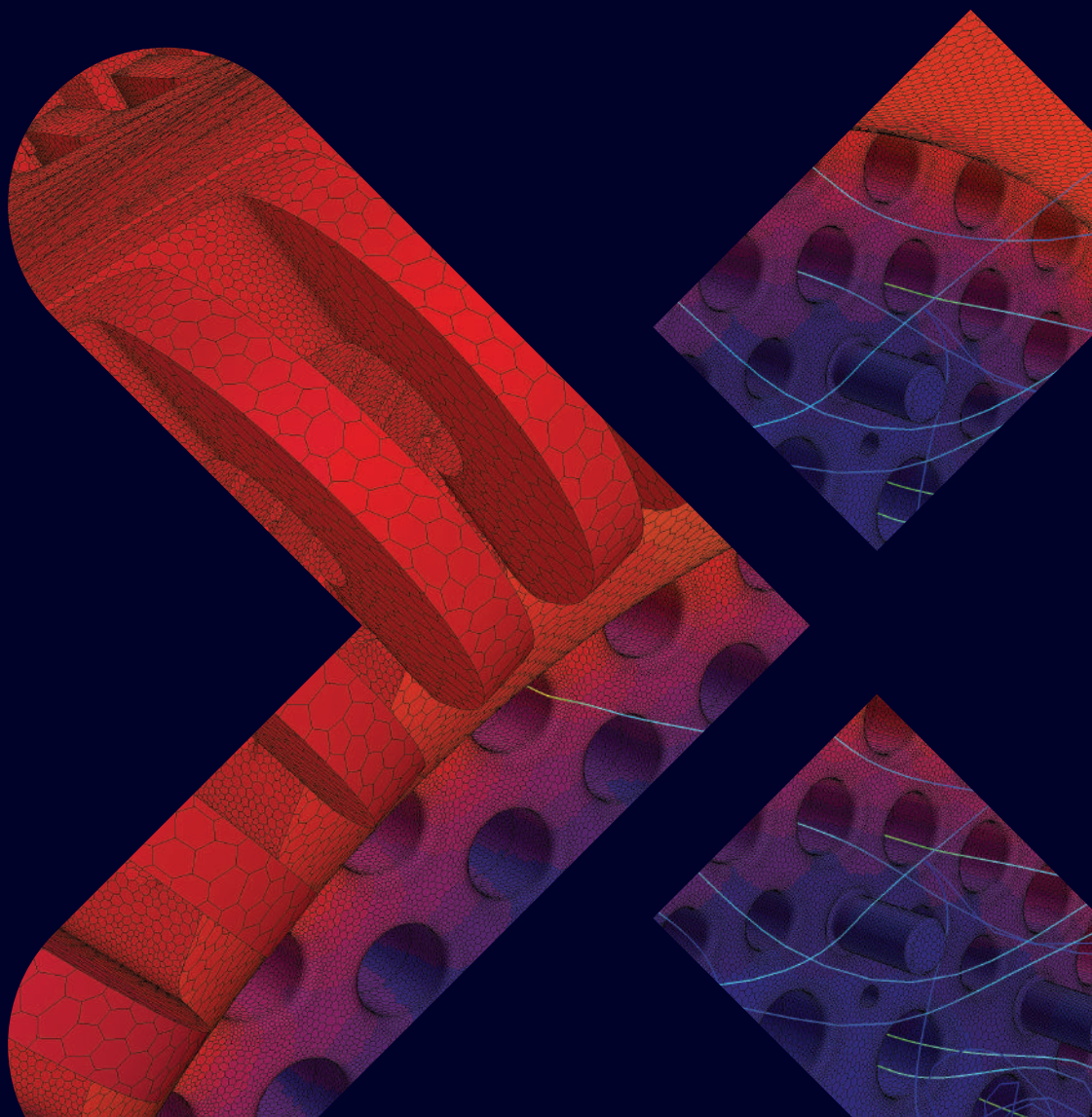
SIEMENS

DIGITAL INDUSTRIES SOFTWARE

Simcenter

Simulation and test solutions for performance engineering

siemens.com/simcenter



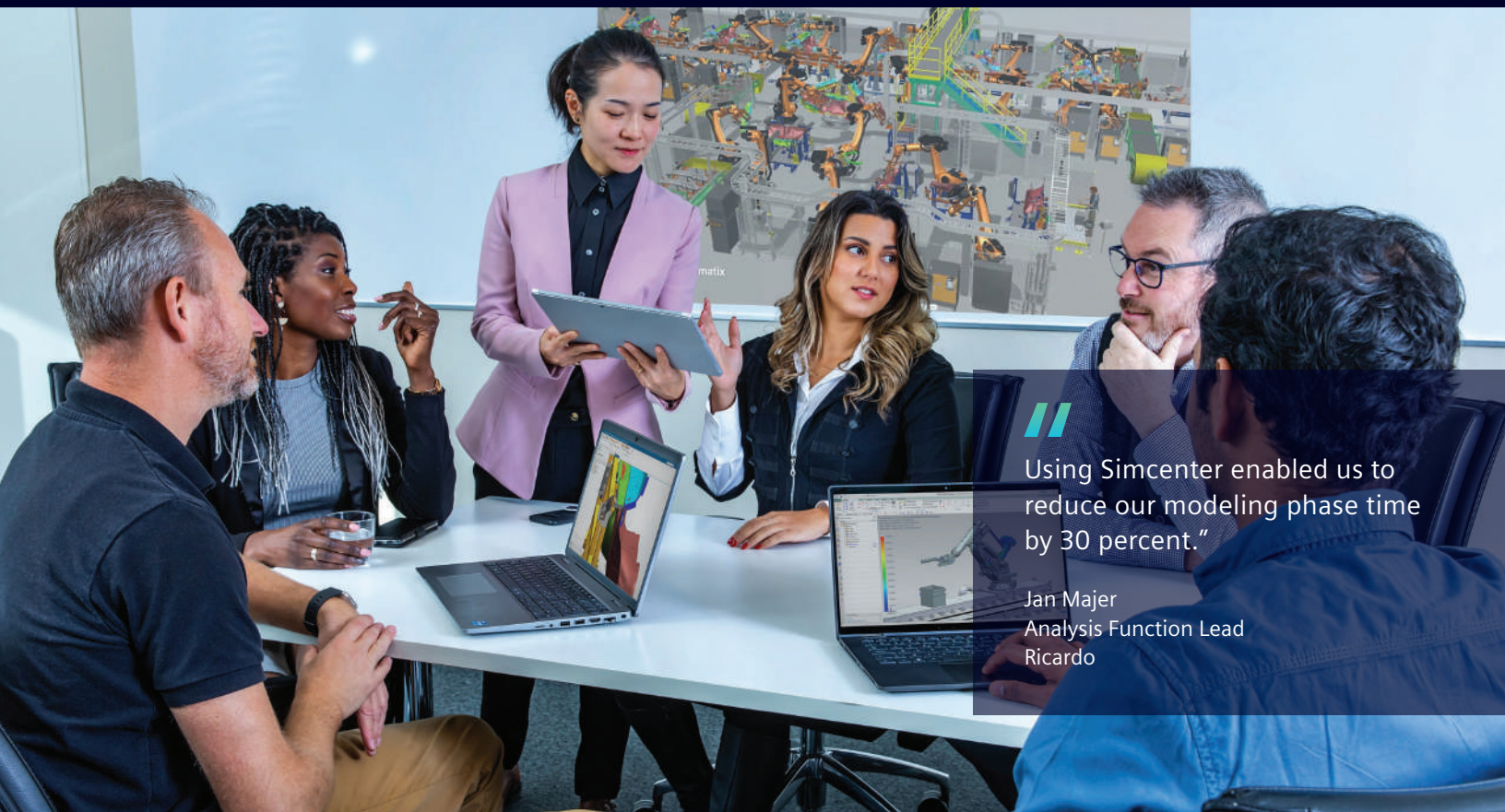
How to engineer innovation in a complex world

Organizations today confront increasing complexity across numerous fronts, including the integration of mechanical, electrical and control systems, using novel materials and manufacturing techniques and the emergence of opportunities stemming from cloud computing and the internet of things (IoT).

Trying to avoid this complexity is not an option, because that means limiting the ability to innovate. Innovation serves as the driving force that can propel companies to surpass their rivals but is more challenging in such an environment. The goal must be to turn complexity into a competitive advantage. Those who are best organized to manage and deal with complexity are the ones best positioned to drive innovation quicker than their competitors.

To successfully design and produce their products, companies must blend various engineering domains and methods to rapidly create new concepts, evaluate them, refine them and bring them to market. A comprehensive digital twin can enable organizations to create closed-loop connections between the virtual and physical worlds to deliver actionable insights and more informed decisions.

The comprehensive digital twin is therefore critical to the future of engineering innovation and simulation and test are the beating heart of the digital twin.



"Using Simcenter enabled us to reduce our modeling phase time by 30 percent."

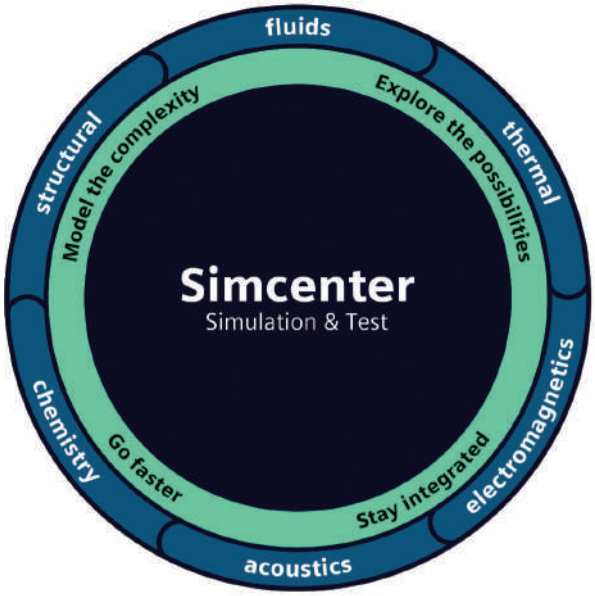
Jan Majer
Analysis Function Lead
Ricardo

What is Simcenter?

Simcenter™ software is a flexible, open and scalable portfolio of the best predictive simulation and test applications that support customers at every step in their digital journey to drive innovation into their products and shorten time to market. Simcenter is a key component within Siemens Xcelerator business platform of software, hardware and services, designed to accelerate digital transformation and value creation – easier, faster and at scale.

By providing our customers with insight into the real-world performance of their product or process, using Simcenter allows them to accelerate innovation over the entire lifecycle.

The portfolio uniquely covers the breadth of methodologies for engineering across system simulation, computer-aided engineering (CAE) simulation and test data acquisition and analytics. Simcenter solutions address a range of physics domains as well as multiphysics solutions that go across these domains. Further, Simcenter solutions are tightly integrated with computer-aided design (CAD) and include capabilities for intelligent design exploration, reduced-order modeling, workflow automation and simulation and test process and data management.



Using Simcenter helps customers gain earlier insights into performance, accelerate innovation through a unique combination of simulation and test and achieve greater productivity be it at the individual, team or organizational levels. Simcenter adds significant value by seamlessly incorporating simulation and testing within the broader scope of product development, leveraging the power of the digital twin concept.

Maturing simulation and test for the digital twin

To take advantage of the opportunities of using digitalization and digital twin technologies, companies need to mature their simulation and test capabilities. There are four key dimensions that organizations should evolve and these correspond with the areas that Siemens is investing significantly with the Simcenter portfolio.

Model the complexity

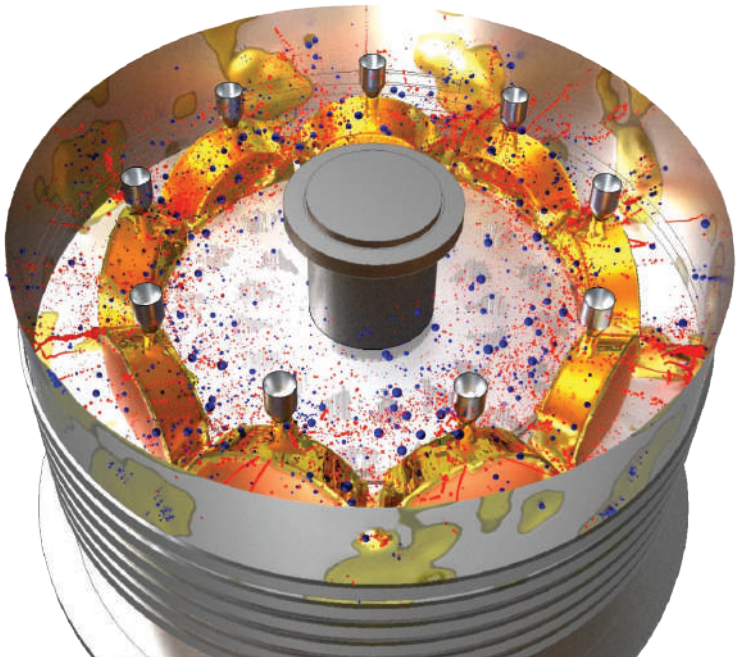
Innovation often introduces new risks and uncertainties. The ability to model the inherent complexity of real-world systems enables companies to gain new insights and anticipate potential risks and challenges early on. Engineering teams can better understand the interactions among different physics by using a comprehensive digital twin that can simulate performance for real-world scenarios.

Simcenter provides users with advanced system simulation, CAE simulation and physical testing solutions to accurately predict and measure product performance. Each modeling approach has its

strengths and delivers unique insights. 1D models provide fast calculations and insights for system performance. 3D models offer detailed representations and accurate simulations, facilitating in-depth analysis and optimization. Physical testing provides empirical validation and verification, ensuring that the product meets the required standards. By leveraging the strengths of each approach, companies can efficiently model and analyze complex systems while minimizing time and resource requirements.

Explore the possibilities

An increase in complexity also means an increase in the degrees-of-freedom (DOF) that can influence performance. To be confident in their designs, engineers need the ability to not only model real-world complexity, but also to fully explore the design space and select the best possible design. The true power of a digital twin is that it allows engineering teams to quickly and precisely predict the impact of modifications and explore various options. Intelligent exploration of the design space is where organizations start to gain tremendous value from the models that they have built. Complex systems always involve multiple conflicting objectives such as cost, performance, reliability and sustainability. Simcenter empowers decision confidence with best-in-class tools for intelligent design space exploration and trade-off analyses. This enables designers to make informed decisions and strike a balance between competing factors to achieve an optimized design solution that meets the desired goals.



Go faster

In the face of increasing competition, the need to bring innovations to market faster is paramount. Across all industries this results in an imperative to increase throughput in product development. Simulation and testing play a crucial role in enabling companies to accelerate their product development processes. However, both increasing model complexity and the desire to fully explore the design space drive the need for even greater speed.

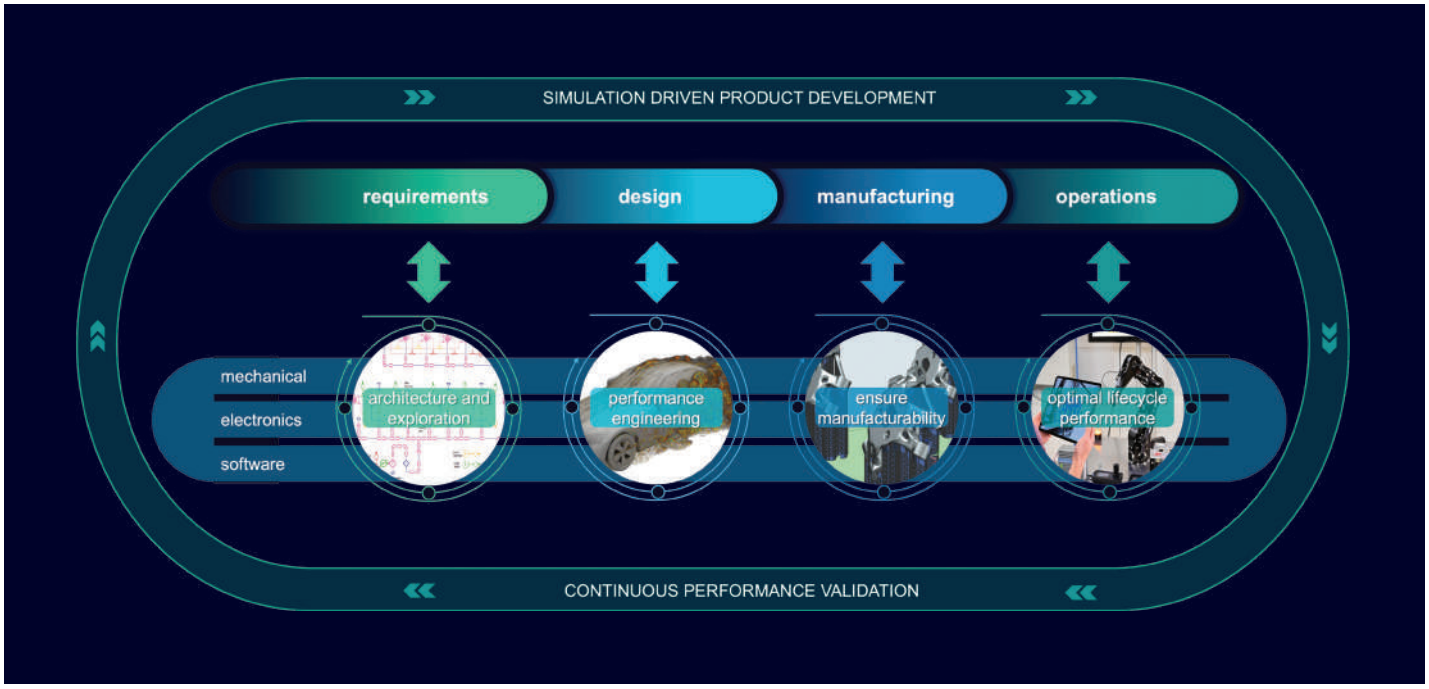
> "By pre-defining major calibration values using HiL simulation, we were able to reduce the number of actual vehicle tests by 40 percent."
>
> Bang Jae-Sung
> Senior Engineer R&D Center
> Hyundai Motor Company

Simcenter addresses this need with an emphasis on fast and efficient workflows in modeling applications and focused innovation on faster solvers, reduced-order modeling methods, AI-enhanced predictions, high-performance cloud computing and more.

Stay integrated

As products become more complex, the potential for misalignment between teams increases. Simultaneous development in various functional areas can lead to decisions that, while optimal for one aspect, may conflict with objectives in others, resulting in development delays or last-minute changes.

Maintaining traceability is essential to allow a comprehensive audit of the decision-making process and an understanding of the stakeholders affected. To achieve this, a digital thread is vital, connecting relevant stakeholders, models and data, ensuring integration throughout the product development journey. Simcenter solutions are built to ensure this alignment, helping to break down silos and blur boundaries between disciplines, teams and organizations so companies achieve engineering effectiveness, even against a backdrop of increasing complexity. Simcenter integrates with other Siemens Xcelerator solutions such as NX™ software and Capital™ software to enable multidisciplinary design across mechanical, electrical and software functions and with Teamcenter® software to fully enable a digital thread that encompasses performance engineering.



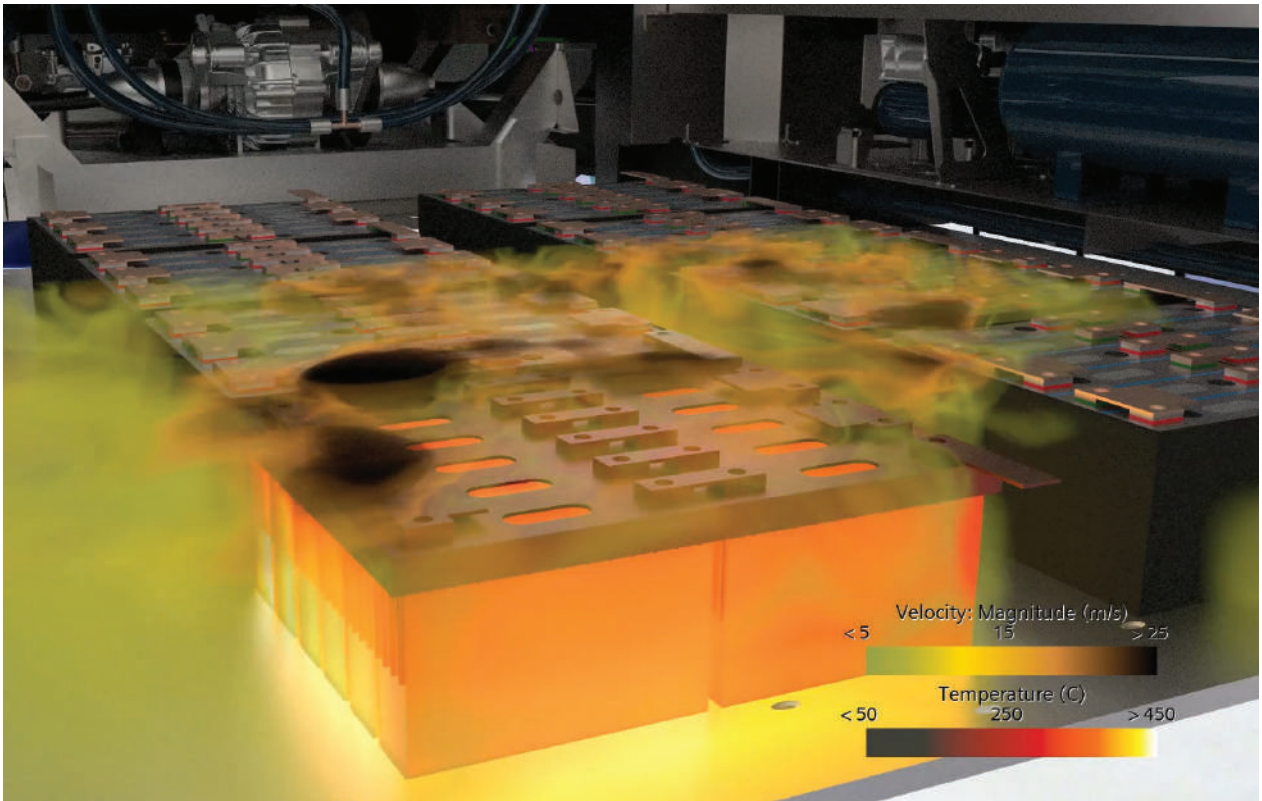
Advancing key initiatives

The pursuit of enhanced competitiveness drives most companies to undertake diverse initiatives tailored to their specific goals and objectives. Today, Simcenter serves as a critical tool in bolstering these initiatives across industries.

The pursuit of enhanced competitiveness drives most companies to undertake diverse initiatives tailored to their specific goals and objectives. Today, Simcenter serves as a critical tool in bolstering these initiatives across industries.

With its advanced capabilities and comprehensive solutions, Simcenter enables companies to drive sustainability by optimizing product designs and reducing their environmental impact. It plays a pivotal role in the evaluation of various design alternatives, leading to the development of energy-efficient and eco-friendly solutions. You can use

> "By adopting simulation early on the project, we significantly reduced cost and time on the front-end as we got the right design answer in the shortest possible time. It is massively important because we can get people to make the right design decision, thereby reducing development time by 50 to 80 percent."
>
> Euan Freeman
> Principal Engineer
> Cox Marine



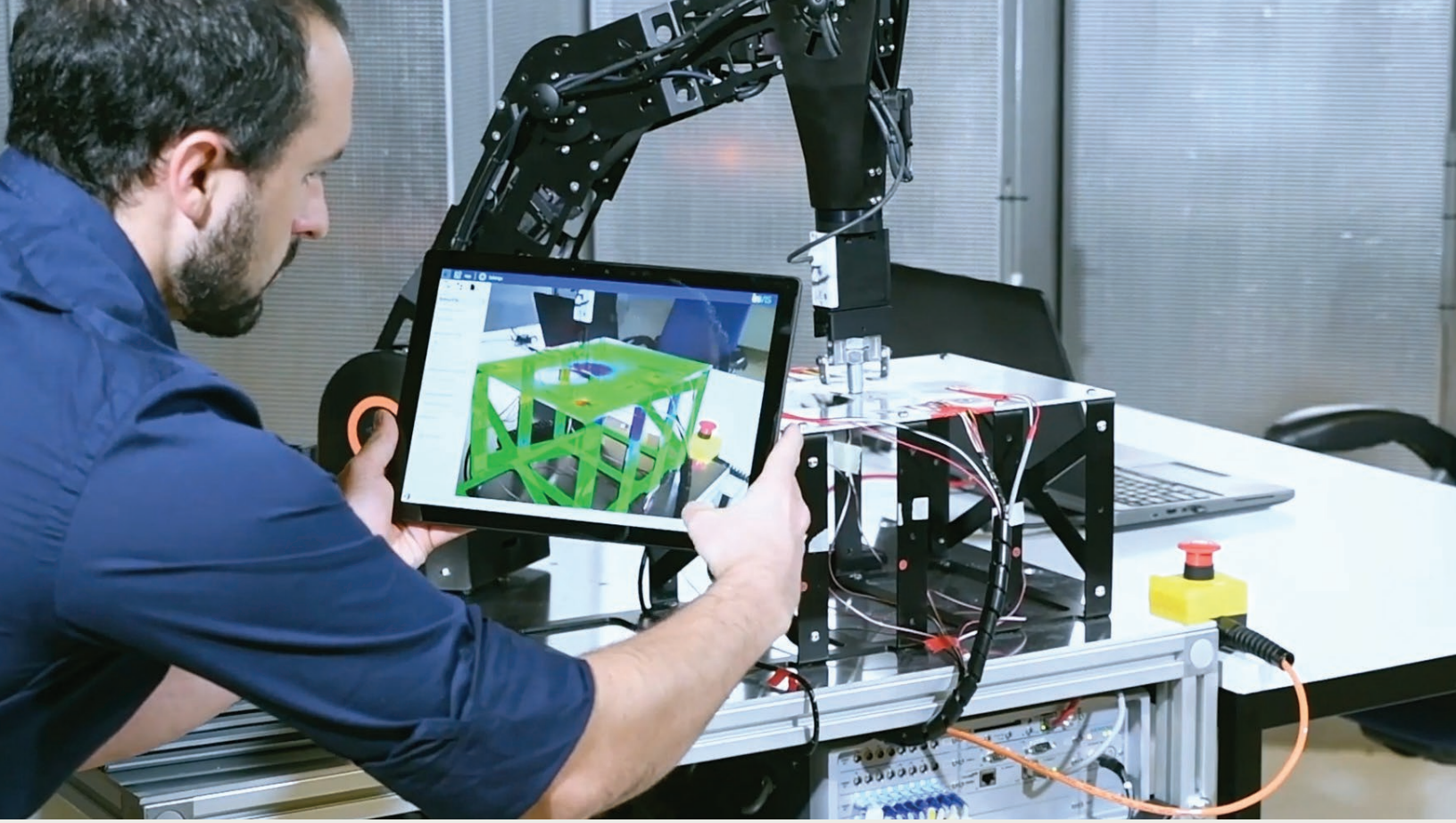
> For a specific project, let's say we could save one prototype round. This is easily one month and shortens a typical total development time for us from six months to five months."
>
> Lauri Puranen
> Magnetics Manager
> Salcomp

Simcenter in the electrification revolution by aiding in the design and validation of electric vehicle systems including batteries, motors and power electronics. Simcenter solutions support the democratization of simulation by offering intuitive interfaces and cloud-based collaboration tools, empowering engineers across disciplines to leverage simulation in their daily work. Simcenter facilitates model-based systems engineering, enabling companies to seamlessly integrate and validate complex systems, leading to improved product performance and reliability.

Simcenter customers can bring better products and solutions to market faster while achieving greater return on their existing investments. Our open philosophy enables Simcenter to work within a broader ecosystem of product development tools and our ability to partner with our customers on technology development ensures a pathway for proprietary methods to be integrated into future workflows.

No matter the current initiative or simply pursuing excellence, Simcenter is an invaluable asset for companies looking to gain a competitive advantage through engineering innovation and digital transformation.


AST GUARD



Simcenter portfolio solutions

Simcenter includes solutions that span system simulation, multidiscipline and multiphysics 3D CAE simulation, physical testing, intelligent design exploration, workflow automation, process management and autonomous vehicle development solutions. In addition, Simcenter technology powers the simulation capabilities in NX and works seamlessly across other solutions in the Siemens Xcelerator business platform.

"Siemens has a similar vision to Northrop Grumman in terms of growing with the product. Our team performs all kinds of simulation, including stress, dynamics, kinematics, shock utilizing and rigid and flexible bodies using the powerful and user-friendly Simcenter pre-post processors and solvers. Interconnectingand integrating Simcenter tools in the Siemens Xcelerator business platform has been groundbreaking for us."

Dr. Tom Stoumbos
Simulation and Test Leader
Northrop Grumman

Systems simulation

> "Simcenter Amesim was so effective that Sub-Zero expects to have its design exploration time reduced from two months to one week, a decrease of 88 percent."
>
> Anderson Bortoletto
> Principal Engineer, Advanced Product Development
> Sub-Zero Group

Simcenter Amesim

Simcenter Amesim™ software is a 1D multidomain system simulation solution that allows engineers to model, simulate and analyze complex mechatronic systems. Simcenter Amesim combines ready-to-use multiphysics libraries with application- and industry-oriented solutions that are supported by powerful platform capabilities.

Simcenter Flomaster

Simcenter Flomaster™ software is a 1D computational fluid dynamics (CFD) simulation solution specifically designed for analyzing and optimizing fluid systems. Simcenter Flomaster enables engineers to model and simulate fluid flow, heat transfer, pressure and other relevant parameters within complex piping and thermal systems.

Simcenter System Analyst

Simcenter System Analyst software is a collaborative solution that allows project and program engineers to create industry-specific applications to drive system simulation models and run variant analysis within an easy-to-use simulation environment.

Mechanical simulation

> "Our new seat belt brackets are up to 78 percent lighter than our previous designs, while achieving a higher safety factor due to extensive structural optimizations made using Simcenter Nastran."
>
> Will Chen
> Design Engineer
> RFK Racing

Simcenter 3D

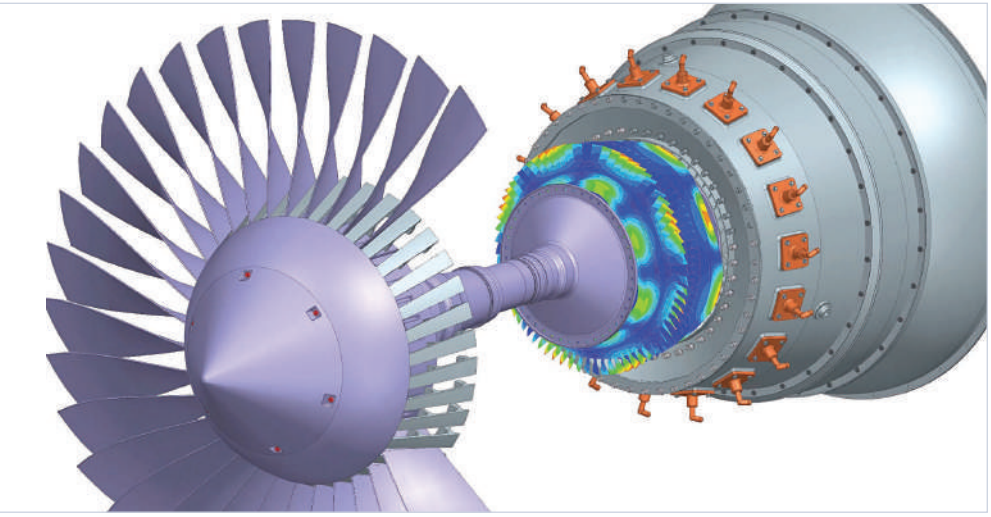
Simcenter 3D software is a comprehensive, fully integrated CAE solution for complex, multidisciplinary product performance engineering. Simcenter 3D combines geometry modeling with CAE pre- and post-processing and integrates various industry-standard solvers across multiple physics domains such as structural, thermal, acoustics, motion, safety, electromagnetics and more.

Simcenter Nastran

Simcenter Nastran software is a premier finite element method (FEM) solver known for computational performance, accuracy, reliability and scalability. Trusted as an industry standard for over 50 years, it is used for linear and nonlinear structural analysis, structural dynamics, acoustics, rotor dynamics, aeroelasticity and optimization.

Simcenter Femap

Simcenter Femap™ software is an advanced CAE pre- and post-processor to model components, assemblies or systems. Simcenter Femap is used in combination with finite element solvers for the simulation of various physical phenomena such as stress, vibration and heat transfer.



> "The knowledge we gained from working with the Simcenter Engineering team has been invaluable. Being able to optimize our vehicle with this project will have a positive effect on future projects, as we no longer need to build our entire process and models from scratch. We estimate that working with Siemens on this project will help us save over $200,000 on production of this vehicle."
>
> Jaeyong Seo
> Principal Research Engineer
> SsangYong Motor

Simcenter Madymo

Simcenter Madymo® software is a multiphysics, CAE solution for simulating human safety of occupants in transport and vulnerable road users. It includes a database of crash test dummy and human body models that have been validated to international guidelines.

Simcenter Tire

Simcenter Tire software is an end-to-end solution for modeling tires that you can apply to applications ranging from vehicle handling to durability. Using Simcenter Tire helps you apply accurate tire modeling for vehicle performance simulation.

> "The multiphysics system modeling of the hydraulic tensioner has reduced the number of necessary prototypes by half, from 15 down to 6 or 7. This process improvement also saves us about 6 months of development time."
>
> Fabien Zarka
> Manager, Systems and Mechanical Products
> Hutchinson Transmission

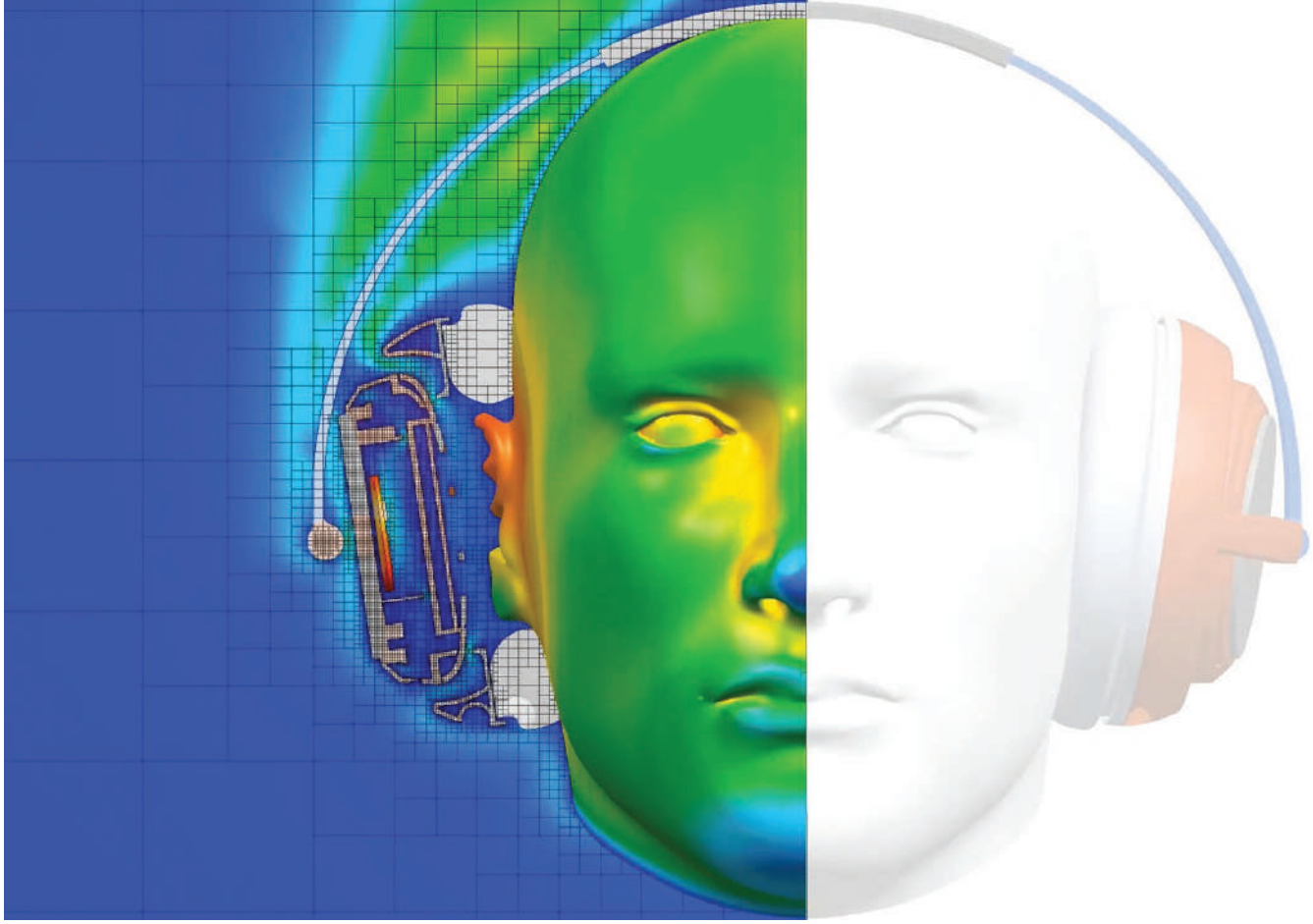
Fluids and thermal simulation

> We have found that the simulated results and actual data only show a 1 percent difference in accuracy. This means that we can use Simcenter to create smart simulators that can perform maneuvers with 99 percent accuracy. For this reason, we trust Simcenter STAR-CCM+ to simulate high-risk applications like vessel launches."
>
> Dr. Davide Grassi
> Senior Naval Architect
> CETENA

Simcenter STAR-CCM+
Simcenter STAR-CCM+™ software is a multiphysics CFD solution that includes preprocessing, meshing, multiphysics solvers, data analysis and photorealistic visualization within a single user environment. The built-in multiphysics solvers can simulate CFD, computational solid mechanics, electromagnetics, heat transfer, multiphase flow, particle dynamics, reacting flow, electrochemistry, aero-acoustics and rheology.

Simcenter SPH Flow
Simcenter SPH Flow™ software is a rapid meshless CFD solution that leverages an integrated smoothed-particle hydrodynamics (SPH) solver. Simcenter SPH Flow is particularly well suited for high-dynamics flows with complex boundaries and interfaces.

Simcenter FLOEFD
Simcenter FLOEFD™ software is a fully CAD-embedded CFD solution for design engineers. It enables frontloading of fluid flow simulation and thermal analysis, working with CAD geometry directly in NX, Solid Edge, CATIA or Creo.



Simcenter Flotherm
Simcenter Flotherm™ software is a leading simulation solution for electronics cooling analysis. Simcenter Flotherm helps shorten development times for integrated circuit (IC) packages, printed circuit boards (PCBs) and enclosure levels through to large systems such as data centers.

Simcenter Flotherm XT
Simcenter Flotherm XT software is a CAD-centric electronics cooling solution. It enables thermal engineers to optimize thermal management of electronics earlier by connecting ECAD and MCAD design flows.

Simcenter Culgi
Simcenter Culgi™ software is a multiscale computational chemistry solution for discovering and designing innovative soft materials. Simcenter Culgi helps accelerate materials development in domains such as specialty chemicals, energy storage, pharmaceuticals and personal care.

Simcenter Battery Design Studio
Simcenter Battery Design Studio™ software is a dedicated solution for validating lithium ion (Li-ion) cell designs through detailed geometrical cell specifications and cell performance simulation. It offers a physics-based, macro-homogeneous model to get insights into the cell's electrochemical mechanism as well as an equivalent RCR circuit model for computational efficiency.

> "Simcenter Flotherm helped us to find what we believe is the lowest-cost cooling solution for the product."
>
> Ferdinand Sluijs
> Technology Manager
> NXP Semiconductors

Electro-magnetics simulation

Simcenter MAGNET

Simcenter MAGNET™ software is a powerful electromagnetic field simulation solution for performance prediction of motors, generators, sensors, transformers, actuators, solenoids or any component with permanent magnets or coils. It provides capabilities for accurate material modeling such as nonlinearity, anisotropy, hysteresis and demagnetization.

Simcenter SPEED

Simcenter SPEED™ software allows design engineers to rapidly analyze motor designs using analytical simulations. Simcenter SPEED supports several types of e-machines including synchronous motors, single, 2- and 3-phase machines, induction machines, switched reluctance motors, DC machines, wound-field commutator machines and axial flux machines.

Simcenter Motorsolve

Simcenter Motorsolve™ software is a complete design and analysis solution for permanent magnet, induction, synchronous, electronically and brush-commutated machines. A dedicated tool for motor designers, it leverages finite element analysis (FEA) with an intuitive interface for accurate simulation of electric machines.

Physical testing

> As a result, by using Simcenter Testlab the computing time for the analysis has decreased by about 50 percent compared to the in-house developed solution."
>
> H. Moritz Rügamer
> Test Engineer
> SRAM

Simcenter Testlab

Simcenter Testlab™ software is an integrated solution for test-based engineering, combining high-speed data acquisition with integrated testing, analytics and modeling tools. Simcenter Testlab software suite seamlessly integrates with Simcenter SCADAS™ data acquisition hardware systems and covers the extensive testing requirements of noise and vibration and durability engineers.

Simcenter SCADAS

Simcenter SCADAS™ hardware includes handheld solutions, compact and portable mobile units, autonomous smart recorders and high channel-count laboratory data acquisition systems. Simcenter SCADAS hardware supports a variety of analog and digital transducers for acoustic, vibration and durability engineering. The hardware is seamlessly integrated with Simcenter Testlab for accelerated test setup and accurate data processing.

Simcenter Testxpress

Simcenter Testxpress is a sound, vibration and durability analyzer that combines the ease of use of a traditional analyzer with the high-speed performance and measurement quality of an advanced measurement system.

"Models are becoming more accurate and we need to capture more physical realism. You can guarantee we will frequently require more powerful HPC resources in the future. Simcenter Cloud HPC offers that agility, which translates to a more competitive offering for our customers."

Dr. Larisa von Riewel
Computer-Aided Engineering
Group Leader
Heraeus Noblelight

Simcenter Anovis

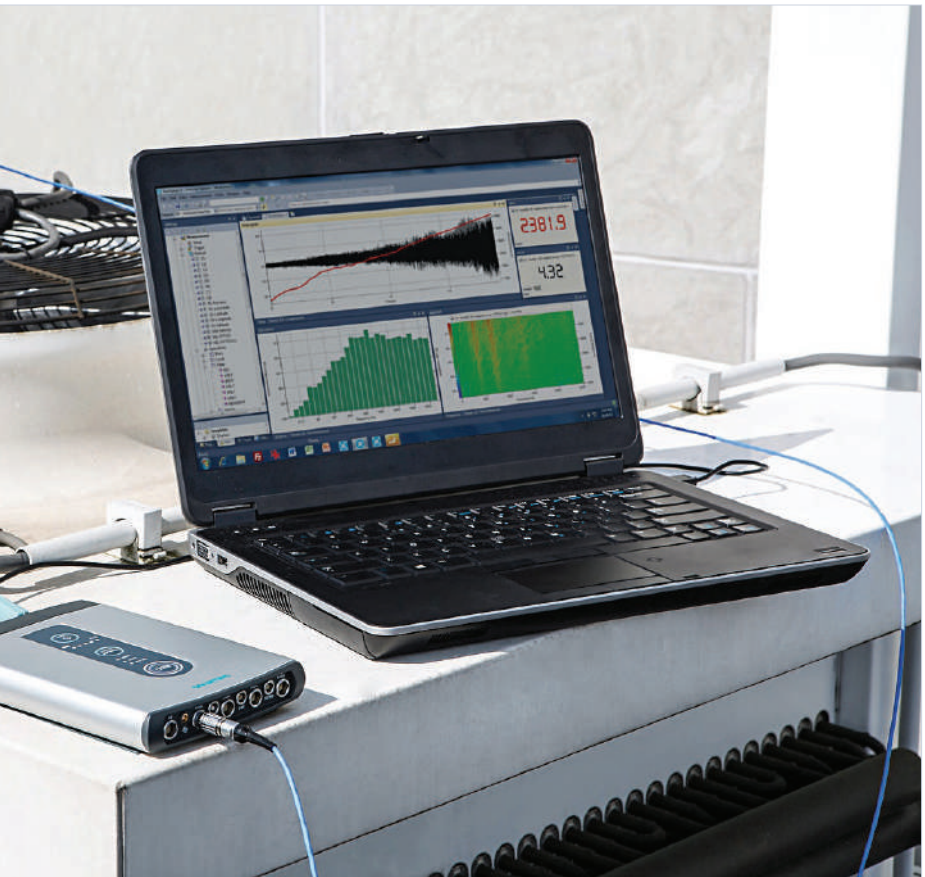
Simcenter Anovis™ software is a complete solution for precise and objective pass or fail checks: from end-of-line testing of rotating machinery to non-destructive component testing and production machine monitoring with vibration and sound analysis. It combines all necessary sensors, sound and vibration signal recording hardware, smart signal analysis and flexible test bench control software.

Simcenter Sound Camera

Simcenter Sound Camera™ software is a modular, high-quality digital microphone array that offers an instant overview of sound sources for any noise-generating object. The combined hardware and software solution helps you quickly track down unwanted noise sources. The array is robust and shockproof yet can be comfortably handheld throughout a measurement campaign.

Simcenter Qsources

Simcenter for Qsources™ hardware is a comprehensive suite of innovative sound and vibration excitation hardware designed to measure driving points and structural and vibroacoustic frequency response functions.



"Engineering experts developed a target durability test track sequence that accurately replicated the excitation of the actual road and significantly reduced the amount of time that would have been required for road testing...The truck cabin test on the four-poster durability test rig took only four weeks, about half the time required for the proving ground test cycle."

Murat Arslan
Vehicle Durability Supervisor
Ford Otosan

Simcenter Micred T3STER

Simcenter Micred™ T3STER™ software is an advanced nondestructive transient thermal tester for the thermal characterization of packaged semiconductor devices and multi-die devices. It can also be used to calibrate detailed 3D models for use in thermal simulation.

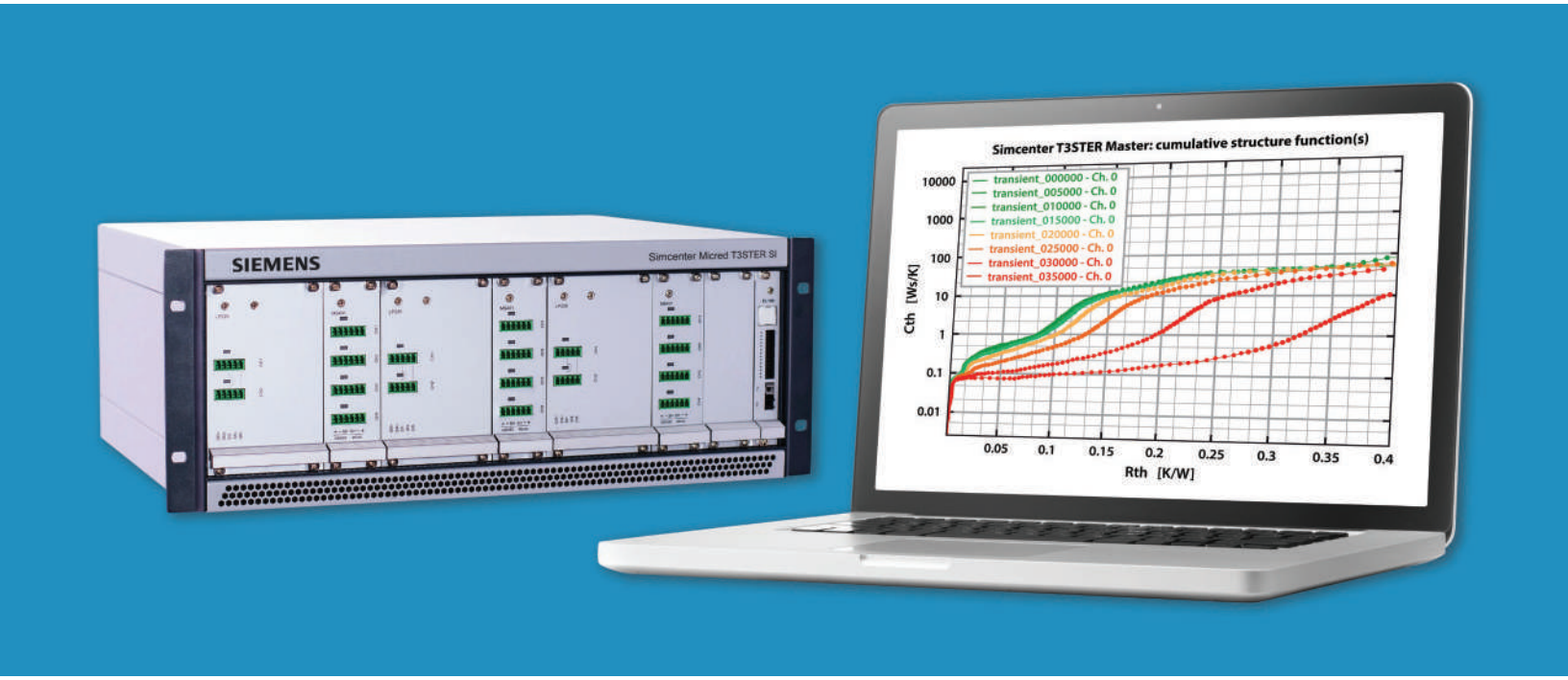
Simcenter Micred Power Tester

Simcenter Micred Power Tester software is used in power electronics applications for power semiconductor thermal reliability and lifetime assessment. It combines active power cycling with transient thermal characterization and thermal structure investigation for failure diagnosis.

Simcenter Micred Quality Tester

Simcenter Micred Quality Tester hardware enables the assessment of a semiconductor package thermal structure to identify manufacturing defects, including die attach issues. It combines precise thermal impedance measurement with high throughput automatic binning.

> Due to the Simcenter Micred power cycle thermal test system, we have established the reliability test and verification platform, which can be used to accurately perform qualitative and quantitative testing and analysis of our self-developed power electronics IGBT modules.
>
> Lu Hongshui
> Vice General Manager
> Nari Technology



Autonomy solutions

Simcenter Prescan

Simcenter™ Prescan™ software provides a physics-based simulation platform to develop, test and validate advanced driver assistance systems (ADAS) and autonomous vehicles (AV).

Multi-disciplinary design analysis and optimization

HEEDS

HEEDS™ software is a powerful design space exploration and optimization software that interfaces with CAD and CAE tools. HEEDS includes capabilities to automate analysis workflows, enable distributed execution, perform intelligent design space exploration and powerful post-processing to visualize performance trade-offs.

> "Together with Simcenter STAR-CCM+ and NX, HEEDS helps us discover better designs faster."
>
> Jens Dickhoff
> Project Manager
> B&B-AGEMA

Model-based systems engineering

Simcenter Studio

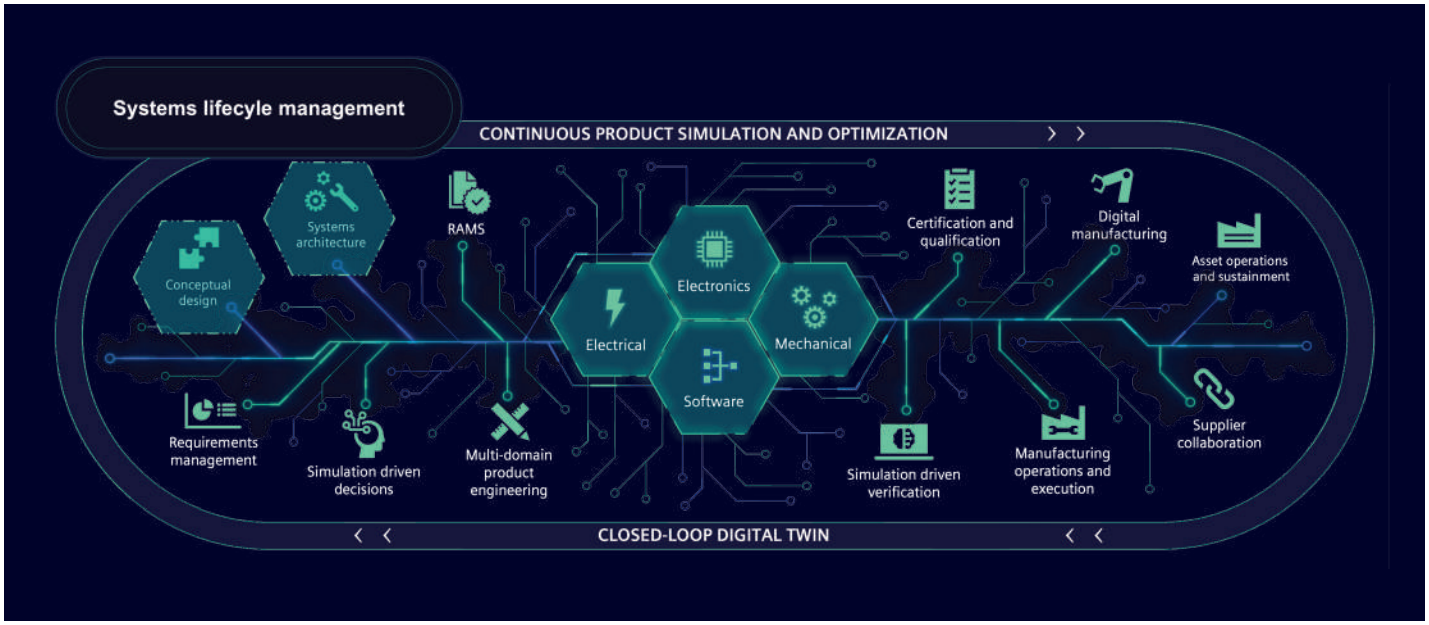
Simcenter Studio™ is a generative engineering application used to generate and evaluate system architectures in the early stages of design. It combines system simulation; optimal control methods and reinforcement learning with state-of-the-art machine learning and scientific computing stack to simulate and evaluate hundreds of architectures.

Simcenter System Architect

Simcenter System Architect software provides a platform to configure and integrate plant and controls models into a logical view of the entire system for simulation. With Simcenter System Architect, system engineers and architects can collaborate on system architecture and design, integrating data and models from multiple authoring applications, such as Simcenter Amesim software, controls software and any application that supports the Functional Mockup Interface (FMI) standard for model exchange and co-simulation.

Maintenance Aware Design ecosystem

Siemens Digital Industries Software offers the Maintenance Aware Design Ecosystem (MADE) from PHM Technology for model-based reliability, availability, maintainability and safety (RAMS) analysis. The MADE platform is designed to use a digital twin to identify and mitigate technical risk, optimize the design process, increase availability and promote continuous engineering innovation for complex engineering systems.



High performance computing

Simcenter Cloud HPC

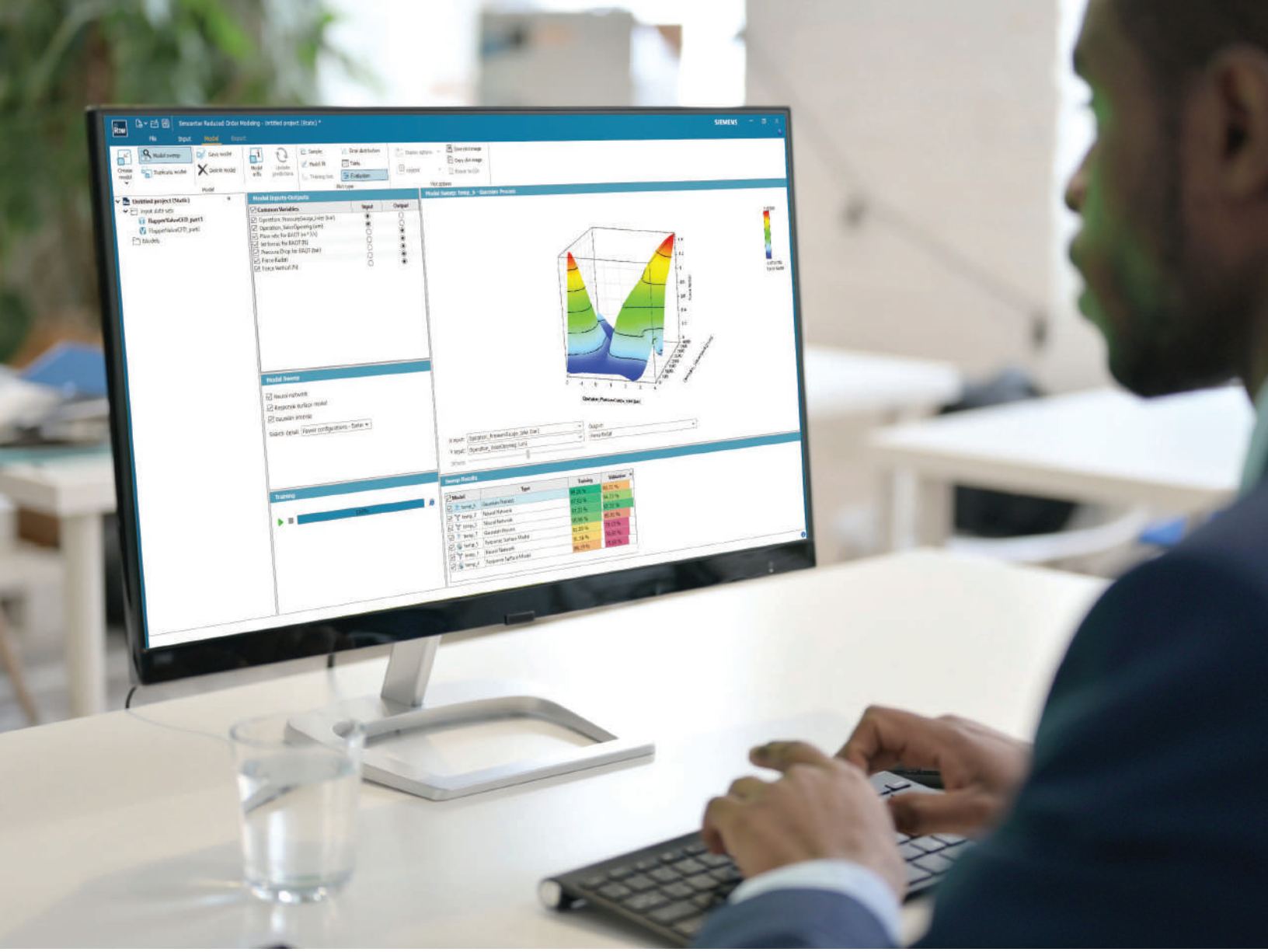
Using Simcenter Cloud HPC software allows you to run CFD simulation on the cloud with instant access to optimized Amazon Web Services (AWS) infrastructure, configured and managed by Siemens with no additional set-up.

> "We are using the tools available to us to create the best possible product in a way that was not possible 20 years ago. We would not have been able to work this way without the modern CAE tools and HPC systems."
>
> Lars Ola Liavåg
> Manager, Thermofluids and Simulations Team
> Wärtsilä

Simulation process and data management

Teamcenter Simulation

Teamcenter Simulation software is a dedicated application for simulation engineers to manage and execute simulation processes and workflows and store all related data, meta-data, models and results in the context of a complete digital thread for product verification. It is an open application to manage simulation and test data regardless of the source.



Reduced order modeling

Simcenter Reduced Order Modeling

Simcenter Reduced Order Modeling is an easy-to-use platform for building, validating and exporting reduced order models from simulation and test data. It enables engineers to apply best-in-class methods including AI/ML to deliver fast predictions from high-fidelity simulation and test data and to create smarter products and processes with embedded predictive power.

An ever-evolving portfolio

Siemens' investments in Simcenter ensure continuous evolution of the portfolio to deliver new capabilities that drive advancements in performance engineering. These investments are focused on four key strategic directions.

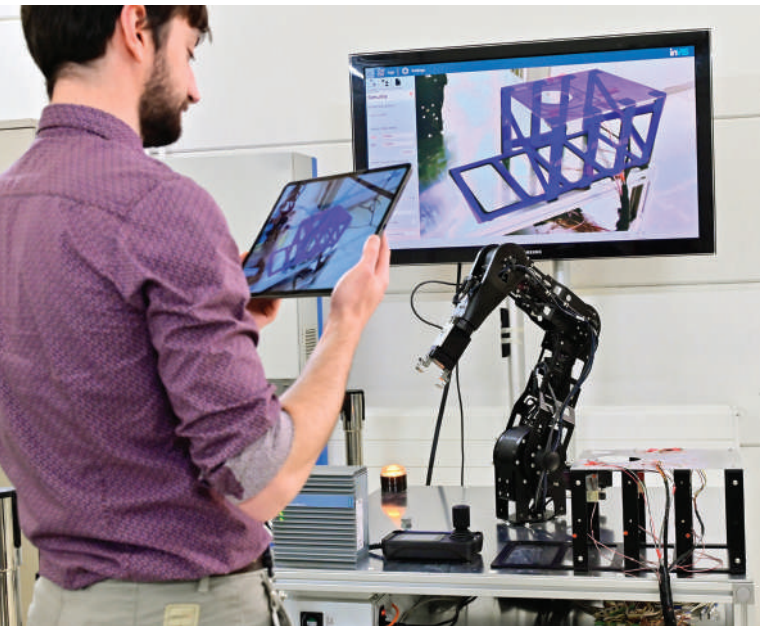
Best-in-class solutions: We are committed to enhancing our core solutions by incorporating a wider range of physics and expanding their capabilities. This enables Siemens' customers to model even the most challenging problems accurately.

State-of-the-art technologies: We leverage innovations in fields such as artificial intelligence (AI) and machine learning (ML), graphics processing units (GPUs) and cloud computing to ensure optimal speed and efficiency in our solutions. By incorporating these advancements, we stay at the forefront of technology and provide cutting-edge tools to our users.

Accessibility and value expansion: We aim to make simulation and testing more accessible and valuable to new communities and functional areas. And to extend the benefits of simulation and test beyond traditional applications, reaching areas such as system architecture, design, maintenance, operations and support.

Seamless integrations and openness: We prioritize seamlessly integrating Simcenter solutions within the portfolio and alongside adjacent domains such as design, manufacturing and data management. By establishing tight integrations, we streamline workflows and enable true digital thread experiences for our users. At the same time, we ensure openness to ensure the maximum return on your existing investments.

Better together



The Simcenter team strives to deliver leading simulation, analysis and test solutions so that together, with our customers, we can have a positive impact on our world improving how we live, travel connect and are cured.

Becoming a Simcenter customer means more than purchasing world-class software and hardware; it opens the door to an unrivaled wealth of engineering expertise. Customers have access to dedicated support engineers and subject matter experts who can speed up adoption of the latest enhancements.

> "Before partnering with Siemens, we spent three months producing a good chassis. With Siemens software, we did this in one month. This saved us a lot of time and gave us many advantages."
>
> Raffaele Boschetti
> Head of IT and Innovation
> Scuderia AlphaTauri

> "The customer support and responsiveness we get from Siemens is like no other vendor I have worked with before."
>
> Dee Wilson
> Vice President of Engineering
> General Atomics

Our technological solutions are also backed by a global team of engineering specialists, dedicated to helping our customers meet their industry's challenges and exceed the expectations of their market. Together, they address complex engineering challenges and help achieve the right trade-off balance amid conflicting performance requirements. Simcenter engineering and consulting teams also assist in technology transfer through training on the latest techniques used in the most competitive real-world development programs.

You work every day to make your products safer, reduce emissions, increase energy efficiency, reduce materials use and waste and improve operational performance to build a better tomorrow, faster. We share this vision and are fully committed to helping you realize it.

> "We weren't just looking at the quantitative answers, but also at how their engineers listened and gave answers. We were extremely impressed with the Simcenter support engineers."
>
> Zach Hazen
> Aerodynamicist
> Martin UAV

Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, Siemens Digital Industries Software – Accelerating transformation.

Americas: 1 800 498 5351

EMEA: 00 800 70002222

Asia-Pacific: 001 800 03061910

For additional numbers, click here.

85535-D7 12/23 C