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engineering & manufacturing

Simulation

Rhinoceros helps Epic Victory go from idea to air in six months

In December 2006, the concept plane was purely that—an idea that was casually discussed among managers and designers. **Epic Aircraft** of Bend, OR, had manufactured several single-engine turbo-props and twin-engine jet models, but a plane with just a single jet had never been attempted.

"It was a crazy idea we tossed out, and it became a real program," said Dieter Koehler, Director of Engineering at Epic. At Christmas, the one-engine jet was merely a subject of conversation; in July, the Victory prototype took off for its first successful test flight.

Epic's urgency was moti-

vated by the desire to fly this type of experimental plane at the 2007 EAA AirVenture show in Oshkosh, WI.

According to Koehler, new aviation customers have been "flocking" to single-engine jets debuted by Epic's competitors, **Diamond** and **Cirrus**. To make the show at Oshkosh was critical to capture a piece of this rapidly growing market.

At first, it seemed more sensible to aim for the 2008 air show, but after Koehler drew up a tentative schedule around the first of the year, "it looked like there was a pretty good potential that we could make the event in 2007. We decided to give it a shot," he said. "In the end, it was the

most stress-free—and also the shortest—program I've ever worked on."

Rather than a commercial passenger-carrier, the Epic Victory is referred to as a PJ, or personal jet. Pilots who maintain their own craft find one engine easier to handle than two, and enjoy all the benefits of jet propulsion as opposed to more traditional propeller-drive mechanics. The Epic PJ is capable of speeds up to 368 mph, and can fly up to 1380 mi without refueling. The real appeal may be that the PJ is easier for the individual pilot to purchase.

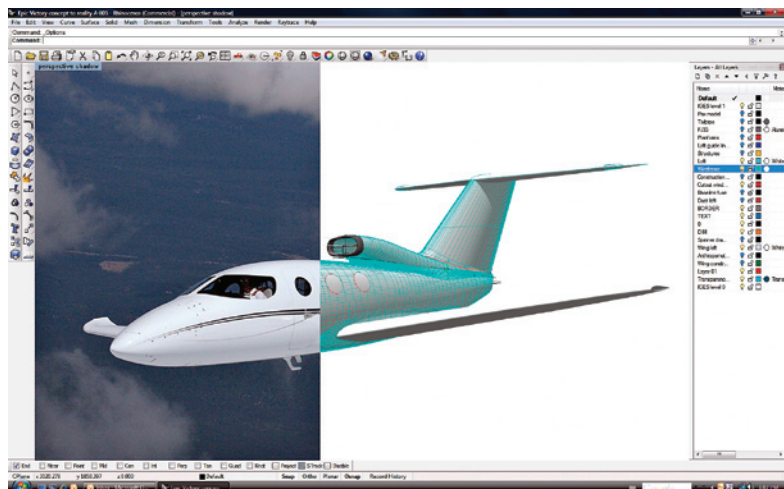
One of the first steps in the Victory development was the exterior styling. The short-order task was commissioned to an expert aviation designer on the other end of the continent. Luc Van Bavel, an independent consultant in Quebec City, Canada, specializes in performance modeling and exterior and interior 3-D renderings of very light jets, with an emphasis on lofting—composing the aerodynamic lines of an aircraft's form.

An early copy of the new **Rhinoceros 4.0** surface modeler captured Van Bavel's conception of the lightweight jet. "Since it was my third production loft experience with Rhino,

I knew I could deliver the goods within strict time constraints," said Van Bavel, who finished the loft model in just 10 days. "The loft needed to be very clean and smooth. If it wasn't, the structural parts created from the loft would have all kinds of geometric issues that would have considerably slowed down the workflow of the design engineers."

Van Bavel's natural feel for aviation shapes not only gave aesthetic form to Epic's new idea, it also gave engineers at Epic a lofting model with the aerodynamics practically complete. Features like the wing-to-body fairing and the engine inlet were viable on the first take, without the dozens of iterations between CFD testing and the model that is oftentimes the case in new development. "I made the loft without CFD analysis. It had to work the first time because we wanted to be quick. So I based it mostly on intuition," said Van Bavel.

With delivery of Van Bavel's lofting model, the Epic design team was ready to fill out the structural elements of the plane starting in February. While engineers confirmed the aerodynamic stability of the Victory's shape, other design-



The Rhinoceros 4.0 surface modeler was used for the exterior styling of Epic Aircraft's Victory personal jet.

ers were already starting to build out the structural components in SolidWorks.

"Everything runs simultaneously and in parallel," said Koehler of Epic's design and production mobilization. "To do something fast, you have to be very disciplined. The set shape is taken from Rhino and those dimensions frozen with respect to all the mechanical development that follows. We close the book on aerodynamics, and all structural work afterward has to conform to that envelope."

Epic's history of success as a manufacturer provided it plenty of 3-D assets. Owning this previously developed intellectual property makes the typical timeline of 12 to 18 months for airplane development unnecessary. The company can skip over the complexities of avionics and pressurization systems by reusing and modifying designs from previous projects. By keeping the lofting model as the master guideline for accuracy, designers model or modify each part to an exact fit, and then immediately order it into production.

"After eight weeks, we were two weeks ahead of schedule. We could give the shops a little more leeway," said Koehler. Epic outsources the CNC manufacture of composite molds to not just one vendor but to many. Four different tooling houses across the country produce the molds for the Victory's wing, tail, and cabin structures. "One just doesn't have the capability to do it so quickly," he said.



The Epic Victory, capable of speeds up to 368 mph, had an accelerated development schedule of six months in effort to debut at the 2007 EAA AirVenture show in Oshkosh, WI.

Additionally, other fabrication tasks—assembly fixturing or custom mechanic components—are distributed among several local shops.

Production and design work can proceed in tandem because all parts adhere strictly to the computerized master model. Employing composite material in construction—which can be automatically cut with 3-D data—proves easier for fast development than the old methods of sheet metal fabrication.

"CNC work on the composite molds gives you extreme accuracy. The dimensions of the tooling and the computer model are pretty much the same," said Koehler. "And it's faster. Six weeks after we're done with a design file, we've got all the tooling delivered. It would never be that quick in metal. Metal fabrication takes too long and would

put too much variability in the final assembly. Inaccuracy creates hiccups in the design process. I can't afford a hiccup, since it may cost me two or three weeks."

The thousands of parts that make up the Victory came together in late June without any hiccups. The aircraft took off for its virgin flight shortly after Independence Day.

"We planned the schedule out in very fine detail. It worked out so well that there was almost no overtime at all. We had one weekend where our engineers came in for the final inspection. Otherwise, the program used no time outside the regular work hours," said Koehler. "A lot of companies give a lot of praise for a rushed project, where everyone chipped in 10 to 16 hours a day. I can't do that, since we do big projects on a regular basis. I would burn out my tal-

ent if I worked them around the clock like that."

CEO Rick Schrameck attributes much of the firm's success in the ability of manufacturers to showcase experimental planes to test market response. The much longer (and more costly) engineering and testing process of **FAA** certification can be completed after the prototype is built and many prospective customers are garnered.

The Victory personal jet now seems to be moving fast in the direction of certification and commercial success. The six-month prototype design for AirVenture was, in Koehler's opinion, ready for production as-is. Instead, a few modifications, like a bigger, faster engine, will be made to sharpen the jet's competitive edge.

Matt Monaghan edited this article based on information supplied by **Brett Duesing**, Senior Technology Writer, Strategic Reach PR.