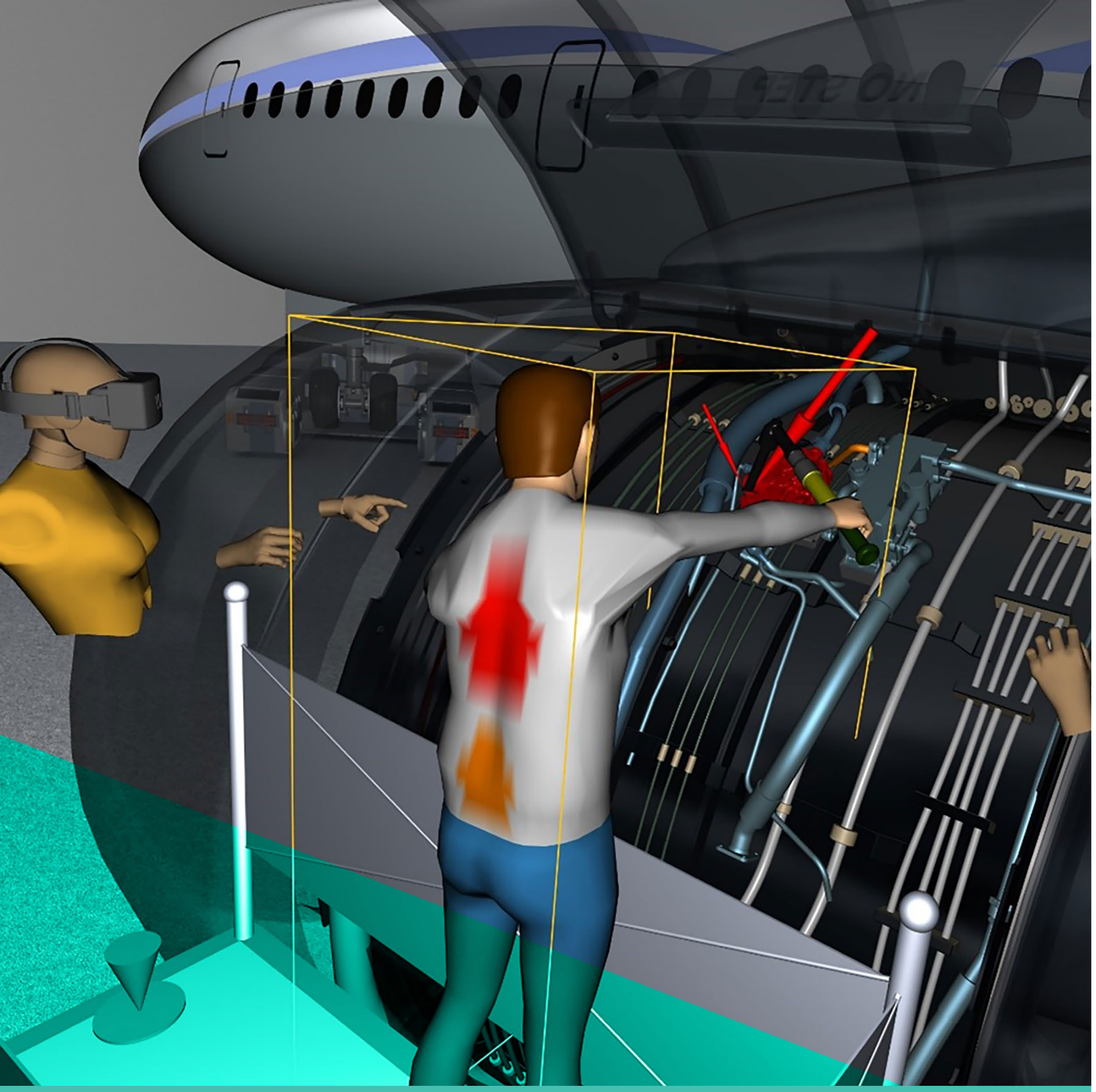
Experience Your Future Aerospace Products Today to Validate Human Centric Processes.



> **Using virtual mannequins, Rolls-Royce can run Virtual Maintenance Process reviews without risk, gaining valuable insights at the right time, helping reduce industrial waste and downstream process inefficiencies.**
>
> **Article in Aerospace & Defense Technology, October 2022 Issue, Rolls-Royce Defense**

Executive Overview

Aerospace enterprises are racing to launch their latest sustainable flight & air mobility innovations. Reduced emissions, new energy sources, and emerging paradigms for urban air mobility drive new engineering decisions that could introduce risks for the people who operate, build, and maintain those products.

New concepts in airframe and propulsion engineering challenge previous assumptions in aircraft design and may require brand-new architectures. What worked for the first century of powered human flight might not be appropriate for the future of air transportation. To accelerate the development of firstof- their-kind products, enterprises are leaning toward digital transformation and virtual prototyping. Unfortunately, human interactions with products in key processes, like assembly or maintenance, are often left until later in the development process when physical mock-ups and operable prototypes are available.

To accelerate the delivery of innovative aircraft, keep costs down, and avoid the late discovery of inefficiencies, aeronautic OEMs understand they must leverage digital solutions. OEMs like the **Boeing Company,** suppliers like **Latecoère, Safran Group** and **Rolls Royce**, and their extended enterprises rely on Virtual Reality software to power collaborative virtual workflows, so that teams can **experience physical interactions with yet-to-be-realized aircraft designs without waiting for construction or requiring traveling to a common site.**

How does Virtual Reality software allow the connected enterprise to immersively visualize their future products and components, analyze product integration, and synthesize human-centric processes for high-fidelity Virtual Mock-ups, that they can rely on to advance their product development timelines?

Let's take a look at some concrete examples from leading aero companies who have been relying on ESI's Virtual Reality software IC.IDO: What are the key enabling functionalities that you need in order to facilitate a seamless mix of virtual objects with your own body and surroundings to push your engineering workflows by months ahead of production?

Orchestrating Work Across the Supply Chain using Collaborative Workflows

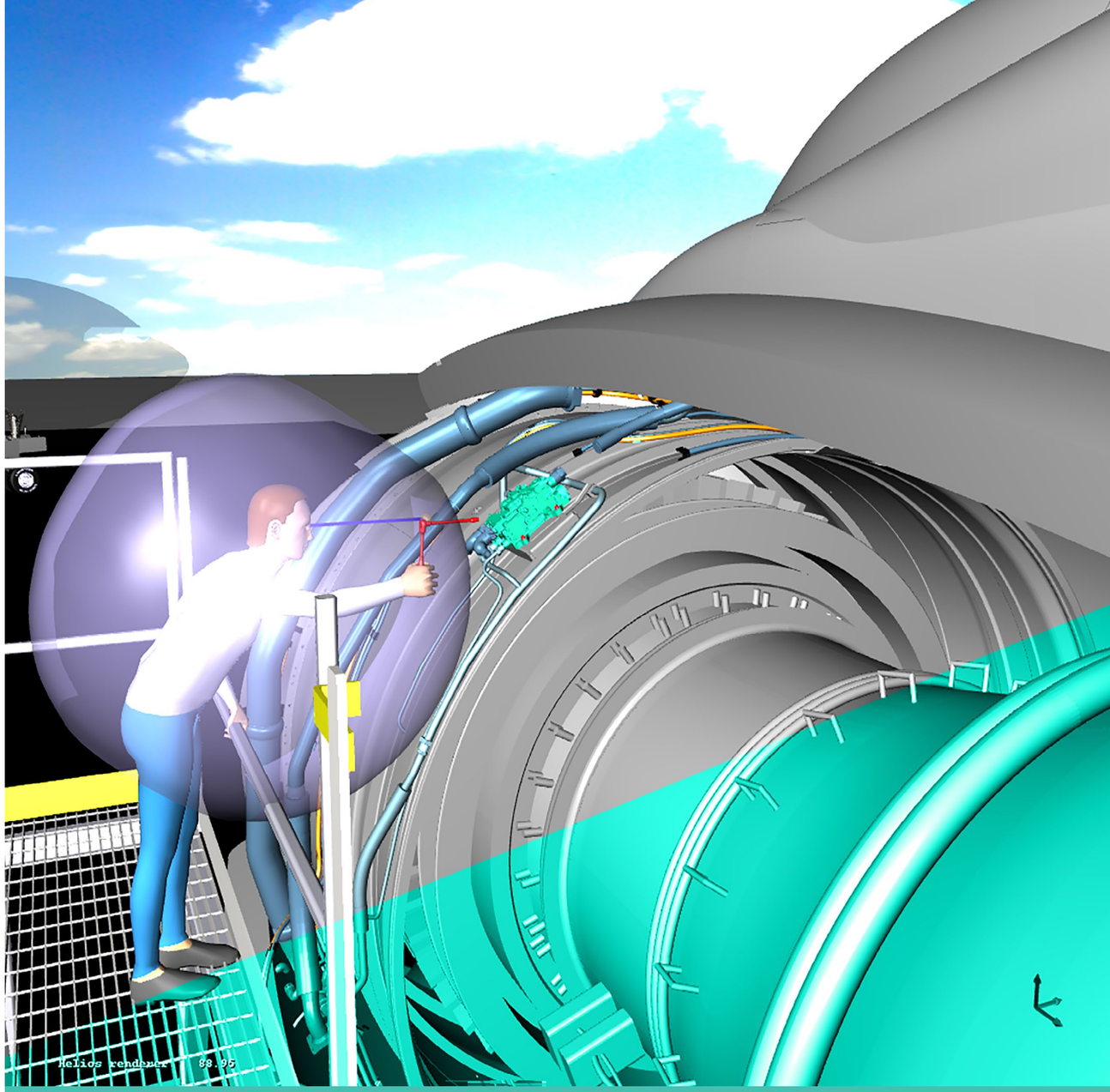
At various milestones throughout product development, **cross-functional workgroups,** or integrated product teams (IPT), converge at a common location to **review product designs, check on engineering progress, and validate decisions** made governing the proposed product; does airframe design, componentry or systems engineering adversely affect decisions of other areas within a design? Conventionally when commissioning new aircraft, designing new power systems, or integrating new componentry, this meant building a fullscale practical prototype, or one-off builds of an aircraft concept used to convince regulators & potential buyers that the aircraft is safe, clean, and sustainable—that it can be built, operated, and maintained—all relying on the availability of a physical prototype or mock-up

However, using real people and a real airplane, helicopter, tilt-rotor, or dirigible to prove to prospective buyers that the future aircraft is safe to build, operate, and maintain is an exercise in work-at-risk that consumes valuable resources, sometimes with minimal odds of recuperation of the funds. Millions of dollars are invested in constructing that one-off device, and thousands of hours of effort contributed to assembling, disassembling, maintaining, and eventually flying those precertification airframes and components. In today's competitive and complex global business environment, the risk of injury, loss, or damage to prototype assets looms over the heads of aviation enterprises.

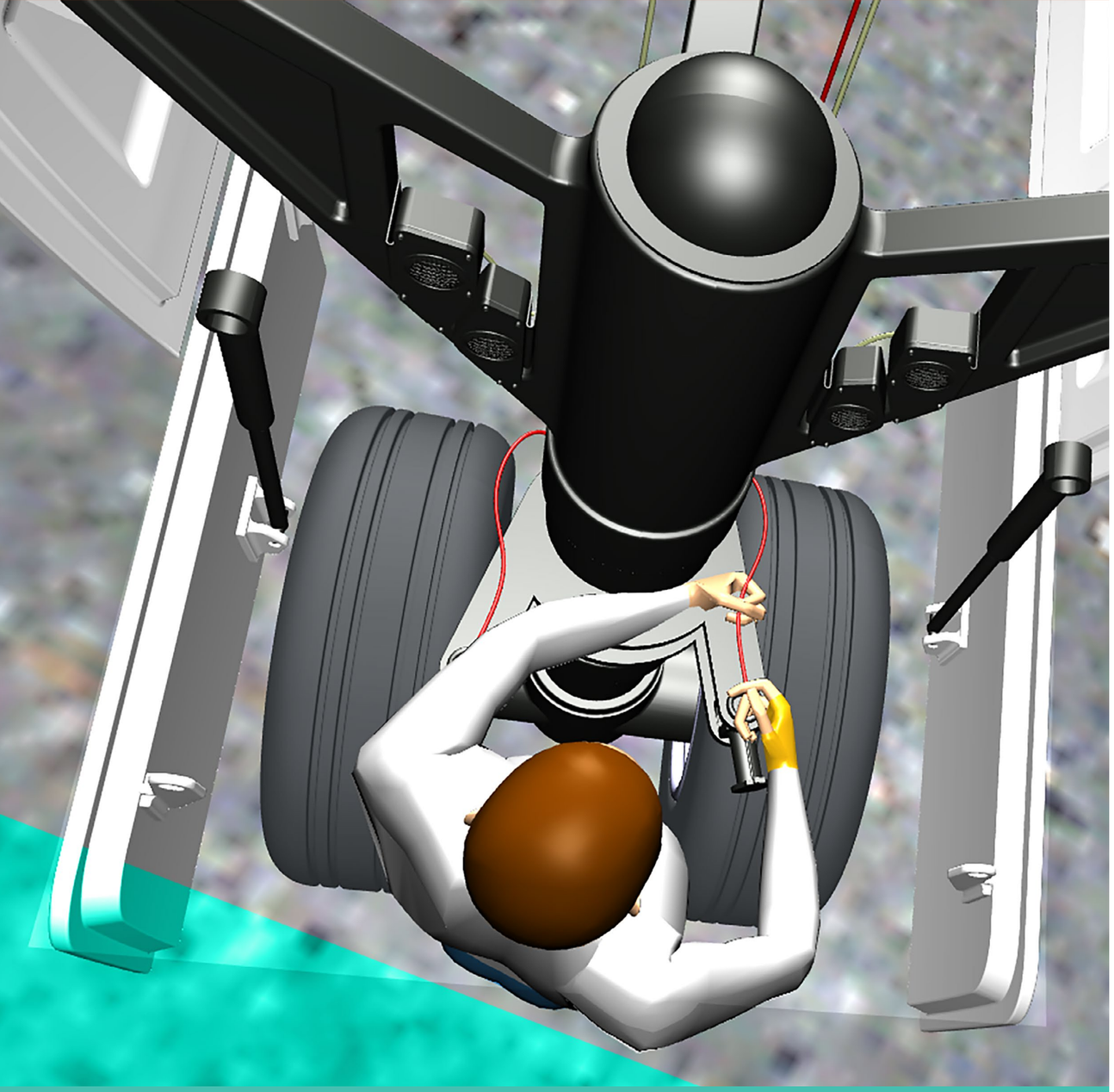
With the shifting economies of remote or local manufacturing and engineering and the ongoing digital transformation of the enterprises competing in that field, accessibility or even the existence of physical prototypes of mock-ups is challenged. If an OEM wants to review a proposed design with third parties (customer, supplier or MRO organization), engineers can rely on deterministic simulations of characteristics such as aerodynamics, airframe stress and durability, or materials selection for manufacturability and structural performance. But when it comes to whether people will be able to build, then operate, ride in/on, and service that aircraft, those decisions are too often delayed until a physical example is constructed, which is late in the product development process. Besides, constructing a mock-up can be as risky as building an actual airplane or helicopter.

Getting together, virtually

Collaboration in Virtual Reality challenges the constraints of space and time to enable integrated product teams to experience, together or independently, their proposed products in the context of human-performed product interactions and human-centric processes, such as aircraft build and maintenance. Without having to wait for the availability of constructed mock-ups, fabrication of pre-production prototypes, or travel of stakeholders, VR users can collaborate amongst themselves. Teams can virtually transport themselves to a common virtual environment with their digital products, whether they are remotely distributed, colocated, or in a hybrid working environment. This way, they can join each other in a virtual workspace with their digital product concepts and participate interactively in process validations, such as assembly or service operations piloting.



> **IC.IDO is profoundly changing the way Safran Nacelles engineers work: Virtual Reality reduces the need for physical prototypes and costly retooling, while promoting live team discussion to depoly optimum designs much faster than when working in silos.**
>
> **Philippe James, Vice President of Continuous Improvement and Risks, Safran Nacelles**



> **Perhaps one of the most unique capabilities in IC.IDO is its incorporation of a near real time physics engine. While IC.IDO and its competitors handle the definition of moving rigid components and assemblies with live clash detection, what makes this unique is how it handles flexible components.**
>
> **Develop 3D Magazine**

A Real-Scale, Real-Time Immersive Experience Integrating Realistic Physics

Computer-aided engineering (CAE) tools, digital mock-up (DMU) documentation solutions, and predictive analytics do little to anticipate how individuals will perform when faced with new human-centric manufacturing tasks, service procedures, or operations.

Until people can experience what it feels like to build & maintain a yet-to-be-produced vehicle we cannot truly know if a product design is truly “feasible”, let alone cost-effective, safe, or realistic to achieve. Virtual Reality powered process and product reviews as achieved with ESI IC.IDO provides immersed participants the experience of being present with a new product, performing human-centric procedures like installing sub-assemblies during manufacturing build, or replacing components to maintain during service, or conducting human-machine interactions in operation.

With real-time physics, IC.IDO offers true-to-life experiences in virtuality.

- Does a component fit in the assembly without colliding with adjacent components or assembly cells?
- Can operators manipulate tooling without damaging the product or injuring themselves?
- Is a proposed cable harness long enough to be installed but not too long that it abrades during operation?
- Will service technicians be able to work around hydraulics or pneumatics hoses without additional removal and replacement?
- Is the existing tooling useful for working with the new aircraft concept, or will new assist devices be required, and will they fit well the existing infrastructure?

These questions risk remaining unanswered until construction of the new vehicle begins in earnest when it is too late to cost-effectively mitigate or resolve any conflicts. During an IC.IDO review, digital design data easily inform these questions virtually, with minimal effort or non-value-added data manipulation or coding.

Through physically realistic human experiences with first- or few-of-a-kind products, product development accelerates by illuminating risk if a product feels impractical to build, unsafe to operate, or impossible to maintain for the people who will do so. Industry need not rely on the methods or assumptions of the past, instead Integrated Product Teams (IPT) gain experience with their products in the context of their planned process to inform engineering decisions, weeks, months, and potentially years in advance.

- ✓ **Avoid finding errors late**
- ✓ **Anticipate inefficiencies**
- ✓ **Gain experience virtually, before operations start**

CASE STUDY

Immersively Validating Human-Centric Engineering Processes to Radically Accelerate Development

Validate Product Integration

How do you know your product is properly designed for assembly, maintenance/servicing, and operations? Using ESI's Virtual Reality software enables OEMs like Safran Nacelles to speed up product development. Teams in charge of Product Engineering use it to validate their product integration strategies early on so they can define their designs agilely, fully digitally, with minimum impact on cost and delays.

To achieve this, look out for a Virtual Reality software that supports the digital evaluation of packaging, clearances and space claim, mechanism design, and interaction, whether for the product in operation or to anticipate issues and bottlenecks for assembly, maintenance, and servicing operations. Thanks to realistic physics, engineers simulate the behavior of wiring, cabling, and hoses, in real-scale and in real-time, empowering teams to discover issues that can arise from tangling, binding, or pinching of hoses and wires, to avoid interference, collision, or abrasion in operation.

Validate Assembly Processes

How can you evaluate different assembly scenarios early enough to accelerate the start of production?

Plan your assembly operations early and safely, without requiring any physical mock-up. Digital human models (or manikins) representing the anthropometry of your choice will let you evaluate ergonomics, operator visibility, reachability, and accessibility to ensure safe and efficient assembly processes, well ahead of production.

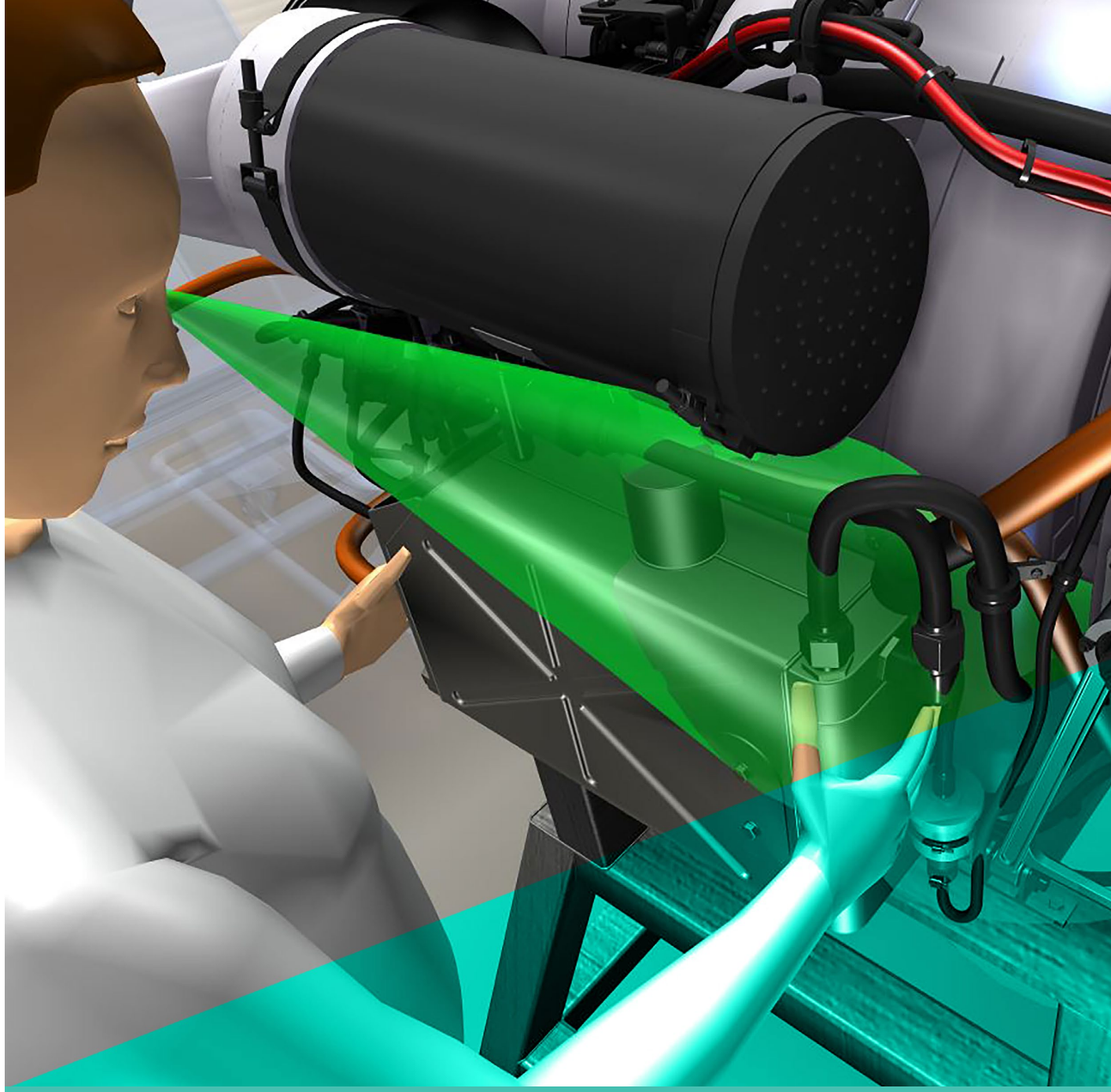
Effective Virtual Reality software offers realistic physics immersed in a virtual world enabling leading aerospace and defense OEMs and their suppliers to validate tooling early and with confidence. They anticipate assembly cell layout and optimization and make sure they reach their deadlines for the start of production and ramp-up phases.

Validate Maintenance Processes

How can manufacturing engineers realistically evaluate their maintenance processes before products are manufactured? When will they find out if an operation is difficult or dangerous to perform as designed?

Leading aerospace and defense OEMs use Virtual Reality software to evaluate and validate maintenance processes well ahead of production when problems are less costly to correct. The immersive, real-time, real-scale experience gained using IC.IDO helps manufacturers integrate human interactions as early as possible to achieve maximum process efficiency.

For Maintenance, Repair and Overhaul (MRO) companies or OEMs providing on-site repair, Virtual Reality helps prepare maintenance interventions taking account of local constraints, helping them define safe and efficient ad-hoc processes.



> **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, ESI Group**

Bringing Your Digital Thread to Life

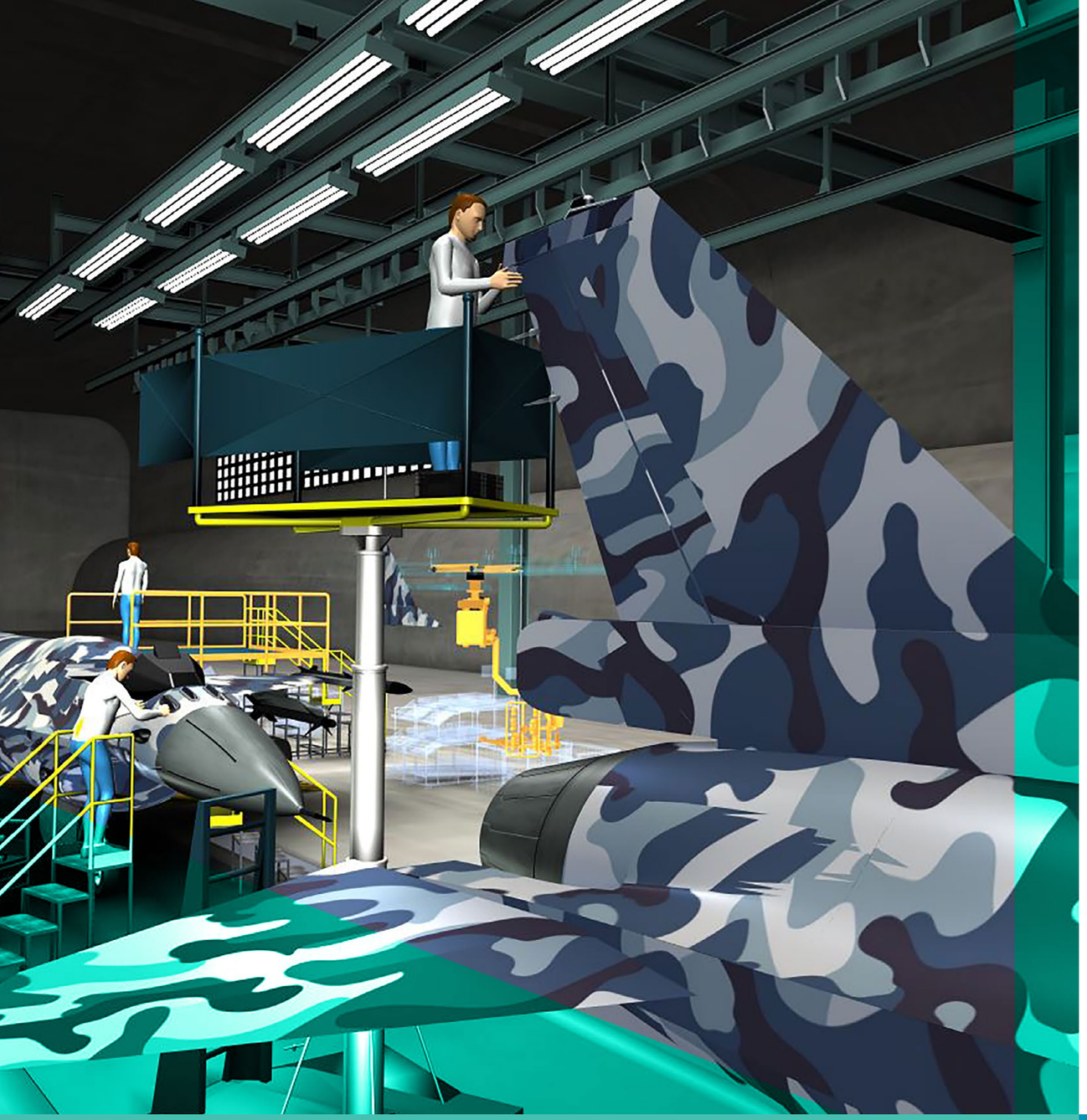
Whether it's for cost, quality, lead time, or flexibility reasons, the integration stakeholders in the aviation industry are getting more complex by the day. More suppliers, more stakeholders, more risk of miscommunications, misalignment, and inefficiencies impacting the product throughout its entire lifecycle, from design to real-world operations.

To face this challenge, and to gain efficiency, automotive companies are striving to build their very own Digital Thread, allowing them to follow a product through its various digital incarnations of data, from stakeholder to stakeholder, downstream throughout its lifecycle – and back upstream to deliver important feedback to engineering.

The primary goal of a digital thread is to help in making key engineering decisions at the right time. It's also to increase the visibility to be able to streamline transformations from product design to manufacturing planning, empowering companies to deliver unified change management, working simultaneously and concurrently across product and manufacturing engineering.

At ESI, we work with a rich ecosystem of partners: software vendors like PTC, hardware vendors like NVIDIA, HTC VIVE, and Varjo, not to mention academics and R&D leaders to make the Digital Thread a reality. As an example, IC.IDO can be fully integrated to PTC Windchill workflows for virtual assembly process validation in assembly lines so that manufacturing process planners can test assumptions months before the start of production. This way, design engineering and R&D can gain virtual experience on the shop floor and improve best practices over time.

Our Virtual Reality software brings together all stakeholders to collaborate efficiently on one virtual prototype throughout the full product lifecycle.



> After two weeks, we tend to remember 10% of what we read, but 90% of what we do. This is why IC.IDO is key to our product development strategy.
>
> **Thierry Eftymadès, Latécoère**

Enable the Developement of Innovative Aerospace Products with a Human-Centric Framework

Thanks for taking the time to learn about how aerospace industry leaders leverage our industrial grade Virtual Reality software IC.IDO. All this is not about us being right but rather about our customers getting it right.

Boeing, Latecoère, Safran, Rolls-Royce and many more use IC.IDO to collaborate virtually, remotely — yet in a physically realistic environment — to experience human-centric operations intuitively, early, and safely, making the right decisions at the right time.

What elevates us and keeps us traveling this journey with you is the common purpose we share: enabling sustainable, safe, and reliable ground mobility.

How about experiencing our Virtual Reality software for yourself through an immersive product demonstration?
We'll be happy to answer all the questions you may have and show you the value that VR can bring to your company.

ESI Group HQ
Batiment Le Seville
3 bis Rue Saarinen, CS 50468
94528 Rungis, FRANCE
+33 (0)1 41 73 58 00

esi-group.com

G/OM/23.17/A

get it right