PRESS RELEASE

Research Project „TAVieDA“

New Concept for Materials and Production Drastically Reduces Manufacturing Time for Aircraft Doors

Passenger aircraft doors are still primarily manufactured by hand. A particularly time-consuming aspect is assembling the door structures using screws and rivets. Numerous intermediate steps are required to prevent direct contact between different materials – which would otherwise lead to corrosion. However, replacing aluminum, titanium, and thermosets with primarily thermoplastic carbon fiber composites (CFRP), which can be welded together automatically without separating layers, makes the process much faster. Manufacturing time for the door structure drops from 110 hours to just 4. A research project by Fraunhofer IWU, Fraunhofer LBF, Trelleborg, and Airbus Helicopters has shown this clearly.

Another key factor in shortening assembly times is the modular design for different aircraft door variants. The project team specifically looked for components across various door models that could be standardized – and found success, for example, with the crossbeam. The researchers designed a fully automated assembly line for the most common models and developed fixtures and clamping elements suitable for resistance and ultrasonic welding technologies.

From Workshop Craftsmanship to High-Paced Industrial Manufacturing

Dr. Rayk Fritzsche, project lead at Fraunhofer IWU, stated:
"Together with our colleagues at Airbus, we closely analyzed all door structures to adapt the geometries for automatic clamping and joining. As a result, we could reorganize and fully automate the individual assembly steps. This way, we slash the lead time to a fraction of what it used to be." Manual labor is now only required to install the locking mechanism.

Two almost identical assembly and joining lines ensure redundancy if one line is unavailable. Thanks to standardization measures, batches of 10 doors can now be organized, allowing for fully automated line retooling at the end of each shift to accommodate the following model series. With a production capacity of 4,000 doors per year, the new material and production concept leads to significant scalability benefits.

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Does Investing in New Production Equipment Pay Off in the End?

Maxi Grobis, from IWU's factory planning, simulation, and evaluation team, simulated all technical and economic aspects of the new assembly line—factors that often influence each other. Key technical assessment criteria included product and process complexity, opportunities and risks of automation (especially concerning flexibility and adaptability), and overall system availability across a chain of individual automated systems.

Automating just for automation's sake wasn't an option. Grobis emphasized: "To deliver a truly integrated solution, we analyzed the entire door production and assembly process and translated it into a dynamic cost model. What works technically also has to make sense in terms of capital expenditure, machine hourly rates, maintenance effort, energy costs, capital commitment, and depreciation. Focusing solely on labor cost savings or shorter lead times would be shortsighted."

Considering all technical, logistical, and financial factors, there is a clear recommendation to implement the newly developed automation solution. Grobis is proud that her integrated simulation approach also reduced planning time by about 25%: Thinking about economics from the beginning saves unnecessary revision loops during planning.

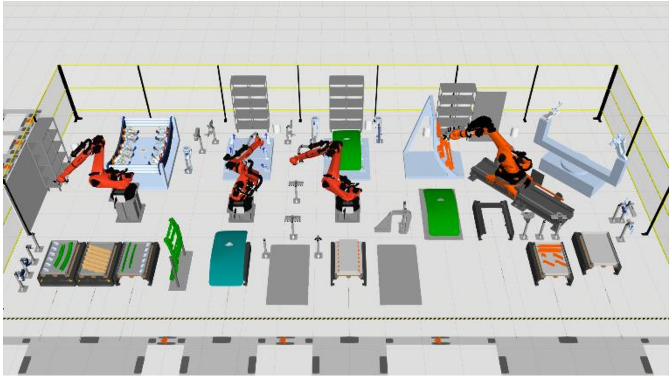

Fig. 1 Screenshot (Video available online): Fully automated assembly/joining processes and logistics for the door structure. © Fraunhofer IWU

Fig. 2 The TAVieDA project team: Christian Wolf, project manager at Airbus, presents a thermoplastic composite side beam. Fourth from the right: Dirk Herborg (DLR Project Management Agency). Wearing a gray blazer: Dr. Rayk Fritzsche. Fifth from the left: Maxi Grobis.

Fig. 3 Clamping element developed at Fraunhofer IWU for automated clamping and joining of thermoplastic carbon fiber composites in aircraft doors (e.g., crossbeam).

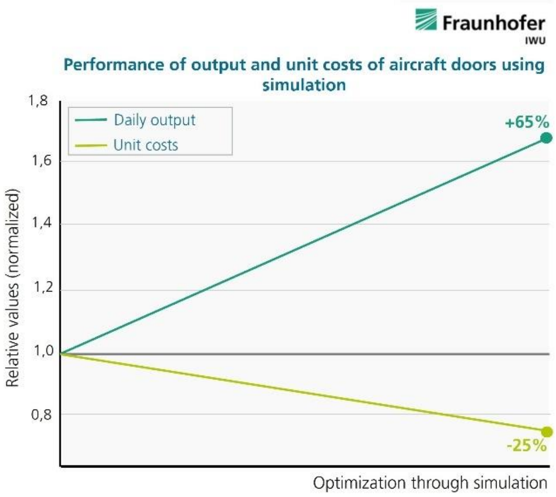

Fig. 4 As part of a new approach, cost modeling was integrated directly into the simulation environment, allowing for simultaneous calculation of unit costs alongside simulation results.

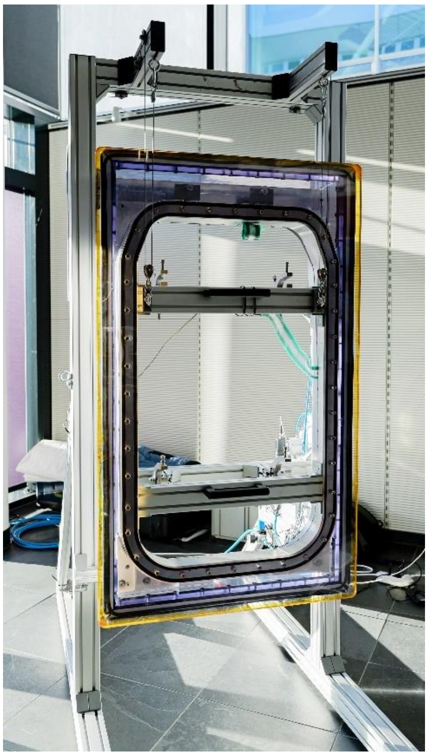

Fig. 5 Fraunhofer LBF developed and validated experimental measurement technology for sensor-integrated aircraft door seals in the TAVieDA project; project partner Trelleborg developed the new sealing geometry with, for instance, the help of finite element simulations. In this process, the component under consideration is virtually divided into a limited number of small, simple geometric elements (finite elements).
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About the TAVieDA Project: TAVieDA (Rapidly Installable and Durable Aircraft Door System Using the Versatility of a Tolerance-Compensating Seal and Automated Assembly) is a collaborative project between Fraunhofer IWU, Fraunhofer LBF, Airbus Helicopters, and Trelleborg. The German Federal Ministry for Economic Affairs and Climate Action funded TAVieDA as part of the national aviation research program (LuFo).

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