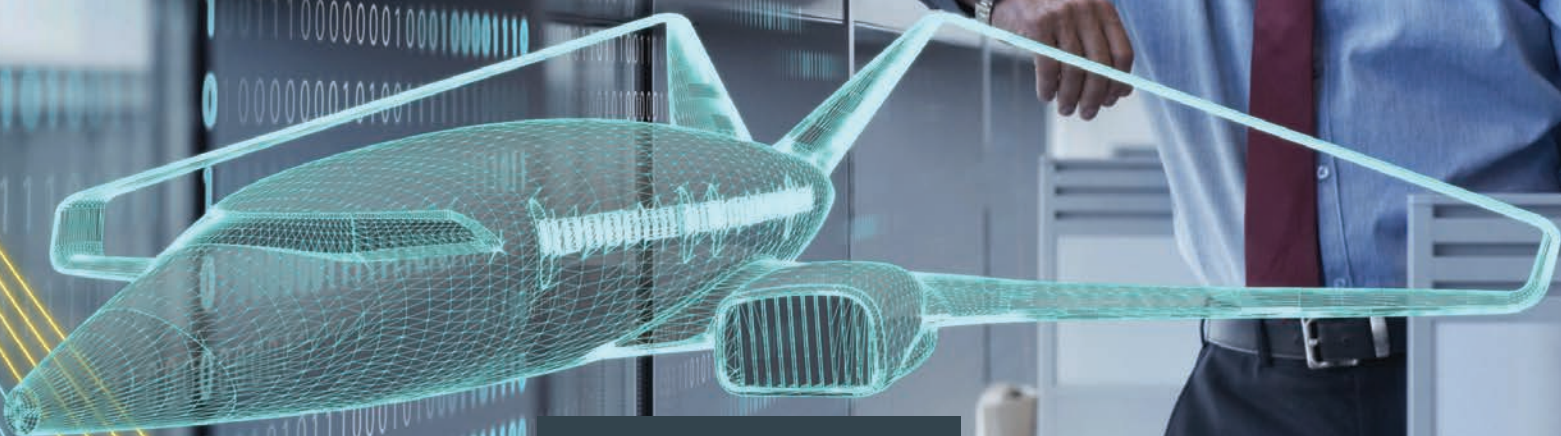
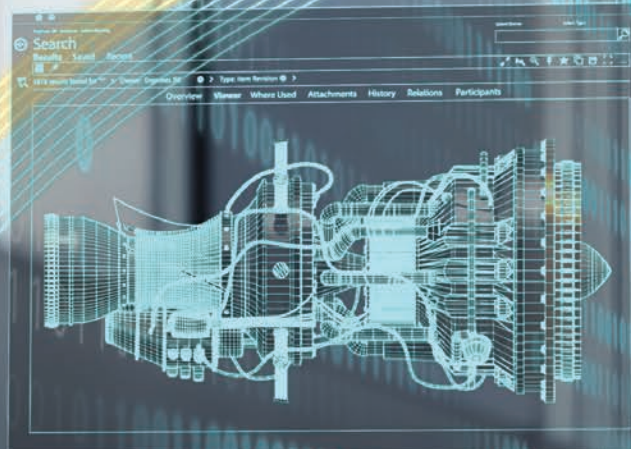


# SIEMENS

*Ingenuity for life*



Siemens PLM Software

## Simcenter

The new era of engineering

[siemens.com/simcenter](https://www.siemens.com/simcenter)





The Simcenter software portfolio from Siemens PLM Software provides you with all the necessary engineering tools to address market trends and meet customers' demands.

# Engineering complex products

Smart products, tailored to personal needs, preferences and habits – that's what consumers want today. As a manufacturer, you must fulfill this request, and design products with increasing complexity. These products include mechanical and electronic components, software and controls.

The industry mandate for energy efficiency also persists. Environmental concerns such as the scarcity of fossil fuels and global warming continue to raise the importance of fuel efficiency. New lightweight materials and manufacturing methods are required to address this challenge, as are intelligent systems that optimize energy consumption.

Smart products also evolve over time. They include many sensors that optimize product performance after delivery, communicate with each other and their environment, and feed information back to design teams for further improvement. This scenario requires powerful data management and analytics in a digital solution that involves the entire product lifecycle.

All these challenges come in addition to classic performance requirements such as comfort and durability, and further pressure the design process. Engineering departments must continuously find ways to deal with more parameters, data and product variations in less time. The traditional verification and validation approach needs to gain efficiency and close the loop with the product in use.

The Simcenter™ software portfolio from Siemens PLM Software provides you with all the necessary tools to address these market trends and meet your customers' demands. Simcenter enables you to evolve your engineering processes from a verification-centric approach to a more predictive approach by implementing efficient multidisciplinary simulation processes. These are backed by the most powerful testing software and hardware solutions to enable the best possible modeling realism and the most effective component and final product testing. Simcenter helps drive your product designs faster than before, resulting in better, less expensive and more reliable products. With Simcenter, you will be able to gain and keep a competitive advantage.

Simcenter helps drive your product designs faster than before, resulting in better, less expensive and more reliable products.



# Implementing predictive engineering analytics

With Simcenter, Siemens PLM Software helps your company deploy a new predictive engineering analytics (PEA) approach in support of closed-loop, systems-driven product development.

Closed-loop, systems-driven product development involves deconstructing the design into separable elements, yet considering their intended interactions and controlling the global system behavior from the start. Individual elements can be further developed as details become available. This approach minimizes risk and avoids late-stage changes by enabling clear target or boundary setting for subsystems, and full understanding of the global system's dynamic behavior throughout the development process.

This process is traditionally supported by continuous verification and validation at the component and full-system level, limiting physical prototyping cycles. PEA pushes this approach to the next level. It includes all the tactics and tools that will help you predict product behavior in actual use. Deploying a PEA vision will help you develop a replica that remains synchronized with the actual product.

The goal is to deliver new innovations for complex products more effectively.

PEA will bring revolutionary improvements that will make simulation a predictive driver of development. PEA achieves these objectives by introducing new technologies and providing a strong alignment between 1D simulation, 3D computer-aided engineering (CAE), controls development, design exploration, data analytics and physical testing. The latter is essential to reach the appropriate modeling realism and enables effective component and final prototype testing.

Simcenter enables PEA by bringing all disciplines together under one umbrella. It will help you build and maintain the digital twin required for realistic full product performance prediction, and will enable you to bring smart products to market faster, adapt their behavior to use conditions and extend their useful life.

Simcenter will help you build and maintain the digital twin required for realistic full product performance prediction.





The goal is to deliver new innovations for complex products more effectively.



# Delivering a portfolio for predicting product performance

Siemens PLM Software also employs a staff of engineering specialists, both on the process level and for each engineering domain. This team offers scalable assistance for software use, application projects and development process innovation.

As an industry leader in test-based engineering, Siemens PLM Software has pioneered many innovative techniques in structural, durability and noise, vibration and harshness (NVH) testing. On the simulation side, Siemens PLM Software has developed high-performance 3D analysis solutions and an integrated hybrid approach that combines test with simulation. Further, with powerful 1D simulation solutions, you can simulate and design for critical functional performance attributes upfront in the product development process.

By uniquely combining these elements and enabling seamless interaction with a strong underlying data management structure, Simcenter helps you accurately predict performance across all critical attributes earlier and throughout the entire product lifecycle. By combining multiphysics simulations with measured data, insights gained from multidisciplinary design exploration and data analytics, Simcenter helps you to implement the vision of predictive engineering analytics, and discover better designs faster and with greater confidence.

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## 1D simulation

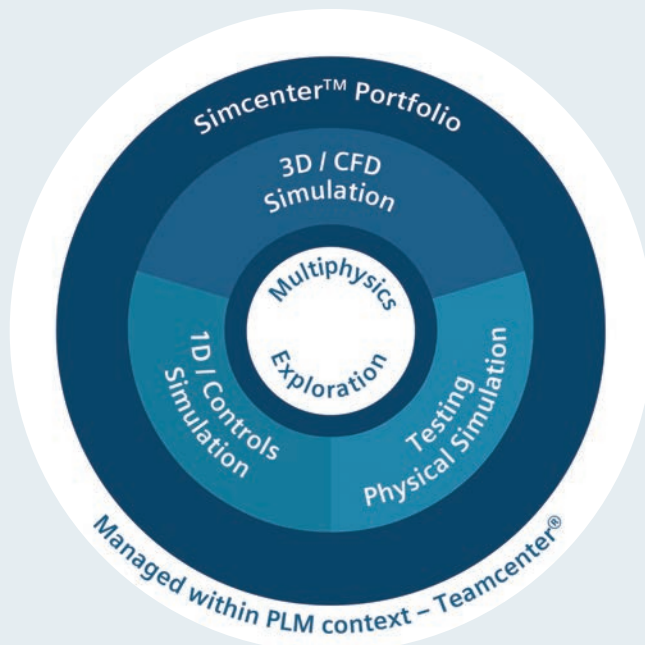
With Simcenter you can predict multi-domain system performance at the concept stage using 1D simulation. With a large set of predefined physical and application libraries, you can effectively build realistic models that can also be used for co-simulation with 3D and for control strategy validation.

## 3D simulation

Simcenter 3D solutions help you predict the multidisciplinary performance of your 3D geometry-based designs. Simcenter combines effective preprocessing, a large variety of powerful solvers and application-specific postprocessing in efficient simulation processes with embedded industry expertise, providing better insight into the real behavior of your product.

## Physical testing

Simcenter physical testing systems allow you to reach unmatched simulation accuracy and to effectively conduct component and final product validation. Simcenter testing solutions offer a complete, integrated environment for test-based engineering.







Simcenter helps you accurately predict performance across all critical attributes earlier and throughout the entire product lifecycle.

#### **Multidisciplinary exploration**

Simcenter includes an efficient and easy-to-use multidisciplinary exploration framework that easily integrates with your current design and simulation tools, and fully leverages your high-performance computing infrastructure. This helps you accelerate performance predictions and design modification decisions.

#### **Simulation data management**

Simcenter enables your analysts to effectively manage data through integration with Teamcenter® simulation process management. This solution keeps analysis models and results in sync with design. By capturing and managing data and processes, you can build long-term knowledge and value for your company.

The software includes easy-to-use multi-port modeling of physical components, as well as a block diagram approach for control systems, and allows coupling them in a comprehensive workflow. Various scripting and customization capabilities enable seamless integration with existing design processes.



### Scalable modeling starting from validated physical and application libraries

Modeling can begin from a large set of dedicated physical libraries and more than 4,500 ready-to-use application components. The complexity can gradually evolve from simple map-based models with standard parameters to fully detailed physics models as data becomes available.

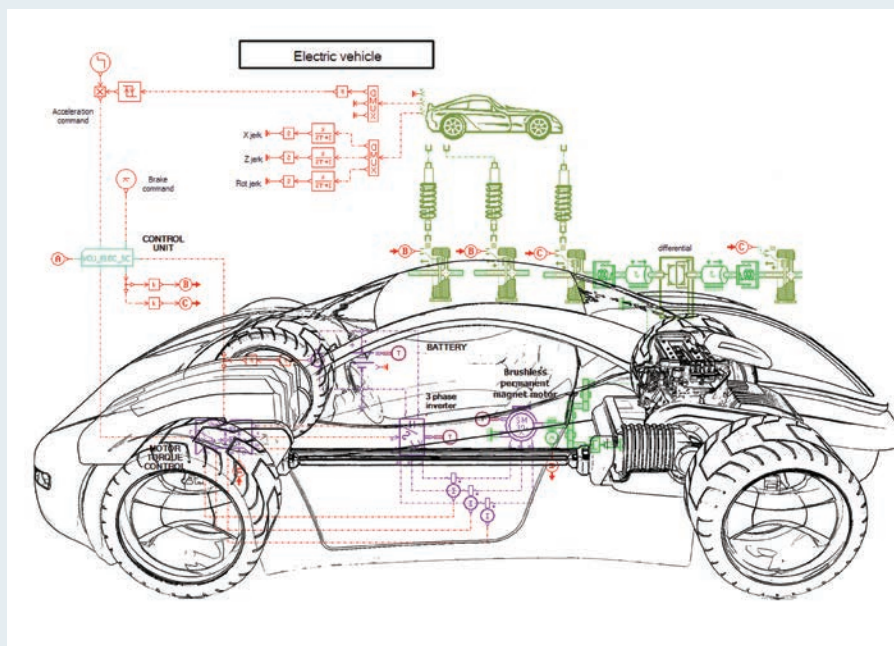
You can also derive models for real-time applications. This makes LMS Amesim a suitable framework for model-in-the-loop (MiL), software-in-the-loop (SiL) and hardware-in-the-loop (HiL) simulation. The software includes plant modeling capabilities for assessment and validation of control strategies during controls design.

### Addressing a broad range of applications

Libraries for automotive and ground vehicles support manufacturers and suppliers designing robust, reliable and environmentally friendly smart systems, from subsystems to vehicle integration.

Aerospace engineers can employ libraries to design safer and more reliable components while reducing time-to-market by integrating physical systems with their controls.

In addition, a wide range of libraries and components covers the rich variety of complex mechatronic systems used across all manufacturing industries.



# Realizing innovation in 3D simulation

Simcenter's high-end, multidiscipline simulation solutions are scalable for use by general CAE analysts and discipline experts.

With Simcenter, you can accurately predict performance of your 3D geometry-based designs. The solution portfolio bundles accurate and effective solutions for a wide range of 3D CAE methods, including finite element analysis, boundary element analysis, computational fluid dynamics and multibody dynamics. Simcenter's high-end, multidiscipline simulation solutions are scalable for use by general CAE analysts and discipline experts. They combine effective preprocessing with a broad variety of powerful solvers and subject-specific postprocessing for better engineering insight. Additionally, by linking 3D simulation to 1D and testing solutions, you can achieve unparalleled accuracy.

## Simcenter 3D

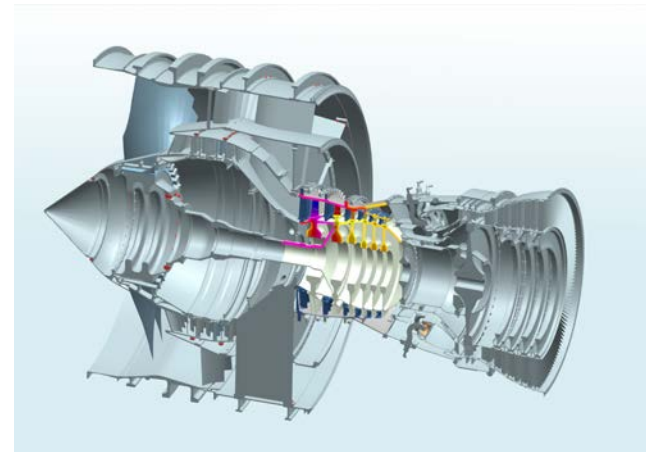
Simcenter 3D delivers a unified, scalable, open and extensible environment for 3D CAE with connections to design, 1D simulation, testing and data management. Simcenter 3D speeds the simulation process by combining best-in-class geometry editing, associative simulation modeling and multidiscipline solutions embedded with industry expertise. Fast and accurate solvers power structural, acoustics, flow, thermal, motion, and composites analyses, as well as optimization and multiphysics simulation.

## STAR-CCM+

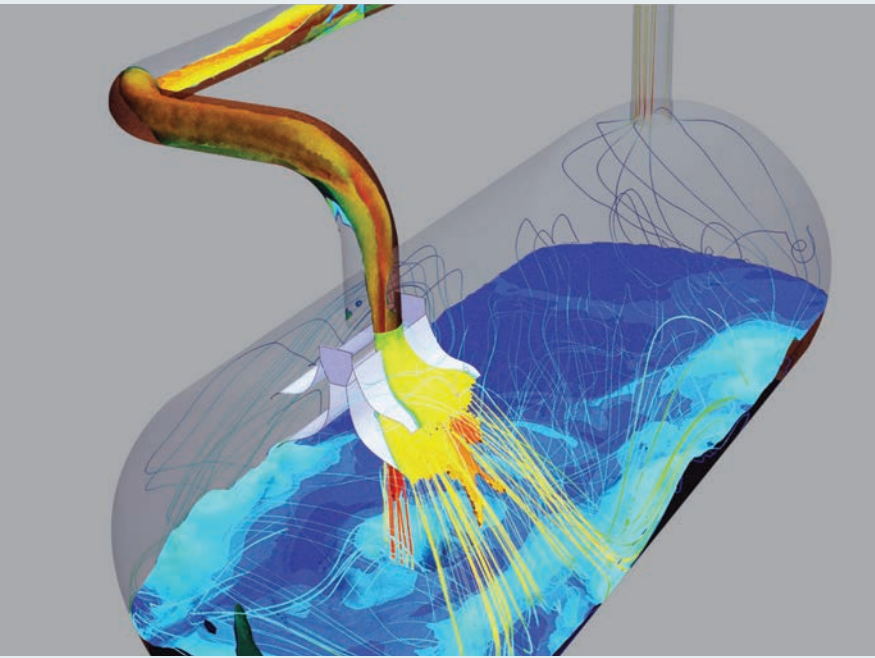
STAR-CCM+® is a simulation solution for fluid dynamics, solid mechanics, fluid structure interaction, heat transfer, particle dynamics, reacting flow, electrochemistry, electromagnetics, acoustics and rheology. It delivers accurate solutions through automated workflows, facilitating analysis of complex real-world problems. With STAR-CCM+, you can predict product performance effectively and get the necessary engineering insight to guide your product design process from start to finish.

## Leveraging mature solutions

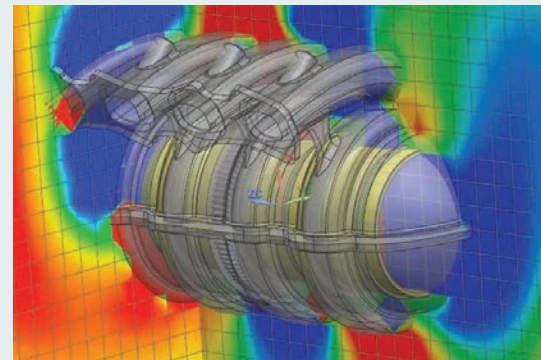
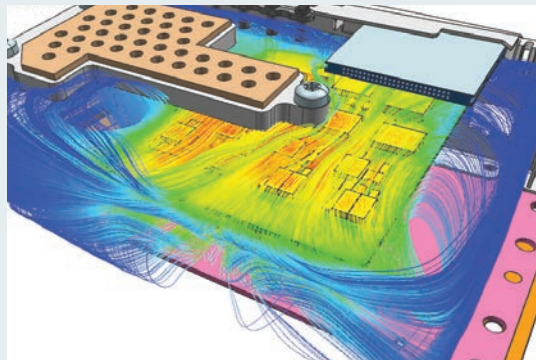
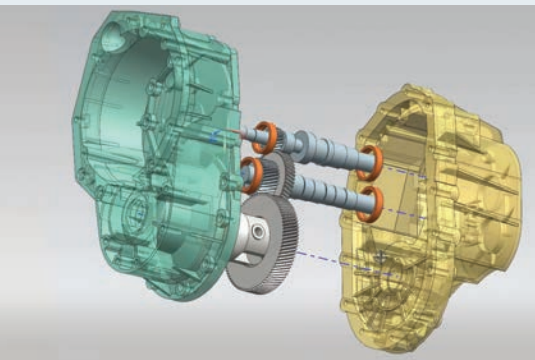
Siemens PLM Software is a pioneer in 3D simulation with decades of experience. We deliver the next generation of software based on the strong foundations of NX™ CAE, LMS™ solutions and CD-adapco® solutions. Applications including NX™ Nastran®, LMS Virtual.Lab™, LMS Samtech™, Femap™ and STAR-CD® software have acquired a unique position in the market for their performance and reliability. These solutions are an essential part of the 3D offering within the Simcenter portfolio.







With Simcenter, you can accurately predict performance of your 3D geometry-based designs.



# Spearheading simulation with Simcenter 3D

You can automatically convert a CAD assembly into a mechanism for motion analysis, and have access to extensive functions for mesh generation, assembly, and model preparation.

## Advanced pre- and postprocessing

In Simcenter 3D, the entire analysis preprocessing can be dynamically associated with computer-aided design (CAD). The software leverages direct geometry editing capabilities powered by synchronous technology to quickly and intuitively edit geometry from any source.

You can automatically convert a CAD assembly into a mechanism for motion analysis, and have access to extensive functions for mesh generation, assembly, and model preparation.

Preprocessing for built-in and industry-standard solvers is performed in a shared application-oriented user environment. Simcenter 3D supports a wide variety of disciplines, and has subject-specific postprocessing that provides you with quick insight into your problem.

Simcenter 3D also includes functionality for efficient modeling of laminar composite structures, and communicates with the Fibersim™ portfolio of software for composites engineering, enabling closer collaboration between analysis teams and composite designers.

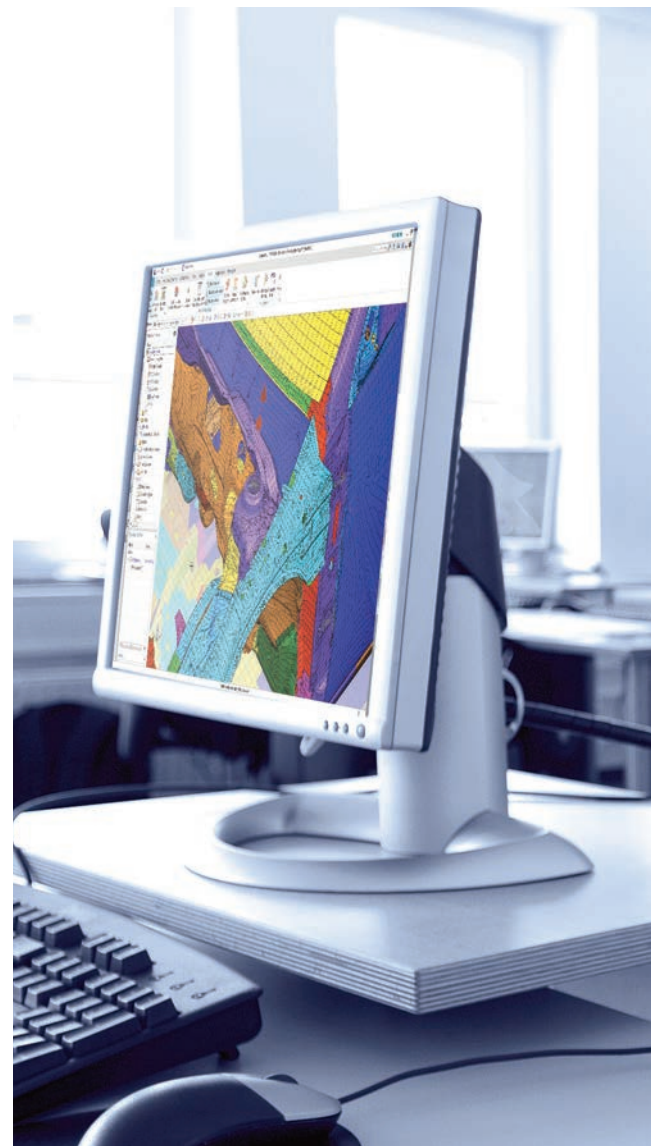
## Effective assembly modeling

Unlike traditional CAE preprocessors that typically generate large monolithic models, Simcenter 3D helps you create FE assemblies by instancing and connecting component models, similar to CAD assembly. After component modifications, you can automatically update the assembly.

FE assembly models can also include test results to increase both accuracy and calculation speed.

## Analysis automation

Simcenter 3D is an open platform that easily connects to external data sources and solvers. It integrates smoothly in any development process. The underlying data management system has been specifically designed for collaboration and data sharing between CAE analysts. You can use the software to capture expert knowledge and best-practice workflows to increase modeling efficiency and automate processes.





### Enabling multiphysical analysis

Simcenter 3D brings together world-class solutions in one integrated platform for domain and application specialists.

Whether you are conducting structural, thermal, flow, acoustic, motion or other types of analysis, you will find the most appropriate solution in a common user interface, with the same file structure and data management scheme.

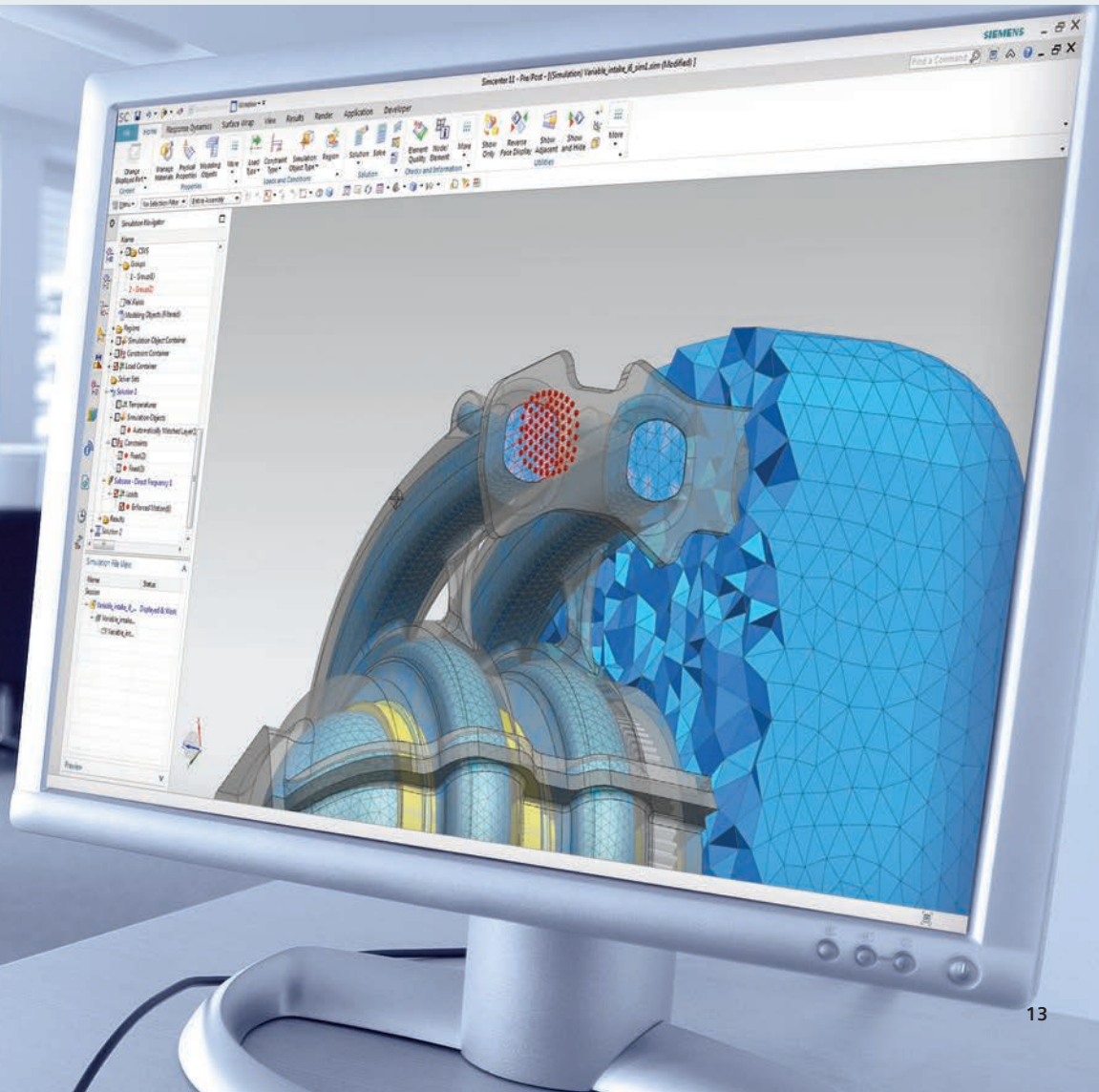
With a breadth and depth of solvers on the same platform as the geometry, everyone involved in the development process can optimize multiple design aspects simultaneously.

### Delivering the platform that drives innovation

Complex products include mechanical and electronic components, software and controls. During development,

it is crucial to understand how these mutually interact. Simcenter 3D has co-simulation capabilities that can combine motion analysis with controls.

Simcenter 3D also includes co-simulation capabilities with LMS Amesim. Co-simulation can dramatically increase the value and fidelity of complex full product models, especially when combined with controls.







STAR-CCM+ provides high-fidelity simulation technologies with an intuitive, integrated user interface.



# Simulating the real world with STAR-CCM+

## Predicting the real-world performance of products

STAR-CCM+ helps you solve sophisticated industrial problems by using one single simulation model that hosts the geometry, mesh and all the required physics and analysis results. With this approach you can take into account a wide range of physics and study them in a fully coupled manner, reducing approximation and giving you confidence that the predicted behavior will match the real-world performance of your products.

STAR-CCM+ includes both a finite volume and a finite element method, giving you the most appropriate numerical schemes for the physics you model. The software can also couple with third-party codes (both in-house and commercial) through its co-simulation application programming interface (API), bringing you the flexibility to use the right tool for the right job.

## Facilitating innovation and collaboration

STAR-CCM+ provides high-fidelity simulation technologies within an intuitive, integrated user interface. This integration enables you to quickly explore a range of configurations involving complex geometries and spanning across multiple engineering disciplines.

STAR-CCM+ provides engineering solutions for your enterprise, whether you are a new design engineer or a research and development (R&D) simulation expert. The integrated user interface makes it easy to learn and deploy, facilitating innovation and collaboration.

## Saving valuable engineering time

STAR-CCM+ automates the entire simulation workflow from geometry to mesh and solution, using a robust and repeatable pipelined approach. It can help you efficiently drive design changes to achieve your engineering objectives while maximizing productivity. Workflow automation also aids in the deployment of best practices, eliminating analyst-to-analyst variations and giving you greater confidence in your results.

## Achieving quick turnaround of results

The STAR-CCM+ solvers are massively parallelized, scaling to hundreds of thousands of cores and optimizing computational resources. Parallel processing helps push the boundaries of your high-fidelity simulations, from solving single large-scale analyses to studying hundreds of variants for simulation-driven design.

## Helping you make design decisions with confidence

STAR-CCM+ integrates a range of powerful data analysis and visualization tools to manage and communicate simulation results. With these tools you can make critical design decisions quickly and with confidence.

## Covering a wide range of industries and applications

STAR-CCM+ is used across a wide range of industry sectors and application areas to predict product performance, drive innovative designs and solve complex industrial problems. Industries include aerospace, automotive and ground vehicle, oil and gas, energy, marine, chemical process, electronics, life sciences, sports, building, civil engineering and manufacturing.

# Leveraging decades of simulation experience

## **NX Nastran**

An industry standard for several decades, NX Nastran is a finite element solver for stress, vibration, buckling, structural failure, heat transfer, acoustics and aeroelasticity analyses. Manufacturers and engineering suppliers in aerospace, automotive, electronics, heavy machinery, medical devices and other industries rely on NX Nastran software for their critical engineering computing needs so they can produce safe, reliable and optimized designs within increasingly shorter design cycles. Available as a standalone solver or integrated in Simcenter 3D, NX Nastran is credited with saving millions of dollars in product development costs.

## **LMS Virtual.Lab**

LMS Virtual.Lab software features an integrated CAE suite for accurate simulation and optimization of various mechanical system performance aspects, especially advanced acoustics and durability. The software enables you to define processes that cover several attributes simultaneously, and features parametric analysis. LMS Virtual.Lab enables fast assessment of multiple design alternatives and optimization prior to physical prototype construction.

## **LMS Samtech**

LMS Samtech software features a finite element method (FEM) solver suite for simulating critical performance engineering attributes for mechanical systems. High-performance solvers handle nonlinear FEM and multibody simulation. The software includes specialized solutions for dedicated applications such as wind turbine development, rotor dynamics, structural and thermal analysis, as well as composites.

## **STAR-CD/es-ice**

Most of the world's largest engine manufacturers depend on STAR-CD/es-ice for the development of internal combustion engines (ICE). STAR-CD/es-ice is an industry-leading in-cylinder CFD solution that incorporates all the required models for accurately predicting charge flow, fuel spray mixing, and combustion that takes place in engines. This allows automotive manufacturers to integrate up-front simulation in the product design process to face the tough challenge of reconciling legislative and market demands.

## **Femap**

Femap is an advanced engineering software simulation application for creation, editing and import/re-use of mesh-centric finite element analysis models of complex products or systems. You can use Femap to model components, assemblies or systems and to determine the behavioral response for a given operating environment. In addition, Femap provides powerful data-driven and graphical results visualization and evaluation. Femap can

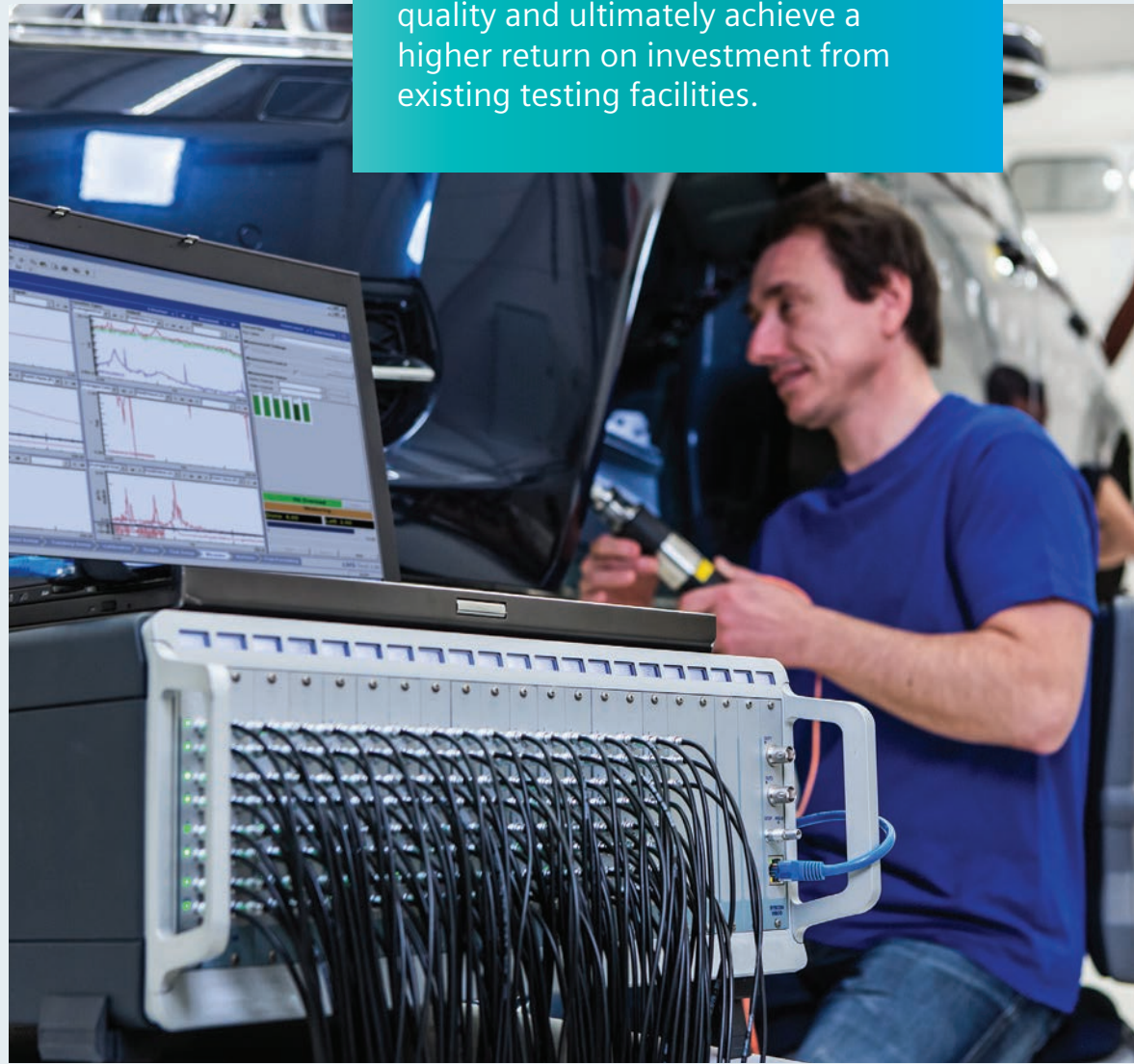


NX Nastran is a finite element solver for stress, vibration, buckling, structural failure, heat transfer, acoustics and aeroelasticity analyses.

be combined with a wide variety of CAD systems and finite element analysis solvers, including the industry-leading NX Nastran application, to deliver a comprehensive computer-aided engineering analysis solution that helps ensure that products perform as designed in real-world environments.



Simcenter testing solutions help you increase test efficiency and productivity, maintain the utmost quality and ultimately achieve a higher return on investment from existing testing facilities.



# Driving innovation and productivity in test-based engineering

A predictive development process requires very high simulation accuracy, which can only be achieved by continuous verification and validation of system and component models, and by completing those with real measured data for boundary conditions and parameter definition. Even though up-front simulation is becoming more important, it is crucial that the product performs as expected in the real world, and that the design is optimized within the constraints of shorter testing cycles. Simcenter testing solutions help you increase test efficiency and productivity, maintain the utmost quality and ultimately achieve a higher return on investment from existing testing facilities.

## **LMS Test.Lab data acquisition and analysis software**

LMS Test.Lab™ software offers an integrated test-based engineering solution, combining multi-channel data acquisition with a full suite of testing, analytics and reporting tools.

LMS Test.Lab fulfills the extensive requirements of noise and vibration engineers with comprehensive tools for structural dynamics, rotating machinery, acoustics and sound quality. The software incorporates unmatched expertise in durability testing with an end-to-end solution for road load data acquisition and processing.

With its convenient workflow-based interface, LMS Test.Lab sets new standards for ease of use, productivity and data consistency. Seamless data sharing between different applications delivers significant efficiency gains. And comprehensive analysis capabilities guide you directly to the sources of problems. Using simple what-if analyses, you can quickly evaluate possible fixes and solve problems effectively.

By combining LMS Test.Lab with Simcenter 1D and 3D simulation solutions, you will be able to make models more efficient and realistic.

## **LMS SCADAS data acquisition hardware**

The LMS Test.Lab software suite is seamlessly integrated with the LMS SCADAS™ hardware data acquisition systems. These deliver the data quality and format required to get the job done correctly the first time, in the lab or in the field, using a personal computer (PC) or recording autonomously.

LMS SCADAS systems support a large variety of transducers and signal conditioning, combining analog and digital signals and covering a broad range of physical types, including vibration, forces, strain, temperature, CAN-bus signals and many more.

# Empowering multidisciplinary exploration

Simcenter automatically explores the design space to quickly identify solutions that meet your goals and constraints such as reducing product costs while keeping stresses below acceptable limits.

With the multidisciplinary exploration solutions of Simcenter you can automate and accelerate your engineering design process to help you discover better designs, faster. Whether you need to improve the design of a single component or engineer complex multidisciplinary systems, Simcenter provides an efficient and easy-to-use design exploration framework. Workflows are easily automated through integration with your current design and simulation tools. Simcenter automatically explores the design space to quickly identify solutions that meet your goals and constraints such as reducing product costs while keeping stresses below acceptable limits.

## HEEDS MDO multi-disciplinary exploration software

HEEDS® MDO software helps you effectively deal with conflicting targets such as mass, cost, manufacturability and performance. This process automation and design exploration software enables you to easily define design parameters and design goals, and choose the most appropriate simulation tools to evaluate design performance. HEEDS performs design iterations automatically

while searching for parameter values that simultaneously meet all targets and criteria. By providing a combination of engineering insight and a powerful hybrid adaptive search algorithm, HEEDS enables engineers to collaborate and discover better designs faster.

HEEDS provides four enabling technologies to streamline your virtual prototyping process. Process automation capabilities simplify the building of virtual prototypes involving 1D, 2D or 3D simulation tools as well as CAD geometry. With scalable computation capabilities you can accelerate virtual prototype testing by leveraging multiple levels of parallelization and efficient licensing schemes. Efficient exploration makes it simple to identify good families of high-performing designs in highly constrained design spaces. Design assessment tools can be used to evaluate design sensitivity and robustness prior to manufacturing.



Process automation and design exploration software enables you to easily define design parameters and design goals, and choose the most appropriate simulation tools to evaluate design performance.



# Managing huge amounts of simulation data

By capturing and managing the data and processes, you can build long-term knowledge and value for your company.

Engineering teams generate huge amounts of data, but it is usually not rigorously managed or tracked. Simcenter makes it easier for engineering teams to manage their data, thanks to integration with Teamcenter simulation process management. The data management capability helps engineers keep their analysis models and results in sync with design. Simulation data management enables you to capture engineering knowledge and make it available for re-use by team members. By capturing and managing the data and processes, you can build long-term knowledge and value for your company.

## Teamcenter simulation process management

Teamcenter simulation process management helps you get control of your simulation data and processes in the context of an overall product lifecycle management (PLM) system. With Teamcenter, you can avoid common problems such as using obsolete data in analyses, poor visibility to simulation results and results arriving too late to influence design direction. You can efficiently manage and share complex product simulations so they are available to all decision-makers throughout your business.

With Teamcenter you can easily manage geometry, meshed models, run-ready decks, results and reports. It helps you to quickly find and re-use data, achieve complete traceability from requirements to simulation results, efficiently build and manage complex assemblies and visually compare models.

Teamcenter accelerates various steps in the CAE process by providing you with a framework for codeless integration of simulation tools. Teamcenter delivers data to the tools and can capture and store results with minimal input and accurate associations to design and requirements data.

By providing global access to simulation data, Teamcenter promotes effective collaboration between teams. It allows your entire organization to interactively visualize all types of results without requiring specialized tools.





Teamcenter simulation process management helps you get control of your simulation data and processes in the context of an overall product lifecycle management system.

Siemens PLM Software uniquely combines experience, skills and application know-how to help customers optimize complex product designs and improve processes.





# Combining skills and experience in engineering services

Siemens PLM Software uniquely combines experience, skills and application know-how to help customers optimize complex product designs and improve processes. The team of technical experts has broad engineering proficiency that helps OEMs and suppliers in automotive, aerospace and other industries reduce costs and get to market faster by balancing functional performance attributes against key program drivers. Using simulation and testing, engineers help achieve complex design goals and deploy innovative engineering processes.

## Product and process innovation

Siemens PLM Software offers a scalable partnering model to support product development from the smallest outsourcing tasks to full program management. At the highest collaboration level, experts help companies refine engineering processes by delivering turnkey systems, software and services.

Our engineers help customers achieve excellence in both product design and late-development troubleshooting. The team enables your engineers to apply the latest attribute engineering tools and methods as part of their standard processes. Customers are personally involved in every step through hands-on collaboration. Many technology transfer programs belong to application-based development projects, providing immediate benefits and corresponding profits through the use of advanced techniques.

The Siemens PLM Software team has a culture of open technology sharing, including models, data and milestone reports. Recognized as a technology leader, the team is an integral part of many engineering departments and development programs. Through onsite projects or customized engineering technology exchanges hosted at in-house facilities, Siemens PLM Software advances corporate engineering knowledge.

# Closing the loop in product lifecycle management

Simcenter enables predictive engineering analytics in support of a closed-loop systems engineering approach that spans the entire product lifecycle.

The comprehensive Simcenter portfolio can help your company take the next step in weaving a digital thread through the entire value creation chain, not only through product development, but also through manufacturing and use. Maintaining traceability between these phases is essential in next-generation product lifecycle management.

Smart products feed information back to design during their use. They include predictive functionality that helps them continue behaving optimally, even in a changing operational environment. The digital twin that enables this approach must remain in sync with the actual product in use.

The span between design and use includes manufacturing. The increased application of lightweight materials leads to many new materials and manufacturing methods. Closing the digital gap with development can help you predict possible complications, and must keep track of corresponding parameter changes.

Realistic and powerful multi-domain simulation, combined with efficient testing, is the only way to successfully realize the digital twin concept. It helps you translate requirements into a product definition and create a predictive model for every stage in the product lifecycle. A strong underlying data management structure is required to close the loop between usage data and design.

With the Simcenter portfolio, Siemens PLM Software brings together all of the components. With these combined solutions, Simcenter enables predictive engineering analytics in support of a closed-loop systems engineering approach that spans the entire product lifecycle.



Realistic and powerful multi-domain simulation, combined with efficient testing, is the only way to successfully realize the digital twin concept.





### **About Siemens PLM Software**

Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of software solutions to drive the digital transformation of industry, creating new opportunities for manufacturers to realize innovation. With headquarters in Plano, Texas, and over 140,000 customers worldwide, Siemens PLM Software works with companies of all sizes to transform the way ideas come to life, the way products are realized, and the way products and assets in operation are used and understood. For more information on Siemens PLM Software products and services, visit [www.siemens.com/plm](http://www.siemens.com/plm).

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