Ford Global Powertrain Organization

Standardizes on CATIA globally to improve design efficiency

Overview

Challenge

Ford's Global Powertrain Organization must redesign nearly all of its North American powertrains within three to four years with a significantly streamlined design team.

Solution

Ford Powertrain selected CATIA as its global design and engineering standard and implemented best-in-class modeling practices for all powertrain programs to reduce cycle times and improve quality.

Benefits

Ford Powertrain engineers have designed one major engine program, two major transmission programs, and multiple driveline vehicle programs with CATIA on time, on budget, and with improved quality.

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Storied automaker looks to future

Founded in 1902, Ford Motor Company has many historic achievements to its legendary name. From large-scale manufacturing of cars using moving assembly lines, to the invention of the pony car category with the still-popular Ford Mustang, Ford has consistently set standards for innovation and quality.

The tradition continues today. In 2007, for example, with five vehicles ranking at the top of their categories, Ford received more initial quality survey awards from J.D. Power and Associates than any other automobile manufacturer.

Still, increasing globalization of the world automobile market means that more companies are vying for consumers' business. To be successful, automakers must introduce increasing numbers of products that exceed consumers' expectations and grab their attention while continually reducing costs. Not surprisingly, one of the four priorities of Ford CEO Alan Mullaly's ONE Ford plan is to "accelerate development of new products our customers want and value."

One solution increasingly helpful to the industry's success is CATIA, a key enabler of product creation. Ford launched CATIA in 2003 for Body-in-White (BIW) development of the Ford Fusion, Mercury Milan and Lincoln MKZ vehicle programs, followed by adoption by Ford's interiors, chassis and electrical groups. Ford's Global Powertrain Organization (PTO), including the engine, transmission and driveline development groups, is the latest major Ford organization to make the switch.

"Companies that adopt the latest technology to streamline decision-making and product delivery at best-in-class quality are the ones that will rise to the top in this extremely competitive environment," said Pete Lamoureux, Manager of C3P-NG Deployment, Delivery & Digital Build, Ford Global PD Digital Innovation.

Empowering global communication

Ford Motor Company operates in 200 markets across six continents, so it is critical for powertrain engineers and designers to easily share design information, processes and tools on a global scale. The Powertrain organization

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alone works with 42 manufacturing plants, four design and engineering centers and six prototype facilities in 14 countries.

The organization's workload also is enormous, adding to the imperative of seamless communications. In the past year the Powertrain organization has launched 20 major programs; overall it supports more than 120 programs, including in-line, diesel and v-engines, drivelines, and automatic and manual transmissions.

One of the latest Ford Powertrain innovations is EcoBoost, a new high-volume, affordable engine technology slated for a range of global vehicles, from small cars to large trucks. EcoBoost uses gasoline turbocharged direct-injection technology for up to 20% better fuel economy, and cuts CO2 emissions by as much as 15%. The new technology will be available in half a million Ford vehicles annually in North America during the next five years, beginning with the new Lincoln MKS and Ford Flex in 2009.

Driving efficiency improvements with CATIA

To meet the challenge of migrating many of Ford's existing global powertrain programs while designing new programs with a significantly streamlined team, major improvements in efficiency are paramount. Key capabilities for meeting this goal included the need to develop and adopt new best practices and methods, launch an integrated template strategy that contributes to more consistent designs of higher quality, and leverage improved design capabilities to prepare all engineering disciplines, including suppliers, for implementation.

Updating PTO's CAD tool to take advantage of new technology also presented opportunities, including the ability to leverage intelligent features through embedded knowledgeware, and accelerated development through a greater reliance on engineering analysis at the design stage to arrive at solutions faster.

The Powertrain organization therefore decided to leverage its new solution worldwide to support Ford's focus on improving time-to-market, further increasing product quality and reducing product development cost.

Moving fast and intelligently

Dassault Systèmes (DS) consultants worked on site with Ford to get the adoption off to a running start, and remain on site to assist Ford in identifying new opportunities to maximize the return from its new capabilities. DS consultants also provided customized training and assisted in the development of methods and improved processes. Advanced Powertrain training was developed based on proven best practices, coupled with Ford-specific content.

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Ford also recently selected DS to provide a global training program based on CATIA and Companion, the DS e-learning solution.

A big change with no productivity loss

Pilot projects were established, and the engine teams in both Europe and North America have completed initial engine designs. More than 95% of the pilot projects for transmission assembly have been modeled and released for production. In all, six programs in the Transmission and

Driveline organization have migrated more than 80% of all activity to CATIA V5. Five programs in the Engine organization have migrated as much as 40% of their activity to CATIA V5. Ford also is taking advantage of its expanded capabilities to migrate away from expensive-to-maintain custom tools and methods it had developed over the years.

“Today, at the one-year point, productivity is already higher and we are positioned for further gains by taking advantage of advanced features,” said Lisa Greene, Transmission and Driveline Engineering CAD/CAE Manager. “With such a major change we would have expected significant delays as our technical team overcame the learning curve, but the initial project was completed in the same time that would have been required with our previous heavily customized tools.”

Master skeletons improve design robustness and reusability

Based on the success of the initial pilot, the Powertrain organization has utilized advanced solution features to achieve additional improvements in its design and engineering methods. For example, to promote robustness and reusable products, Ford Powertrain staff defined master skeletons that allow many related parts to be updated with a single change entry. When the skeleton is updated, all of the designers working on components referenced to the skeleton automatically receive the update.

Within engines, for example, Ford can now iterate concepts for valvetrain designs significantly faster, reducing time and/or allowing more iterations to be completed.

“Templates have helped us reduce the design time for the cylinder head and valvetrain by up to 11 days for each iteration, and we often have 20 iterations,” Bautz said. “This makes it possible to optimize the design to a higher quality level. Preliminary estimates are that we can cut three to four weeks off the time required to concept and design an engine.”

Ford Powertrain engineers also have begun creating templates in CATIA to make the design of hard-to-model parts consistent, leading to higher-quality designs. For example, gears and splines for transmissions were previously modeled manually. This approach was time-consuming and prone to errors such as an incorrect profile angle. If undetected, this could require correcting the dies at a substantial expense after tooling was complete.

“Ford’s integrated template strategy is a top-down philosophy to drive modeling standards, incorporate design engineering rules and increase reusability to drive higher quality and reduce time,” said Sassan Khoubyari, Powertrain C3P-NG Methods and Deployment Lead, Ford Global PD Digital Innovation.

Ford PTO designers can now enter intelligent rules-based information that defines the gear or spline, such as the pitch diameter and number of teeth. The template automatically generates the design, saving an average of two hours for each of the 18 gears in a typical transmission. Additional time is saved downstream, thanks to the ability to quickly make changes by modifying design parameters, and a substantial reduction in errors that would otherwise require costly downstream changes.

Associative capabilities accelerate iterations

Setting the hard points and sizing for the cylinder head and valvetrain is another example of the value Ford has achieved.

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The valvetrain – the portion of an engine that includes the valves, lash adjusters and rocker arms – was not associative in the powertrain organization's previous CAD tool, so portions of the design had to be rebuilt from scratch with each design iteration.

Leveraging associative capabilities in CATIA, Ford engineers developed a head and valvetrain skeleton model that references the required components and their relationships and then automatically updates the design with each new iteration. The valvetrain template will eventually work in concert with other design templates, along with additional templates used for engineering analysis and production tooling.

"The time we save on each design iteration gives us the ability to run substantially more design iterations than was possible in the past," Bautz said. "This means we have more time to produce a more robust design and provide better performance and reliability to our Ford customers."

The Powertrain technical staff is now developing templates and deploying advanced modeling practices for all future powertrain programs.

Fast start is just the beginning

Ford has gotten off to a fast start with strong results, but the Powertrain teams see numerous opportunities to build upon the benefits already achieved and extend them to new areas.

"We are continuing to explore opportunities to increase the integration between CAD, CAE, and engineering disciplines to improve concurrent engineering," Khoubyari said. "We are looking to take days and months from our development process by exploiting this advanced technology."

For example, Ford is starting to integrate design rules into CATIA. One application of this capability is to establish protection zones that can be used to provide clearance for inserting the engine and transmission into the vehicle during the assembly process. Intelligence is provided so that the zone cannot be violated by parts installed before the engine and transmission, but can be violated by parts installed after that point. Protection zones are also defined by sweeping the engine and transmission around an axis to identify areas subject to roll during acceleration and deceleration, so these zones can be kept free of parts.

"It's the technology solution plus the employee knowledge and can-do attitude that brings results," Bautz concludes. "When you give the right tools to a strong team such as ours, there's no limit to what they can accomplish."

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