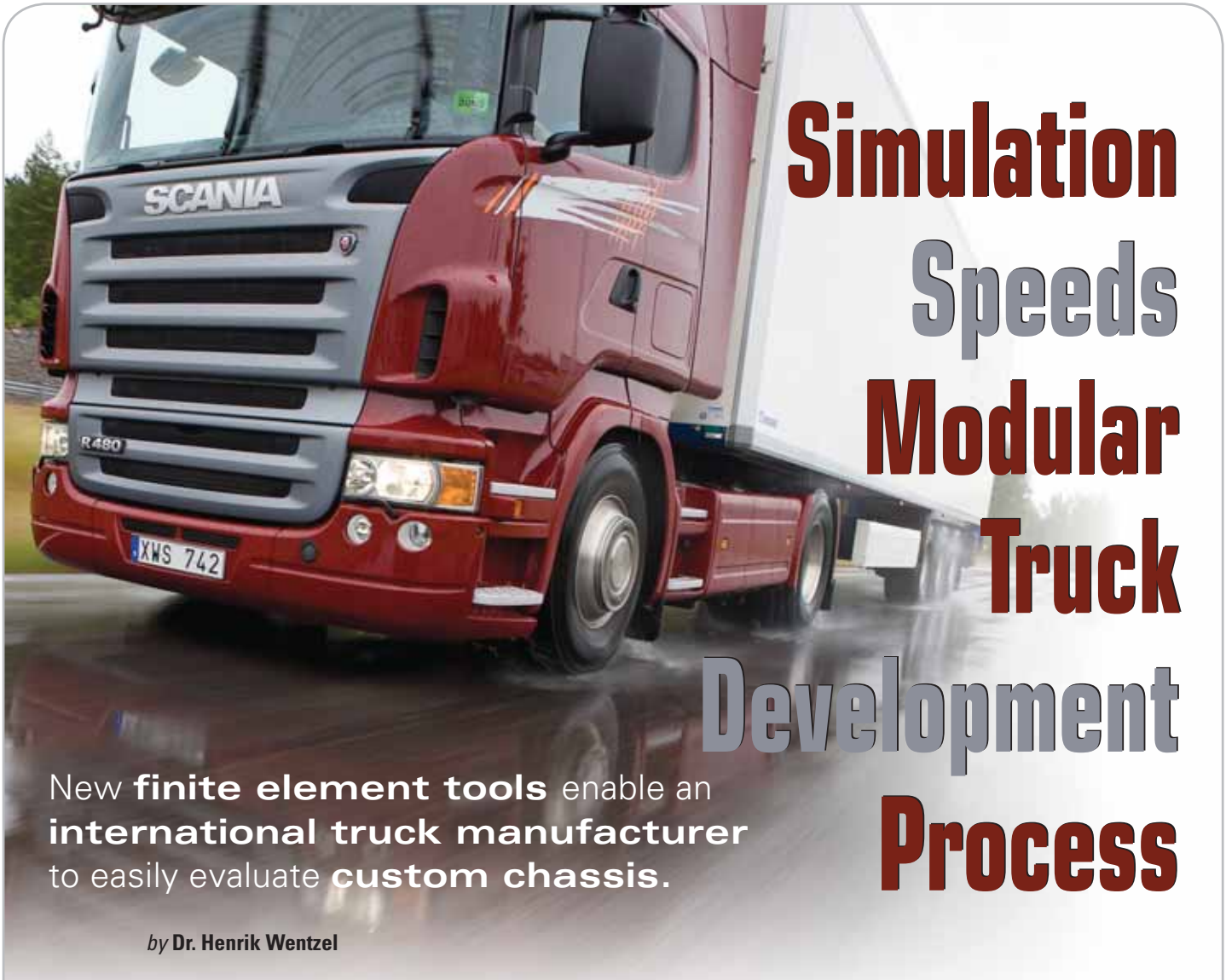


Simulation Speeds Modular Truck Development Process

New **finite element tools** enable an **international truck manufacturer** to easily evaluate **custom chassis.**

by **Dr. Henrik Wentzel**

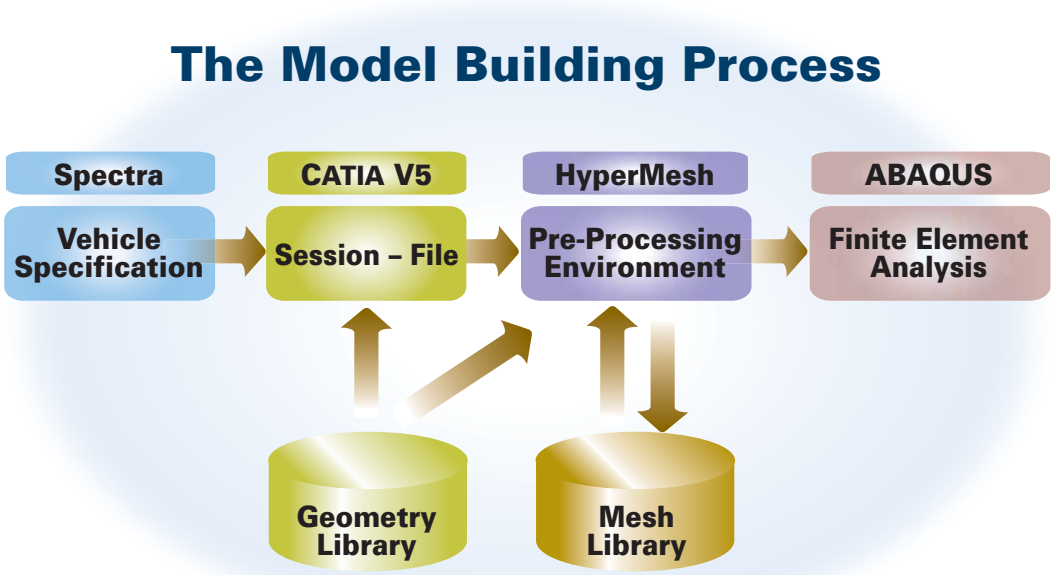
Scania AB, a Swedish manufacturer of heavy trucks, buses and diesel engines, has been in business since 1891. Over that time, the company has built and delivered more than one million trucks and buses for heavy transport work.

The international corporation, with operations in more than 100 countries, supports a "modular" product development process. As such, complete custom vehicles are assembled from a variety of existing parts, enabling Scania to meet the specific needs of customers. Compared to traditional product development approaches, the modular method allows for much faster product development with higher quality – as well as a greater volume of each component to further reduce costs.

However, because no two vehicles are identical in a modular product development process, there is a strong need to model many different configurations in order to assess quality. The implementation of an open framework simulation solution – coupled with a custom, pre-processing manager "toolbox" – enables analysts in the Scania chassis department to do just that.

Our Virtual World

The Scania product development process consists of three phases: pre-development, continuous introduction and follow-up. In pre-development, engineers evaluate various concepts and ideas, exploring new design possibilities. Continuous introduction involves bringing changes to existing products, in essence, refining components to meet customers' needs. Follow-up focuses on the issues of safety and quality.



The Scania model-building process involves several steps. The pre-processing manager toolbox, based on Altair HyperMesh, helps analysts perform more simulations than in the past – and perform larger simulations with higher quality.

While simulation plays a role in all three phases, the bulk of its use is in continuous introduction. In this phase, analysts are engaged in tasks such as increasing strength while decreasing vehicle weight and cost. You will often find analysts sitting with design engineers at Scania as they review various concepts together. One of our goals is to evaluate as many concepts as we can.

For example, a truck's payload is critical to some of our customers. Because the maximum weight of a vehicle is fixed by legislation, we search for ways to decrease vehicle weight without compromising payload size. Simulation tools enable us to cost-effectively conduct these types of evaluations.

In our modular product development process, we often require large models that are assemblies composed of both existing and newly designed parts. The existing parts have usually been analyzed, and it is a goal to profit from past work done as we develop new components. Sharing and recycling models are ways of doing just that.

Building a Better Process

Six years ago, Scania analysts had no structured way of sharing finite element (FE) models. Although models were shared through disk areas, broad access to the data resulted in a lack of all sorts of control. From design colleagues, we received models for new components that were meshed in a customized version of CATIA V4. With complex models being shared this way, issues sometimes arose over version control and quality.

With rapid advancements in commercial CAE simulation technologies, we saw an opportunity to identify a new FE pre-processor to better address our specific needs, in particular our needs regarding automated model assembly.

For pre-processing, we required software that would provide greater user interaction. The solution we had been using was fully automated but did not provide for any user interaction during execution. As a result, analysts frequently had to modify and improve input decks of truck models manually in a text editor. Geometry compatibility, the ability to read geometry files and excellent meshing capabilities – including support for brick elements – were also key criteria.

After looking at a number of products, Scania selected the HyperWorks CAE framework from Altair Engineering, Inc. Through a thorough benchmarking process, HyperWorks demonstrated native CAD support, in combination with advanced mid-surface creation tools, to significantly reduce time prior to meshing. It also provided meshing tools for advanced solid geometries.

In addition, HyperWorks featured a solver-neutral data model for easy conversion into various formats as well as great reduction of manual edits. In this way we actually gained flexibility with regard to a choice

of solver and post-processing tools. It also enabled us to interactively manage assembled FE models prior to job submission and to perform optimization without the underlying CAD data through morphing, a technique for making geometric mesh changes for new design attributes without remeshing. These capabilities enabled us to significantly increase our simulation efficiency.

Toolbox Customization

Scania also collaborated with the Altair team on refining our existing, in-house, pre-processing manager toolbox. The goal was to further automate the routine modeling and assembly tasks of virtual trucks.

Previously, Scania analysts had developed a mesh library. Similar to the design geometry library, the mesh library's function is to save and store parts, enabling us to efficiently leverage legacy models and quickly generate new FE assemblies.

The mesh library consists of components associated with part numbers and drawings. A CATIA session can be assembled for any complete vehicle, providing all part numbers and their positions. With a mouse-click, we transform that geometry session into an FE assembly of stored legacy models. What we needed to do was to ensure that our existing pre-processing manager toolbox merged into Altair HyperMesh to deliver the capabilities we needed.

For example, we require our simulation software to read CAD libraries and automatically select the appropriate files as well as place components in the correct chassis location. Also, it must be able to perform mesh generation on geometries that are not found in the mesh library. In addition, the software is used to cut holes in geometries and meshes to prepare for bolt connections. What's more, it must be able to generate what we call "spider connections," simplified models of bolted joints that are critical for the overall stiffness of the model.

The Altair engineering team demonstrated the openness of HyperWorks, showing us that it was easy to integrate while enhancing our pre-processing manager toolbox using HyperMesh. The transition of the pre-processing manager to HyperMesh was smooth and is generally considered a great improvement. There was never an interruption in the workflow, and we continue to leverage the data from our in-house system today.

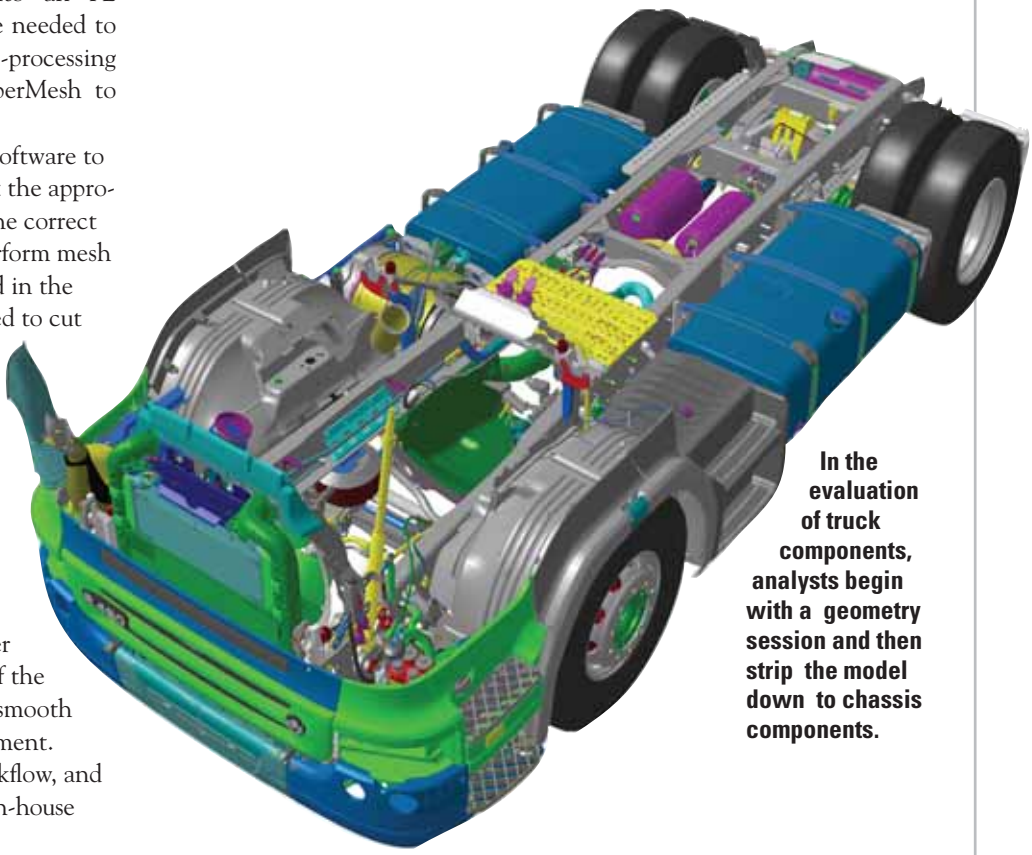
Specifications for Success

Founded in 1891, Scania AB has built and delivered more than one million trucks and buses for heavy transport work. Industrial and marine engines are other key business areas as are marketing and selling a range of service-related products and financing services.

Scania develops, manufactures and sells trucks with a gross vehicle weight of more than 16 tons. These vehicles are intended for long-distance hauling, regional and local distribution of goods and construction hauling. Its bus chassis are used in tourist coaches as well as urban and intercity traffic. Industrial and marine engines are found in generator sets and in earthmoving and agricultural machinery, as well as on board ships and pleasure crafts.

The company promotes a modular product system so that customers can be offered optimized vehicles. The modular system provides a carefully balanced number of main components with standardized interfaces. This results in great flexibility, which is important for Scania's cross-functional product development and global production.

In addition, the modular system allows considerably longer production runs than is possible in conventional product systems. It also simplifies parts management, contributes to higher service availability and makes it easier to train service technicians.



In the evaluation of truck components, analysts begin with a geometry session and then strip the model down to chassis components.

A Toolbox for Truck Meshing

A finite element pre-processing manager toolbox in use at Scania AB enables chassis analysts to further automate virtual truck model assembly.

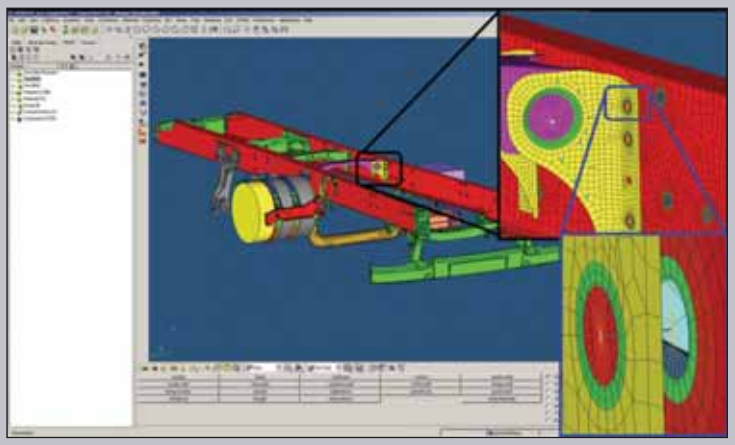
The model-building process involves several steps. When a vehicle is specified, a session file in CATIA V5 begins. The chassis number provides a geometry session. Analysts identify the model then strip it down to chassis components.

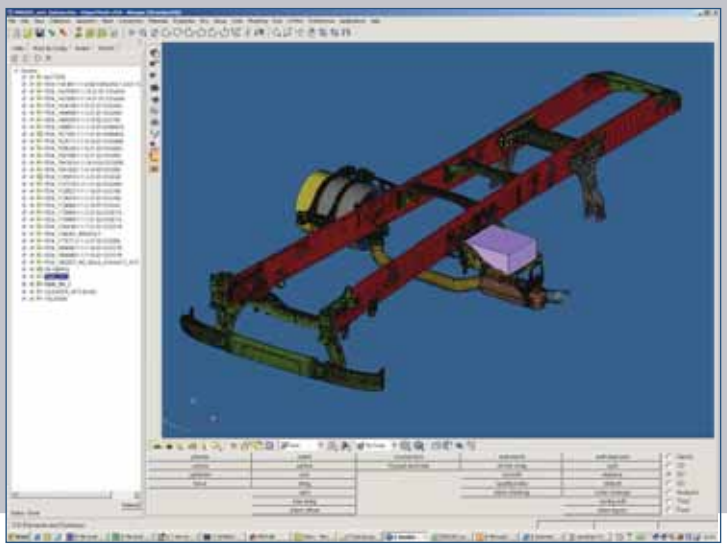
They then open the file in Altair HyperMesh. For every part, analysts choose to import CATIA geometry, a finite element (FE) mesh or a HyperMesh model.

The pre-processor reads CAD libraries and automatically selects appropriate files; monitors the FE and geometry libraries, providing notification if changes are made; and positions components to their correct locations in the chassis. In addition, the software cuts holes in geometries/meshes to prepare for bolt connections and generates "spider connections," solid bolts with pre-tension and contact definitions. When components are attached, analysts export the FE mesh for simulation.

Toolbox use results in improved quality and faster simulation time. Quality is improved because the process is repeatable and not dependent upon the engineer. The latest, up-to-date mesh is always used. Simulation time is quicker because the assembly of a full vehicle, including bolted connections, takes only a couple of hours with the session browser.

Scania analysts employed Altair HyperMesh to improve their customized pre-processing manager toolbox. The toolbox automates tasks such as positioning components to their correct chassis location, generating meshes and cutting holes in geometries/meshes to prepare for bolt connections.





Moving Forward

Development work on the toolbox is an ongoing process. This year, our efforts are focused on creating a new simplified bolt joint element and solid brick screws, which will improve the quality of results. We also want to standardize evaluation of the joints themselves. The Altair team has been available to collaborate with us on any issue that has arisen.

Twenty of Scania's 70 analysts use the pre-processing manager toolbox. In addition, through the HyperWorks units-based software licensing model, all of our engineers have access to the entire HyperWorks suite of tools, which is also used in the analysis of axles, buses, engines and transmissions. For example, we have enough units to allow up to 25 analysts across Scania to use HyperMesh simultaneously – maximizing our software utilization and return on investment.

Scania senior management has come to the conclusion that simulation is the way to move forward. Our directives are very clear: solve more issues with simulation.

We have seen a large improvement in analysts' productivity over the years, thanks, in part, to better technology, including simulation tools. Chassis analysts today resolve five times more calculation assignments than six years ago.

Today, we can assemble complete truck frames – and do it in half a day. If we did not have our pre-processing manager toolbox, it would take up to four weeks to accomplish a single frame assembly. Now, we perform more simulations than in the past, and perform larger simulations with higher quality.

In the future, improved technology will enable us to perform more complex analyses, specifically in the area of evaluating vehicle handling and comfort properties. Optimization tools offer the means for continuous improvement. We have found that simulation solutions have improved our processes. C2R

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For more information about Scania and HyperMesh, visit *www.altair.com/c2r* or check 07 or 08 on the reply card.