SIEMENS

ACADEMIC

Aalto University

Teaching students how to master complex engineering tasks using a digital twin

Products

Solid Edge, NX, Simcenter, Teamcenter, Tecnomatix

Business challenges

Educate new generations of engineers

Prepare students for digital transformation

Collaborate with industry to support future development

Keys to success

Use Solid Edge in all bachelor's degree courses

Use Teamcenter for all engineering-related information from day one

Use NX for mechatronic design work

Use Simcenter for simulation

Results

Helped students gain problem-solving skills

Prepared students for careers in digitalized industry

Supported industry partners' technological progress

Aalto University uses Siemens Digital Industries Software to provide students with digitalization skills

Learning to design the future

Named in honor of Alvar Aalto, a prominent Finnish architect and industrial designer, Aalto University is the second-largest university in Finland. It is located in Otaniemi, across the bay from Helsinki. Aalto University was established in 2010 as a merger of the Helsinki University of Technology, the Helsinki School of Economics and the Helsinki University of Art and Design.

Scientific research and artistic activities are carried out at six schools and their departments and units. The Aalto University School of Engineering performs research and education and seeks new solutions in the fields of mechanical engineering, civil engineering and the built environment.

With the Aalto University Industrial Internet Campus (AIIC), the university provides a platform for students, researchers and companies to innovate and collaborate on creating smart, connected products and services. The AIIC enables professors and students to work with industrial partners on multidisciplinary research, education and innovation.

Providing 3D modeling for all

Aalto University students use a variety of software, including Solid Edge® software, Teamcenter® software, NX™ software, Simcenter™ software and the Tecnomatix® portfolio, all part of the Xcelerator portfolio,

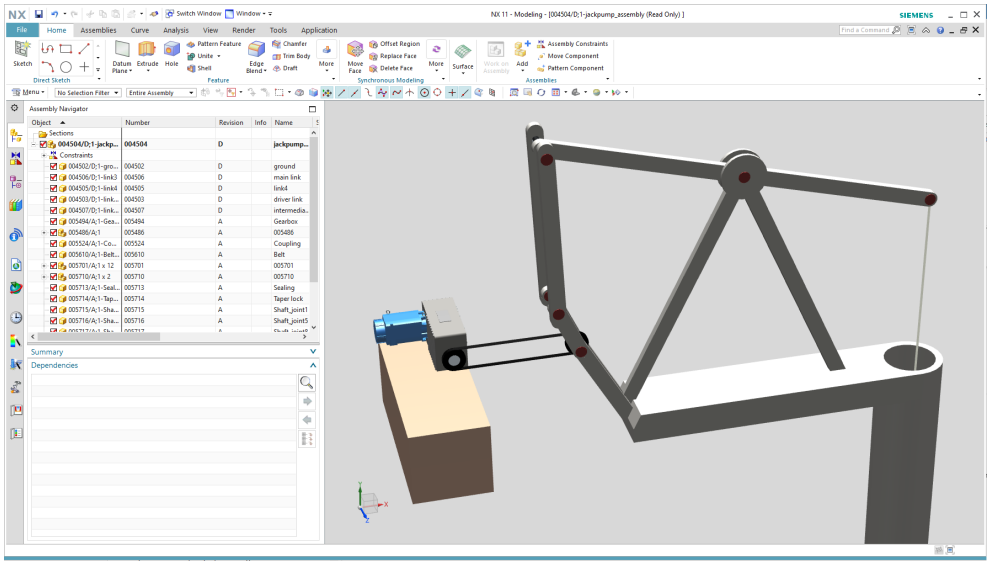

Figure 1. Using Solid Edge and NX for design and verification, Aalto University students design and simulate complex parts, assemblies and machines from ideation to BOM creation.

"Using software products from the Siemens portfolio without leaving familiar user interfaces makes it easier for lecturers and students to spin a digital thread and handle complex engineering tasks. Our efforts are also aided by access to Siemens' Xcelerator Academy and support from Siemens solution partner Ideal GRP.

Professor Petri Kuosmanen
Mechatronic Project Course Leader
Aalto University

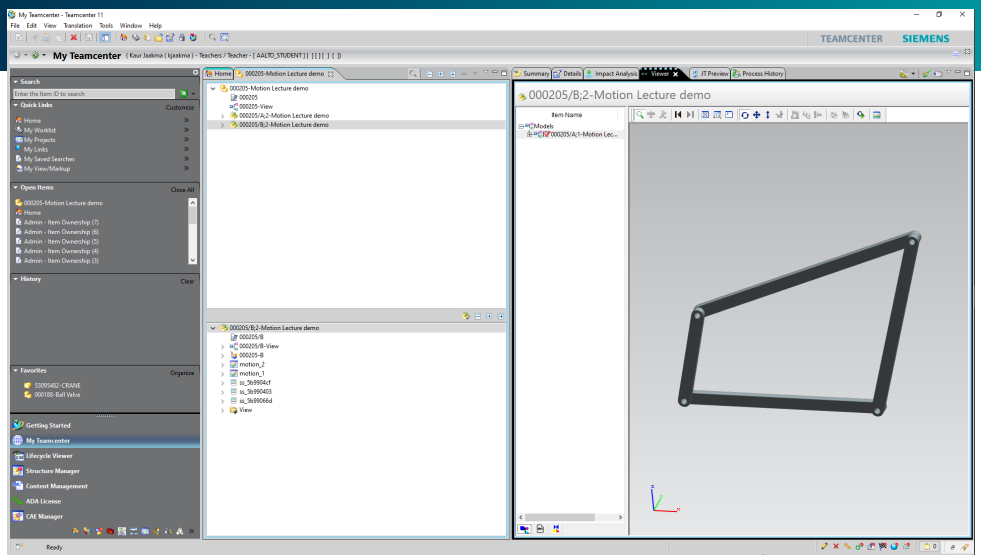

Figure 2. Aalto University students use Teamcenter for product data storage and management not only in engineering courses.

the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software.

Whether they study mechanical engineering, civil engineering or architecture, students at Aalto University attend computer-aided design (CAD) courses to get acquainted with 3D modeling. During the early parts of their education, they use Solid Edge for that purpose. Solid Edge is a portfolio of easy-to-use software tools that address all aspects of the product development process. Due to its synchronous technology, Solid Edge combines the speed, simplicity and intuitivity of direct modeling with the flexibility and control of parametric design.

"Solid Edge is easy to use and provides an entry point to the world of 3D modeling with a very low threshold," says Kaur Jaakma, CAD/computer-aided engineering (CAE) lecturer at Aalto University. "Thanks to its synchronous technology, students can intuitively learn both history-based and parametric design methods."

Students at Aalto University store and manage all product data they create using Teamcenter. This product lifecycle management (PLM) system connects people and processes with a digital thread, which promotes innovation.

At the master's degree level, Aalto University students use more sophisticated software for design and verification. In civil engineering and architecture, these tasks are performed mainly using specialized industry packages. Students in the mechatronics group at the school of engineering predominantly use NX, an integrated solution for CAD, computer-aided manufacturing (CAM) and CAE.

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Kaur Jaakma
CAD/CAE lecturer
Aalto University

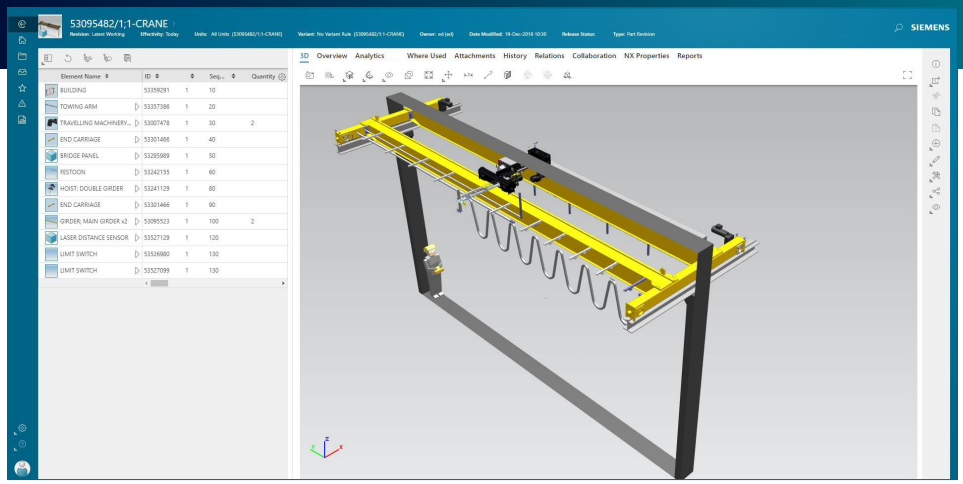

Figure 3. Using NX and Teamcenter, Aalto University students created a comprehensive digital twin of an overhead crane.

Following the preliminary design stage, Aalto University students use the CAD functionality within NX to enrich the basic models with detail. They also perform multibody motion and finite element method (FEM) simulations to verify the structural integrity of the parts they design as well as vibration simulation. Thanks to the comprehensive portfolio of solutions within NX, they do not need to leave their familiar software environment.

A focus on industry collaboration

Aalto University emphasizes cooperation with industry. Upon entering the more specialized phases of their studies, Aalto University students participate in various collaborative projects. "Our students and their future employers benefit from experience they gain in industry projects," says Kari Tammi, associate professor at the Aalto University School of Engineering. "They can rely on project-oriented collaboration and problem-solving skills using leading-edge tools and methods."

Among the industry partners is Konecranes. The industry-leading Finnish crane manufacturer donated an overhead crane to the university for students to work with, hoping to benefit from scientific findings and supplementary project work. In a project resulting in several master's degrees theses, students teamed up to investigate the sway motion of the load as it was moved sideways by the crane. Based on their findings, they designed a fuzzy logic-based anti-sway control for the overhead crane.

To build the simulation of the crane and the load, they used Simcenter Amesim™ software. The ready-to-use multi-physics libraries of this integrated, scalable system simulation platform allowed them to virtually assess and optimize the performance of this complex mechatronic system.

A comprehensive digital twin

At Aalto University, work with and around this crane is not limited to individual projects. The crane is the central element of the university's DigiTwin project. "With the help of the crane manufacturer and Siemens solution partner Ideal GRP, our students have created a comprehensive digital twin of the crane," confirms Tammi. "This can be enriched with real-life data from the actual crane to provide feedback for future design improvements or predictive maintenance."

The open factory ecosystem in the digital infrastructure at Aalto University can also be used as a testbed for products and services from other companies that work with a crane.

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Kari Tammi
Associate Professor, Mechanical Engineering
Aalto University

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The university uses Teamcenter to store and manage the digital twin of the crane. It is made up of as-built information from an enterprise resource planning (ERP) system plus design criteria. The programmable logic controller (PLC) in the real crane acquires usage information and sensor data. This is relayed to MindSphere®, the leading industrial IoT as a service solution from Siemens, where it is enriched with data from virtual sensors and analyzed using advanced cloud-based algorithms.

Their results provide feedback that is incorporated in the digital twin in Teamcenter. An embedded MindSphere app provides simultaneous views to product structure, usage data and a 3D model of the crane. This makes it possible to design, analyze and simulate both product and processes in the digital environment and to enrich these models with performance data from the digital performance twin.

“Industrial cranes like the one we are using are needed in almost all factories around the world and will likely become yet another robot in the future,” says Tammi. “Using the digital twin will make development of the required software much easier.”

End-to-end digitalization

Aalto University’s DigiTwin research project is embedded in the MACHINAIDE program, an international EUREKA ITEA3 project with industrial partners from different fields. It examines the requirements for cooperation between a digital twin made for different manufacturers’ devices and the efficient combination of the information obtained from them.

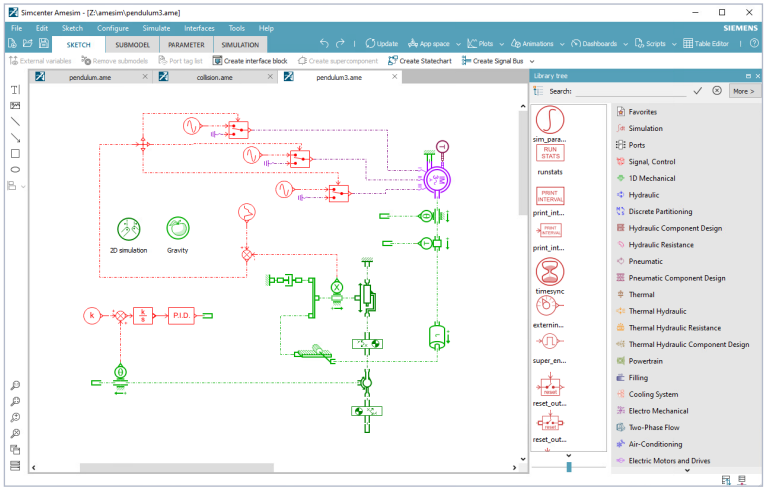

Figure 4. Using Simcenter Amesim, a group of doctoral candidates designed a fuzzy logic-based anti-sway control for the overhead crane.

At Alto University, the digital twin is not only found within the AIIC. Students taking manufacturing courses at the master’s degree course level use the digital twin to design and evaluate production facilities. For this task, they use Plant Simulation software to simulate and optimize production systems and processes. This software is part of the comprehensive Tecnomatix portfolio of digital manufacturing solutions.

It helps students create digital models of logistic systems (for example, production) to explore the systems’ characteristics and to optimize performance. Exploiting the benefits of end-to-end digitalization, they can run experiments and what-if scenarios without requiring or disturbing real production systems.

Solutions/Services

Solid Edge
solidedge.siemens.com

NX
siemens.com/nx

Simcenter
siemens.com/simcenter

Teamcenter
siemens.com/teamcenter

Tecnomatix
siemens.com/tecnomatix

Customer's primary business

Aalto University is a public research university with about 17,500 students on its main campus in Espoo, Finland. It is Finland's second largest university and was established in 2010 as a merger of three major Finnish universities. The close collaboration between the scientific, business and arts communities is intended to foster multi-disciplinary education and research.
www.aalto.fi/en

Customer location

Espoo
Finland

Solution Partner

IDEAL GRP
www.ideal.fi

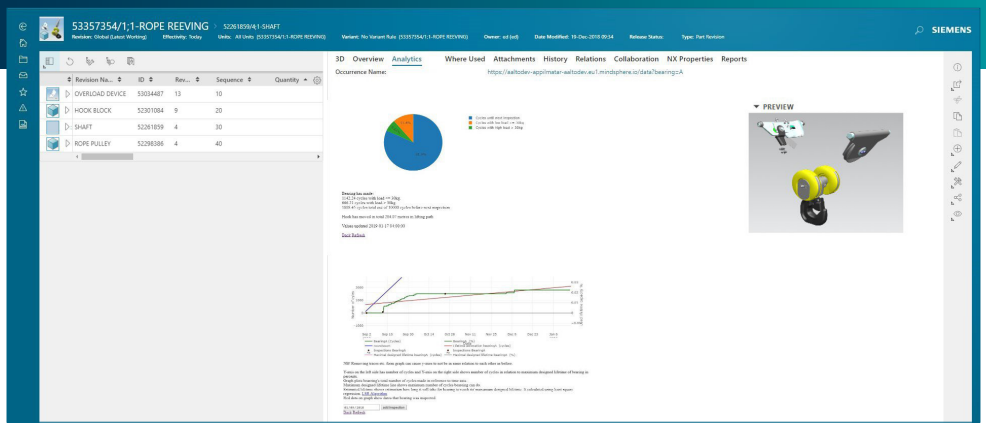

Figure 5. The comprehensive digital twin of the crane can be enriched with real-life data from the actual crane to provide feedback for future design improvements or predictive maintenance.

Enhanced process skills

The majority of students, however, concentrate on creating products. By taking professor Petri Kuosmanen's mechatronic project courses, they learn how to design parts, assemblies and entire machines from product ideation all the way to providing an engineering bill-of-materials (BOM). They use Solid Edge and NX for design and Simcenter for design optimization by simulation, as well as Teamcenter to store and manage all product-related information.

Aalto University professors do not consider it their main task to teach students how to use software tools. They encourage them to use and freely mix various tools to handle the processes with all their aspects. "Using mainly software products from the Siemens portfolio without leaving familiar user interfaces makes it easier for lecturers and students to spin a digital thread and master complex engineering tasks," says Kuosmanen. "Our efforts are also aided by access to Siemens' Xcelerator Academy and support from Siemens solution partner Ideal GRP."

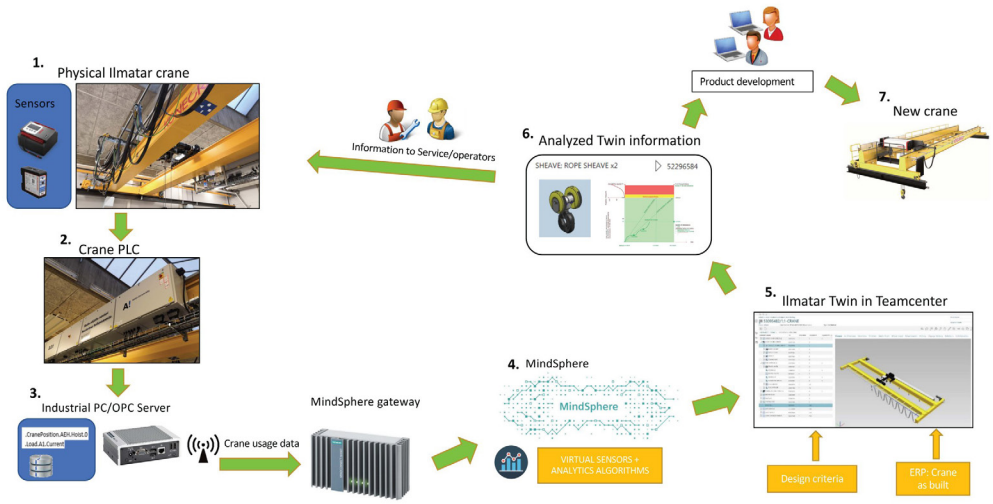

Figure 6. An embedded MindSphere app provides simultaneous views to product structure, usage data and a 3D model of the crane.

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