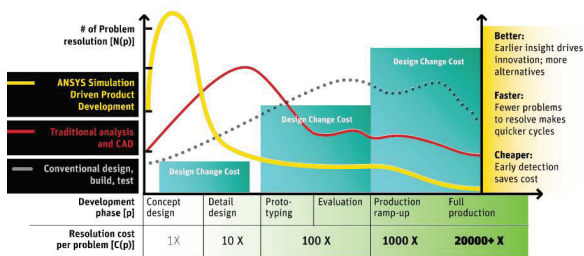


Strategic Engineering Simulation



Today is the era of the virtual world. Your product development group probably employs some kind of computer testing to vet design ideas. However, if you take engineering simulation out of the tactical realm and apply it strategically, you'll discover how it can drive innovation across your organization.



Studies have shown that the cost of change increases exponentially with each stage of development. ANSYS software not only delivers efficiency but also drives innovation. Modeling and simulation can be used to drive new solutions rather than to merely verify existing ones.

Source: Aberdeen Group: *The Impact of Strategic Simulation on Product Profitability*

Global economic pressures are forcing companies to innovate more in a faster time frame and to deliver robust and sustainable solutions from the first product release while keeping costs down. To succeed at these objectives, leading world-class companies are adopting engineering simulation to design, optimize, manufacture and test new products in the virtual, digital world before committing to production. This virtual approach was used initially for aerospace applications in which failures are not acceptable and physical tests are not always possible. It has quickly spread across other industries, such as automotive, energy, electronics and even healthcare, consumer products and food processing. Business studies confirm that engineering simulation adoption is leading to pervasive simulation — a world in which no new product design will be introduced without extensive numerical modeling to optimize and test it.

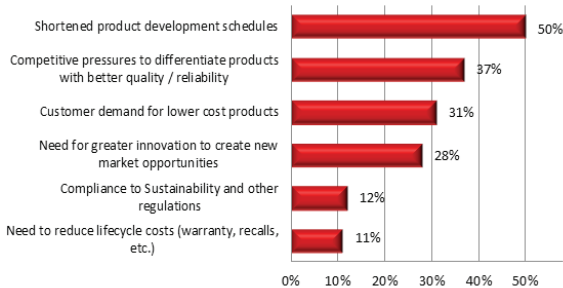
ANSYS is fueling and driving this technological revolution. Engineering simulation tools and processes enable engineers worldwide to quickly realize product solutions that address emerging challenges, including sustainability, safety, energy, medical breakthroughs and, in short, global prosperity and improvement of the human condition.

Engineering Simulation and Simulation Driven Product Development

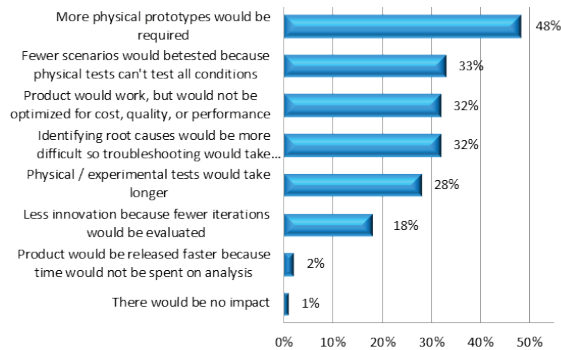
Engineering simulation involves applying physics-related software tools to the design process to create a comprehensive and reliable computer model of any product or process. Using such a model, you can virtually test operational performance of either existing or potential designs for your products or processes.

Without engineering simulation tools, physical prototypes for each design candidate must be built and tested through physical experimentation. Small changes to a design may require manufacturing and testing an entire new prototype, delaying development and increasing costs. Furthermore, a test may yield final results that show a design to be successful — but without any indication or explanation as to how and why it is so.

Simulation Driven Product Development takes engineering simulation to an even higher level. It involves applying the principles to the entire product development process, especially in the early stages when it can have the greatest benefit in terms of reduced prototype testing, faster time to market and improved market acceptance of innovative new products.



Top business pressures driving a better understanding of product behavior



Leading impact of NOT using engineering simulation

Strategic Business Impact

A 2011 market survey by the Aberdeen Group states that current key business drivers are time to market, quality, cost, innovation and sustainability (in order of relevance). Depending upon the macro-economic situation, the relative importance may change: For example, cost to market was the primary driver just 18 months ago. Nevertheless, time to market remains a significant concern whether the company enjoys a favorable situation or suffers during difficult times.

Similar investigations conducted among those involved with simulation clearly state that the direct impact of not using engineering simulation is an immediate increase in the number of physical prototypes and the de facto increase in cost and time to market. Other impacts include solutions that lack robustness or are not optimized from the outset.

Forward-thinking product development companies around the globe — many of them the largest in their industries — today extensively employ simulation. Usage is spreading across mid-sized and small companies as simulation becomes more accessible and perceived as an important part of their business processes. At the same time, large companies that already employ simulation continually increase the pervasive nature of simulation by making it more systematic, more parametric and better integrated into their processes.

As a consequence, no new airplane, car, nuclear or chemical facility, turbine, or engine is currently released without extensive numerical modeling during both design and production phases. As simulation becomes more widespread, it is expected that within a decade every major industrial product will benefit from digital investigation during its design, manufacturing and testing phases.

Real-Life Business Benefits

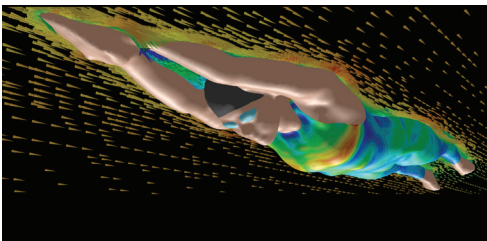
Over the last 10 years, the industrial landscape has completely changed: Reliable technologies have fallen short on market demand; consumer expectations have increased in both size and complexity; *FORTUNE 500* leaders have wavered due to product integrity issues in flagship products; and strong competition is coming from emerging countries.

The news media regularly reports on amazing technological challenges that pioneering companies around the world address in the aerospace, automotive, civil engineering, energy and life science areas, among others. In parallel, product developers in all corners of the globe increasingly adopt engineering simulation. Initially developed for rocket science research a few decades ago but progressively migrating toward industrial design, this digital prototyping approach has penetrated all major industries and is spreading step by step into the manufacturing world.

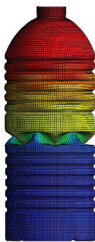
It is no surprise to see leading companies' industrial initiatives and engineering simulation converge, joining forces to build an innovative future. The results of this successful collaboration are already visible. Though engineering simulation is not a "household word," it is used extensively for a huge number of common problems and well-known applications. Not using this technology is considered a competitive disadvantage.

Case Studies

As more companies use engineering simulation tools at various product development stages, problems can be designed out before they are manufactured in — making airplanes and automobiles, for example, safer. Vehicle manufacturers constantly work to provide better-looking, better-performing and more cost-efficient transportation, and virtual analysis helps the industry reach its goals. In the consumer product, businesses that emphasize product development use simulation tools to evaluate alternatives, exclude bad ideas, spot and fix mistakes early on, and optimize designs. And in areas such as construction, industrial equipment, home appliances and plant machinery, Simulation Driven Product Development meets the needs of engineering customers by providing solutions from concept through production.



Courtesy SPEEDO®.



→ Best-in-Class Swimsuit

Researchers investigating shark behavior used modeling to analyze how water flows around the fish as it moves. Simulation revealed micro-flow patterns that can significantly impact resistance to motion. Translating this approach to a virtual swimsuit on a virtual swimmer confirmed the positive impact an advanced swimsuit could have on the swimmer's performance. At the Beijing Olympics, sporting equipment contributed to some amazing performances.

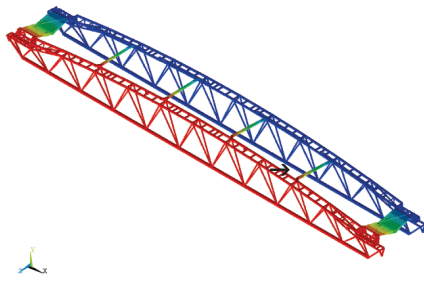
→ Plastic Soda Bottles

Every day around the world, we consume 200 million water and soda plastic (PET) bottles — more than 10,000 tons of PET discarded into the environment every year. One careful investigation employed engineering simulation to test different shapes and adjust manufacturing processes, significantly reducing bottle weight without impacting its resistance to shock and dropping. This result has the opportunity to save the planet from 10 percent of current plastic waste, to reduce manufacturing costs, and to consume less raw materials.

→ Life-Saving Electronic Devices

Implantable defibrillators have saved countless lives, and the new generation of these devices will do even more for patients. In the event of a heart attack, a modern defibrillator can simultaneously send a pulse to reset the heart while automatically transmitting a message to the healthcare team stating that the patient has experienced a major cardiac problem before even he or she knows it. Signal interference, a common challenge for electronic devices, can lead to dramatic consequences. Engineering simulation

of electronic devices ensures that signal integrity, and in this application the patient's life, is not endangered. Wireless devices today use rechargeable batteries so repetitive replacement surgery is not needed; but it is crucial that the recharging process design doesn't induce inconvenience or injury. Consider this case application: If battery recharge results in local heating, virtual prototyping helps to minimize it, making the patient safer and more comfortable.



Courtesy ACA Engineering Consultants.

→ Olympic Stadium

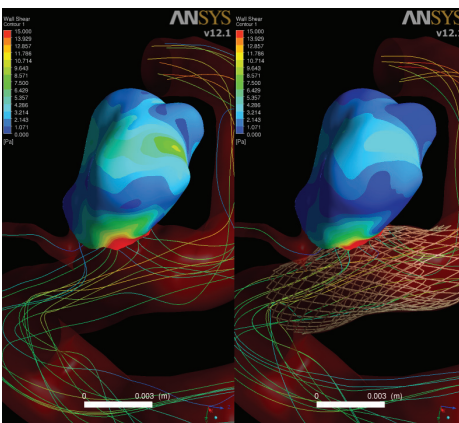
The Beijing Olympics stadium, the Bird's Nest, is an amazing construction achievement. During its anticipated lifetime, it will host exceptional events that draw huge cheering crowds; it was designed with the expectation that it would survive devastating winds and a major earthquake. But it was impossible to create prototypes of the intricate structure prior to construction. Similar to other landmark stadiums built over the last few decades, engineering simulation validated its stability and behavior under a wide range of circumstances. In another application, designers used engineering software to verify parts of the retractable roof over Centre Court at Wimbledon, one of the most famous tennis venues in the world.

→ Resistance to Earthquake

Despite their rarity, disasters such as devastating earthquakes and tsunamis do happen. Commercial buildings as well as important energy and industrial facilities must survive the blow. Simulation can predict a structure's exact behavior in the wake of tremors. If the facility fails virtually, parametric numerical simulation can suggest modifications that would ensure its integrity. Catastrophic disasters can be virtually modeled via engineering simulation, ensuring that a product's final design will successfully survive any real-world event.

→ Cerebral Aneurysm

A cerebral aneurysm, the ballooning of an artery in the brain, could be life threatening if it ruptures. While minimally invasive solutions exist — such as coiling and stenting — they are not risk free; they should not be considered if the risk of rupture is minimal. Currently, surgeons are making decisions based on aneurysm morphology, in which the healthcare team assesses the risk of rupture driven by hemodynamics, or blood flow. Using a patient's head scan, researchers extract patient-specific aneurysm geometry and model the exact blood flow. The process results in providing the surgeon with more information, such as peak pressure, blood flux at the neck, wall shear stress — valuable data that can assist in making the right treatment decision. This experimental approach is currently being tested by a number of hospitals.



Courtesy @neurIST Project.

40 Years of Success Stories:**From NASA to Pervasive Simulation for Design and Production**

Engineering simulation emerged a number of decades ago out of the need to understand processes in which physical measurement was impossible (nuclear industry>structural analysis) or full-scale preliminary tests were not feasible (aerospace>computational fluid dynamics). Leading industries (aerospace, automotive, energy, chemicals) and pioneering companies quickly came to realize the potential benefits of virtual investigations. The first engineering simulation codes were commercialized in the early 1970s.

Rapidly increasing hardware performance quickly enabled a variety of simulation and design of experiment (DOE) techniques that could be performed. The popularity of numerical simulation in the academic and industrial worlds resulted in an explosion of research to develop reliable and robust models able to accurately predict behavior of ever-more complex structures. This trend initially encompassed only single-physics models of advanced fluids, structural dynamics or electromagnetics. The market quickly perceived the value of combining different physics into single models, just as reality encompasses multiple domains. Multiprocessor and multi-core computers opened the door to parametric simulation (DOE) and optimization, empowering designers to go beyond prediction of complex system behavior. Simulation became a tool used to test future solutions against any number of scenarios that could be experienced during a product's lifecycle — a technology that could systematically explore a range of solutions to identify the best one. Engineering simulation moved far beyond research to development, production and manufacturing.

While all industries are not at the same computational maturity, they are all following the same path of progressively adopting simulation to model components or entire systems, to challenge existing solutions via what-if scenarios, and to virtually optimize a process before deploying it across the company. With the increasing power of high-performance computing (HPC), designers are embarking on including the probabilistic nature of materials and processes. Specific material properties are never the same, but they vary slightly around an average value. The same observations apply to geometry and operating conditions as well. Although these small variations may sound insignificant, combining them can lead to dramatic consequences. Thus was born the need for design for six sigma (DFSS). Modeling appears to be the only serious option to combine an optimized solution with a probabilistic approach — a concept that literature refers to as robust design optimization (RDO), the new frontier and an important objective.

ANSYS Footprint

ANSYS has emerged as a market leader and a visionary by being the first, and so far only, company to bring together the three major physics (fluids, structural and electromagnetics) in a single environment.

Once understood only by pioneering companies, simulation has been widely adopted as the most effective, efficient and accurate way to predict, challenge and optimize new products in the virtual world, reducing time and cost to market without compromising product integrity and sustainability for innovative products.

But bringing together advanced physics into one environment is not enough, based on feedback from market leaders and engineering simulation users. Making advanced multiphysics technology easily accessible so that engineers, designers and manufacturers can systematically take full advantage of it is the next new challenge.

With more than 40 years of delivering product promises, ANSYS expects to continue helping organizations solve their complex design problems and produce the most innovative, best performing and most reliable products on the market.

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ANSYS, Inc. is one of the world's leading engineering simulation software providers. Its technology has enabled customers to predict with accuracy that their product designs will thrive in the real world. The company offers a common platform of fully integrated multiphysics software tools designed to optimize product development processes for a wide range of industries. ANSYS can significantly speed design and development times, reduce costs, and provide insight and understanding into product and process performance.

Visit www.ansys.com for more information.