



GET STRATEGIC WITH **DIGITAL ENGINEERING**

Why digital engineering is critical to future-proofing your business



WHAT IS **DIGITAL ENGINEERING?**



/ In a literal sense, digital engineering is as old as the first back-of-the-napkin sketch that was shoved in a pocket before being modeled in a computer-aided design (CAD) program. Those pencil marks became data points, and they were soon joined by millions more as product complexity exploded. We're now awash in engineering data coming from all corners of the enterprise, as well as from partners, suppliers, and vendors. Product geometries, multiphysics simulations, materials intelligence, market research, digital twins, artificial intelligence datasets, and cyber-physical systems of all kinds contribute to the data deluge.

Digital engineering is no longer just about making the physical digital and all the benefits that entails. Today, digital engineering is about making the digital physical — in other words, being able to gather useful insights from all those data points, bring those insights together into a strategy, and turn that strategy into reality.

It's not part of your "digital transformation journey," as it's often referred to, because there is no destination, no end to the journey — there is only a continuum that supports constant optimization. Digital engineering is a way of doing business that enables organizations to not just cope with technological and market-driven challenges, but also to thrive now and in the future in an ever-changing environment.

WHY DIGITAL ENGINEERING NOW?



/ Organization leaders face significant headwinds to innovation. While the concept of digital engineering is not new, a perfect storm of factors makes it imperative. In fact, some of the most promising business opportunities today are also challenges that a digital engineering strategy can address.

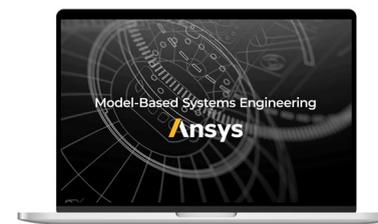
New technologies can increase engineering innovation or disrupt business. Nowhere is this more apparent than in AI, which itself is reliant on the huge pools of data being used for training and on the accelerated computing technologies needed to run algorithms and return results in a timely manner.

Those algorithms are one response to **increased engineering complexity**. System engineering continues to expand, requiring representations of hardware and software components to come together earlier in the design cycle.

As more organizations embrace digital engineering to shorten innovation cycles, the resulting **competition** can lead to missed market windows and a loss of business for the organizations that fall behind.

Compliance with government directives, such as the recently released DoDI 5000.97 in the U.S., Germany's Industrie 4.0 Framework, or the UK Ministry of Defence Equipment & Support digital engineering strategy, can be achieved only by modern digital engineering methods. DoDI 5000.97 mandates the use of digital engineering methodologies, technologies, and practices across the life cycle for defense acquisition programs. Other industries employ digital engineering to help comply with functional safety, cybersecurity, and sustainability guidance.

Another argument for implementing a digital engineering strategy now is that tomorrow's workforce will demand it. The young, digital-native engineers of the evolving workforce know no other way. Your new employees expect digital engineering now.

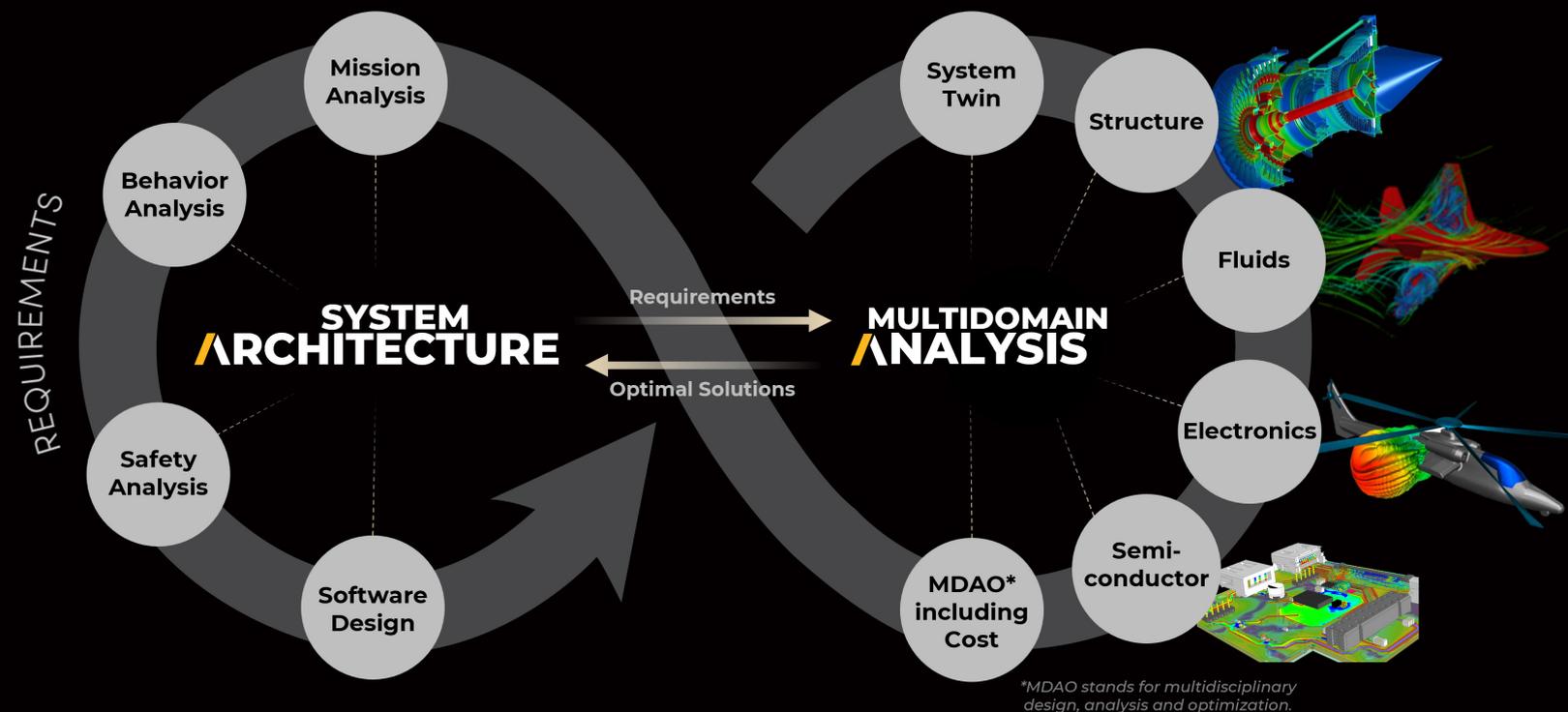


Many of these challenges can be met with a model-based systems engineering (MBSE) methodology that enables digital engineering.

/ Understand Model-based Systems Engineering

Model-based systems engineering (MBSE) is a methodology at the heart of digital engineering that uses digital systems and models instead of documents to design, manufacture, and maintain complex architectures. It involves creating and using digital systems and engineering domain models to facilitate the exchange of key information, feedback, and requirements.

MBSE offers a structured, systemic approach to solving intricate engineering problems, thereby streamlining the development process and increasing efficiency. MBSE involves three major components: **an overarching SAM, engineering simulation software, and a centralized computation center.**



Model-based systems engineering (MBSE) enables the collaboration, connectivity, and interoperability needed for digital engineering.

An Overarching SAM

In a system architecture model (SAM), the system being designed is represented by a series of connected block diagrams that describe the system's physical and functional architecture including system structure, expected behavior, and system requirements. SAMs also contain a comprehensive list of a system's required qualities and functions. Within MBSE, a SAM acts as the source of truth for the architecture of the system you're studying.

2 Engineering Simulation Software

You can use engineering simulation software to determine SAM requirements and to analyze various physics to verify that your design meets these requirements. This type of software is computationally intensive when taking a comprehensive multiphysics approach, which results in the need for the third element in MBSE.

3 An Authoritative Source of Truth (ASOT)

An ASOT is a definitive source of a given piece of revision-controlled information that all consumers of that information should reference to mitigate the risk of relying on outdated, inconsistent, or inaccurate information. To reference it, an ASOT must be stored in an accessible computation center, whether it's on-premise or on the cloud, to create a digital thread that combines all parts of MBSE.

THE BENEFITS OF **DIGITAL ENGINEERING**



/ Leading organizations already understand the benefits of using simulation early in the product development process and throughout the product life cycle. It enables them to make better-informed decisions by developing high-fidelity, virtualized models of products in their environments, which supports the development of complex systems. A digital engineering strategy brings those insights to key decision-makers across the organization.

Such benefits are possible because digital engineering extends beyond simulation, enabling transformation by integrating multiphysics simulation with workflows like MBSE, simulation and material process and data management (SPDM), embedded software, security and safety, and AI-based optimization. Creating bidirectional connections between your engineering analyses and system requirements constantly ensures functionality, cost, and performance are on track.

That's why an open ecosystem is key to a digital engineering strategy. Organizations already have established workflows. Connecting them enables engineers to use the tools they want to use — both now and years from now — by fitting technologies into gaps in a scalable, interoperable way. An open ecosystem that can quickly conform to the latest technological needs, market trends, and compliance mandates is the only answer to the flexibility required in today's and tomorrow's fast-changing business environment.

50%

Reduction in development time with automation of analysis

25%

Fewer design turns

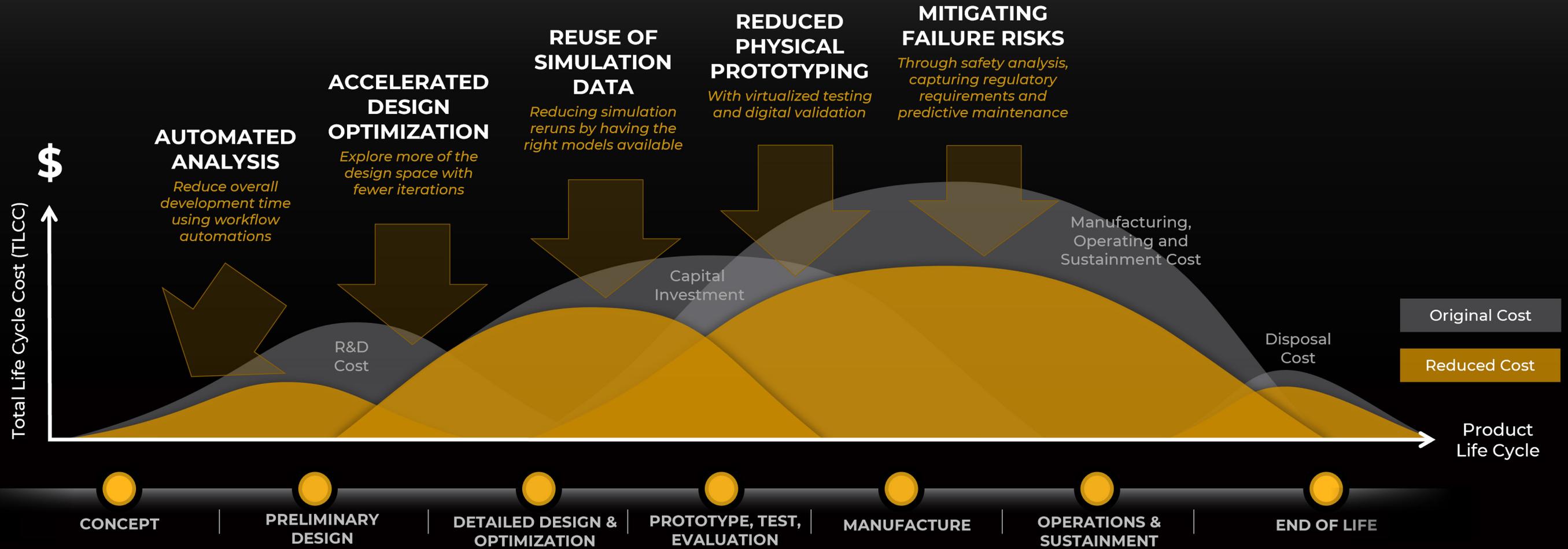
10%

Reduction in physical prototypes and upfront testing

30%

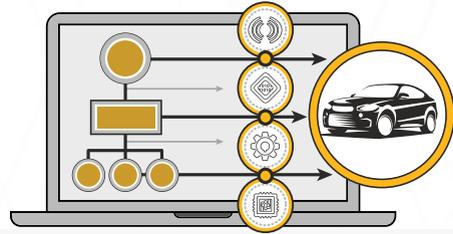
Increased use and reuse of simulation with data sharing and automation

As measured by an *Ansys Simulation Transformation Assessment* of a large automotive supplier.



Cost drivers for adopting digital engineering

HOW TO REAP THE BENEFITS OF DIGITAL ENGINEERING



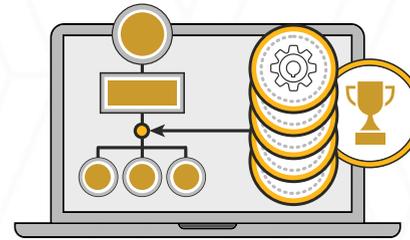
COMBINE COMPLEX SYSTEMS INTO LEADING PRODUCTS

Product complexity has already outpaced human beings' ability to keep up with the ramifications that one seemingly simple design change could have on the rest of the system or system of systems. Using technologies like MBSE connects requirements, system architecture, and engineering analysis with traceability across engineering domains. This connection accelerates program time to market while reducing total life cycle costs.



"We believe that the integration of Ansys simulation tools and MBSE gives us visibility into the entire design process, reducing development costs, improving engineering efficiency, driving innovation, and designing competitive products."

Takeo Hashimoto, general manager of the MBSE Design Center, Hitachi Industry & Control Solutions



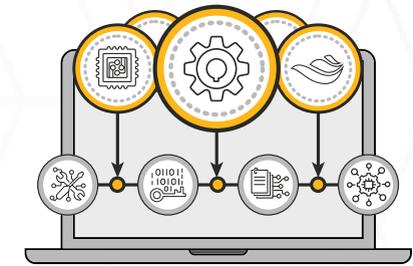
SOLVE SYSTEM COMPLEXITY WITH LEADING ANALYSIS

Experts from different engineering domains using specialized tools, data, and models need to be able to share and collaborate in ways only possible via digital engineering. By integrating multiphysics engineering analyses into the digital models that represent these systems, cross-team and cross-domain collaboration yield early insights to validate and optimize designs, reducing costs, rework, and the need for physical testing.



"Our vision is all about integrating simulation-driven design into our workflow so that it can accelerate our development process from design study to prototype, thus shortening our time to market and reducing our costs."

Yadhu Krishnan M K, global co-lead of Electromagnetic Simulation, Continental



EVOLVE AT THE PACE OF TECHNOLOGY WITH AN OPEN ECOSYSTEM

As new technology paradigms arrive and disrupt, there is a competitive imperative to evolve. Adopting open ecosystem technologies help fill the gaps in an engineering ecosystem to derisk this transformation. Bringing in technology accelerators from AI, cloud computing, and high-performance computing provide the speed, flexibility, and scalability needed.



"With Ansys SimAI™ AI cloud-enabled generative AI software, we will be able to easily test a design within minutes and rapidly analyze the results, ultimately redefining our digital engineering workflow and reshaping our perception of what is possible."

William Becamel, expert leader in numerical modeling and simulation, Renault Group

PRODUCT LIFE CYCLE

CONCEPT
DEVELOPMENT

PRELIMINARY
DESIGN

DETAIL DESIGN
& OPTIMIZATION

PROTOTYPE, TEST
& EVALUATION

MANUFACTURE

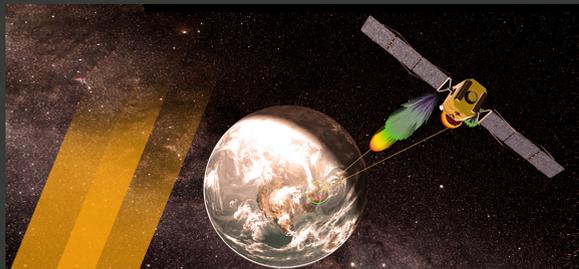
OPERATIONS &
MAINTENANCE

END OF LIFE

APPLICATION LIFE CYCLE MANAGEMENT (ALM), COMPUTER-AIDED DESIGN (CAD),
PRODUCT LIFE CYCLE MANAGEMENT (PLM), ENTERPRISE RESOURCE PLANNING (ERP)

ENGINEERING SIMULATION ANALYSIS AND DESIGN

Ways to Get Started with Ansys



/ Digital Mission Engineering

- Mission analysis and evaluation
- Build design reference missions
- Model operational environment with physics-based simulation



/ Model-based Systems Engineering

- Analysis-driven trade studies
- Connect analysis to requirements
- Add embedded software, safety & security



/ Simulation Digital Thread

- Add material intelligence
- Simulation data management
- Create workflows

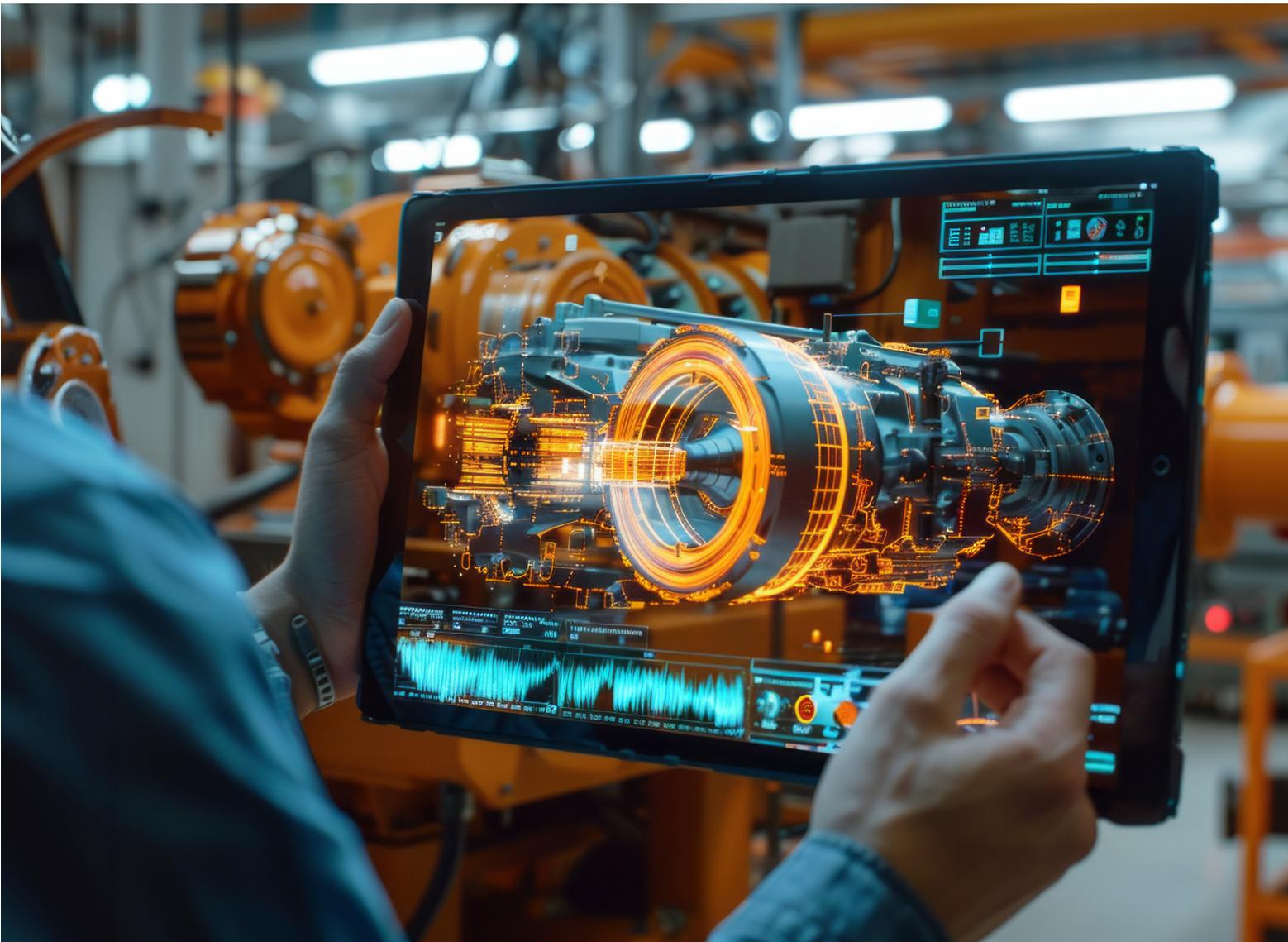


/ Applications & Democratization

- Automate workflows
- Build simulation apps
- Access for developers

The illustration above shows where Ansys engineering simulation software and connecting technologies can be used to advance digital engineering across the various phases of the product life cycle.

SOLUTION SHOWCASE

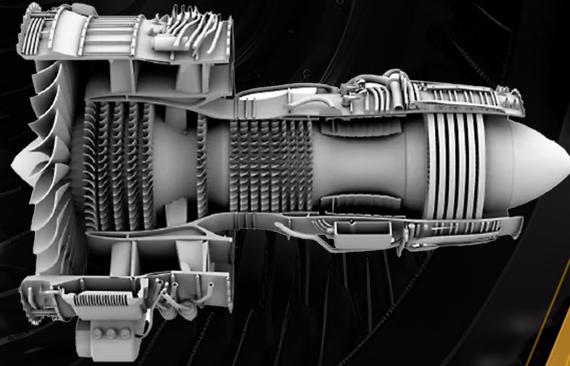


Learn how customers across various industries save time and money while improving quality in these **digital engineering solution showcases.**

In these showcases, specialists from across Ansys demonstrate how organizations can create cross-domain workflows using a variety of Ansys physics-based simulation and digital engineering enabling technologies alongside third-party tools in an open ecosystem.

These case studies illustrate how a connected digital engineering strategy can significantly impact business.

/ COMMERCIAL AEROSPACE



APPLICATION

Gas turbine development



CHALLENGE

Gas turbines require engineering across disciplines, including aerodynamics, combustion, acoustics, structural durability, compression, and more.



SOLUTION

Simulation accelerates designs that can be validated through testing and connects disciplines with digital engineering.



BENEFIT

An end-to-end solution helps manufacturers increase safety, performance, and efficiency while reducing emissions, noise, weight, and maintenance costs.

[WATCH THE WEBINAR >](#)

/ ADVANCED AIR MOBILITY



APPLICATION

Electric vertical take-off design and operation



CHALLENGE

Helping to ensure flight safety by building up a simulation-based verification environment for the autonomous software stack.



SOLUTION

Develop the right system configuration for an eVTOL in the context of its mission by using integrated high-fidelity simulation.

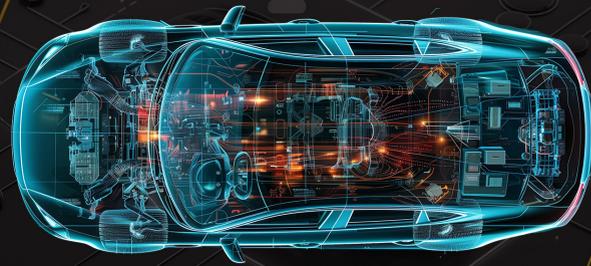


BENEFIT

Use virtual verification with simulation to accelerate time to market for complex system design.

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/ AUTOMOTIVE



APPLICATION

Software-defined vehicles



CHALLENGE

Engineers are increasingly developing new hardware architectures and electronics, as well as new software features.



SOLUTION

An integrated suite of tools to enable MBSE can solve challenges ranging from electronics design and chip to system to software development using real-time plant models and virtual validation of customer features.

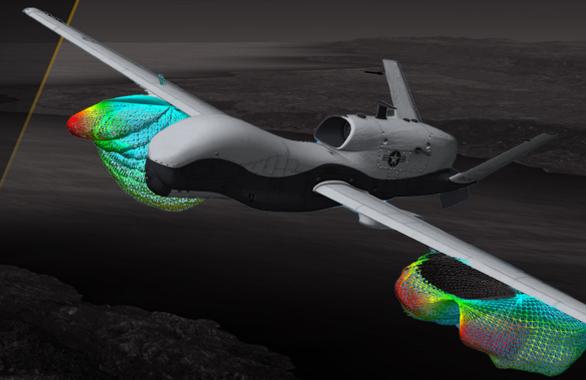


BENEFIT

Early validation, modular design, and scalable architectures can accelerate innovation, reduce costs, ensure futureproofing, enhance safety, and improve customer satisfaction, keeping businesses competitive with adaptable, high-quality, and trusted vehicles.

[WATCH THE WEBINAR >](#)

/ DEFENSE



APPLICATION

Unmanned aerial vehicle (UAV) system design optimization



CHALLENGE

The need to balance antenna options with mission requirements is critical in defense applications.



SOLUTION

A workflow connecting to the SysML system definition helps enable parametric variation of antenna design validated by mission performance metrics and compared against requirements.



BENEFIT

This solution accelerates the consideration of alternative designs and connects directly to the system model within SysML.

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/ SPACE



APPLICATION

Developing a workflow for a satellite sensor system to adjust a lens to reduce deformation impact



CHALLENGE

To assess how structural and thermal loads affect the optical performance of a system, a structural-thermal-optical performance (STOP) analysis must be conducted.



SOLUTION

The STOP analysis helped with the import of the structural-thermal results through an integrated workflow.



BENEFIT

Time to market is accelerated for these optical systems, which are optimized for improved performance and reliability.

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/ HIGH TECH



APPLICATION

High-speed interconnect solutions



CHALLENGE

Engineers need quick turnaround times in high-performance interconnect solutions that support industries such as datacom, industrial, military and aerospace, medical, computer and semiconductor, instrumentation, and automotive.



SOLUTION

A holistic simulation, analysis, and modeling environment that correlates to physical reality helps with development within a short time span.



BENEFIT

The ability to iterate in real time with simulation accelerates the design process.

/ INDUSTRIAL EQUIPMENT



APPLICATION

Optimize manufacturing with digital twins



CHALLENGE

Improving internal operations and maintenance (O&M) while producing cleaner products requires incorporating new technologies that enable virtual monitoring, testing, and prototyping.



SOLUTION

Hybrid digital twins blend data and physics to enable real-time monitoring, predictive maintenance, and performance optimization across operating scenarios and product variations.



BENEFIT

An **Ansys paper published in IEEE Software** found that data-driven models provide roughly 80% accuracy while simulation-based models deliver about 90% accuracy. The journal reported that combining these methods produces about 98% accuracy.

/ HEALTHCARE



APPLICATION

Virtual heart model



CHALLENGE

Predictive modeling of cardiac mechanics would help doctors reproduce a heart's functionality for more accurate diagnoses.



SOLUTION

A reference framework can combine the power of photorealistic visualization, AI, and advanced physically accurate simulation.

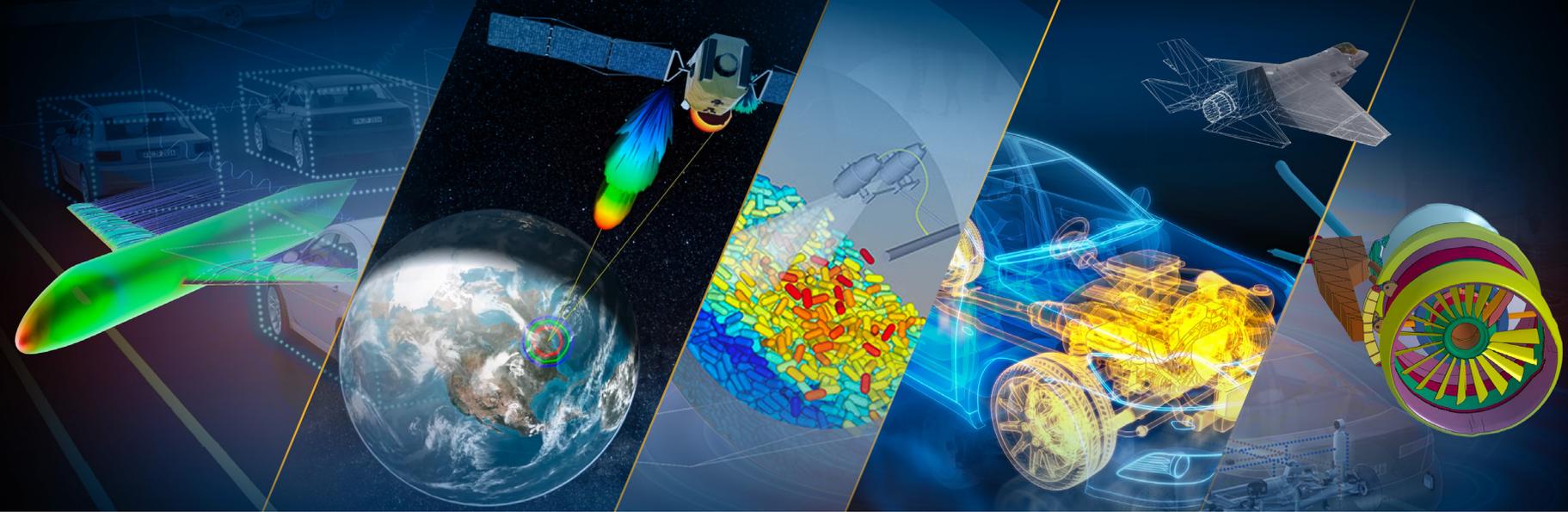


BENEFIT

The workflow empowers clinicians, researchers, and medical device manufacturers to visualize the physiology and functions of the heart in ways that are difficult to obtain in a clinical setting, equipping them with deeper insights to make more informed decisions.

[WATCH THE WEBINAR](#) ▶

NEXT STEPS



/ WHAT TO LOOK FOR

<p>Best-in-class engineering simulation</p>	<p>No lock-in</p>	<p>Future-proof scalability</p>	<p>Collaboration</p>	<p>Business insights from engineering</p>
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/ WHY

<p><i>Engineering leaders are using digital tools, models, and data to spot design flaws earlier, explore the design space fully, and keep costs down. Accurate data equates to accurate simulation-driven engineering.</i></p>	<p><i>Integrating digital tools, methods, and processes in an open ecosystem throughout the design cycle gives engineering teams the contextual insight to turn disparate systems into a leading integrated solution.</i></p>	<p><i>Product and system complexity continues to explode, even as time-to-market cycles shorten. By connecting engineering data across engineering domains using automated, integrated workflows, systems can be studied together in an efficient, cost-effective, and consistent way.</i></p>	<p><i>Digital engineering enables teams to use an authoritative source of truth with clear traceability, which supports safety and cybersecurity initiatives across the organization.</i></p>	<p><i>Competitive advantage can be driven by using engineering insights to make decisions earlier in the design cycle, collaborating across domains in real time to iterate on virtual designs to validate a mission, system, or component while it's still feasible to modify.</i></p>
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KEY TAKEAWAYS



Visit [ansys.com/technology-trends/digital-engineering](https://www.ansys.com/technology-trends/digital-engineering) to explore digital engineering enablement solutions that will get strategic leaders, decision makers, and engineers on the same page.

/ Digital Engineering for Executives

- Download the white paper “*Digital Engineering Best Practices*” to learn about the Ansys Assessment program.
- Watch a digital engineering customer success story video to understand how companies are taking advantage of digital engineering.

/ Digital Engineering for Managers

- Join a digital engineering webinar geared to managers
- Get an understanding of digital engineering solutions

/ Digital Engineering for Engineers

- Join a digital engineering webinar geared toward engineers in specific industries
- Download the white paper: “*A Perspective on the Adoption of Digital Engineering within an Enterprise*”

Powering Innovation That Drives Human Advancement

When visionary companies need to know how their world-changing ideas will perform, they close the gap between design and reality with Ansys simulation. For more than 50 years, Ansys software has enabled innovators across industries to push boundaries by using the predictive power of simulation. From sustainable transportation to advanced semiconductors, from satellite systems to life-saving medical devices, the next great leaps in human advancement will be powered by Ansys.

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