

INTERSTELLAR LAB

Case Study



Photo © Interstellar Lab

Challenge

Interstellar Lab develops environmentally controlled, closed-loop modules designed for self-sustainable life on Earth today, and in space in the near future. Combining architecture, agronomy, engineering, product design and science, the company needed an industry-leading platform to support its geographically dispersed and multidisciplinary research teams and empower them to innovate at speed.

Solution

Interstellar Lab partnered with Dassault Systèmes to design its modules on the **3DEXPERIENCE** platform on the cloud through the *Reinvent the Sky* solution. The platform allows the team of scientists, engineers and architects to access a set

of integrated applications and connect in real time, ensuring data integrity at every stage.

Benefits

The **3DEXPERIENCE** platform on the cloud enables Interstellar Lab to ensure seamless, centralized global collaboration. The team can work on the station's virtual twin concurrently, rapidly optimize and validate iterations using the solution's powerful simulation capabilities. All disciplines are gathered on a single platform to address some of the planet's greatest challenges and make life possible, even in the most extreme environments.



"The platform supports us to have the most efficient working processes and avoid reworking designs from scratch."

— Barbara Belvisi, Founder and CEO, Interstellar Lab

SUSTAINABLE LIFE ON EARTH AND BEYOND

The Earth. The Moon. Mars. What if humans become a multi-planetary species?

This is the mission of Interstellar Lab, an innovative French-American startup driven by the ambition to create systems that will enable us to live better on Earth and preserve its biodiversity, and prepare humanity to settle on other planets. The project embodies the vision of founder and director Barbara Belvisi, who draws on her passion for the environment and space travel to create a meaningful and lasting impact.

"Climate change is a real emergency and we only have a small window to bring about positive change," Belvisi said. "Yet what we need to live on Mars can also help alleviate the climate crisis we are facing."

Interstellar Lab's team of scientists, engineers and architects designs environmentally controlled, closed-loop systems inspired by aerospace technologies that will produce and recycle almost everything, making water, air and food as renewable as possible to live in total autonomy. Composed of independent modules or combined to form a complete, self-sufficient unit, these experimental bio-regenerative stations (Ebios) are the first habitats of their kind. Each Ebios will operate as a mini-city, housing all the infrastructure and resources needed to support and sustain human life without outside intervention.

"It's not about running away from Earth," Belvisi said. "We are building a new environment for sustainable life on Earth and providing a test bed for future space missions. We wish to lay the groundwork for what will be the future of humanity."

One of the first modules to be developed is a self-sustaining food production system called BioPod. Built to withstand extreme climates, the biosphere is designed to revolutionize food production, reducing the land and water needed to produce food on Earth by more than 99%.

Combining advanced technology with predictive maintenance to achieve high-precision agriculture, the BioPod creates the specific environmental conditions required to grow a diverse array of crops and plants that are too complex to survive in a traditional indoor farming set up.

"Our first objective is to create the main pods, including the BioPod, which will form an integrated, closed-loop sustainable environment – from food production to water and waste treatment systems," said Jim Rhoné, chief product officer at Interstellar Lab. "A huge part of the design work is currently dedicated to this aspect. Beyond the functionality and engineering focused on efficiency and sustainability, the

station and modules must also satisfy basic human needs wherever we are, on Earth, the Moon or Mars – space to live and grow."

For a project of this magnitude, Interstellar Lab has pulled in talents and expertise from NASA, Space X, Airbus, and Dassault Systèmes. The latter collaborates with the startup to support its growth and scalability. As part of this, Interstellar Lab is handling all of its design and development processes for the Ebios on the **3DEXPERIENCE®** platform on the cloud.

"Many tools today allow for an innovative approach and support the modern data flow load," Rhoné said. "But very few integrate all our constraints within a single platform. We are a company at the cutting edge of a lot of disciplines, skills and applications – biology, aerospace, control systems, architecture, mathematics and materials science. We needed a platform that could bring all these areas together. The **3DEXPERIENCE** platform does exactly that."

ACCELERATING INNOVATION ON THE CLOUD

Spread across Paris, France, and Los Angeles, USA, Interstellar Lab's teams work around the clock on the Ebios design.

"We have people working on the model 24 hours-a-day," Belvisi said. "They can all work together, connect seamlessly and simultaneously on the platform to move the project forward."

Accessible on the cloud, the **3DEXPERIENCE** platform not only provides secure, instant access for the company but also maintains a single version of the truth for the team.

"This is really important as we're working on many different components and need to ensure we don't duplicate work and are always referring to the latest version," Belvisi said.



"It's a game changer for us as we're able to design and iterate at speed, bringing all our expertise together in one place to come up with the best solutions."

— Jim Rhoné, Chief Product Officer, Interstellar Lab

"The platform supports us to have the most efficient working processes and avoid reworking designs from scratch. Having real-time access is critical as we can be running lots of different iterations at any one time."

Both global and multidisciplinary by its nature, Interstellar Lab's team also required a platform that could handle its complex requirements in one platform, able to manage project and design reviews as the BioPod comes to life, while ensuring technical compliance.

"As we progress to the next stage, ENOVIA's program and project management capabilities will be invaluable to us for

storing and retrieving design knowledge and managing the BioPod lifecycle effectively,” Belvisi said.

Through the cloud-based platform, the team has access to all the functionalities it needs. It saves everyone time switching between third-party tools and platforms and converting data as they go between applications.

“Interoperability can be time-consuming,” Rhoné said. “Not many platforms can provide that kind of functionality out of the box. **3DEXPERIENCE** is a game changer for us as we’re able to design and iterate at speed, bringing all our expertise and domains together in one place to come up with the best solutions. It allows us to move and innovate faster.”

THE FIRST BIOPOD IN PARIS

To withstand the most rigorous conditions, the BioPods use a combination of composites for the solid technical base, and soft and resistant polymers for the inflatable membrane.

“We want to end up with a village that is very easy to deploy and requires a minimal workforce,” Belvisi said. “That’s how we came up with the inflatable, foldable domes design, stacking everything we need to support life within the structure.”

Each module is designed with CATIA on the **3DEXPERIENCE** platform.

“We opted for a parametric design approach that enables us to generate shells and structures with complex, scalable geometry from a large amount of data,” Rhoné said. “Then we can iterate and simulate as we refine our design. A BioPod houses many different structural components. Being able to centralize all in one platform helps us work more efficiently.”

Although Interstellar Lab’s first space-ready villages will be deployed on Earth, the team keeps its space ambitions front of mind.

“We look to space to come up with new, more efficient concepts and systems that we are testing on Earth,” Belvisi said. “If you think about going to another planet, the system must be light and super-resilient. We also must consider a lot of constraints in terms of solar radiation, extreme temperature and so on.”

Before the company deploys the first BioPod, it is harnessing the simulation power of **3DEXPERIENCE** with SIMULIA to optimize the BioPod’s installation.

“To ensure that the domes perform as expected, even in extreme conditions, we need to simulate their real-life situation accurately – for example, testing the strength of the entire structure including the flexible membrane, maintaining the inside airflow to get the exact air pressure,” Rhoné said.

“Temperature variations outside the dome affect the internal air pressure that must remain stable,” Belvisi added. “The oxygen and carbon dioxide levels need to be set at optimum levels for plants to grow, depending at what stage they are in their lifecycle. SIMULIA enables us to emulate the multiple possible scenarios.”

THE VIRTUAL TWIN AT THE HEART OF THE SYSTEM

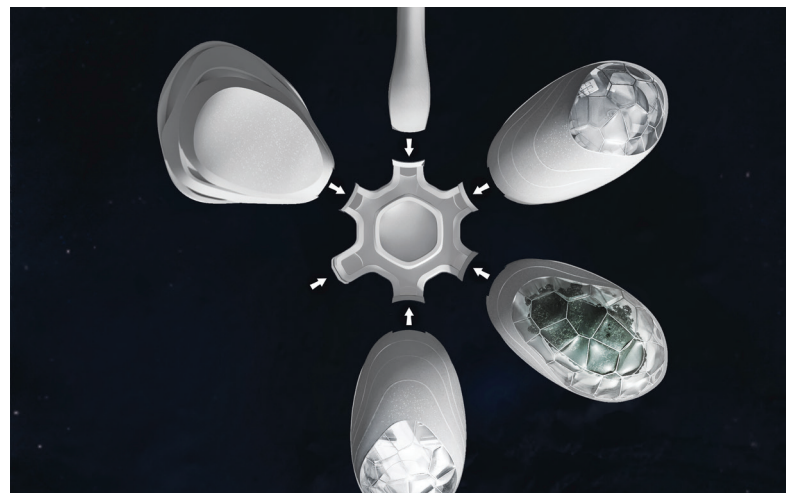
The domes will evolve as they are built and experimented on. The startup needs to be able to date, track and control the changes made to the physical models. Having a virtual twin is invaluable. This process covers everything from operations and

More about the solution:

The *Reinvent The Sky* Industry Solution Experience supports startups, small and medium enterprises (SMEs) and original equipment manufacturers (OEMs) to develop disruptive solutions: from small, light aircraft to electric VTOL, as well as space launchers and equipment. Companies seeking new ways to integrate technology into product development can leverage the solution on the cloud to accelerate the product lifecycle from concept to certification and gain critical first to market advantage.

Benefits:

- Shorten time from concept to prototype
- Ensure digital continuity from concept to final product
- Enhance collaboration between functional teams
- Full traceability for regulatory compliance



Top image: Ebios modules are a combination of multiple environmentally controlled units that communicate via airlocks.

Bottom image: Exterior design of the BioPod, the first module dedicated to autonomous food production in a controlled environment, developed by Interstellar Lab.

Focus on Interstellar Lab

Interstellar Lab develops and builds closed-loop habitats and biospheres generating and recycling food, water and air to support human life sustainably on any planet – on Earth first and, in the future, on Mars and the Moon. Based in Paris, France, and Los Angeles, USA, the research company combines architecture, engineering, product design and science to bring its space-ready villages to life.

For more information: www.interstellarlabor.com

maintenance, through to gathering data around food production and the environment. The **3DEXPERIENCE** platform will allow Interstellar Lab to assimilate all this data within an accurate 3D representation, which will be crucial for large-scale deployment.

"Ultimately, the 3D models will be used as virtual duplicates of BioPods and Ebios, connected to our own software, which will gather data generated by the stations and the environment," Rhoné said. "They will enable us to set up an artificial intelligence-assisted control center to monitor the pods in an optimized, ultra-automated manner throughout their lifecycle, on Earth and in space."

Until the BioPods are operational and on the market, Interstellar Lab is relying on augmented reality and photo-realistic renderings to communicate its vision.

"We can use the **3DEXPERIENCE** platform to go from a 3D model of the dome to a photo-realistic representation so people can visualize and understand what we're aiming to achieve," Belvisi said. "Augmented reality will also enable more people to experience what life will be like in the domes without having to physically visit. They'll be able to go on a tour and feel the functionality of such a unique space and interact with the environment."

The virtual twins of BioPods and Ebios are also essential asset for the manufacturing, execution, operation and maintenance phases.

"As we start producing the various components of the BioPods, the digital twin evolves, integrating the specificities of each part from our manufacturers and suppliers to get virtual replicas of the product built, 'unique' and centralized on the platform,"

Rhoné said. "This same digital avatar will enable us to control the quality and precision of the execution, and integrate the performance of each BioPod by acquiring data from sensors to then be able to simulate, make more reliable decisions, automate control, and develop predictive maintenance."

VALUES IN PERFECT SYNERGY

In many ways, Interstellar Lab's partnership with Dassault Systèmes is a wonderful alignment of values, interests and skills.

"Dassault Systèmes is renowned for its expertise in aerospace," Rhoné said. "But the company's venture into life sciences makes it the ideal ally to bring Interstellar Lab's mission to life."

"Listening and proactive since the beginning of our collaboration, Dassault Systèmes understands the direction we want the project to go in, and offers the best solutions to support us in our approach," Belvisi said. "We share the same passion, and the same vision. The dream of a human civilization beyond Earth has never been so close."

Our 3DEXPERIENCE® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the 3DEXPERIENCE Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating 'virtual experience twins' of the real world with our 3DEXPERIENCE platform and applications, our customers push the boundaries of innovation, learning and production.

Dassault Systèmes' 20,000 employees are bringing value to more than 270,000 customers of all sizes, in all industries, in more than 140 countries. For more information, visit www.3ds.com.

