



How virtual prototyping propels aerospace innovation to new heights

Discover how virtual prototyping is helping aviation businesses lower development costs, accelerate time-to-market, and ramp up digital transformation.



get it right.

Executive Introduction

The last decade has seen the aerospace industry focus on a strong increase in production rate and facilitating quick ramp up to keep pace with the huge demand. And then came 2020. The pandemic allowed time to reengage with a new mindset, natively digital, enabling aerospace innovators to restart stronger and to prepare necessary structural manufacturing operations developing and adopting cleaner technologies without any compromise on efficiency and robustness.

Now, several years on, companies can launch programs faster than ever before. They can reach greater levels of industrial efficiency and have overwhelmingly emerged from the crisis with greener, leaner processes – with less scrap, more throughput, and more profitability.

ESI is proud to play a part in this transformation. We partner with industry leaders across the globe, working with them to leverage innovative technologies to achieve bold carbon-free goals. We work with aircraft manufacturers to pivot away from single-point numerical simulation to 100% virtual prototyping.

We provide the technology for aerospace players to design, engineer, manufacture, assemble and test a new vehicle concept fully virtually. In turn, companies reduce scrap and emissions while introducing more agile and safe operations with a strong focus on the well-being of humans.

In this white paper, we explore how virtual prototyping is helping aviation manufacturers meet operational challenges, such as overcoming barriers to innovation adoption, meeting sustainability KPIs without compromising on additional business priorities, and ramping up digital transformation, safely and sustainably.



get it right.

A renewed focus: Sustainable, digital, and innovative practices take flight

Across the board, aerospace leaders are ramping up sustainable flight and air mobility breakthroughs with reduced emissions, new energy sources, and emerging paradigms for urban air mobility drive. Digital transformation is powering these efforts, with industry 5.0 and PLM applications speeding up innovation, lowering development costs, and reducing time to market.

Aerospace industry players are held to a result, or an “outcome”, that they offer to operators and passengers. The service that their aircraft or part offers, such as mobility, hours of maintenance-free flight, or the number of landing events, makes them accountable for environmental and societal impact and for the “in service” experience.

As such, they need to anticipate the way their industrial product or asset operates in numerous and uncertain use-conditions. So, the standards of success shift to performance in use, rather than standard product development efficacy.

At ESI, our mission is to enable key players in the aerospace sector to commit to these outcomes.

Investing in new technologies may at first appear to simply be an extra financial stretch. Yet, it is mission-critical for business recovery – and it will be key for operating in today’s modern landscape.

Stand-alone CAD and CAE designs using empirical and historical safety margins and traditional test-and-learn protocols relying on physical testing will be abandoned. And in their place: an end-to-end digital thread that seamlessly connects product design, manufacturing, and in-service operations.

This is where **virtual prototyping** comes in, enabling aviation businesses to:

- Empower engineers to digitally validate a design’s performance
- Bring confidence about manufacturability with the most efficient manufacturing process in early development stages
- Experiment virtually with real data and real physics, simultaneously
- Design, manufacture, and assemble right the first time – without real tests or prototypes

Because **sustainability, productivity, and safety matter** for future aviation business models.



get it right.



Remove barriers to innovation: Guarantee optimal Acoustic Performance, 100% virtually

Noise is a key discipline where innovative OEMs are focusing their efforts to improve operating performance, sustainability, and societal impact and acceptance. So, whether a manufacturer is working on the development of a new passenger jet, helicopter, eVTOL, or any other type of aircraft, there is often a balance between reaching their goals and dealing with constraints for environmental noise and acoustic comfort.

Space engineers face similar acoustic challenges – and they only have one shot to get it right. The environmental loads experienced during launch, flight and deployment can easily damage the space structures. With the introduction of new, lightweight materials such as composites and honeycomb panels, the risk is even higher. So, rigorous assessment is essential to gain confidence in the structural integrity of space hardware and reach acoustic qualification.

“The VA One Shock Analysis tool enabled Boeing and NASA to assess potential damage to Space Station electronic boxes that might occur from inadvertent impacts during on-orbit assembly. The VA One Shock Module ensured that the current assembly operations would not affect critical Space Station hardware and eliminated the need to implement expensive operational and hardware changes.”

Ed O’Keefe, Associate Technical Fellow in Noise and Vibration, Boeing

Using virtual simulation technology enables space engineers to compare alternative noise control strategies, efficiently control their testing budget, and accelerate product qualification.

ESI’s virtual testing for acoustic performance

Get new designs right first time and achieve development flexibility whilst minimizing physical prototype testing

Test and certify vibro-acoustic performance of new designs fully virtually with your own emission-friendly test system and minimize processes, tooling, and scrap material cost.

Achieve superior sound quality

Test new aircraft lightweight designs fully virtually with your own virtual acoustic chamber to get noise certification right the first time.

Get Acoustic Qualification right first time

Virtually qualify space structural dynamics safely, fast and at low-cost, minimizing the need for expensive remote test facilities.

get it right.

Create stable, robust manufacturing processes and achieve the highest material performance

Aerospace engineers face many manufacturing challenges. Notably, producing defect-free parts and testing expensive hardware – not just financially by affecting cost and profitability, but the waste of material and emissions also costs the environment and is no longer an acceptable practice in terms of sustainability.

As such, manufacturers are turning towards digitalization, with solutions bringing immediate and long-term benefits to manufacturing industries. Innovative simulation technology is helping to accelerate the safe, sustainable development of first-of-their-kind products. Enterprises are leaning toward digital transformation and virtual prototyping to speed up the delivery of innovative aircrafts, keep costs down, and avoid the late discovery of inefficiencies.

For example, Rolls-Royce engineers are shifting away from physical try-out toward a digital workflow based on ESI's casting simulation software. Relying on a co-design workflow enables engineers to be more proactive, and to support the work of Rolls-Royce's design, stress, and manufacturing experts.

“With a simulation run of around ten minutes, our newly implemented co-design workflow gives us the ability to locate 97% of potential casting issues associated with designs. It is accessible to most engineers, not only FEA simulation specialists. It would be difficult to justify why you wouldn't run a co-design simulation, especially for large and/or expensive cast parts.”

Nick Calcutt, Materials and Process Modelling Engineer, Rolls-Royce

They can integrate the output of the co-design workflow in their Design for Manufacturing sessions (DfMs), which empowers them to identify most manufacturability issues, before the part design is sent to the supplier. The team can immediately look for potential solutions, and even evaluate the cost of rework, all very early in the [manufacturing process development](#).

Composites simulation software replaces design complexity with consistency to optimize the performance of the final product, so that the organization is free to pursue innovation without the risk of disruption, in a

financially sustainable way. In turn, the organization can digitally experience and validate the fabrication, assembly, and behaviour of their new product in different environments, early and throughout the entire product lifecycle – in a zero-emission, zero scrap fashion.

“Mitigating all these risks, not only have we been able to deliver a successfully manufactured demonstrator on time, first time, cost and time savings were made through the use of the manufacturing process simulation. This 7-meter cover is not a standalone instance of our collaboration with ESI, we have been working with them over a number of years across multiple projects.”

Conrad Jones, Senior Composite Development Engineer, Spirit AeroSystems

ESI's virtual manufacturing of high precision parts

Speed up time to market and unlock greater levels of industrial efficiency

Create stable, robust manufacturing processes to secure production ramp-up, minimize scrap cost, save natural resources, and ensure on-time delivery.

Achieve the highest material performance

Simulation-based testing allows you to gain a deeper understanding of material physics with unlimited analyses and experiences.

get it right.



Create an industrial metaverse to power virtual collaboration and accelerate engineering workflows

Aerospace leaders are expanding digital capabilities faster than ever before. OEMs like the [Boeing Company](#), suppliers like [Latecoere](#), [Safran Group](#) and [Rolls Royce](#), and their extended enterprises rely on virtual simulation software to power collaborative virtual workflows. In doing so, teams can experience physical interactions with yet-to-be-realized aircraft designs by using VR or XR experiences to virtually build and virtually disassemble product designs in fully immersive and physically realistic virtual workspace.

ESI's industrial metaverse

Harness the digital thread

Venture into digital transformation with industry 5.0 and PLM applications to speed up innovation and lower development costs and time to market.

Push engineering workflows months ahead of production

Immersively explore new vehicle concepts from a worker and operator perspective and gain a hands-on experience of the processes required to make and maintain them.

Power collaborative virtual workflows

Create your own industrial metaverse to experience physical interactions with yet-to-be-realized vehicle designs without waiting for construction or required travelling to a common site.

This enhanced collaboration is made possible by the ramping up of digitalization, and the integration of virtual reality into key product development workflows.

“We get return on investment by achieving first-time-right product and process designs – in technical terms, but also for factory layouts and safety aspects. All in all, we estimate a 15% saving in our total tooling budget.”

Nicolas Lepape, Virtual and Augmented Reality R&T Project Manager, [Safran Nacelles](#)

get it right.

Embark on the Virtual Prototyping journey for a sustainable aviation future

Operating 100% virtually in an end-to-end fashion, with one single source of truth, is truly sustainable. In this way, digitalization holds the key to realizing critical carbon-free goals with the speed and confidence to be credible in the eyes of consumers.

Virtual prototyping is all about combining engineering expertise and advanced virtual capabilities to start exploring equipment performance fully virtually – with minimum physical prototypes and tests.

The successes of [Joby Aviation](#), [Rolls Royce](#), [Safran Nacelles](#), and many more in the aeronautics field of play demonstrate the value that virtual prototyping brings when collaborating in an end-to-end fashion and making intelligent decisions with simple, precise visualizations to share between different teams.

What drives us and keeps us flying this path with you is the common purpose we share: enabling safe, clean, and productive aviation processes and systems.

A predictive, real-time, immersive physics-powered simulation solution, combined with our extensive talent and intellectual property, help our clients save valuable time, resources, and money by avoiding costly and limited physical testing.

This is the only way to solve complex simulation problems at scale and protect what matters most – our people and our planet.

Engage with us.

Let's talk about how we can help you get it right the first time.

“

“At ESI Group, we are committed to a future where aerospace companies are empowered to design, test and validate their products and processes virtually, enabling them to reach greater levels of industrial efficiency, and bring cleaner, safer products to market faster at a lower cost”

Slaheddine Frikha, Industry Director – Aerospace and Defense, [ESI Group](#)

www.esi-group.com



get it right.