

# SIEMENS

Ingenuity for life

Automotive and transportation

## Scania

Using Simcenter Amesim enables truck and bus manufacturer to considerably reduce driveline modeling time

### Product

Simcenter

### Business challenges

Reduce truck and bus transmission development costs and time

Streamline modeling and simulation process

Offer best-in-class truck and bus attribute tradeoff

### Keys to success

Study drivability, gearbox losses, NVH comfort, pneumatic actuation and gearbox oil flow

Take into account driver behavior, driving cycles and road elevation

Get a deep understanding of phenomena using postprocessing tools and animations

Adapt the modeling level throughout the design cycle

Perform fast simulations using real-time capabilities

### Results

Reduced modeling time by a factor of 2 to 10

Accelerated CPU time



*Multi-attribute balancing analysis and vehicle integration are proving to be the major challenges for truck and bus manufacturers.*

### Scania complements testing by applying a system simulation approach

#### Offering the best attribute tradeoff

Headquartered in Sweden, Scania develops and manufactures transport solutions to support worldwide development of freight logistics and the growing need for passenger transport. From long-haul trucks and school buses to firefighting and garbage collection vehicles, Scania products offer the best-in-class compromise between fuel efficiency, performance, drivability, noise, vibration and harshness (NVH) comfort and safety. In addition, Scania is working on new technologies in order to meet the most stringent emission standards for reducing nitrogen oxide (NOx) and particulate matter (PM) emissions.

Scania's design engineers deal with tight timeframes when developing multiple driveline variants and transmission architectures. Without a model-based systems engineering approach and relying only on tests, it would be extremely costly and time-consuming to manage continuously expanding design options.

#### Complementing the simulation toolkit

In 2012, Scania started looking for a simulation solution that would enable them to rapidly handle issues related to multi-domain driveline components, such as mechanical, electrical, pneumatic or hydraulic. The tool needed to allow design engineers to carry out larger studies to ensure optimal truck and bus drivability, NVH comfort and transmission performance.

**Results** *(continued)*  
Streamlined development processes

It was not an easy choice since multi-attribute balancing analysis and vehicle integration are proving to be the major challenges for truck and bus manufacturers. Such tradeoffs require a multi-level simulation approach that enables engineers to easily switch from one modeling level to another when optimizing component design, system sizing and behavior as well as entire vehicle performance and fuel efficiency. Moreover, since the design process is split between multiple departments, it is vital to streamline the simulation

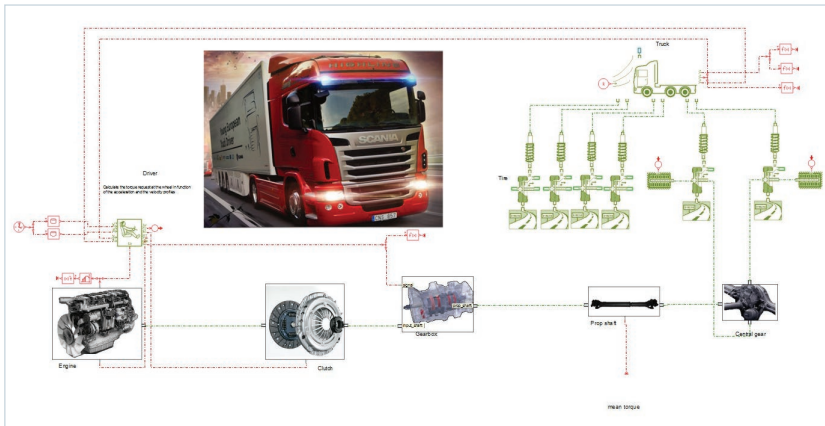
approach by efficiently managing data, model versioning and knowledge capitalization.

**Driving a virtual truck with Simcenter Amesim**

At the beginning of 2013, Scania was already using Simcenter™ Testlab™ software when it decided to extend its Simcenter solution portfolio by investing in Simcenter Amesim™ software.

Simcenter Amesim helps Scania simulate the most physics in order to solve various engineering issues related to transmission design: drivability, gearbox losses, NVH comfort and torque vibrations, pneumatic actuation and gearbox oil flow.

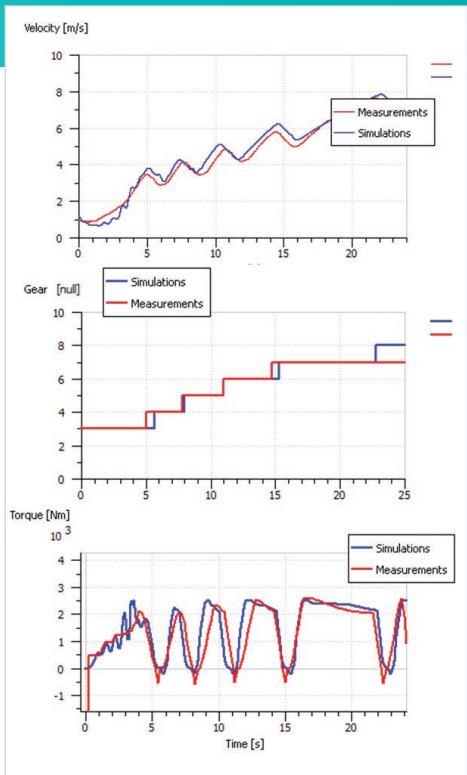
Scania development specialists work with engine, clutch, gearbox, propeller shaft, central gear, tires and chassis supercomponents, which they connect to the driver and vehicle models as well as to controls in order to conduct analysis according to the driver's behavior and driving cycles. They use multiple Simcenter Amesim post-processing tools and ready-to-parameterize automotive industry-oriented demonstrators as well as import/export



The model (generated using Simcenter Amesim), including engine, clutch, gearbox, propeller shaft, central gear, tires and chassis supercomponents connected to the driver and vehicle models and controls, enables Scania to analyze transmission performance according to various driving cycles and the driver's behavior.

**“Using Simcenter Amesim and other advanced simulation tools, Scania complements testing by applying a system simulation approach and, therefore, cuts development costs and time-to-market.”**

Fredrik Birgersson  
Senior Engineer  
Analysis and Testing  
Transmission Development  
Scania



The drivability analysis (here the truck is climbing a hill) demonstrates consistency of the simulation results with measurements.

Simcenter Amesim is employed from the development of the driveline component to the system design phase. At the component level, Scania carries out 3D computational fluid dynamics (CFD) analysis to understand complex flows. Finite element analysis (FEA) is applied to obtain the stiffness, weight, fatigue and computer-aided design (CAD) geometry as well as to understand the effect of forces on the structure and the behavior of nonlinear components, such as bearings. The results are used to refine the model created with Simcenter Amesim. During the system-design phase, Scania's engineers interface this model with a control model created in the Simulink® environment, analyzing the transmission's behavior in the context of the entire vehicle.

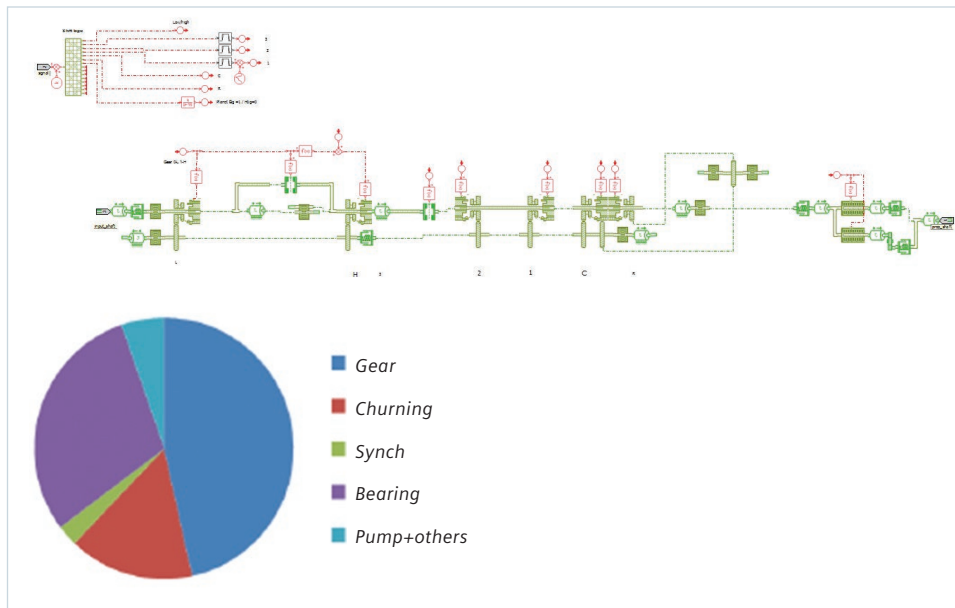
“Even though we have several simulation tools that we could use instead of Simcenter Amesim, we prefer to use the Siemens solution because modeling is very fast with Simcenter Amesim, especially when designing a new driveline. With Simcenter Amesim, it is very intuitive to model a new driveline since we know exactly which parameter we have to find.”

Fredrik Birgersson  
Senior Engineer  
Analysis and Testing

“Even though we have several simulation tools that we could use instead of Simcenter Amesim, we prefer to use the Siemens solution because modeling is very

capabilities that allow the Siemens Digital Industries Software solution to fit well with Scania's simulation toolkit.

“I really like this fast and easy clicking in Simcenter Amesim, enabling us to take a parameter and move it into our model,” says Fredrik Birgersson, senior analysis and testing engineer in the Transmission Development Department at Scania. “When re-running a simulation, we can see the direct impact of the change. Moreover, we find the road profile generation functionality of Simcenter Amesim very useful. Using global positioning system localization, we now can drive our virtual truck on real roads with real elevation levels and background scenery.”



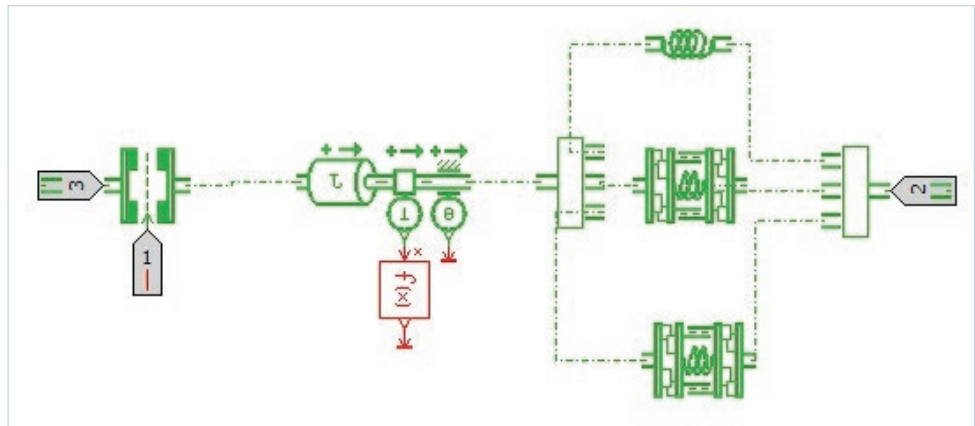
Using detailed gearbox models created with Simcenter Amesim according to the design parameters, Scania's design engineers identify the main source of losses in various types of six-gear gearboxes and shift strategy.

*“Simcenter Amesim allows Scania to first understand the main issues, and then reduce modeling time by a factor of 2 to 10 compared to the modeling process prior to the Simcenter Amesim implementation at Scania. Moreover, we can run some simulations faster than real time.”*

Fredrik Birgersson  
Senior Engineer  
Analysis and Testing  
Transmission Development  
Scania

*“Scania is a top-level brand that guarantees its customers best-in-class drivability, NVH, comfort and vehicle performance. To be the best in terms of these vehicle attributes, we have to be the best in simulation. Our customers expect from us an optimal multi-attribute tradeoff that we can simulate with Simcenter Amesim in order to reach the highest level in all the areas at the same time.”*

Fredrik Birgersson  
Senior Engineer  
Analysis and Testing  
Transmission Development  
Scania



*The clutch model built with Simcenter Amesim allows Scania to analyze static and dynamic friction; pre-damper behavior and damping are tuned to real clutch behavior. Building more complex clutch models, Scania's specialists account for actuation and geometric non-uniformity.*

fast with Simcenter Amesim, especially when designing a new driveline,” says Birgersson. “With Simcenter Amesim, it is very intuitive to model a new driveline since we know exactly which parameter we have to find.

“Without Simcenter Amesim, even at the concept phase, we would need some CAD geometries and might focus on the wrong

things, such as why a flexible body is flexing strangely, or what happens with contact pressure in dynamics. Simcenter Amesim allows Scania to first understand the main issues, and then reduce modeling time by a factor of 2 to 10 compared to the modeling process prior to the Simcenter Amesim implementation at Scania. Moreover, we can run some simulations faster than real time.”



## Solutions/Services

Simcenter Amesim  
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Simcenter Sysdm  
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simcenter-sysdm

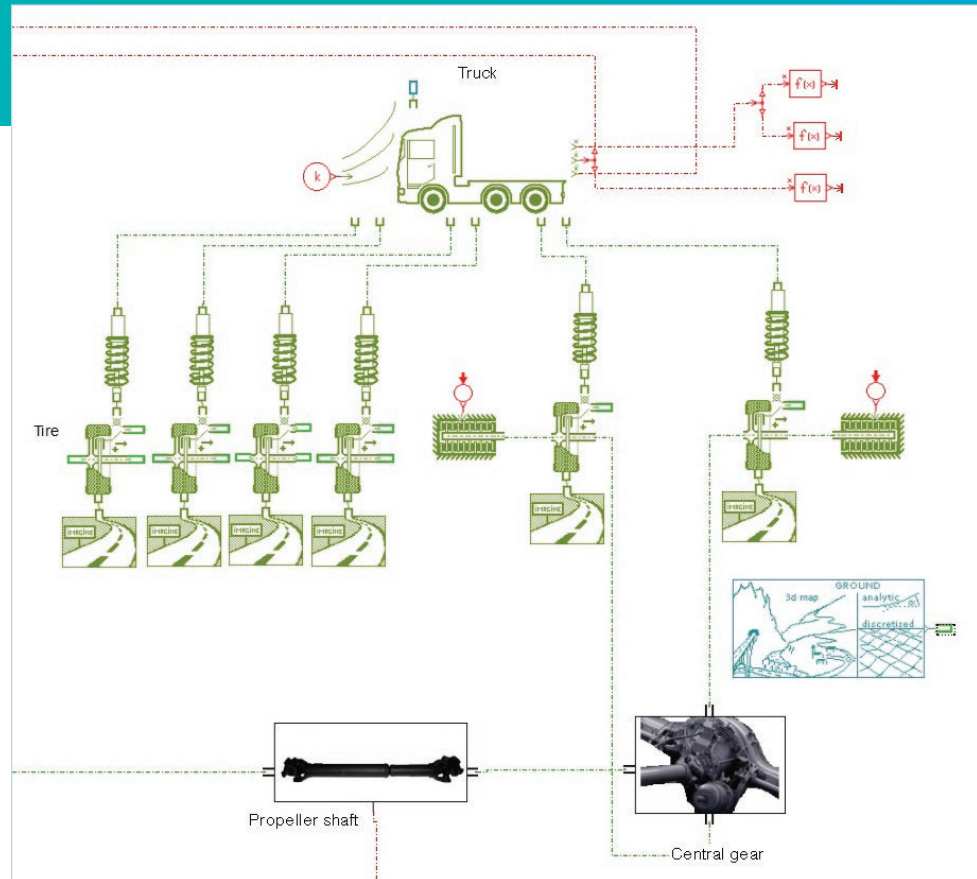
## Customer's primary business

Scania specializes in developing and manufacturing truck, bus, industrial and marine engines. With 38,600 employees and production facilities in Europe and Latin America, Scania is a global company with sales and service organizations in more than 100 countries.

www.scania.com

## Customer location

Södertälje  
Sweden



Simcenter Amesim enables Scania to take into account different road profiles; the suspension and tires are modeled with prebuilt Simcenter Amesim components.

with other departments that are not particularly interested in the detailed behavior of our gearbox. At the same time, since they specialize in studying the functioning of a different system, they can provide us with an optimized supercomponent to allow us to enhance the accuracy of our simulation results. With Simcenter Amesim, switching from one modeling level to another is seamless and effortless.

"In such a complex and collaborative simulation context, efficient model management will become increasingly important and we believe that with Simcenter™ Sysdm software, Siemens Digital Industries Software follows these trends. We are con-

vinced that model versioning will be critical since all development companies will have to implement an accurate methodology to keep their models updated for model-in-the-loop, software-in-the-loop and hardware-in-the-loop applications.

"Scania is a top-level brand that guarantees its customers best-in-class drivability, NVH, comfort and vehicle performance. To be the best in terms of these vehicle attributes, we have to be the best in simulation. Our customers expect from us an optimal multi-attribute tradeoff that we can simulate with Simcenter Amesim in order to reach the highest level in all the areas at the same time."

## Siemens Digital Industries Software

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