

EDUCATION

Paderborn University and Fraunhofer IEM

Enabling students to use advanced systems engineering to drive interdisciplinary, sustainable product development

Platform

Siemens Xcelerator

Business challenges

Educate future engineers on systems design

Enable students to drive product origination processes

Provide industries with decision-makers

Help SMEs leverage digital transformation

Keys to success

Implement an interdisciplinary system modeling approach

Build interdisciplinary development processes

Use Siemens Xcelerator for all product-related work

Operate technology transfer center to aid SMEs

Develop sustainable lifecycle engineering projects

Results

Provided students with holistic systems design engineering skills

Prepared students for multi-disciplinary decision-making

Empowered future decision-makers to tackle complex challenges

Paderborn University leverages Siemens Xcelerator to produce graduates that help companies enhance competitiveness

Engineering the future

Digitalization and artificial intelligence (AI) have a significant impact on today's technical systems, which leads to increased complexity of products, services, production systems and the underlying work organization. This complexity will only grow in the future. Creating these intelligent, networked systems requires close interaction among all involved disciplines. Getting

there not only requires new technologies but also calls for a drastic change in the way services, products and production equipment are designed. Engineers need to be capable of mastering the increasing complexity using digital tools, and to develop a culture of multidisciplinary innovation and change based on systems engineering.

At universities as well as in industry, however, research and development (R&D) activities are traditionally organized according to faculties or disciplines. To overcome the shortage of specialists able to develop the systems of today and tomorrow across



Figure 1. Scientists and lecturers at Paderborn University and Fraunhofer IEM are working on the methods and skills engineers need to tackle the technologies of the future.

Results (continued)

Enabled creation of more sustainable products

Supported industries' long-term competitiveness



Figure 2. In an interdisciplinary system engineering approach, Paderborn and Fraunhofer IEM educate IT-savvy generalists with in-depth knowledge of all aspects of engineering.

disciplines, it is imperative to remedy the existing lack of holistic engineering methods and tools required to enable engineers to pursue advanced systems engineering (ASE). This interdisciplinary product development approach encompasses the entire innovation process from market analysis through design, verification and production to operations and reuse.

Scientists and lecturers at Paderborn University, a mid-sized university in Germany with a strong focus on research and knowledge transfer, are working on

the methods and skills engineers need to tackle the technologies of today and the future. The university is embedded in a network with industry and independent research partners in the Eastern Westphalia Lippe region. Dr. Roman Dumitrescu is a professor who doubles as head of the Advanced Systems Engineering Department at Paderborn's interdisciplinary Heinz Nixdorf Institute and as director of the Fraunhofer Institute for Mechatronic Systems Design IEM. He is also in charge of strategy, research and development as managing director of the Intelligent Technical Systems technology network.



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Dr. Roman Dumitrescu
Head, Advanced Systems Engineering Department
Paderborn University

Advanced systems engineering

“Developing 21st century systems using 20th century methods is less than sustainable,” says Dumitrescu. “Taking an interdisciplinary approach and involving a powerful partner network helps us take an all-out, holistic approach for developing the advanced systems engineering methods needed to educate future product creators.” This approach leverages digitalization, using methods and process models based on creativity and agility. It also combines the existing concepts of virtual product creation, the digital twin and product lifecycle management (PLM) as well as AI design assistance.

Advanced engineering makes it possible to exceed the current boundaries of engineering to revolutionize products and services. It requires concentrating the information needed in any collaborative product development in a comprehensive computer model with full data consistency. This is why it is frequently also referred to as model-based systems engineering (MBSE). Semantically networked, the information embedded in the model creates a common understanding among the decision-makers.

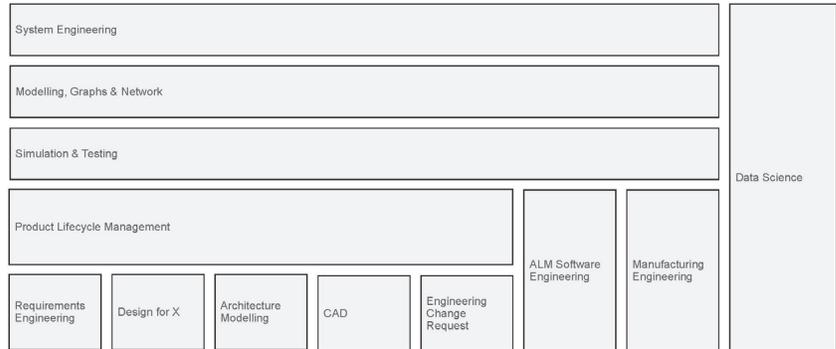


Figure 3. The Paderborn technology and knowledge transfer center is an entry point to digital transformation, which aims to empower small and midsize enterprises to leverage advanced systems engineering using cutting-edge software.

To support the information requirements of the ASE approach, both Paderborn and Fraunhofer IEM use a comprehensive stack of information technology (IT) solutions, prominently including the Siemens Xcelerator business platform of software, hardware and services. “Siemens Xcelerator covers the entire product life-cycle and the associated process chain, from ideation to production to acquiring usage data,” says Dumitrescu. “Using Siemens software, the most advanced tools, our students can experience and practice the future-oriented methods and

“Using Siemens’ software throughout the value chain will lower the entry threshold, especially for SMEs.”

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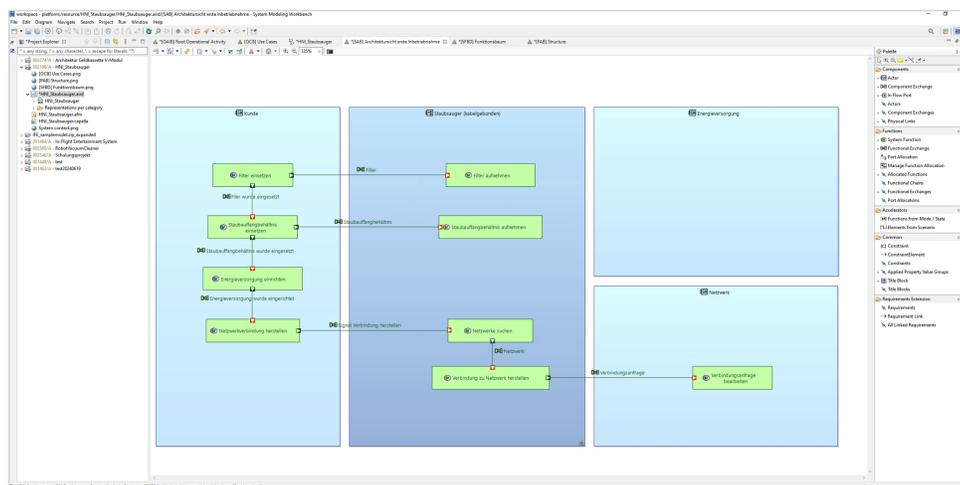


Figure 4. Students at Paderborn and Fraunhofer IEM use Siemens Xcelerator throughout the interdisciplinary advanced systems engineering product development process.



Figure 5. To support the information requirements of the advanced systems engineering approach, Paderborn and Fraunhofer IEM use Siemens Xcelerator solutions.

processes that are relevant to their careers.” They are also highly likely to use these Siemens Digital Industries Software tools during their careers.

Educating product creators

Students at Paderborn become acquainted with the theory behind systems engineering and the use and interplay of the various specialized software tools during their bachelor’s degree courses. Advanced systems engineering is at the core of master’s degree courses that are organized

in various modules. During the model-based systems design module, students implement these basics mainly using Teamcenter® software and Polarion™ ALM software for PLM and requirements specifications, respectively.

For bachelor’s or master’s theses and during specific projects, students also use NX™ software for computer-aided design (CAD) and manufacturing and Mechatronics Concept Designer™ software. They are primarily using these solutions to analyze the potential for improving software tool chains. About 50 students complete their master’s theses in this field every year.

Teamcenter, Polarion, NX and Mechatronics Concept Designer are part of Siemens Xcelerator.

Rather than educating specialist design engineers in particular disciplines, Paderborn and Fraunhofer IEM provide the industry with IT-savvy generalists with in-depth knowledge of all aspects of engineering. “They use Siemens’ software along the entire product lifecycle,” says Dumitrescu. “This empowers our alumni to break existing silos, combine methods and achieve better results in systems engineering.”

“By deeply integrating relevant sustainability information with PLM using Teamcenter, the SLE project strives to revolutionize the design of products and systems by focusing on sustainability from the outset, contributing to a greener and more future-oriented development.”

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Paderborn University

Solutions/Services

Teamcenter
siemens.com/teamcenter

Polarion
siemens.com/polarion

NX
siemens.com/nx

Customer's primary business

With about 20,000 students, Paderborn University is a midsized university in Germany with a strong focus on research and knowledge transfer. Its five faculties, arts and humanities, business administration and economics, science, mechanical engineering and computer science, electrical engineering, and mathematics, offer 70 study programs, some of which are unique in Germany. www.uni-paderborn.de/en/

Customer location

Paderborn
Germany

Sustainable lifecycle engineering

Ideally, ASE enables students to understand the consequences of their decisions so they can consider and fulfill all interface requirements in the early development phase. Because sustainability is often uncertain early in the product development process, Paderborn, Fraunhofer IEM and the Wuppertal Institute for Climate, the Environment and Energy started the Sustainable Lifecycle Engineering (SLE) project. "Trade-off decisions such as whether to encapsulate an electric motor to minimize heat loss, or whether to leave it naked to facilitate recycling, can have significant ecological and economic consequences," says Dumitrescu. "It is also difficult to determine which solution will have the greater effect on saving CO₂."

Supported by Siemens and several other industry partners, the project aims to equip developers and product managers with the tools to systematically incorporate sustainability into their decision-making while designing complex systems. To achieve this, existing MBSE methods and approaches will be extended to include the dimension of sustainability, integrating environmental, social and economic considerations into the development process.

"Without Siemens software, we wouldn't be able to offer a comprehensive advanced systems engineering portfolio," says Dumitrescu. "By deeply integrating relevant sustainability information with PLM using Teamcenter, the SLE project strives to revolutionize the design of products and systems by focusing on sustainability from the outset, contributing to a greener and more future-oriented development."

Gathering and transferring knowledge

Dumitrescu knows when students graduate they are only part way to being what the industry needs to successfully manage the digital transformation. In cooperation with Fraunhofer IEM and Siemens, Paderborn is setting up a technology and knowledge transfer center as an entry point to digital transformation, which aims to empower small and midsize enterprises (SMEs) to use ASE.

This puts the university in an excellent position to bridge the gaps between teaching, academic and applied research and industrial application. "By performing industry-sponsored projects and offering continuing education for managers and engineers already employed in our technology and knowledge transfer center, we will be able to guide and support industry partners through their transition to ASE," says Dumitrescu. "Using Siemens' software throughout the value chain will lower the entry threshold, especially for SMEs."

This will help the industry apply these future-oriented methods and tools and leverage digital transformation. The hope is by helping students gain expertise in the engineering of intelligent, networked products, services and production systems, the German economy will be more competitive on a global basis. The improvements initiated by Paderborn's research activities should also benefit Siemens users around the world.

Siemens Digital Industries Software

Americas 1 800 498 5351
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