



Best Practice, Best Product

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Up to 80 percent of the cost of a product's development is determined by decisions made early in the design process. Digital exploration, or upfront simulation, is the best way to investigate thousands of design options before product costs are locked in. With its widely adopted simulation platform, ANSYS enables every member of the product development team to participate in digital exploration. The result is more innovative products, faster time to market and lower development costs.

For almost half a century, engineering simulation has been helping the world's leading businesses launch their innovative product designs faster, and at a lower cost, by verifying them in a risk-free virtual world. For over 40 years, ANSYS has supplied best-in-class engineering software worldwide and currently supports the success of product development teams at more than 45,000 customer organizations.

Across all these customer engagements, one fact has emerged: the earlier that product teams can apply simulation, the better. While simulation has often been viewed as a complement to physical testing once design concepts are ready for validation, simulation can add even greater value upstream, during product ideation. By empowering the product development team to quickly explore thousands of design options via simulation at the earliest stages, companies can reduce final product cost, unleash game-changing innovation, and cut weeks or even months from their launch schedules.

Nearly 20 years ago, ANSYS pioneered upfront simulation with a product that set the bar for ease of use, automation and productivity: ANSYS DesignSpace. Building on this success, the company has worked with engineering teams across every industry to design and develop the capabilities that allow them to make better engineering decisions earlier using simulation.

Today, ANSYS offers the industry's broadest and most robust range of capabilities for digital exploration — from proven flagship solutions to leading-edge new products and capabilities designed specifically to support digital exploration.

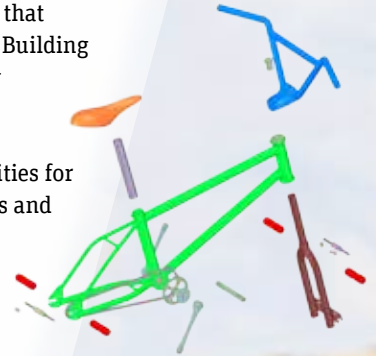
THE ANSYS SIMULATION PLATFORM: A FOUNDATION FOR EARLY DECISION-MAKING

By understanding how product development teams work, ANSYS has identified simulation solutions that specifically support the concept of digital exploration and has incorporated them into the ANSYS platform.

“Companies cannot realize the full value of digital exploration without giving every member of the design team access to simulation.”

Before designs begin to harden and before simulation is used to verify product performance, engineers ask many questions about the design, make changes and iterate until they either arrive at an optimum design or run out of time (typically it is the latter). To start, system architects will use 0-D models and system simulation to explore different product architectures and determine high-level requirements for various subsystems. They determine how much torque is required, how much heat needs to be dissipated or what loads need to be supported. To answer these questions up front requires system simulation, and integrating a heterogeneous mix of models and physics domains to simulate overall product performance. A versatile system simulation tool like ANSYS SImplorer, which supports various modeling languages and can co-simulate mechanical, electrical and embedded software systems, is paramount.

Once requirements for the various subsystems have been established, designers typically use 3-D modeling to experiment with the design. They determine the look and feel of the product and subsystems, ascertain the size and design a form that conveys what these subsystems actually do. Designing these early ideas requires a 3-D modeling tool that is easy for engineers to use to mock up their ideas at the speed of thought. ANSYS SpaceClaim, a multipurpose 3-D modeling application built on direct modeling technology and an array of intuitive tools, enables CAD experts and non-CAD experts alike to quickly create and morph designs during product ideation. ANSYS SpaceClaim also provides robust and easy-to-use tools to de-feature and simplify geometry for simulation.



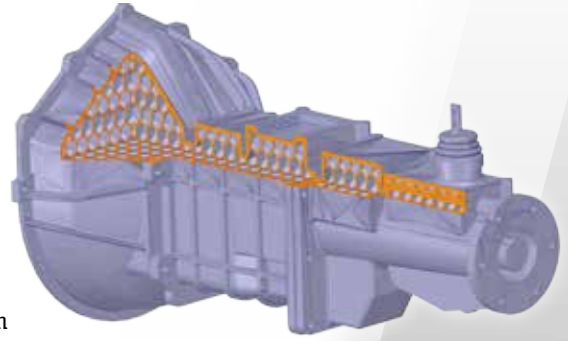
With the product architecture and basic form of the product established, designers and engineers can explore design performance using simulation, and perform what-if analysis to improve the design for functional requirements across a range of engineering disciplines, including mechanical, thermal and electrical. The parametric and persistent architecture of the ANSYS platform is very powerful at this point in the design process. Once a simulation is set up, an engineer can easily change the geometry, material, loads or a host of other design parameters, and then regenerate simulation results with a single mouse click.

In addition to manual what-if studies, designers can benefit from automated parametric optimization. A number of specialized capabilities within the ANSYS platform make it possible to systematically explore the entire design space using design of experiments (DOE) and find the best design faster.

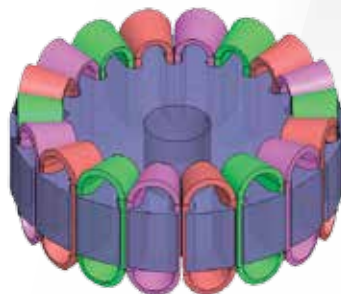
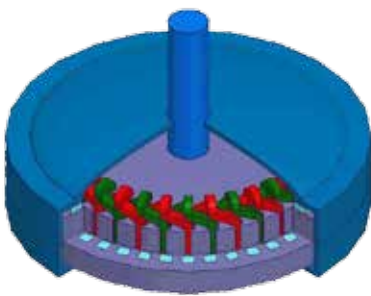
- ANSYS DesignXplorer provides persistent, automated parametric optimization.
- ANSYS optiSLang enables product developers to not only find the best design, but the most robust design given variations in manufacturing, material or usage.

“Businesses of all types, in every industry, can realize dramatic cost and time savings while also supporting groundbreaking product innovation — by taking advantage of upfront simulation.”

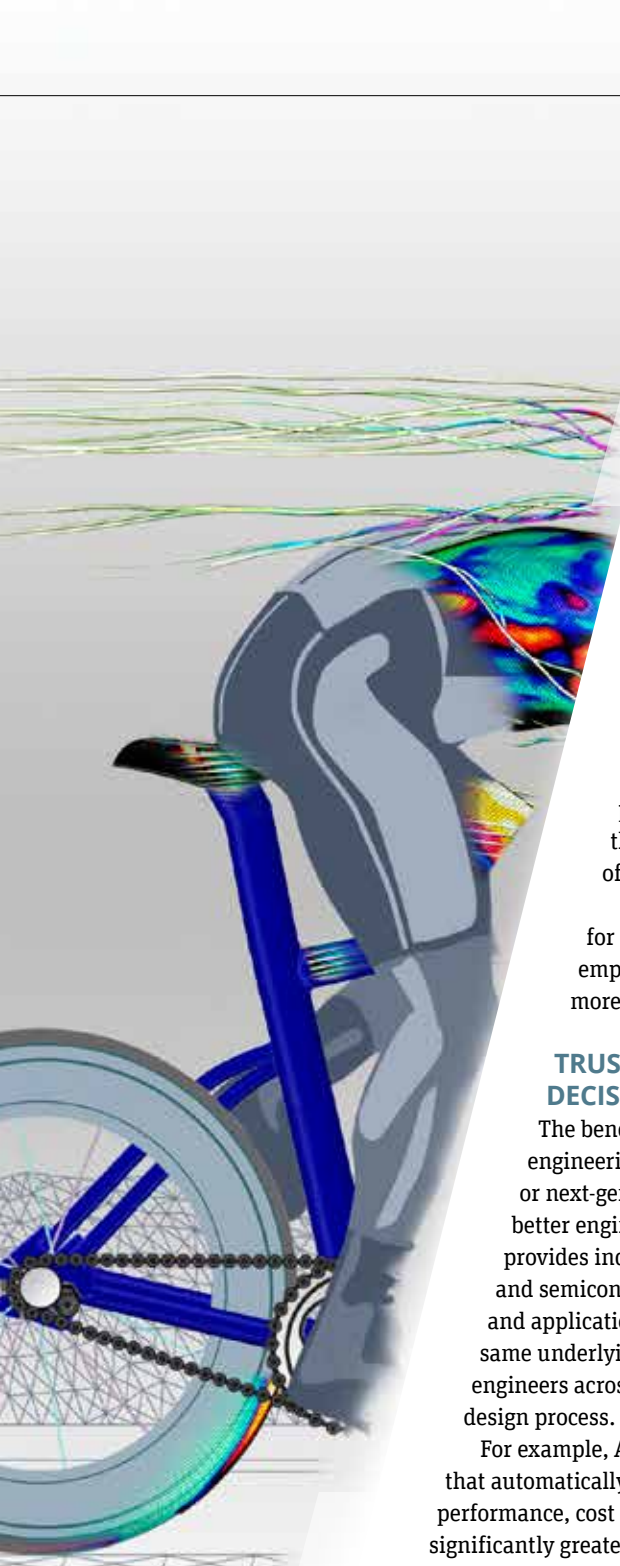
Most companies standardize on CAD and perhaps a PLM system to document their design decisions. CAD systems are often too complex and heavy for digital exploration, but, to document the design, an engineer’s platform for digital exploration must be interoperable with these enterprise systems. To this end, the ANSYS platform provides bidirectional associativity with all the major CAD systems so that a parametric change to a model can automatically revise the geometry in its native CAD format. Design specialists can quickly explore changes and easily update their design of record in the CAD system.



▲ ANSYS SpaceClaim enables designers to easily make changes to their design concepts and to digitally explore options long before a design is solidified.



▲ ANSYS RMXprt aids designers in the early-stage development of electric machines.



Engineering teams typically have many years of experience designing the same family of products and have developed unique simulation workflows and result calculations. The ability to customize a simulation suite and create specialized applications to automate steps and integrate third-party tools or data unique to their product is vital to repeatable success in digital exploration. ANSYS ACT is an easy-to-learn yet powerful customization interface to the platform based on standard Python and XML. Engineers can create custom applications from scratch or use the

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ACT App Builder to interactively create apps. The ecosystem of ANSYS partners has also developed a rich set of simulation apps and made them available on the App Store. Customers can choose from a variety of free or cost-effective applications based on ANSYS ACT.

To bring together all these capabilities that are commonly required for digital exploration and to make it easy for non-analysts to effectively employ upfront simulation, ANSYS has developed ANSYS AIM. Learn more later in this article and throughout this issue of *ANSYS Advantage*.

TRUSTED RESULTS FOR EARLY DESIGN DECISIONS IN EVERY DOMAIN

The benefits of digital exploration are not confined to a particular industry or engineering application. Whether designing large fabricated structures for mining or next-generation semiconductor technology, early use of simulation results in better engineering decisions, less redesign and higher-quality products. ANSYS provides industry-proven solutions for advanced structural, fluid, electromagnetic and semiconductor simulation, but these products also deliver unique capabilities and applications to designers to use at the beginning of the workflow. Built on the same underlying technology used by high-end analysis products, these solutions help engineers across different engineering disciplines make better decisions earlier in the design process.

For example, ANSYS Mechanical now includes a topology optimization capability that automatically determines where material should be added or removed to meet performance, cost or weight requirements. Using topology optimization, a designer has significantly greater freedom to create a part or assembly that is closer to the optimal design than is possible with traditional parametric optimization. The resulting design is typically more innovative but complex, making it ideally suited for additive manufacturing. By combining topology optimization with additive manufacturing strategies, companies can dramatically reduce material costs while delivering innovative, higher-quality products.

For semiconductor design, the ANSYS suite now includes ANSYS RedHawk-SC, which is based on the new SeaScape elastic computing architecture for electronic design automation. Designed to handle extremely large data sets and computations on commodity compute



Revving Up Product Development
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hardware, ANSYS RedHawk-SC enables semiconductor designers to rapidly assess many electromigration and voltage drop scenarios prior to final verification stages and sign-off.

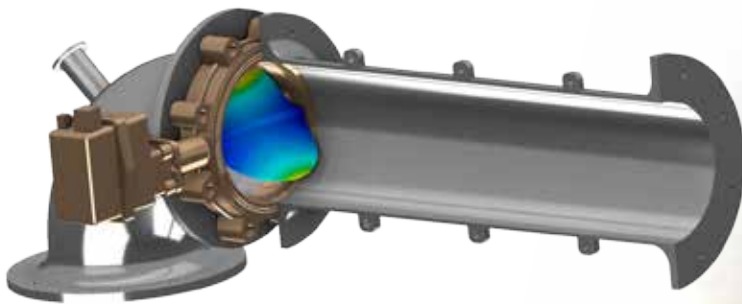
In the area of electromagnetic simulation and motor design, ANSYS RMxprt is a template-based design tool included with ANSYS Maxwell. At the conceptualization stage for electric machines, RMxprt quickly calculates overall machine performance, supports initial sizing decisions and analyzes hundreds of what-if scenarios in a matter of seconds.

In the embedded software space, software engineers can leverage the power of design exploration by relying on SCADE Test Rapid Prototyper, which works in conjunction with SCADE Display – the industry standard for human-machine interface development. Product developers can use SCADE Test Rapid Prototyper upfront in the design process to create a large number of test cases. By leveraging the power of automated image comparison and regression testing, display developers can save significant time and money by accurately predicting real-world results upfront during design.

ANSYS AIM: REALIZING THE POWER OF DIGITAL EXPLORATION

One of the most exciting developments at ANSYS has been the introduction of ANSYS AIM, a new, easy-to-use simulation solution that can be mastered by every member of the design team.

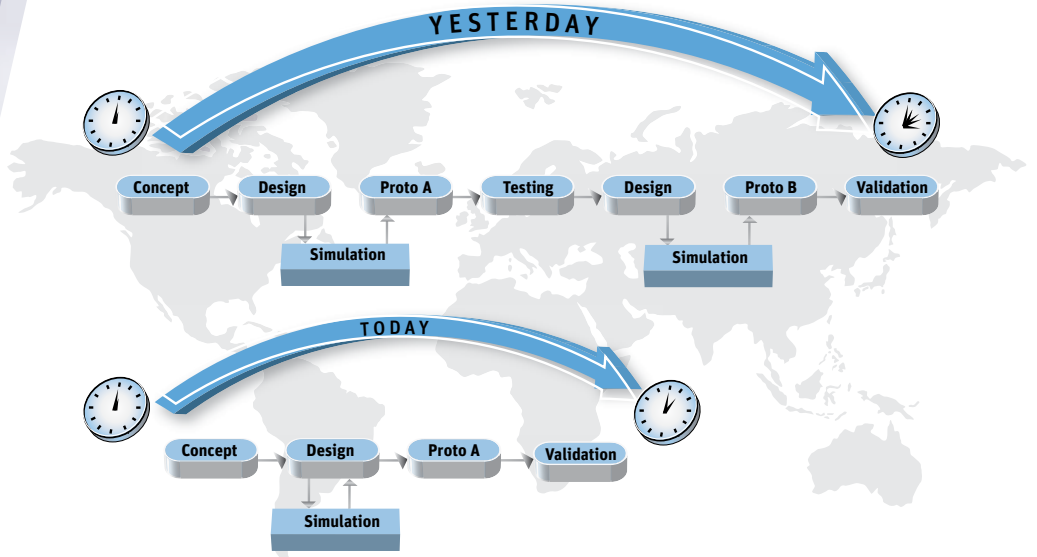
As the value of digital exploration is discovered, more and more companies are asking nonexperts to apply simulation at the early stages of product conceptualization. While some CAD vendors offer add-on simulation modules based on different technologies than those commonly used by the analyst community, ANSYS AIM delivers pervasive engineering simulation using the same proven core solver technology as that applied by analysts, but with features that make it easy to learn for designers. Companies cannot realize the full value of digital exploration without giving every member of the design team access to simulation. To learn more about ANSYS AIM, see page 39.



▲ Butterfly valve simulated in ANSYS AIM, an easy-to-use simulation solution for every member of the design team



ANSYS App Store
[ansys.com/appstore](https://www.ansys.com/appstore)



▲ Cornaglia group has increased innovation and earned a 10-times return on investment by using simulation upfront in the product design process.

EXPLORE THE BENEFITS NOW

With a wide range of solutions and capabilities designed specifically to support digital exploration, ANSYS has eliminated almost every barrier that companies face in leveraging this best practice for product development. Businesses of all types, in every industry, can realize dramatic cost and time savings – while also supporting groundbreaking product innovation – by taking advantage of upfront simulation.

Cornaglia Group, an Italian manufacturer that develops leading-edge automotive components, including exhaust systems and fuel tanks, began implementing the concept of digital exploration in 2012. Says Massimo Marcarini, director of R&D, “Cornaglia was patenting only three innovations annually before 2012. [After implementing simulation-driven design], in 2014 alone we filed 10 patent applications. The financial benefits have been tremendous; in fact, I estimate that Cornaglia has earned a 10-times return on its investments in simulation technology.”

With the potential for these kinds of returns, it simply makes good business sense for companies of all sizes and types to implement the concept of digital exploration. ANSYS will invest in new solutions and innovative capabilities that support digital exploration so our customers can continue to experience the advantages. Our goal is to help you achieve the dramatic results, in terms of both product innovation and financial returns, that position your company for leadership today and tomorrow. ▲



ANSYS AIM: Try It Now
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