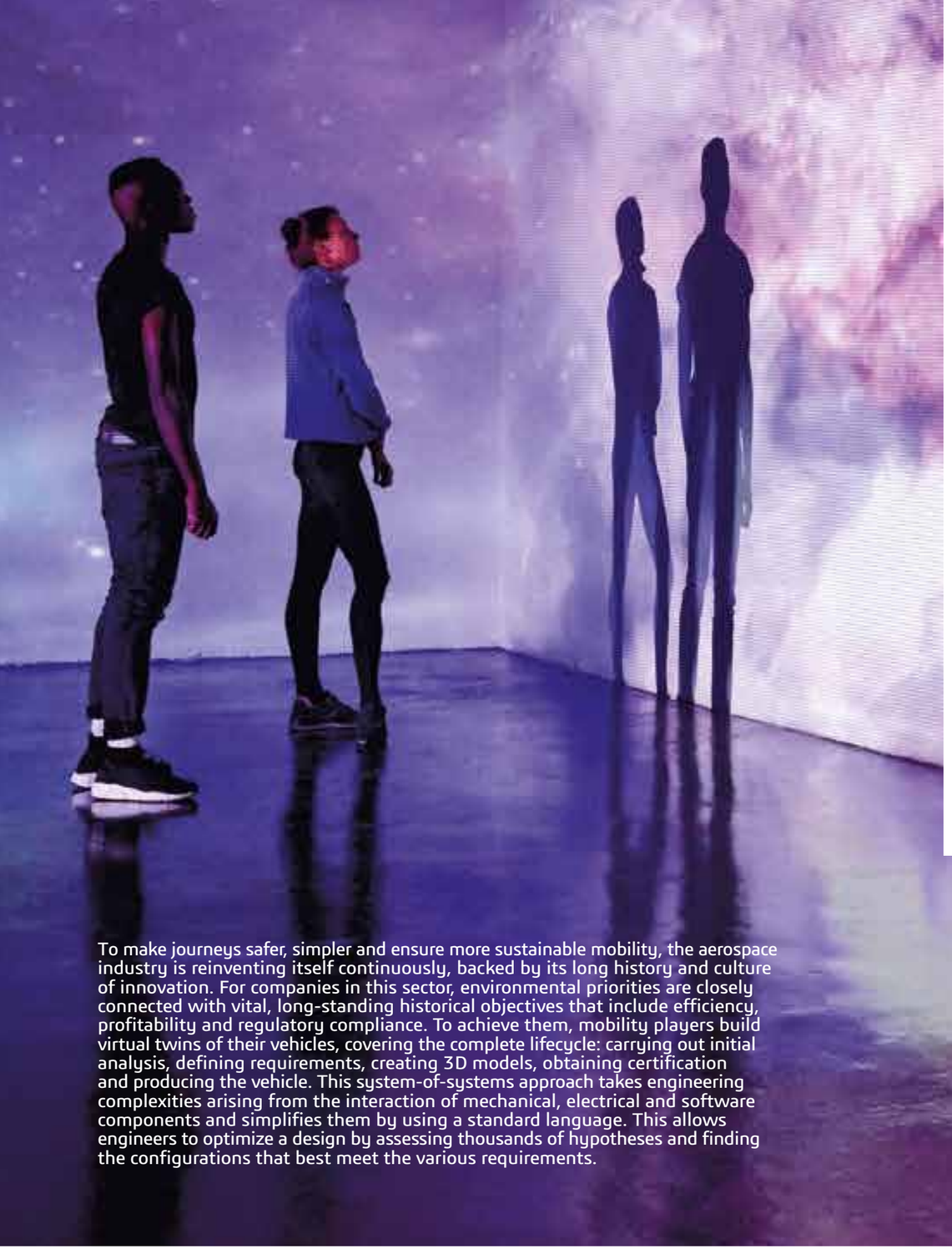
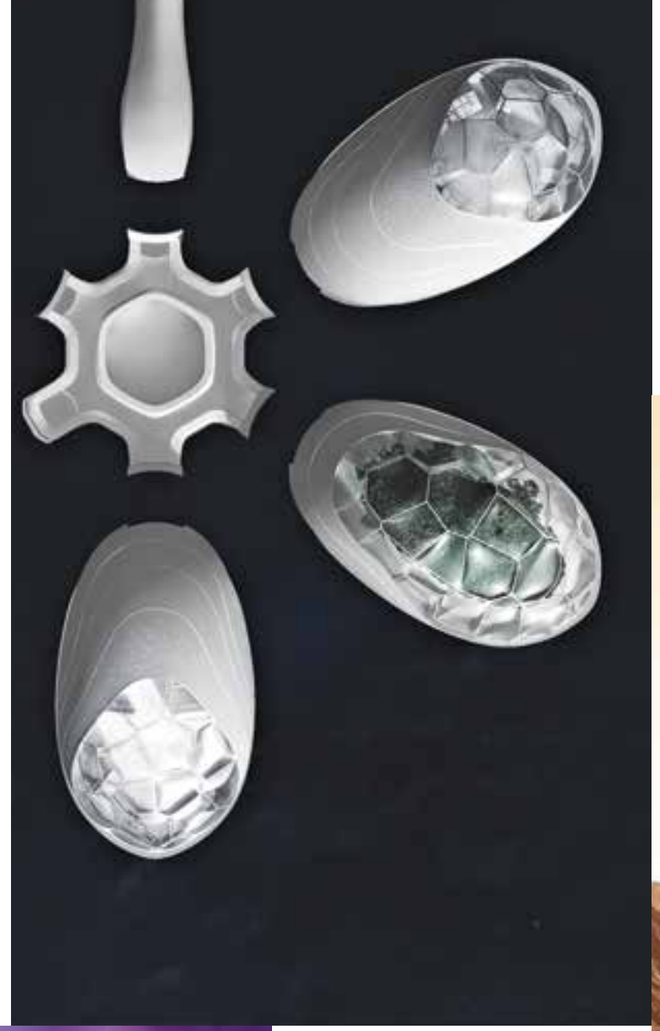
WE
ARE
WHERE...

THE FUTURE TAKES OFF

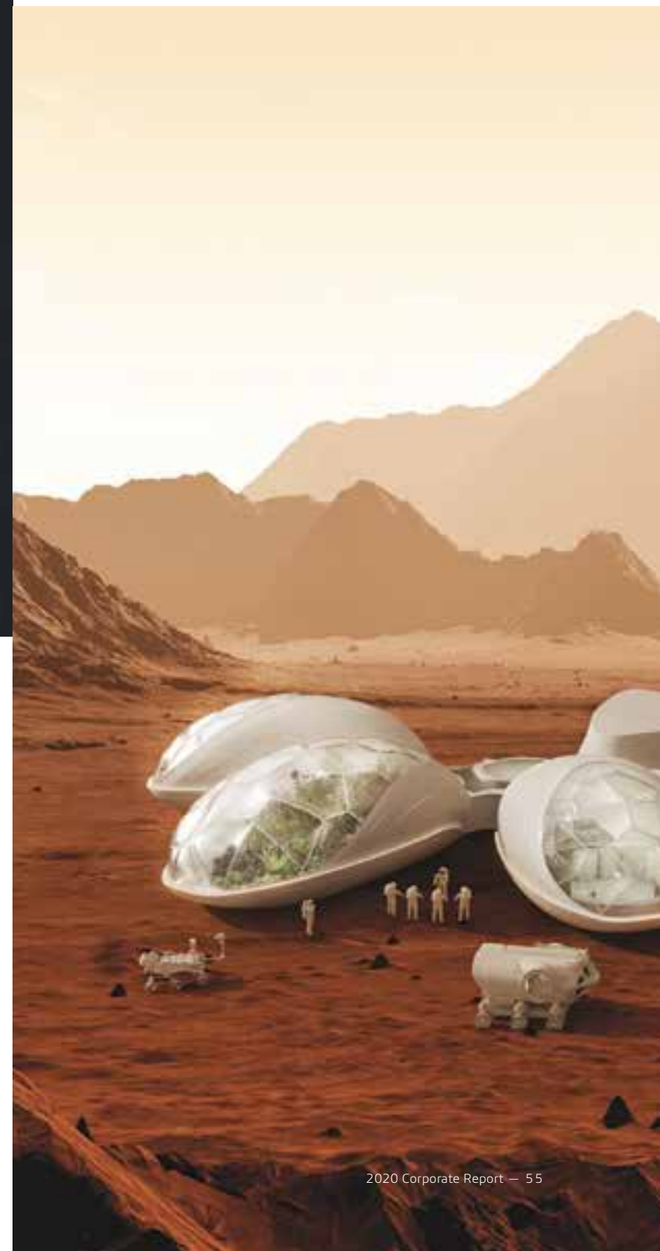
More fluid, simpler, quieter and more energy-efficient transport solutions are taking shape as a result of virtual universes facilitating the design, modeling and simulation of new mobility experiences. On land, on the sea, in the air and even in space.

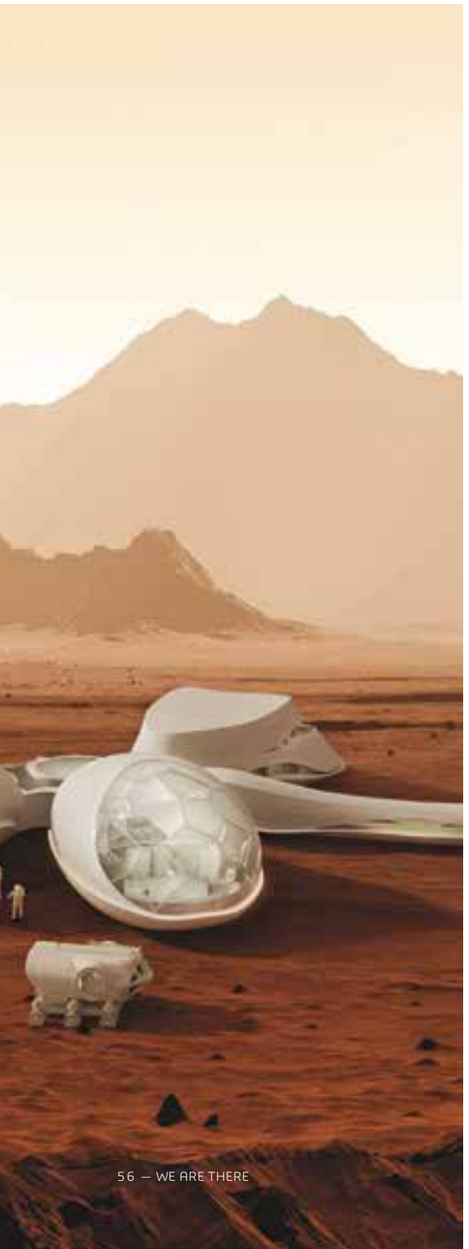


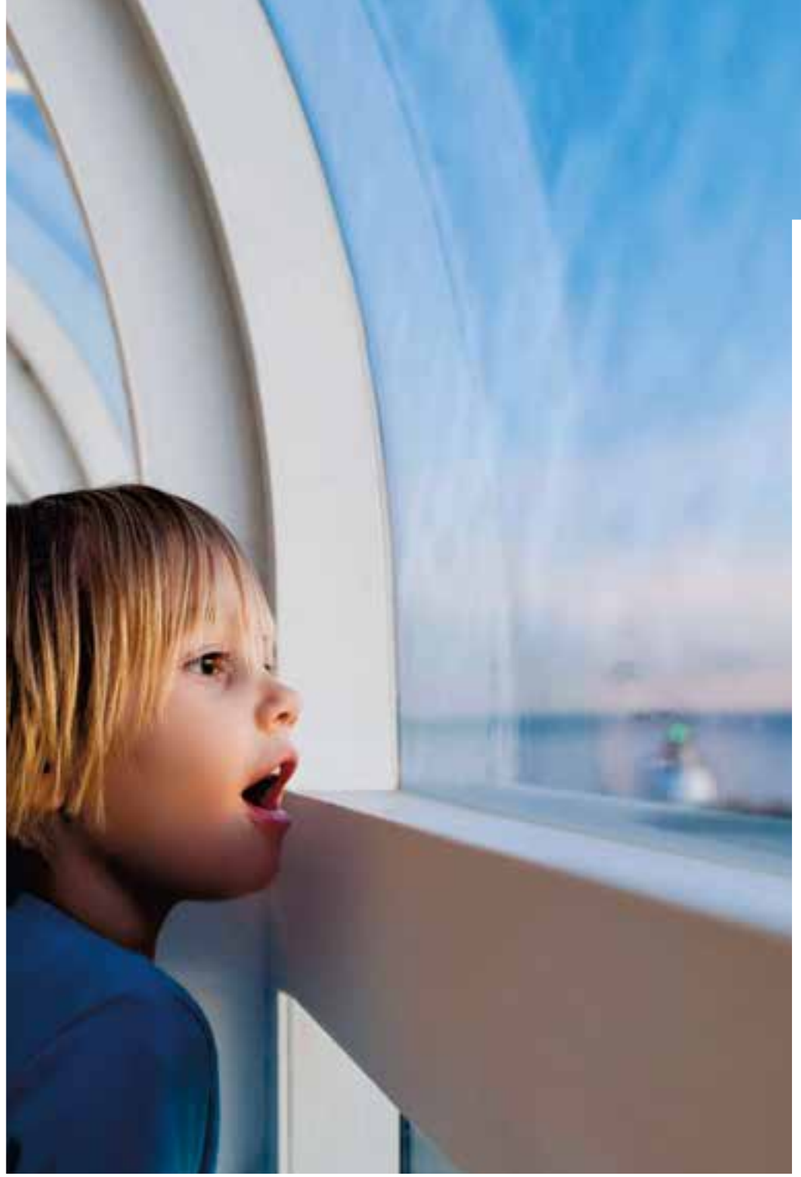
To make journeys safer, simpler and ensure more sustainable mobility, the aerospace industry is reinventing itself continuously, backed by its long history and culture of innovation. For companies in this sector, environmental priorities are closely connected with vital, long-standing historical objectives that include efficiency, profitability and regulatory compliance. To achieve them, mobility players build virtual twins of their vehicles, covering the complete lifecycle: carrying out initial analysis, defining requirements, creating 3D models, obtaining certification and producing the vehicle. This system-of-systems approach takes engineering complexities arising from the interaction of mechanical, electrical and software components and simplifies them by using a standard language. This allows engineers to optimize a design by assessing thousands of hypotheses and finding the configurations that best meet the various requirements.

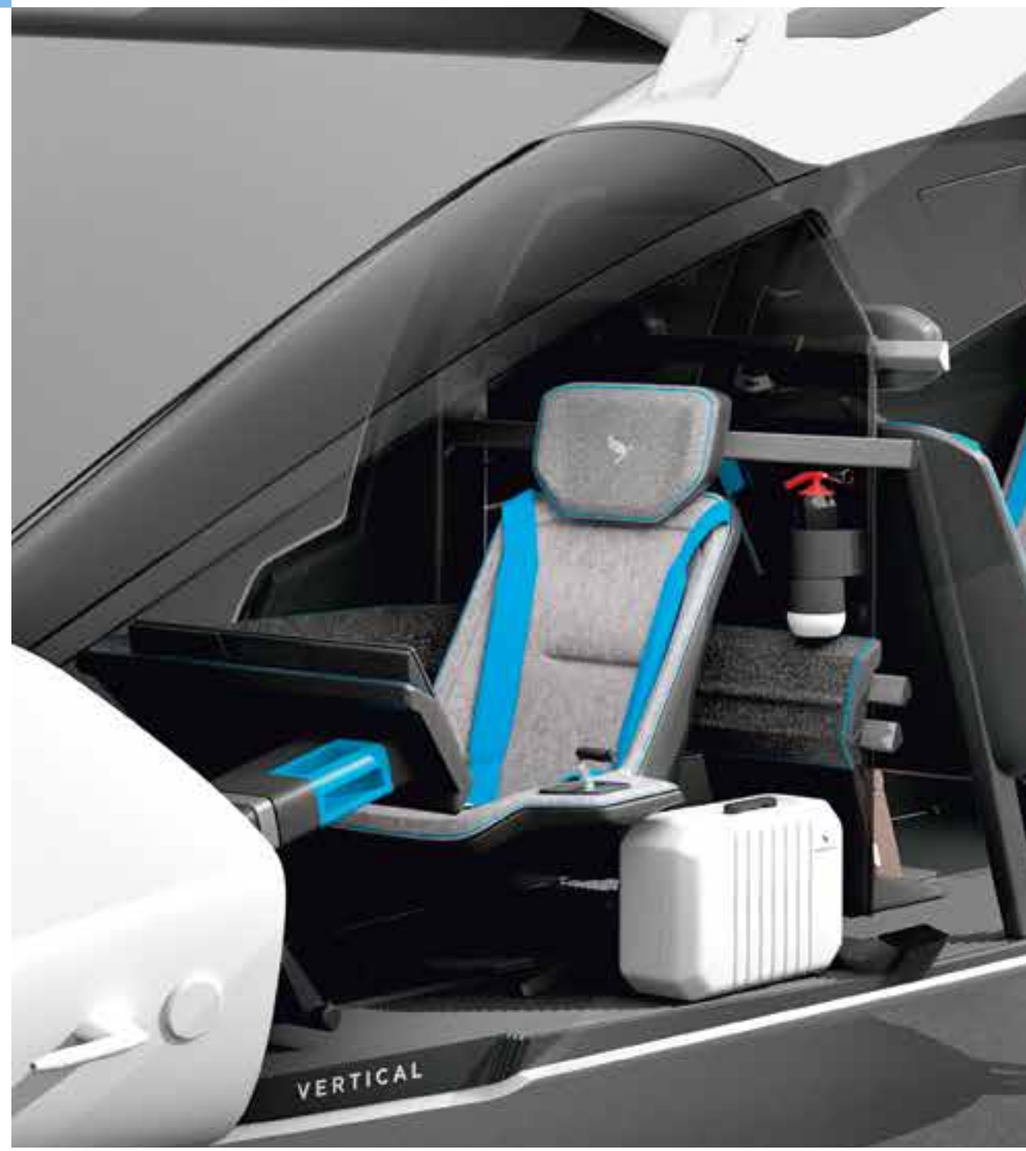


INTERSTELLAR
The Interstellar Lab research group, split between France and California, builds and tests experimental, bio-regenerative stations that aim to be self-sufficient. On the Moon, on Mars and on Earth.

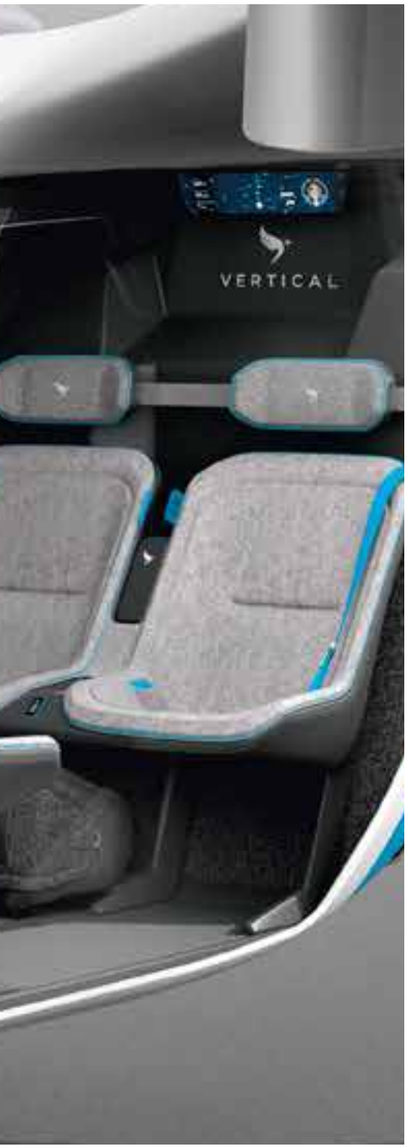








VERTICAL AEROSPACE
Vertical Aerospace, a UK-based startup, is about to launch the world's first certified eVTOL (electric Vertical Take Off and Landing) vehicle, which could see its first commercial flights in 2024.



ZURI
On its eVTOLs, Czech company Zuri has adopted a combination of fixed wings for cruising and rotary wings for take-off and landing.

XSUN
French company XSun has designed, tested and demonstrated the capabilities of its long-range, solar-powered drones.

Using the technologies of interstellar travel to support a more sustainable lifestyle

In 2023, the Moon is due to become the first staging post for space travel to more distant destinations, beginning with Mars. Inspired by the potential for humans to live on the Moon or on Mars, the Interstellar Lab startup, with operations in France and California, builds and tests experimental, bio-regenerative stations, modular, space-ready stations that can be configured as villages or even cities, featuring closed-loop, controlled-environment systems that aim to be self-sufficient. Virtually everything within these stations is recycled, making water, air and food as renewable as possible. This reduces the amount of land needed to feed their residents by more than 99%, while ensuring a steady, year-round supply of fruit and vegetables using 98% less water. Interstellar Lab brings together the expertise of NASA, SpaceX, Airbus, Safran, Saint Gobain and Dassault Systèmes, whose **3D**EXPERIENCE platform and Reinvent the Sky solution provides a space in which many different specialists contribute their skills: biologists, aerospace and aeronautical engineers, specialists in control systems and materials science, architects and mathematicians. Using a parametric design approach, the platform allows Interstellar Lab's team of engineers and architects to perform iterations and simulations to refine and optimize the design and production of the EBIOS stations and their modules, the BioPods. The station's virtual experience twin will become hugely valuable as Interstellar Lab moves toward making and operating its modules. Because the solution is in the cloud, teams have secure access to it at all times from any location.

Reinventing mobility with electric vertical take-off and landing aircraft

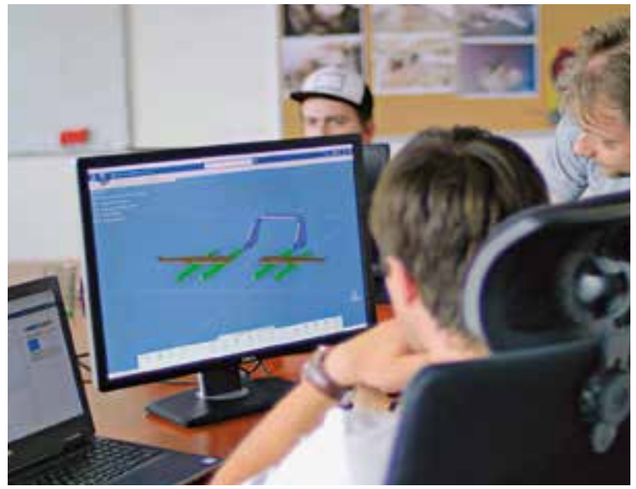
eVTOL (electric vertical take-off and landing) aircraft are quiet, efficient and have zero carbon emissions, representing a disruptive solution for traveling within and between cities in the near future. One of the pioneers in this sector, UK company Vertical Aerospace, is set to build one of the world's first certified passenger carrying eVTOLs, the VA-X4, which could see its first commercial flights in 2024. The aircraft is quieter and less expensive to run than a helicopter, and aims to address the market for travel between locations poorly served by high-speed trains and regional airlines. To ensure that its processes are fully operational when fleets of its aircraft are in service, particularly regarding the traceability of components, Vertical Aerospace is using the **3D**EXPERIENCE platform. "By working in the cloud, we can make sure that the company is resilient and that we can continue to work whatever the circumstances," says Eric Samson, Head of Engineering at Vertical Aerospace. "We have built an aircraft from scratch. So not only do we have to organize our current processes, but we need to establish them firmly for the future." The solution offers a full set of functions enabling engineers to design and validate composite structures. Engineers also use the platform to find the best way of manufacturing each component from start to finish.

The platform brings together all teams, and solutions can be accessed using the web application. As the company expands its network of partners and suppliers, it will use its enhanced 3D model to send digital data and specific instructions to each participant in the supply chain. Finally, the **3D**EXPERIENCE platform provides full traceability, which will help the company certify through the CAA (Common Aviation Area) and obtain DOA (Design Organization Approval) certification from EASA, the European Aviation Safety Agency.

The noise reduction enabled by Vertical Aerospace's eVTOLs make them 100 times quieter than a traditional helicopter.

Combining fixed and rotary wings

The VTOL aircraft developed by Czech company Zuri combines rotors and wings for on-demand, door-to-door mid-range flights. Multicopters are generally designed to travel short distances within cities and are ideal for vertical take-off, but are not effective for cruise flights., Wing-borne Zuri is ideal for covering distances of 200-700 km (124-435 miles), which is a sweet spot where VTOLs are faster than both cars and big airliners (when considering the time spent in airports). From the start of its project, Zuri used CATIA to handle initial analysis, aerodynamics and measurement tasks, and the company is now exploring the potential of the **3D**EXPERIENCE platform in the cloud.



NEW SPACE
A NEW FRONTIER

"For the first 60 years of the Space Age, the space industry was dominated by major government programs. Now, private-sector companies are playing an increasingly important role, launches are more frequent and the number of operational satellites orbiting the Earth – currently numbering 3,400 – could rise to several tens of thousands in the next 30 years. The industry is now being inspired and invigorated by a wave of entrepreneurs pioneering groundbreaking, new technologies. With the **3D**EXPERIENCE platform, companies in the space industry can develop innovative engineering, manufacturing and operational solutions by modeling virtual missions, which will be front and center to sustainability in space and on Earth. The evolving landscape of international regulations, geo-politics, and the constant stream of new technologies and business models sets the background not just for the proliferation of satellites but also the challenge of managing space debris in orbit. Currently estimated at over 28,000 objects, this debris threatens the sustainability of space activity. Space traffic management will be key to today's industry renaissance in space."

Jeff SMITH
Aerospace & Defense Strategy & Innovation, Dassault Systèmes

All its teams can work on the platform from any internet-connected device, with each individual contributing his/her own expertise, while gauging the end user's experience with virtual-universe experiences. With ENOVIA, the platform also allows Zuri to reuse shared processes and components, bringing its aircraft to market more quickly. To test and certify its aircraft, Zuri uses integrated safety processes and full traceability to comply with various regulations. It applies virtual twin technology to test and check its digital prototype before beginning physical construction, to manage and maintain the aircraft throughout its lifecycle and to offer an immersive experience to investors, as well as existing and prospective customers.

A double-wing, solar-powered drone observing the Earth

French company XSun is committed to designing, testing and showing the capabilities of solar-powered, long-range drones that can conduct surveillance, research and environmental-protection missions. Economical to produce and run, its latest model offers a greater range, increased endurance and improved sustainability. In an endurance test carried out in 2020, XSun's drone flew for 12 hours and covered 600 km (373 miles), with no carbon emissions. Making extensive use of composite materials, it weighs less than 25 kg (55 pounds), is more than 4.5 meters (nearly 15 feet) wide and has a payload capacity of 7 kg (15.4 pounds). The team aims to increase its endurance from 12 hours to 20.

Possible applications include monitoring oil and gas pipelines and railways, observing fauna and flora in forests, carrying out large-scale military surveillance at sea, and detecting oil spills and illegal discharges. The idea is that autonomous drones will eventually perform work currently done by space satellites. XSun's double-wing machines also can accommodate twice as many solar panels as single-wing designs. The concept, developed using the **3D**EXPERIENCE platform, also offers certain advantages in terms of aerodynamic performance. Double-wing design has traditionally been ignored by the aerospace industry, which has until now been dominated by single-wing designs.

Faster and more reliable certification process for Pipistrel

Pipistrel Vertical Solutions, a subsidiary of Slovenian Pipistrel Group, specializes in designing innovative electric and hybrid aircraft and battery-based propulsion systems. It has used Dassault Systèmes solutions to speed up the performance-testing process and to assess the reliability of materials before physical prototyping. For certification, full-scale testing is required to determine the aircraft's natural frequencies and associated structural energy absorption – typically a long and costly process. To accelerate the process of performance tests, Pipistrel has opted for SIMULIA Abaqus to simulate and assess the structural behavior of its new Virus SW Electro 128 aircraft in a virtual environment, accelerating the pace of certification, securing the first-ever Type Certificate for an electric airplane.

Instead of using physical measurements before starting test flights, Pipistrel has proven, with the positive results of virtual tests, that its structural design is reliable and robust. The EASA has recognized the test process and results, allowing Pipistrel to achieve final confirmation of the newly developed aircraft's structural integrity more quickly, resulting in significant cost and time savings.

Digital and Sustainable – The next milestone in shipbuilding transformation

Some of the main principles of shipbuilding were adopted back in the 17th century. However, driven by intense competition and the compelling sustainability imperative, a wave of innovation is currently carrying the industry to develop transformative approaches.

NAVAIS: setting the course for next-generation European shipbuilding

Building on Damen's proven standardization experience, one of its divisions, Damen Shipyards Gorinchem, is coordinating the New Advanced Value Added Innovative Ships (NAVAIS) program in close cooperation with Netherlands Maritime Technology (NMT), Dassault Systèmes, Bureau Veritas, Delft University of Technology, MARIN (The Maritime Research Institute Netherlands) and 10 other partners.

Co-funded by Horizon 2020, the biggest EU Research and Innovation program ever conceived, NAVAIS aims at finding new shipbuilding methods to maintain the European shipbuilding industry's global leadership in complex vessels, while also making sustainability more integral to new projects, from the design stage onward.

NAVAIS is developing guidelines and KPIs for low-impact ship design and operations, reducing or, preferably, eliminating emissions (exhaust emissions, oil, ballast water, as well as airborne and underwater radiated noise) to the environment. To increase efficiency in vessel design and flexibility in production networks, NAVAIS explores standard and modular design and production principles. Leveraging a Model-Based Systems Engineering (MBSE) approach, NAVAIS is developing a

THE MBSE APPROACH DECODED

Model-Based Systems Engineering (MBSE) is inseparable from the ever-growing sophistication of products across industries. The Marine & Offshore industry is no exception. Marine assets are complex systems that involve multi-disciplinary teams dealing with mechanics, electronics, software, telecommunication, cyber-systems, chemicals, batteries, hydro-dynamics and more. Consequently, MBSE methodology, which focuses on creating and using multi-physics 3D as the primary means of exchanging information between engineers, as opposed to documents, is being gradually adopted across the naval and commercial shipbuilding segments to cut through the complexity.

platform-based modular product family supported by the **3D**EXPERIENCE platform, focusing specifically on e-ferries and workboats. The program will profoundly change the way in which new shipbuilding projects are approached. Traditionally, these projects involve an engineering-to-order business model, where specifications are defined and design work is carried out on the basis of the customer's needs and vessel's intended purpose. The new approach involves an assemble-to-order business model, resulting in shorter lead times, consistent quality, reduced design and production costs and improved supply chain integration, while ensuring the continued focus on clients' specific needs.

To achieve this, users define related groups of products that share characteristics, components, subsystems, interfaces and manufacturing processes; these groups meet a wide array of customer requirements, and various modules are created with the required attributes to fulfill the various functions of a vessel's structure. It also involves defining the modular design process and the library of modules that can be reused: design and production data, business rules, documents and spatial information are stored in the library, allowing users to standardize production and propose multi-user environments to create models, test behavior and centralize information using a MBSE approach. NAVAIS is defining a completely new class-approval procedure, where pre-engineered product modules are approved to support an evolution to an assemble-to-order business model. Bureau Veritas also simulates the vessel's energy efficiency within the **3D**EXPERIENCE platform. The manufacturing plan can be simulated for each production module, and the process plans for various modules can be combined to create the main process plan for the vessel as a whole. NAVAIS is scheduled to complete its work in June 2022 and demonstrate the feasibility of these concepts for shipbuilding.

A paperless shipyard, thanks to virtual twin technology

CSSC Jiangnan Shipyard, one of China's largest shipbuilding companies, builds, repairs and converts commercial ships. Founded in 1865, it has a solid reputation in complex vessels. After decades of development, the company wanted to strengthen its competitiveness, focusing on higher-value vessels that include gas carriers, large container ships and scientific vessels and moving away from volume production of low-value ships such as bulk carriers. In 2015, Jiangnan Shipyard selected the **3D**EXPERIENCE platform to lead the digital transformation of the CSSC Group and take China's shipbuilding industry to the next technological level.

The transformation meant moving from a traditional shipyard organization based on 2D documents and plans to a paperless shipyard, putting the 3D model at the center of its design and production processes. To ensure digital continuity and have a solution based on 3D models that factor in all of its processes end-to-end, Dassault Systèmes helped Jiangnan Shipyard to define, share and monitor key performance indicators based on typical use cases. The first vessel ever designed and built using this 3D model-based approach is the Haixun 160. Jiangnan Shipyard did not use a single piece of paper for its design or construction, which required only three months for the engineers and workers to build the various parts of the ship and assemble them. On site, teams no longer have to look at often-complex 2D blueprints. Each detail of the ship can be closely examined directly on the 3D model, and a laptop or a tablet is all that is required to access all of the detailed information.

Some of the key benefits include:
- Avoiding error-prone interpretation during manufacturing, thanks to direct usage of 3D, which provides a perfect match between the real and virtual world, with a reliable end-to-end digital thread.
- Using Virtual Twin technology with VR and ergonomics, the **3D**EXPERIENCE platform can simulate on-board crew actions such as walking, operations, and maintenance. This helped the shipyard to detect issues early in the design phase, effectively control and manage construction cost, shorten cycle time, and improve build quality.
- Using 3D models instead of drawings led to a reduction of errors, thanks to better understanding.

Jiangnan Shipyard plans to further advance its processes, leveraging the virtual twin to help ship owners with maintenance throughout the ship's lifecycle.