An Integrated Simulation Tool Framework for Process Data Management

By taking a methodical approach to process data management, automotive, aerospace, medical and discrete manufacturing companies can create a collaborative design environment that optimizes the product development process and accelerates time to market.

Executive Summary

Engineers worldwide use various design and analytic tools to conduct digital simulations that play a vital role from product concept through validation. These tools perform complex simulations or analyses and are typically integrated in a common product information management framework to accelerate product lifecycle management (PLM) processes, and ensure faster and more complete design changes.

Simulated data management can help make a reliable design process even more reliable and comply with global regulations, thereby providing a virtual laboratory to meet safety standards and resolve complex testing scenarios.

Thus, simulation data management (SDM) provides a multidisciplinary approach for evaluation, design verification, validation, risk management and data analysis.

This white paper elaborates the challenges faced in traditional SDM and explains the integration of PLM systems with computer-aided engineering (CAE) applications using the PLM XML protocol to support a simulation-driven product development approach. This framework bridges the product lifecycle with digital simulation tools interacting with each other on all design changes, thus improving quality and reducing the lead time of simulation engineers and the costs incurred throughout all product development phases.

The paper also shares our engagement experience in simulation data management through an implementation at a global automotive major. It also explains how the SDM framework can be applied in the medical device industry.

The Need for Simulation in Product Development

In recent years, the need to satisfy diverse consumer demands has forced manufacturers to create better, safer and greener products. This has inevitably impacted all phases of product development, increasing the complexity at the design, validation and manufacturing stages. The use and importance of simulation has been elevated as a result.
The demand for models with more variations and options, that satisfy tighter regulations and that are prepared at shorter time-to-market intervals drives the need for an increased number of credible simulations delivered in shorter times and at reduced cost.

Among the challenges product development engineers face in simulation:
- Dealing with the significant and increasing amounts of diverse data generated throughout various phases. Loose simulation data management leads to error-prone procedures that delay crucial design decisions.
- An uphill task in searching for and finding relevant data and configuring the simulation environment.
- Migrating data from a computer-aided design (CAD) environment to a computer-aided engineering (CAE) environment.
- Lost simulation process information due to organizational attrition.
- Complicated interaction between design, simulation and field/prototype testing engineers due to the lack of a well-laid-out process framework.
- Security breaches: Loss or theft due to sharing of simulation data through mails and folders.
- Lack of a single source of truth available from which design engineers can make decisions.

**Concept of CAE-PLM Integration**

Industry leaders manage various aspects of a complex product from start to end using PLM tools. These tools manage complex design data and the design process across the product development lifecycle using bill of materials (BOM) and structure management, CAD data management and workflow management. Similar to design data management, the PLM and CAE worlds are developing frameworks to align CAE processes and data into the PLM framework.

CAE processes typically gather product data related to simulations; this data contains information about product structure, its CAD model,
as well as metadata that extends to simulation scenarios, and evaluation of reports. Since the bulk of this information already resides in PLM systems, it is beneficial for the PLM tool to communicate this to the CAE environment to serve downstream processes. The motivation is to accelerate the product development process, increase the maturity of the CAE process and enhance the impact of simulation throughout the product development cycle.

Independent software vendors in the simulation industry have developed frameworks with the aim of maintaining process flow and data in PLM, or in their own simulation environment.

**CAE PLM Integration Framework**

CAE PLM integration is facilitated through PLM XML files, which define a protocol (or set of XML schemas and associated services) that enable open, high-content product lifecycle data sharing to boost PLM interoperability. It is open, published and compliant with the Worldwide Web Consortium (W3C) XML schema recommendations.

The PLM XML file and associated data serve as input to the CAE application. In turn, the CAE application performs all required preprocessing actions based only on the information residing inside the PLM XML file. Finally, the CAE application reports the result back to the PLM system through PLM XML. Integration through this protocol is an ongoing process, which will result in an enhanced solution for CAE model preparation within a managed design and simulation environment.

**Simulation Data Management Framework**

Traditional data management practice is to maintain CAE files in shared drives. A simulation data management framework overcomes challenges when engineers adopt traditional practices such as finding relevant CAE data on shared drives.

The framework has three major stakeholders – the CAE model engineer, the analyst and the design engineer. Importantly, the framework integrates the CAD, CAE and PLM tools.

- CAD data from the PLM tool is migrated to CAE tools using a migration framework.
- Preprocess and setup of finite element model uses automated scripts and templates and information residing in the PLM XML file.
- Stress and durability analysis is performed after the data is loaded.
Post-processing of output includes generation of reports, plots and animation.
Reports and relevant information are integrated with PLM using the PLM XML file.

**SDM Framework Challenges**
Several gaps typically emerge when using this approach, such as CAD to CAE interoperability issues, cross-discipline (analysis) barriers and process management issues. These gaps can be overcome by:

- **Automating data exchange** between geometry modelers, preprocessors and different analysis disciplines.
- **Coordinating data exchange** capabilities across multiple sites, including vendors.
- **“Channelizing” triggers** for design changes resubmit analysis and receive analysis reports.

**SDM in the Medical Device Industry**
Global regulatory agencies recommend that the medical device industry performs CAE analysis and provide them with their reports to support approvals. (For more on U.S. FDA recommendations on the need for simulation in the medical device Industry refer to this draft guidance.)

Computer-aided modeling and analysis enables device manufacturers to use different clinical trial methods and experiments on various test stages in a virtual laboratory. It is therefore possible for a device or biomedical implant manufacturer to secure test data in its own workspace and use it for benchmarking, revise it based on the customer requirements, transfer the design swiftly from one platform (CAD) to another (CAE) using lighter interface data communications (which enables engineers to make design changes digitally), verify and validate the changes, and generate reports based on the feasibility studies.

SDM helps device manufacturers to overcome cognizant 20-20 insights
challenges in design and CAE processes effectively, thereby:

- Offering a more collaborative design process, thus reducing design and simulation data loss.
- Reducing CAE build time and thereby reducing time to market and staying ahead of competitors.
- Optimizing model design conforming with regulatory mandates.
- Recording expert knowledge and decisions for repeatability of best practices and providing a standardized and automated CAE process flow.
- Enabling rapid verification with virtual models and compare with physical tests.
- Reducing cost with accelerated simulation solutions.
Quick Take

An Automaker Shifts Simulation Gears

Business Situation
A global automotive major with design and simulation centers across the world found it difficult to manage larger simulation projects using shared drives and e-mail.

Challenge
Its engineers primarily ran simulations with outdated design data. There was no standard process for model build.

Solution
The company decided to adopt a framework for SDM using PLM XML files.

Benefits
As a result of adopting the new framework, the automotive major can now:
• Manage global teams doing separate simulation functions.
• Reduce time taken to gather input data and generate simulation results.
• Redeploy engineers in crucial functions rather than in repeatable work.

Going Forward
While the PLM XML framework is most widely used across industry as a PLM data exchange standard, it is also clear that other leading independent software vendors such as Dassault Systemes, MSC, Altair and ANSYS also offer frameworks to manage simulation data in their system's environments.

Simulation Data Management Business Benefits

- Enabling better traceability of pre- and post-process data across global sites.
- Offering automated big data reporting and “single source of the truth” dashboarding.
- Providing end-to-end traceability from requirements through prototyping.
- Increasing accuracy of digital simulation results using corporate test procedures.

Collaborate
Improved collaboration between global design & simulation teams.

Optimize
Optimize model design conforming to regulatory compliance.

Knowledge Management
Repetitive & reproducible simulation data captured in the framework.

Efficiency
Improved efficiency of designers & simulation engineers.

Time
Reduced time to market; reduced time to perform simulations.

Traceable
Data traceability & data mining.

Integrated SDM Framework
(For further study on other PLM/CAE frameworks, refer to this Siemens white paper.)

In today’s fast-paced product development environment, managing simulation process challenges across the lifecycle requires more than just shared drives and Excel sheets.

Companies that hold onto traditional methods to handle CAE processes and data should consider migrating to an integrated framework that can better address simulation data and processes.

SDM builds confidence in CAE data management among all integrated units of global product development companies seeking a unified platform for virtual product testing, verification and validation.

Product development companies that use CAE processes should embrace an integrated SDM framework by:

- Choosing a solution provider with expertise in CAE and PLM domains.
- Choosing an SDM tool based on its flexibility and an open data model.
- Building a plan to manage the migration in a structured fashion.
- Preparing a cultural and organization change plan.

References

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