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# SIMATIC Machine Simulator

Virtual Commissioning of Machines

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# SIMATIC Machine Simulator – Virtual Commissioning of Machines

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# With virtual commissioning machine builders are able to tackle the major challenges in the commissioning process



How can we speed up the commissioning of machines?



What levers can be used to lower the risks and costs during the commissioning?

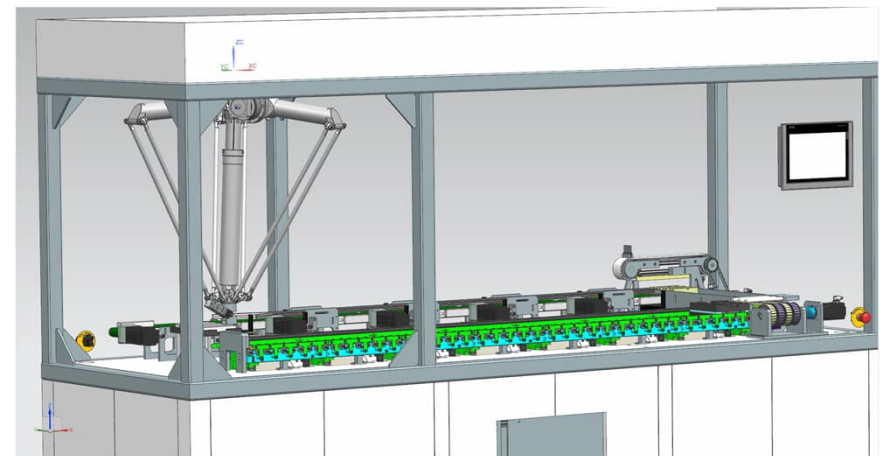


How can unplanned machine behavior be avoided?



How can mechanical or software failures be identified at an early stage?

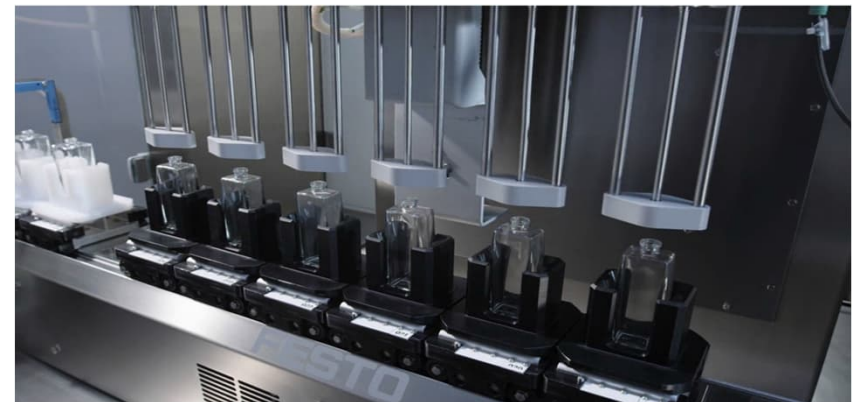
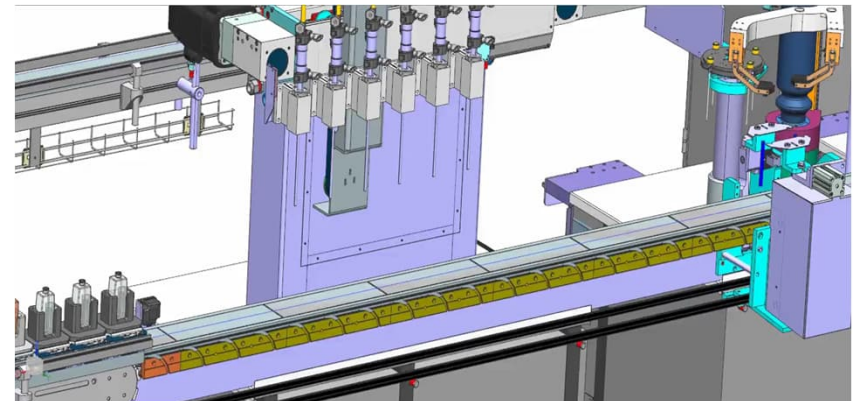
The most efficient way to speed up commissioning of machines, while simultaneously improving production quality, is to use **Virtual Commissioning**



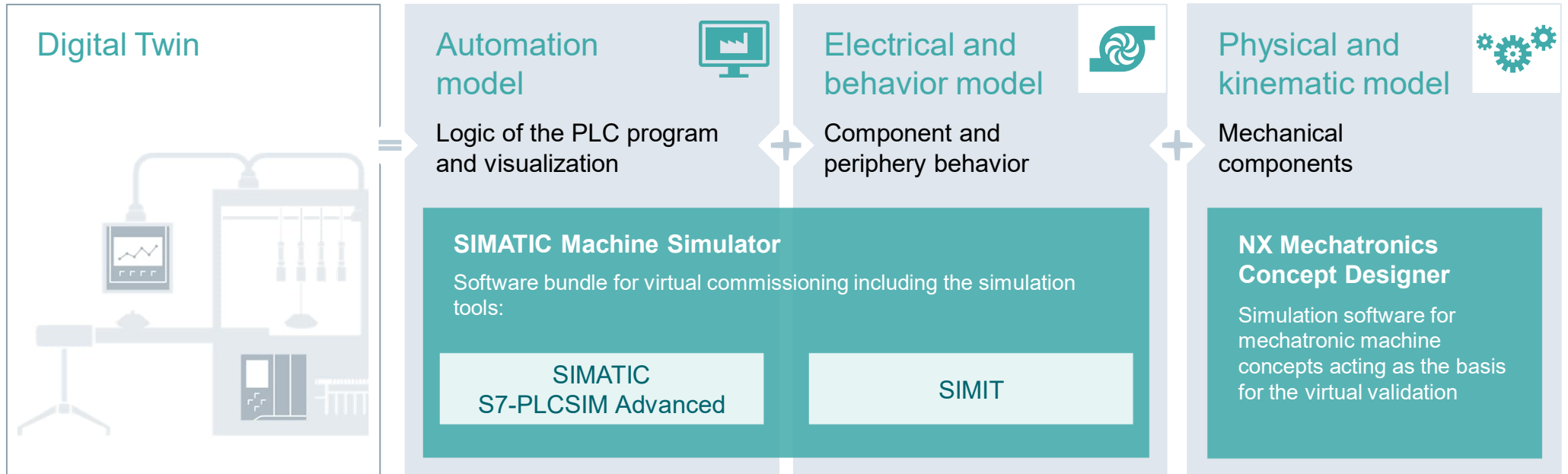
# Digital twins of machines lead to faster commissioning, reduced costs and risks

## The digital twin of a machine

- is created **without having real prototypes**
- allows to **identify errors at an early stage** in the product life cycle
- **saves time & costs** when it comes to the actual commissioning
- enables machines builders to **engineer and program the machine from your preferred workplace**, i.e. mobile working & home office
- can be used for **virtual testing, machine optimization and operator training**

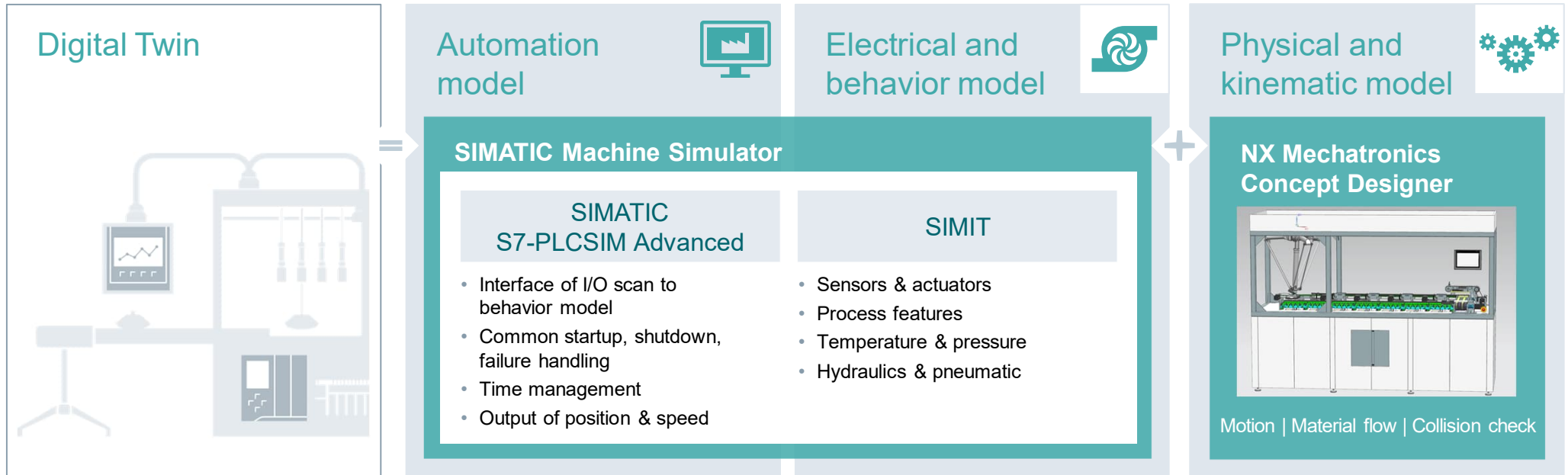


# The digital twin of a machine is a combination of three different simulation models



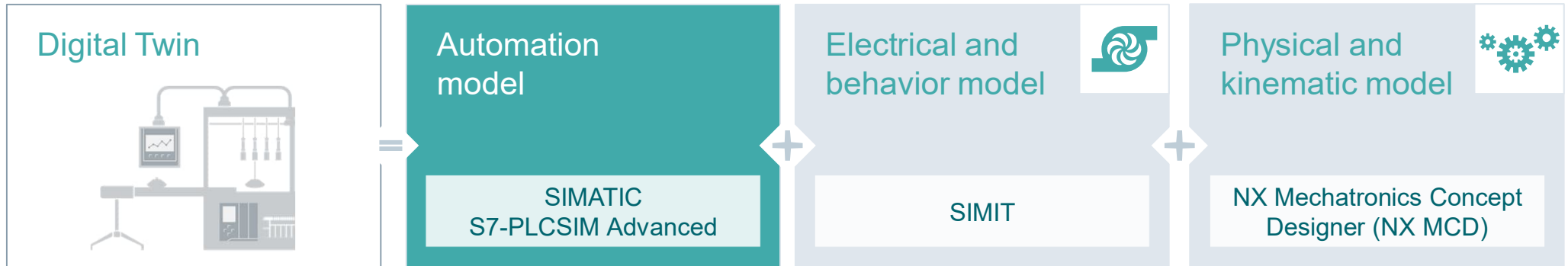
The integrated software landscape makes it possible to simulate and validate machines – ranging from simple to complex machine specifications.

# Validation of mechanical concept, controller code, physical behavior and automation model on one platform



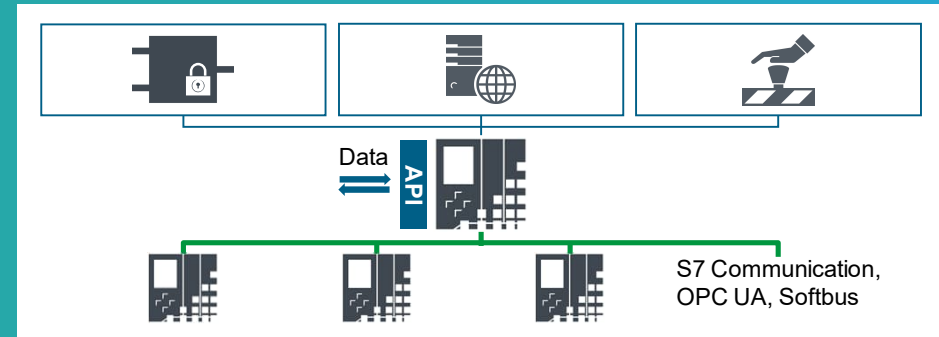
Synchronize mechatronic, behavior and controller simulation for reliable validation and testing

# Creating the digital twin – Step 1: Automation model with SIMATIC S7-PLCSIM Advanced



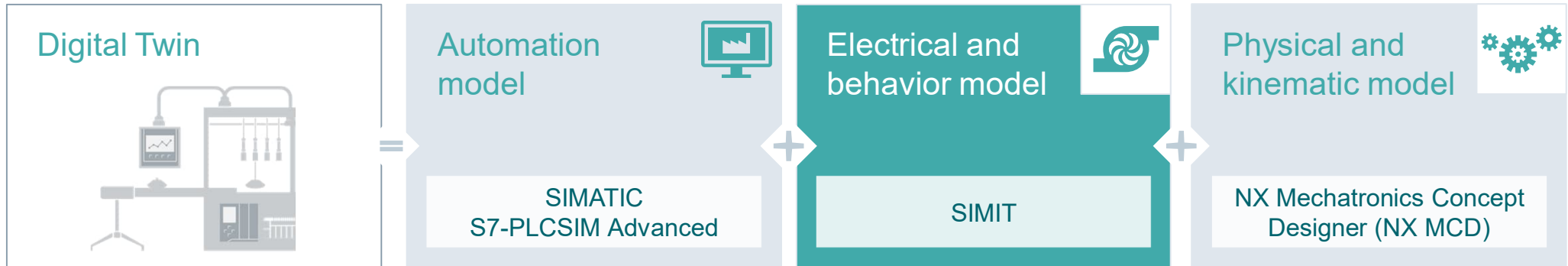
## SIMATIC S7-PLCSIM Advanced: Emulation of SIMATIC S7-1500 controllers

- **Extensive function simulation** including communication, know-how protected blocks, safety and web server
- **Public interfaces for exchange of data** with customized co-simulation or test software
- **Support of multiple and distributed instances** for simulation of multiple controllers on a PC/in the network
- **Virtual Time Management and synchronization**



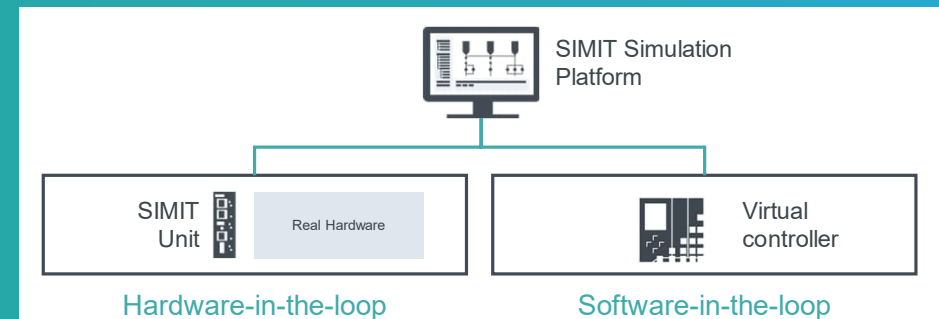
## Creating the digital twin – Step 2: Electrical and behavior model with SIMIT

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### SIMIT: Simulation for engineering and operation

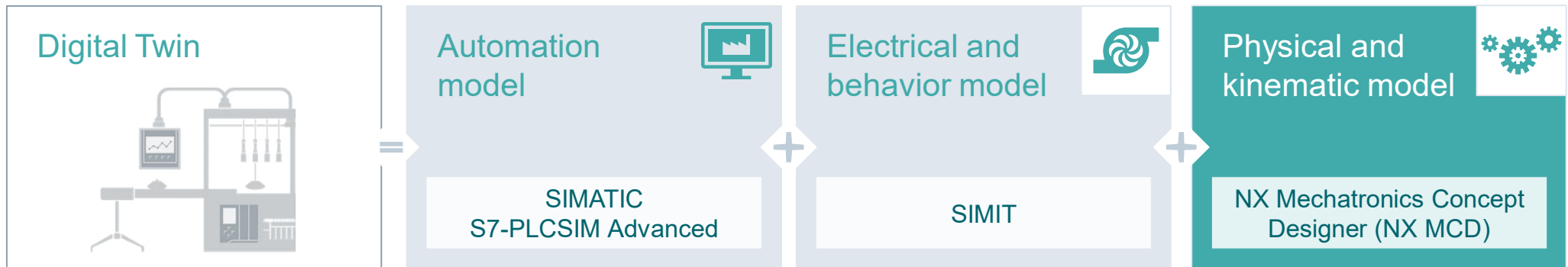
- **Decentral periphery is emulated** through behavior modelling, i.e. sensors and actuators, process features, temperature and pressure, hydraulics
- **Enabling co-simulations**
  - Functional Mockup Unit / Functional Mockup Interface
  - Direct connection to Design Simulation Tools (AMESIM, Matlab)
- **Alternatively, testing with real hardware** and connection of 3<sup>rd</sup> party applications with SIMIT Unit possible





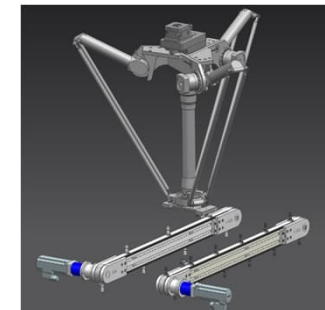
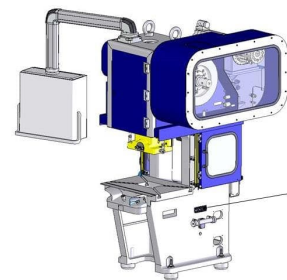
## Creating the digital twin – Step 3: Physical and kinematic model with NX MCD

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### NX MCD: Creation of the machine concept & mechanical simulation

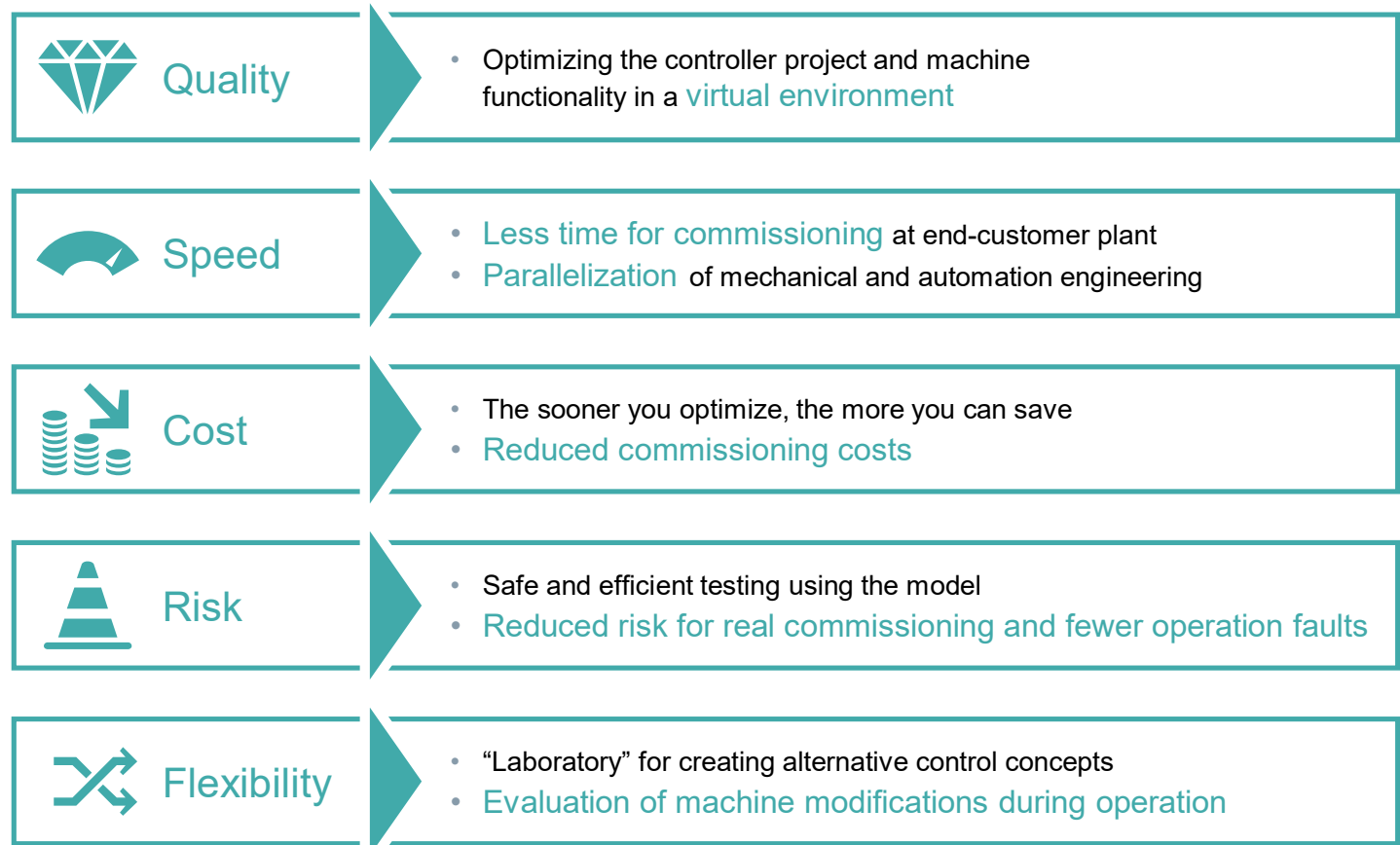
- **Creation of mechanical model** by using CAD-Data
- **Physical and kinematic enrichment** components like motion, material flow, gravity or collisions
- **Different design alternatives can be simulated** and validated in an easy way
- **Optional:** NX MCD Player offers a cost-efficient chance to run existing simulations at multiple work-stations. But to configure the simulation a full NX MCD License is required.



# Benefits of virtual commissioning at a glance: faster commissioning, reduced costs and risks

The advantages of virtual commissioning using SIMATIC Machine Simulator apply for

- development of new machines
- extension of existing machines
- retrofit and machine optimization



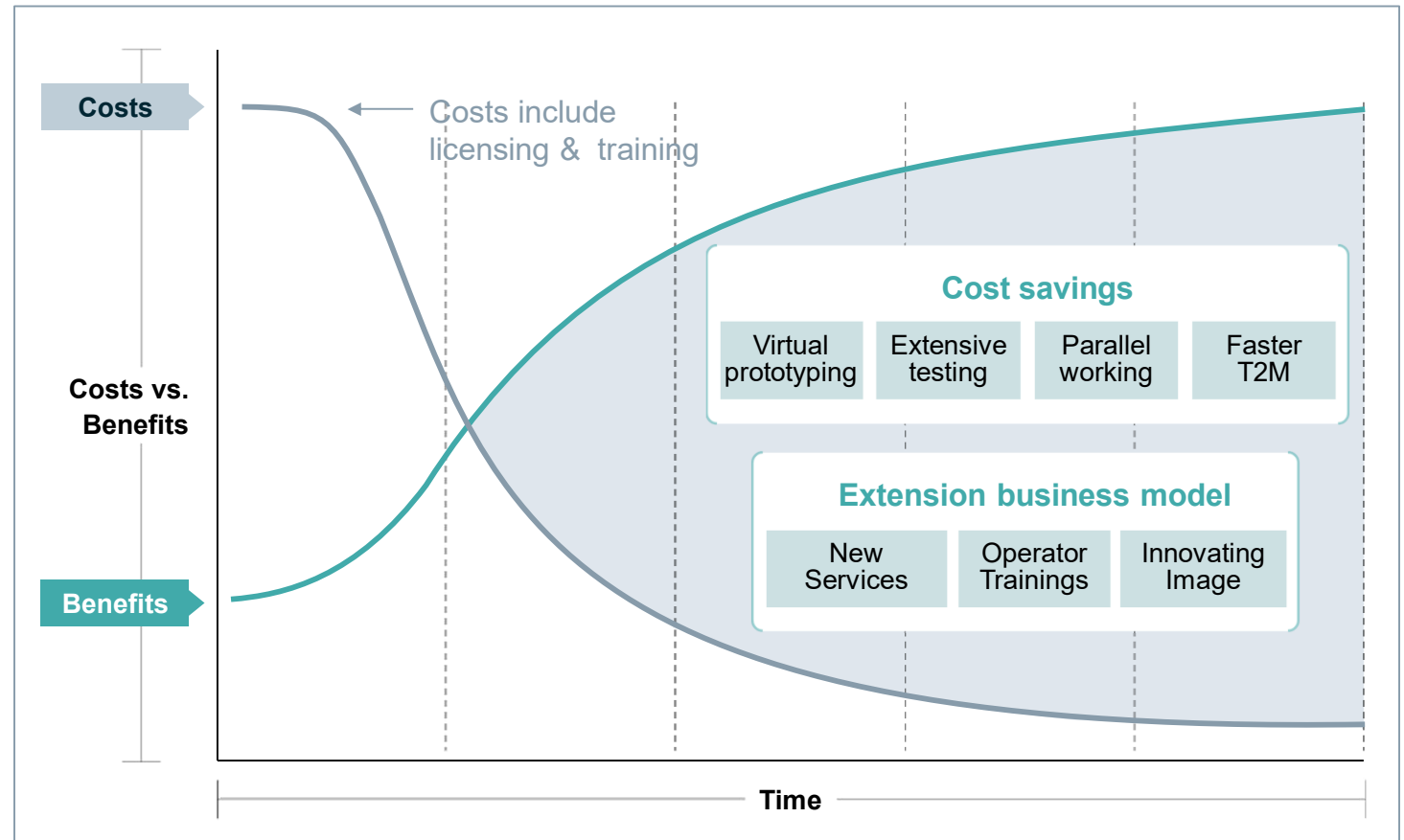
# Investment vs. Benefits: Investments for virtual commissioning amortize shortly

## Investments amortize shortly:

- licensing costs for virtual commissioning software
- training efforts

## Long term benefits

- costs-savings
- extension of business models



# Virtual commissioning helped leading machine builders to speed up their development and commissioning

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**Tonrud Engineering**  
Packaging machines

*“We have reduced the design phase by 10 percent and the commissioning phase by around 20 to 25 percent.”*

Tor Morten Stadum, PLM Manager at Tronrud Engineering



[Find out, how Tronrud Engineering cuts engineering and assembly times for world's fastest packaging machine ...](#)



**DISA**  
Casting and moulding equipment

*“It has been important for us to establish a new way to test our software and test our equipment before going to the physics of the machine.”*

Jan Hemmingshøj, Head of Electrical Automation



[Discover the story of DISA and how they integrated simulation into their workflow ...](#)



**Autefa Solutions GmbH**  
Manufacturer of textile fiber baling presses

*“We are convinced that digitalization will deliver the added value that both we and our customers are seeking.”*

Rudolf Kuhn, Head of Technology & Planning of Autefa Group



[Click here to read about how to realize efficient bale press with virtual commissioning](#)

## Virtual commissioning also offers advantages for machine operators – and thus a USP for OEMs

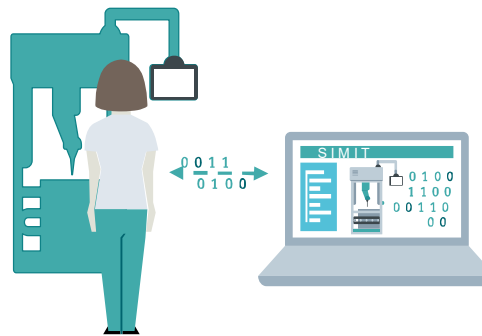
### “(Pre)-Production”-Training

- Machine operators can familiarize themselves with the operating behavior before using the machine

### Advantages for the machine operator

- Fast & smooth production start-up
- Efficient troubleshooting by trained operators
- Avoidance of operating errors
- Reduction of downtimes

### Training scope with the Digital Twin of the machine



### Training scope for machine operators

- Operator units through HMI simulation
- Machine behavior
- Critical scenarios (error/fault handling)

### Advantages of the training

- Training under real conditions
- Reproducible error scenarios

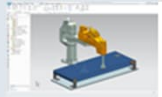
**For plant operators** it is possible to simulate not only the individual machine but also the entire production. For this purpose, the scope of training can be extended with SCADA systems (WinCC) for the simulation of the plant behavior.

# Virtual commissioning of machines

## Available resources for getting started



### Getting started

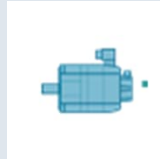


#### SIMATIC Machine Simulator

Step-by-step explanation with application example for getting started with virtual commissioning



### Libraries for SIMIT



#### Drives Behavior Library

Simulation of automation technology



#### RFID Behavior Library

Simulation of sensor and actuator behavior

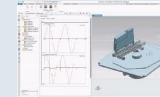


#### Control Elements Library

SIMIT Library control and indicator elements



### Motor Sizing with NX MCD



#### Motor Sizing with NX MCD

select a motor with the help of NX Mechatronics Concept Designer and SIZER

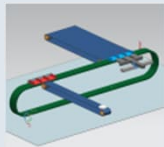


# Virtual commissioning of machines

## Machine models for industry specific applications



### Machine Modules for NX MCD & SIMIT



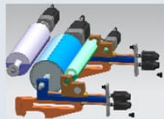
#### Intelligent Belt

With the multi-train control, products arriving one after the other can be picked up and made available together at one unloading position



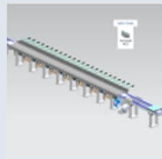
#### C Frame Press

Software package for automation of a conventional flywheel press with SIMATIC S7-1500 including press safety library



#### Cylinder Positioning

Application for positioning the printing cylinders of a flexo printing machine



#### Multi-Carrier-System

Simple creation of models for MCS lines



### Models for SIMIT



#### Continuous web simulation

Mechanical & process elements like winders, driven axes, guide rolls, dancers, and web behavior



# Virtual commissioning of machines

## Getting started with SIMATIC Machine Simulator

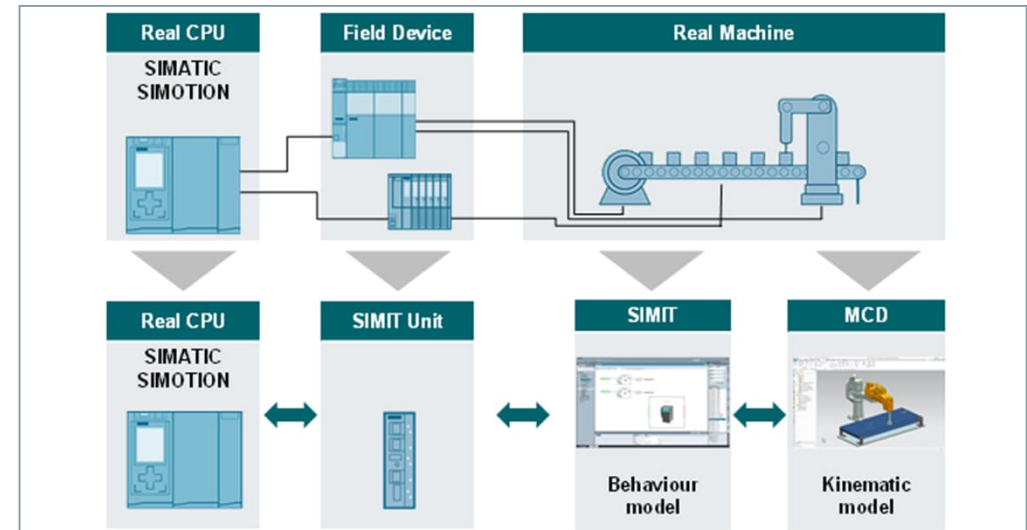
### Use Cases

- Learn how to do build up simulation models for HIL and SIL to perform virtual commissioning
- Simulate your machine in NX MCD
- Create NX MCD, SHM, SIMIT UNIT and SIMATIC S7-PLCSIM Advanced coupling in SIMIT
- Simulation model for PROFIdrive devices

### Technical description



- Introduction to Virtual Commissioning
- Software in the Loop (SIL) Simulation with NX MCD, SIMIT and SIMATIC S7-PLCSIM Advanced
- Hardware in the Loop (HIL) Simulation with NX MCD, SIMIT UNIT and SIMOTION / SIMATIC
- Illustration of coupling and interaction of different programs



### Information & Download in SIOS

[SIMATIC Machine Simulator – Virtual commissioning of machines Getting Started](#)

[SIMATIC/SIMOTION Virtual Commissioning with Hardware in the Loop](#)



# Virtual commissioning of machines

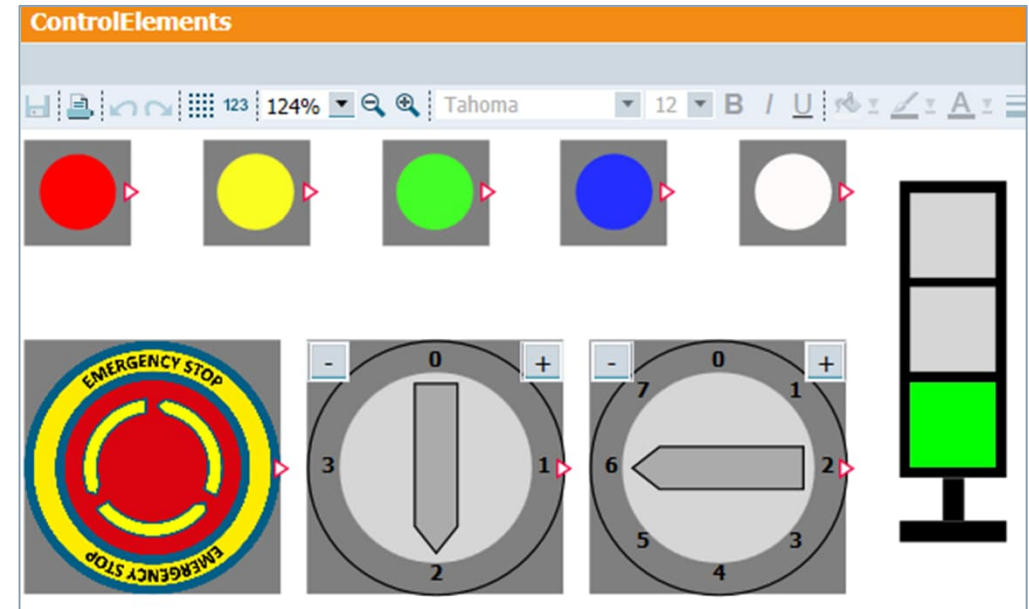
## Control element library in SIMIT

### Use Cases

- Rebuild the control panel of your machine
- Operator Training with a digital twin
- Open library, can be adopted to own requirements

### Technical description

- SIMIT Control elements developed with Component Type Editor (CTE)
- Lightbutton, parameterizable (NO – NC, color, default value)
- Emergency Stop button
- Rotary switch, parameterizable (no. of states, color, default value)
- Indicator and indicator tower
- Key switch



### Information & Download in SIOS

[SIMIT library and example project available](#)

# Virtual commissioning of machines

## Motor Sizing with NX MCD

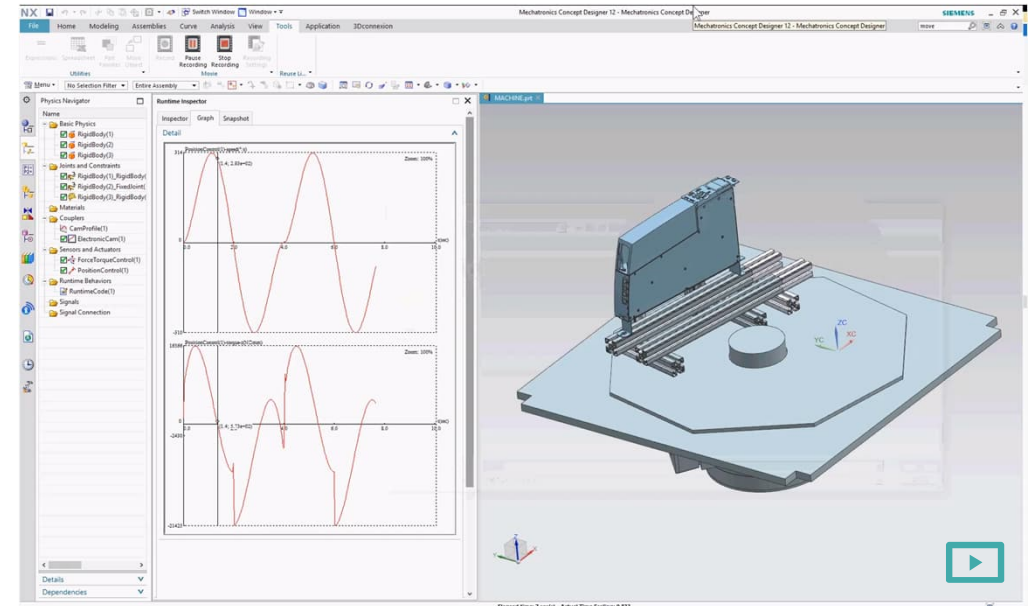
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### Use Cases

- Learn how to do use NX MCD for sizing drives together with SIZER
- Use example project for getting started

### Technical description

- Exchange CAM profiles between SIMOTION SCOUT and NX MCD
- Configure Cam profiles in NX MCD
- User defined friction model in NX MCD
- Export load curves from NX MCD to SIZER



### Information & Download in SIOS

[NX MCD model, TIA Portal Project and SIZER projects available](#)

# Virtual commissioning of machines

## Industry specific applications: Intelligent Belt



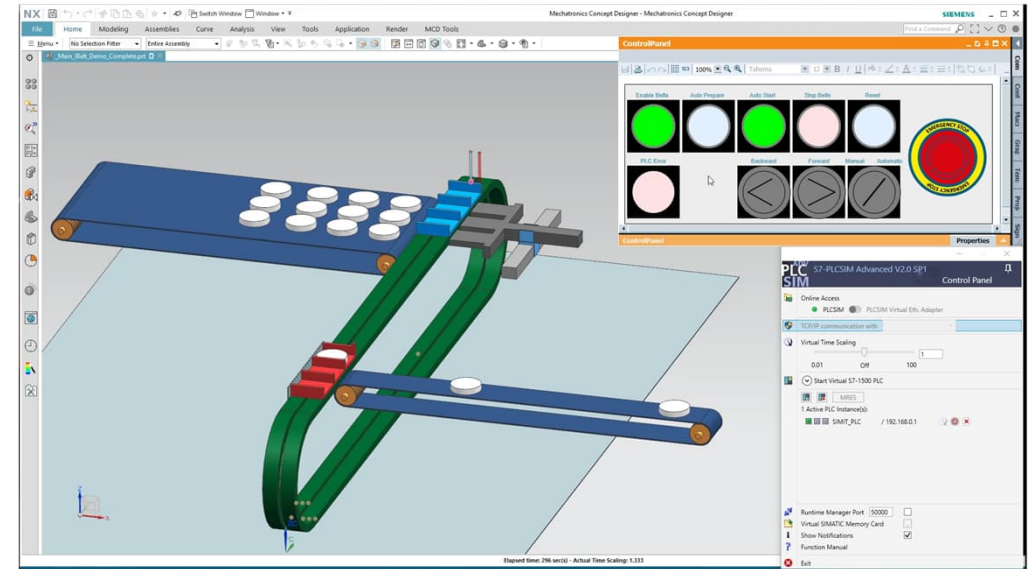
### Use Cases

- Evaluate the mechatronic concept (e.g. collision check of the trains, conveyors and products)
- Test step sequences and operation modes of the intelligent belt application
- Test intelligent belt application flexible on variable infeed and outfeed velocities
- Simulate different packaging modes, e.g. sequential or pattern station
- Validate homing process

### Technical description



- Digital twin of a multi belt system for packaging machines with NX MCD, SIMIT and PLCSIM Advanced
- PROFIdrive simulation for the belt axes in SIMIT
- Simulation of control panel in SIMIT
- Product handling and collision simulation in NX MCD
- Supply and outfeed conveyors - simulated and controlled by SIMIT



### Information & Download in SIOS

[NX MCD, SIMIT model and TIA example project available](#)

# Virtual commissioning of machines

## Industry specific applications: Cylinder Positioning

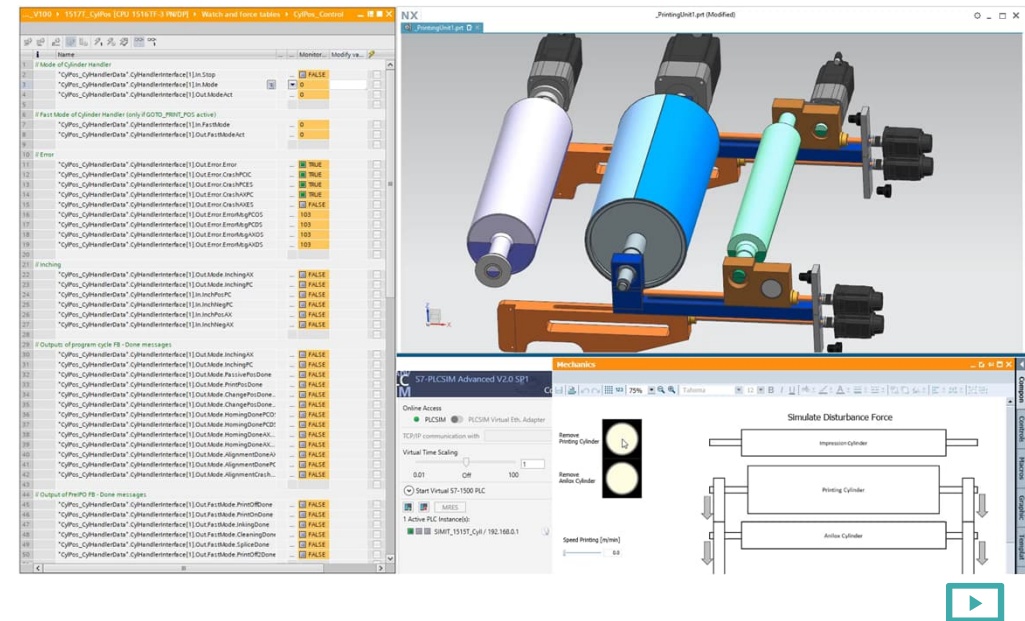


### Use Cases

- Evaluate the mechatronic concept (e.g. collision check of the motors)
- Test step sequences and operation modes of the cylinder positioning application
- Validate the geometry calculation
- Simulate homing on fixed endstop
- Test alignment and crash observation

### Technical description

- Digital twin of a flexographic printing unit with NX MCD, SIMIT and PLCSIM Advanced
- PROFIdrive simulation for the cylinder positioning axes in SIMIT
- Simplified simulation of contact pressure in SIMIT
- Remove and install printing and anilox cylinders during simulation (e.g. for homing) in NX MCD
- Flexible mechanic: adjustable geometry of printing unit



### Information & Download in SIOS

[NX MCD, SIMIT model and TIA example project available](#)

# Virtual commissioning of machines

## Industry specific applications: Simapress & Press Safety Blocks

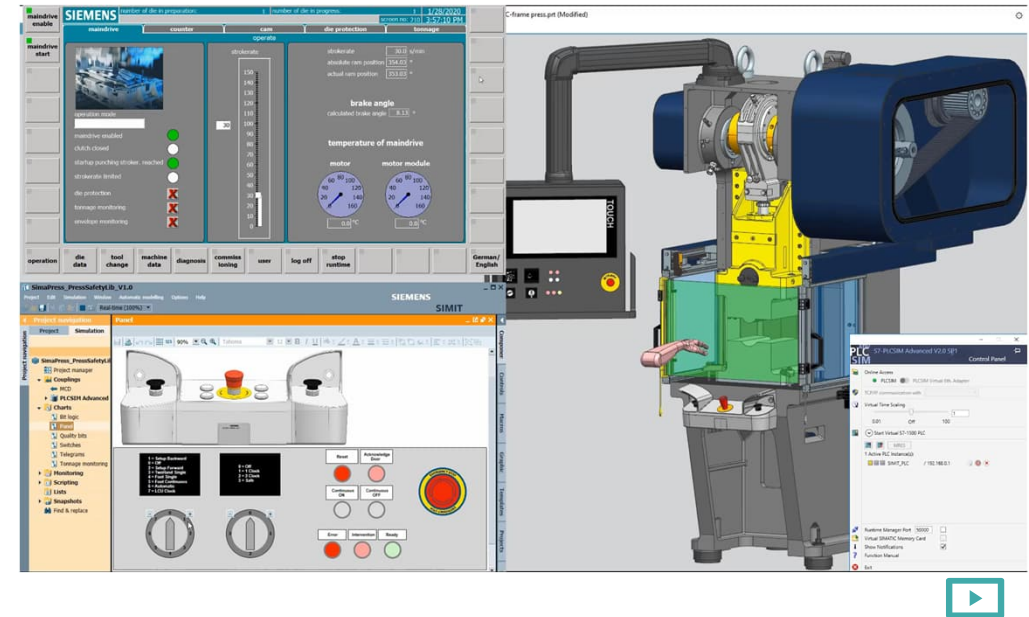


### Use Cases

- Test step sequences and operation modes of the Simapress and press safety application
- Test safety functions of the machine
- Operator training and training on the simulation
- Validate die protection, tonnage and envelope monitoring

### Technical description

- Digital twin of a mechanical flywheel press with NX MCD, SIMIT and PLCSIM Advanced
- PROFIdrive simulation for the driven axis in SIMIT
- Simplified simulation of press tonnage in SIMIT
- Fully implemented operator panel in SIMIT
- Implemented failure scenarios like multiple sheets in the press
- Safety signals simulated in SIMIT and MCD



### Information & Download in SIOS

[Information regarding the software package to automate a conventional flywheel press](#)

# Virtual commissioning of machines

## Industry specific applications: Continuous web simulation

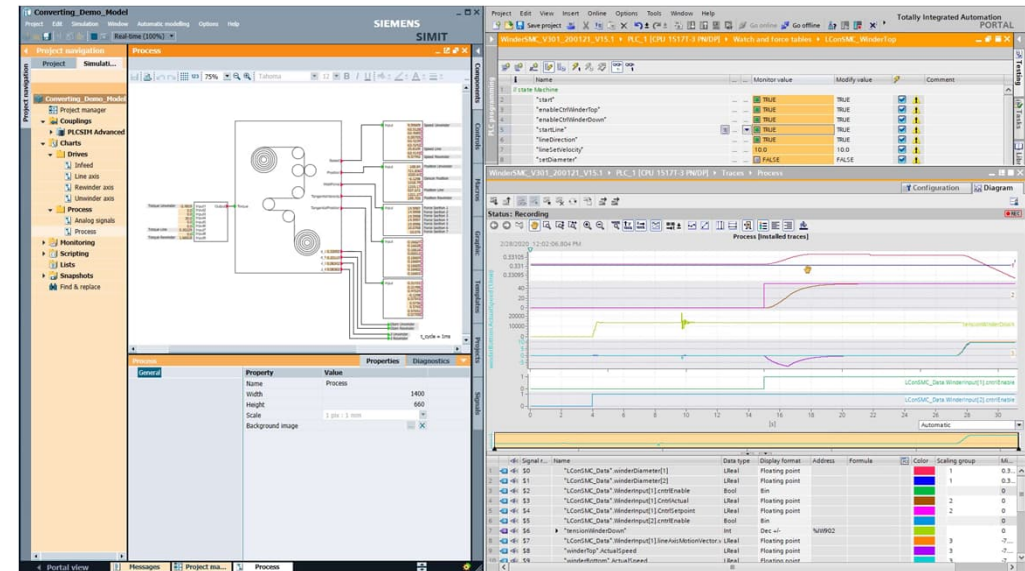


### Use Cases

- Virtually commission your converting application including line tension control, winders and dancers
- Test and analyze the winder diameter calculation
- Validate the behavior of the chosen line tension control mode in combination with the defined web process and mechanics
- Simulate a web break and validate how your PLC program reacts
- Optimize your technology controllers

### Technical description

- Digital twin of a converting machine including winders, dancers, infeed, outfeed and passive axes
- SIMIT component for the simulation of a continuous web process with physical web equations as 1D-model
- Simulation of web position, web tension and loadcells
- Rotatory and linear dancers
- Combine different web sections to one web material



## Information & Download in SIOS

[SIMIT library and application example available](#)

# Virtual commissioning of machines

## Industry specific applications: Multi-Carrier-Systems

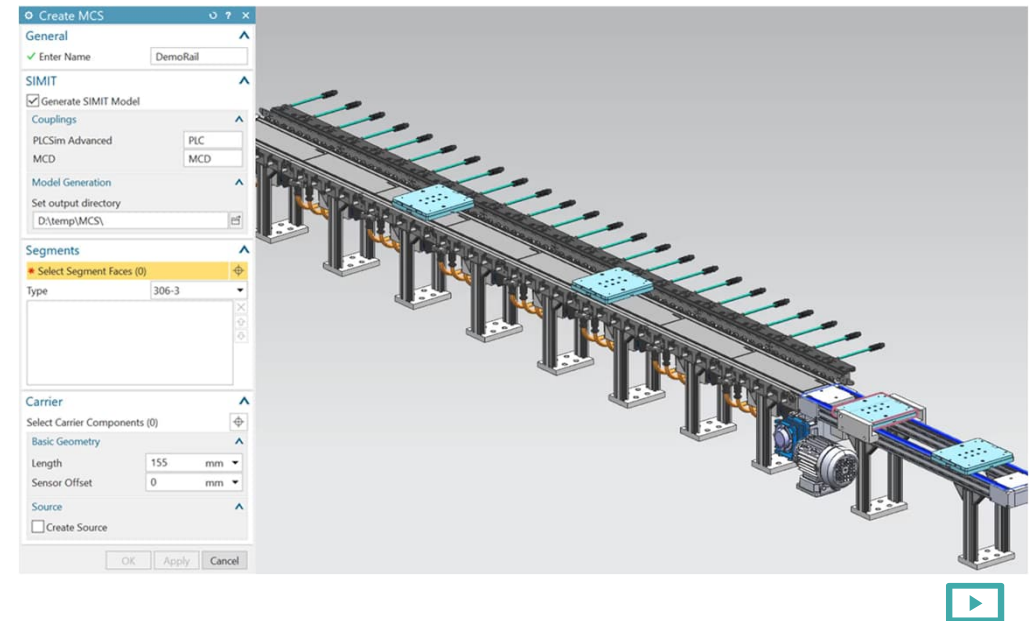


### Use Cases

- Quick and easy generation of fully functional NX MCD and SIMIT models for integrated Multi-Carrier-Systems based on supplied CAD Data
- Time efficient virtual commissioning of Multi-Carrier-Systems with just basic knowledge required
- Showcase for automated model creation
- Virtually commission your packaging application including MCS systems

### Technical description

- Extension for NX MCD
- Automatic generation of kinematics for NX MCD
- Automatic generation of SIMIT charts for all MCS segments, including the connection of signals
- Simulation of the SINAMICS OA Application *TECRailCtrl* by a dynamic Runtime Behavior (NX MCD)
- Implementation of LRailCtrl telegrams in SIMIT




### Information & Download in SIOS

[MCS Toolkit and application example available](#)

# SIMATIC Machine Simulator Ordering



Software Package 	MLFB	Package contains	Typical use-case
SIMATIC Machine Simulator S	6ES7823-1HA03-0YA5	SIMIT Engineering S V10.2 SIMATIC S7-PLCSIM Advanced V3.0	simple machine design
SIMATIC Machine Simulator M	6ES7823-1HA13-0YA5	SIMIT Engineering M V10.2 SIMATIC S7-PLCSIM Advanced V3.0	Medium-high complexity of machines

[More information about NX MCD](#)





## Contact page

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