SIEMENS
Ingenuity for life
Siemens PLM Software
Simcenter Amesim
Delivering engineering innovation with system simulation
siemens.com/simcenter

System simulation
has become a must-have
for your design process.

System simulation

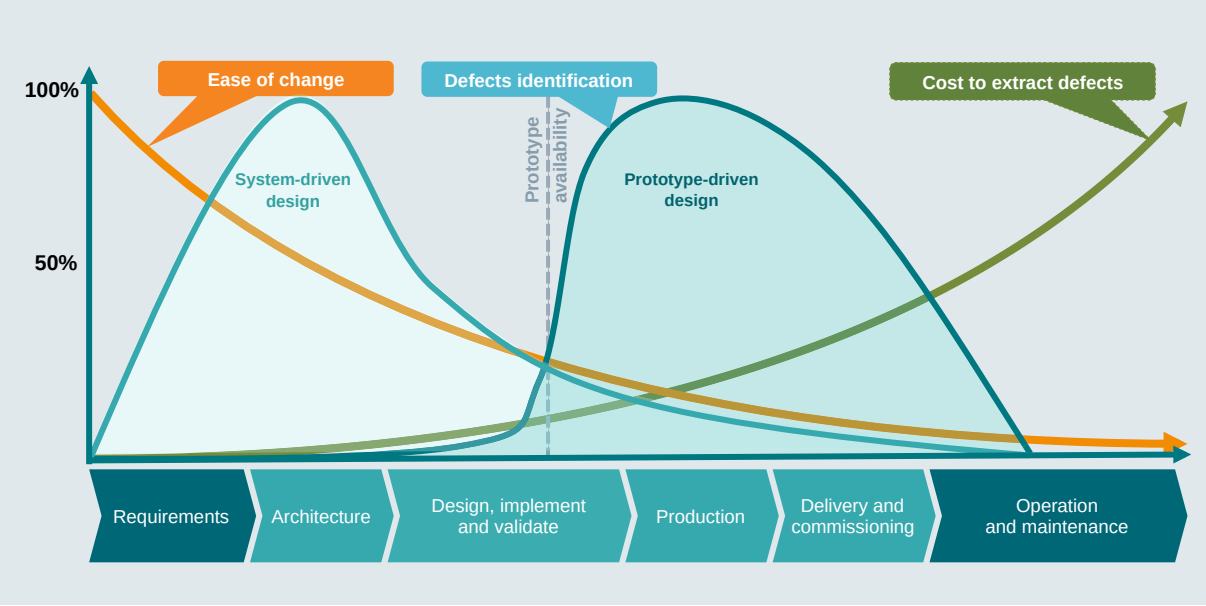
Addressing system complexity

It has never been more critical to optimize design in a system's early development stages when it is still conceptual. There is immense pressure to reach the ever-increasing performance levels in the context of increasingly complex, interconnected and smart products. Any defect identified early in the process will be easier to solve and have little impact on the project timeline and cost. That cost will be negligible compared to product recalls and the negative impact on brand image if the issue is discovered later in the design cycle.

System simulation supports design, manufacturing and maintenance across industries by enabling you to:

- Predict the behavior of mechatronic systems
- Balance conflicting performance attributes
- Benchmark multiple design options to improve your product
- Reduce physical prototyping and testing to a strict minimum

This results in accelerated design cycles, reduced development costs and superior products that excite your customers. System simulation enables you to engineer the right product.



Simcenter system simulation solutions

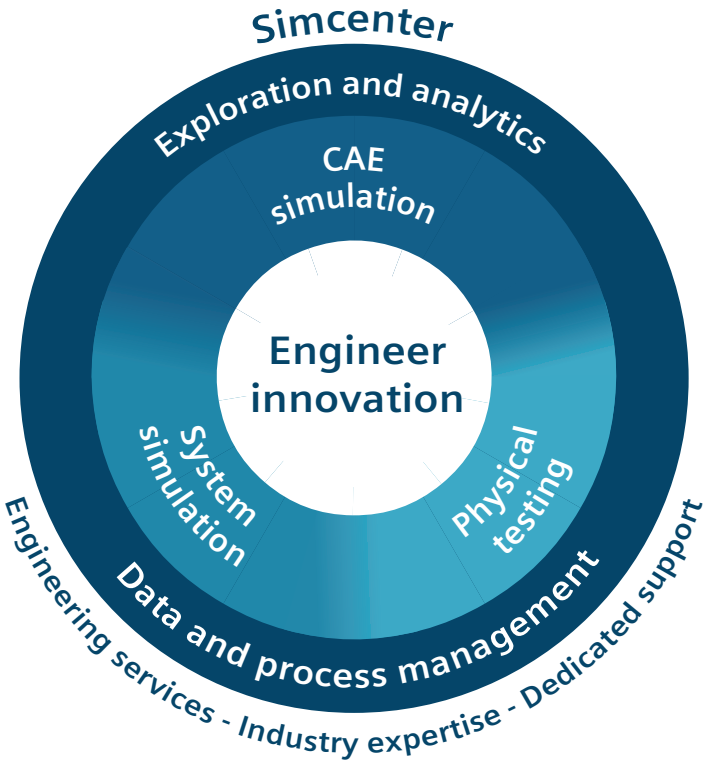
Building digital twins faster and earlier

Our system simulation solutions, part of the Simcenter™ software portfolio, boost overall systems engineering productivity from the early development stages until the final performance validation and controls calibration. They enable you to rapidly build digital twins before the first physical prototype becomes available in order to optimize the interactions between mechanical, hydraulic, pneumatic, thermal, electric and electronic systems.

To save time when creating models, Simcenter system simulation solutions have been tailored to support automotive, aerospace, industrial machinery, heavy equipment, energy and marine applications.

In addition, you can take advantage of efficient solutions for workflow customization, architecture-driven simulation, model-based software engineering as well as model and data management. Moreover, web-based access and predefined system model parameterization in custom graphical user interfaces (GUIs) help you extend the use of system simulation throughout your company.

Finally, with Simcenter Engineering services, our team of experienced engineers can help you achieve fast turnaround and timely project delivery. System simulation experts offer you the required skills and unique simulation approaches to support your development programs.

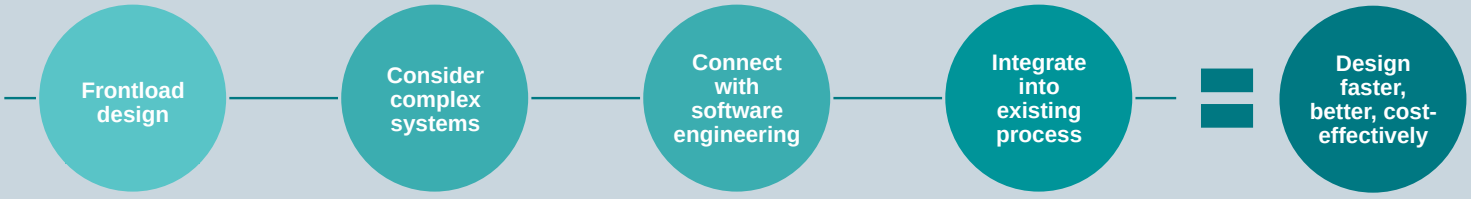


“We have really succeeded evaluating many more possibilities in shorter time thanks to using Simcenter Amesim.”

Ing. Giacomo Papotti
R&D Transmission Department
Automobili Lamborghini

Simcenter Amesim

Driving innovation without compromising time-to-market and quality



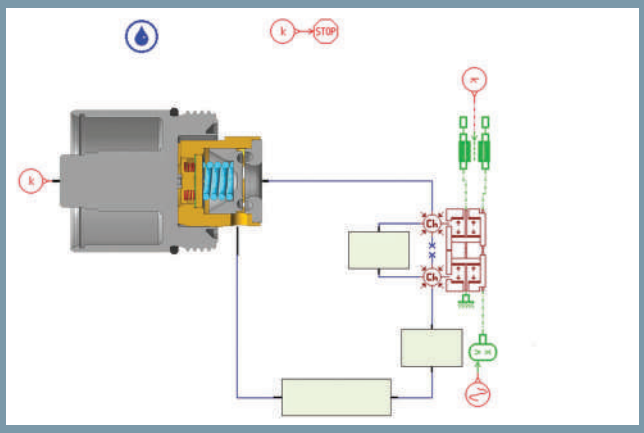
Simcenter Amesim™ software is a leading integrated, scalable mechatronic system simulation platform that allows design engineers to virtually assess and optimize system performance. This boosts overall systems engineering productivity from the early development stages until the final performance validation and controls calibration. Therefore, Simcenter Amesim can be your tool of choice to develop successful mechatronic products by helping you optimize the mechanics, electronics and software simultaneously as an integrated system.

Simcenter Amesim includes ready-to-use multiphysics libraries combined with application and industry-oriented solutions that are supported by powerful platform capabilities to let you rapidly create models and accurately perform analysis.

The software offers an open environment that can be integrated into your enterprise processes. You can easily couple the software with major computer-aided engineering (CAE), computer-aided design (CAD) and controls software packages, interoperate it with the Functional Mockup Interface (FMI), Modelica®, and connect it with other Simcenter solutions, the Teamcenter® portfolio and Excel spreadsheet software.

"Simcenter Amesim has become the global mechatronic simulation platform at Voith Turbo. We use the software for all our simulations on all product lines in this division every day."

Sebastian Knirsch
Head of System Engineering
Voith Turbo Rail



"We have reduced the number of physical prototypes by a factor of 10 using Simcenter Amesim, which results in huge cost savings and significantly shortened development time."

Urban Forssell
Vice President
Mechatronic Systems
Öhlins Racing AB

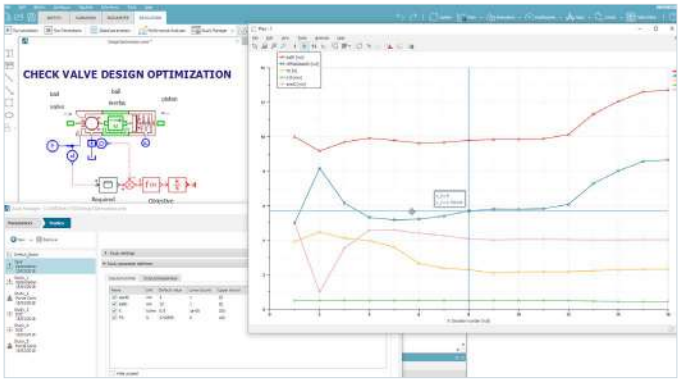
Simcenter Amesim platform

Ramping up system simulation productivity

An open and powerful platform is at the core of Simcenter Amesim software. It offers you cutting-edge technologies and aligns with your processes at the enterprise level. Thanks to its seamless user experience, you can focus on innovating.

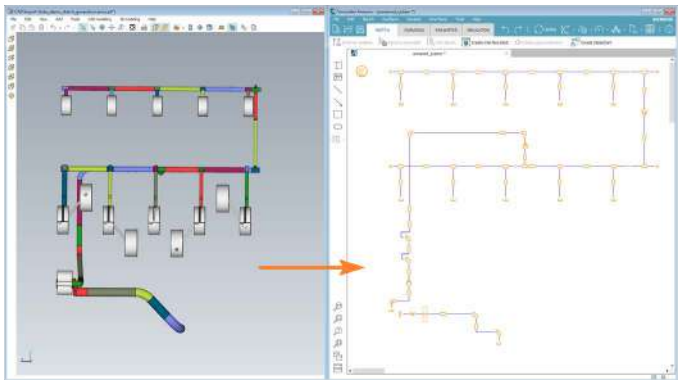
Leveraging best-in-class simulation technologies

For high-performance computing (HPC) or real-time simulation, you can create, analyze and run your multiphysics models efficiently and almost everywhere. Its multiple interfaces and support of FMI and Modelica standards make Simcenter Amesim one of the most interoperable platforms on the market.



Boosting the return from your simulations

Advanced pre- and postprocessing tools allow you to gain in-depth information regarding your systems. You can customize model processing and analysis using easy-to-configure apps. Optimization and design exploration capabilities enable you to configure your system right the first time. Simulator scripting helps automate a large part of your simulation activities.



Enabling company-wide workflows

To extend the implementation of system simulation, Simcenter Amesim facilitates the customization, automation and integration for your vertical applications. It can be integrated into your CAD, CAE or process integration and design optimization (PIDO) processes to deliver data continuity from CAD and experiments to system simulation.

“At the end of our working day, we launch about 1,000 simulations with Simcenter Amesim performing the analysis at night. I have never seen such a powerful tool.”

Andreas Klein
Senior Expert for Hydraulic System Simulation
Corporate Sector Research and Advance Engineering
Bosch

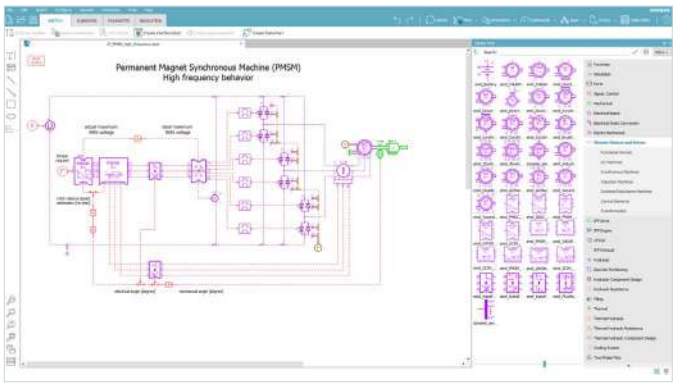
“The co-simulation using Simcenter Amesim and Simulink enabled us to reduce the controls validation effort by 50 percent. Consequently, the time on the test bench has been considerably reduced as well.”

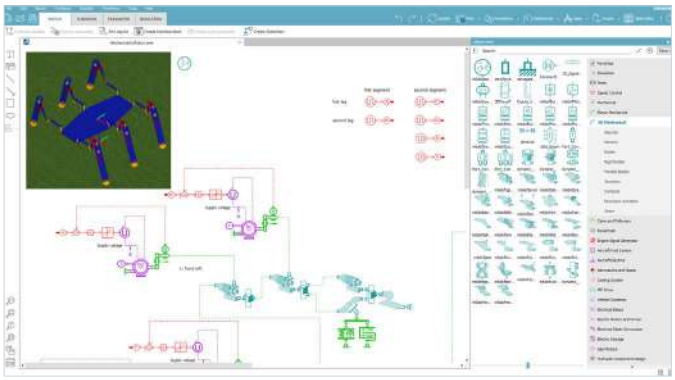
Marco Parotto
Mechanical Engineer
Magneti Marelli

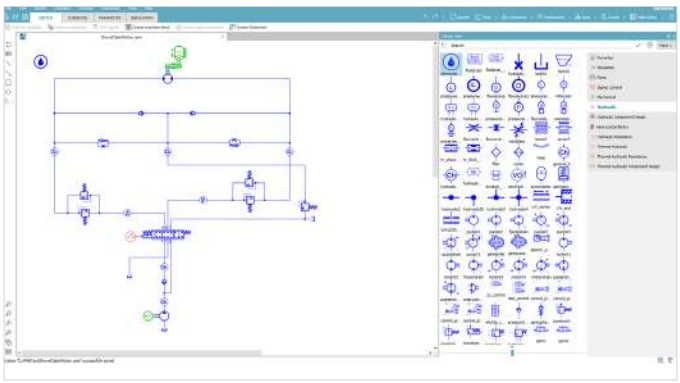
Simcenter Amesim libraries

Capturing all physics in the same model

To save time when creating models, Simcenter Amesim offers a large set of ready-to-use multiphysics libraries with more than 6,500 components based on the analytical representation of physical phenomena. The libraries have been developed and validated in cooperation with industrial partners. This broad set of components supports both hardware and software modeling, allowing you to virtually validate control strategies from early design phases.







Electrics
- Electric motors and drives
- Electric storage
- Electrical basics and converters
- Electric static conversion
- Electromechanical
- Automotive electrics
- Fuel cell

Mechanics
- 1D mechanical
- 2D mechanical
- 3D mechanical
- Cam and followers
- Powertrain
- Vehicle dynamics

Fluids
- Hydraulics
- Hydraulic component design
- Pneumatics
- Pneumatic component design
- Gas mixture
- Filling

Thermodynamics
- Thermal
- Thermal-hydraulics
- Thermal-hydraulic component design
- Cooling system
- Heat exchangers assembly tool
- Two-phase flow
- Air conditioning

Controls
- Signal control
- Engine signal control

Internal combustion engine
- IFP engine
- CFD1D
- IFP exhaust
- IFP drive

Aerospace
- Aeronautics and space
- Aircraft fuel systems
- Liquid propulsion
- Gas turbine
- Aircraft electrics

"Using the thermal, hydraulic, mechanical and fuel equipment capabilities of Simcenter Amesim, we can create a model that enables us to accurately predict the fuel system's behavior."

Stéphane Amerio
Simulation Engineer
Airbus Helicopters

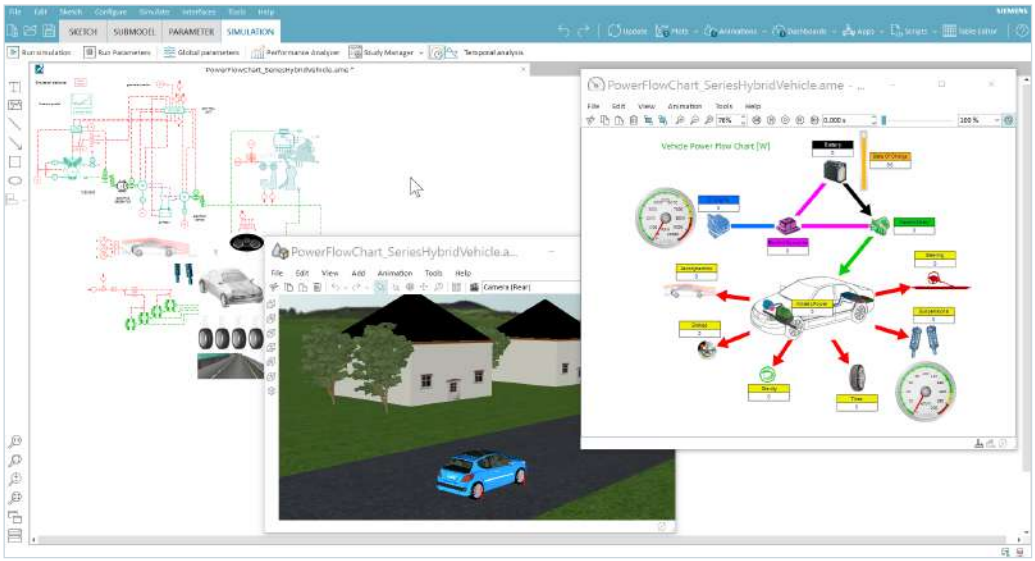
Simcenter Amesim for automotive and transportation

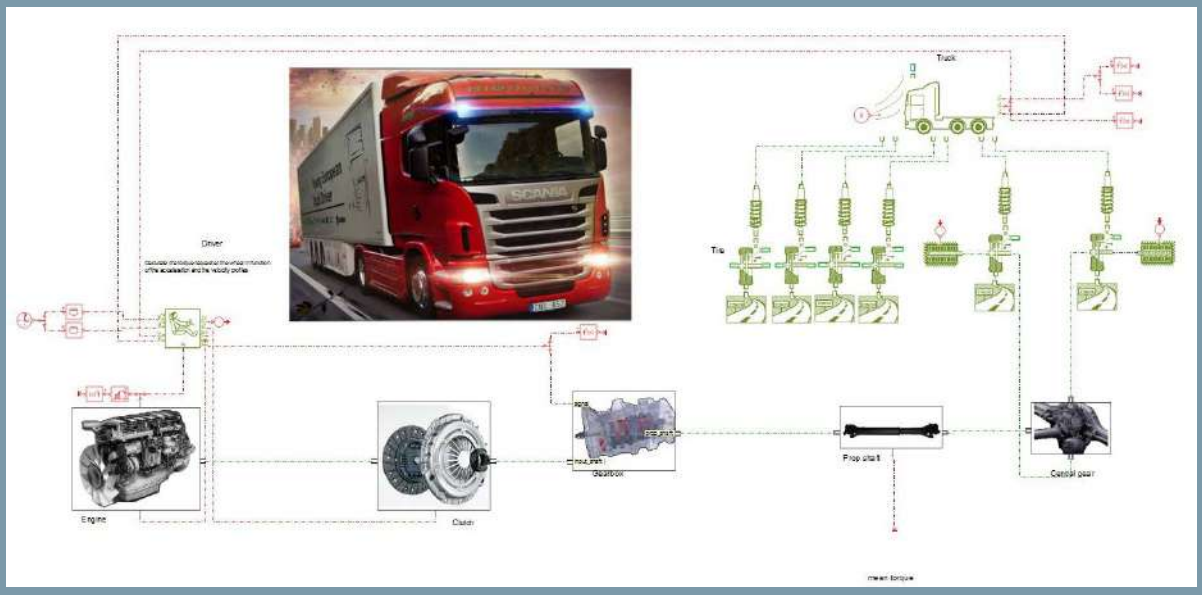
Striking the best tradeoff

Meeting strict emissions regulations and financial constraints while ensuring a high level of vehicle performance and comfort requires the adoption of a new engineering process that considers the complete vehicle. System simulation brings an effective solution not only to automotive original equipment manufacturers (OEMs) and suppliers, but also to truck, bus, motorcycle and rail manufacturers.

Simcenter Amesim supports early design phases by allowing you to create simulation models for range and performance. It also enables you to create advanced vehicle energy management models, including predictive dynamic modeling of the engine, powertrain, battery, heating, ventilation and air conditioning (HVAC) and all associated thermal management systems for any kind of vehicle, be it conventional, hybrid or electric.

The software also helps you win the electrification race by providing the appropriate tools to embrace this technology evolution. To manage the complexity that comes with introducing a new energy source into the vehicle, Simcenter Amesim offers state-of-the-art multilevel modeling for all critical subsystems, such as internal combustion engine, electric machine, battery and transmission. On top of that, it supports your integration processes by delivering the best-balanced design in terms of energy efficiency, performance and drivability for any kind of powertrain architecture.





"Our customers expect from us an optimal multi-attribute trade-off that we can simulate with Simcenter Amesim in order to reach the highest level in all areas at the same time."

Fredrik Birgersson
Senior Engineer
Analysis and Testing
Transmission Development
Scania

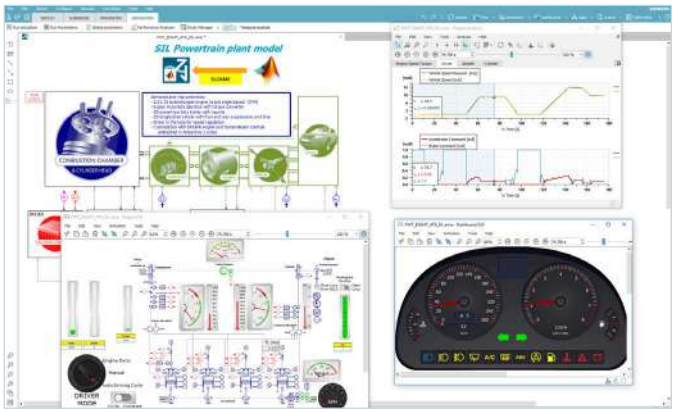
Simcenter Amesim for automotive and transportation

Boosting vehicle subsystems and components performance upfront

To prepare for vehicle integration, Simcenter Amesim comes with a large set of application-oriented capabilities that help you size components and optimize subsystem efficiency.

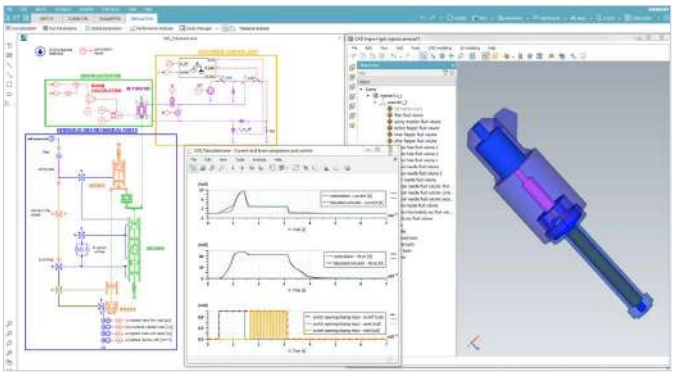
Electrified powertrain

Master the engineering complexity of vehicle electrification. Whether you deal with architecture definition, battery sizing or electric machine design, benefit from efficient modeling workflows to design and validate subsystems and their integration.



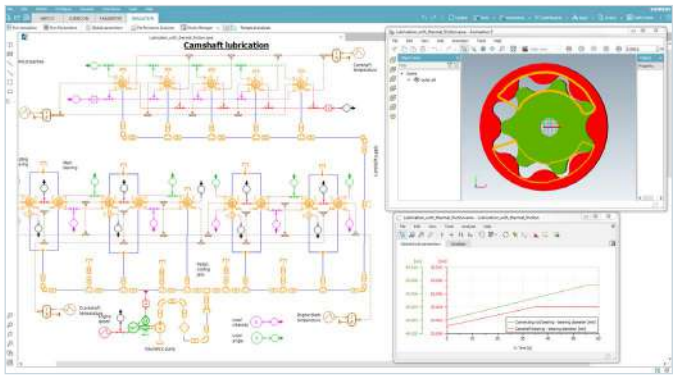
Internal combustion engine design and controls

Optimize complete ICE systems, from air management and combustion to exhaust after-treatment. Develop physical plant models to support engine controls development and validation. Study engine integration in a full powertrain and vehicle context.



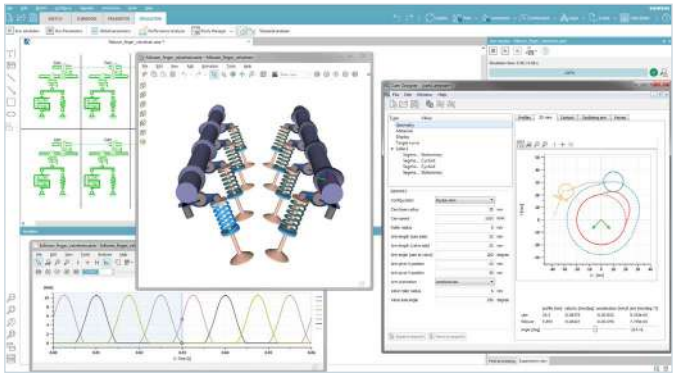
Fuel injection

Enhance the injector design to minimize the activation energy, perform the proper needle lift and achieve the right fuel delivery. Optimize the pump geometry, cam profiles and control valve designs to reduce hydraulic losses, pressure oscillations, noise and vibrations.



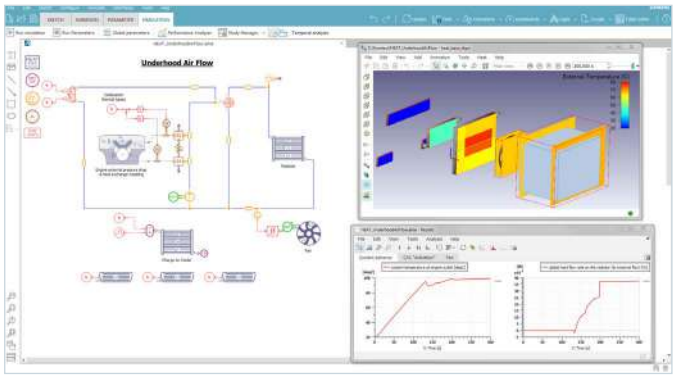
Lubrication

Compute flow rates and energy losses by simulating the integration of hydraulic (pumps, bearings) and mechanical subsystems (crankshafts, camshafts). Analyze pressure dynamics and thermal aspects relative to the oil circuit.



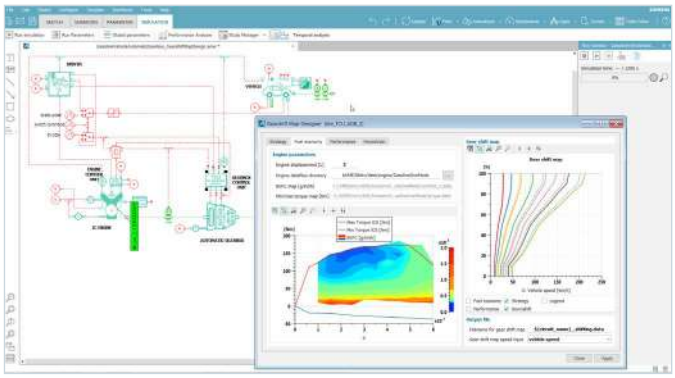
Valvetrain and cranktrain

Simulate the dynamic behavior of valvetrains and ckranktrains. Comprehensively evaluate engine subsystem losses to assess their impact on engine efficiency and fuel consumption. Find the best subsystem design and combination to maximize performance.



Cooling systems

Improve cooling system designs and study interactions with connected subsystems and the underhood environment. Model engine warmup and associated criteria (fuel consumption, cabin heating), study the influence of topological or component changes (split cooling, electric pumps).

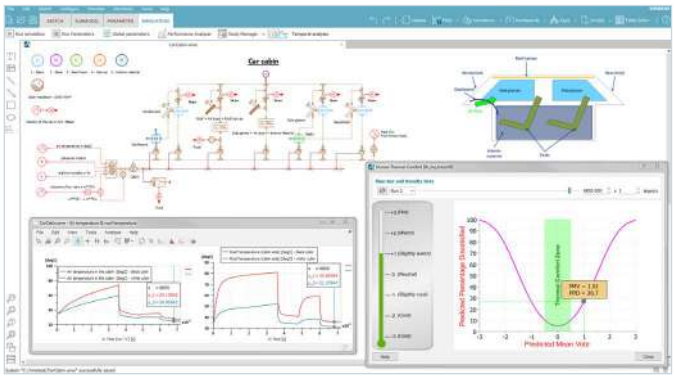


Powertrain transmission systems

Optimize the integration of any kind of transmission system to balance performance, fuel economy, drivability, comfort and reliability. Improve fuel consumption by predicting losses; reduce noise and vibrations by analyzing the contributors and reducing contact force variations.

Vehicle system dynamics

Model the chassis and its components, and balance comfort, handling, stability, drivability and fuel economy. Get access to scalable solutions to support the design and validation of systems and controls.



HVAC and cabin comfort

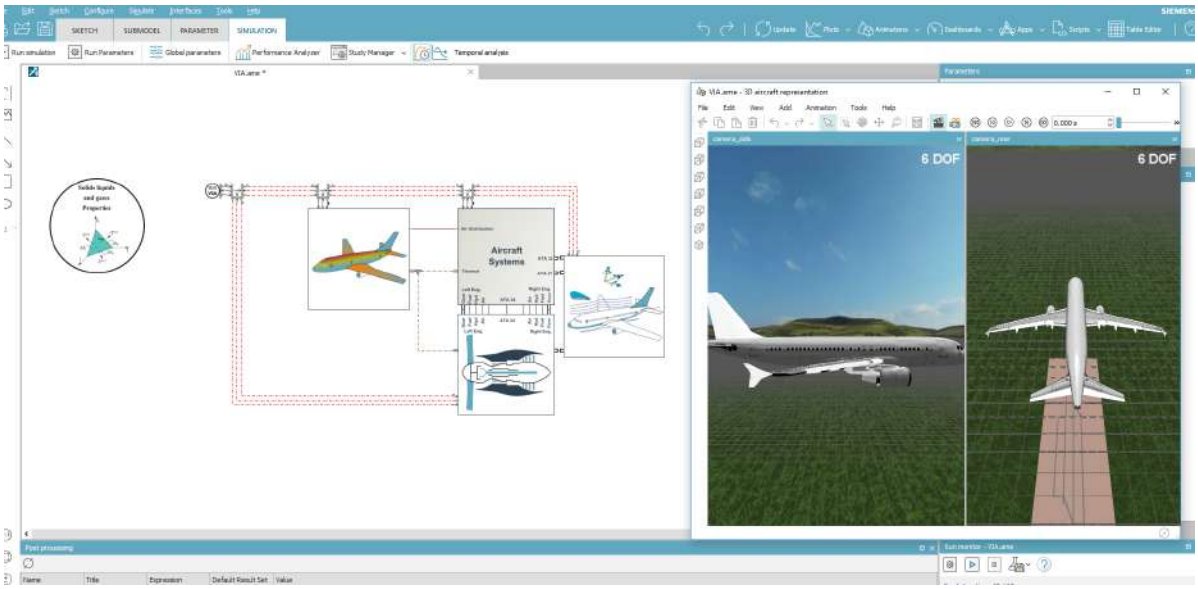
Design air conditioning loops or heat pump systems and analyze thermal interactions with the cooling system and the cabin. Optimize cabin cool down or heating processes; study the integration of additional heaters and their influence on passenger thermal comfort.

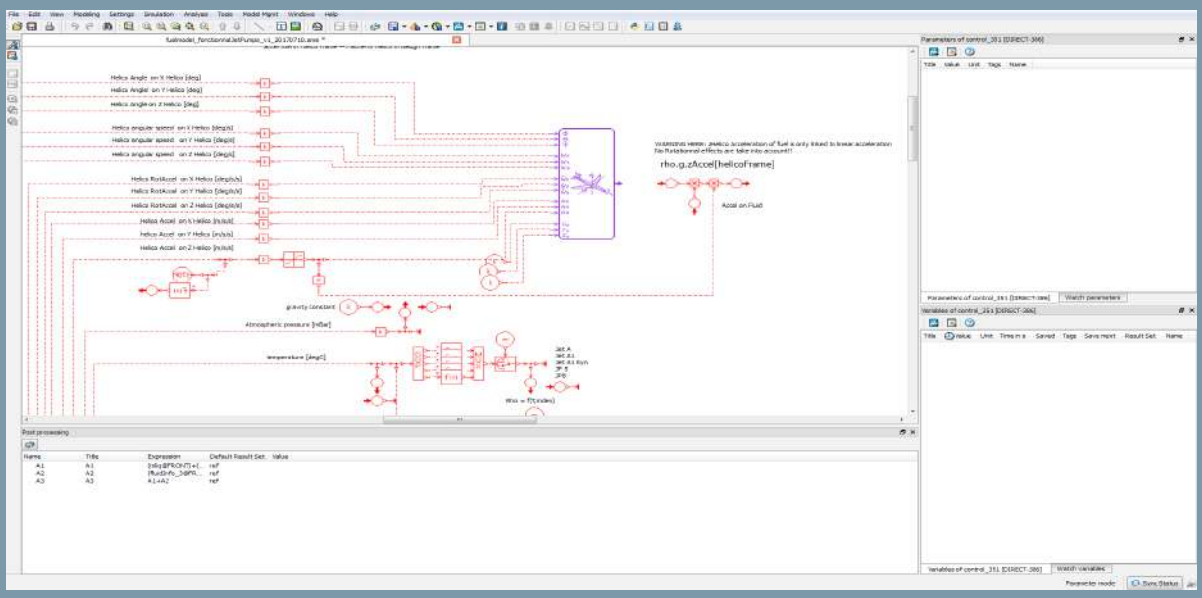
Simcenter Amesim for aerospace and defense

Building a virtual integrated aircraft

Stringent environmental regulations and increased worldwide competition have forced the aerospace industry to speed up innovation. To deliver new designs with greater confidence and increase the efficiency of aircraft programs, companies need to address the complexity of aircraft systems, taking into account system interactions from early design phases.

To help you optimize critical performance and reduce physical testing, Simcenter Amesim enables the virtual integrated aircraft (VIA) approach to support your model-based systems engineering, modeling and simulation, verification and validation processes. The approach can be tuned to the structure of your organization and allows your engineering team to collaborate instead of working in silos.





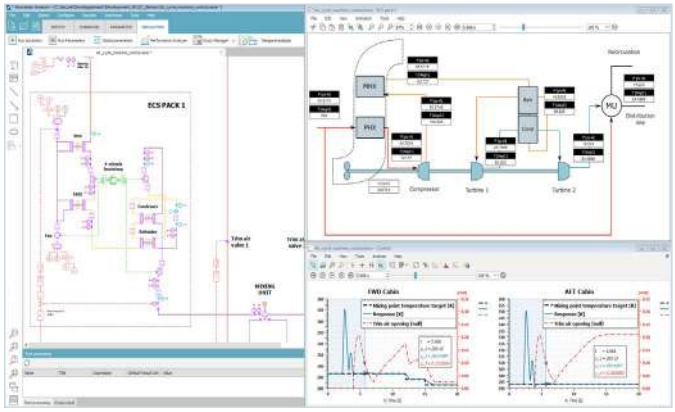
“Simcenter Amesim enabled integration specialists to create easily understandable models that can be shared within our organization. The unique model can be adapted to our analysis goal and can be used for system design, controls validation, simulators and test rigs.”

Franck Nicolas
Head of Simulation and Tools
Airbus Helicopters

Simcenter Amesim for aerospace and defense

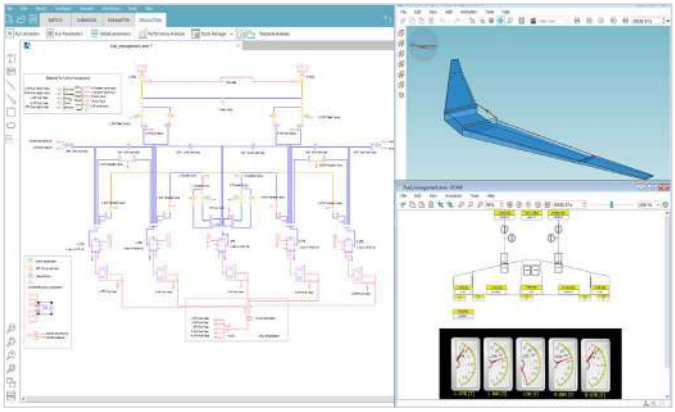
Creating digital twins of aircraft systems

To enable the VIA approach, Simcenter Amesim helps you rapidly build digital replicas of aircraft systems.



Environmental control systems

Ensure the comfort of passengers and crew by optimizing energy management, air conditioning and ventilation. Account for temperature, humidity, pressure and change of pressure rate in dynamic conditions. Design systems with higher efficiency, improved safety and lower weight.

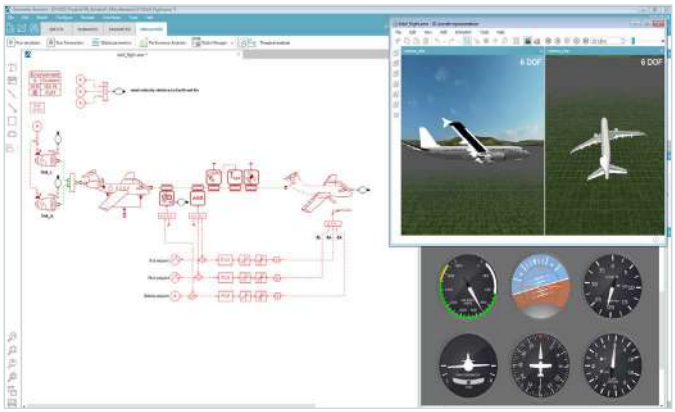


Fuel systems

Improve efficiency, reduce weight and energy consumption of the fuel systems while satisfying certification requirements. Optimize fuel pressurization, fueling, refueling and defueling of reservoirs with complex shapes while accounting for aircraft attitude, acceleration, wing bending or twisting.

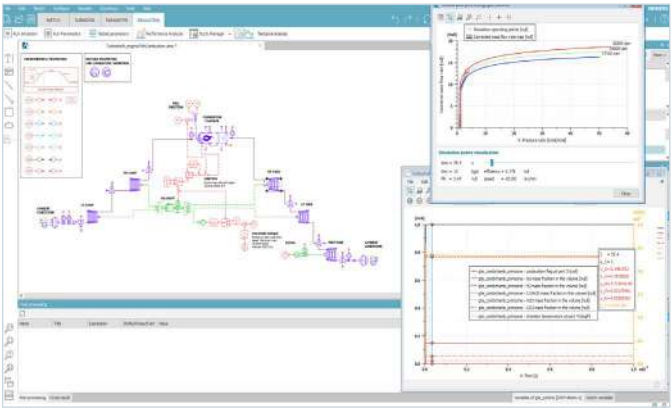
Electrical systems

Create a more electric aircraft by optimizing the electrical network and accounting for thermal integration. Analyze the impact of power network reconfiguration on generators and loads in steady-state and transient phases.



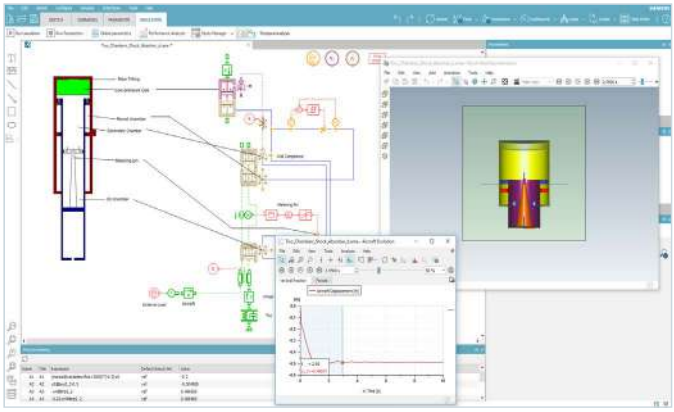
Flight dynamics

Optimize aircraft stability and improve early stage autopilot controller design. Account for mass, inertia and center of gravity position to assess handling qualities during the flight mission.



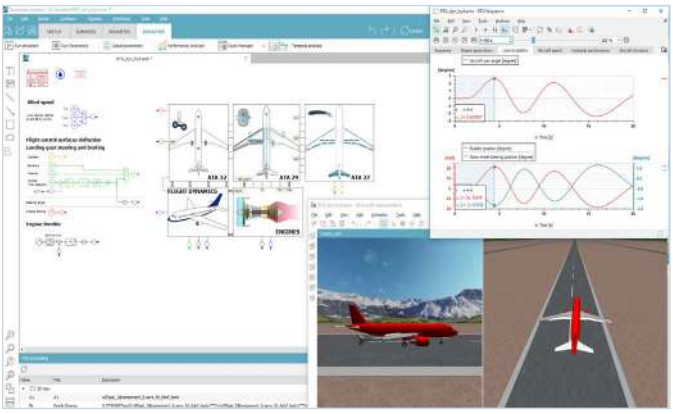
Aircraft engine and equipment

Balance the performance of conventional and innovative aircraft engine architectures: simulate their complete thermodynamic cycles in various operational conditions, accounting for environmental conditions and degradation of compressors and turbines, and integrate their equipment and consumers.



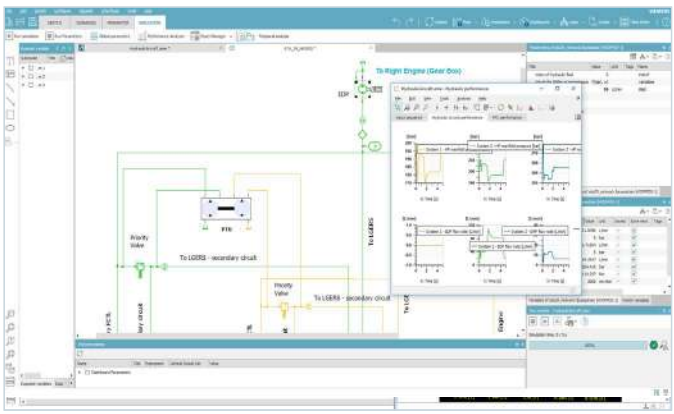
Landing systems

Simulate mechanical, fluid, electrical and thermal aspects. Analyze system sizing options under various operating conditions. Meet shock absorber requirements, optimize the kinematics for extraction and retraction, as well as improve braking and steering systems.



Flight controls

Analyze the behavior of servo-hydraulic, electromechanical and electro-hydrostatic actuators for primary flight controls, cable actuation for light aircraft, and rotary actuators for high-lift devices. Evaluate their performance by considering thermal aspects and the integration with hydraulic or electrical systems.



Hydraulic systems

Simulate hydraulic systems' behavior for different sizing scenarios and flight missions. Integrate your hydraulic systems with flight controls, electrical or landing systems, to assess overall aircraft performance. Estimate the system's degraded performance to meet certification requirements.

Simcenter Amesim for industrial machinery

Boosting productivity, reliability and energy efficiency

Developing industrial machines for packaging, bottle filling, metal forming and textiles requires an optimal balance between various attributes:

- Productivity while reducing production costs
- Accuracy while limiting the reject rate
- Reliability while maximizing production time
- Efficiency while reducing energy costs and complying with environmental regulations

As a consequence, industrial equipment companies have to size multiphysical systems, including hydraulics, pneumatics, electrical, mechanical and thermal, to increase production speed. But this should not impact product quality or the accuracy and reliability of the machine. In addition, tracking energy losses of machines is important to both optimize existing systems and develop new energy efficient ones.

In this context, Simcenter Amesim provides you with a set of capabilities to:

- Boost machine productivity by performing multiphysical systems sizing
- Deliver accuracy and reliability through the simulation of transient behavior
- Reduce commissioning time by validating and calibrating programmable logic controller (PLC) programs using a model of the machine
- Improve energy efficiency by finding the sources of energy losses
- Balance energy consumption, productivity and vibration in different operating conditions

"A platform like Simcenter Amesim offers extensive libraries of components that also connect to describe complete multiphysics systems, a prerequisite for advanced model-based system engineering."

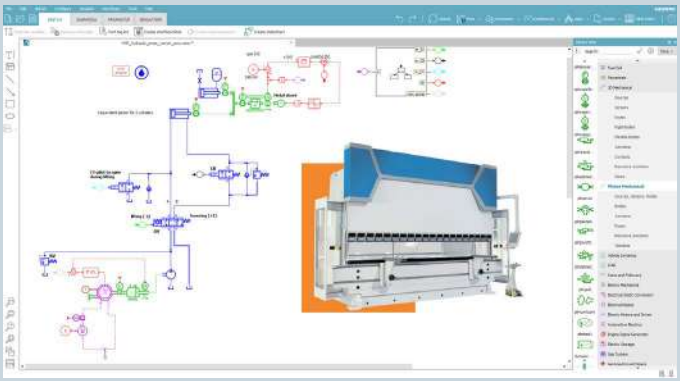
Kristof Roelstraete
Director
Weaving Machine Development
Picanol

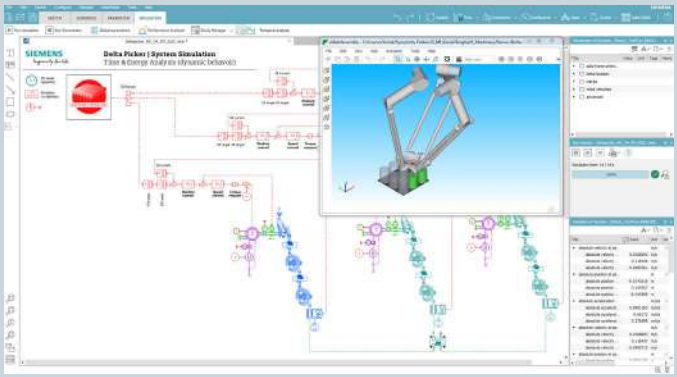
Designing optimal components and systems

With Simcenter Amesim, you can simulate various technologies of actuators (hydraulic, pneumatic and electrical) coupled with mechanical moving parts, as well as simulate various architecture layouts and component dimensions in order to achieve the best balance between productivity and energy efficiency.

You can easily remedy vibration issues generated by actuator behavior on mechanical structures or the coupling between fluid components, mechanical and electrical systems. By simulating the vibration-related behavior of rotor dynamics of generators, motors, pumps, compressors, hydraulic or pneumatic systems in time domain, Simcenter Amesim helps you correct potential system response time disturbances and curtail risks of premature wear.

The solution enables you to understand the heat generated in the machine and size the cooling system accordingly. You can boost machine durability by applying the adequate cooling operation upgrades early in the development process. From heat exchangers to the cooling circuit and pumps hydraulic network, all subsystems can be fine-tuned to decrease the fabrication costs of industrial machinery.





"If you are interested in the global parameters of the system, a 1D simulation tool such as Simcenter Amesim is the best option because it is fast, reliable and easy-to-use."

Gabriele Pastrello
R&D Engineering
RONCHI MARIO

Simcenter Amesim for heavy equipment

Balancing operability, productivity and fuel efficiency

Due to market demand and stringent regulations, heavy equipment must perform better in terms of reducing pollutant emissions, machine work output, total cost of ownership (TCO) and operator working conditions.

In this context, heavy equipment OEMs must embrace innovation to maintain their market share by providing reliable, comfortable and safe machines. Suppliers must also adapt to these changes and evolve from simple system suppliers to real integrators that can tailor products to OEM specifications.

System simulation has become a cornerstone of virtual machine design from early development stages. Simcenter Amesim possesses a set of powerful capabilities that allow you to address the complexity of intelligent heavy equipment systems. The solution helps you:

- Accurately predict fuel consumption
- Analyze the impact of design options and control strategies
- Recover energy lost during machine operations
- Virtually evaluate the potential of a waste heat recovery system

With Simcenter Amesim, you can prepare the shift to electrification. It helps you easily assess and optimize hybrid architectures early in the design cycle, improve machine energy management and maximize autonomy.

"By using Simcenter Amesim, the development phase can be reduced significantly, up to 30 percent in some cases."

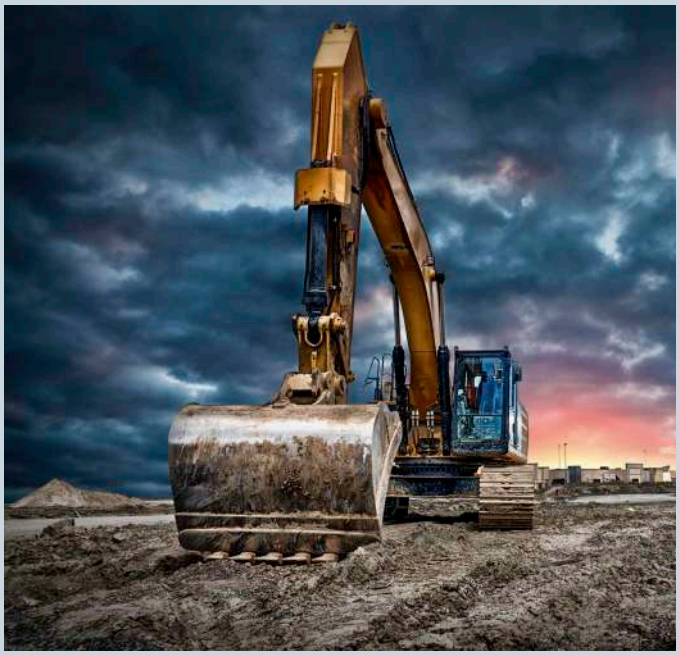
Riccardo Bonacina
Base Engine Validation and Reliability Lead Engineer
SDF

Maximizing performance of each machine subsystem

Using Simcenter Amesim, not only can you tackle vehicle integration challenges but you can also independently study each mechatronic subsystem before incorporating them into a unique environment to evaluate their interactions.

Powertrain systems

With Simcenter Amesim, you can optimize comprehensive engine systems (from air management and combustion to fuel injection and engine controls) and design innovative transmissions. The solution helps you accelerate the validation of control strategies through the simultaneous optimization of mechanics and software.



Vehicle thermal systems

Easily size and analyze thermal subsystems. Simcenter Amesim gives you the opportunity to analyze vehicle thermal management subsystems, such as engine cooling, lubrication, air conditioning and in-cabin systems.

Vehicle system dynamics

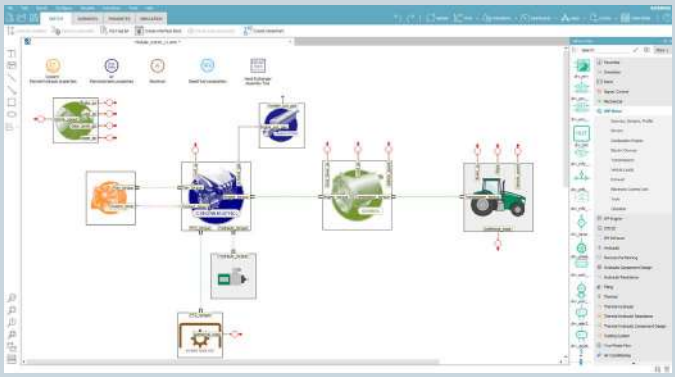
Evaluate the static and dynamic performance of any chassis system. With Simcenter Amesim, you can optimize the chassis system in order to shorten braking distance and reduce vibration with an optimized mounting system and advanced suspension while improving ride comfort and productivity.

Electrical systems

Seamlessly simulate electrical and electromechanical systems, including batteries, drives and electric motors. Simcenter Amesim supports the analysis of issues such as power consumption estimation, transient response evaluation and thermal effects.

Mobile hydraulic actuation systems

Design robust fluid power actuation systems for crane, crawler, earthmoving and mining equipment, machine tools and more. Simcenter Amesim delivers the required insights to reduce power generation (such as variable displacement pumps and load sensing) and develop new functions (such as self-leveling and control strategies).



"The way we integrated Simcenter Amesim into our process covered everything from controls, fine-tuning, hydraulic systems and vehicle performance assessment. We saved a lot of time and we were able to mitigate risks."

Anab Akanda
Principal Mechatronics Software Engineer
Joy Global

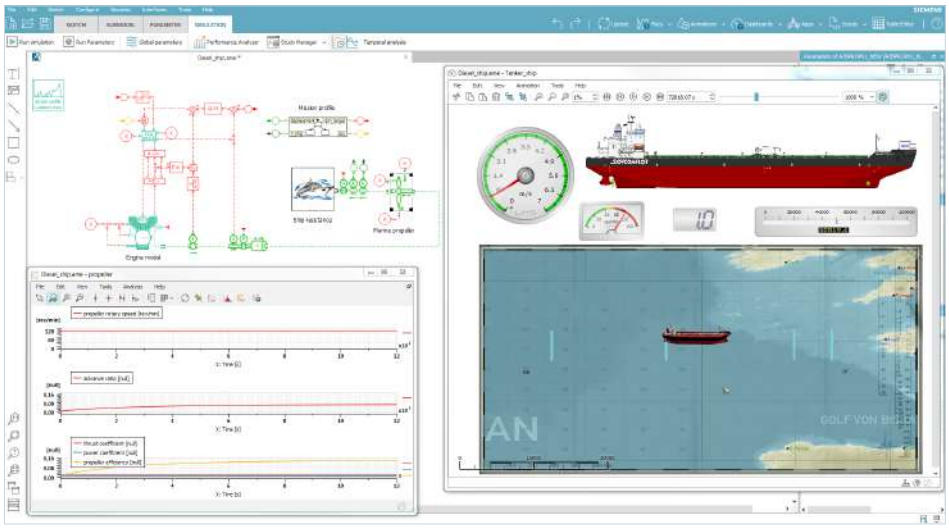
Simcenter Amesim for marine

Accelerating propulsion design and hybridization

System simulation offers the marine industry an efficient solution to cut operational costs as well as carbon dioxide (CO_2) and nitrogen oxide (NOx) emissions while reducing the cost and risk of innovation. It offers naval architects the ability to rapidly predict vessel performance across a complete set of operating and maneuvering conditions.

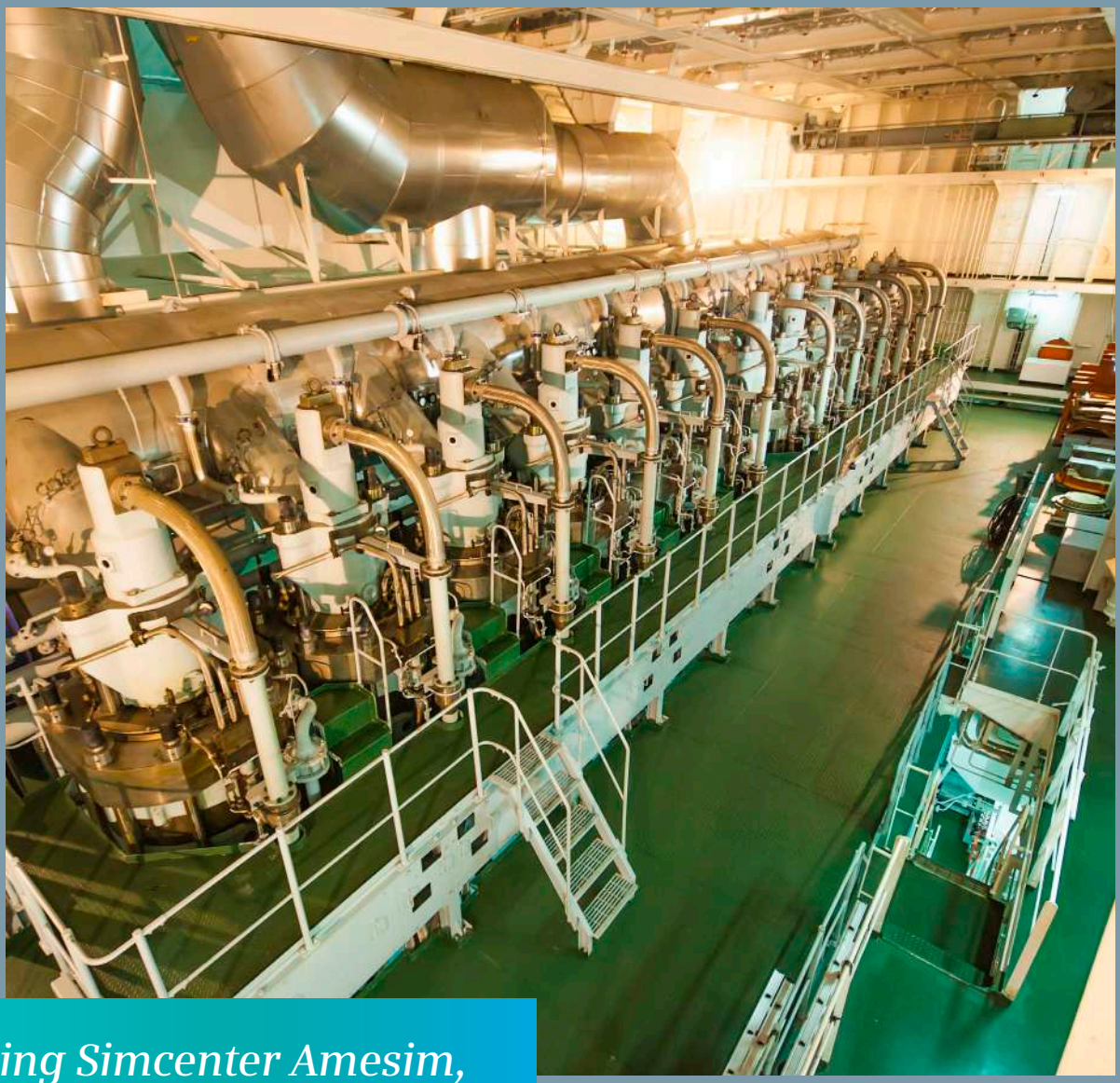
Simcenter Amesim lets shipbuilders virtually predict the dynamic performance of smart systems early in the development process. The software gives you the ability to study all engine subsystems such as air path, fuel injection, valvetrain, lubrication and cooling. It also offers an in-depth understanding of powertrain system noise, vibration and harshness (NVH) performance.

Simcenter Amesim helps optimize the hydrodynamic performance of your ship propulsion system by simulating multiple powertrain configurations, such as conventional, hybrid or electric battery under different scenarios. You can integrate your engine model and controls into the full ship architecture to estimate fuel consumption and NOx emissions for different load cases. Simcenter Amesim allows you to ramp up the efficiency of electrical, hydraulic, mechanical and thermal systems such as cabin HVAC, deck cranes and steering systems.



"Simcenter Amesim and Simcenter Engineering services enabled us to provide our customers a system which can simulate the real world in a perfect way. We wouldn't have been able to do that with other solutions."

Kay Tigges
Senior Naval Architect
Siemens Marine



"Using Simcenter Amesim, development time has been reduced by a factor of five."

Mikkel Thamsborg
R&D Project Manager
R&D Injection and Hydraulics Department
MAN Diesel & Turbo

Simcenter Amesim for energy and utilities

Optimizing conventional power generation

Oil and gas industry

With increased demand for energy sources, the challenge facing the oil and gas industry is drilling further and deeper while making systems safer and more durable. Simcenter Amesim offers a broad range of components to virtually design and test subsea controls, emergency safety and drilling systems.

Using Simcenter Amesim, you can evaluate startup behavior of high-pressure unit pumps, accumulator filling time, umbilical pressurization time and gate valve dynamics. You can simulate discrete events such as emergency shutdown (ESD) procedures on the platform to show transient response times of the gate valve closure on the ocean floor. With Simcenter Amesim, you can design fluid power actuation systems for clamping devices, balancing of pylons and hoisting applications while reducing power consumption.

Gas turbines

Simcenter Amesim comes with a unique set of components that allow you to model any power generation gas turbine cycle.

The solution provides you with the capabilities to optimize co-generation, fuel and lubrication systems, and assess the impact of combustion and the thermodynamic cycle on pollutant emissions. You can also evaluate the effect of control strategies on the overall gas turbine performance and efficiency during transient operations while considering startup and shutdown.

Simcenter Amesim helps you virtually design and test subsea controls, emergency safety and drilling systems.

Supporting green power production

Simcenter Amesim supports renewable energy production by helping manufacturers optimize wind turbines. The solution enables you to analyze the coupling between mechanical subsystems like the turbine blades and gearbox on one hand, and the electrical generator and the power grid on the other.

Simcenter Amesim enables the development of pitch and yaw control drive systems and controls, helps to optimize cooling and lubrication systems as well as reduce torsional vibration in the gearbox and driveline.

You can simulate the rotating velocity of the wind turbine and assess the electrical power that is generated by the input wind velocity. It allows you to:

- Compare the use of a synchronous machine or induction machine
- Compare the use of a mechanical reducer or machine with a high number of pole pairs
- Optimize energy management
- Detect potential failures

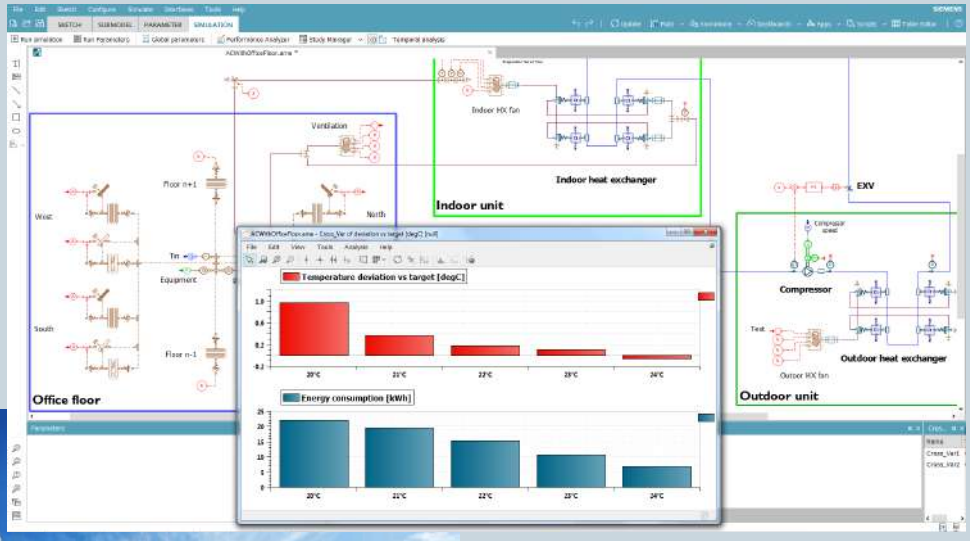
Simcenter Amesim for consumer products

Designing optimal home appliances

A shift towards energy efficient home appliances and HVAC devices is one of the key drivers behind the growth of this market. Consumers demand more eco-friendly appliances in order to reduce their environmental impact and lower utility bills. Following stringent energy and safety regulations, many appliances have to be re-engineered to meet minimum performance standards.

System simulation helps manufacturers make great strides in developing more efficient appliances. Simcenter Amesim provides all the required capabilities to:

- Assess performance and power consumption of the refrigerant loop system under transient conditions
- Correctly size components such as compressors, expansion devices, heat exchangers and electrical motors
- Assess the performance of heat exchangers starting from the geometry
- Evaluate innovative architectures such as multi-evaporators or heat pumps
- Introduce new refrigerants and materials
- Reduce noise and vibration
- Virtually evaluate various control strategies to maximize energy efficiency

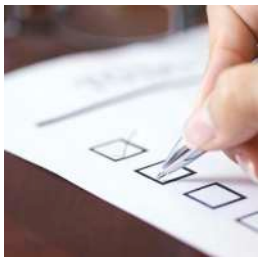


Supporting your engineering transformation

Applying a continuous modeling approach from early architecture design to the calibration stage has become a necessity. To support you in this engineering transformation, Simcenter Amesim offers a multilevel philosophy that allows you to gain efficiency throughout all phases of the design cycle.

Versatility in physical modeling combined with dedicated, unique analysis capabilities will help you set up the most effective engineering design process for a car, plane, excavator, ship or any other industrial application. From components to the entire system, we offer you the solution that enables you to focus on your engineering challenge and address it as fast as possible with the available data.

Meet regulations and market requirements



Rapidly make decisions along the development process

Evaluate systems' performance earlier

Innovate without compromising time-to-market and quality

Enable collaborative engineering and traceability

Simcenter Amesim offers a multilevel philosophy that allows you to gain efficiency throughout all phases of the design cycle.

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.

Headquarters:	+1 972 987 3000
Americas:	+1 314 264 8499
Europe:	+44 (0) 1276 413200
Asia-Pacific:	+852 2230 3333

© 2018 Siemens Product Lifecycle Management Software Inc. Siemens and the Siemens logo are registered trademarks of Siemens AG. Femap, HEEDS, Simcenter 3D and Teamcenter are trademarks or registered trademarks of Siemens Product Lifecycle Management Software Inc. or its subsidiaries in the United States and in other countries. Simcenter, Simcenter Amesim, LMS Samtech Samcef, LMS Samcef Caesam, Simcenter SCADAS, Simcenter Testxpress, Simcenter Soundbrush, Simcenter Sound Camera, Simcenter Testlab and LMS Virtual.Lab are trademarks or registered trademarks of Siemens Industry Software NV or any of its affiliates. Simcenter STAR-CCM+ and STAR-CD are trademarks or registered trademarks of Siemens Industry Software Computational Dynamics Ltd. All other trademarks, registered trademarks or service marks belong to their respective holders.

72523-A20 10/18 A