

LOCOMACHS

CASE STUDY



The LOCOMACHS physical demonstration fixture is built with reconfigurable tooling and simulated in **3DEXPERIENCE**® to fully demonstrate and test key technology enablers for future wing production. Peter Helgesson (pictured) demonstrates a virtual to real image of the demo cell ("Digital Twin").



Challenge:

As part of the LOCOMACHS research and development project led by key European players in the aircraft industry, Prodtex needed to improve the efficiency of the wingbox assembly process and the entire assembly line for an aircraft wing.

Solution:

The company chose the **3DEXPERIENCE** platform, including DELMIA® for Digital Manufacturing, to virtually plan and simulate the wing fixture and assembly line.

Benefits:

Virtual simulation with DELMIA helped drastically reduce the time associated with the shimming process, improved the cost-efficiency of composite structural part assembly, and enhanced human safety, ergonomics, and feasibility.

MAKING MANUFACTURING EFFICIENCY IMPROVEMENTS TO MEET FUTURE TRAVEL DEMANDS

According to a recent Airbus study, air traffic will double within the next 15 years.¹ Increasing demands from airlines for more planes and growing competition from countries like China and India will consequently require European aircraft manufacturers to improve the efficiency of their manufacturing and assembly operations to meet these demands in a timely and cost-effective manner. A collaborative research and development project called LOCOMACHS (LOW COst Manufacturing and Assembly of Composite and Hybrid Structures) involving 31 key European players in the aircraft industry was launched in 2012 to develop technologies that, if adopted, will allow manufacturers to accelerate and more efficiently produce and assemble composite structural parts. Among the objectives is to mitigate non-added value activities that include many shimming or dismantling operations that are time-consuming and generate recurring costs from composite production lines.

LOCOMACHS, therefore, aims to create a new build philosophy that generates both cost and time savings in aircraft development, and reaps results for leveraging in other industries. Dassault Systèmes business partner Prodtex, one of the 31 companies participating in this research project, worked on two work packages. "The first work package is to design and build the fixture for a section of the wing (the demonstration wingbox)," said Peter Helgossion, Director, Production Technology at Prodtex. "Inside a wing, you have the spars or main structural members, a leading and trailing edge, and the ribs. The project involves individually moving aerospace parts in six degrees of freedom to install them. We designed and built two hexapod robots to automatically position the leading edge and a third hexapod to position the wingrib using a force feedback sensor against the other wingbox components. One of the difficulties here is that carbon fiber is not as easy to work with as metal here, because the thickness of the material varies. So when

the rib is positioned, there are always slight adjustments to be made, which are usually done manually by two operators which is time-consuming and labor-intensive. Much of the time is spent shimming the gaps to correctly position the rib. We found that automating this activity reduced shimming by 50%, which was one of the targets of the LOCOMACHS project. If you multiply these savings by the number of ribs to be installed per wing, we would end up with an overall leaner manufacturing process," he said.

The second work package focused on what aircraft production lines should look like to satisfy increasing global air travel demands. This work package called on Prodtex's 3D modeling and assembly line expertise to create a full-scale virtual production line to assemble wings in a leaner, faster and more cost-effective manner. "We virtually modeled a full lean production line, or wing factory of the future if you will, that not only simulates the trajectory of a wing on the assembly floor, but also shows the different robots performing their assigned tasks. Here we integrated other technologies developed by our LOCOMACHS partners, as well as our own hexapods, to design the factory," Helgossion said.

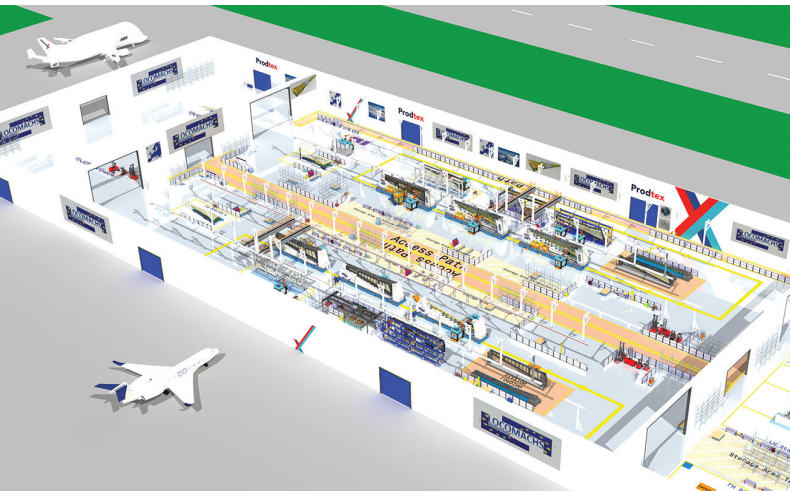
Magnus Engström, Technical Director of LOCOMACHS and Project Leader at Saab Aeronautics, explained the significance of this: "Modeling a virtual factory provides many benefits," he said. "Simulating the physical flow and work environment in which both robots and humans interact highlights details that are easy to miss in a static 2D drawing. For example, we can detect and correct accessibility and safety issues, improve ergonomics, and decide how materials should be handled," he said.



"Virtual simulation with DELMIA enabled us to prove our build concept, verify the assembly path of the parts in the factory, and more efficiently balance the workload between stations, thereby reducing overall lead times."

**— Peter Helgossion, Director (M.Sc),
Production Technology, Prodtex**

"In EU projects, it is important to demonstrate the potential of the developed technologies and how they can be implemented in products and production," Maria Weiland LOCOMACHS Project Coordinator, Saab Aerostructures said. "In LOCOMACHS, we chose to implement the most promising technologies in the virtual wing factory of the future to show the possibilities and efficiency of these technologies."



Wing of the future production lines simulated using the **3DEXPERIENCE** platform. Applications used: Process Planning, Manufacturing Definition, Plant Layout Design, Robot Simulation, and Equipment Simulation

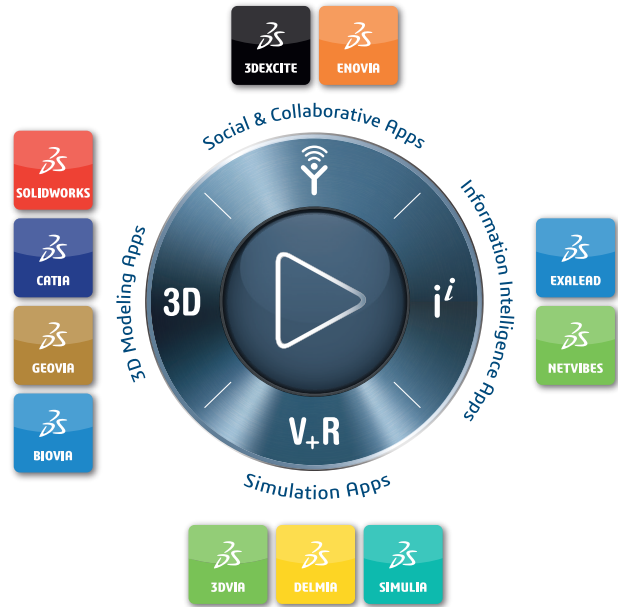
“For example, there were 70 work packages in the LOCOMACHS project, which translated into 70 different technologies being tested by the 31 participating companies,” Helgesson said. “One project may involve two companies, whereas another one comprises several companies working on a particular technology, such as a new drilling process or a new measurement system. If one party is designing a fixture to hold the wing and another is designing a new type of drilling technology, then they obviously need to collaborate at one point or another, right? In addition, to having a powerful simulation solution like DELMIA to rapidly try out new designs to see if they work before committing to the final build. The aerospace industry has a lot to gain by adopting an integrated and collaborative environment that facilitates the complex process of building an airplane. An environment like the **3DEXPERIENCE** platform can definitely facilitate this process,” he concluded.

Watch this video on “Future Lean Wing Factory Simulation in **3DEXPERIENCE** – LOCOMACHS” at www.youtube.com/watch?v=jmmNTUkSyug&t=6s

1. Global Market Forecast, Mapping Demand 2016-2035

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Virtual simulation confirms best design option

Prodtex developed virtual demonstrators to prove the concepts put forth in these two work packages and used Dassault Systèmes **3DEXPERIENCE** platform including CATIA® to design the hexapods for the wing's fixture system. DELMIA was used to simulate the assembly process of the wing and future assembly line. "Before building a physical demonstrator for each of these projects, we first virtually simulated the processes virtually using DELMIA," Helgossion said. "For example, we had the 3D model of the wing, but there were multiple ways of assembling it. Thus, we used the software to determine the best result. Based on this, we designed and simulated the hexapod robots to install the ribs in the wingbox. We tested various scenarios and any clashes or interferences were clearly displayed, which allowed us to correct our robot design accordingly before we built hexapod robots."

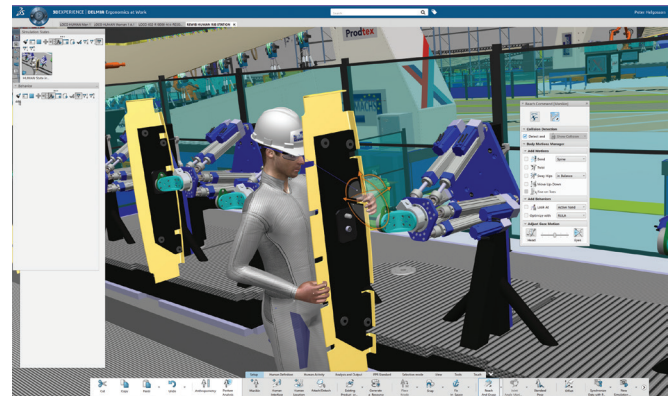
"For the second work package, through simulation, DELMIA helped us define the number of operators required to assemble the wingbox. It also allowed us to check our takt time and enabled us to foresee potential bottlenecks. In addition, in terms of operator's health and safety we used the ergonomics aspect of the software to help us design platforms to allow an operator to safely reach the work area."

There were many benefits to using DELMIA in these two work packages. "Virtual simulation enabled us to prove our build concept and verify the assembly path of the parts in the factory," Helgossion said. "In addition to access and reach of operators and equipment as well as ergonomics improvements, we were able to more efficiently balance the workload between stations and reduce overall lead times because there were fewer errors to correct. DELMIA can also produce virtual work instructions that are easier to understand than text-based documents, which cuts operator training and ensures information is live and updated," he said.

The LOCOMACHS project ended in the summer of 2016 and many of the participating companies have since continued perfecting certain technologies in preparation for new aircraft programs. "Manufacturers are looking ahead preparing for their new generations of planes," Helgossion said. "And maybe one day, if I'm lucky, I'll get a phone call from a company asking to use our new hexapods for their new wing assembly line. That would be rewarding."

Collaboration, the path to efficiency

Peter Helgossion believes the aerospace industry still has some progress to make when it comes to collaboration. "Real-time collaboration is not yet culturally the norm," he said. "Project stakeholders work more in silos than together in parallel, which causes delays and reworks. We've really stretched an engineer's lead time. They can't go any faster because we have individual people doing their jobs, and passing it over to the next person who needs to review the work, provide feedback, and make corrections. This all takes time. If, however, everyone accessed the same trusted data on the same platform and made decisions together, the potential for savings would be huge."



Different **3DEXPERIENCE** applications were used to simulate the future wing production line (for example, Ergonomics at Work application was used to study operators workstations layout, reachstudies, and ergonomics). Robot and equipment simulation was used to demonstrate the assembly processes of the wing structure and equipment.

Focus on Prodtex

To deliver high-end solutions, development and sales of software and production equipment to the manufacturing industry. The focus is to rationalize our customers processes and methodologies. We deliver accompanying consultancy in management and engineering technology internationally in the automotive, aircraft, and offshore industries.

Offering:

Production of tools and equipment, as well as consulting services and software solutions in automation and manufacturing for the automotive, aerospace, and offshore industries.

Employees: 20 (approximate)

Revenue: approximately 2.5m €

Headquarters: Gothenburg, Sweden (and Bristol, UK)

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