Volvo Aero harnesses knowledge to gain a commanding advantage

Volvo Aero's knowledge-driven automation (KDA) system integrates design and analysis to quickly produce engine components to order

VOLVO AERO CORPORATION

Business challenges

Shrink bidding and development cycles

Respond faster to OEM's design changes

Support corporate commitment to quality

Keys to success

Incorporate design rules into modeling environment using NX Knowledge Fusion software

Create applications that integrate modeling and analysis

Control third-party programs with knowledge-driven applications

Every iteration verified using proven FEA strategy

Results

Shorter lead times; more accurate bids

Four design iterations evaluated per day vs. one per week previously

Month-long changes now completed in hours

Volvo Aero needed to speed its overall development process and improve its handling of clients' design changes.

Competitive pressures
Volvo Aero produces highly specialized components for aircraft and rocket engines. The company must respond quickly with competitively priced bids and develop new products within constantly shrinking lead times. Each of Volvo Aero's products is subject to a great deal of analysis, both finite element analysis (FEA) and computational fluid dynamics (CFD) analysis, as well as rigorous physical testing. While these activities ensure quality and manufacturability, they take time, which more than ever is at a premium.

Another challenge that Volvo Aero faces is that of adapting quickly to design changes by the client. "While we are working on our components, the entire engine system is also still in development," explains Dr. Ola Isaksson, company specialist, engineering design, at Volvo Aero. "Because there are so many interfaces between our parts and the engine, our designs change frequently." A seemingly simple question by the client such as "What will happen if we move this bearing 50 mm?" can require a great deal of work. As Isaksson explains, "Depending on how far along in development we are, we may need to do new modeling, new analyses, perhaps even physical testing and drawings." In the past, this process has taken a few weeks up to a month.

Knowledge-based solutions
Seeking to streamline product development, Volvo Aero's management evaluated knowledge-driven automation (KDA). Using this technology, design rules and other engineering intelligence – usually stored in hardcopy or people's memories – are incorporated into software. Knowledge-based applications then drive a design, automating much of the modeling and ensuring consistence and adherence to corporate standards. Volvo Aero engineers saw even greater potential for KDA. They realized that in addition to automating geometric modeling, KDA could serve as a way to standardize and control other development activities, e.g., a knowledge-driven application might be developed to integrate analysis tasks such as finite element analysis.
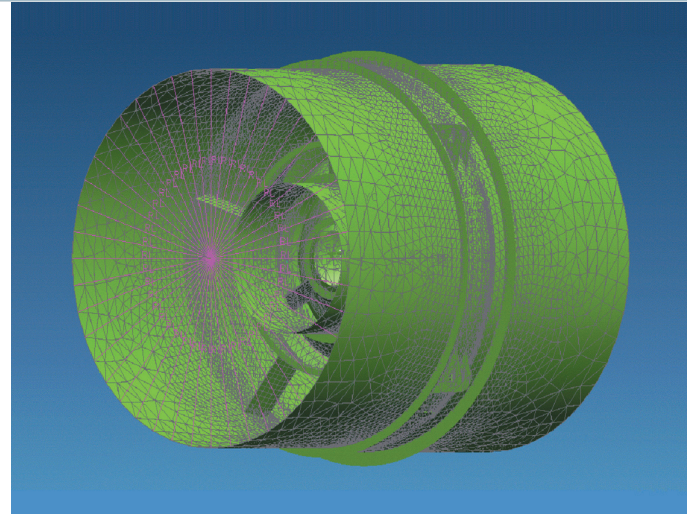
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Client's primary business

Volvo Aero develops and manufactures components with a high technology content for commercial aero and rocket engines, partnering with the world's leading manufacturers. Volvo Aero also develops and manufactures military engines.
www.volvo.com

Client location

Trollhättan
Sweden

"Knowledge Fusion allows us to create a standardized design process that ensures quality while shortening our lead times."

*Dr. Ola Isaksson
Company Specialist
Engineering Design
Volvo Aero Corporation*

"The ability to integrate feature-based CAD with demand-driven modeling and analysis has not previously been seen."

*Mats Lindeblad
Specialist, CAE Integration
Volvo Aero Corporation*

In searching for KDA software capable of supporting this vision, Volvo Aero's engineering management evaluated most of the commercial KDA programs available at the time. They chose NX™ Knowledge Fusion for several reasons. One key advantage was its tight integration with feature-based CAD, making it easier than other programs to transfer knowledge into the CAD environment. Also, Volvo Aero believes that, through development work with Siemens, this software has the best potential for controlling the broader range of development activities, including those involving third-party programs.

Impressive results

Volvo Aero has created several knowledge-driven applications. One "proof of technology" application, created for the design of an engine part called an inter casing, offers a good example of how the company will take advantage of this technology. Engineers enter functional specifications of the inter casing such as aerodynamic definitions of gas flow, a temperature map, cost requirements, assembly methods and so on. Knowledge Fusion uses the inputs to calculate design parameters, then generates a solid model and mid-surface representations automatically. An analysis mesh is also created automatically, allowing finite element stress calculations to be rapidly performed. The application generates a report, including manufacturability issues, a cost analysis, and material lists in addition to CAD geometry and behavioral analysis.

This application allows Volvo Aero to evaluate four inter casing design iterations per day instead of one per week evaluated in the past. The application creates a standardized process focused on quality where every design iteration is verified using a proven FEA strategy. The company uses the application to obtain more accurate cost estimates during the concept stage, and to react quickly to changes in the engine design. Changes that formerly took as long as a month can now be handled in hours while simpler changes are done in 20 minutes. Overall, these efficiencies result in shorter lead times for the part.

Some of Volvo Aero's other knowledge-driven applications are even more complex than the inter casing application. The company has also used Knowledge Fusion to streamline certain commonly performed CAD operations. Design processes for which knowledge-driven applications have been written are 70 percent to 80 percent more efficient compared to previous approaches. Isaksson and his colleagues continue to expand their use of KDA. The next plan involves bringing third-party applications such as CFD analysis into the KDA environment. "We see tremendous potential for KDA, in both streamlining our development process and ensuring quality," says Isaksson. "We are relying on Knowledge Fusion to provide the functionality we need to achieve our KDA vision."
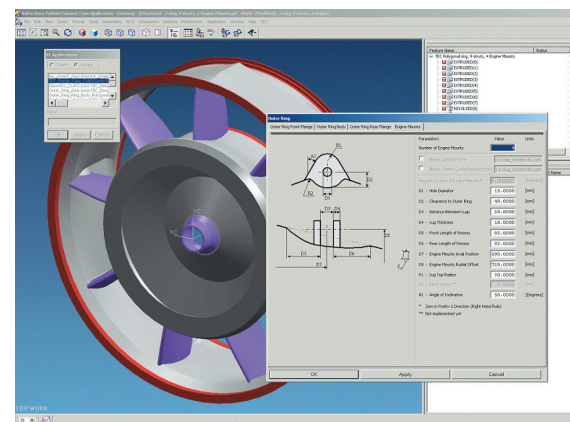
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