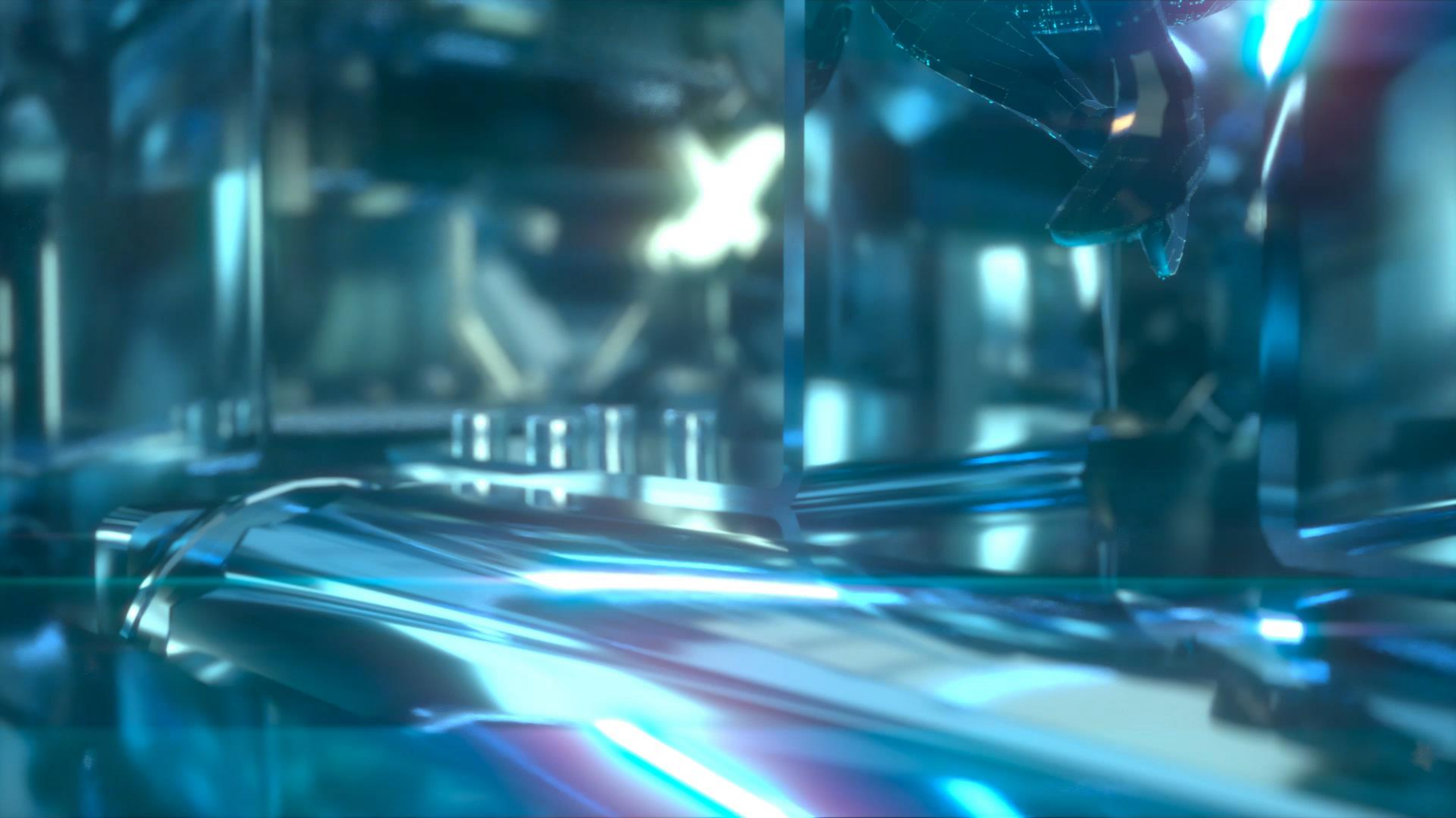




+1000  
credits

CHECKING SCORE  
LEVEL UP!





# What is the CEO/management interested in?



How can we speed up **commissioning** of machines?

---



Which optimization levers **can be used to reduce the risks and costs** of commissioning?

---



How can **unplanned machine behavior** be avoided?

---



How can **mechanical defects or software errors** be detected at an early stage?





# What is the CEO/management interested in?



How can we speed up **commissioning** of machines?

---



Which optimization levers **can be used to reduce the risks and costs** of commissioning?

---



How can **unplanned machine behavior** be avoided?

---

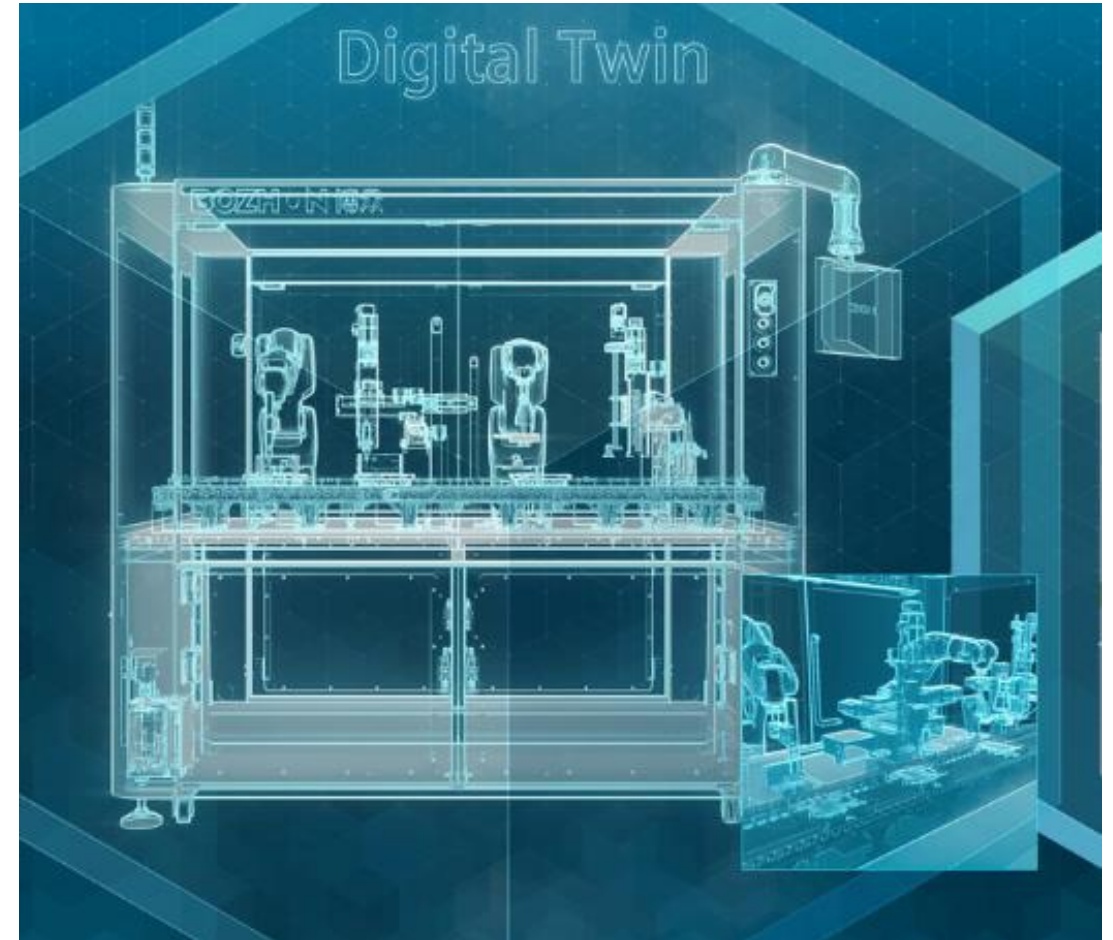


How can **mechanical defects or software errors** be detected at an early stage?



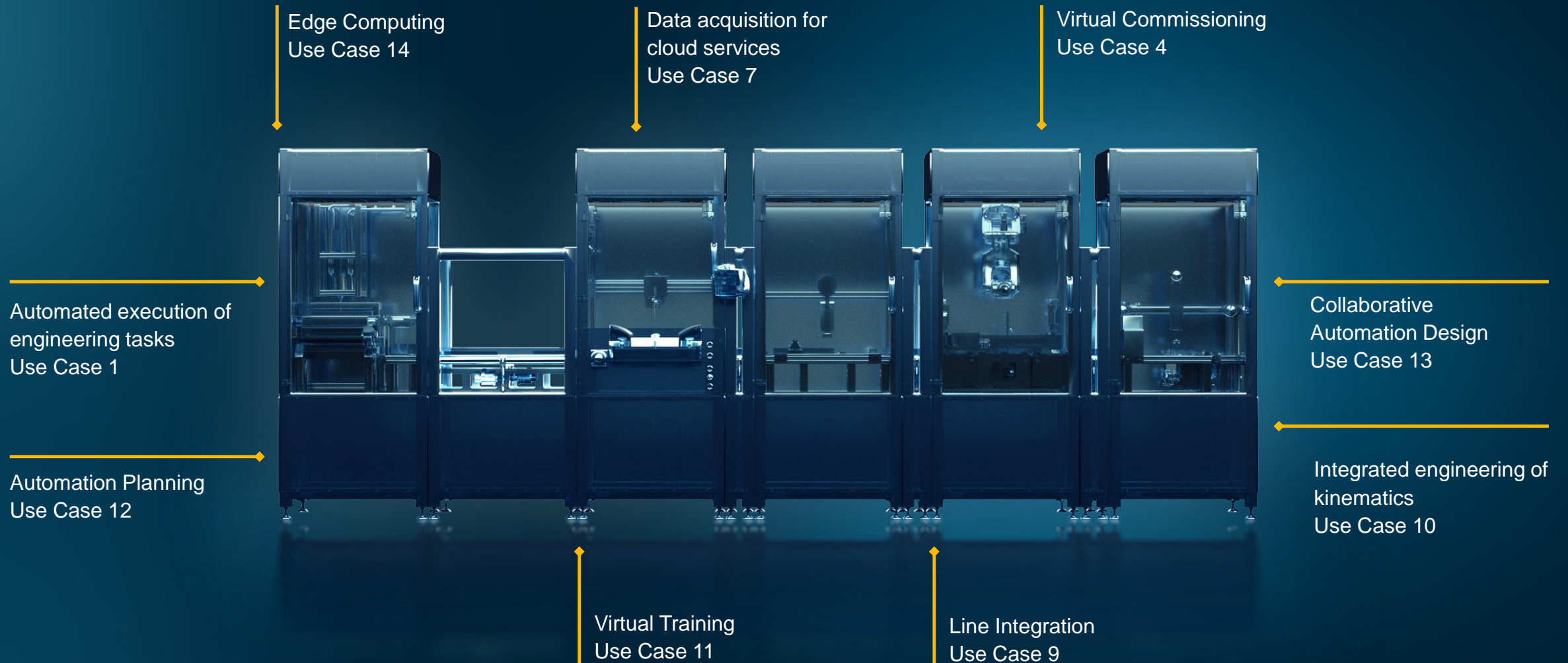
# What is the CEO/management interested in?

**SIEMENS**  
*Ingenuity for life*



# Automation Days 2019 – Discover the power of simulation

## Digitalization line – TIA use cases





# Automation Days 2019 – Discover the power of simulation



**Challenge 1**

**Challenge 2**

**Challenge 3**

Customer identification /  
customer classification

Prepared for  
on-site commissioning

Virtual training

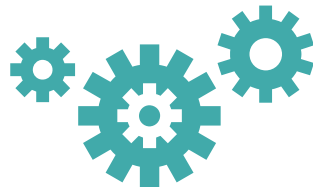
# Challenge 1

Evaluation of the program logic

# Evaluation of the program logic

## Requirements

- Evaluation of the various automation concepts
- Shorter commissioning time and less faulty behavior at the installation site
- No change of the machine program
- The behavior of the digital twin should be as close to reality as possible



# Evaluation of the program logic

## Target customers



Machine manufacturers from the discrete industry  
(construction / automation engineer)

## Deployment scenarios/ target applications



- Testing the program logic
- Testing the machine program in the event of an error
- Test of the machine before production / delivery

## Requirements for customers



- TIA Portal
- PLCSIM Advanced (S7-1500)
- SIMIT
- NX MCD

# Virtual Commissioning – Logic test with integrated simulation options of the TIA Portal

## HMI simulation as an integral part of the TIA Portal

No adaptation effort



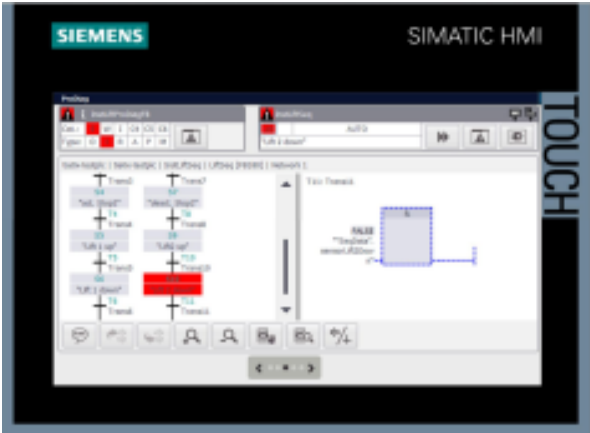
## PLCSIM for simulation of the control logic in the TIA Portal

- Free option
- Optimal for manual testing of straightforward control logic

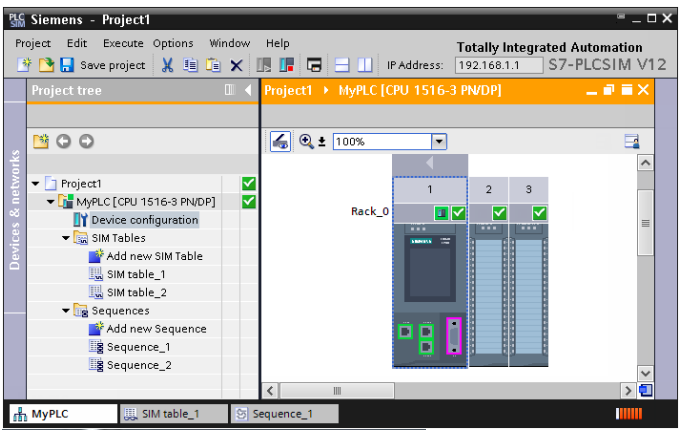


## But

- Communication?
- Networks >2 CPUs?
- Automatic tests?



**HMI simulation**  
in the TIA Portal



**PLCSIM**  
in the TIA Portal

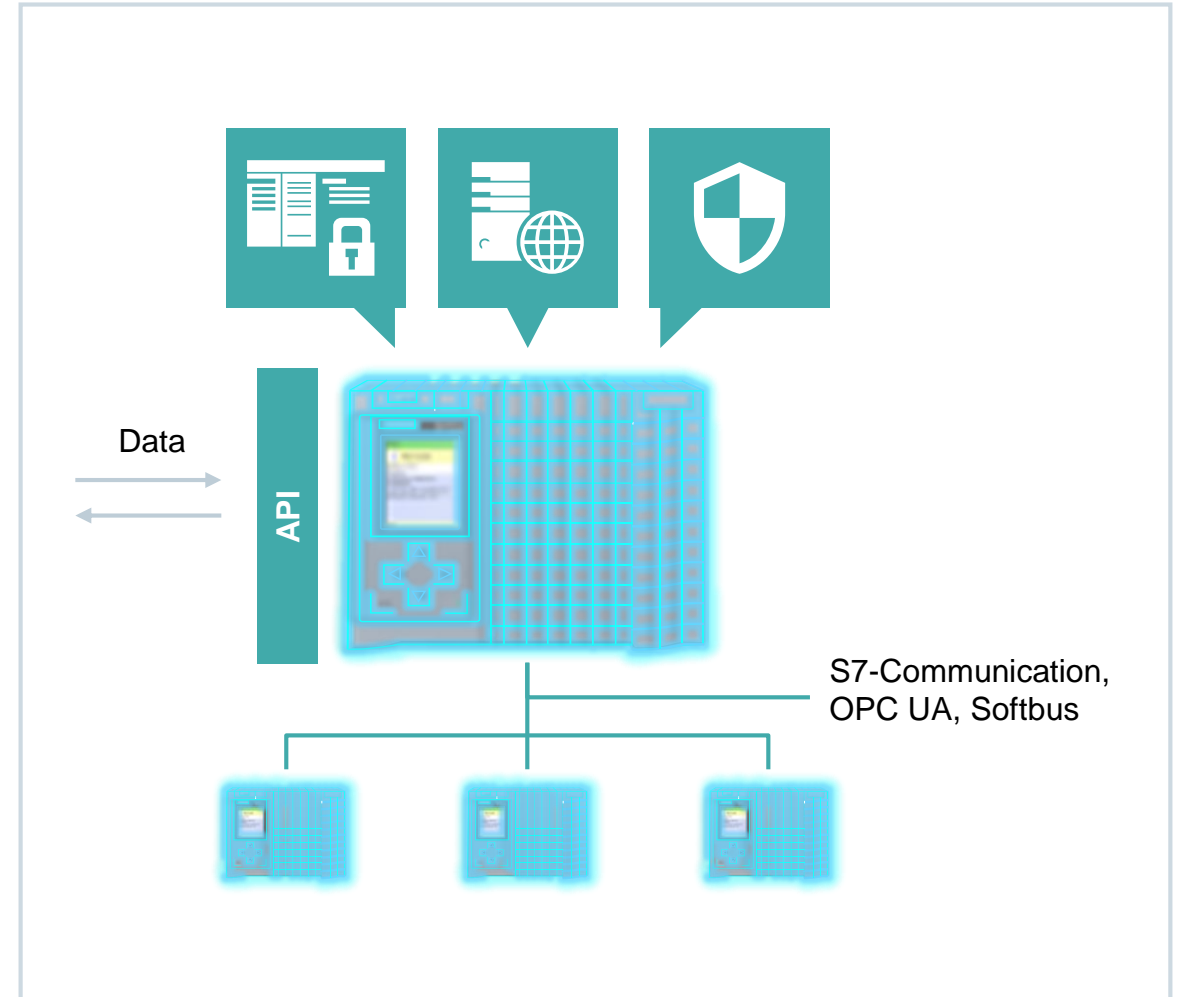
# Virtual Commissioning – SIMATIC PLCSIM Advanced is the virtual controller for SIMATIC S7-1500

**Virtual controller ...** for the wide-ranging simulation of functions including communication, know-how protected blocks, security and web server

**Includes a documented public interface ...** for the exchange of data (I/O, bit memory, DBs, timers) with customer-specific co-simulation or test software

**Support of multiple and distributed instances ...** for the simulation of multiple controllers on a single PC/In the network.

**No program changes required ...** ET200xx, 1500 T/F



# Virtual Commissioning – SIMATIC PLCSIM Advanced V2.0

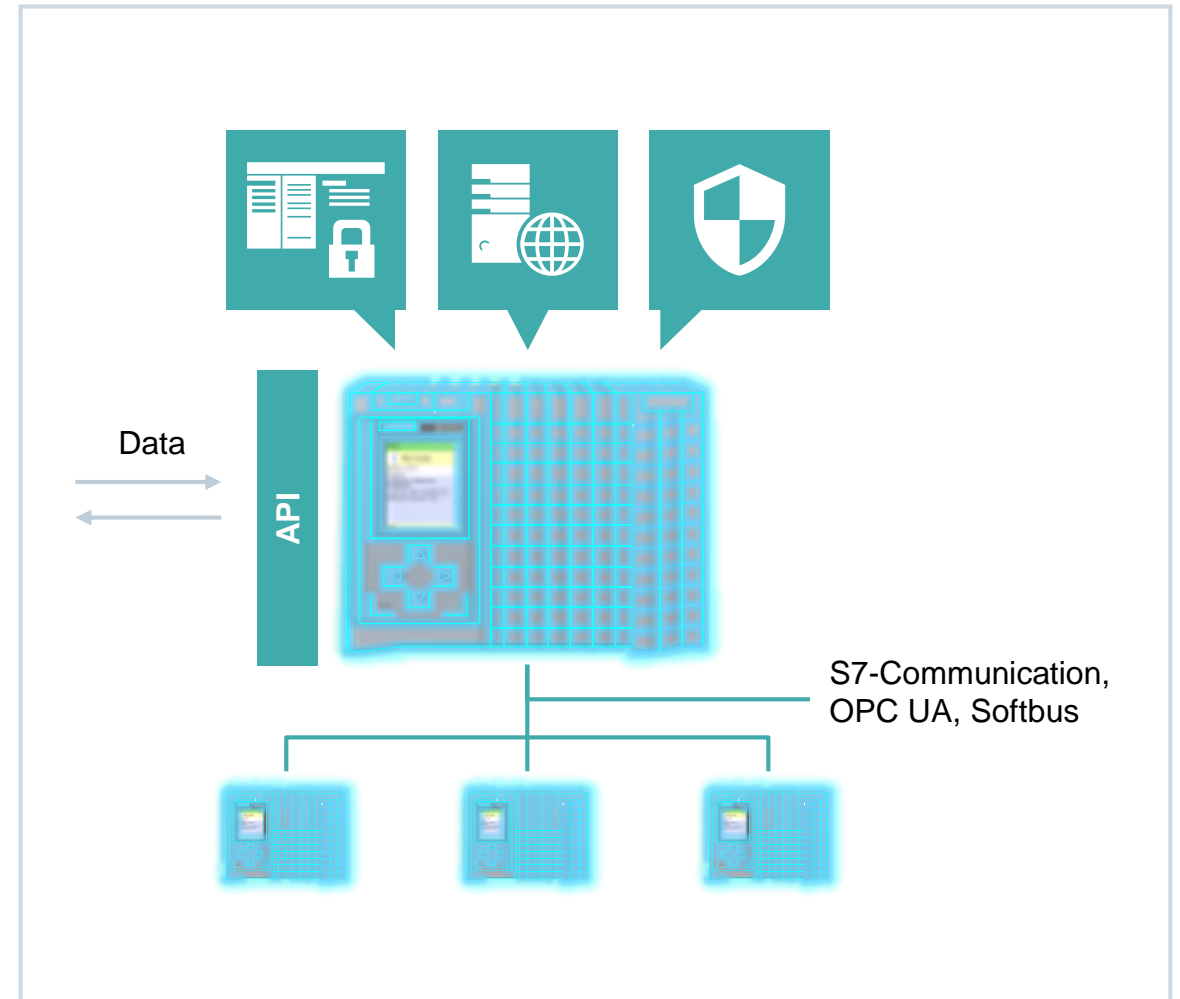
Support of error blocks ... and even more organizational blocks



Parallel installation ...  
for PLCSIM and PLCSIMS Advanced



GUI extension ...  
RUN, STOP and Memory Reset



## Notes

Explanation of the new options with PLCSIM Adv. V2.0

The following features are supported

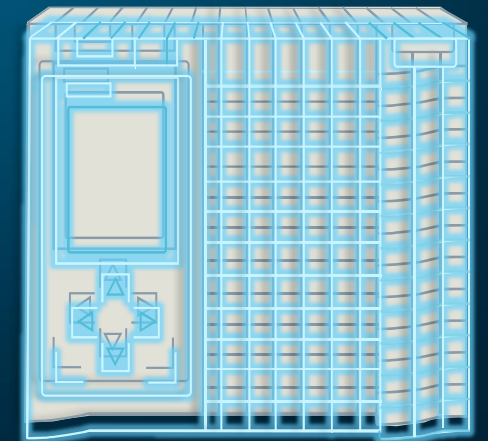
- Module for pulling or pugging (OB83)
- Rack or station failure (OB86)  
→ with hardware selection
- Diagnostic error (OB 82) → with hardware selection

## Content

TIA project press + Test Program

PLCSIM Advanced + Test Program

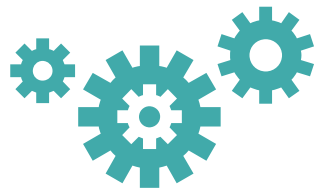
# Live demo





## Requirements

- Assessment of the various automation concepts
- Shorter commissioning time and less faulty behavior at the installation site



## Siemens Solution

- Comprehensive simulation of control functionality with SIMATIC PLCSIM Advanced
- Connection to virtual models of machine and plant behavior with open API



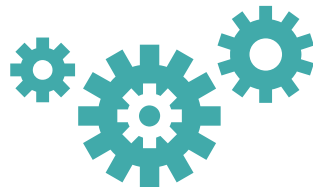
# Challenge 2

Prepared for on-site commissioning

# Prepared for on-site commissioning

## Requirements

- Shorter commissioning time and less faulty behavior at the installation site
- No change of the machine program
- The behavior of the digital twin should be as close to reality as possible



# Prepared for on-site commissioning

## Target customers



Machine manufacturers from the discrete industry  
(construction / automation engineer)

## Deployment scenarios/ target applications



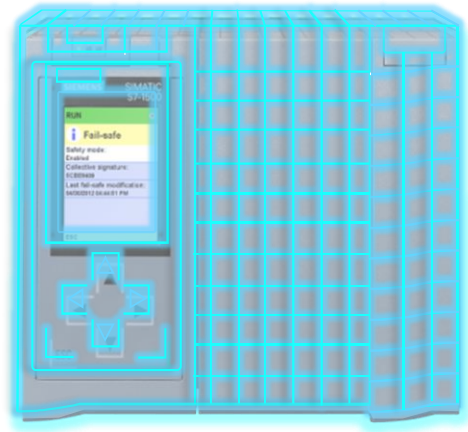
- Digital tests before machine construction/delivery
- Compatibility test with existing machines/systems (line integration)
- Test of the machine before production / delivery

## Requirements for customers



- TIA Portal
- PLCSIM Advanced (S7-1500)
- SIMIT
- NX MCD
- Understanding of automation
- Design skills

# PLCSIM Advanced – The right co-simulation is determined by the application

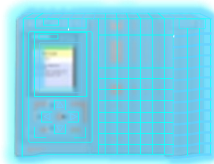


PLCSIM Advanced

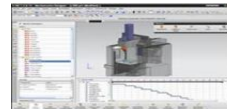
## API

### Siemens portfolio

**Universal**  
PLCSIM Advanced



**Machines**  
NX Mechatronics  
Concept Designer



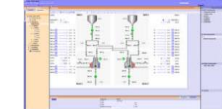
**Robot cells**  
TECNOMATIX Process  
Simulate



**Simulations for material flow technology**  
TECNOMATIX Plant  
Simulation



**Process simulation**  
SIMIT



### Siemens portfolio specific simulation

- AMESIM
- NX Simcenter
- CD-Adapco
- ...

### Third party vendors

**Universal**  
Application in  
programming  
language C/C++



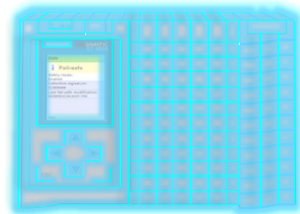
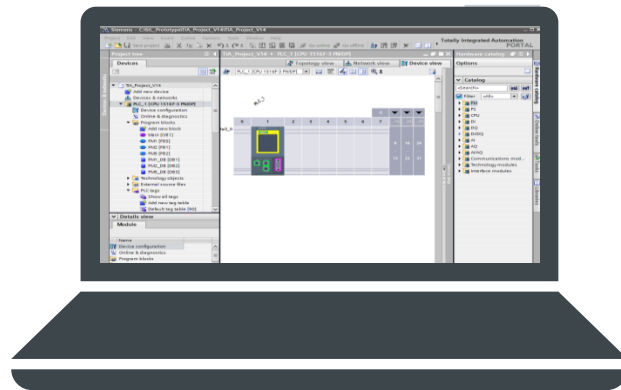
**Technology-oriented applications**  
Matlab Simulink



... and many more

# PLCSIM Advanced and NX MCD – TIA Portal/NX Framework

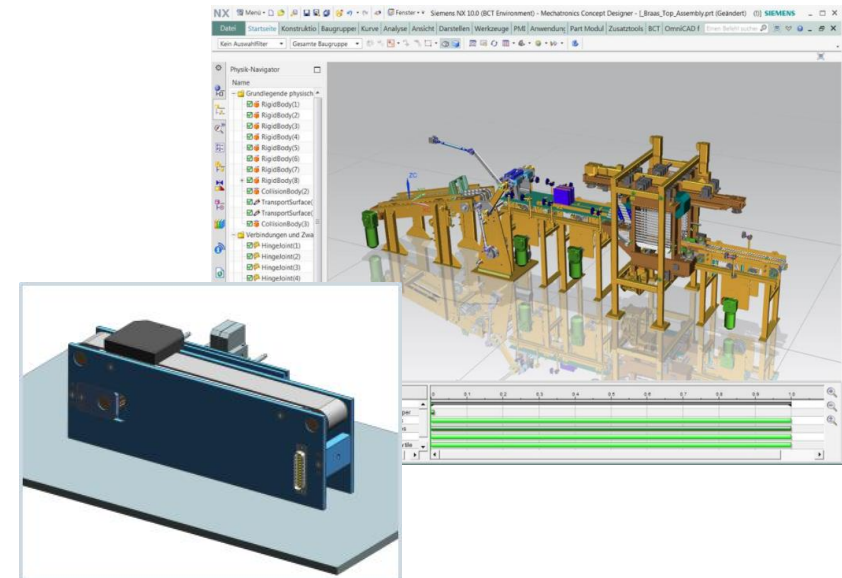
## Automation Framework



Data  
Connection

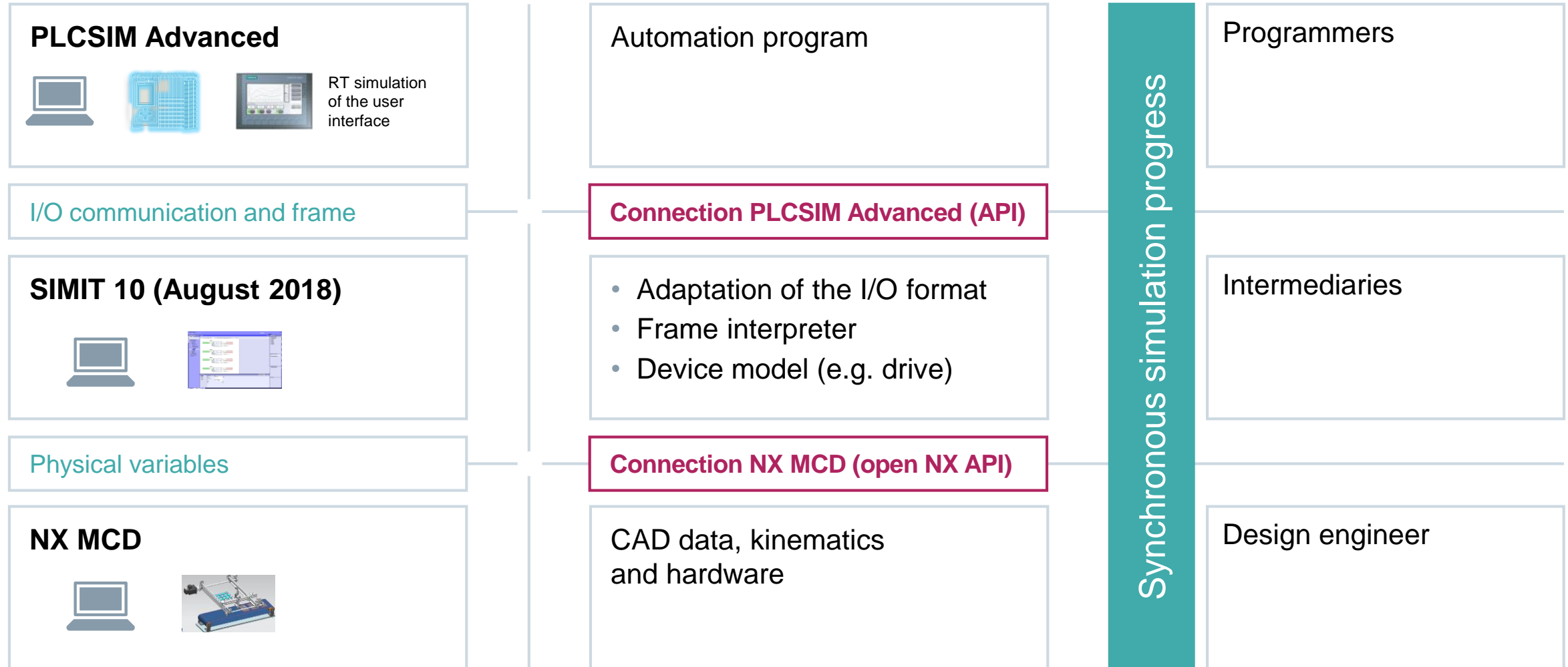
- **TIA Portal**
- **SIMATIC S7-PLCSIM Advanced**
- Simulation of PLC, HMI and I/O
- Engineering of the automation tasks

## Design Framework



- **NX**
- **Mechatronics Concept Designer (MCD)**
- Simulation of the machine
- Improvement of the mechanical model

# PLCSIM Advanced and NX MCD – communication



# Components of the digital twin – Controller simulation with PLCSIM Advanced

Automation  
model



**SIMATIC S7- PLCSIM  
Advanced**



Electrical and  
behavior-based model



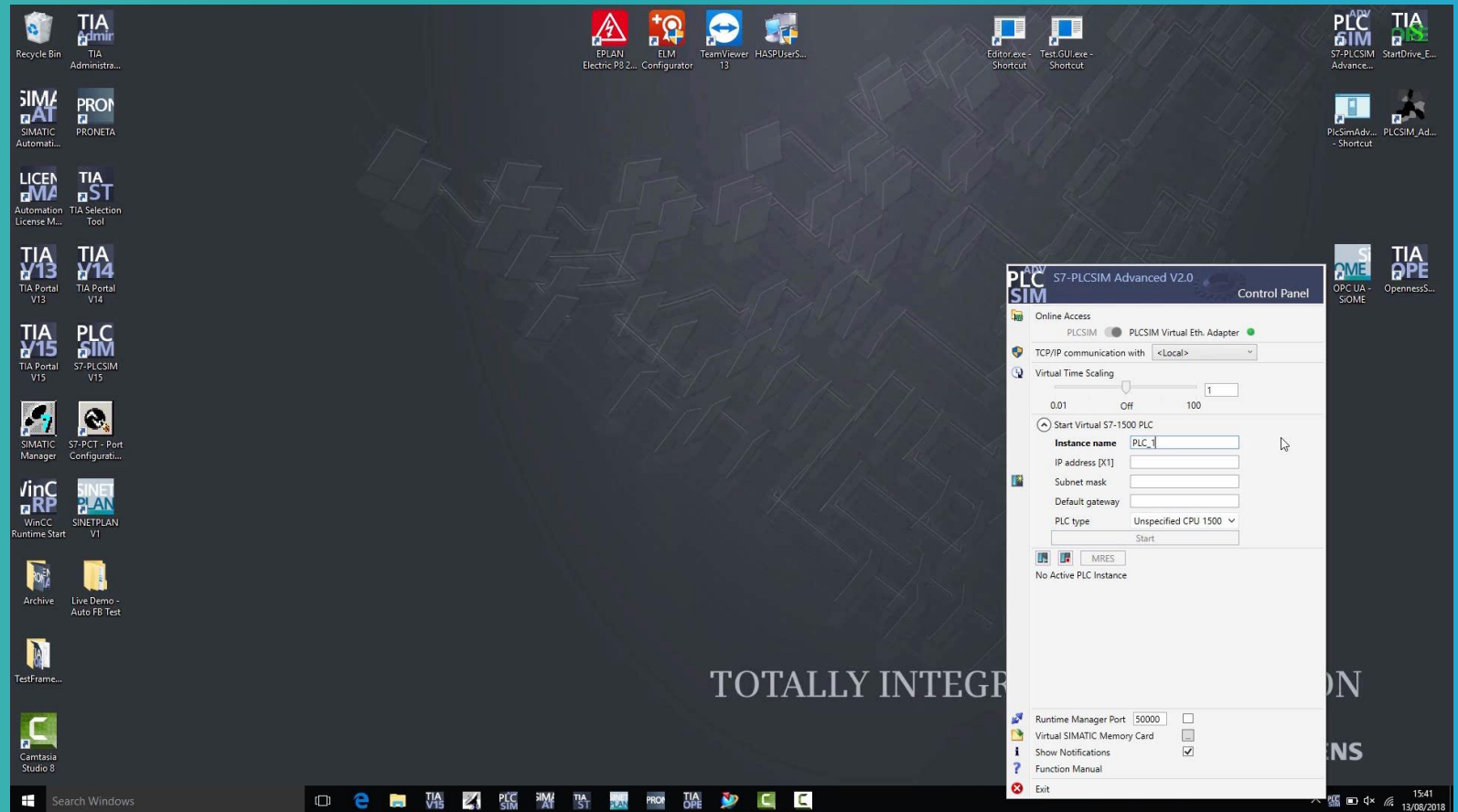
**SIMIT**



Physical and  
kinematic model



**NX Mechatronics  
Concept Designer**





# Components of the digital twin – Electrical and behavior-based model with SIMIT

**SIEMENS**  
*Ingenuity for life*

Automation  
model



**SIMATIC S7- PLCSIM  
Advanced**



Electrical and  
behavior-based model



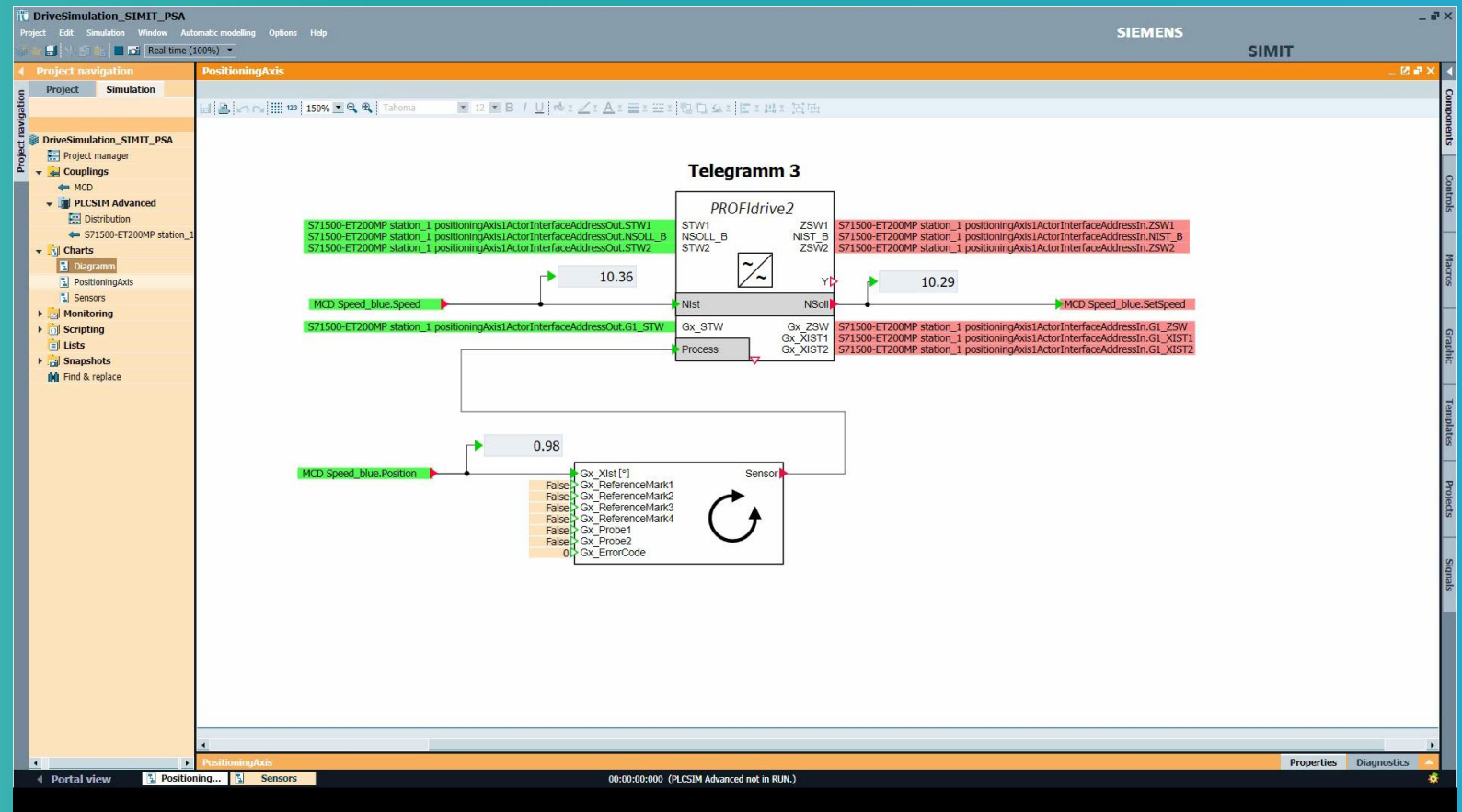
**SIMIT**



Physical and  
kinematic model



**NX Mechatronics  
Concept Designer**



# Components of the digital twin – Physical and kinematic model with NX MCD

**SIEMENS**  
*Ingenuity for life*

Automation  
model



**SIMATIC S7- PLCSIM  
Advanced**



Electrical and  
behavior-based model



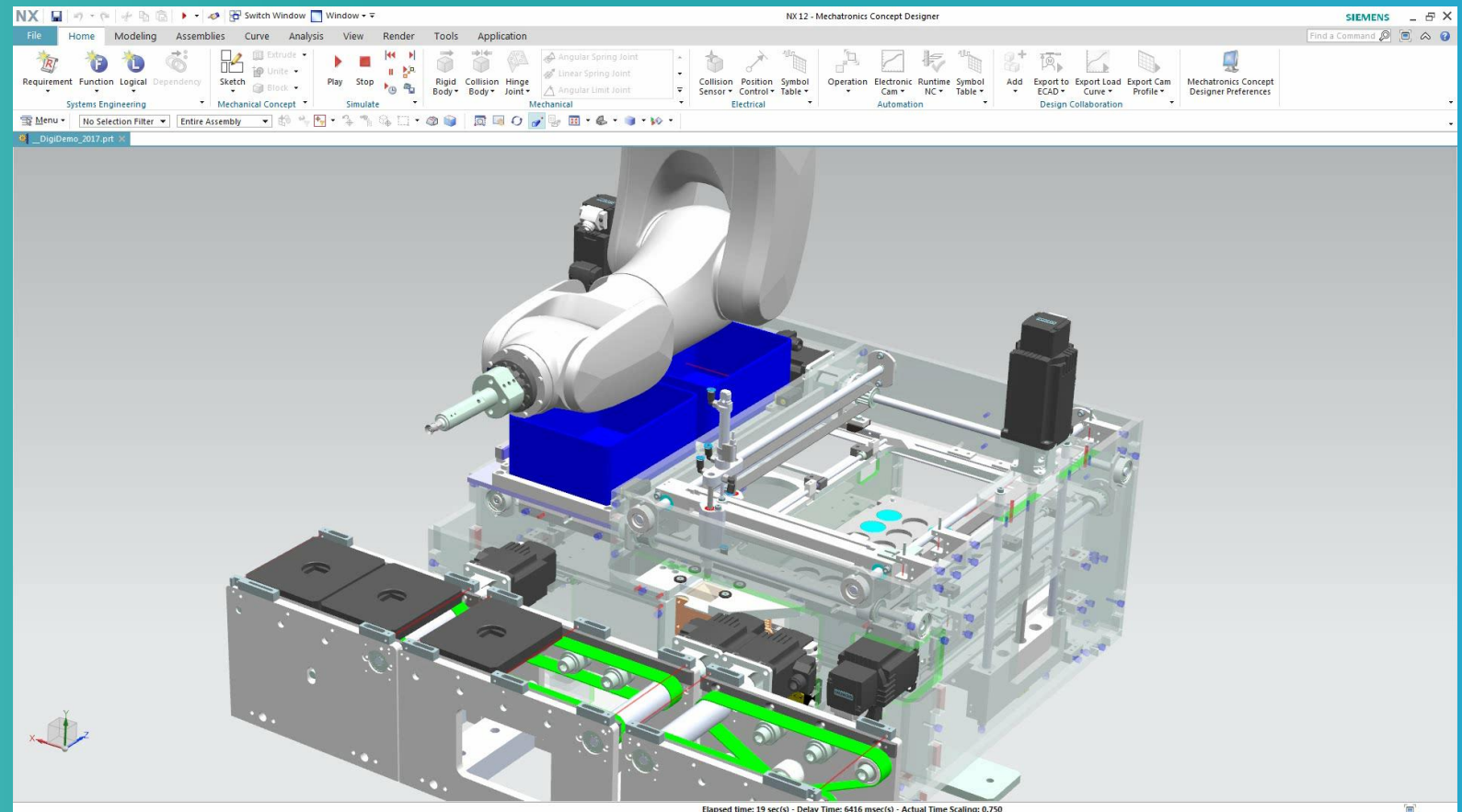
**SIMIT**



Physical and  
kinematic model



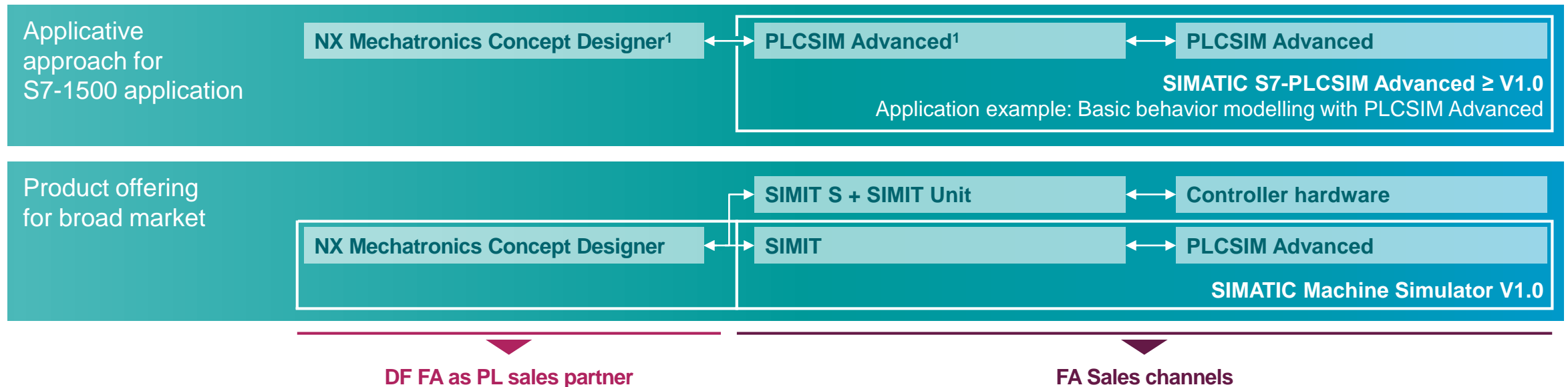
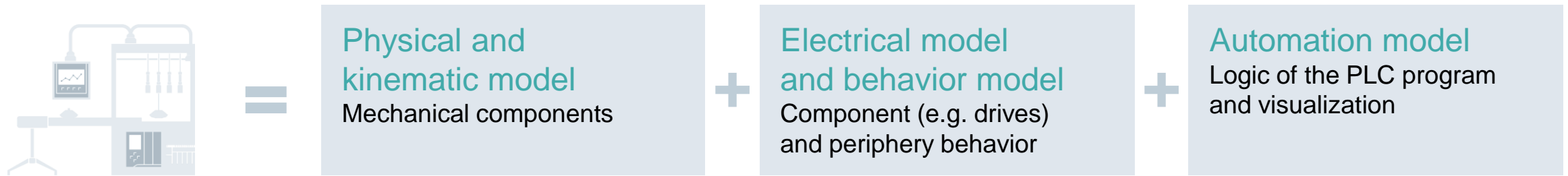
**NX Mechatronics  
Concept Designer**



# Siemens offers a scalable portfolio as a basis for different VC scenarios for machine builders



## Virtual machine model



<sup>1</sup> Not always required

## Notes

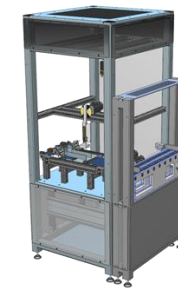
Explain the digital twin of the machine

- Start the machine via SIMIT
- Control signals with SIMIT
- Test the automation program

## Content

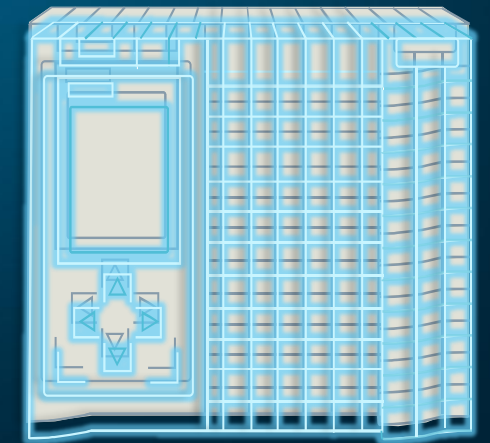
Press model in NX MCD

### NX MCD



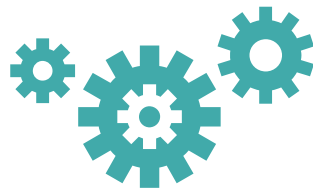
**NX MCD + SIMIT + PLCSIM Advanced**

# Live demo



## Requirements

- Evaluation of the various automation concepts
- Shorter commissioning time and less faulty behavior at the installation site
- No change of the machine program
- The behavior of the digital twin should be as close to reality as possible




## Siemens Solution

- Comprehensive simulation of control functionality with SIMATIC PLCSIM Advanced
- Simulation of electrical machine behavior with SIMIT
- Simulation of physical machine behavior with NX MCD
- Fully integrated connectivity between PLCSIM Adv, NX MCD and SIMIT




# Virtual Commissioning lowers the risks for real commissioning

## Without Virtual Commissioning Unexpected problems increase ...

... Time requirements 

... Personnel requirements 

... Material requirements 

And when international projects are involved ... 

**= Incalculable costs**



## With Virtual Commissioning Problem scenarios are known from Virtual Commissioning

Best case: Cause of error eliminated

Solution strategies are already developed

Replacement material is at the ready



**= Calculable costs**



# Challenge 3

Virtual training

## Requirements

- Shorter startup times and fewer operating errors
- Shorter training phases for operators
- Customer training before delivering the machine
- Fluctuation of operating personal





# Virtual Training



## Target customers



- End customers
- Machine operators
- Machine manufacturers

## Deployment scenarios/ target applications

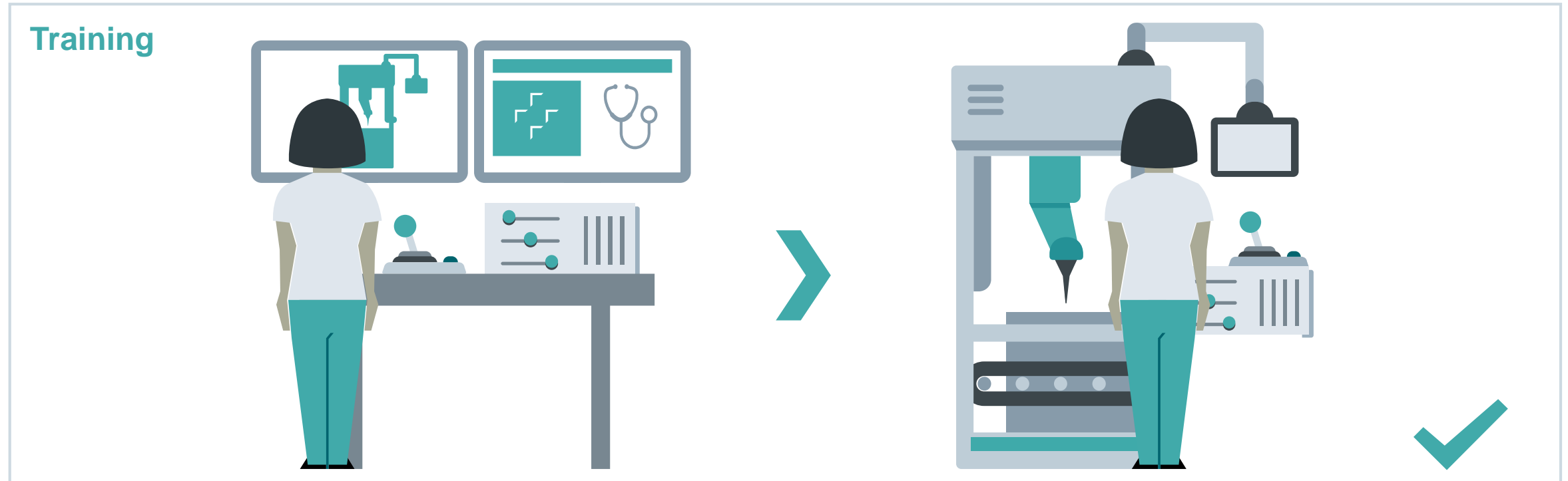


- Training of operating personnel
- Usability check
- Improve human/machine interaction

## Requirements for customers






- PLCSIM Advanced
- WinCC Runtime
- SIMIT
- NX MCD
- Optional real hardware



- Improved user-friendliness of the HMI devices even during the engineering phase based on feedback from the training sessions
- Operator training under realistic conditions to ensure faster ramp-up and fewer operator errors caused by inexperienced operators






# Future versus present - Training operating personnel as early as possible

## Without virtual training

-  Only theoretical training possible before commissioning
-  Inexperienced operators increasingly cause errors during the start-up phase
-  Limited user-friendliness of the operator interfaces can only be detected during the start-up phase, which means that costly repairs may be necessary.

VS

## With virtual Training

-  Practical training under realistic conditions
-  Fast qualification of new employees
-  Shorter ramp-up times for new machines and plants
-  Usability of the operator interfaces can be validated and optimized during the engineering phase
-  Reduced training costs due to location independence

## Notes

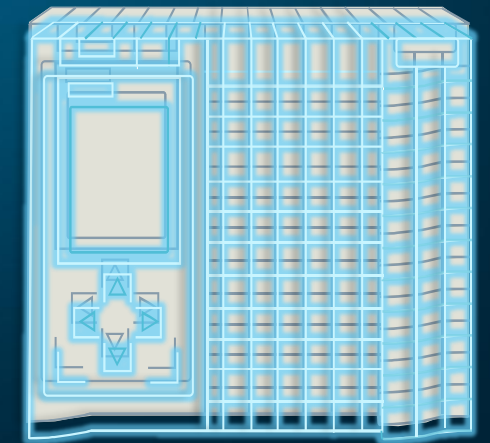
- Advanced operator training – with real hardware
- Operate the machine with a real hardware panel
  - Simulate errors and react accordingly
  - See the behavior of the machine in different scenarios and optimize it

## Content

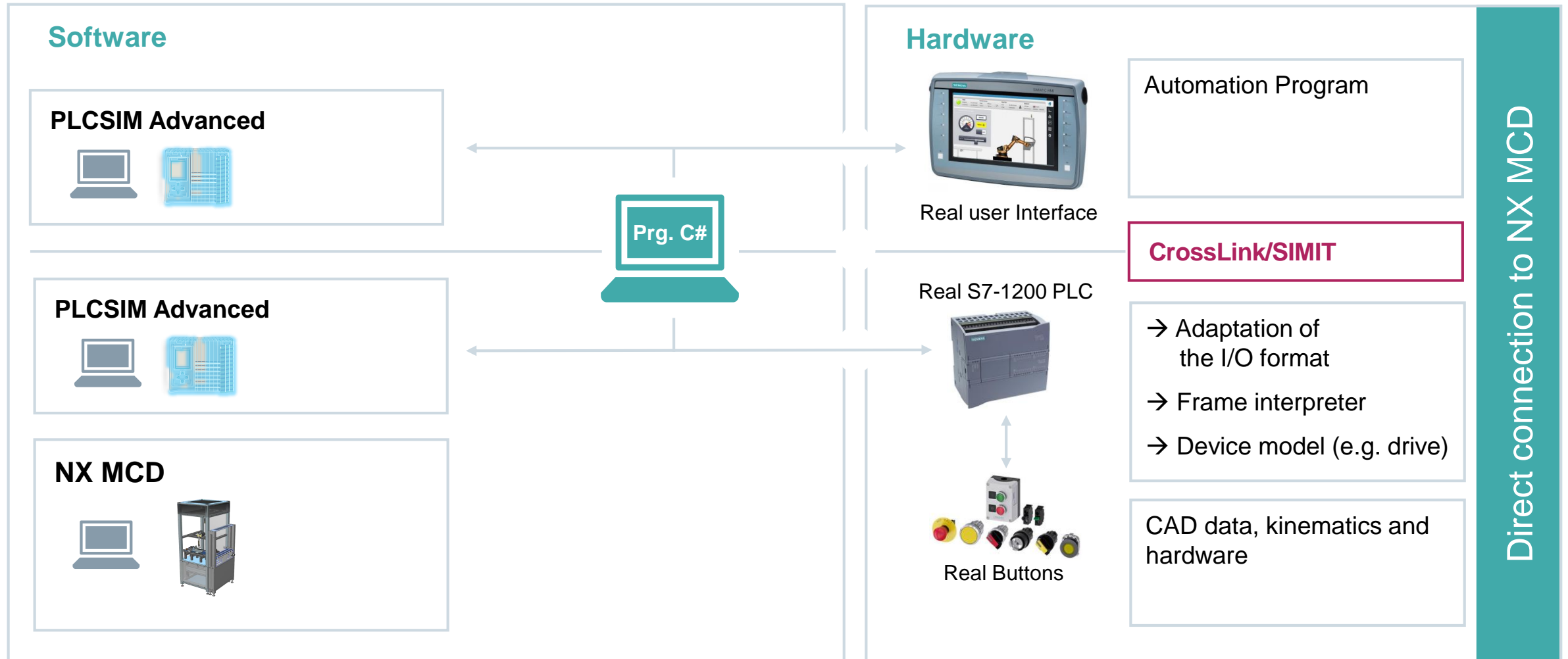
Press model in NX MCD

**NX MCD + PLCSIM Adv. + test program + real hardware**

# Live demo



# Virtual Training – with real hardware



## Requirements

- Shorter startup times and fewer operating errors
- Shorter training phases for operators
- Customer training before delivering the machine
- Fluctuation of operating personal



## Siemens Solution

- Virtual training on the virtual model
- Original operator interfaces such as SIMATIC HMI or SIRIUS ACT are used.
- Full virtual training models with virtual HMI devices via HMI simulation in the TIA Portal).



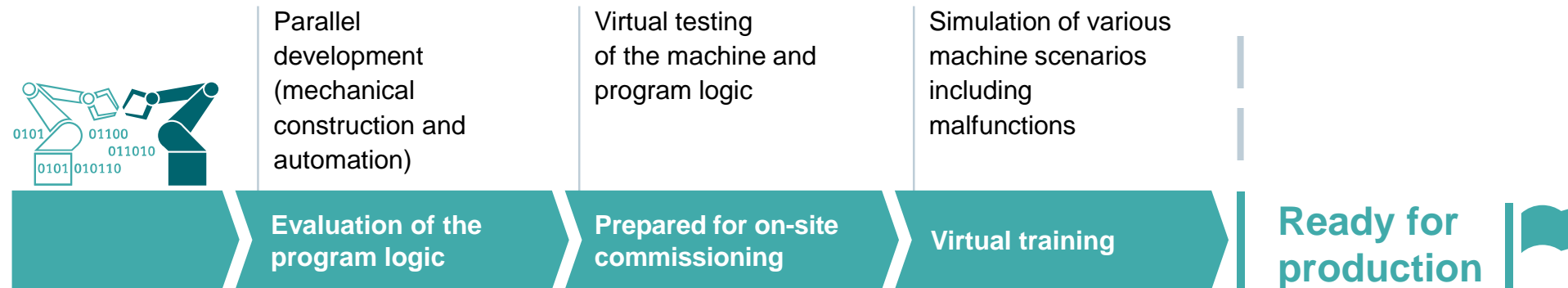
The background of the image is a futuristic factory floor with a blue color scheme. In the center, there are two human figures. The one on the left is a glowing blue digital or particle-based human figure, standing with hands on hips. The one on the right is a real human figure in a dark, athletic outfit, running towards the viewer. The floor is highly reflective, showing the figures and the surrounding machinery. In the top right corner, there is a white rectangular box containing the Siemens logo and tagline. In the bottom left corner, there is a teal rectangular box containing the word 'Benefits' in white text.

**SIEMENS**  
*Ingenuity for life*

**Benefits**

# Virtual commissioning with the digital twin enables faster commissioning and reduces costs and risks

## Virtual Commissioning



## Standard commissioning





# Virtual commissioning with the digital twin enables faster commissioning and reduces costs and risks

Quality



Optimization of the automation program and machine functionality in a **virtual environment**

Speed



- **Faster commissioning** at the end customer's plant
- **Parallelization** of mechanical and automation-related engineering

Costs



- The earlier you optimize, the more you can save.
- **Lower commissioning costs**

Risk



- Safe and efficient testing based on the model
- **Reduced risks** for real commissioning and fewer operating errors

Flexibility



- "Laboratory" for the development of alternative control concepts
- **Evaluation of machine modifications** during operation

**Q&A**