

Automotive

Joe Gibbs Racing

NASCAR races are won on the track...and in the shop

Product

NX

Business challenges

- Fine-tune cars before each race
- React quickly to rule changes involving equipment
- Conduct R&D for future vehicle enhancements
- Stay ahead of the competition

Keys to success

- Model parts and subassemblies using NX CAD software
- Transfer geometry to NX CAM software
- Produce parts on CNC and FDM machines
- Comply with dynamic regulations

Results

- Won three NASCAR championships
- Redesigned key steering component and saved more than \$1000 per part
- Reduced time needed to tune the suspension for each track from two weeks to two hours



Joe Gibbs Racing, a three-time Sprint Cup champion, uses NX to help design and fabricate parts for its racing teams.

Since adopting NX, Joe Gibbs Racing has won three NASCAR championships

The race between the races

You need great drivers to win NASCAR® races. Joe Gibbs Racing (JGR), winner of three Sprint Cup championships and 4 Nationwide championships, has great driv-

ers including Kyle Busch, Denny Hamlin, Matt Kenseth and Elliott Sadler.

You also need great pit crews with the strength, agility and know-how to ensure fast and effective pit stops. JGR recruits former college and professional athletes to staff its pit crews.

And, you need great cars.

“Using NX, we have the capability and flexibility to make any part in the few days we have between races.”

Mark Bringle
Technical Sponsorship
and Marketing Director
Joe Gibbs Racing

Joe Gibbs Racing designs and builds racing versions of the Toyota Camry at its facilities in Huntersville, North Carolina. The company currently fields three teams in the Sprint Cup Series, three in the Nationwide Series and two motor cross teams. Twelve complete cars or motorcycles are built for each team.

For the 2013 racing season, NASCAR mandated that car bodies more closely resemble the street versions consumers purchase. But the resemblance ends there. Underneath the body shell is a machine designed to reach speeds as high as 200 miles per hour.

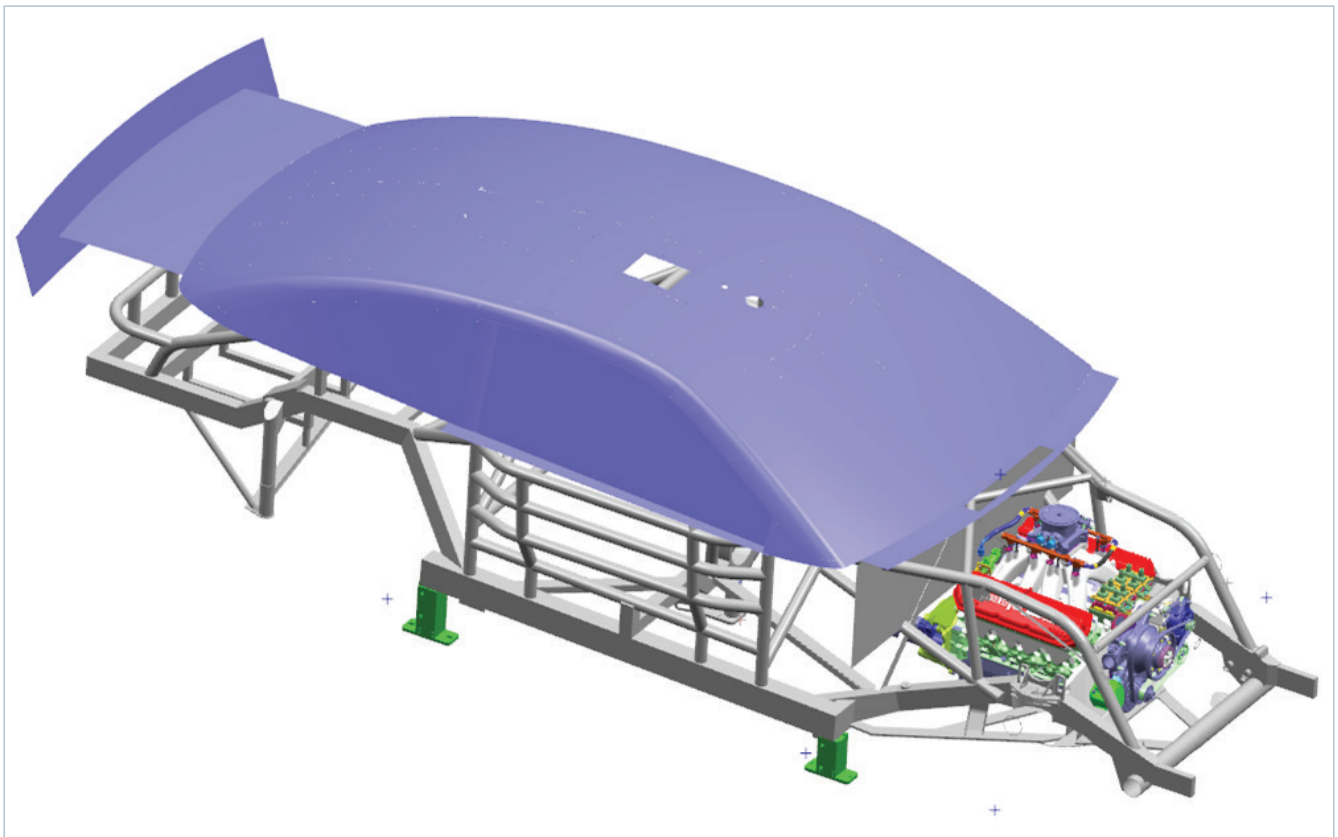
Meeting NASCAR’s mandatory requirements

More than 50 engineers at JGR develop these high-performance automobiles using

NX™ software offered by product lifecycle management (PLM) specialist Siemens PLM Software. NX is used for integrated computer-aided design, manufacturing, and analysis (CAD/CAM/CAE). For the 2013 season, JGR engineers modeled more than 3,000 parts using NX CAD and manufactured those parts with the help of NX CAM.

“Being able to design and machine our parts using one package is very important to us,” says Mark Bringle, technical sponsorship and marketing director at JGR. “We also do analysis using NX. It is totally seamless, enabling us to work without doing any translations.”

NASCAR requires every car to fit a detailed “formula,” including overall weight, to “level the playing field.” As mentioned



Common surfaces of the outer body include the roof, rear window, side glass and all metal in-between.

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Left: 2013 Toyota Camry street version. Right: 2013 Toyota Camry racing version.

above, for the 2013 season, teams had to design and build cars that look more like street cars from the three manufacturers who participate in NASCAR races.

The new JGR car bodies feature a nose that is 2” longer and a tail that is 6” shorter, as well as features to satisfy new safety regulations and material requirements. The hood and the deck are made of carbon fiber, the front and rear panels are made of composite material, and the body panels are made of stamped sheet metal.

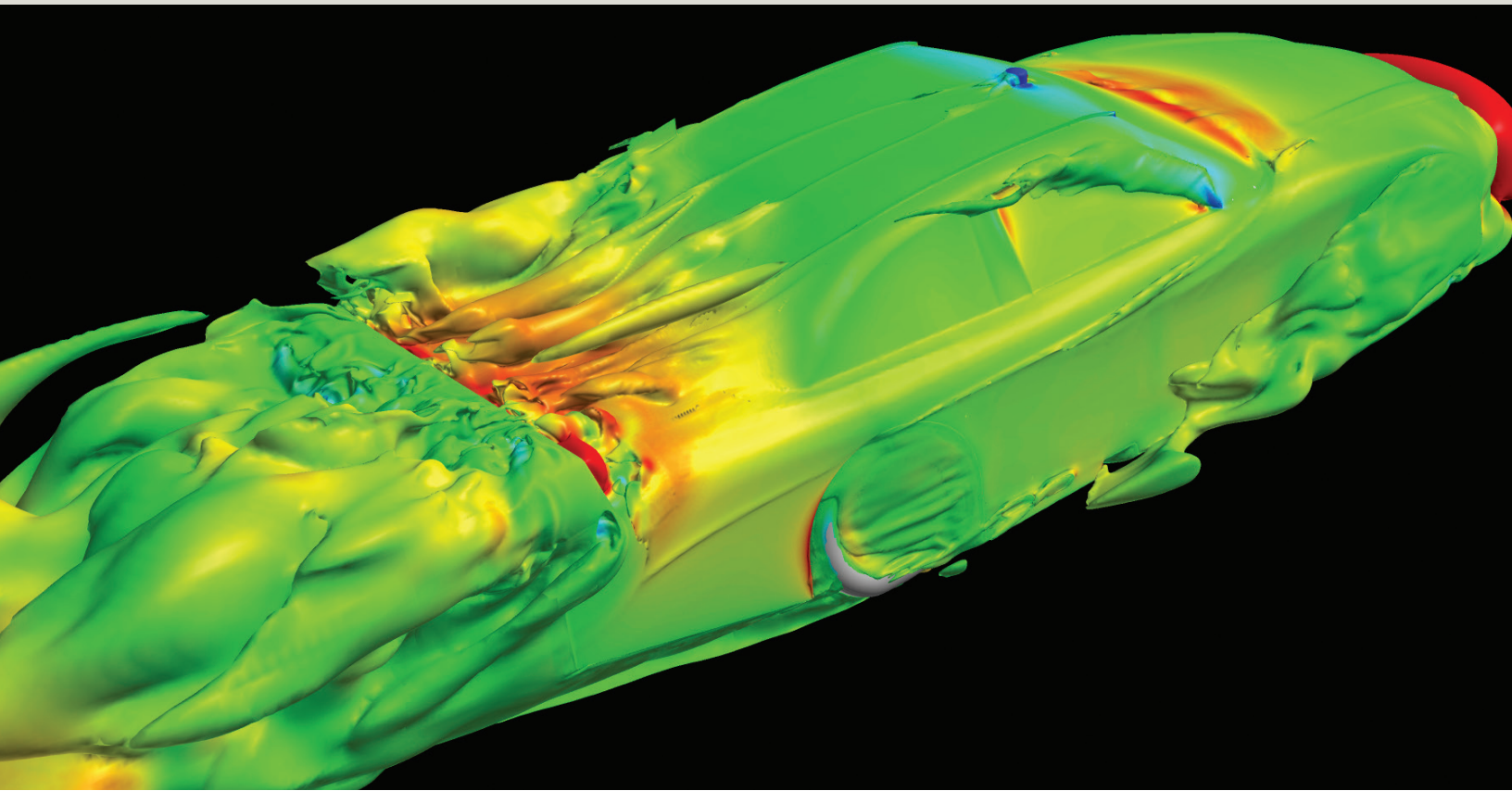
NASCAR mandated that all body panels must be within .070 of an inch of the CAD model submitted by Toyota. The governing body checks the car that finishes first in each race for compliance with the standard. If a car exceeds the specified tolerances, the team faces penalties and its crew chief can even be suspended. To help ensure compliance, JGR’s 2013 cars are accurate to within .035 of an inch.

Using NX to improve cars and processes

Using NX not only helps JGR meet requirements, it also enables engineers to improve parts and assemblies wherever possible to help boost car performance.

“Since we installed NX, we are in the championship hunt every year. We’ve won the championship three times. It’s hard to say how much the software has to do with that, but you have to admit, there’s an impressive correlation.”

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Using the geometry created using NX, a variety of analyses are performed, including computational fluid dynamics.

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For example, engineers redesigned the front suspension draglink to consolidate three parts into one. The new single part not only helps improve cornering, but it is also easier – and less expensive – to manufacture. Cycle time was reduced by 1 hour, while setup time was slashed from 42 hours to 9.5 hours. Since there is now only a single part, no welding is needed.

The savings in cycle time and setup time enables JGR to save \$1,117 per part. The part also weighs less, which is crucial for racing in NASCAR. Weight saved in one part of the car can help optimize the car’s down force, which also helps improve performance.

Before the cars are shipped to the next event, parts that have worn during the previous race must be replaced. Suspensions must be adjusted for each track. If a rule change has been handed

down by NASCAR, the new equipment must be installed and tested before the next race. While all this is going on, the team is also working on future enhancements.

A solid start with NX

Prior to 1998, the crew had tried using CAD/CAM software to speed the production of custom components. Although this was faster than making drawings and then machining parts by hand, data translation between the two software programs caused errors that slowed the process. That problem was solved with the installation of NX, with its fully integrated design, analysis and manufacturing capabilities.

Soon, parts that previously took days or weeks to manufacture were made on computer numerical control (CNC) machines and available within hours. As familiarity with the new software grew and more components were modeled



Joe Gibbs Racing designs, engineers, manufactures and assembles cars at its facilities in Huntersville, North Carolina.

using NX, the team started using the software to virtually evaluate new engine and suspension configurations.

The team also began using the digital environment to optimize weight distribution. At first working virtually, and later in the shop, engineers stripped excess metal from upper components and applied the weight to areas below the centerline of the axles. This way, they were able to improve handling while maintaining NASCAR's required vehicle weight.

"We are constantly asking ourselves: 'How can we make each one of these parts lighter?'" says Bringle. "Anytime you can get weight out of the top end of the car and put it into the bottom end – you've got a competitive edge."

Weight is always an issue with NASCAR racing. Almost every part and assembly is analyzed using NX CAE. If there is an opportunity to use less material or more lightweight material in a part, JGR will find a way. "We do tons of simulation and finite element analysis," says Bringle. "This way we can make sure that a more lightweight part can still withstand the stresses experienced on the track."

The software also helped the team find ways to increase engine horsepower. Performance on the track reflected the increasing use of NX, with faster times and better finishes. "Using NX, we have the capability and flexibility to make any part in the few days we have between races," says Bringle. In 2000, just three years after installing the software, Joe Gibbs Racing won its first NASCAR championship.

"In the past, it was very difficult to check internal clearances. Using NX, we can visualize all the different parts of the engine in motion."

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Solutions/Services

NX
www.siemens.com/nx

Customer's primary business

Joe Gibbs Racing, owned by former Washington Redskins head coach Joe Gibbs, competes in the NASCAR Sprint Cup and Nationwide series.
www.joegibbsracing.com

Customer location

Huntersville, North Carolina
United States

Advanced technology, exemplary race standings

Since then, the team's use of NX has expanded greatly, to the point that nearly every part and subassembly, including the entire engine, has been modeled using NX. The JGR parts library contains approximately 9,000 parts, 887 assemblies and 3,700 drawing files. "We're running 25 CNC machines along with a laser, a water jet, EDM wire, EDM sinker and rapid prototyping capabilities," says Bringle. "We built up our engineering and manufacturing groups to enable us to get from concept to car as quickly as possible, deal with quality issues and retain, leverage and protect company knowledge." The beauty of this approach is that almost all parts can be made in-house very quickly.

The team's use of NX is extensive. Jon Rittle, a design engineer in vehicle dynamics at JGR who does a lot of the modeling, uses the software's mechanism analysis functionality to test new engine configurations long before metal is cut. "In the past,

it was very difficult to check internal clearances," Rittle explains. "Using NX, we can visualize all the different parts of the engine in motion."

Rittle has also created a digital model of the suspension using NX. This model, in concert with another software program, helps the crew chief quickly tune the suspension for each track. That process used to take two weeks. Now it takes two hours.

Geometry created with NX is also being used as the basis for stereolithography and other prototypes used in wind tunnel tests. Geometry is also used in building carbon fiber parts and pieces for the race cars and provides the data for computational fluid dynamics (CFD) simulations.

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