# PLM solutions help launch revolutionary jet

Next-generation digital mockup and validation capabilities compress development and permit an unprecedented level of design optimization

## Issues:

Deliver a completely new – industry-changing – aircraft

Control costs so company is profitable with jet price around $1 million

Meet FAA requirements

## Approach:

Manage all aircraft information from a single repository

Compress design cycle by optimizing aircraft and factory in virtual space

Use digital models for in-house and FAA design reviews and communication with suppliers

Validate with digital models so prototypes are production-representative

## Results:

Product information accessible and meeting FAA requirements

Early error detection with rapid navigation through virtual mockup of entire plane

Assembly time for jets reduced from months to days

More than 2,100 planes pre-sold

## ECLIPSE AVIATION CORPORATION

▶ Eclipse Aviation's new jet will break open the small aircraft market, selling for around $1 million and costing one-half less to operate than today's smallest jet. The company plans to produce more than 1,000 aircraft/year.

**A jet that costs less than a turboprop**

Eclipse Aviation is doing something very unusual. The company is creating a six-place, twin-turbofan jet aircraft that will cost less than most used turboprops. The revolutionary Eclipse 500 aircraft, available in early 2006, will sell for $1 million, approximately one-quarter the cost of similar small jets. It is also designed to be more economical to own and operate than most of today's large single-engine aircraft and almost all multi-engine piston and turboprop aircraft. The

Eclipse 500 will make it possible for those who have only dreamed of owning a jet to actually buy one. And for those who don't want to pilot themselves, Eclipse believes that its aircraft will open the market to aircraft charter and air taxi services, complete with professional pilots, that will be competitive with full-fare airline tickets.

Not only is Eclipse starting from scratch with the aircraft, its factory will be brand new, too. The company plans to produce more than 1,000 aircraft each year. This is an order of magnitude beyond what most other small aviation companies achieve. "In this market segment, it's considered a success if you produce 100 aircraft a year," explains Dr. Oliver Masefield, senior vice president of engineering at Eclipse Aviation. "To reach our goal of producing 1,000 plus aircraft annually, we must develop new technologies that let us manufacture at high volume and low cost."

## UGS
The PLM Company

The challenges associated with this undertaking are enormous. Among the biggest is, of course, cost. Eclipse is aiming to deliver its first aircraft at a dramatically reduced cost, in fact, an industry changing price model. Having some of the aircraft's components manufactured offshore will help control costs. But a global supplier network brings its own challenges, such as communication and information control. Time is another key element, especially during certain phases of aircraft development, such as the design cycle.

### Building the IT infrastructure

Eclipse Aviation's management realized early on that meeting these goals would require a sound foundation of product lifecycle management (PLM) technology. The company has worked closely with UGS to make sure it uses the most advanced PLM technology available. For example, Eclipse designers have modeled the entire aircraft, down to the last rivet, in NX. All product information, from digital models to the last scrap of paper documentation, is managed within Teamcenter®, which also permits visualization, digital mockup and validation capabilities. The factory is being designed and optimized in E-factory, which can import digital models of the aircraft to permit simulations of different factory layouts.



"Our ability to meet our targets depends on digital mockup and validation," says Dr. Masefield. "This allows us to achieve a degree of optimization that was previously only possible with hard prototypes. We don't have time to learn from prototypes. The ability to create digital mockups and validate them in software means that our prototypes are production-representative aircraft."

### Pioneering a new FAA relationship

Eclipse's tight design timeframe made it necessary to do as much of the design work as possible digitally. "To optimize this aircraft for weight, cost and maintainability requires many, many design iterations," says Masefield. "Typically optimization is done by building and testing metal mockups and revising the design based on the results. By doing this work digitally, we cut an enormous amount of time out of the design cycle."
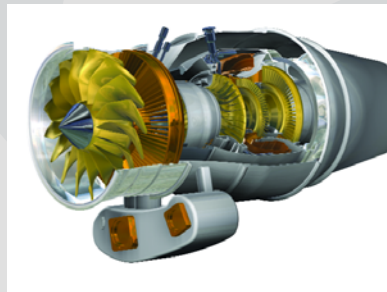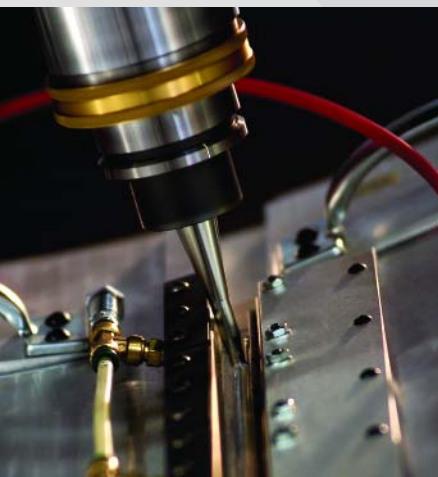


Eclipse is one of the first companies to work with the FAA using digital models. In most cases, the FAA requires aircraft manufacturers to supply paper drawings as they go through the certification process. But the agency conducts design reviews with Eclipse using the company's digital models. It also allows Eclipse to maintain its own documentation rather than requiring the company to provide a complete set of documentation that resides with the FAA. This was contingent on Eclipse being able to demonstrate that it could access product information quickly and accurately.

### Rapid navigation and validation

With Teamcenter, Eclipse is able to use digital models for its frequent design reviews (3x/week during the intensive design phase). At those sessions, everyone connected with a certain section of the aircraft gets together to discuss what has recently been updated in that area. This type of visual design review takes place with suppliers as well. Because certain systems encompass a great deal of the aircraft, it is important to be able to view large assemblies and often even the entire digital aircraft, which represents tens of thousands of parts.

Normally, a model of an entire aircraft would be too large to use in a design review. It would require enormous amounts of computing power just to display the model. Zeroing in on a particular area of interest would waste everyone's time while the computer churned through the necessary calculations. This is where Teamcenter's Repeatable Digital Validation (RDV) has been invaluable to Eclipse. This solution allows reviewers to perform detailed searches of the model, such as "Show me everything connected to the cooling system" and quickly retrieve just the information they want.

"RDV lets us quickly navigate through the entire plane," explains Masefield. "We can create the precise digital mockups we need at any given moment. This has transformed the design process by allowing our designers to conduct iterations to optimize the design and keep up-to-date with current product configurations. We also use Teamcenter RDV capabilities company-wide to permit true concurrent engineering across all disciplines." This has allowed Eclipse to detect design errors early, especially cross-disciplinary errors that usually don't show up until a metal prototype is built.

### Broader uses for product information

Teamcenter's visualization technology lets Eclipse leverage product information, even very large digital models, by making it accessible to people outside engineering. Through the use of lightweight .jt image files, Teamcenter can create a mockup of the entire plane that can run on a regular PC. People involved in quality control, marketing, sales and the creation of technical publications import this fully detailed product information into their own applications, saving time and ensuring accuracy in their representations of the aircraft.

One area where the digital product information is particularly useful for Eclipse is plant design. Since the company is building a facility, it has the opportunity to customize the building for its unique needs. This demands the ability to lay out operations digitally and simulate different plant configurations. "Simulation is key with a new facility," says Charles Kraft, head of Electronic Data Management at

*"This whole aircraft program hinges on the capability of Teamcenter to manage the product lifecycle."*

*Oliver Masefield
Senior Vice President of Engineering
Eclipse Aviation*

Eclipse. "We import aircraft models into E-factory so that we can design factory spaces such as workcells and machine centers around them. Then we simulate different arrangements to find the ones that work best."

Validating a workcell in software is critical because Eclipse wants to be able to extend these production centers beyond its own operations. To meet its goal of producing six aircraft each day, that will need to happen eventually. As Masefield explains, "The biggest benefit of simulation for us is that we can validate the virtual factory at a level of detail where we can be totally confident that what we designed will work, even if we ship a workcell somewhere else."

E-factory's Factory CAD solution takes Eclipse industrial engineers (IEs) into the business of detailing the factory components such as stairs that make factories real. As Kraft explains, "Because Factory CAD is deeply integrated in AutoCAD Architectural Desktop, industrial engineers can follow their concepts into installation modeling and drawings. This marries our airplane design to facilities building by helping us take our exotic aircraft tools designed in NX into an AutoCAD environment that most every architect and installation contractor can use." Factory CAD's SmartObject tools make creating typical factory equipment a simple process of rules-based design. "Our IEs expect that SmartObjects will make it easy to create something like mezzanine stairs with handrails," Kraft adds. "The rules embedded in Factory CAD know how many steps and how high the rails should be according to regulatory requirements. So everybody working at Eclipse gets a safer factory, built faster."

By connecting Factory CAD and AutoCAD ADT to databases, Eclipse is already detailing implementations that put facilities management right into the IE's CAD workspace. Even before building a factory, asset location, cost, even the seating chart are mapped into Factory CAD. Kraft has been given a true lifecycle facilities management goal. "Our Factory CAD implementation should allow our IE's to design, simulate and present our facilities with very accessible visualization, while handling all the details in COTS databases," Kraft says.

The use of PLM software such as NX, Teamcenter and E-factory is helping Eclipse Aviation stay on track to meet its cost targets. As Masefield noted, these solutions permit the optimization of both the aircraft and factory operations to an unprecedented level in a very short time. Already the company can see proof, as prototypes are going together incredibly quickly. "A prototype of the left wing was assembled in days," says Masefield. "Under normal circumstances, that would take months." The company's vision – that an affordable jet would be well received – has been more than validated as more than 2,100 aircraft have already been presold.