

Aerospace and defense

Pratt & Whitney

Jack works for Pratt & Whitney and its customers

Product

Tecnomatix

Business challenges

Control costs and speed delivery of new military and commercial aircraft engines

Provide customers with engines that require fewer maintenance hours

Keys to success

Include design for maintainability considerations upfront

Simulate human maintenance in software to optimize the design

Communicate maintainability issues via 3D visualizations

Validate maintainability with virtual reality immersion

Results

Reduced development costs through earlier consideration of maintainability features and elimination of physical prototype

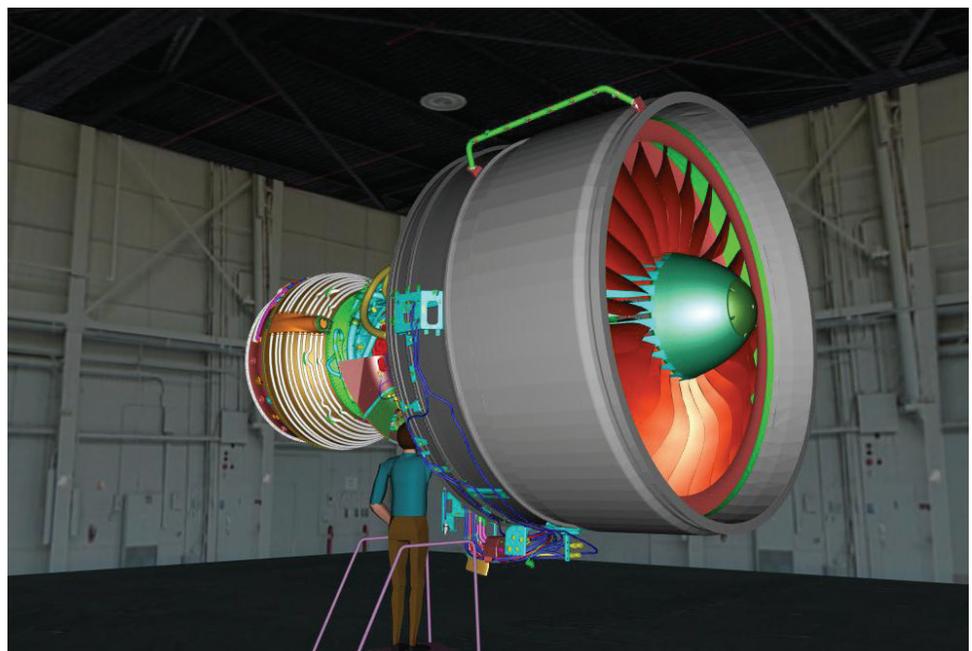
Customers' maintenance costs and downtime reduced

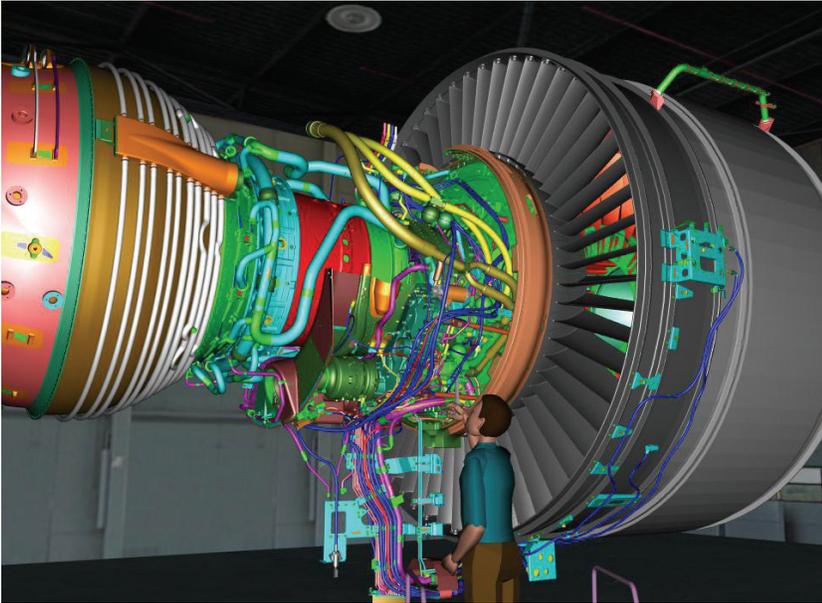
Jack human simulation software helps Pratt & Whitney by speeding aircraft engine development. Customers benefit from reduced maintenance downtime.

With routine maintenance accounting for a big part of aviation costs, Pratt & Whitney designs engines with the goal of minimizing maintenance downtime.

Considering maintainability from the start

Aviation experts agree that maintenance accounts for a large part of the cost of owning airplanes. Cost estimates range from 12 to 35 percent depending on the situation, such as whether it's a military or commercial airplane, the type of plane, etc. The cost isn't just the parts and labor, although they are significant. The downtime is even costlier. For every hour that a passenger airplane, for instance, sits on the ground for maintenance, the carrier loses hundreds of thousands of dollars in revenues.





Knowing that customers want to keep their planes flying as much as possible, Pratt & Whitney builds engines with maintainability in mind – from the beginning of the design process. The company, which has built more than half of the 34,000 commercial aircraft engines in service today and more than 40,000 military engines, practices design for maintainability. Its goal is to minimize downtime by making maintenance operations as simple as possible. “We strive to ensure that all line-replaceable components are one-deep,” says Ken Bennett, a senior engineer in Pratt’s Maintainability Engineering Group. That means the mechanic doesn’t have to remove more than just the one part that needs replacement. And that can mean the difference between a 15-minute operation and a half-day process that might even necessitate removing the engine from the plane.

Virtual human mechanics

Like all engine manufacturers, Pratt & Whitney also strives to control its own development costs while getting new

engines into circulation as quickly as possible. One technology that helps do this, while facilitating design for maintainability, is the human modeling software, Jack™. Jack lets Pratt designers create digital people who interact with digital engines. (Engine geometry, from NX™ software, is imported seamlessly into Jack so maintainability analyses can be updated quickly as the design evolves.) Issues such as accessibility, visibility and tool clearances are studied by having Jack perform maintenance operations virtually. The human model can easily be scaled to see how people of different sizes will perform a task. The ergonomics capabilities of Jack let designers evaluate operations for safety and comfort.

In the past, maintenance operations were evaluated by building a physical mockup of the engine and having real mechanics work on it. One drawback to this approach is that the design had to be fairly developed to build a mockup and if problems related to maintainability were found, it was late in the design process when changes were quite costly and difficult to make. Results of Jack simulations guide engine design from the earliest stages. “Because these maintainability studies are done up front, in the early stages of the design, we don’t have to go back because of a maintenance issue and rework a problem found in a physical prototype, when the cost would be much greater,” says Bennett.

The more serious drawback to the old method, however, was the cost of the physical prototype. It was typically a full-sized metal mockup that was very expensive to produce. The government was well aware of this when it required Pratt to perform all maintainability analyses of the Joint Strike Fighter (JSF) military jet virtually. “They actually wrote that into the contract, that no prototype could be built with the sole purpose

Solutions/Services

Tecnomatix
Jack
www.siemens.com/tecomatix

Customer's primary business

Pratt & Whitney, a United Technologies company, is a world leader in the design, manufacture and support of aircraft engines, gas turbines and space propulsion systems.
www.pratt-whitney.com

Customer location

East Hartford, Connecticut
United States

"With Jack, we build in maintainability from the start, so we don't have to make expensive design changes later. That, and the fact that we don't need a physical prototype, are significant cost savings for us. The optimizations we're able to make because of Jack lead to cost savings for our customers."

Ken Bennett
Senior Engineer
Maintainability Engineering Group
Pratt & Whitney

being maintainability," says Bennett. "By having us address these issues with virtual reality, it's a big cost savings for them."

Benefits for company and its customers

Along with the JSF engine, Pratt & Whitney is using Jack on a number of other engine programs, including the GP7000, an engine being developed jointly with General Electric for the new Airbus A380 aircraft. In addition to using the program for maintainability analyses, Pratt has begun incorporating Jack animations into design reviews, both internal and external. "We're using Jack in front of customers, and management sees the value of that," says Bennett. "Jack animations provide a powerful advantage for visualizing issues and responding with answers prior to building. It also reinforces to customers that we're taking advantage of the most up-to-date technology in our design for maintainability efforts."

One of the programs where Jack is getting a good workout is the GP7000. In addition to maintainability studies and optimization of the engine layout, Pratt is using Jack to create animations demonstrating different maintenance operations, with the goal of optimizing them. As with the JSF engine, a crucial benefit to Pratt is avoiding the cost of a physical prototype by doing these maintenance studies virtually. Jack is also helping keep development on schedule by eliminating late design changes driven by maintenance issues.

Pratt & Whitney's customers also benefit from the use of Jack. They get an engine optimized for the lowest maintenance downtime possible. In the case of the Airbus A380, this will result in huge savings. This plane is going to carry the biggest payload in aviation history. It stands to reason that it will also incur the biggest downtime losses of any aircraft. With an engine that has been optimized for maintainability by Jack, Airbus should save millions of dollars over the life of these planes.

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