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Virtual commissioning in the factory

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with
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Autodesk

Learning Objectives

- Create a Digital Twin based on Inventor or Factory Design
- Faster time-to-market
- Minimize the issues/failures in the engineering process
- Test the machine during the engineering process

Description

Virtual commissioning, industry 4.0, Digital Twin are today's buzzwords in factory planning. 3D planning is already standard in many areas today. However, with Factory Design Utilities and Industrial Physics from machineering, new far-reaching simulation possibilities are emerging. The Digital Twin accompanies machines throughout their lifetime; daily business, changes or modifications on the machine, service works…. Its goal is to prevent errors, optimize machines and avoid failures. Use the simulation model as basis of the Digital Twin in the early stages of the development process to safeguard your concepts.

Speaker – Florian Wegmann

Mr. Wegmann graduated in business administration and IT system administration, along with several years of experience in sales. He has been supporting machineering since 2015 with his expertise in technical sales and selected customer projects. Within machineering he manages key accounts and is responsible for extending the global dealer network. Previously Florian worked at XR Systems for four years.

Co-Speaker – Daniel Lutz

Content

Virtual commissioning in the factory

Virtual commissioning, industry 4.0, Digital Twin are today's buzzwords in factory planning. 3D planning is already standard in many areas today. However, with Factory Design Utilities and Industrial Physics from machineering, new far-reaching simulation possibilities are emerging. The Digital Twin accompanies machines throughout their lifetime; daily business, changes or modifications on the machine, service works…. Its goal is to prevent errors, optimize machines and avoid failures. Use the simulation model as basis of the Digital Twin in the early stages of the development process to safeguard your concepts.

Virtual commissioning

Virtual commissioning is the practice of using 3D-technology to create a simulation model of a manufacturing plant so that proposed changes and upgrades can be tested before they are implemented into the actual plant.

Why simulate?

More planning security

The bidirectional integration with the CAD process leads to an easily available real-time digital simulation model, called ´Digital Prototype´. Mechanical, electrical, and software engineers work together easily, no matter where they are located. The team will always work with the ‘real’ model. Besides better quality, the improved planning control guarantees that you always meet your deadlines.

Virtual commissioning

Higher quality and reduced costs: thanks to virtual commissioning, machine designers and manufacturers can visualize and test the future machine before the actual equipment is assembled. It is possible to examine different planning scenarios and increase security, for example in the case of planning complex machines. The risk for bottle necks is also reduced thanks to early detection.
The dimension of buffers, conveyors, workpiece carriers and other transport mechanisms can all be modified and, can then be throughput and changes instantly validated. This way, concrete and binding statements on throughput and overall equipment effectiveness (OEE) can then already be elaborated on during the planning phase.
The visualization of production processes not only optimizes the comprehension and acceptance of planning within the team but also helps to keep customers updated on the latest status.

More transparency

The integrated software exonerates the developer from error prone processes, e.g. from copying and opening data models in data exchange formats; every developer can continue to work in their native system but, will always have access to the latest model. Modifications on the machine are visible to everyone. As a mechatronic refactoring tool, the simulation software helps to detect obsolete functions & redundancies and is able to form new functional units. The ability to check and double-check the structure and behavior of the machine enables a better modularization as well as optimized efficiency.

Significant cost and time savings

A study executed at the Institute for Machine Tools and Industrial Management (iwb) of the Technical University of Munich showed that the commissioning time can be reduced by 75% when performing virtual commissioning in advance. The total process time can also be cut down by roughly 15%. Software quality is optimized by 40% and costs are potentially then reduced, thanks to running simulation software like industrialPhysics – which have been confirmed by users.

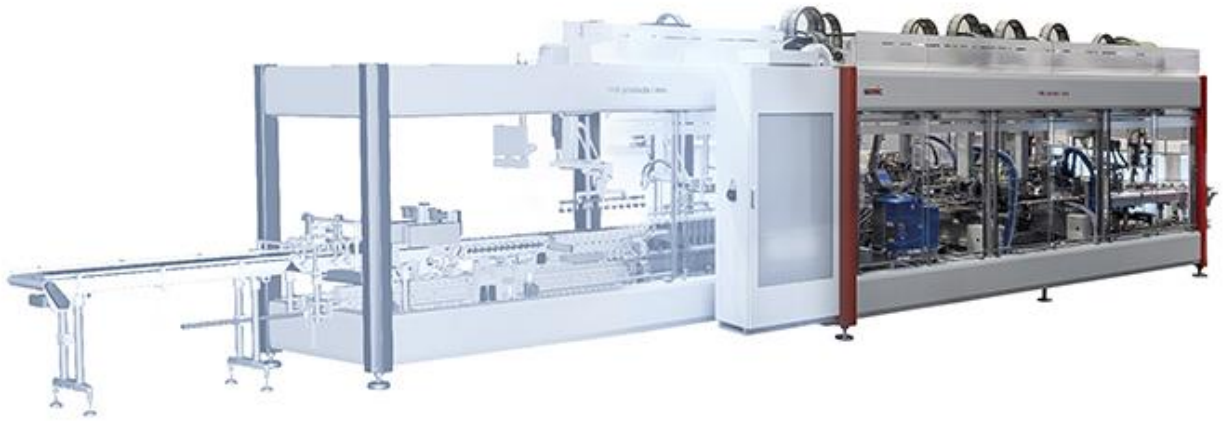
machineering GmbH & Co. KG

machineering GmbH & Co. KG is located in Munich (Germany) and develops innovative software solutions for real-time material flow and robot simulation. Our expert team advises companies on topics such as visualization and simulation in order to improve development, distribution and virtual commissioning.
3D simulation of complex material flows and mechatronic production represent the biggest efficiency reserves in mechanical and machine engineering. 3D simulation and virtual prototyping make it possible to accelerate and test the development and construction of machines. With industrialPhysics future installations can be visualized in an efficient way together with clients during the project acquisition phase.
The highest saving potential, however, represents virtual commissioning of machines and production streets: It is a proven fact that by running a simulation you can reduce installation, testing and optimization costs up to 75%.

With the foundation of machineering in 2007 – a spin-off company of the Institute for Machine Tools and Economics in Munich (iwb), the team of Dr Wuensch started developing the physics-based simulation software "industrialPhysics" which, since then, has been continuously refined and adjusted according to our customer's requirements. In 2009 Dr Georg Wuensch and Beate Maria Freyer changed the company's name into machineering GmbH & Co. KG. Today the 3D simulations developed by machineering's engineers have been successfully applied in leading companies around the world which deal with mechanical engineering, construction and production.

industrialPhysics

industrialPhysics is a physics-based 3D simulation software used to visualize the virtual commissioning of mechatronic systems in real-time. Given the innovative simulation technology, industrialPhysics allows for quick and easy modeling of complex machinery along with robots for intensive PLC testing. industrialPhysics offers a wide variety of functions for various fields of application like development, commissioning, production and sales.



DIGITAL TWIN AND REAL MACHINE (SOMIC VERPACKUNGSMASCHINEN GMBH)

The advantages at a glance

Simulation model derived directly from your CAD data:
Design and simulation go hand in hand, directly and with no additional effort. Always simulate the newest development status of your machinery!

Connect PLCs:
industrialPhysics can be connected to a variety of PLCs. Test functionalities at a very early stage in the design process.

Industry robots just a mouse click away:
Visualize the virtual commissioning of robots with industrialPhysics. Decide to use internal kinematics or to connect to real robot controllers.

Synchronized engineering:
Thanks to industrialPhysics, engineers from different departments can already work together in the early stages. Checking feasibilities and synchronizing the workflow

Put on VR or AR glasses:
It is easy to render the running simulation in Virtual Reality (VR) or Augmented Reality (AR). Step into your running virtual machine!

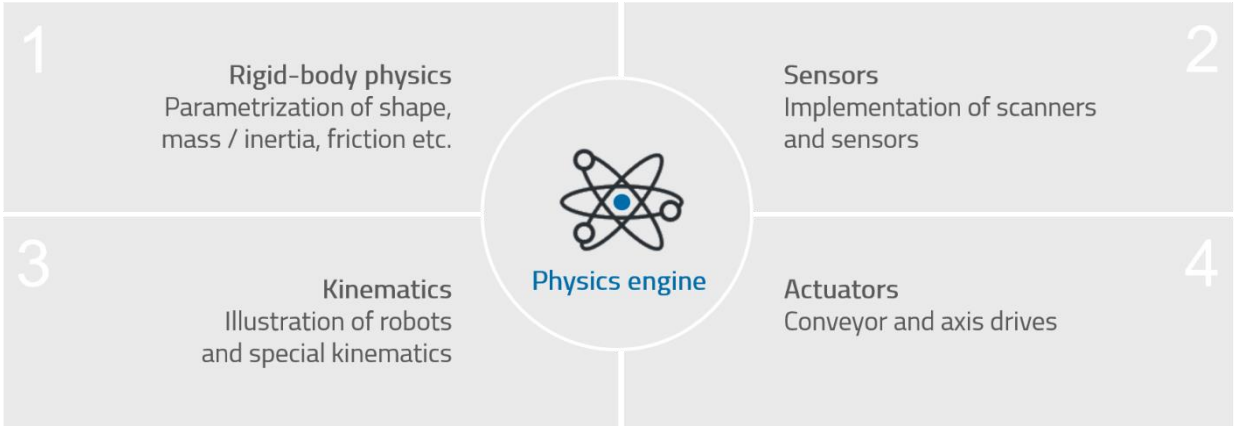
Process consistency along the value chain
industrialPhysics smoothens the entire process: from first ideas to running systems and service cases at the end.

Field bus emulation with the Field Box 1
machineerings Field Box 1 enables virtual commissioning with real PLCs via a native field bus.

Generate a Digital Twin
The simulation model (Digital Prototype) within industrialPhysics forms the basis for the Digital Twin. Its aim is to prevent failures on running machines and to pretest enhancements on existing installations.

Technology of the Physics simulation

With the Physics-Engine inside industrialPhysics you are able to simulate the rigid-body physics, Sensors, Kinematic and Actuators

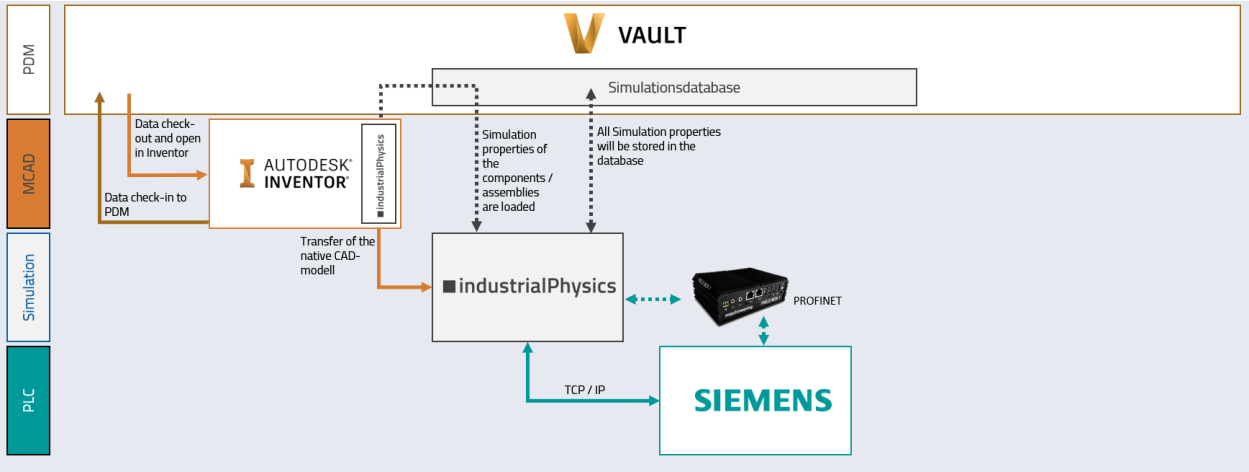


TECHNOLOGY OF THE PHYSICS-ENGINE

The Virtual commissioning process with industrialPhysics

industrialPhysics could be integrated into all existing engineering processes. With the bidirectional interface for Inventor there is no STEP-export required. Other benefits of this interface are: being able to use the original CAD model and the delta synchronization of mechanical changes.

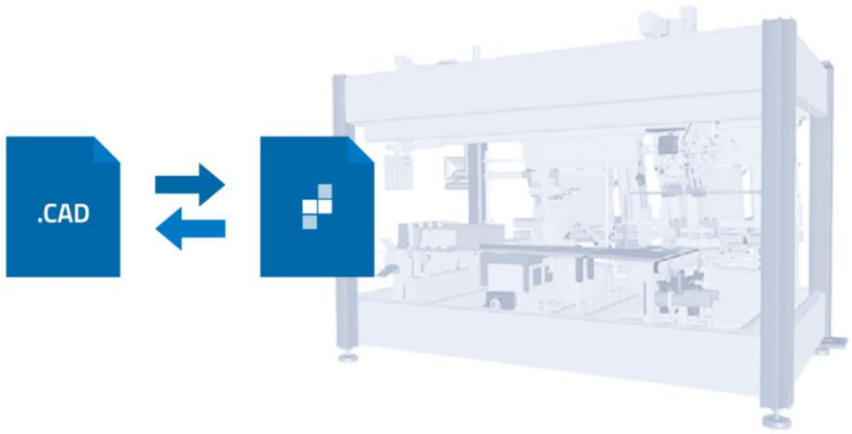
With this functionality engineers are able to review their construction quickly, save costs and potentially be integrated into the PDM-process.



THE VIRTUAL COMMISSIONING PROCESS WITH INDUSTRIALPHYSICS

The Workflow in Autodesk Inventor

Design and simulation remain linked to each other with no additional effort thanks to a bidirectional interface. At any time, the design can be checked using industrialPhysics. Feedback can be quickly integrated back into the design.



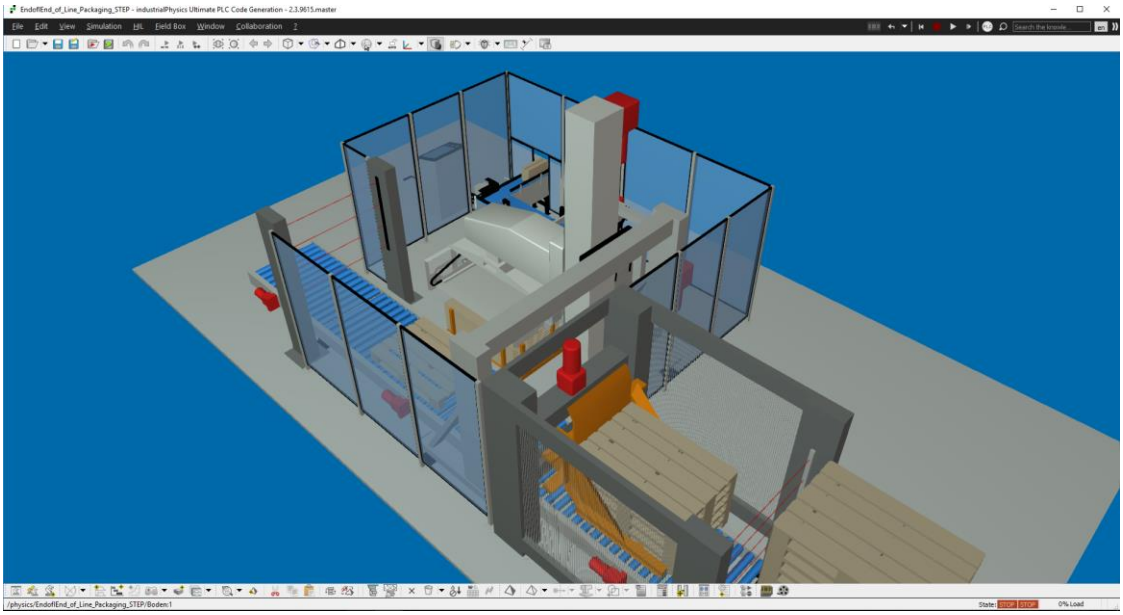
LINK BETWEEN CAD AND INDUSTRIALPHYSICS

ADD-INS OF INDUSTRIALPHYSICS IN INVENTOR 2019

1. Push the “Transfer All” button in order to transfer the mechanical data from Inventor to industrialPhysics.

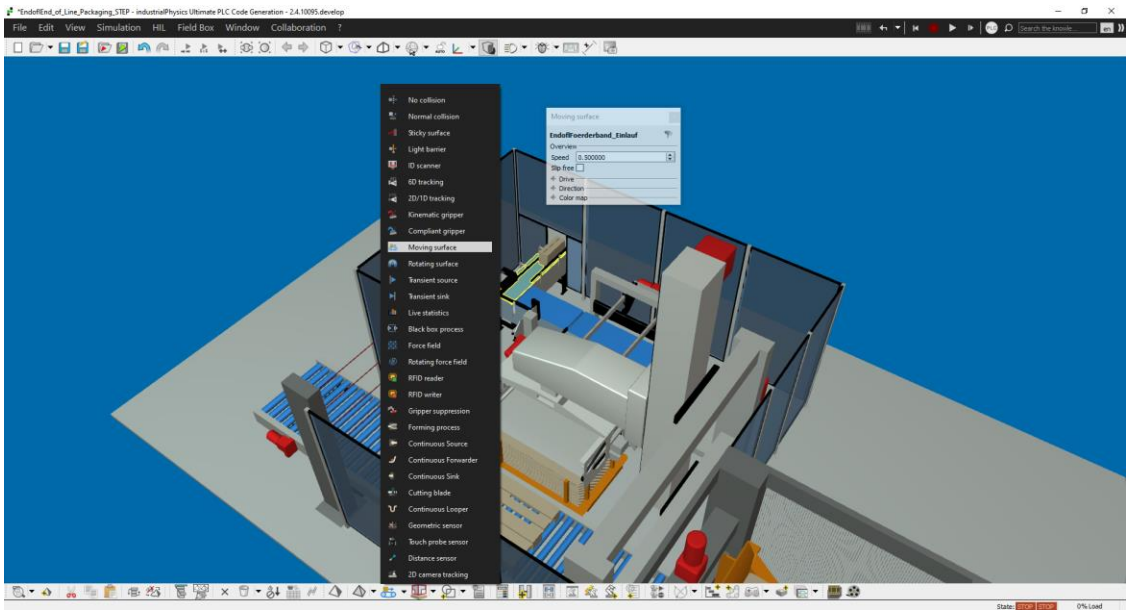
ZOOM INTO THE ADD-IN

2. Now open industrialPhysics and transfer the model from Inventor to industrialPhysics



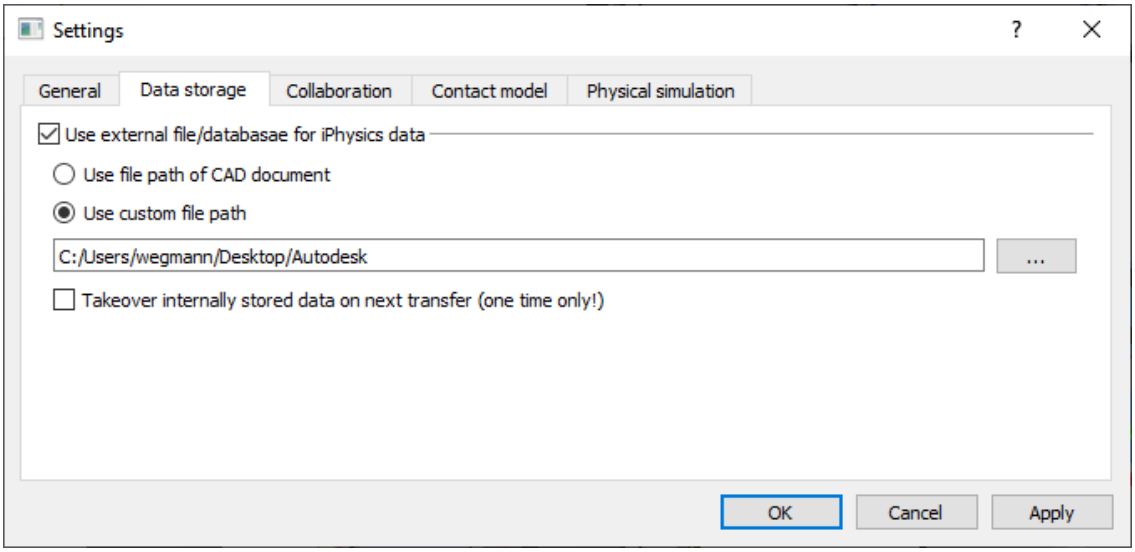
INDUSTRIALPHYSICS WITH THE MECHANICAL DATA

3. Now provide parts and assemblies some specification for simulation



THE SPECIFICATION IN INDUSTRIAL PHYSICS

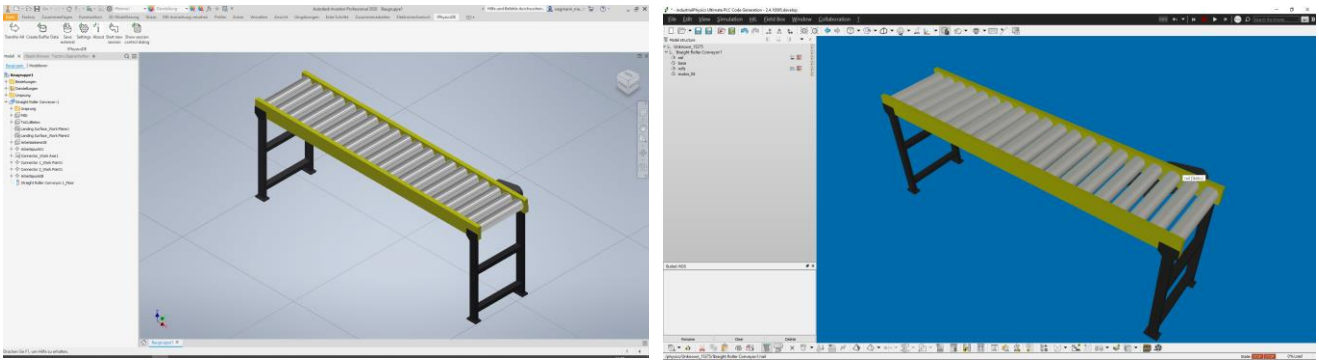
4. All Information is then assigned to the part/assembly as an “iProperty” or to an additional folder. If you use this part/assembly in a new project or change the dimension of the part, all industrialPhysics information is restored from the database.



SETTINGS IN THE INVENTOR-PLUGIN

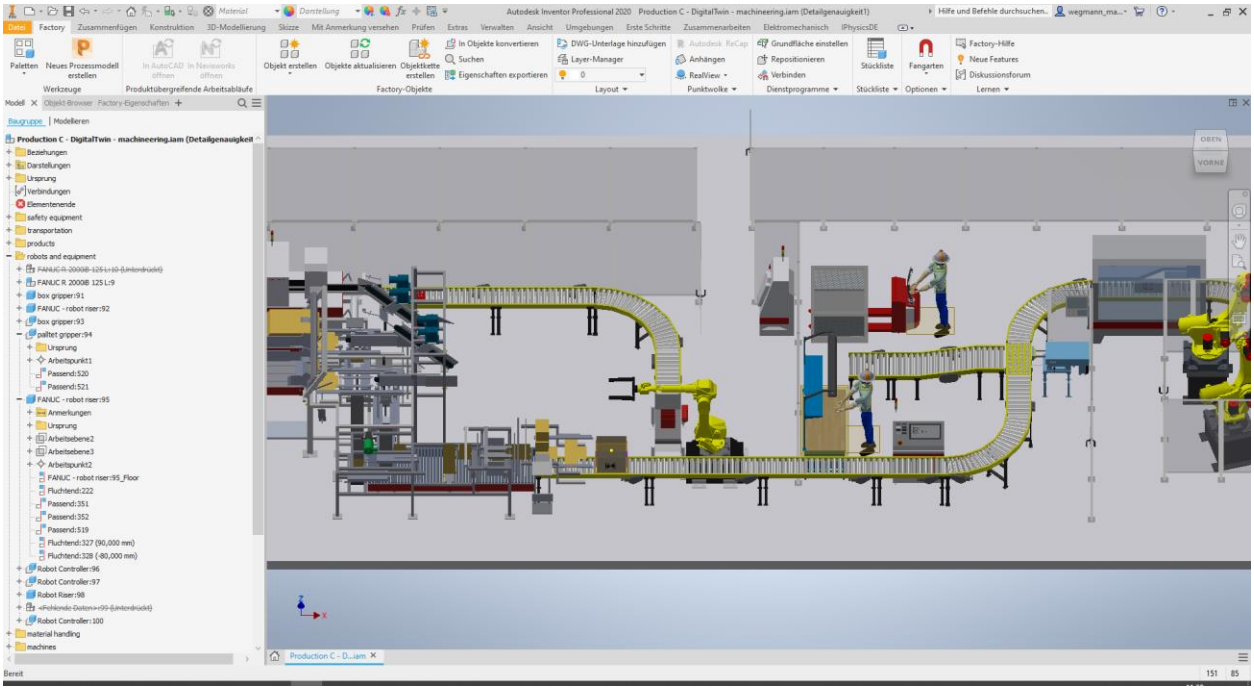
The Workflow with Factory Design and the Factory Assets

The same Workflow for Autodesk Inventor also works with Autodesk Factory.



FACTORY ASSET IN INVENTOR (LEFT) AND IN INDUSTRIALPHYSICS (RIGHT)

1. Transfer all Assets onetime to industrialPhysics.
2. Provide all Assets with specific simulation properties
3. Save the industrialPhysics information
4. Save these Asset to your library
5. Now all Assets have simulation properties
6. Simulations are now able to start very quickly



A DEMO DATASET IN AUTODESK INVENTOR

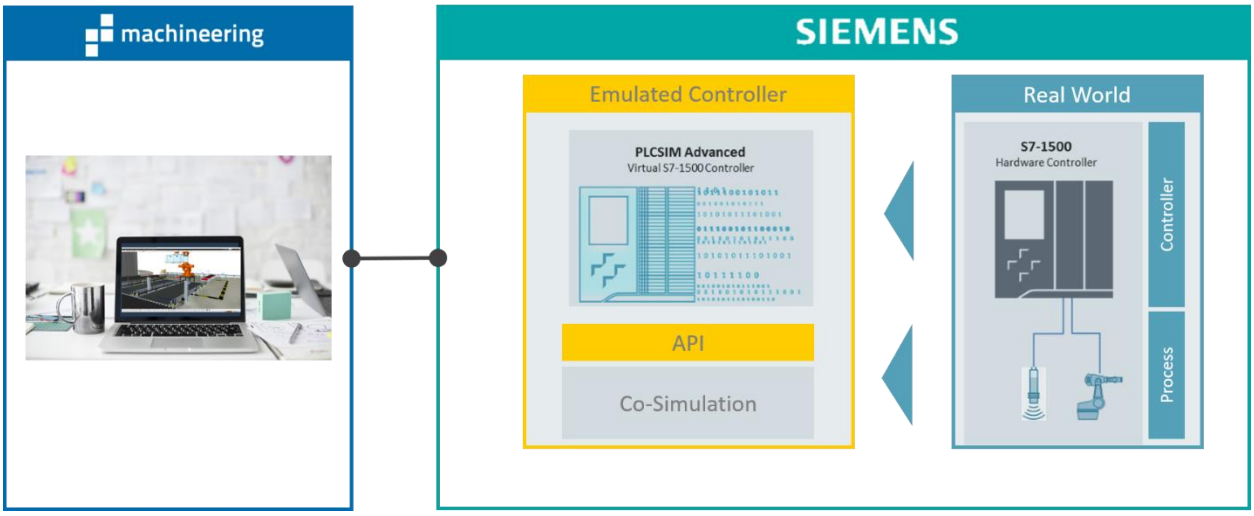
HIL- / SIL-Engineering – Secure your PLC software at an early stage

industrialPhysics offers an integrated Hardware-in-the-Loop (HIL) PLC connection to a variety of common PLC platforms. This simulation model can also be run on any computer and, not having to install any additional hardware can save costs and increase availability.

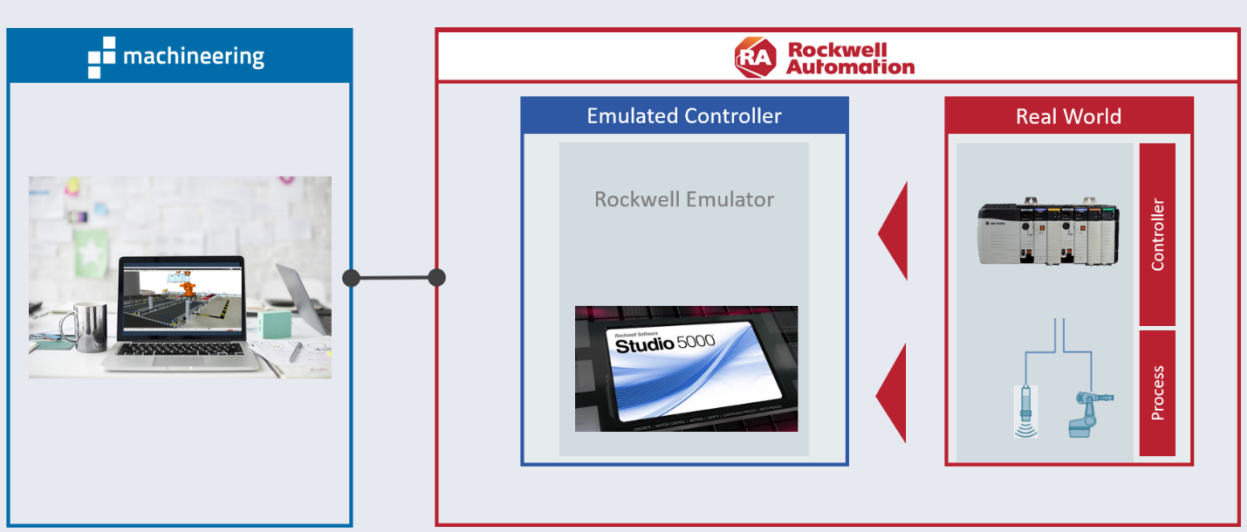
Furthermore, HIL engineering significates a gain in quality: the 3D model and its peripheral devices are calculated in a 1 to 10 msec cycle. Besides common PLCs, other PLC platforms can also be integrated. The only requirement is the need for a free Ethernet interface in the PLC.

Connect the following PLCs

- ABB
- B&R
- Beckhoff
- BoschRexroth
- Rockwell
- Schneider Electric
- Siemens



SOFTWARE-IN-THE-LOOP SIMULATION WITH SIEMENS



SOFTWARE-IN-THE-LOOP SIMULATION WITH ROCKWELL

Virtual Commissioning including field bus emulation

For a real-time simulation via native field bus systems, machineering offers the Field Box 1.

The Field Box 1 enables multi device emulation for most common field bus systems.

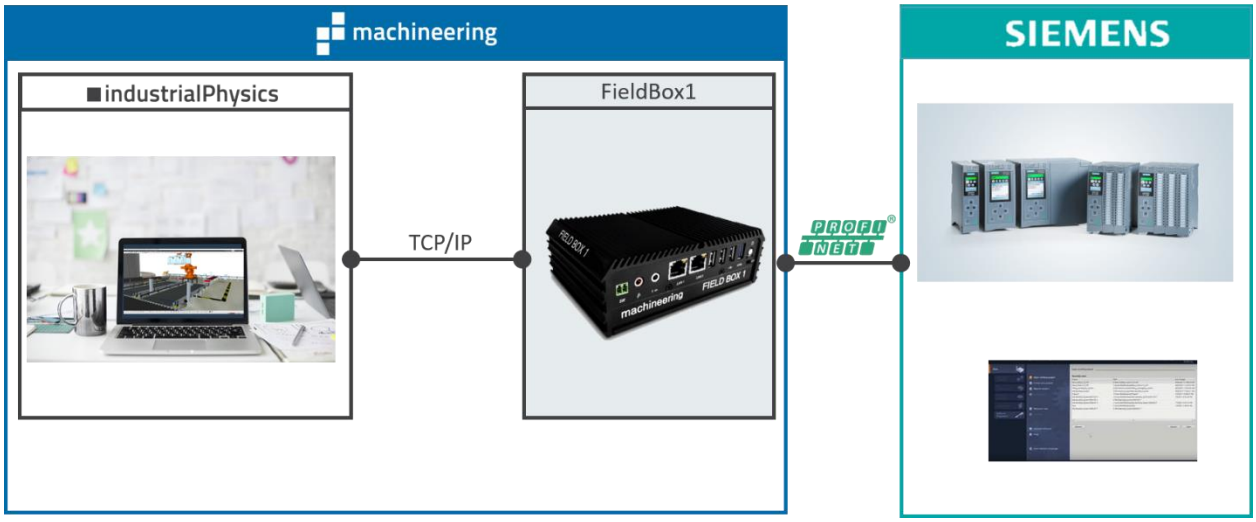
In combination with the simulation software, industrialPhysics, you need only connect the Field Box 1 to both your computer and the controller, then open the multi device field bus emulation, via a smooth web-interface.

The main advantage (in comparison to conventional virtual commissioning) is that this field bus simulation does not use any of the simulation computer´s resources. The entire field bus simulation is processed within the Field Box. Changes in the PLC program are obsolete

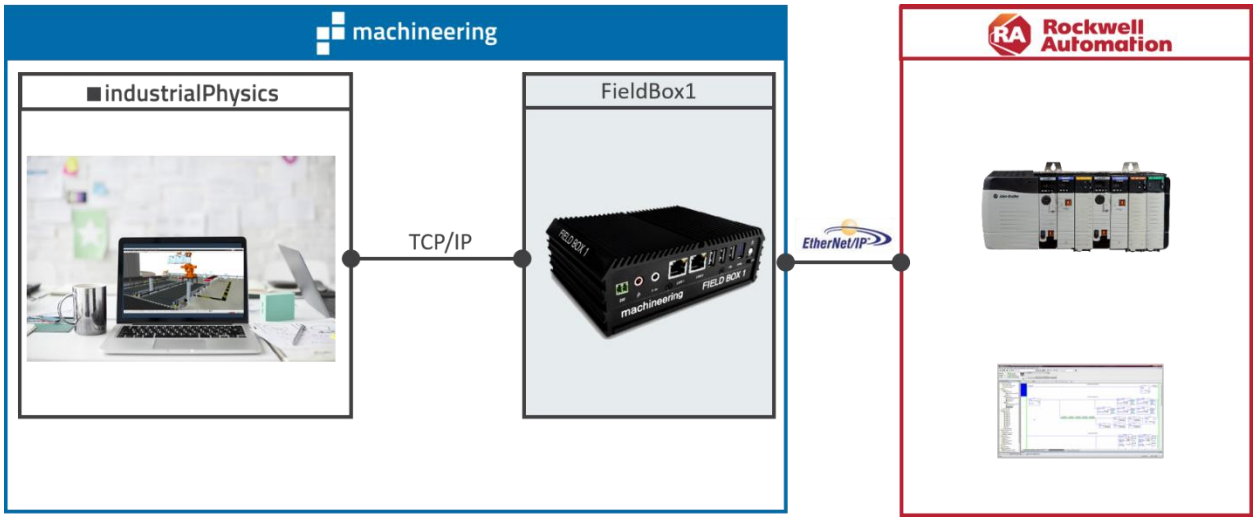
Supported field bus systems

- Profinet
- Ethernet/IP
- EtherCAT

PICTURE FROM THE SPS IPC DRIVES IN NUREMBERG



HIL-SIMULATION WITH SIEMENS



HIL-SIMULATION WITH ROCKWELL

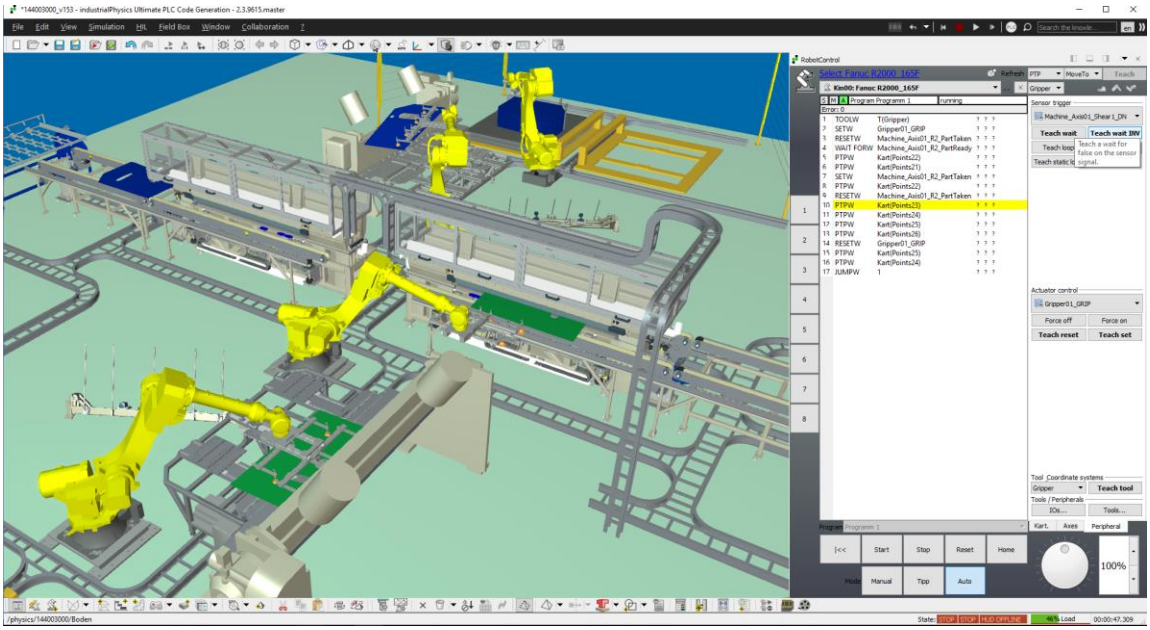
Industry robots just a mouse click away

Thanks to industrialPhysics, the virtual commissioning of complete installations is now possible - no matter if you use kinematic models or real robot controllers. industrialPhysics forms the simulation platform which enables mechanical and electrical automatization engineers to work hand in hand from the very beginning. This way, in the early development stages, it is possible to: evaluate design concepts, test & optimize PLC software, and plan robotics.

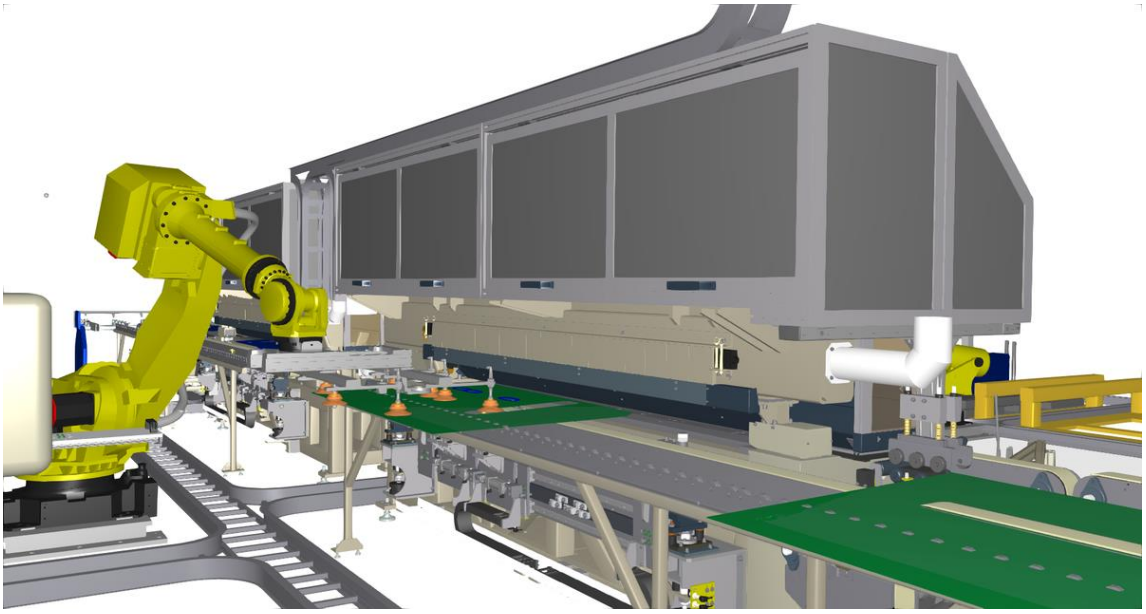
ROBOTIC SYSTEMS IN THE REAL WORLD

Running a virtual commissioning with industrialPhysics can offer many benefits to companies, including:

- Choosing from a large variety of robot kinematics and then selecting the one which best suits your installation.
    - Our Robot library includes kinematics of well-known robot manufacturers, such as: ABB, Comau, Fanuc, Kuka, Stäubli, Universal Robot, Yaskawa
- Connecting real robot controllers
- Virtual commissioning of complete robot installations
- Running calculations during the development process for collision detection.
- Special task e.g. simulation of tube packets mounted to robot kinematics.



EXAMPLE OF A ROBOTIC SYSTEM IN INDUSTRIALPHYSICS



EXAMPLE OF A ROBOTIC SYSTEM IN INDUSTRIALPHYSCIS

Experience tomorrow, today – with VR/AR

With no additional effort, industrialPhysics models can be viewed on both Virtual Reality glasses and Augmented Reality glasses. This allows the user to experience planned equipment, as well as, augmenting a real Plant with additional process data in the third dimension - with dynamic simulation, via motion, in the fourth dimension.

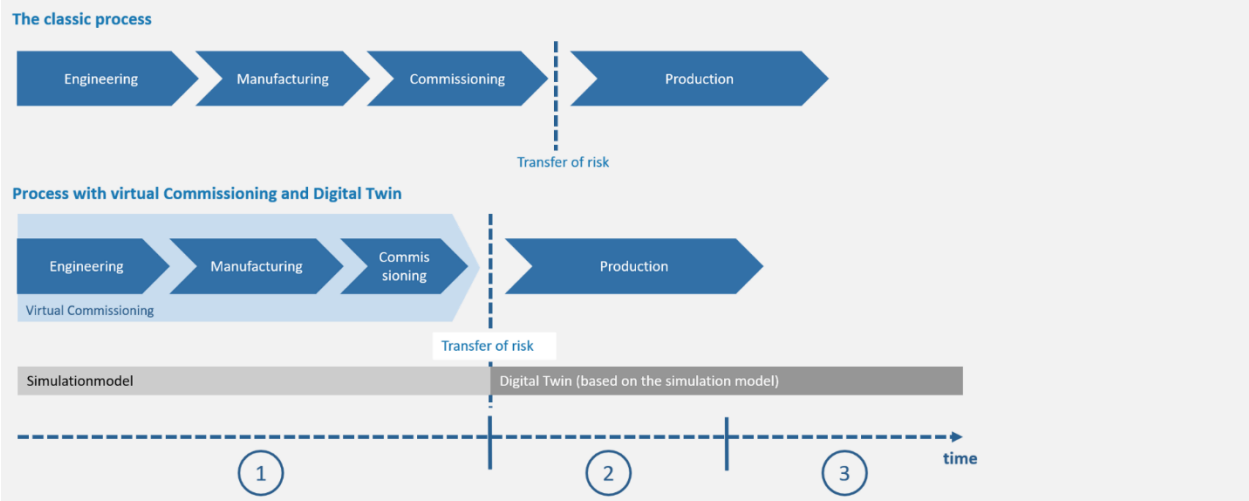
The new quickness:

Transform data within minutes into a virtual reality environment, derive changes from the experience and then update with unmatched quickness for immediate review. Generate emotional moments with these plans for your colleagues and impress your customers!

PICTURE AUGMENTED REALITY

The virtual counterpart in the cabinet

In the best case scenario, the production equipment comes from the manufacturer with the "machineering Digital Twin", which already contains all the relevant data for the machines. With an industrialPhysics model running directly in the cabinet, the machine can easily be enhanced with a wide variety of new functions. Parallel to the physical implementation of the machines, the Digital Twin will deliver a virtual counterpart with deep insight into the actual state of the machine parts that cannot easily be measured. An operator can then immediately benefit from all the advantages that the application of a Digital Twin Box provides.



PROCESS- THE DIGITAL TWIN IN THE CABINET

Furthermore, you are able to upload all the important production process data to the Digital Twin behind your firewall, without the risk of losing any strategic data in the internet cloud.
The Digital Twin is easy to integrate into your standard production. It delivers all the necessary data for smoothly running systems and can easily calculate complex geometric models. Virtual testing of new products can also be executed in parallel to the real production process. A Look-Ahead-Function will also help to find possible collisions or bottlenecks in the machines and to react in the real system before they occur.

THE DIGITAL TWIN

Consulting with machineering

Yes, simulation with industrialPhysics can save time and money. And yes, simulation can bring along an enormous gain in safety. However, the real potentials can only be reached if the infrastructure is regarded as a whole. Therefore, it is important to us to also act as consultants for our customers when it is about aligning both the entire development process and, later on, the production & simulation models.
The trend shows that, in addition to the design, electrical system & automation, simulation is also making inroads into engineering as a new process step. But, how is it to be implemented?

The broad set up of industrialPhysics

IndustrialPhysics is the simulation basis of the entire engineering process. Starting with the design, industrialPhysics offers a bidirectional data exchange of the CAD data from popular CAD systems such as SolidWorks, Inventor, Creo, etc. Real controllers can also be connected to the virtual model in order to carry out virtual commissioning. Our customers are also able to access a large number of robot kinematics from various manufacturers, integrate drives and use numerous VR and AR glasses as standard with industrialPhysics.
The simulation is a part of the big picture, wherein everyone involved can access at any time in order to examine the state of development or production process in real time.
As a software manufacturer and, for you as a customer, it is important not to regard industrialPhysics as a stand-alone solution. The advantages, that the use of our simulation software can offer, are only able to be optimally realized if they are a fixed component of the entire process.

Away from the stand-alone solution

Our experience has shown us that nowadays many companies do not use simulation widely enough and are thus missing out on any potential benefits. In order to circumvent this, it is crucial that the principles of efficient working are established within the organization and the corporate processes. Which is only possible with a deep, structured implementation.
For every company there is a different way of integrating the simulation. One that has stood the test of time however, is to establish a department or core team specifically for this purpose.

Start simulation management in a small way

Many companies have also taken the route of creating simulation teams consisting of top experts from the fields of design and automation. Both work simultaneously on modelling projects (virtual prototype) and commission virtual plants on the screen step-by-step. At the end of this process they obtain a precise mechatronic image of a real machine (Digital Twin), on the basis of which the machine's behavior can be tested and optimized in advance.
After the completion of a project, the simulation models can continue to be used by adopting common parts, including simulation data, into libraries. This facilitates the simulation of follow-up systems enormously. In addition, they can also be used by sales for customer acquisition, by after-sales and, for production monitoring or training purposes. The simulation models or Digital Twins can also be visualized by VR / AR, web or apps.
"No machine leaves our company without simulation", states one of our customers, which has been putting the simulation process into practice for years. And, it´s market leadership proves that it has been right to do so. The initial investment, in the form of manpower, has quickly paid for itself; the software costs were already amortized in the first project.

We support you with the implementation

Every company is aligned and organized differently. In order to facilitate the implementation for users of industrialPhysics, machineering cooperates with experienced consultants. On the basis of defined levers, a concept is developed to enable the simulation to unfold its full potential in the company. Coupled with a simulation project running in parallel, the feasibility and practical application are guaranteed.

May we support you in using industrialPhysics profitably in your company? We would be delighted to send you all the relevant documents.