Simulation Data Management in Action

Highlights of the NAFEMS France SPDM Conference 2017

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The most recent NAFEMS SPDM Conference was held in Paris, France, in November 2017. This was an opportunity for French speakers to hear about impressive SPDM deployments led from France and to interact with expert practitioners. It followed on from the 2012 "Challenges of SDM" (link) conference in Paris and could have been entitled "Achievements of SPDM". Four industrial organisations; Faurecia Seating Systems, Safran Landing Gear Systems, Airbus and Valeo shared their diverse experiences of SPDM solution deployments.

NAFEMS members can download the presentations from this event by visiting nafe.ms/2GKXo4b

Albrecht Pfaff presented PDTec's state of the art SDM solution and described the deployment across the VW Audi Group. However, Jean-Philippe Claeys of Schneider Electric echoed the sentiments of Dirk Ruschmeier of Porsche (from his keynote at the 2017 NAFEMS Wold Congress) by saying that there are still challenges that existing SDM solutions don't yet address as standard functionality.

The conference was chaired by Gilles Besombes of Valeo Thermal Systems who also emphasised the full capabilities needed in an ideal SPDM solution including intelligent exploration of intellectual property accumulated about the performance of the product as well as structured exploration of design options and parameter combinations.

Christophe Lemaitre, Director of Validation and Testing, followed on from his 2012 presentation on the challenges of implementing SDM to describe five more years of productive use of the solution his team developed in Faurecia Seating Systems. He emphasised the importance of a coherent approach to virtual and physical testing and described the overall software suite built up at Faurecia Seating to capture the complete requirements set and then develop the testing plan to ensure that all requirements are met. He described the challenges of automotive seating development especially the ~4000 Finite Element simulation runs required for each new seat.

The key factor that led to the development of the SDM system was that Faurecia had moved to a granular FE definition of all the parts and components of a seating system. It had proved impossible to manage the digital thread of the versions and variants of all these FE models and the resulting systems' performance with manual data management methods. Christophe emphasised that the SDM solution was developed by FE engineers for FE engineers and saves them significant time through data management automation. Mattieu Debray, who combines the dual roles of Engineering Analyst and SDM solution developer, showed how parameterisation of parts enables a simulation to be re-run with a different nominal material thickness of a given part with just a few mouse clicks and keystrokes. This represents a considerable time saving compared to manual methods.

Perhaps the most visually impressive development was the replacement of walls of whiteboards for program status reviews and team meetings with 50-inch touchscreens which display program dashboards and enable deep dives into the information in the SDM solution.

Christophe emphasised that SDM is a journey, not a big bang transformation, and that the system has been enhanced progressively based on discussions with the analysts in each country. Also the importance of the

partnership of virtual and physical testing symbolised by this Global Validation Services graphic, in which the crash test dummy is shaking hands with his digital twin. This conference was sponsored by the magazine Essais(Testing) et Simulations so this joined-up simulation and testing philosophy even has its own publication in the French language.

Vincent Raimbault presented the Safran deployment of Ansys EKM to manage the simulation data and processes for the certification of a Landing Gear System. His initial slides graphically illustrated the extreme and diverse set of loads that a landing gear could encounter in service. The consequence of the large number of load cases to be satisfied is that it's necessary to manage as many as 1.5 million objects and 9 million attributes for a program, a large set of data, even by SDM standards. This SDM deployment is an impressive achievement as it is the first large scale industrial deployment of EKM presented at a NAFEMS conference. It's also unusual in that the design of landing gear is mainly carried out using classical stress calculations. The SDM system manages the input data and results relating to these classical stress calculations, instead of the finite element analysis.

Once the SPDM solution had been successfully deployed to support the certification of the landing gear, it became apparent that the Digital Thread stored in the SPDM database could be reused to simulate the performance of a specific instance of a landing gear to support manufacturing or service operations. It's now possible to stand up a Digital Twin and simulate the performance based on exact part geometry to support concessions. The Stressapps SPDM enables a manufacturing concession analysis to be turned around in a day, backed up by comprehensive calculations. This is now possible for Landing Gear programs certified through SPDM since the solution already holds the data and simulation process definitions.

Safran also expect the SPDM solution to accelerate the analyses required to certify the landing gear for higher aircraft weights as the aircraft matures. The Safran Stressapps solution demonstrates the power of SPDM solutions to support the Digital Thread for certification and then Digital Twins throughout the product lifecycle.

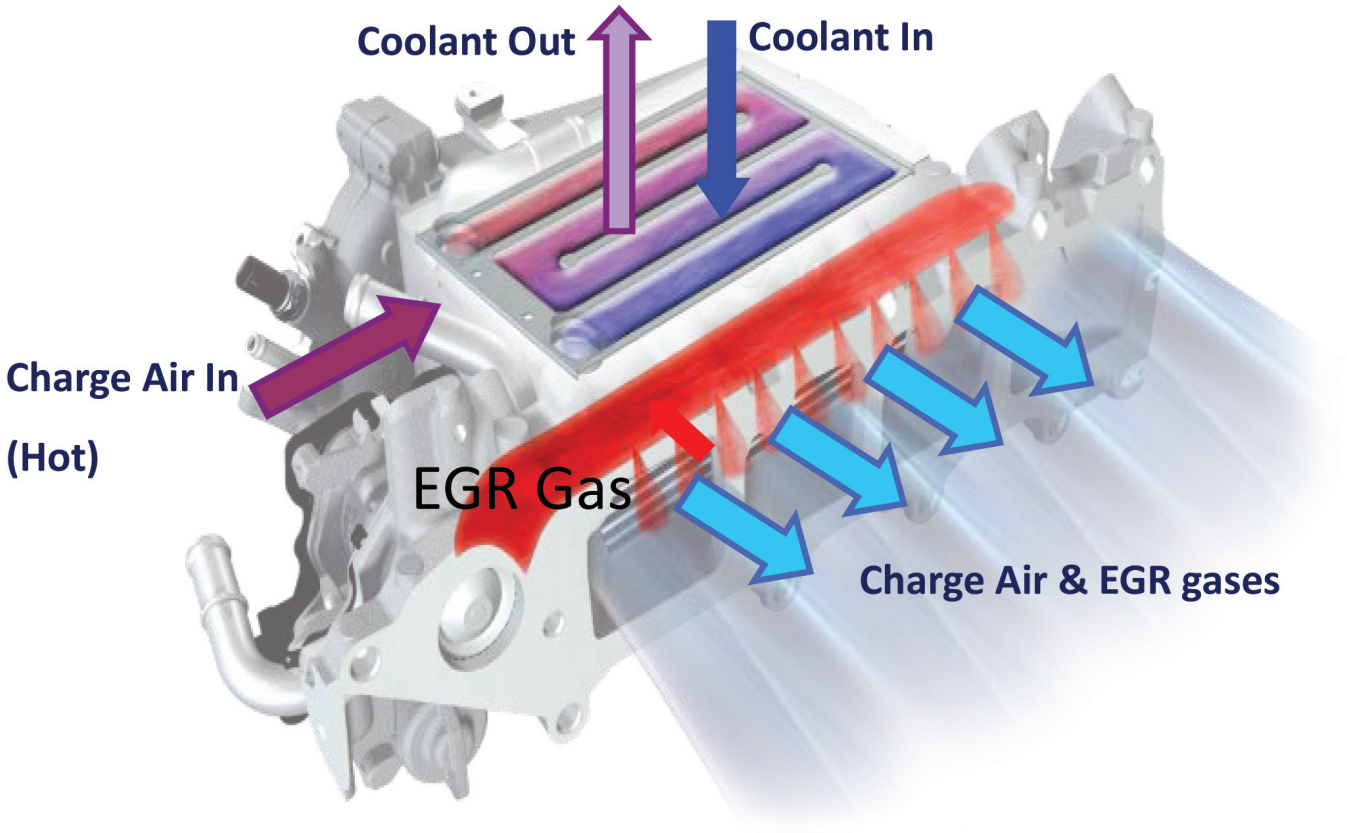
Faurecia and Safran presented SDM solutions for the particular divisions of their individual companies. Valeo and Airbus presented solutions designed to maintain the digital thread across departments and between companies. Valeo Thermal Systems presented a case study of the use of the KARREN simulation collaboration solution to design an Air Intake Module, Valeo's award winning solution to improve the performance of turbocharged engines and reducing emissions. KARREN addresses the issue of simulation collaboration between a design engineer at the Automotive OEM and a simulation engineer at a tier 1 supplier. These engineers need to iterate over many potential design solutions whilst retaining the digital thread between design parameters and simulated performance.

The design engineer needs access to the CAD models in the overall vehicle assembly whilst the simulation engineer needs access to the simulation software and compute resources. So collaboration is traditionally difficult with CAD data exchanges between the companies' PDM systems or email exchanges which are hard to track and don't provide a dashboard of progress. KARREN is a novel, even revolutionary, solution developed by DPS based on shared, parameterised CAD models of the system the supplier is proposing.

The design of an Air Intake Module is simulation intensive; the heat exchange performance is evaluated using CFD and many thermal/structural simulations need to be carried out to assess the effect of thermal shocks and to determine the fatigue life of the system. The key difference of KARREN as a collaborative approach is that it enables the exchange of design parameters through the user interfaces of the engineers' everyday tools, their CAD system and interactive CAE applications. The designer requests a performance evaluation of a set of CAD design and duty-cycle parameters and the analysts respond with the performance results from their simulations. KARREN also has an interface in a web browser to search for previous simulations and display project status.

The designers and the simulation engineers are connected through the exchange of numerical parameters with the KARREN server, metadata which doesn't pose a cybersecurity risk. It's clear that an initial consulting phase is required to agree the parametric model of the system. Valeo cited the issue that one team may specify the zero value for a valve parameter as fully open whereas the other may use zero to represent fully closed. once the parameter definitions are agreed though, including value mapping where necessary, it's easy for the OEM and supplier to collaborate and evaluate what-if scenarios.

In contrast to the collaboration platform approach of KARREN, Dr Peter Schroll of Airbus presented, in idiomatic French, the operational prototype that his team has built and deployed internally to enable multi-disciplinary aircraft trade-off studies. This is a challenging implementation of simulation collaboration based on system to system communication between different SPDM platforms. In this project, an aircraft architect is sitting on a Dassault Systems 3DEXPERIENCE platform to orchestrate the overall



Air Intake Module with water coolant flows superimposed.

trade-off process. All the relevant information for the airframe study is routed from the DS platform to SimManager SPDM platform and thence to the airframe simulation engineers.

The prototype has been in "run-mode" since 2016 and successfully applied on three Research & Technology trade-off studies for Airbus aircraft programmes. Peter confirmed that inter-platform collaboration, based on a subset of the MoSSEC standard, works well. In terms of user benefits, the architects found that there was an 80% reduction in the number of clicks to send data-sets and trade-off requests to other departments. This both saves time and ensures a consistent, error-free digital thread between the architects and both other departments and external organisations.

Jean-Philippe Claeys of Schneider Electric gave a presentation which explained how the evolution of their product technology requires evolution of their simulation technology which presents significant challenges to SPDM solutions. Schneider needs to integrate simulation for six disciplines to address the functional performance of the system and then consider the seventh discipline of electromagnetic compatibility as control electronics are packaged close to electrical and electromagnetic systems, whilst not forgetting thermal compatibility. Schneider need to integrate Model Based Systems Engineering as well as Design Space Exploration and Robust Design. Schneider consider that the breadth and depth of integrations that they require is beyond the current capabilities of commercial SPDM solutions, but encourage software vendors and systems integrators to deliver more advanced SPDM solutions.

At this conference we learnt about real industrial examples of SPDM-based Digital Threads to justify simulation results to regulatory standards. We saw the re-use of the SPDM Digital Thread built for certification to rapidly stand up digital twins to support manufacturing concessions. Furthermore, these real-life, productive industrial examples were built by the simulation and IT teams of the industrial companies concerned. The Safran project rightly won an internal award. These industrial teams deserve our congratulations for making digital threads and digital twins reality amongst all the marketing hype from consultancies and software vendors. ■

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