



Application example

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DigitalTwin@Education

Digital twin of a transport system

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Preface

Teaching the complex interactions of Industrie 4.0 in vocational training is placing new demands on teachers and trainers, and requires modern teaching concepts. The Digital Twin can support training with a wide range of applications as a digital image of industry 4.0 machines. An application example is presented by means of a video which demonstrates the commissioning of a digital twin of a transport system in interaction with a virtual automation system.

This video exemplary shows the following procedures:

- Design of the CAD static model
- Design of the CAE dynamic model
- CAE dynamic model with electrical signals
- Development of an automation program and visualization program
- Commissioning of the digital twin
- Expansion and testing of the digital twin

Here are some examples of skills that can be taught in courses with the concept of the digital twin:

- Implementation of the design of a simple mechatronic system in NX
- Dynamization of a static system in NX MCD
- Development of the control and HMI program of a system with the TIA Portal
- Virtual commissioning of the dynamic system and the automation program
- Expansion and optimization as well as troubleshooting and fault rectification by means of a digital twin

Software components used

SCE trainer packages suitable for this application example

SIMATIC STEP 7 software for training (including PLCSIM Advanced)

- **SIMATIC STEP 7 Professional V15 - single license**
Order no.: 6ES7822-1AA05-4YA5
- **SIMATIC STEP 7 Professional V15 - 6x classroom license**
Order no.: 6ES7822-1BA05-4YA5
- **SIMATIC STEP 7 Professional V15 - 6x upgrade license**
Order no.: 6ES7822-1AA05-4YE5
- **SIMATIC STEP 7 Professional V15 - 20x student license**
Order no.: 6ES7822-1AC05-4YA5

NX V12.0 Educational Bundle (for schools and universities, not for company vocational training departments)

- **Contact:** academics.plm@siemens.com

Miscellaneous: Files as zip for free download

- **Application example – video playable with VLC player**
Video_DigitalTwin_Transportsystem.zip
- **Step-by-step guide to commissioning – video playable with VLC player**
Video_Guide_Commissioning.zip
- **TIA Portal as a project**
TIAP_Project.zip
- **NX MCD project:**
NX-MCD_Model.zip

Procedures

CAD static model

The objective of the first step is to sketch and draft a design (assembly) consisting of several modules (parts). The individual modules are explained and the design presented in an understandable manner. Finally, the design of the system can be shown as a static 3D CAD model.

CAE dynamic model (automation behavior model)

The specification of the physical properties shows how a 3D CAD model is transformed into an automation behavior model. The following physical properties are specified for this purpose: Rigid body, collision body, object source and object sink, the definition of axes and joints as well as sensors and actuators, such as collision, clearance and position, in the static design. It is shown what happens if none of these properties are specified.

CAE dynamic model with electrical signals

Finally, signals are defined for the system as an interface to the external connection so that these can ultimately be controlled and validated with the aid of an external automation system.

Development of an automation and visualization program in the TIA Portal

This procedure uses a PLC program of the dynamic 3D NX MCD model, which is intended to demonstrate the control of the dynamic 3D NX MCD model and validate the automation behavior model. It is shown which crucial function the PLC variables have for the automation program and the dynamic 3D NX MCD model.

An HMI program is also used for operator control and monitoring of the automation behavior model. It enables the direct activation and speed control of the transport surfaces.

Simulation of an automation and visualization program in the TIA Portal

After completion of the automation and visualization program, this section shows the simulation in PLCSIM Advanced and the TIA Portal.

Signal mapping between the dynamic CAD model and the automation program

This section shows how the relevant signals in NX MCD are linked to the signals of the automation program executed in PLCSIM Advanced.

Virtual commissioning of the automation model and the physical/kinematic model in NX MCD

After the simulation of the dynamic NX MCD model has started, it shows how the transport surfaces can be activated and their speed specified through the HMI in order to visualize and validate the behavior of the automation program and of the mechanical design.

Optimization, troubleshooting and fault rectification on the virtual model

This section illustrates what effect increasing the throughput would have on the system and what possibilities there are for optimizing or rectifying faulty process control.