SIEMENS

American Axle & Manufacturing

Tier one automotive supplier uses NX and LMS software to reduce warranty costs

Products
NX, LMS

Business challenges
Select next-generation simulation software for NVH analysis

Develop drivelines that deliver power from engine to wheels without perceivable noise or vibration

Create accurate simulation models

Shrink simulation process time

Gain a deeper understanding of product performance in the consumer environment

Keys to success
Standardize on NX CAE and NX Nastran for driveline NVH simulation

Leverage integrated CAD and CAE processes

Develop a strong reliance on simulation and correlation of analysis results with physical testing with LMS Test.Lab and NX CAE

Siemens PLM Software solutions enable American Axle & Manufacturing Holdings to significantly speed up simulation processes

American Axle & Manufacturing Holdings, Inc. (AAM) is a tier one, global automotive supplier founded in 1994, but its manufacturing expertise goes back more than 90 years. AAM is a leader in driveline and drivetrain systems and related components for light trucks, sport utility vehicles (SUVs), passenger cars, crossover and commercial vehicles.

AAM's success can be measured with sales of approximately US$3.7 billion, more than 30 locations worldwide, and more than 13,000 associates serving over 100 customers. AAM attributes this success to its ability to provide exceptional value with an intense focus on quality, warranty, reliability, delivery and launch support.

Delivering power anonymously
"The goal of AAM is to deliver power anonymously," says Glen Steyer, executive director of product engineering. What this means is that a driver cannot perceive how power is transmitted from the engine to the wheels, so they cannot hear or feel vibrations from the driveline. For an original equipment manufacturer (OEM), a quiet, vibration-free driveline is an attribute that can be tied directly to higher quality rankings and better customer satisfaction.

To facilitate meeting strict, industry-leading standards, AAM utilizes a combination of simulation and physical testing for its axles and drivelines.
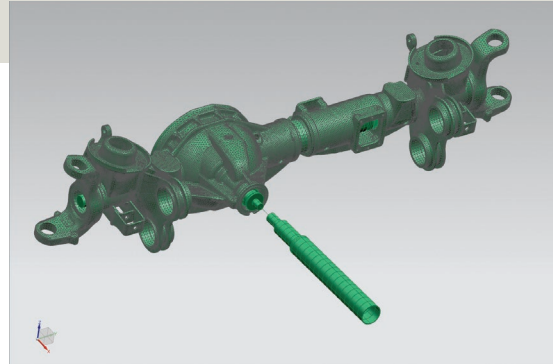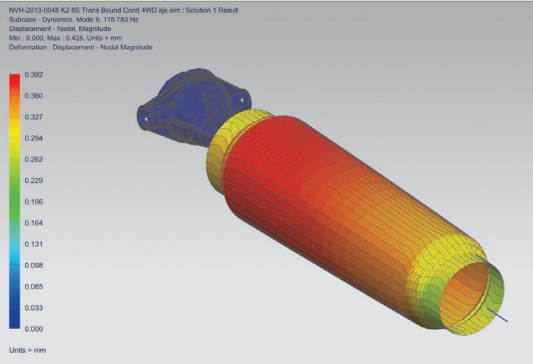
Results

Reduced warranty costs

Provided ability to go from detailed CAD model to simulation results in one day

Enabled confident prediction of real-world performance

Reduced over-design by performing simulation prior to building a prototype

Diminished costs by developing equivalency between two proving grounds

"We heavily rely on upfront finite element computer simulation of the product performance and noise and vibration characteristics," says Steyer. AAM uses Siemens PLM Software's NX™ software for computer-aided engineering (CAE); NX Nastran® software for noise, vibration and harshness (NVH) finite element (FE) simulation; and LMS Test.Lab™ software for data acquisition, physical testing and test-based engineering.

Selecting NX CAE

Two years ago, AAM recognized it would need to migrate to a new CAE tool because its legacy simulation system, I-deas™ software, was being phased out.

"We wondered what we should do because we were so successful with I-deas," states Zhaohui Sun, senior manager for NVH Engineering. "Moreover, we understood

this may be a great opportunity to evolve and expand our capabilities."

To determine AAM's next steps, Sun's team needed to define the requirements it would need for its next-generation simulation software, including capabilities from I-deas that the team members liked and wanted to retain in the new simulation tool. The engineers also considered new capabilities that I-deas didn't have but they would like to have in their future software.

AAM considered a few commercial FE simulation tools, and made a matrix to compare each against its requirements. In the end, NX CAE stood out as the only tool that met or exceeded its requirements. Among the reasons Sun states for choosing NX CAE as AAM's tool of choice for driveline NVH simulation are its strong, efficient manual and automatic meshing

"Since we began using NX CAE, we are able to go from CAD design to the FE model to simulation results all within a day."

Alex Sandstrom
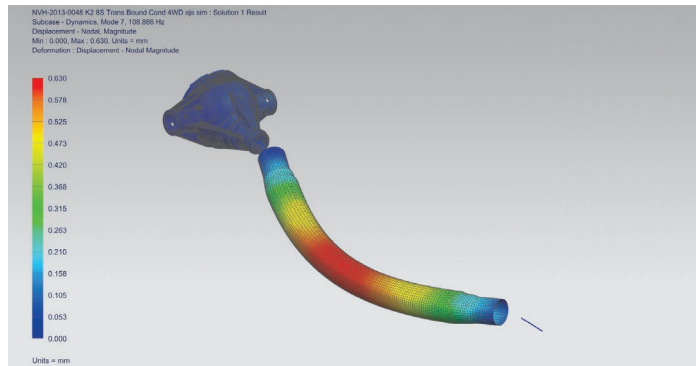Senior NVH Engineer
AAM

capabilities, integrated modal response simulation module, and facilitation of modeling automation and batch runs. AAM also recognized the value of using the Nastran solver, which has been a standard in NVH analysis in automotive companies for decades. NX Nastran is integrated with NX CAE, and the solver is widely recognized and has the confidence of NVH engineers around the world.

Shrinking CAE process time

Since AAM also uses NX CAD for design, Sun's team recognized the benefits of using NX CAE to speed CAE process time. Since NX CAE is based on the same platform as NX CAD, it allows the seamless transfer of computer-aided design (CAD) data to the simulation team without translation errors. Once the data is in the NX CAE environment, AAM's engineers can create geometry-based FE models that can be automatically updated when the CAD design changes. This means AAM can achieve more rapid design-to-analysis iterations.

"Since we began using NX CAE, we are able to go from CAD design to the FE

model to simulation results all within a day," says Alex Sandstrom, senior NVH engineer.

Sun adds that the goal for the NVH team is to shrink simulation process time even further. The target: half a day.

"We believe this is achievable with NX CAE," Sun says. The team cites the journaling, automation and batch meshing process capabilities of NX CAE as additional advantages it can leverage to achieve this aggressive goal.

Solutions/Services

NX CAE
www.siemens.com/plm/nxcae

NX Nastran
www.siemens.com/plm/nxnastran

NX CAD
www.siemens.com/plm/nxcad

LMS Test.Lab
www.siemens.com/plm/lms-test-lab

Customer's primary business

AAM is a global, tier one automotive supplier, and is a leader in driveline and drivetrain systems and related components for light trucks, SUVs, passenger cars, crossover and commercial vehicles. www.aam.com

Customer location

Detroit, Michigan
United States
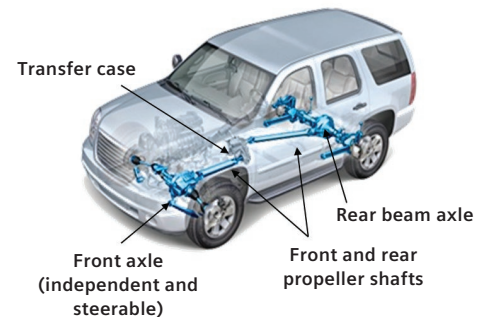
Correlating analysis with testing

The beauty of simulation is that it helps engineers predict product performance before any metal is ever cut, thus reducing the time and cost of physical prototypes. But simulation is worthless if it cannot be used to accurately predict product performance in the real world. To enable AAM's NVH simulations to effectively predict performance, the NVH engineering team correlates its analysis models with physical test results from their state-of-the-art testing facility.

AAM's engineers generate correlated CAE results through an iterative loop between NX CAE and LMS Test.Lab. First they construct and solve the FE model using NX CAE. They also use a specialized NX CAE module called NX Response Simulation to interactively investigate dynamic behavior. The curves generated from this module can then be easily passed to LMS Test.Lab for comparison and correlation to physical test data. Using the correlation data, the engineering team is then able to perform design studies to get its analysis models to match physical test behavior so they can be applied toward accurate simulation of future designs.
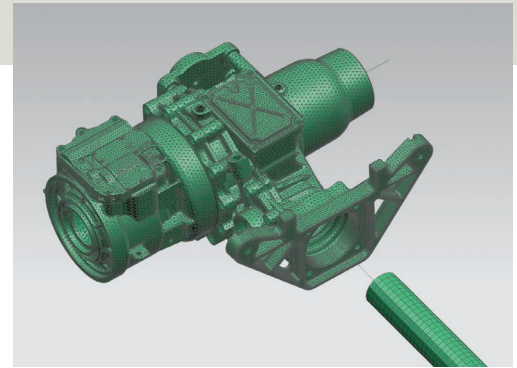
Reducing warranty costs

AAM has been focused on gaining a deeper understanding of product performance in the consumer environment. "We are reducing our warranty costs annually," says Steyer, who directly attributes the team's success, in part, to the efforts it has has put into noise and vibration engineering. He notes, "Siemens PLM Software has been very beneficial to us throughout our establishment of NVH best practices."

Transfer case

Rear beam axle

Front axle
(independent and
steerable)

Front and rear
propeller shafts