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Ingenuity for life

Automotive and transportation

Daimler

Daimler successfully standardizes global durability process

Product

Simcenter

Business challenges

Maintain durable quality: critically important to the Daimler brand DNA

Reduce the number of prototypes and save time and money during entire vehicle development

Successfully standardize global durability process

Design right the first time when it comes to durability

Manage increasing complexity in new vehicle development

Keys to success

Find the right mix of simulation and testing solutions

Do as much computer-aided engineering (CAE) as possible

Test and measure at the right time on a very high level

Standardize globally on the same data formats and process management tools

Results

Completely eliminated the mule testing phase and replaced it with CAE

Virtually created missing test data to streamline final testing process

Simcenter portfolio from Siemens PLM Software enables simulation and testing success

About a decade ago, durability testing was mostly conducted on the test track. Today, with the arrival of digital twins and cutting-edge simulation technology, the old school way of testing is bound to disappear. Or is it?

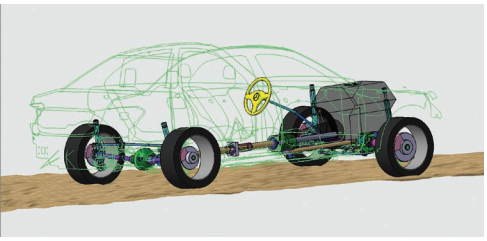
According to Bruno Seufert, of Daimler AG, not really. Seufert, who is responsible for chassis durability and load data collection and calculation for the vehicles at Daimler, estimates that 65 percent of vehicle validation still occurs using testing hardware, mostly on test benches and sometimes on test tracks, and 35 percent is completed digitally. And he sees the trend reaching 50 percent simulation and 50 percent testing by 2020.

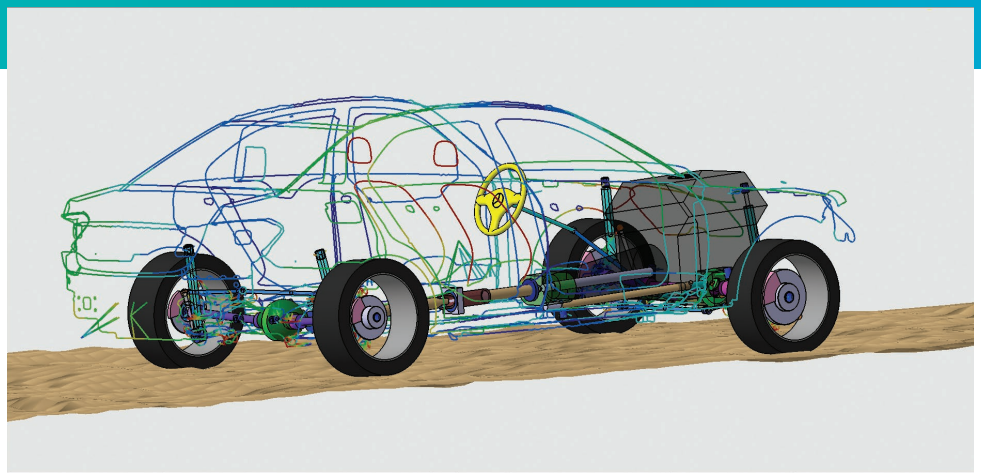
Seufert should know. He leads a team of 50 engineers who work on chassis durability and vehicle load collection. He and his team know how to design quality vehicles that are built to last and they know they need testing to do this.

Results *(continued)*

Radically changed durability engineering process from early development prototyping to CAE simulation

Standardized globally on data format and process management tools, including Simcenter Tecware for the time history and frequency phases and use motion simulation solution from the Simcenter portfolio for CAE-based durability road loads calculation





Durability and the brand DNA

Ask anyone who owns a Mercedes-Benz® about their choice and one of the key purchase drivers you will hear is its durable quality. Owners know that a Mercedes-Benz can run for miles and miles and even decades. It is part of the brand DNA and has been for ages. So, understandably, durability plays a very important role at Daimler and a trait the company feels strongly about retaining.

"Our customers don't want to have something rattling on a car with merely 50,000 kilometers on the odometer because of a worn-out ball joint or a bushing that is no longer doing its job," says Seufert.

"Durability plays a big role in these types of quality issues. Not surprisingly, durability can influence the product costs quite a bit. Suppose you needed to strengthen a component with a special heat treatment to improve durability. This costs time and money. And this is why we need to make sure that we design right the first time in regards to durability."

Daimler's "Design-Right Roadmap"

Daimler's roadmap for the future of durability focuses on doing as much computer-aided engineering (CAE) as possible without doing parallel tests or measurements. The idea is to do the tests and measurements at the right time on a very high level.

"We made a decision ten to fifteen years ago to standardize our durability process. We didn't want to have different technical solutions on every site. We wanted to have solutions that would be global."

Bruno Seufert
Senior Manager
Chassis Durability and Vehicle Load Data
Daimler AG

"We made a decision ten to fifteen years ago to standardize our durability process," says Seufert. "We didn't want to have different technical solutions on every site. We wanted to have solutions that would be global. When our test engineers evaluate a time history signal, they do it with the same tool. No matter if they are a test bench engineer, a measurement engineer, a multi-body simulation engineer or a finite element engineer, they are all using Simcenter™ Tecware software for the time history and frequency phases. They are all using the same tools, like motion simulation solution from the Simcenter portfolio for CAE-based durability road loads calculation. They all use the same data formats and process management tools. The Simcenter solutions help it all fit together. It really pays off."

Ten or twenty years ago, Daimler worked vehicle by vehicle when it came to chassis durability. Now the company creates families of vehicles or vehicle platforms, if you will. There is a lot more complexity to manage.

"When we are developing a new or updated platform, we sort out the decisive durability factors using calculations," explains Seufert. "It is really a survival strategy in our competitive market today. We calculate and sort out the best possible component simulations. If they are of a high enough quality maturity, the components will be built and tested."

The new world of durability engineering

This methodology is a radical change in durability engineering that has developed the past ten years and matured the past three years. In the past, Daimler, like many other automotive manufacturers, relied on prototype vehicles in the early development phases. Now, the work is mostly done digitally.

Seufert notes, "It is a more focused way of working. We model all different types of vehicles and then we drive them digitally through our digital test programs and we analyze the damage content of the loads and forces that we see and then we select the critical ones that need more analysis work. We do the critical work concerning loads much earlier in the development process. Up to two years earlier! With our new development architecture, which integrates motion simulation solution from the Simcenter portfolio, we can tell which spot in the structure gets a certain type of load."

The end of the measurement campaign?

That being said, Daimler still does measurement campaigns on-site. Cars are hooked up to 200 or so sensors and driven for hours to evaluate the collected digital data statistically. In a way, it is a cross-check, but these ideas are taken directly from the Simcenter™ solution: Customer Correlation (CuCo) method. Developed over two decades ago, CuCo originated from a long-term partnership with experts

"We still want to reduce the number of prototypes and time is still a huge factor in the testing process. That being said, we have eliminated a phase when it comes to collecting loads. Usually we don't measure the mule phase any more. The mule phase looks like the old vehicle but has the next-generation technology underneath. We only measure this stage if the degree of innovation is very high. Otherwise, it is CAE simulation only."

"Even though you have a digital twin, it doesn't necessarily mean that the measurement team is home free."

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from Germany's leading automotive manufacturers, including Daimler. For years, durability departments in many of the leading original equipment manufacturer (OEM) companies used this durability methodology and its data for load acquisition.

"We can still get very valuable information from Simcenter CuCo," explains Seufert. "We still use the CuCo database in combination with our own signal measurements and digital road classification. We mix road types to create different customers in the computer statistically. What we try to find is the 'most severe' customer scenario, that one percent that represents the driving extreme."

Digital twins in durability

In the past, Daimler, like many automotive manufacturers, took predecessor data from a test database. In simple terms, the engineers determined that the new car looked similar to an existing vehicle, and used the data from the older model. It usually was close enough, but if there was a new design element like a different axle, there would be missing data.

"When this happened, we would have to run physical tests," says Seufert. "With our new digital system, we can digitally create the data that is missing to precisely match the new architecture. This is a great advantage."

Daimler is working towards having digital twins of all its models and designs. Having these types of accurate simulations provides a clear transition from the digital to the "physical" world.

"Quite often, it is not possible that the last vehicle we calculated can be measured accurately," notes Seufert. "For example, we get the actual physical prototype, perhaps for 10 weeks. So the pressure still remains on the measurement campaign. Even though you have a digital twin, it doesn't necessarily mean that the measurement team is home free."

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Solutions/Services

Simcenter CAE simulation
www.plm.automation.siemens.com/global/en/products/simcenter/simcenter-cae-simulation.html

Simcenter Tecware
Simcenter Customer Correlation
www.siemens.com/simcenter

Customer's primary business

With Mercedes-Benz Cars, Daimler Trucks, Mercedes-Benz Vans, Daimler Buses and Daimler Financial Services, the Daimler Group is one of the biggest producers of premium cars and the world's biggest manufacturer of commercial vehicles. Daimler continues to shape the future of mobility today, selling its vehicles and services in nearly all the countries of the world. With production facilities in Europe, North and South America, Asia, and Africa, the Group sold about 2.9 million vehicles in 2015. Daimler employs a workforce of 284,000+ people.

Customer location

Stuttgart
Germany

The durability challenges

Even if Daimler is performing its durability work digitally, the prototype still plays a role in the process. When the engineers receive the prototype vehicle, they perform a measurement campaign, combining up to five different measurements at one time. This data is then fed to all the test rigs and suppliers to prepare the final release.

"We still want to reduce the number of prototypes and time is still a huge factor in the testing process," says Seufert. "That being said, we have eliminated a phase when it comes to collecting loads. Usually, we don't measure the mule phase any more. The mule phase looks like the old vehicle but has the next-generation technology underneath. We only measure this stage if the degree of innovation is very high. Otherwise, it is CAE simulation only."

The future of testing

In an ideal world, you would sign off on the simulated digital twin, but it is far from this process at the moment. It still requires at least a final test for production release.

"Some properties within chassis durability are really far away from pure simulation," says Seufert. "Think about rubber and its natural properties. Or all the terrible things everyday people do to cars – scraping the chassis over curbs and speed bumps, splashing through huge muddy potholes. These things aren't covered in the CAE world yet. Whether it is confirming the accuracy of a simulated component on the test bench or accounting for misuse events on the test track, I can't see how these critical final testing steps can be eliminated. It is just necessary. Ideally, everything can be cut until those final steps. The final safety test we cannot cut. It gives the unpredictable a chance to occur. We are looking for the unknown."

The verdict in the end? It seems that the test track and the test bench are here to stay – even if the process of using digital twins is catching up.

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