TECHNOLOGY TRENDS IN PLM

Ford Motor Company Scores Quick Win with Teamcenter Simulation Process Management

Keith Meintjes, Research Director, CAE • December 7, 2010

The CPDA Design/Simulation Council has focused consistently on simulation data management, process management, and the automation of CAE workflows. Part of the Council's effort is to document case studies on the payoffs and challenges of simulation data management and process automation.

Teamcenter Simulation Process Management was recently installed at Ford Motor Company, which quickly realized substantial gains in their process to develop CAE models. In 2009, Ford began planning to exploit Teamcenter's simulation process management capabilities, to replace their in-house tools. The system was installed in April 2010, and deployed to production in May. One key objective was to fully leverage an out-of-the-box solution and not a dedicated or proprietary solution. Virtually no customization and a low effort on configuration of Teamcenter were required, in part because Ford has had extensive experience with the toolset. Within a few weeks, Ford saw efficiency gains of four to eight times in critical steps for creating and managing CAE configurations. Dr. Ulrich Fox, manager of the Mesh Development group, attributes these gains to the richer, more capable data model in Teamcenter to handle CAE items, and to "structure maps," which aid in creating CAE configurations.

Success factors for Ford include clear expectations, good planning, and good vendor support. Ford has a clear vision of the benefits of an integrated suite of PLM tools. Also, the new tools supported an established business process. This increases the likelihood of successful deployment because many projects fail when they involve new tools together with drastic changes in how people do their work.

Introduction

As companies drive towards virtual or digital product development and simulation-driven design, the need to manage simulation data becomes critical. The product development process at many companies involves "stage gates," with the process divided into stages and assessments at the end of each stage of the current design. The assessments culminate in a gate review, where decisions on future product development directions are made.

CAE digital simulations of product performance, based on physics, heavily support the assessments. After the design is released for a gate review, CAE models must be constructed, and the simulations must be carried out. While this is being done, CAE is on the critical path for overall program timing.

The process of going from CAD to CAE involves many difficulties. The correct design revisions and configurations must be found, and the appropriate representation of the components and assemblies must be transferred to the CAE team. The parts must then be meshed and connected to correctly represent the system or assembly under review. CAE models may be specialized for a particular type of evaluation depending on the engineering discipline and solver technology. Various load cases have to be calculated, and finally the

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simulation results have to be compared against requirements for product performance. Major issues often include:

- The conversion from CAD to CAE is manual and time-consuming.
- Data from many sources, not just CAD geometry, is required to complete a CAE model.
- The connection of the CAE model to CAD and other sources of data (the "pedigree") is lost or cannot be proven.
- Performance requirements are not tied to product design.
- There is little reuse of simulation models and previous results.

All too often, there is no available framework that links all the disparate items together.

Solution vendors have been developing applications to address the above issues. These tools, for simulation data and process management (SDPM) have, in CPDA's assessment, only recently reached sufficient maturity and capability to significantly impact the role of simulation in the product development process.[1]

One such product is Siemens PLM Software's extension of Teamcenter to handle simulation data. Teamcenter for Simulation Process Management was recently installed at Ford Motor Company, which quickly realized substantial gains in their process to develop CAE models.

Mesh Development at Ford of Europe

At the Ford of Europe engineering center in Cologne, Germany, a team of roughly ten specialists builds "baseline" finite element CAE models for structural simulation: crash safety, NVH (noise, vibration, and harshness), and durability. (They do not provide models for aerodynamics. This is because aerodynamic evaluations are done earlier, working from clay and styled surfaces.) This Mesh Development (MD) group has about 150 customers, CAE analysts at Ford of Europe. The common baseline model is then adapted and specialized for specific CAE disciplines by the customer groups. Suppliers provide a portion of the analysis model content, such as seats.

[1] Simulation Data and Process Management – Vendor Scorecard, Michel Vrinat, Collaborative Product Development Associates, December 15, 2009.

Stages of Simulation Model Development

Model Type	Created By
Baseline	Mesh Development Group
Discipline Specific	CAE Functional Groups
Load Case	CAE Engineers

Dr. Ulrich Fox is Supervisor, Mesh Development, Body Engineering in Product Development, at Ford of Europe in Cologne, Germany. He also has an informal role for CAE data management globally. CPDA spoke with him, and others, about the engineering process at Ford, and about their project to deploy Teamcenter's simulation process management capabilities.

Ford currently uses CATIA as their primary CAD system and most of the product geometry data resides in CATIA V5, with some defined in I-DEAS. Teamcenter on the unified architecture is the PDM system. For CAE pre-processing, the Mesh Development (MD) group uses only ANSA, from Beta CAE Systems. (For all structural CAE at Ford, excluding aerodynamics, the use of ANSA and HyperMesh from Altair Engineering is about equal.) The CAE baseline model data is stored in the same database as the CAD PDM data. This is a single logical database that is shared globally.

Ford has a matrix organization. Engineers belong to a core expertise group, either for commodities or for performance attributes. Engineers are then given periodic assignments to vehicle programs. The MD group provides support to product engineering only (and not, for example, to manufacturing engineering).

Ford has a very strict global product development process, Global Product Development System (GPDS), which is a stage-gate process. The process starts with the development of the underbody, the portion of the vehicle architecture that will be shared by different models such as a coupe, sedan, or wagon. This is leveraged as a platform of shared technologies. After that, there are programs with gateways for specific vehicle models. Vehicle models (upper body) may be developed at other global engineering centers, and Ford of Europe may supply underbody CAE models for those vehicle models. Those global customers working on the vehicle models are not included in the count of 150 above served by the Mesh Development group.

The MD team is primarily responsible for creating the baseline models associated with each stage of the program. During development, the CAE functional teams do small changes in parallel with new parts and changes. If there is a bigger change that affects many attributes, the MD team makes the change. They start by providing a baseline, and

then the CAE analysts in the programs make changes to adapt the baseline to their particular development effort.

Data Management

Ford has used Teamcenter for CAE data storage for a number of years[2] starting in the late 1990s with Metaphase. When Teamcenter Engineering was deployed as the PDM system, they began managing CAE data in Teamcenter with custom tools to support the approach. A copy of the Teamcenter CAE data would be placed on a shared drive. This included a file that is the CAE BOM list describing the model. The master copy of the information was retained in Teamcenter.

In the current process, the data developed by the MD group is maintained entirely within Teamcenter on the unified architecture. In the future, Ford wants all downstream models to be stored in Teamcenter, and hopes to accomplish that task in the next eighteen months. Today, downstream users, as the customers of the MD group, do not use Teamcenter to store their data. They store their models on a shared drive (NAS server) with some of the models on local UNIX drives or local hard disks. While there is an archiving system for the models that need to be kept long term, there is no single process for CAE data storage.

Teamcenter Simulation Process Management Implementation

As reported, the MD group has been using Teamcenter to access CAD data and to store their baseline models for a number of years. They had developed custom, in-house tools to aid in creating and managing the CAE configurations, and to interface with ANSA. In 2009, Ford began planning to exploit Teamcenter's simulation data and process management capabilities as a replacement for their in-house tools.

Since an in-house Teamcenter-based solution had been in place for some time, the key objective was to fully leverage an out-of-the-box solution and not to have a dedicated or proprietary solution. Ford wanted to capitalize on the capabilities of the software vendors to develop the solution and provide professional support. In addition, Ford used their previous experience with their in-house tools to drive requirements for Teamcenter simulation process management capabilities. "That is what has driven the design of Teamcenter for Simulation to quite an extent," says Dr. Fox.

Ford had three particular expectations for the project:

- First, they targeted an out-of-the-box data model. Their previous solution used generic items that were used for various purposes, but they lacked a CAE data

[2] Digital Simulation to Meet Today's Product Development Challenges, Monica Schnitger, Daratech White Paper, December 2003.

model with the proper CAE item types. Ford did indeed successfully amend the data model with the needed attributes.

- Second, they needed to support the creation of CAE item types and to link them with other product information. This was also to leverage the PDM utilities for functions such as data comparison and search.
- Finally, the capability to interface CAE applications like preprocessors needed to be supported. PLM XML has been used to configure an interface to ANSA, which can now read the Teamcenter CAE structure and the underlying data. ANSA is also able to store data back into the Teamcenter structure.

When asked about the level of effort that went into customization and configuration of Teamcenter, Dr. Fox replied, "There was virtually none. We demanded an out-of-the-box solution." Ford kept the requirements simple by, for example, having only two roles defined for data access. (A third role was initially defined, but has not been used.) One administrator in the methods team creates a very high level structure. For specific applications, team analysts have the permission to create CAE assemblies and information within this structure.

The level of effort and amount of time required of end users was also minimal in defining requirements and mapping out business processes to properly set up the system. "We have been using Teamcenter to do this for years," says Dr. Fox. "We have very capable on-site support from Siemens. They know our business, and what we need to get done. They set it up quickly and efficiently."

Asked about out-of-the-box functionality and the level of user involvement required to configure the system, Fox replied, "You need to consider this. Even if the functionality is out-of-the-box, customers have to do the configuration to adapt the data model to their needs and to the rest of the environment. For us to do that took quite a low effort. We had an experienced Siemens expert that knew our process well. He was efficient and only required a few interviews with technical experts. It wasn't much effort also because Ford has had a lot of experience with the toolset. It could be different for other companies."

When asked if they had considered other vendors and products for this project, Fox replied, "Not really. We have been working with SDRC, UGS, EDS, Siemens, for some time. It was a natural choice as the vendor of our PDM system. We had the idea of full integration from the start. Other vendors were proactive showing us what they have. But it would not have given us the benefit we expect from this integrated, enterprise solution."

Deployment and Initial Results

As noted, the project started in 2008. The system is now in production. Installation was in April 2010, and the system is available to every analyst with a license. The first production deployment was done in May. Performance improved by simplifying the data structure. Within a few weeks, Ford saw efficiency gains of four to eight times in critical steps for creating and managing CAE configurations.

Dr. Ulrich Fox, manager of the MD group, attributes these gains to the richer, more capable data model in Teamcenter to handle CAE items, and to the "structure maps," which aid in creating CAE configurations. Also, increased functionality has been provided in the interface to ANSA, which is coded in PLM XML.

Previously, Ford was able to manage the CAE BOM inside Teamcenter and make comparisons with CAD product structures using self-developed tools. Now, Teamcenter supports out-of-the-box functionality to maintain this capability. Another feature in Teamcenter is structure maps, which enables them to create CAE information in automated ways from product information. Templates are used to create and automatically link data items in a BOM for CAE.

Ulrich is very positive about Teamcenter but does reference some Teamcenter 8 functionality that has been implemented as add-ons to Ford's current Teamcenter 2007 implementation. "We are still using Teamcenter 2007. Teamcenter 8 has yet to be deployed," he said. "There are features we need now, and these are provided as 'add-ons' with a PLM XML interface. There are minor issues in handling transformation matrices (to put parts in their proper position) that also required an add-on. Another add-on is used to adjust the structure by suppressing items. But, no one is customizing the basic Teamcenter code for us." Siemens experts maintain these add-on utilities.

Projects for data management often encounter resistance from end users, but this was not the case at Ford. The MD group at Ford is familiar with Teamcenter, and had used the previous in-house solution. "They are happy to use the new toolset. It comes with changes they need to learn, but they are not resistant," says Fox.

Future Plans and Vision

Ford is doing a staged rollout. First, they have deployed to the MD team to establish core expertise. Next, they will spread usage to other sites like India, which supports efforts in building CAE models.

The third stage is to have their customers retrieve data directly from Teamcenter, rather than from the shared drive. For the moment, however, they continue to use the shared drive to provide data to their customers.

When asked about using Teamcenter for CAE work in process data, Ulrich Fox replied, "Good question. We have to consider the CAE analyst's requirements. If we could make this no pain for them, then yes we could do it. Other than that, it would begin with the storage of their major iterations and not their intermediate ones."

The project to use Teamcenter's simulation management capabilities began with support from Ford of Europe management. Now that global deployment is in progress, the Global CAE Chief Engineer is championing the capability.

In CPDA's view, the basic driver for the program related to the need to improve the MD group's process in creating the models for CAE and, to a certain extent, to improve the interface with their customers. They did not specifically target further enterprise benefits in this first implementation, such as publishing CAE data to the global enterprise. Dr. Fox says, "Initially, we looked at efficiencies within CAE areas, where a fully integrated system can realize that potential right away. We would also want to leverage this at some point in time. You have to grow – if the first step of efficiency does not work, you will not achieve the other steps."

Starting at the workgroup level, the program will expand to more users and different customers. Dr. Fox continues,

"We have seen the capability that you can attach something like lightweight research information to the PDM system. Then, engineers can see the results for the design direct in the PDM system. This would be an obvious benefit at some point in time.

"The next stage is to talk to people that have never before used CAE data management. They have to be convinced down to the finest details, and be shown how the process works. There must be 100% efficiency at the start – they will test every detail. So far, they are interested and positive.

"There is organization benefit to using a system like this, but it must also boost individual productivity. The system must be compelling and easy to use, while reaping enterprise benefits. Management could try to force people to use the system. Even then, without a boost to individual productivity adoption would stall."

In the future, Ford expects to exploit automation within ANSA, using the ANSA Task Manager. They are also looking to enable data exchange and interaction with other systems, such as test and requirements management.

Success Factors

Ford Motor Company has been able to achieve success in a very short time with deploying a tool for Simulation Data Management (SDM) where others have taken much more time, or even failed. Here are the factors contributing to their success:

- A clear vision for PLM, and a well-defined strategy – this project was initially deployed to one workgroup; Ford is in the process of deploying globally and has a clear understanding of how this project fits in the bigger picture.
- Established business process: Ford had been using in-house tools for many of the same tasks for several years. Users did not have to make dramatic changes to their work processes.
- Familiar tools, minimal training: the MD group has been using Teamcenter for years and the addition of Simulation Process Management only required minor re-training.
- Constrained scope and expectations to ensure the rapid demonstration of benefits: with this first deployment, Ford did not try to expand the scope beyond the tasks of the MD group.
- Good support: Siemens' on-site team understood the requirements and was able to execute the project.
- Leverage: Ford leveraged an out-of-the-box solution for minimal implementation cost and effort.