SIEMENS

TU Graz

Educating future engineers via a closed-loop engineering environment and holistic systems design engineering skills

Platform

Siemens Xcelerator

Business challenges

Provide industries with systems design engineers

Teach future engineers product data management

Impart the ability to cover the entire product origination process

Educate engineering students capable of taking a broader perspective

Keys to success

Provide engineering courses spanning the entire product origination process

Implement an interdisciplinary system modeling approach

Build interdisciplinary development processes

Use the Siemens Xcelerator platform for all product-related work

Leverage the Siemens Research and Innovation Ecosystem program

Results

Provided a closed-loop engineering environment

Provided students with holistic systems design engineering skills

TU Graz uses Siemens Xcelerator solutions to help industries shift to interdisciplinary, sustainable product development

Shaping future engineers

Engineers are essential in developing solutions for many modern-day challenges. Although students in engineering schools and applied science universities learn how to effectively leverage existing tools and methods to convert changing requirements into practicable and sustainable products, Graz University of Technology (TU Graz) takes them several steps further. In its Institute of Machine Components and Methods of Development (IME), it provides students with opportunities to learn not only how to design, verify and manufacture products but also how to develop the necessary processes behind this.

"We teach students how to react to rapidly changing requirements by embracing the concept of transformation," says Professor Dr. Hannes Hick, head of TU Graz IME and dean of studies for production science and management. "We firmly believe this is what the industry needs to improve the resilience it requires to prosper in view of the ever-increasing speed of change it faces."

Focusing on systems engineering

TU Graz IME provides students with opportunities to learn and apply a broad, interdisciplinary spectrum of design, simulation, testing and development methods.


With access to the entire range of Siemens Xcelerator portfolio software solutions, students experience systems engineering and PLM in a real-world environment at the TU Graz DLL.

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Results (continued)

Prepared students for complex engineering software environments

Empowered future engineers to tackle complex challenges

Supported the industry's long-term viability
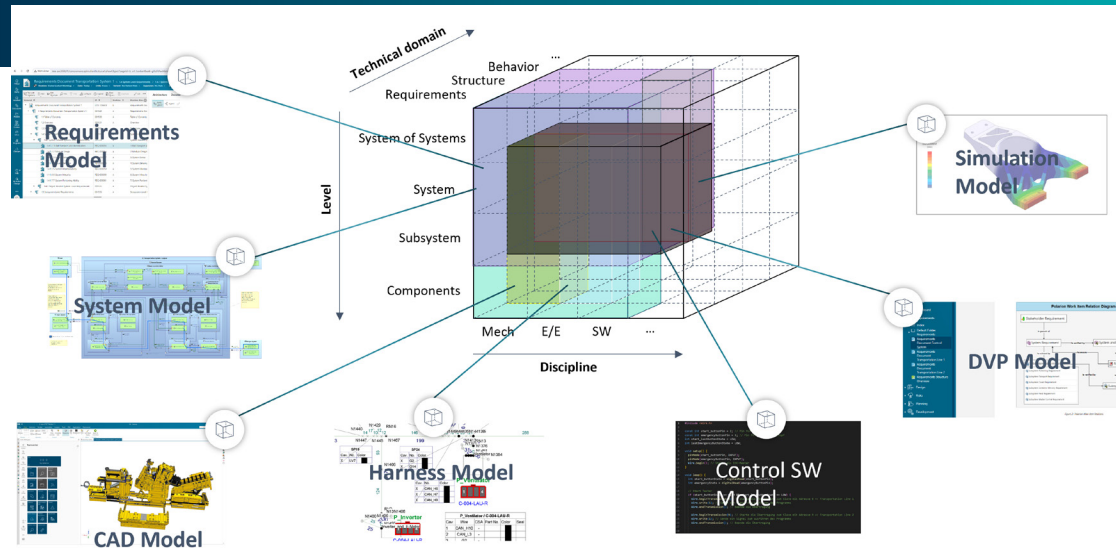
Linking digital artifacts created using various Siemens software tools, TU Graz students make systems cubes to represent the product models to develop, thus implementing an innovative approach to systems engineering and PLM.

"Cooperating with Siemens on the DLL helped us create a new platform for transitioning students between academic research and the industry. With the opportunity to transfer the competencies we gathered here to our smart factory, we created a genuinely comprehensive scope of product development skills."

Professor Dr. Franz Haas
Dean of the Faculty of Mechanical Engineering and Economic Sciences
Graz University of Technology

The institute's development methodology research area focuses on fundamentals and principles necessary for tackling future challenges like growing complexity, limited development time, increasing variant and functionality diversity and tight cost targets.

It also defines competencies and skills future systems engineers require to satisfy labor markets. "Our main research area is model-based systems engineering, a development methodology that combines methods, models and tools for participating engineers and stakeholders to develop systems," says Hick. "It relies on interdisciplinary collaboration and a holistic perspective, which makes our graduates sought-after candidates for engineering management positions."

To support the students' heavily project-oriented work and the vast scope of the interdisciplinary development tasks, TU Graz opened a digital lifecycle lab (DLL).

"Developing an understanding of development methodologies and applying this knowledge in a laboratory situation beyond the scope of specific design tasks is a novel didactic challenge," says Hick. "It also requires using a broad range of software products covering the various aspects of the overall product creation process."

Achieving end-to-end digitalization

IME at TU Graz developed the DLL in collaboration with Antemia GmbH, a startup company with a focus on industrial needs. Although the university focuses on academic research and is limited by commercial aspects, Antemia concentrates on providing industrial offerings to support customers in taking their next steps toward digitalization. Antemia offers training, consulting and software services in the field of interdisciplinary engineering for industrial customers. It also provides the DLL information technology (IT) infrastructure necessary to fully implement software solutions and make them tangible using hands-on application.

As part of the global Siemens Research and Innovation Ecosystem (RIE) program, Siemens created a tailor-made bundle that provides the DLL with a wide variety of software products and a sufficient number of concurrent user accesses.

"Partnering with Siemens opens up new dimensions of teaching, research and industrial application in the field of systems engineering and product lifecycle management," says Hick. "This uniquely comprehensive implementation of Siemens Xcelerator solutions allows us to research methods and processes in greater depth and to evaluate their application in industrial projects."
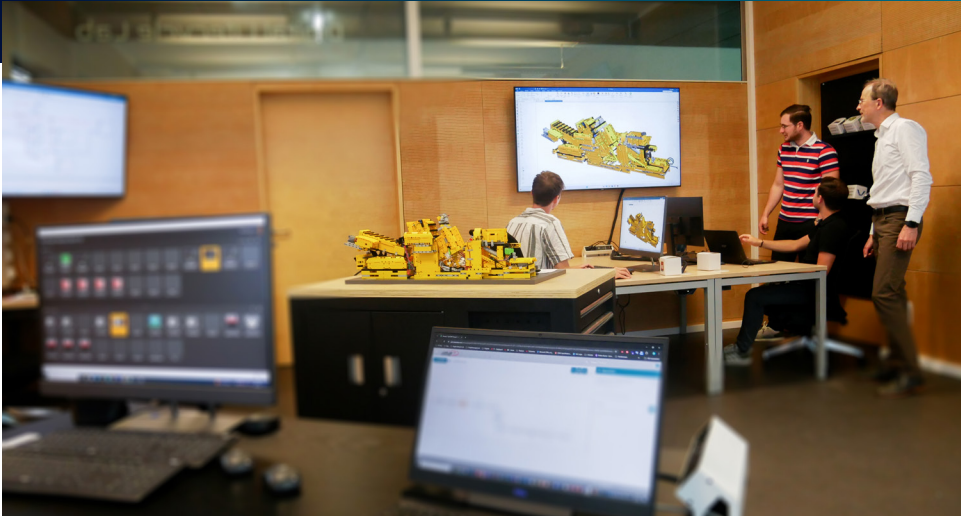
Using methods and tools from systems engineering and model-based systems engineering, a TU Graz team developed a physical prototype of a technical logistics conveyor system.

Leveraging comprehensive systems creation

The new jointly developed approach starts with holistic system modeling and combines all disciplines of product development. For example, during the project mechatronic systems course, students can carry out comprehensive development projects in an industry-oriented environment using specific Siemens Xcelerator software products. These projects span a semester and range from initial ideation to realizing a prototype.

Pursuing a comprehensive systems design approach, students use Teamcenter® software and Polarion™ applications lifecycle management (ALM) software for requirements specification and product lifecycle management (PLM). They also use Solid Edge® software and NX™ software for mechanical design, and Capital™ software and PADS™ software for electronic and electrical design. Additionally, to simulate and verify designs, they can leverage Simcenter™ software and the Tecnomatix® portfolio for plant simulation and robot integration. This gives students in-depth insights into practically applying systems engineering, model-based systems engineering, descriptive modeling, PLM and the digital thread.

In this closed-loop engineering environment, students can visualize other perspectives like the process view and project management information. This provides a holistic view of the system within a uniquely comprehensive development environment, making students aware of what it means to develop complex systems in an interdisciplinary way.

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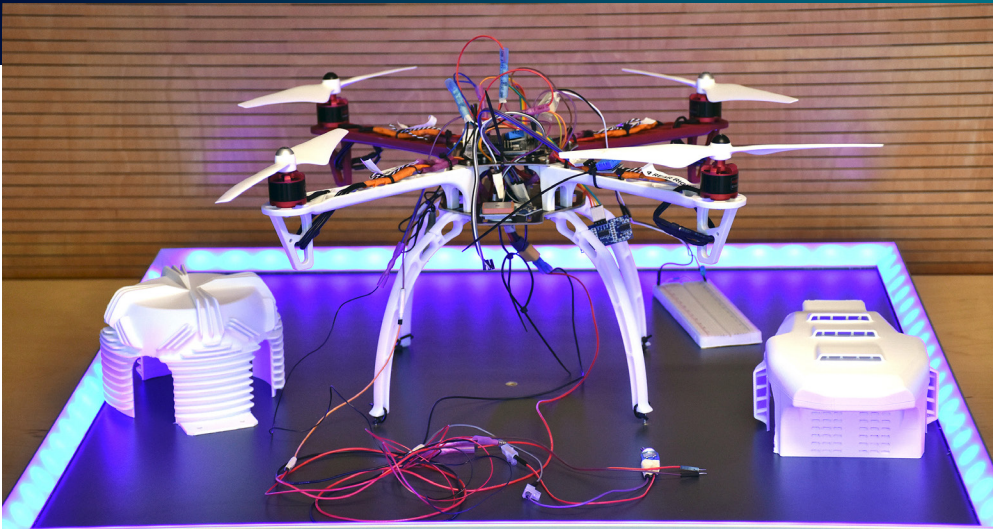
Professor Dr. Hannes Hick
Head of IME and Dean of Studies for Production Science and Management
Graz University of Technology

Using the Mechatronics Concept Designer and a range of Siemens Xcelerator software, TU Graz students developed an all-weather rescue drone.

"Cooperating with Siemens on the DLL helped us create a new platform for transitioning students between academic research and the industry," says Professor Dr. Franz Haas, dean of the TU Graz faculty of mechanical engineering and economic sciences. "With the opportunity to transfer the competencies we gathered here to our smart factory, we created a genuinely comprehensive scope of product development skills."

Specializing based on methods

One challenge at TU Graz is providing the right skill set for future employees. Many software engineers are unaware of what the hardware architecture is capable of, while many hardware designers do not know which software solutions it takes to build highly performant, cyber-physical solutions. However, thanks to their coursework in the DLL, TU Graz students use tried-and-true approaches in mechanical engineering for electronic assemblies and vice versa to apply these methods to the challenges they are solving.

"By using Siemens software in our DLL, we enable a deep dive into interdisciplinary methodological work as well as into individual engineering disciplines," says Hick. "This empowers our alumni to break existing silos, combine methods and achieve better results in systems engineering."

Several academic year groups have already worked with the Siemens Xcelerator business platform in the DLL via master courses. Using methods and tools from model-based systems engineering, one team developed a physical prototype of a technical logistics conveyor system. They used Teamcenter to document and support the entire product lifecycle, mapping various forms of digital consistency, starting with requirements, system models and specific structural and behavioral models. Creating a systems cube to represent the various product models to develop, they linked the digital artifacts created using various Siemens software tools with each other, thus implementing an innovative approach to systems engineering and PLM.
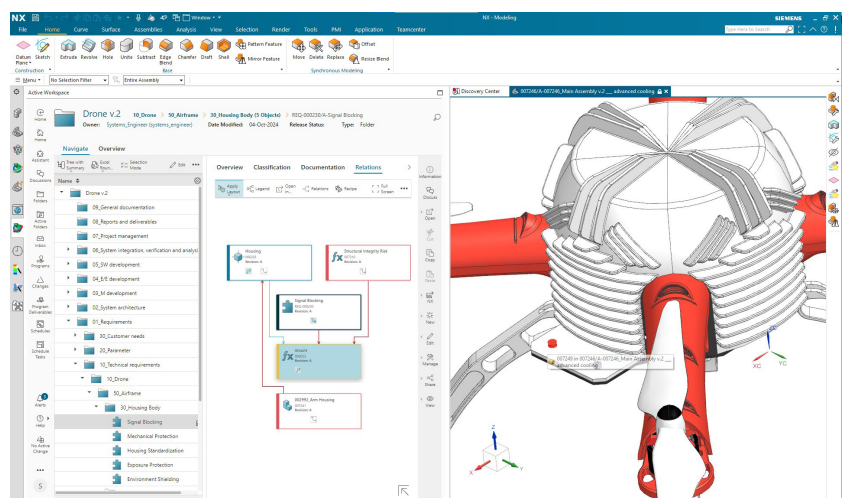
Aside from designing, simulating and testing various forms of weatherproof housing components, the students also investigated interdisciplinary interdependencies between the drone's components.

With the current project to develop a rescue drone, the IME aims to make even more extensive use of Siemens tools, starting with the Mechatronics Concept Designer™ software within NX, and deepen the understanding of how students can use them efficiently and profitably. Additionally, production is a high priority in PLM.

Another central aspect of their project is researching and integrating artificial intelligence (AI) into product development. Implementing AI technologies like copilots should increase efficiency and develop innovative solutions that meet current and future industry requirements.

Gathering and transferring knowledge

Using Siemens software in the TU Graz DLL, students employ a consistent and connected model-based development approach to generate a digital master. This starts with smaller design tasks during their bachelor's courses. Later, they derive a digital twin after the initial development phase. This provides various opportunities for systems optimization.

From current research activities during semester projects to master's and PhD theses, these courses leverage a descriptive modeling approach to support system development, as well as an evaluation of system modeling languages, analyses and development method structuring. This aims to improve students' ability to consider the human factor in technical decision making and systems engineering. Additionally, in a joint academic program with Siemens, TU Graz awards students with badges throughout their academic career.

At TU Graz, the DLL serves as a laboratory for project-based education and supports the transfer between university education and industrial practice. Industry partners frequently visit to get acquainted with TU Graz's systems engineering methods. They turn to Antemia for consulting, software support and engineering staff training, helping them transition towards more future-oriented engineering methods and software. Aside of providing industry partners with future high-level engineering staff, this is a key element in designing their individual digital transformation.

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Solutions/Services

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Teamcenter
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Simcenter
siemens.com/simcenter

Tecnomatix
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Customer's primary business

Founded in 1811, Graz University of Technology is a public research university and is the oldest science and technology research and educational institute in Austria. In seven faculties, the university offers 19 bachelor's and 36 master's study programs, 14 doctoral schools and has over 17,000 students.
www.tugraz.at/en/

Customer location

Graz
Austria
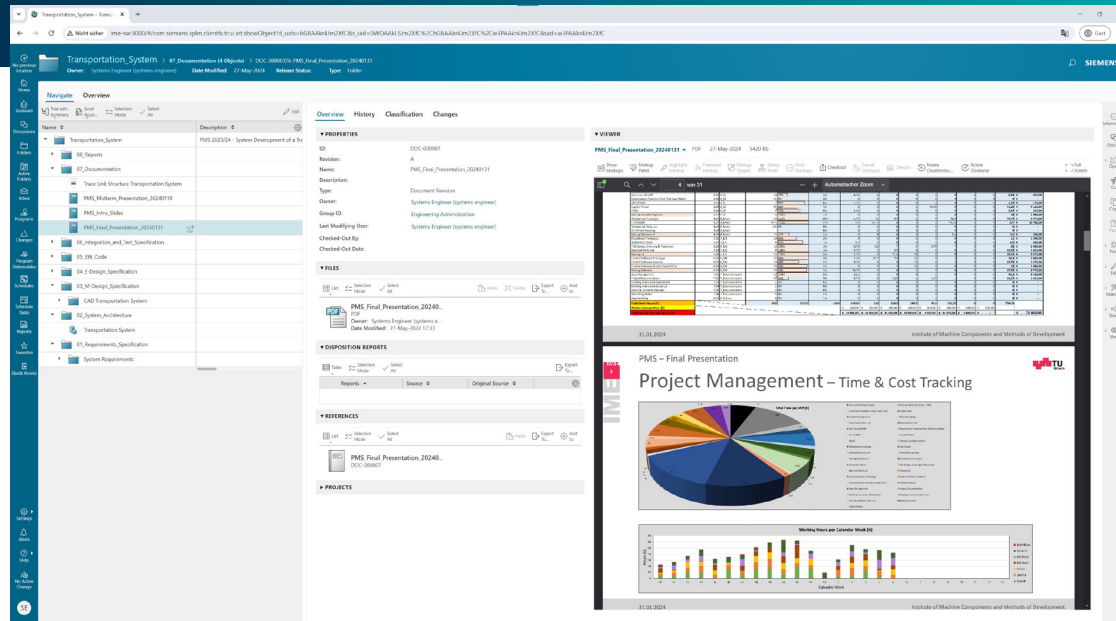
Using a broad range of software products in the TU Graz DLL, students cover the various aspects of the overall product creation process, all the way to time and cost tracking.

Video:
https://www.tugraz.at/fileadmin/user_upload/Institute/IME/Videos/DLL/Dllinaction2.mp4

Siemens Digital Industries Software

Americas   1 800 498 5351
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