

TERRAFUGIA, INC.

Designing an airplane that can drive down the road with SolidWorks software



Using SolidWorks software, Terrafugia was able to innovate the first practical, integrated, roadable aircraft within a compressed design cycle.

Planes fly through the sky and cars drive along roads, but a vehicle that can legally do both is an idea that has resided in the realm of science fiction, until now. Founded by engineering and flying enthusiasts who attended the Massachusetts Institute of Technology (MIT), Terrafugia, Inc., has turned the flying car—or, more accurately, drivable plane—into a reality. Established in 2006 by award-winning, MIT-trained aeronautical engineers and MBAs, the company has combined the experience of passionate pilots, the ingenuity of skilled engineers, and the advent of new Federal Aviation Administration (FAA) regulations to create the Transition® Roadable Aircraft, a personal airplane that converts into an automobile.

The company's founders realized that the technical challenges of merging a plane and a car would require a robust and flexible development platform. "We needed a design package that could handle the mechanical assemblies required for the project, such as engine, suspension, and drive train systems, as well as the complex, aerodynamic surfaces involved in developing the fuselage, wings, and controls," Engineer Gregor Cadman notes. "As a startup company, we also valued a design system that provided the diverse range of tools we needed at an affordable price."

Because the company's engineers had learned the SolidWorks® design system during their studies at MIT, they already knew how to use the software and were aware of its capabilities. "Ever since we started to create CAD models, we have used SolidWorks software," Cadman says. "It was a natural transition for us because there was no learning curve involved. Many of us had used it in school, and knew that the software was capable of doing what we need."

Terrafugia chose SolidWorks software, acquiring five licenses of SolidWorks Professional and one license of SolidWorks Premium, because it is easy to use, provides advanced surfacing tools, offers robust large-assembly capabilities, and includes integrated applications, such as SolidWorks Simulation and SolidWorks Routing. The company also prizes the flexibility afforded by the widespread use of SolidWorks software in the industry, such as the ability to download component and system models from websites like 3D ContentCentral®, or to interface effectively with vendors.

Challenge:

Develop a new type of aircraft that converts into a street-legal car for driving on roads in addition to flying through the sky.

Solution:

Utilize SolidWorks design and simulation solutions to accelerate development by quickly addressing aircraft and automotive vehicle safety and performance requirements.

Results:

- Accelerated development process
- Minimized weight while maintaining strength
- Saved time with automated routing application
- Innovated the first practical, integrated, street-approved aircraft

A plane that drives, a car that flies

Unlike novelty flying cars, the Transition® is first and foremost an aircraft. Terrafugia designed the plane for use by sport pilots who fly to business and personal engagements and need a road vehicle for commuting to and from airports. Because the vehicle functions as both an airplane and a car, it must meet two very different sets of government safety and performance standards, including FAA and National Highway Traffic Safety Administration (NHTSA) requirements.

"The Transition® has to be light enough to fly yet strong enough to pass crash safety tests. Therefore, our challenges involve optimizing components and assemblies for weight without sacrificing strength," Cadman explains. "With the large-assembly capacities of SolidWorks software, we can move components around within the context of an assembly, and then use SolidWorks Simulation to reduce material wherever possible to drive down weight while maintaining strength."

Routing vehicle systems

Terrafugia engineers have come to rely on another SolidWorks tool: SolidWorks Routing, which automates the design of distributed systems. Instead of manually modeling every wire, cable, and hose in the vehicle, the company's engineers use SolidWorks Routing software to automatically create these systems, saving time in the process.

"We use SolidWorks Routing to route electrical wiring, brake lines, fuel lines, cooling hoses, and control cables," Cadman stresses. "The software helps us to make sure we have the necessary room for these systems as we try to conserve material and reduce weight."

Flexible, agile development

The ability to modify designs quickly and easily in SolidWorks software is important to the project and has allowed Terrafugia to accelerate the development process. From the first proof-of-concept vehicle through the preproduction prototype, prototype, and production models that follow, SolidWorks software is helping Terrafugia to maximize the utilization of resources and move the project forward. For example, the company's engineers downloaded SolidWorks models of off-the-shelf components used in the design from the web, including the 100 hp, four-cylinder engine.

"Instead of modeling everything from scratch, we can download models online and import them directly into our design," explains Cadman. "The more time we can save the better. SolidWorks software has proven to be a good tool for helping us do that."

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Gregor Cadman
Engineer



In addition to using SolidWorks design software, Terrafugia leveraged SolidWorks Simulation and Routing solutions to accelerate the Transition® design.



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