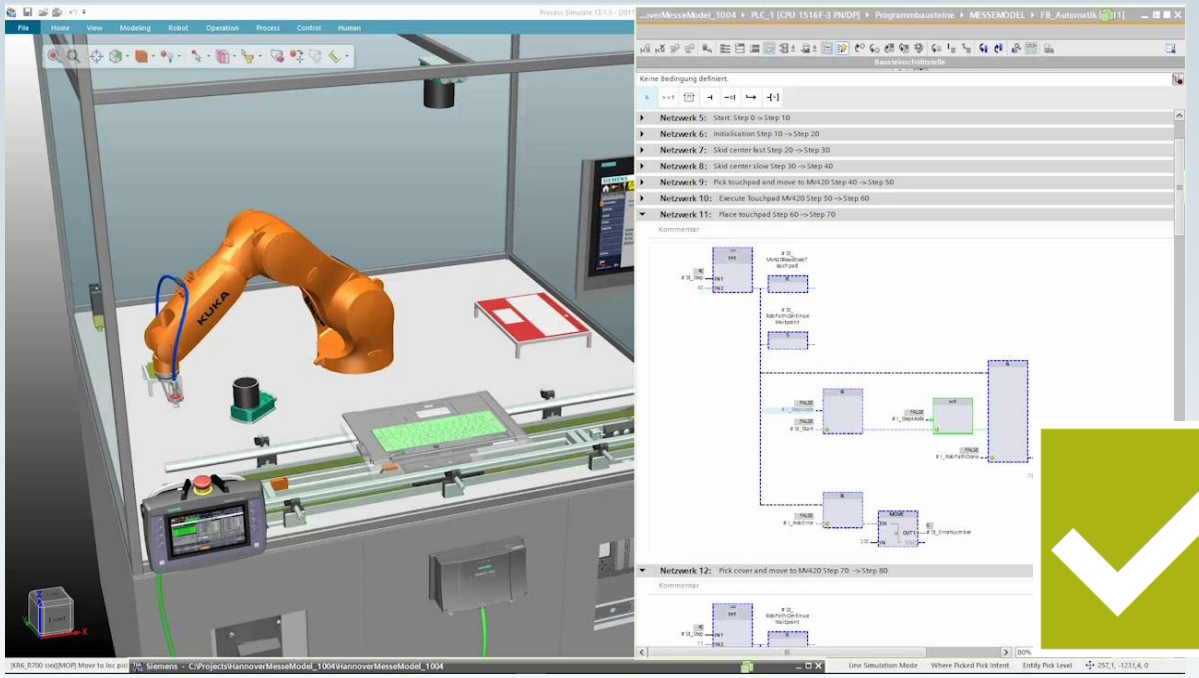
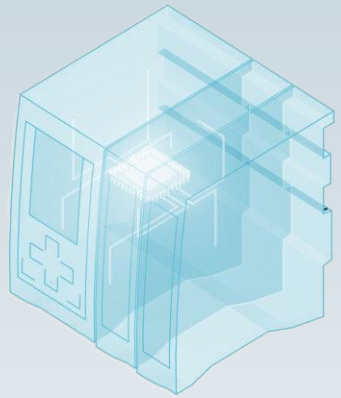
Validate robotic cells

Tecnomatix
Process Simulate





Digital Twin
of SIMATIC
S7-1500

Cell validation

Simulation – typical objectives

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Safety

Build Quality

Cycle Time/ Throughput

Reach and Clearance

System Layout

Control Validation

Off-Line Programming

- **Regulatory**

  Comply with geographic facility requirements

- **Safety**

  Achieve interlock and operator safety requirements

- **Customer**

  Meet volume production and quality targets

Cell validation

Virtual commissioning with Process Simulate

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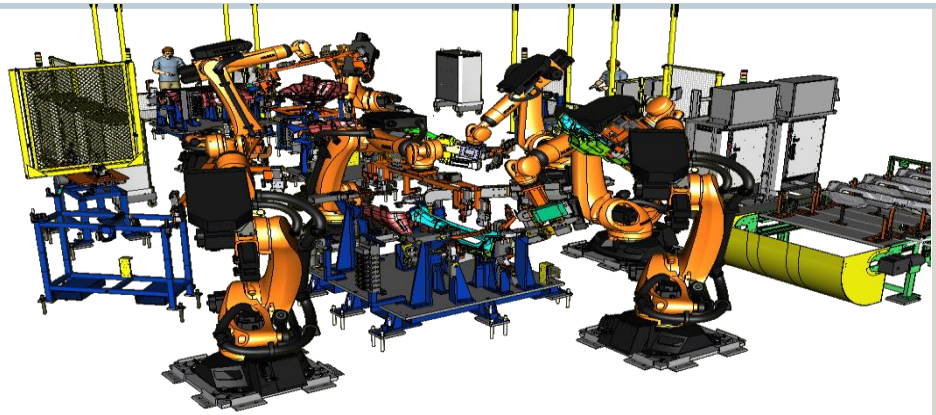

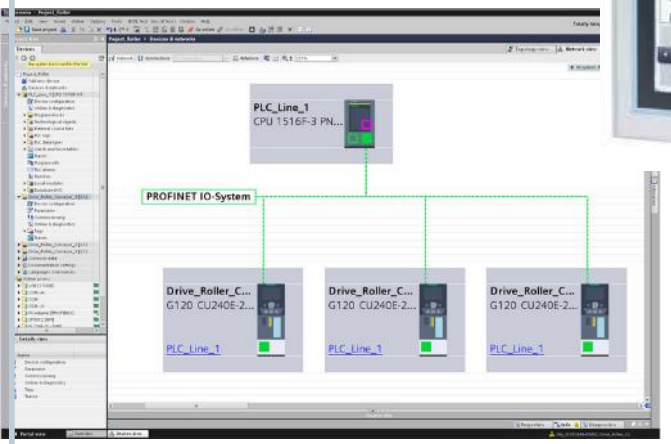

Capabilities

- Validate Mechanical Sequences
- Verify PLC code, Robot Programs and HMI
- Test Safety Interlocks
- Perform System Diagnostic testing

Key Points

- Develop complete robot programs
- Perform “what-if” scenarios (Failure Modes)
- Validation prior to cell construction

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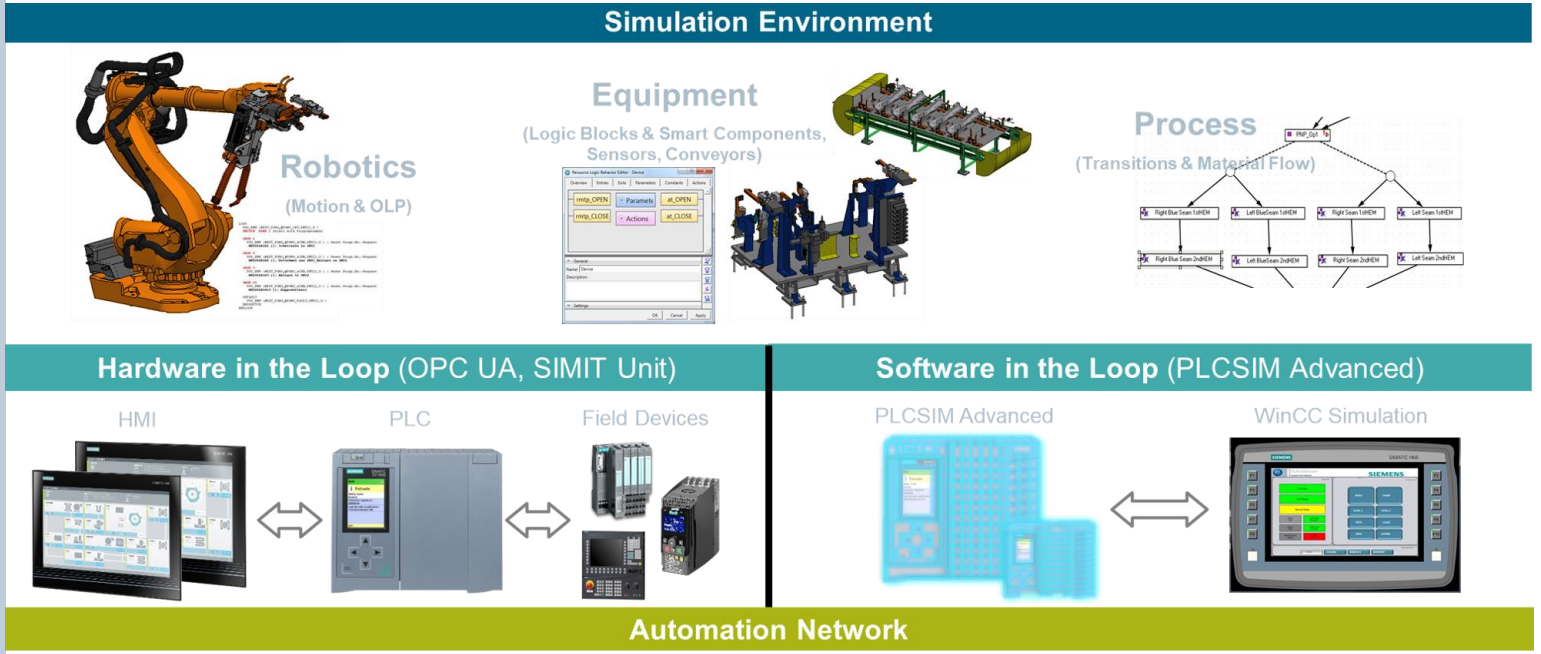
Virtual Commissioning



Robot Signal Creation

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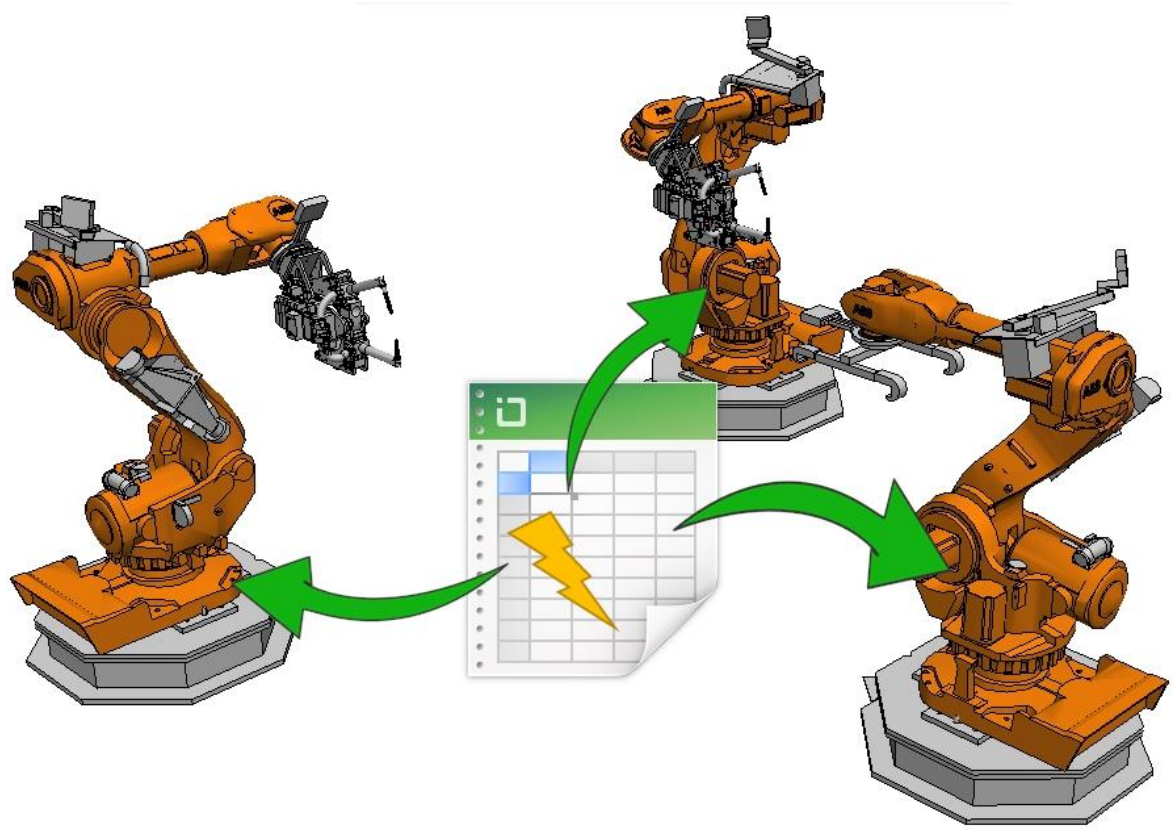

Signal Mapping Enhancements

- Ability to create robot signals for multiple robots at one time using the Signal Mapping application
- Ability to use Tags in the mapping Excel spreadsheet to replace using Macros and allow adaptive spreadsheets
- Improved report after signal mapping, making it easier to understand imported\mapped signals
- Signal Mapping templates are now included in the Process Simulate setup folder

Tecnomatix 14.0.1 eMServer Teamcenter

Easier debugging in Line Simulation

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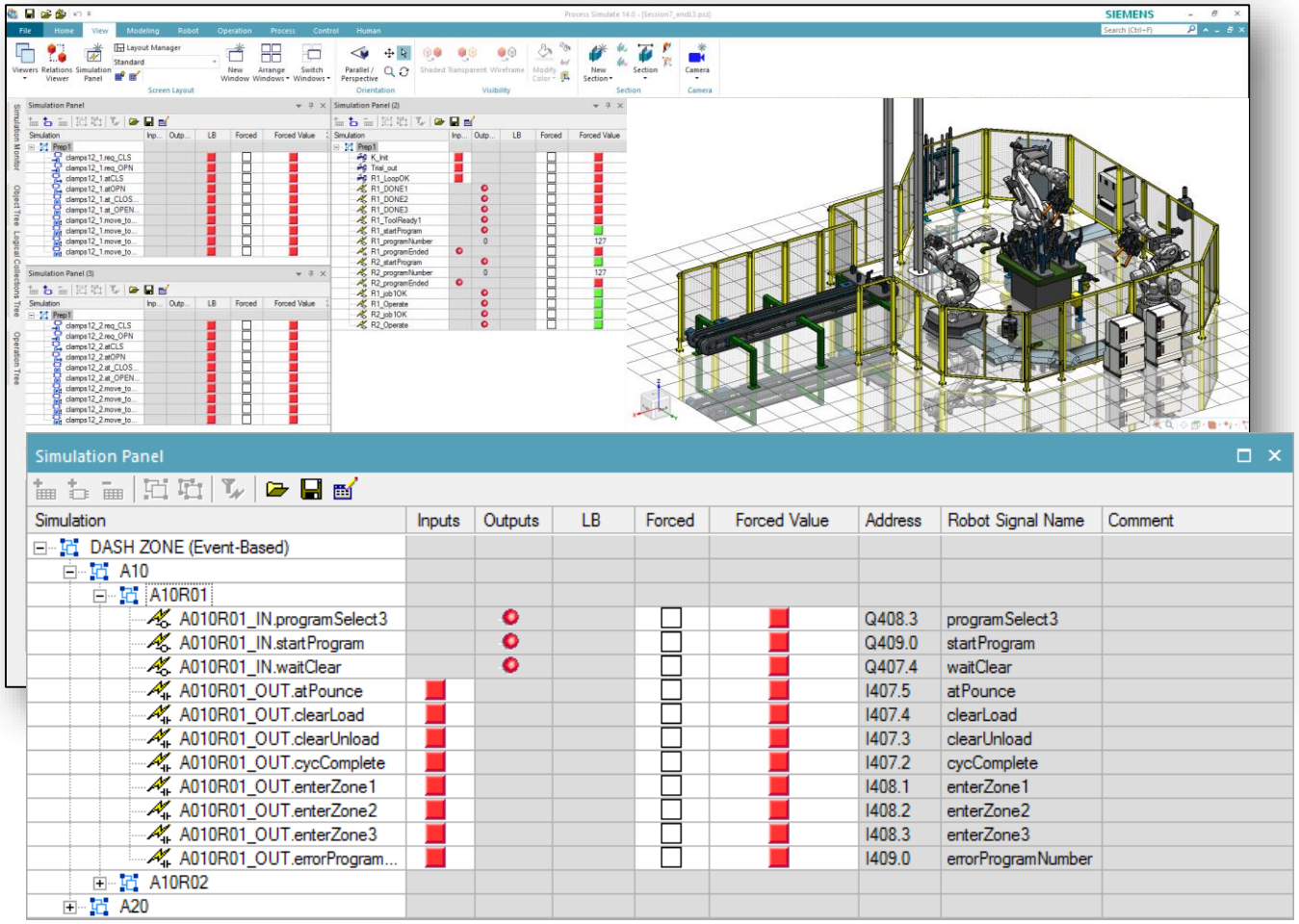

Simulation Panel improvements

- Process Simulate stores the current list of signals in all panels on Save and restores them on Open Study
- Users can open multiple Simulation Panels
- Panels hold more information for easier referencing
- Forced signals removed from *all* panels become unforced
- Input signals can be triggered like Keys

Tecnomatix 14.0.1 **eMServer** **Teamcenter**

Logic Block Editor

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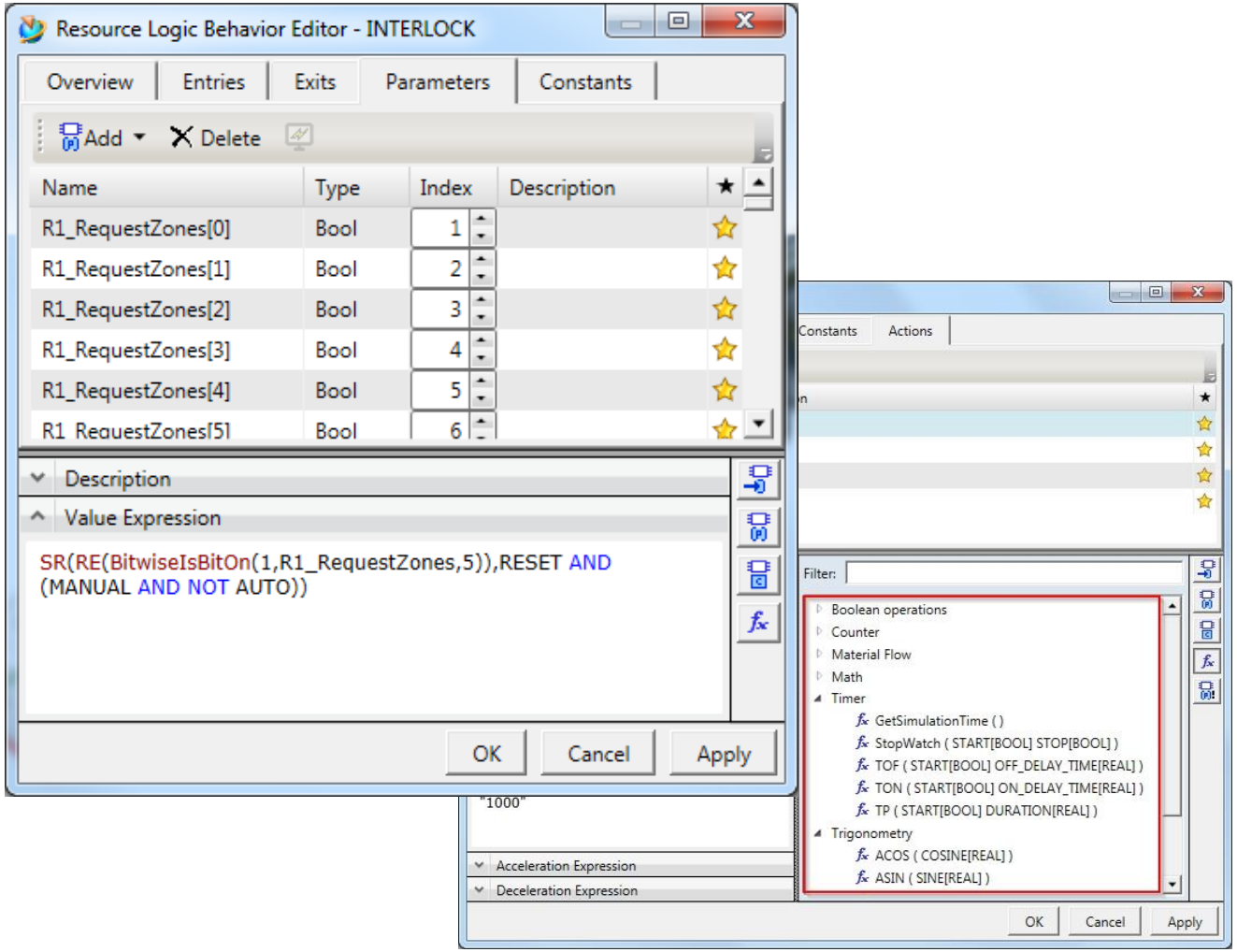

Simplify Logic

- Allow nested expressions in Logic:

```
DestroyAppearanceAtLocation(MAX(X,LowerLimit ),MAX(Y,
LowerLimit ),MAX(Z , LowerLimit ),CTU(Sensor , Reset ,#Part )
*ROUND(ABS(UpperLimit -LowerLimit)))
```

- An extended Logic Function library
- Support of User LB functions with retainable memory (multi-instance)
- Syntax improvements for better code readability

Tecnomatix 14.0.1 – 14.0.2 eMServer Teamcenter

PLC Connectivity

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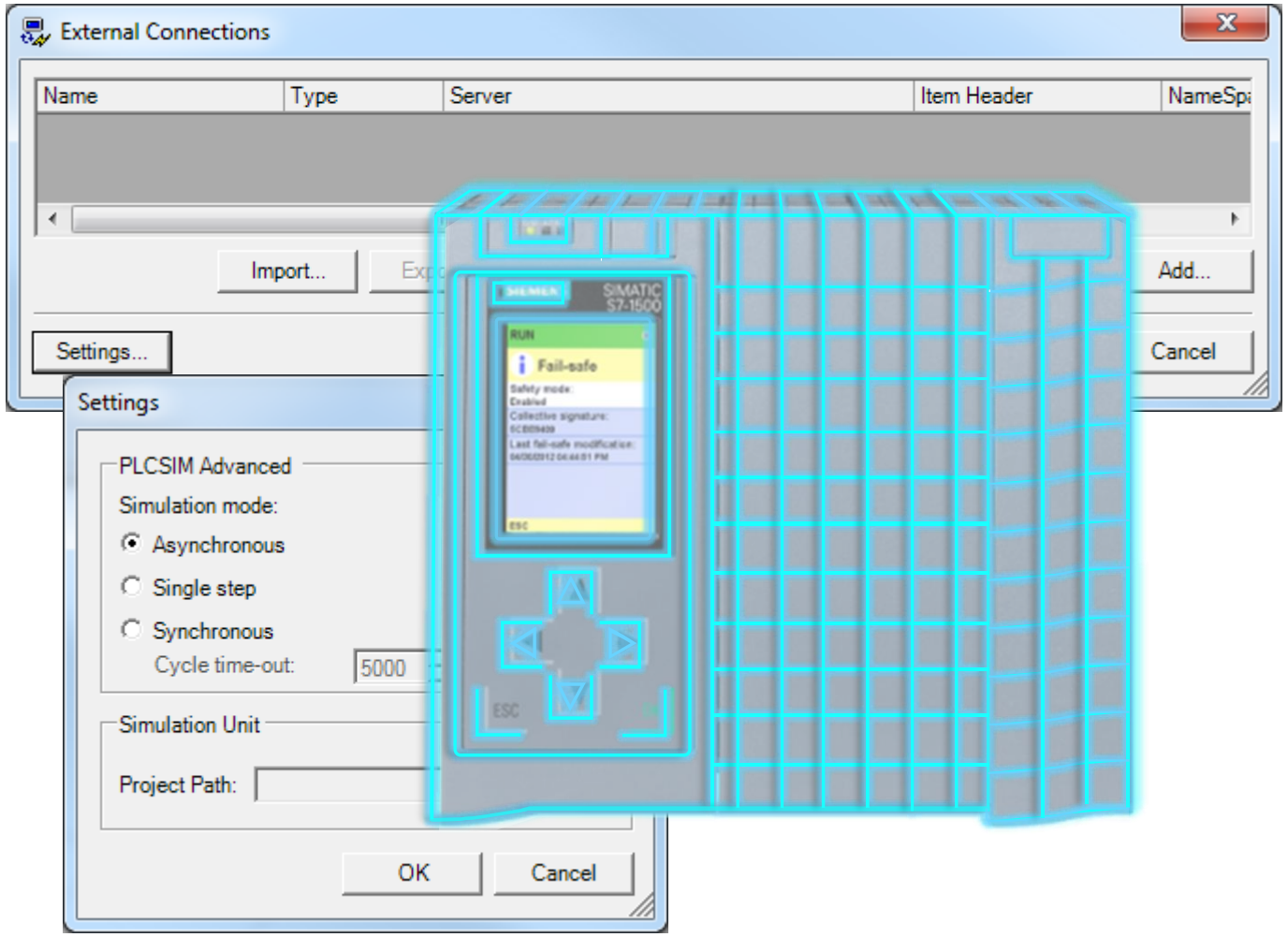

External Connections Settings

PLCSIM Advanced: 3 synchronization modes are available for the PLCSIM Advanced Connection: *Asynchronous*, *Single Step* and *Synchronous*.

Process Simulate version 14.1 and higher supports only PLCSIM Advanced V2.0 and higher featuring an Improved User Interface, newer Firmware support (FW 2.5) and improved simulation performance for *Name Based* connections

Simulation Unit: The Simulation Unit Project Path (.spf) definition is now under the External Connection dialog

Tecnomatix 14.1 eMServer Teamcenter

Sensors

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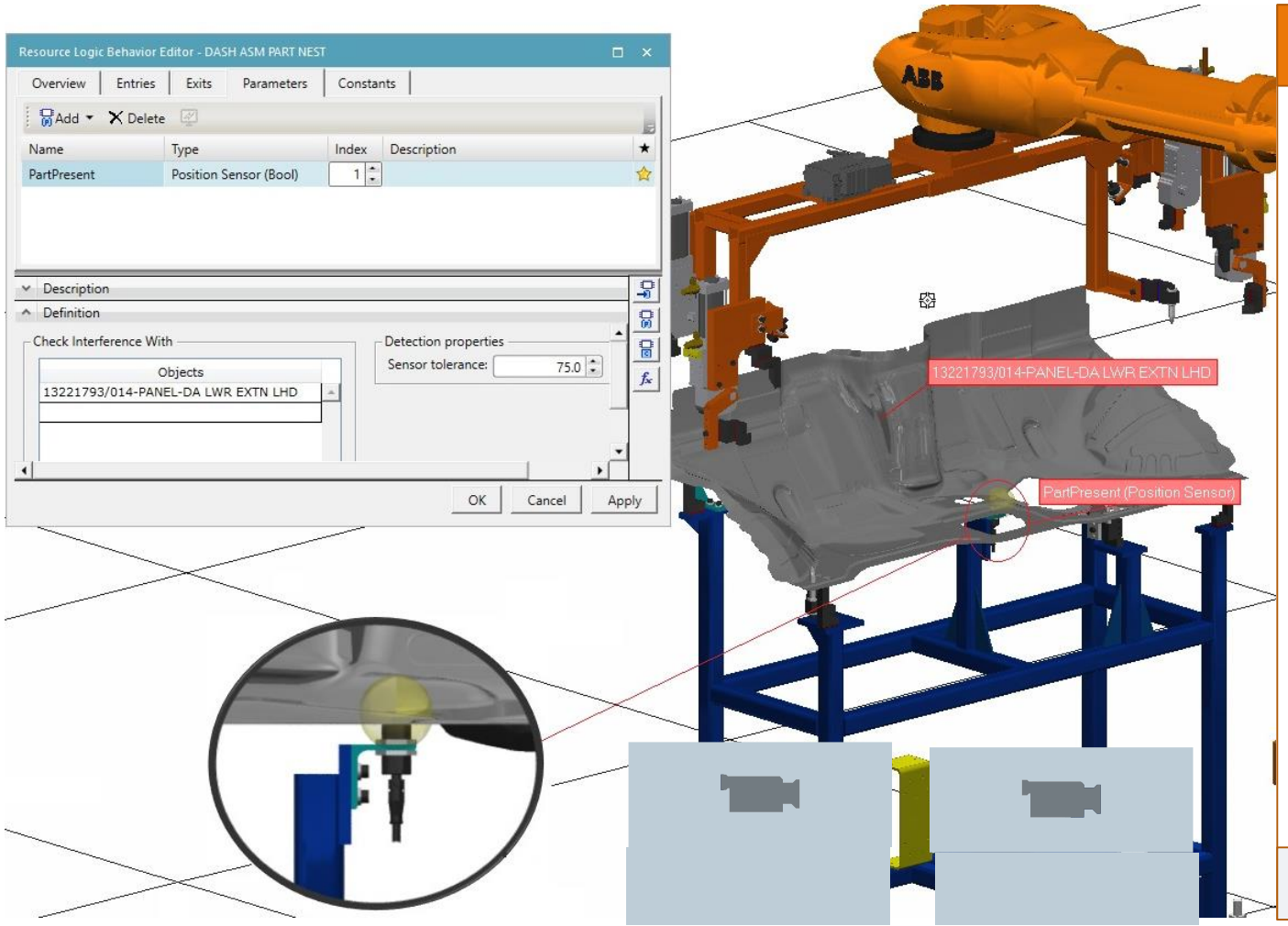

Position Sensors

A New Boolean sensor for fast-performing object detection based on distance measurements between Self Frames.

Position Sensors are introduced as Logic Block Parameters and provide:

- Fast performance
- Detecting through obstacles
- Easy reuse as part of a prototype
- Direct use of sensor output in logic expressions without signals
- Part detection within Compound Equipment

Tecnomatix 14.1.2 eMServer Teamcenter

CEE-SENSOR INTROUCTION

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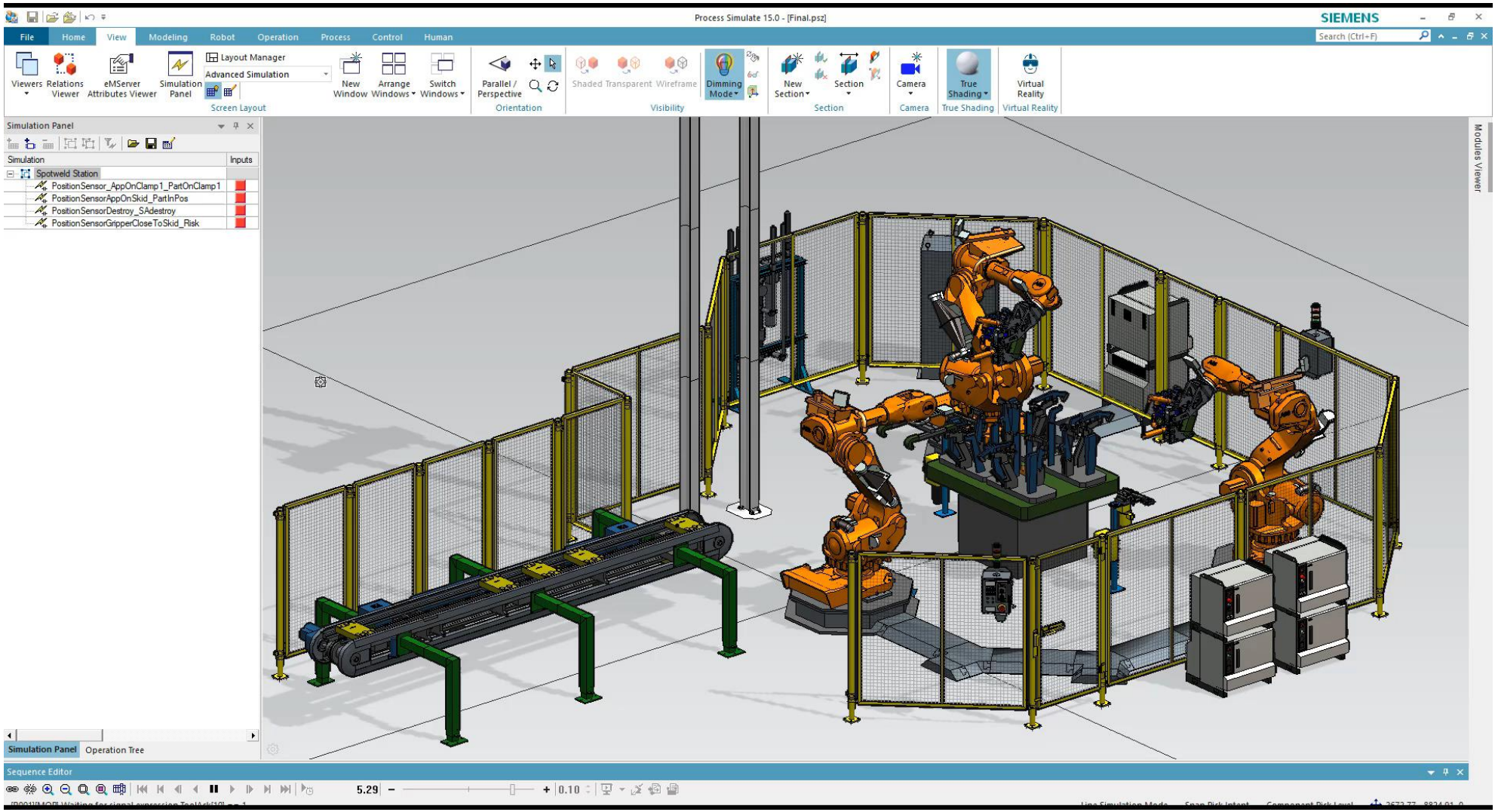

CEE-HOW TO SET SENSOR

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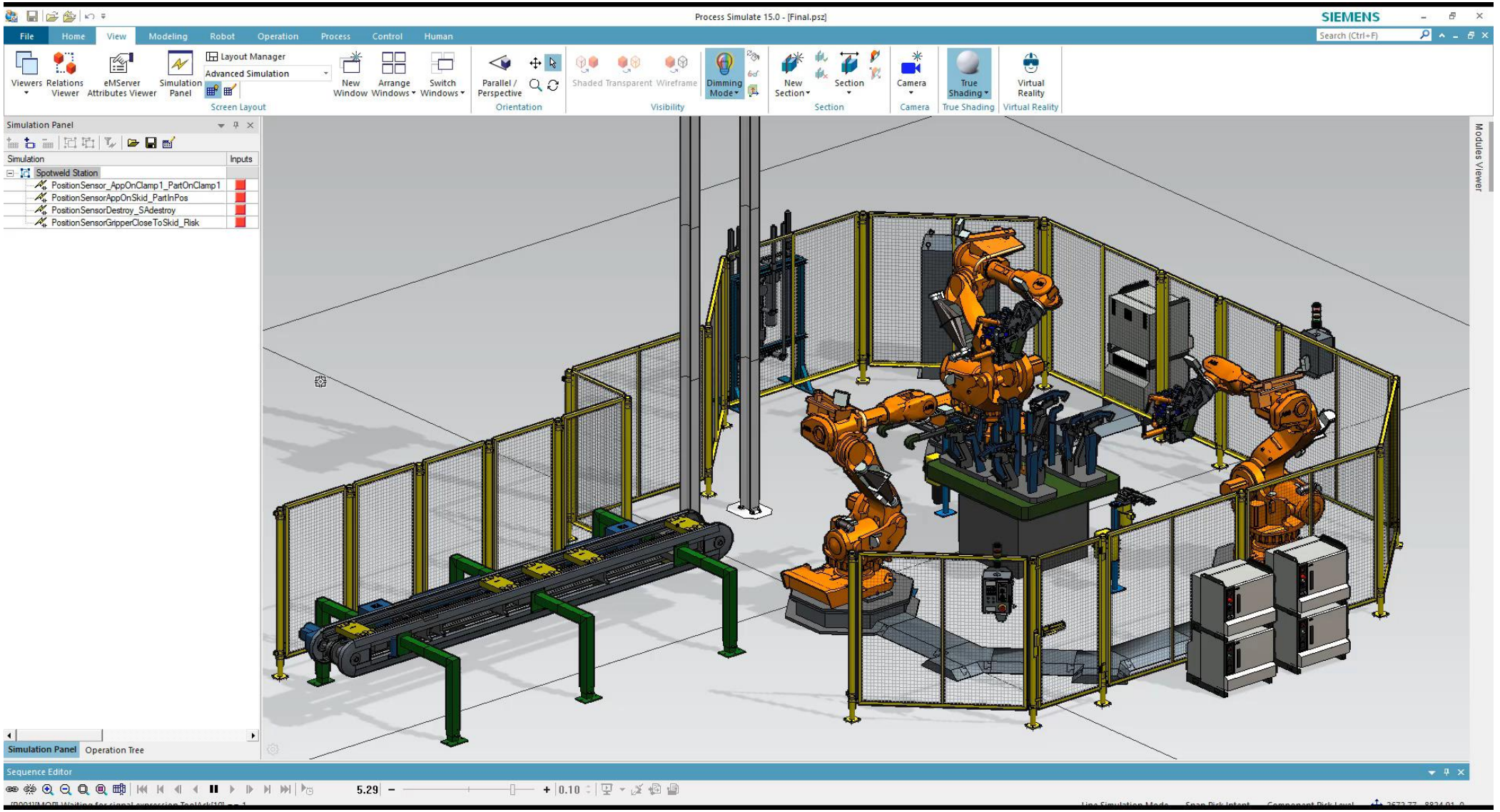

Drive Conveyor in LS Mode

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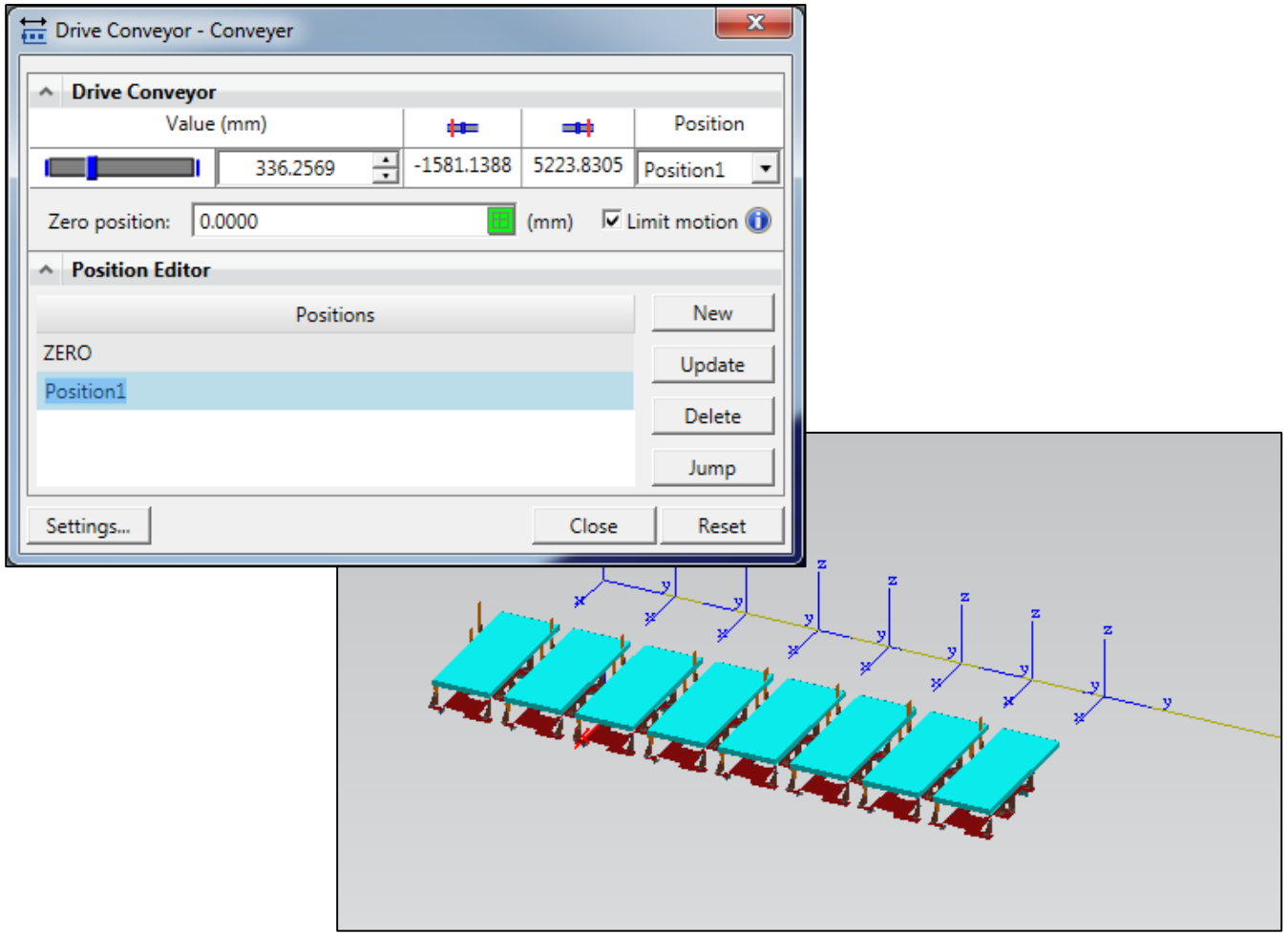

Drive Conveyor in Line Simulation

- Drive Conveyor functionality is now possible in Line Simulation Mode
- Enables driving conveyor skids to a certain position before starting the line simulation
- Useful mainly in cases of single skid or product modeled as resource (for painting use cases)

Tecnomatix 14.0.2 eMServer Teamcenter

Conveyors

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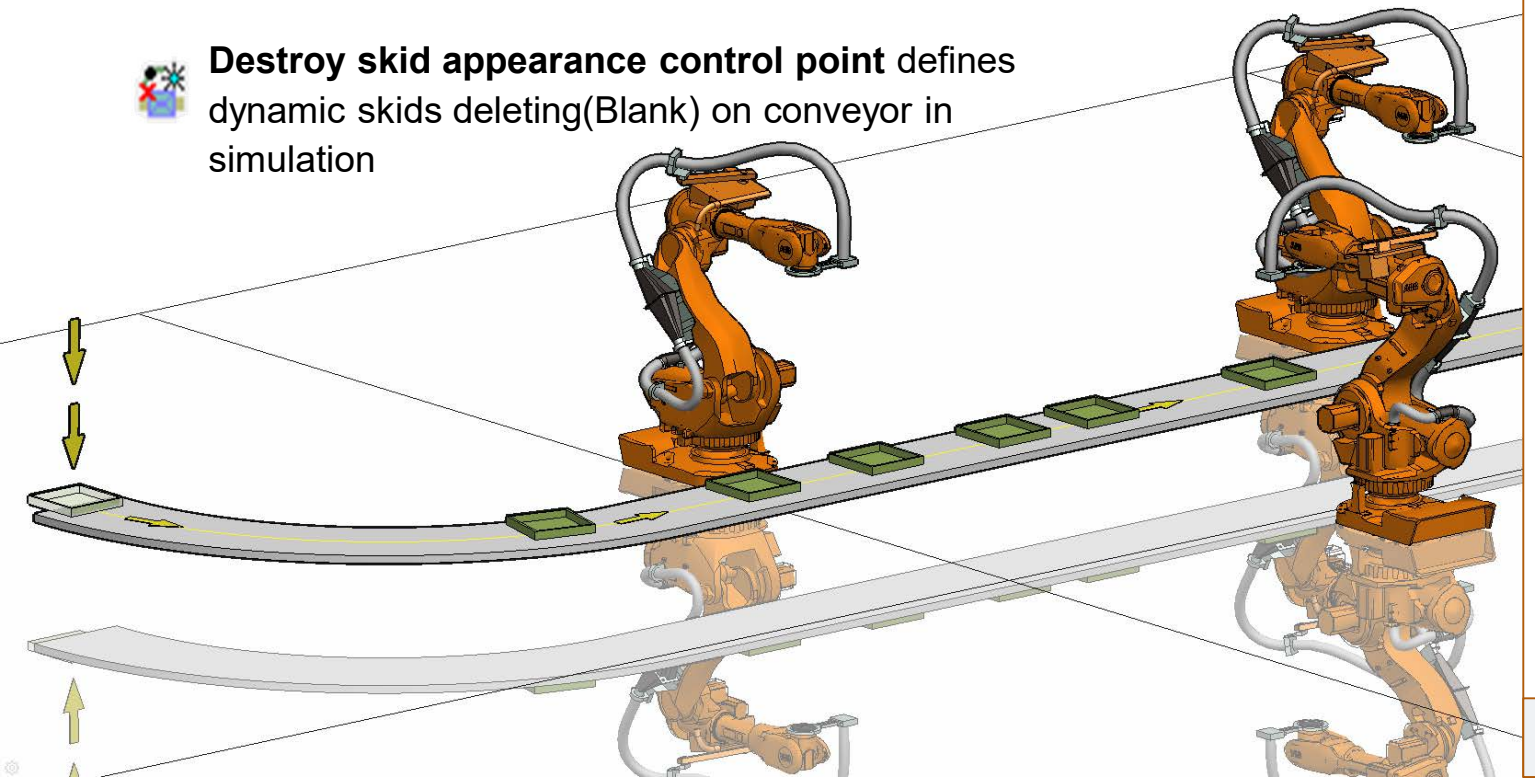
Generate skid appearance control point defines dynamic skids generation (Display) on conveyor in simulation

Destroy skid appearance control point defines dynamic skids deleting(Blank) on conveyor in simulation



Skid Source\Sink

- **Create** and **Destroy** skid appearances on a conveyor during simulation run time
- Skid handling is done using Control Points (Generate Skid and Destroy Skid)
- Skid Appearances behave like regular skids (Stacking, Motion, Part Conveying)

Tecnomatix 14.1 eMServer Teamcenter

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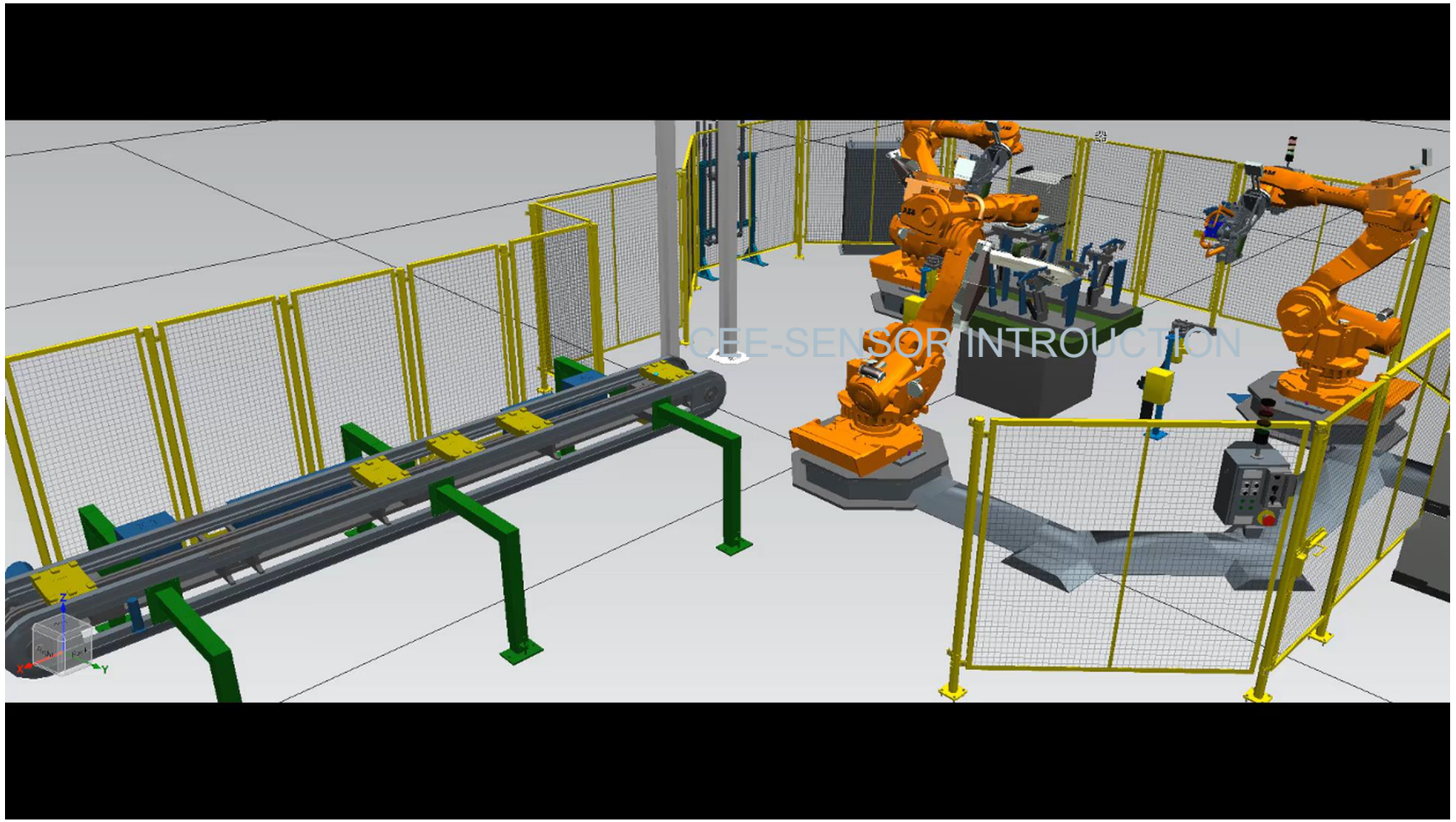

Improved usability for Line Simulation
提高line simulation的可用性

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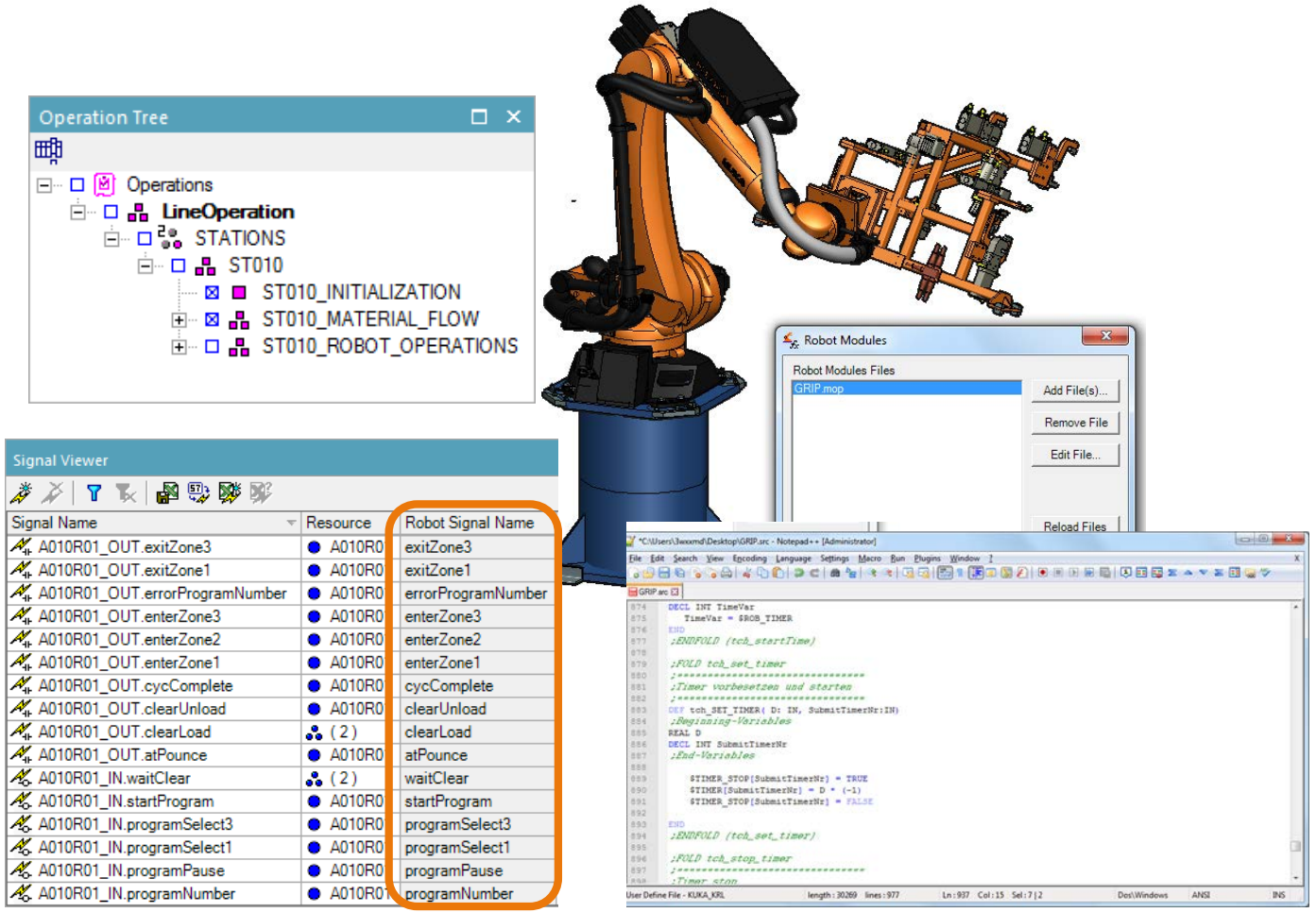

UX

- New column in **Signal Viewer** for “Robot Signal Name” and mention of **I\O** in Address column [14.1.2]
- Now when a study is loaded in Line simulation mode the “LineOperation” node is set as “Current Operation Scope” automatically [14.0.1]
- “Edit Module” now launches the default text editor defined according to the file type of the Module (OS default) [14.0.1]

Tecnomatix 14.1.2 eMServer Teamcenter

Rule Based Mapping 基于规则的映射

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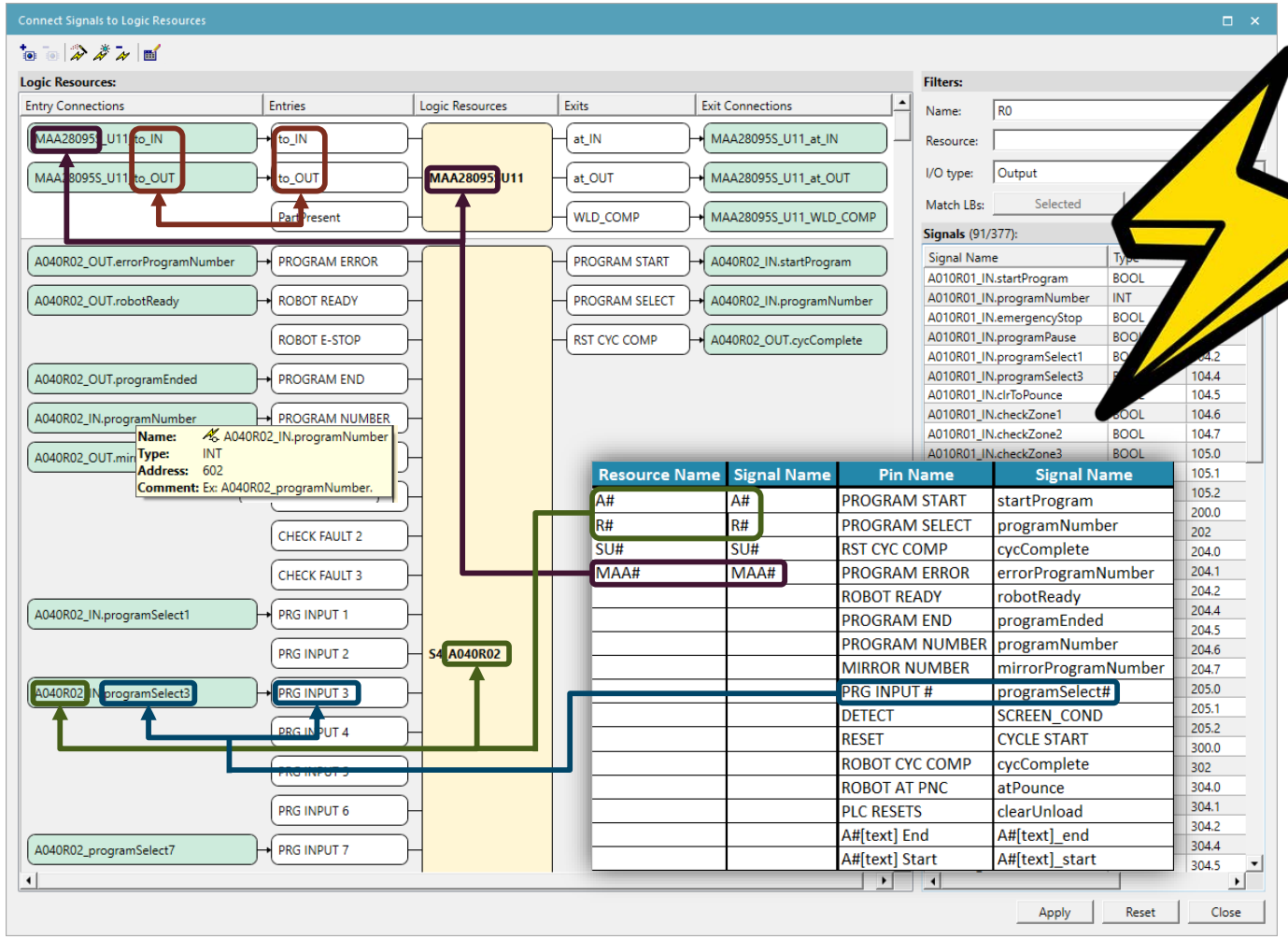

Connect Signals to Logic Resources

- Easily connect Signals to Logic Resources via simple drag and drop in a single dialog
- Automatically connect signals in batch to Logic Resources based on pre-defined and customizable rules
- An easy and dynamic user interface with informative tooltips and useful filters
- Replaces the old command of "*Connect Signals to Logic Resource*" (removed)

Tecnomatix 14.0.2 – 15.0 **eMServer** **Teamcenter**

Double precision Floating Point signals 双精度浮点信号

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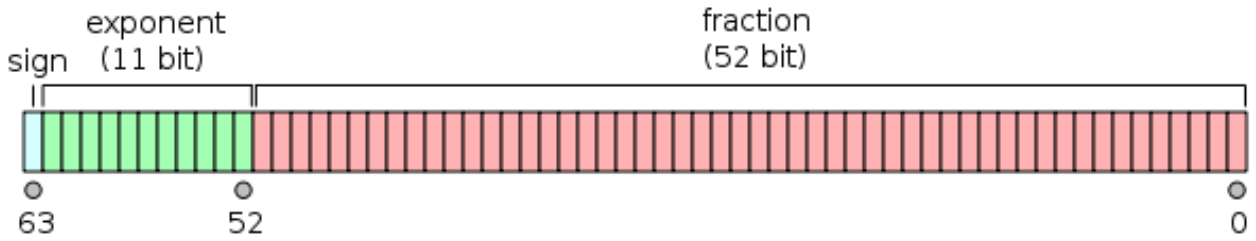

Signal Viewer

Signal Name	Memory	Type	Robot Signal Name	Address	IEC Format
ST010-DrivePosition:IN		LREAL		45	I45
ST010-DrivePosition:OUT		LREAL		45	Q45
ST010-FL01_[X]_toClose		BOOL		No Address	Q
ST010-FL01_[X]_toDown		BOOL		No Address	Q
ST010-FL01_[X]_toOpen		BOOL		No Address	Q
ST010-FL01_[X]_toUp		BOOL		No Address	Q

DOUBLE (LREAL)

- Support of Double precision floating numbers (64-bit float) in Process Simulate as a new signal type: LREAL
- Better matching of signal types with TIA portal LREAL
- Improved accuracy for signal exchange of Motion applications

Tecnomatix 15.0 eMServer Teamcenter

Function Block for Behavior Modeling 行为建模的功能块

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```
// Function Calls
#RE (CLK:=#A);

// Conditions
IF #RE.Q THEN
  #Counter := #Counter + 1;
END_IF;

// Advanced mathematical Expressions

#Degree:= arctan((#Farenheit-32)*9/7);
```

Function Block Editor

- Enhancement of the behavior modeling capabilities of Process Simulate
- Implementation of a new type of LB, the FB (function block)
- The function block can be written in SCL/ST (Structured control language), an IEC standardized automation language for PLC programming
- Direct import from TIA Portal is possible
- This makes use of existing behavior models in TIA Portal
- Advanced drive models are now possible

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Improved Behavior Modeling and PLC accessibility
改进了行为建模和PLC可访问性

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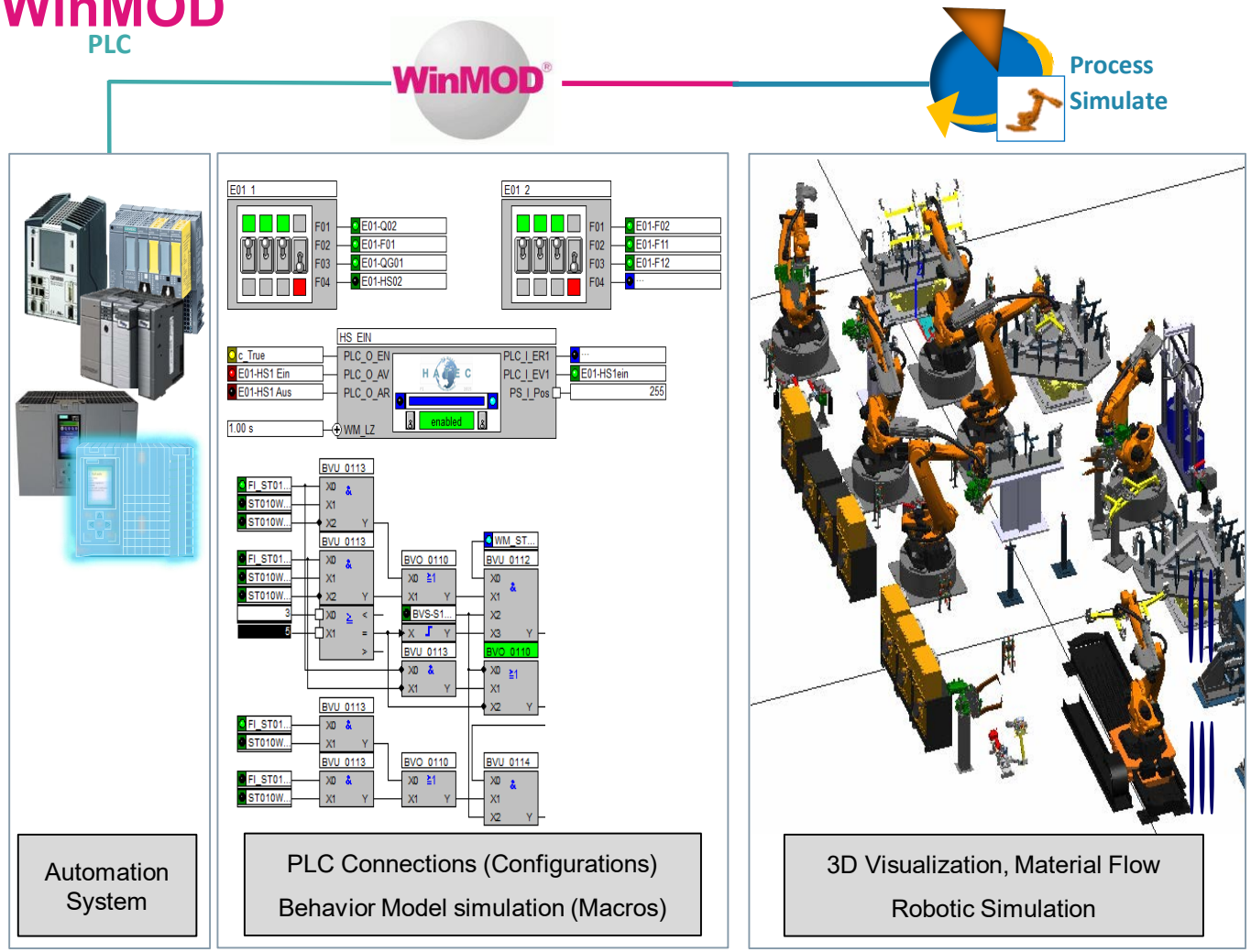
WinMOD
PLC



WinMOD External Connection

- A new direct External Connection between Process Simulate and WinMOD
- Connect Process Simulate devices to WinMOD developed Behavior Model libraries for Line Simulation
- Additional PLC Connections available through WinMOD Configurations
- Easy setup of Virtual Commissioning for existing mutual customers via a direct high performance link

Tecnomatix 15.0 **eMServer** **Teamcenter**

Process Simulate Performance

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- PLC-based Simulation performance is influenced by various factors:
  - # of I/Os in zone/station
  - # of variables used in robot program
  - Level of details of JT files
  - Behavioral modeling complexity
  - # and type of sensors in station
  - HiL vs. SiL
  - H/W and graphic card performance
- Optimizing performance requires strong H/W, implementation of best practices, and data optimization
- Documented Public Examples:

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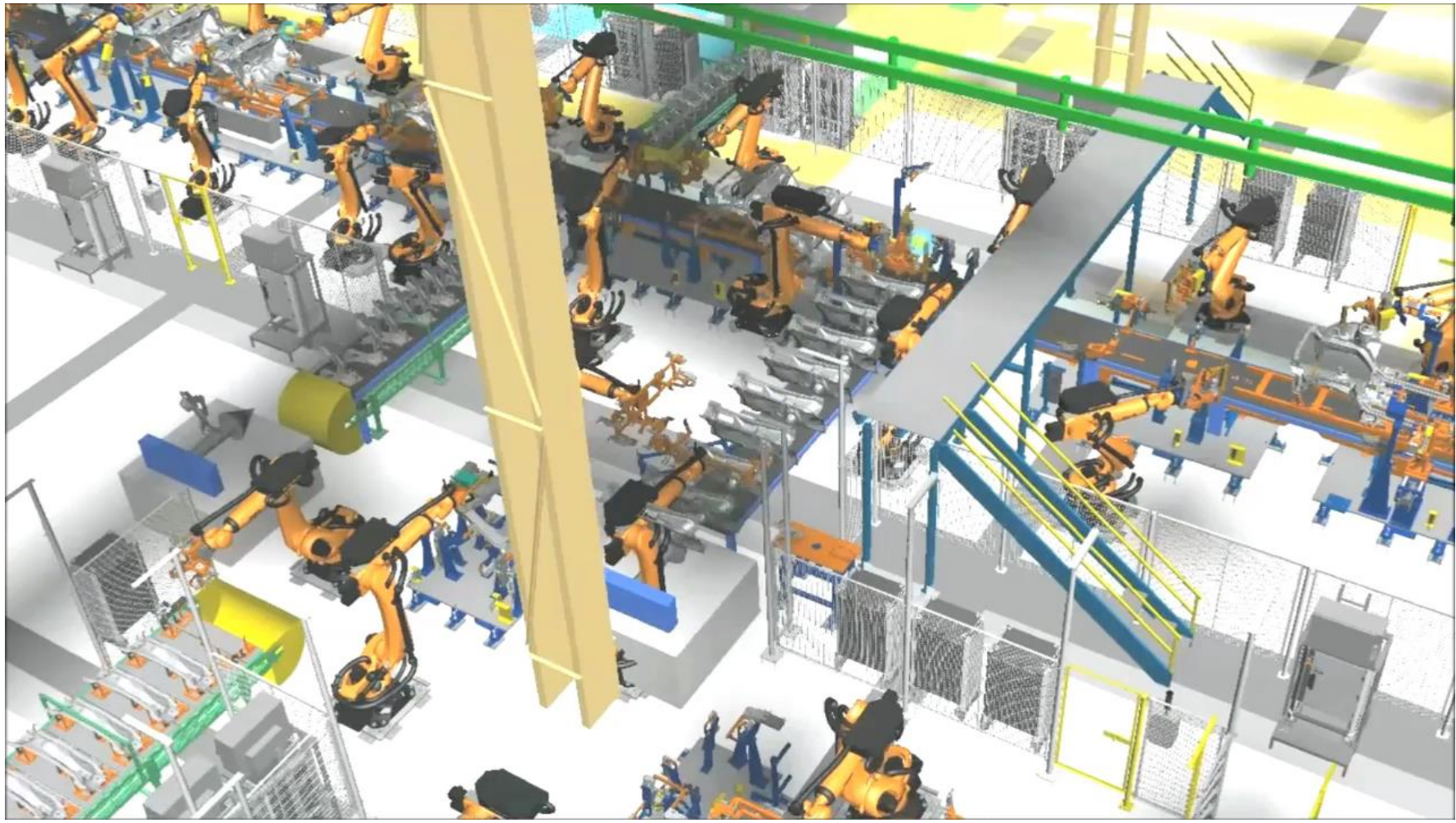
Optimize material flow

Tecnomatix
Plant Simulation



Material flow optimization

Simulation – typical objectives

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Reduced throughput time

Optimized lot size

Reduced stock size

Less work in progress

Reduced over dimensioning

Increased flexibility on customer demands

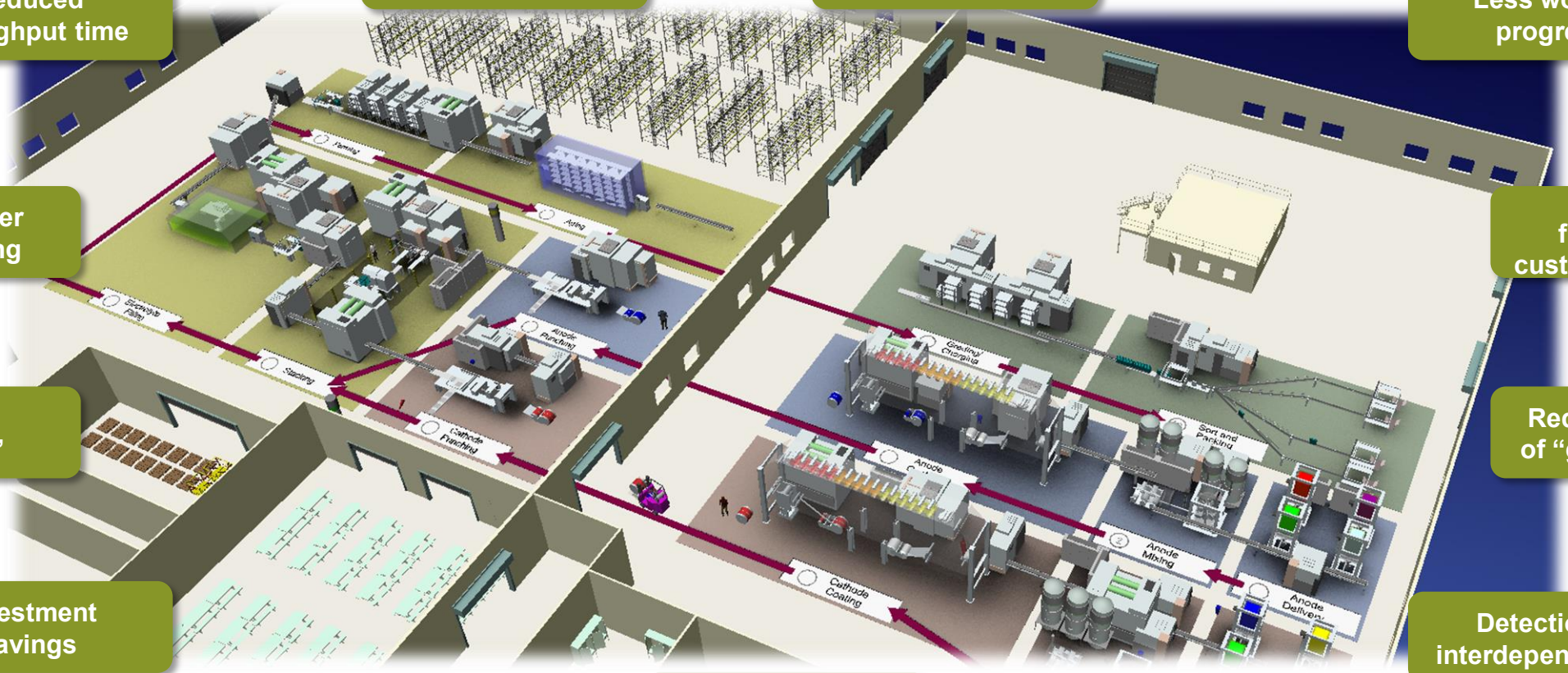
“What if scenarios”

Reduced number of “gut decisions”

Investment savings

Detection of interdependencies

Optimized control strategies



Material flow optimization

Point cloud integration example

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Cell validation

Virtual commissioning with Plant Simulation

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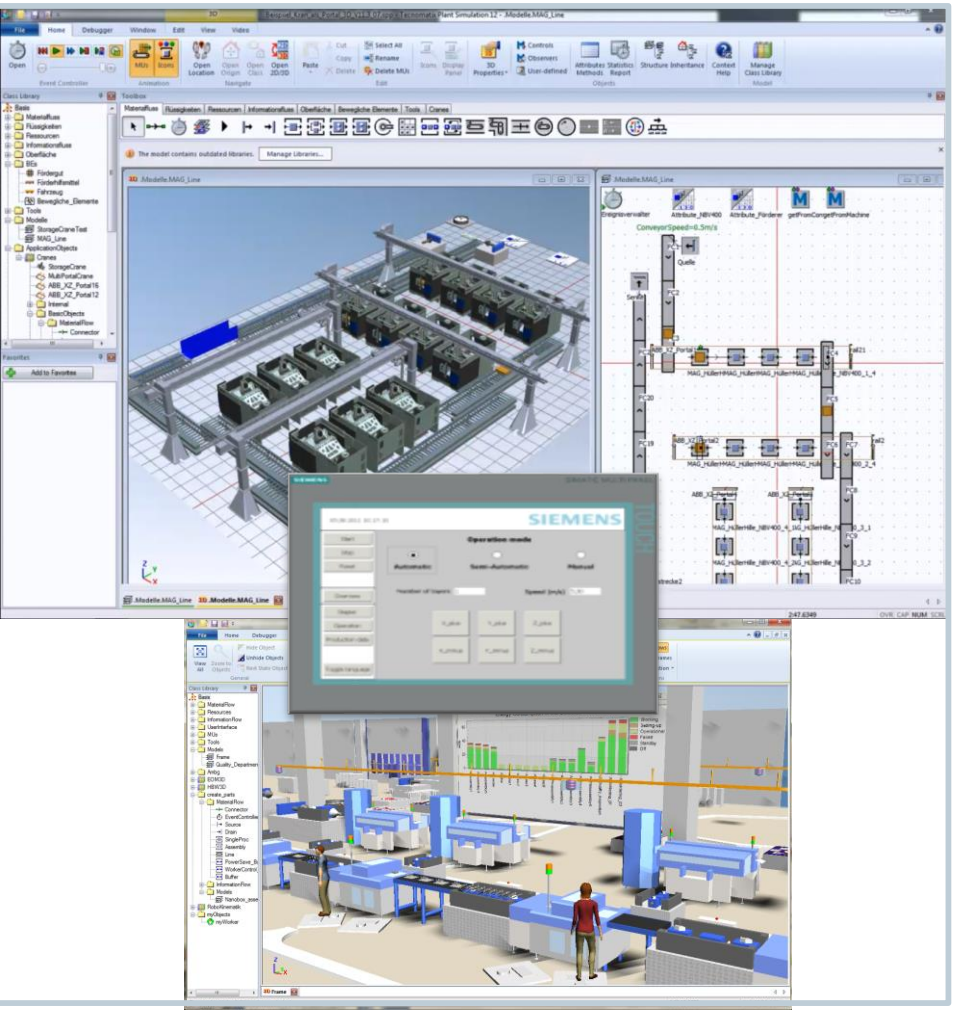

Capabilities

- Validate material flow and control logic
- Verify PLC code and HMI
- Verify conveying unit and head unit level
- Perform system diagnostic testing

Key Points

- Perform “what-if” scenarios (Failure Modes)
- Validation prior to conveying system construction
- Operator training

Plant Simulation typical setup

Hardware in the Loop (HiL) & Software in the Loop (SiL)

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Hardware in the Loop

Software in the Loop

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Automation for virtual commissioning

PLCSIM Advanced

Basis for software in the loop

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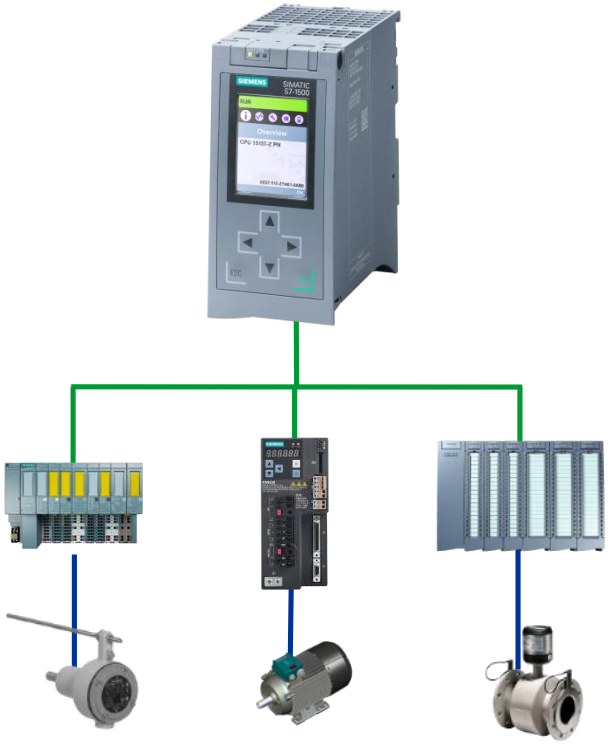
Real world

Controller

Process

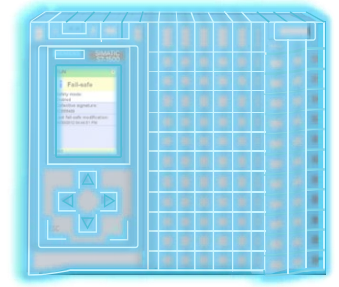
S7-1500 hardware controller



Virtual world

PLCSIM Advanced

Virtual S7-1500 controller

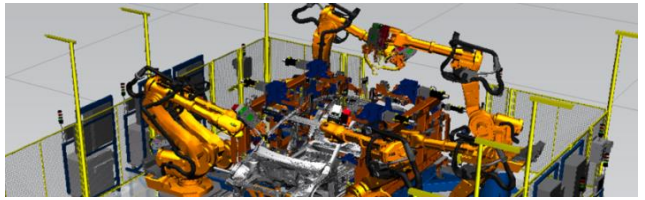


API

Virtual time base

Co-simulation

MCD | **Process Simulate** | **Other (ex. WinMod)**



PLCSIM Advanced as basis for "Software in the Loop"

- Extensive function simulation without adapting the STEP 7 program
- Interface for a connection to different co-simulations via API

PLCSIM Advanced

Supported controllers: S7-1500 CPU incl. C/F/T and ET200SP CPU incl. F

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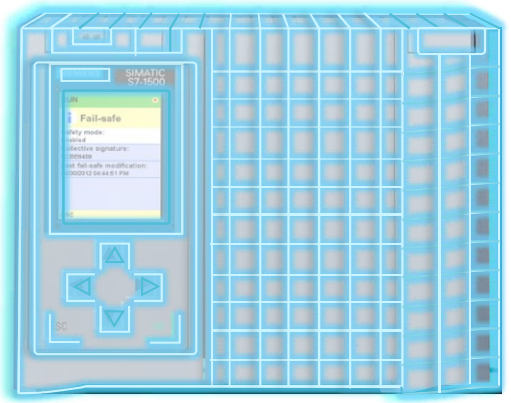
S7-1500

S7-1500T(F)

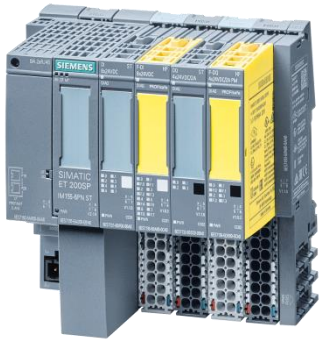
S7-1500F

Virtual controller



Mapping of the real controller

S7-1500C



ET 200SP(F) CPU

With Siemens' integrated technologies, Bausch + Ströbel realized digitalization across the entire machine lifecycle

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30% shorter engineering time

Increased flexibility

Consistent, end-to-end digitalization with the **Digital Twin**

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Realize your digital transformation with the Digital Enterprise Suite

使用数字企业套件实现数字化转型

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Make the future yours.

Thank you.