

**Strength and  
durability strategies  
for lighter, stronger  
and more durable  
vehicles**

# Strength and durability strategies for lighter, stronger and more durable vehicles



- Trends
- Performance engineering
- Deliver lighter, stronger and more durable vehicles
- Key innovation areas
- Conclusions & wrap-up



# #Reliable Vehicles

#Emerging Markets



#Eco-friendly



#Economic Pressure



# Trends in the Automotive and Transportation Industry

## Automotive OEM and Tier-1 supplier



### #Reliable Vehicles

Customer expectations for long-term quality and high mileage are increasing.

**Toyota**

The Corolla is synonymous with quality, durability, reliability and lasting value



### #Emerging Markets

The key source of growth for the Automotive and Transportation industry.

**IHS Auto Inside**

85% market growth in Emerging Markets



### #Eco-friendly

Finite oil reserves and growing metro areas require new solutions.

**Energy.gov – US Energy Office**

A 10% reduction in weight results in a 6%-8% fuel economy improvement

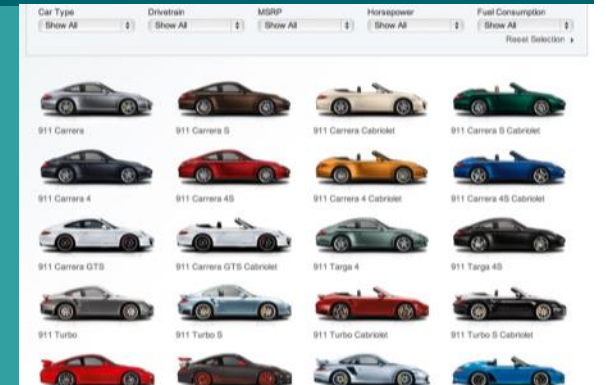


### #Economic Pressure

Competition has never been fiercer with more design variants in a shorter time.

**Porsche**

There really are 20 different Porsche 911s for sale





# Trends in the Automotive and Transportation Industry

## Trucks, buses and RVs



### #Reliable Vehicles

Customer expectations for long-term quality and high mileage are increasing.

#### Mercedes Benz

Job #1 Actros returns. After over 1 million kilometers, now comes retirement



### #Emerging Markets

The key source of growth for the Automotive and Transportation industry.

#### Mercedes Benz

Service camp in Nigeria



### #Eco-friendly

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Competition has never been fiercer with more design variants in a shorter time.

#### Volvo Trucks

Model line up



# Strength and durability strategies for lighter, stronger and more durable vehicles

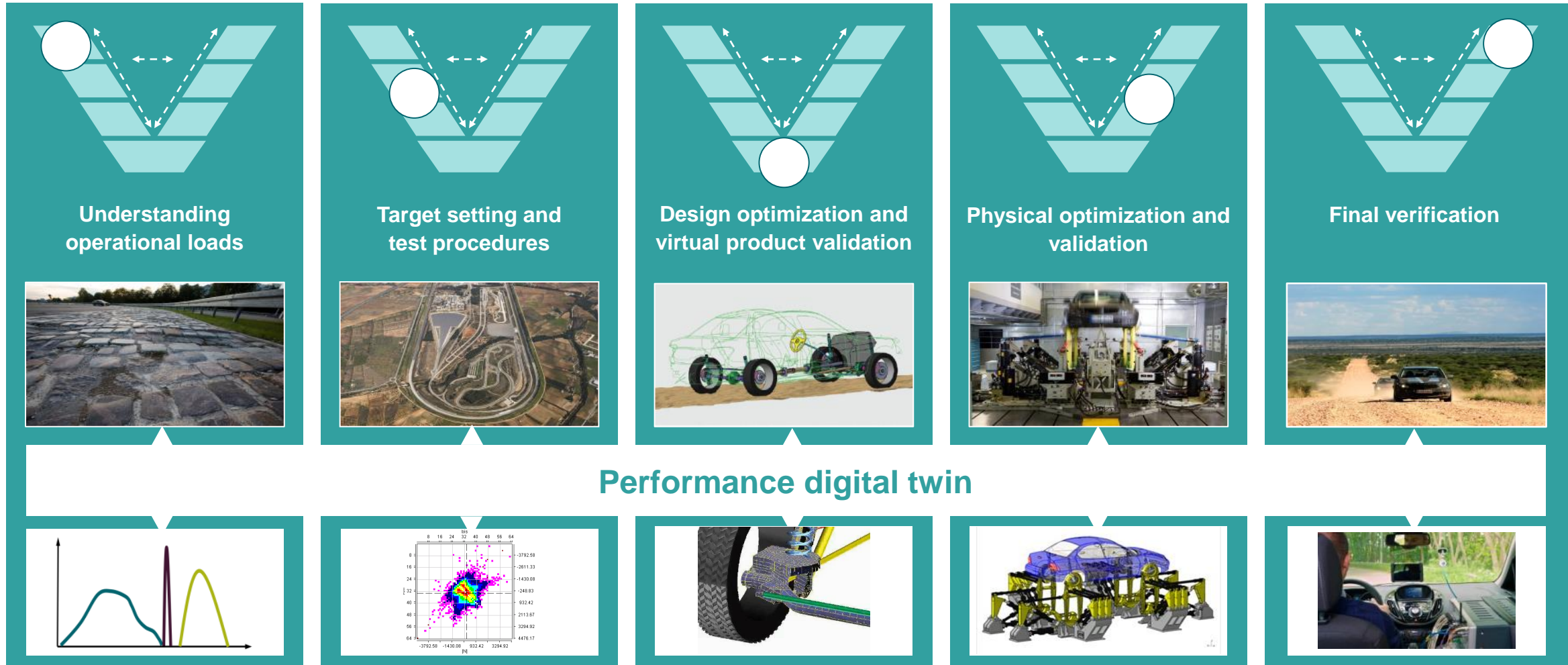


- Trends
- **Performance engineering**
- Deliver lighter, stronger and more durable vehicles
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# Simcenter for Automotive Performance Engineering

## Performance digital twin – Strength & Durability

**SIEMENS**  
*Ingenuity for life*





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# #Reliable Vehicles

Deliver reliable & durable designs

## Vehicle Durability Engineering

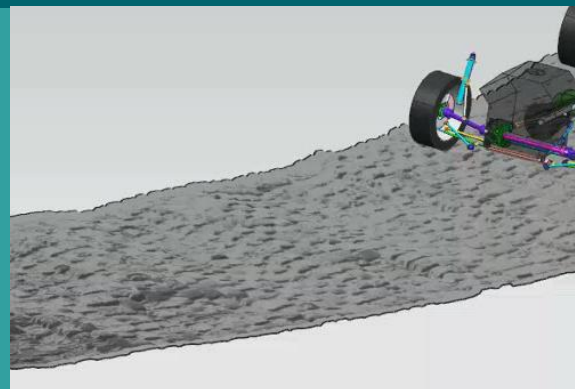
To guarantee reliable and durable designs durability engineering is an integral part of development.

Toyota – For every road in the world  
Recreating poor road conditions to those that exist around the world



## Virtual Prototyping

Validate strength and durability performance of vehicles, subsystems and components before committing to a physical prototype.



## Strength & Durability Analysis



Simulation software and services integrating loads prediction, stress and fatigue analysis

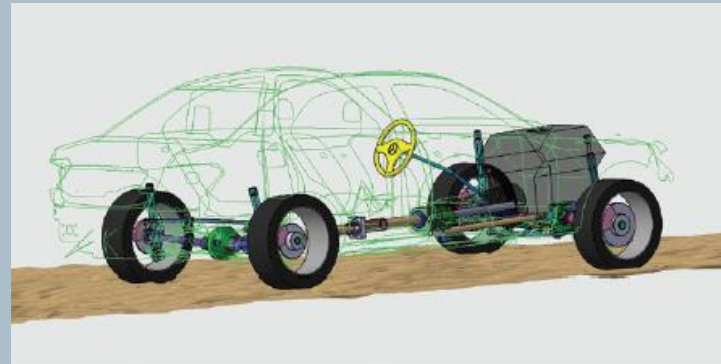
# Daimler AG

## Standardizing the global durability process



- Eliminated the mule testing phase and replaced it with CAE
- Changed durability engineering process from early development prototyping to CAE simulation
- Standardized globally on data format and process management tools

### Reduce number of prototypes and save time and money



Predicting road loads



Correlating simulation and test

- Simcenter durability engineering solutions are key for simulation and testing
- Standardize globally on the same data formats and process management tools

**“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.”**

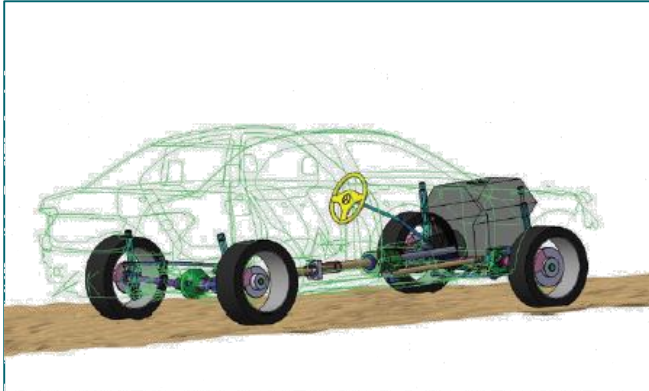
Bruno Seufert, Senior Manager, Chassis Durability and Vehicle Load Data”



# #Reliable Vehicles

## Strength & Durability Analysis

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*Ingenuity for Life*



### Daimler standardizes global durability process

Reduces number of prototypes and saves time and money

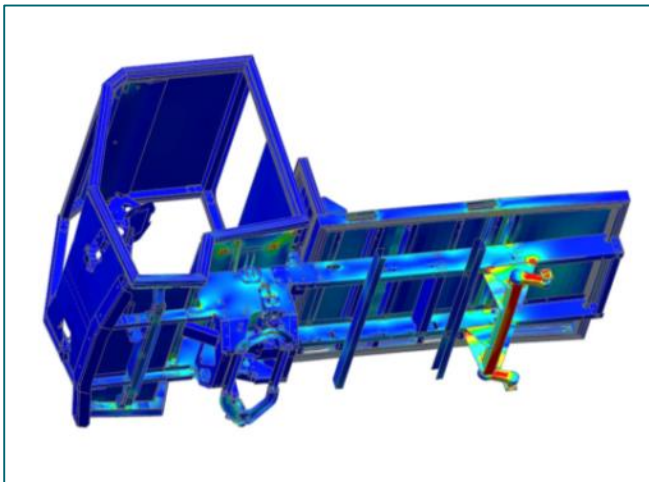
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### LOHR Industrie delivers long-lasting transportation system

Accelerates analysis for welded assemblies

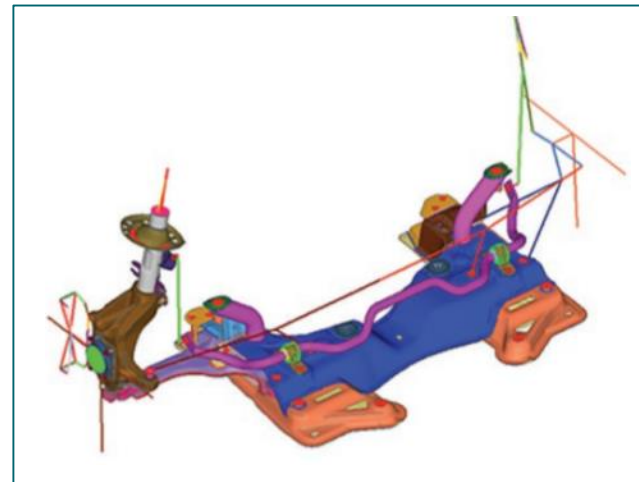
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### Services Précicad increases carrying capacity

Designs vehicles with a load-carrying capacity of 1,000 lbs

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### FIAT virtually verifies and validates durability

Conducts chassis fatigue analysis with excellent results

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# #Emerging Markets

Deliver for any road in the world

## Glocalization

Account for geographic differences in customer preferences and product requirements.

Carbuzz.com

China gets a whole bunch of long wheelbase models

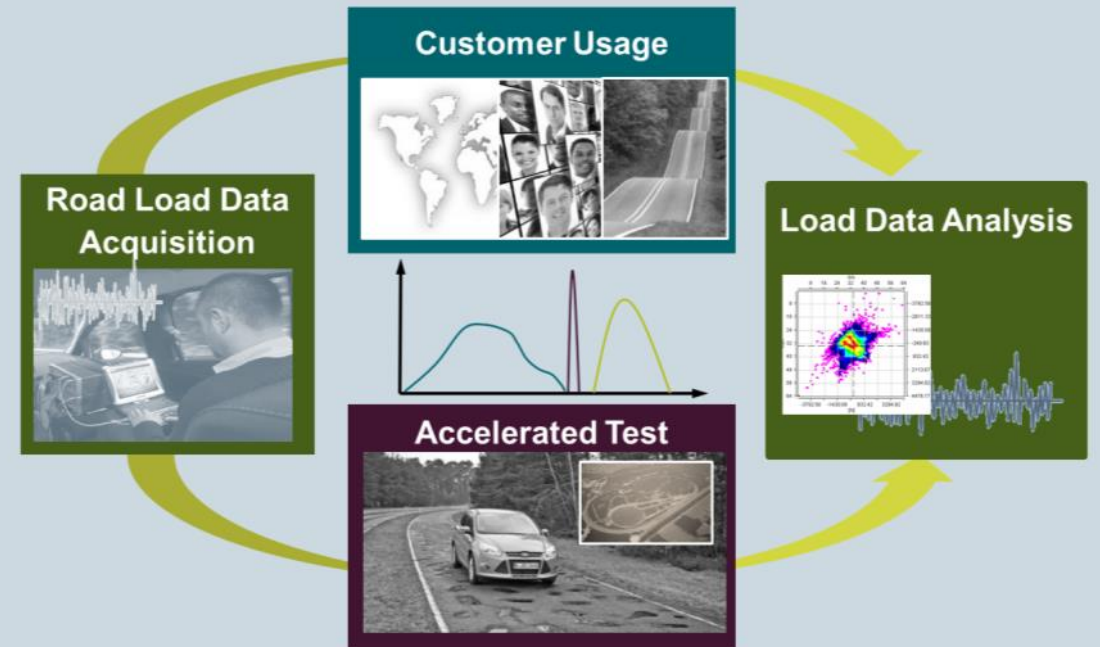


## Customer Usage

Incorporate local roads, driving habits and vehicle loading to set realistic durability vehicle targets.



## Road Load Data Analytics



Road load data acquisition hardware, load data analysis software and data mining services



# Faurecia Emissions Control Technologies

## Building long-lasting exhausts



- Improved product quality & durability
- Reduced test campaign setup time and complexity
- Streamlined testing & measurement

### Conducting efficient RLDA campaigns



Expanding the number of measurement channels



Designing clean, long-lasting systems

- Efficiently acquire reliable road load data with a compact and robust system
- Rely on a single hardware and software platform to cover all different road load data acquisition steps

**“We aim to create products that are as good as possible and that last a certain number of miles. We are happy to say we can effortlessly achieve this with a combination of Simcenter SCADAS Recorder and Simcenter Testlab”**

Warren Selig, Durability Team Lead

# #Emerging Markets

## Road Load Data Analytics

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**Nissan Technical Centre Europe**  
Implementing end-to-end solutions for test-based durability engineering

[More on web](#)



**Daimler Trucks enhances durability testing**  
Meets the specific product durability needs of customers in different regions

[More on web](#)



**Faurecia builds clean, long-lasting exhaust systems**  
Improves product quality and durability

[More on web](#)



**Ford Otosan**  
Truck manufacturer cuts time to reproduce 1.2 million kilometers of customer use with Simcenter solutions

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# #Eco-friendly

Save weight. Save fuel.

## Lightweight Vehicles

Increasing demand for lightweight vehicles to meet stricter regulations and fuel economy standards.

DriveAluminium.org

The new Ford F-150 all-aluminum body is 39% lighter than its predecessor.



## Multi-Material Design

Reduce weight of chassis and body structures by mixing lightweight materials and optimizing geometry.

Worldsteel

Volkswagen reduced fuel consumption and CO2 emissions by around 23%.



## Multi-attribute Balancing



Simulation and design exploration software and services balance weight, strength and durability

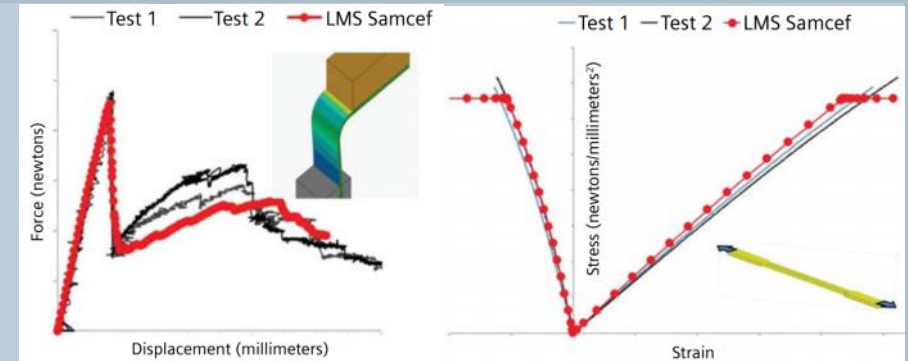


- Predictive damage models at the coupon level and at composite subsystem design concept level
- Development of the parameter identification procedure, based on a limited amount of physical tests on coupons

### Target: reaching 50 percent weight reduction



Damage of a specimen after test



Innovative methodology for progressive damage analysis of composites

- Simcenter Samtech Samcef Mecano non-linear finite element solver for accurate modelling
- Simcenter Engineering Services for composite damage model identification

**“Not only at Honda, but many engineers in this field think that we can still make vehicles that have a 50 percent lighter body structure using composites while maintaining the mechanical properties of the replaced metallic parts.”**

Yuta Urushiyama, Composite body innovation programs Honda R&D Co., Ltd.



# #Eco-friendly Multi-attribute Balancing

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## WorldAutoSteel

Reduce body structure weight by 35 percent and achieve performance targets

[More on web](#)



## ZF Lemforder designs lightweight control arm

Balances weight, strength and durability using design space exploration software

[More on web](#)



## Magneti Marelli optimizes design

Enhances strength & durability of suspension components before developing prototype

[More on web](#)



## Honda engineers super lightweight car

Targets to save 50% on vehicle weight by using composites

[More on web](#)

# #Economic Pressure

## Accelerate Time-to-market

### Accelerate Time-to-market

Accelerate time-to-market from concept to start-of-production.

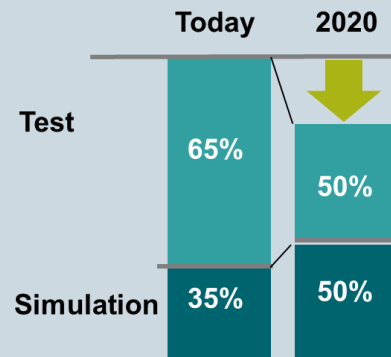
#### Volvo's Rapid Strategy

Volvo aims at 50% reduction of develop lead-time until 2020 (42 to 20 months)



### Process Innovation

Innovate vehicle durability engineering at the requirement, concept, virtual design and physical validation stages.



### End-to-end Durability Engineering

Concept

Release

Optimization

Design

Validation

Durability simulation and test software, powerful hardware and expert engineering services

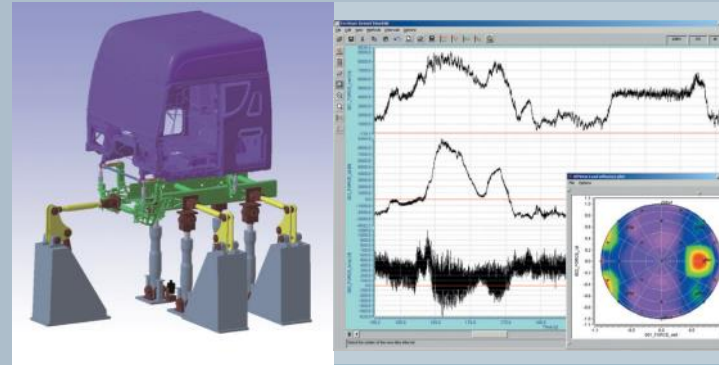


# China FAW

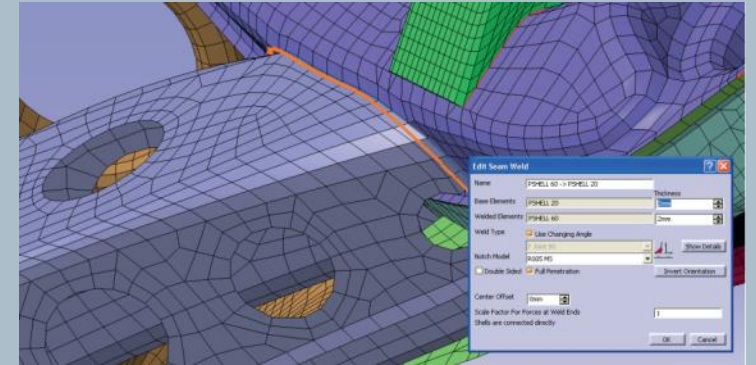
Cutting significantly vehicle development time and costs for durability



## Durability as a key differentiator in challenging times



Optimizing structural components for durability performance



Accurately predicting road loads on vehicle components

- Optimized component structures for durability performance
- Significantly cut the cost of vehicle development by shortening the design cycle
- Brought robust products to market faster than the competition

- Employ a pragmatic approach that includes data measured on the track in a complete, integrated simulation solution
- Replicate a laboratory vehicle road load test using multibody simulation and experimental data

**“Thanks to the use of Simcenter solutions from Siemens PLM Software, we cut costs during the development of the commercial truck by 20 million rmb.”**

Xin Yan, Body Department

# #Economic Pressure

## End-to-end Durability Engineering

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### Daimler standardizes global durability process

Reduces number of prototypes and saves time and money

[More on web](#)



### FAW cuts vehicle development time and costs

Introduces award-winning durability engineering process

[More on web](#)



### NISSAN Europe cuts development time from 6 to 3 years

Creates award-winning vehicle using digital platform focusing on quality, cost and time



### Hendrick Motorsports delivers in time for the next race

Rapidly designs and analyses high-performing, durable components

[More on web](#)



# Strength and durability strategies for lighter, stronger and more durable vehicles

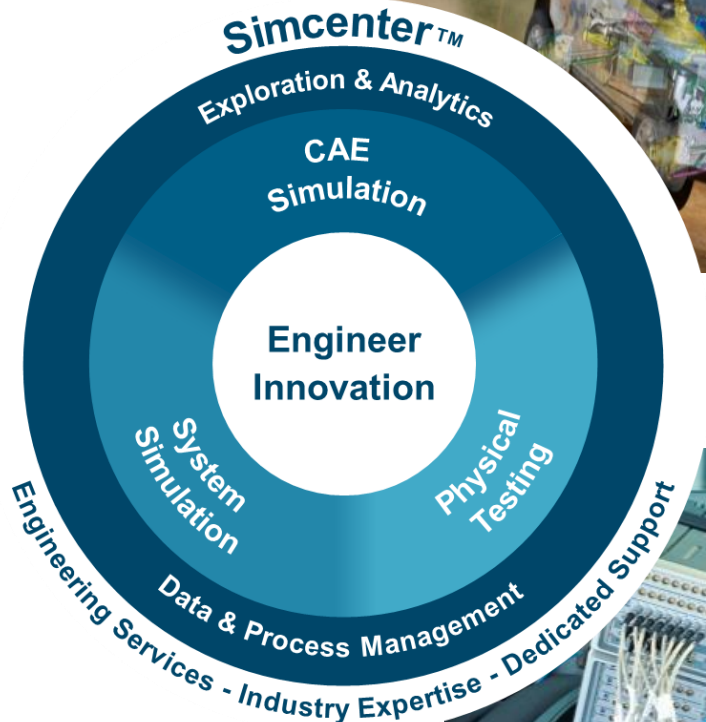


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# Simcenter™ Durability Portfolio

## Vehicle Strength & Durability

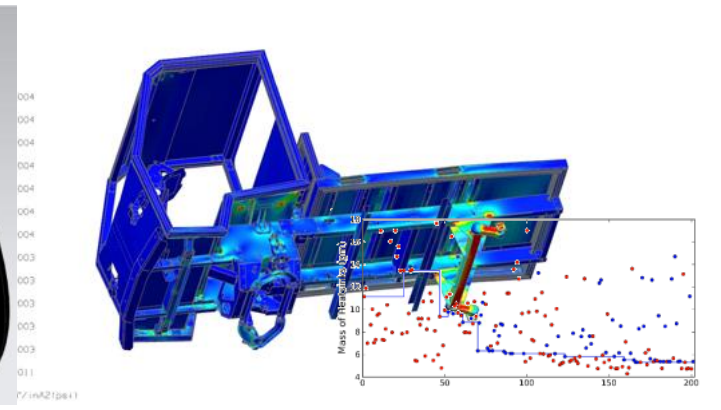
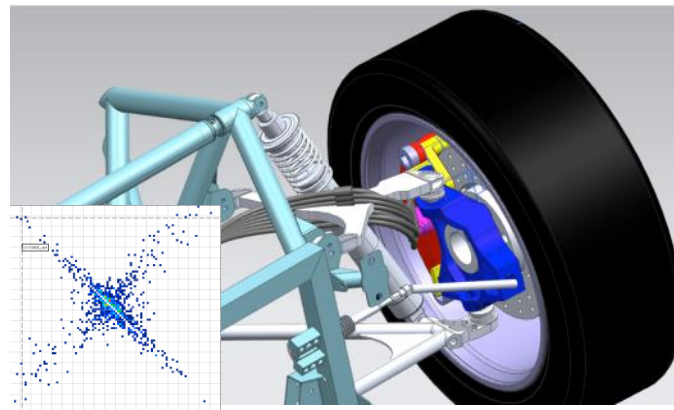
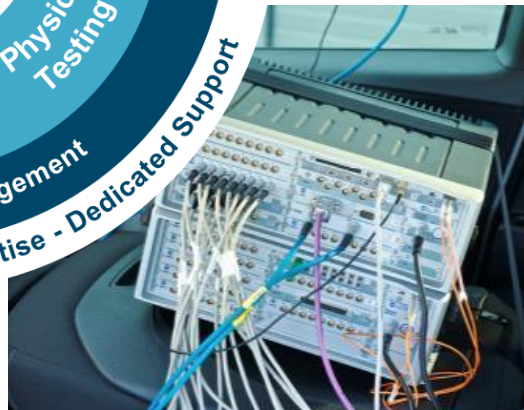
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**Hardware**

**Software**

**Services**





# Innovation areas

## Vehicle Strength & Durability

**Road Load Data  
Acquisition**

**Road Load Data  
Prediction**

**Load Data Analysis**

**Load Data Mining**

**Strength & Fatigue  
Analysis**

**Multidisciplinary  
Exploration**

# Road Load Data Acquisition Challenges

**SIEMENS**  
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## Accurate road loads

Acquire real life road loads as input to virtual & physical validation



## Maximize productivity

Faster setup, increased uptime, faster analysis & quicker results delivery



## Maintain quality

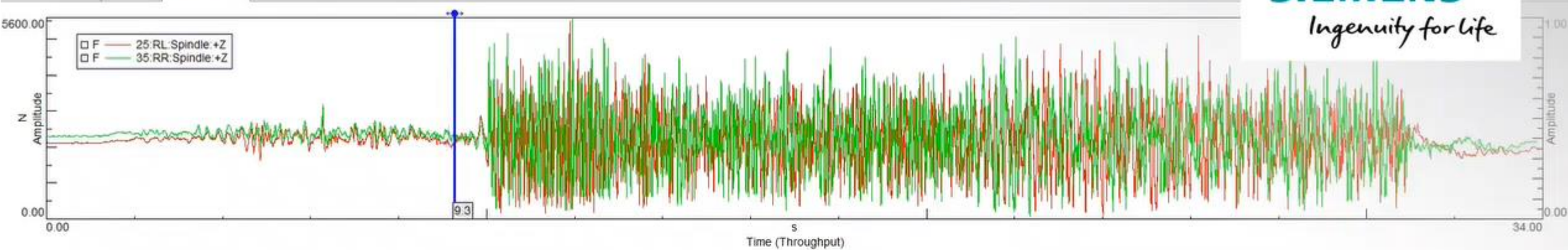
Perform campaigns in full confidence & automate repetitive tasks





Display

Preview Time Video 1 Video 2 +



**End-to-end durability testing**  
Fast and accurate data collection

# Road Load Data Acquisition

with Simcenter SCADAS and Simcenter Testlab



## Acquire real-world vehicle loads on proving grounds and public roads

- Integrated hardware, software and services covering instrumentation, acquisition, analysis and reporting
- **Faster road load delivery** by maximizing productivity and output of every single process step
- Perform test campaigns with full **confidence**
- **Reduce test campaign costs** by shifting workload from engineer to technician

### Flexible hardware

Centralized



Distributed



### End-to-end software

Technician



Engineer



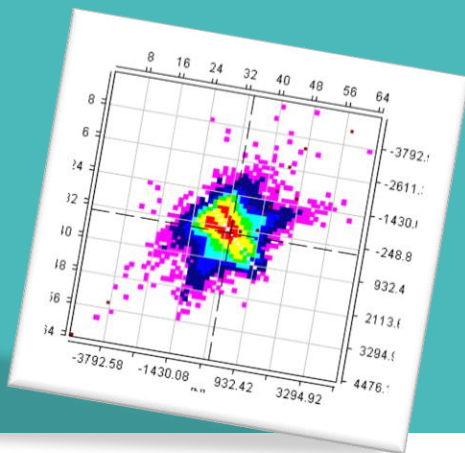


# Load Data Analysis Challenges

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## Valuable insights

Qualify and quantify the durability potential of vehicle loads



## Accelerated tests

Design accelerated damage equivalent test schedules



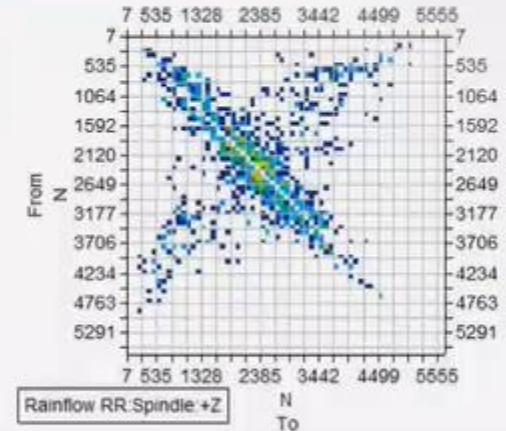
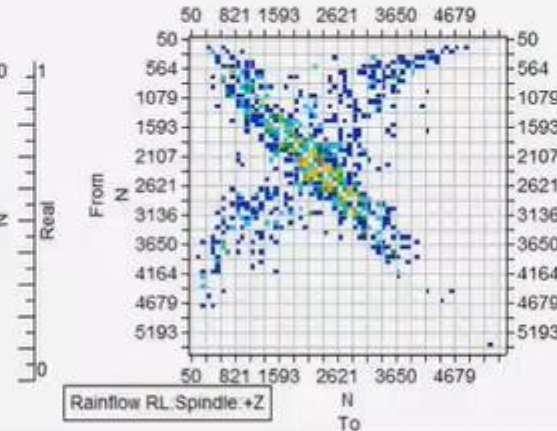
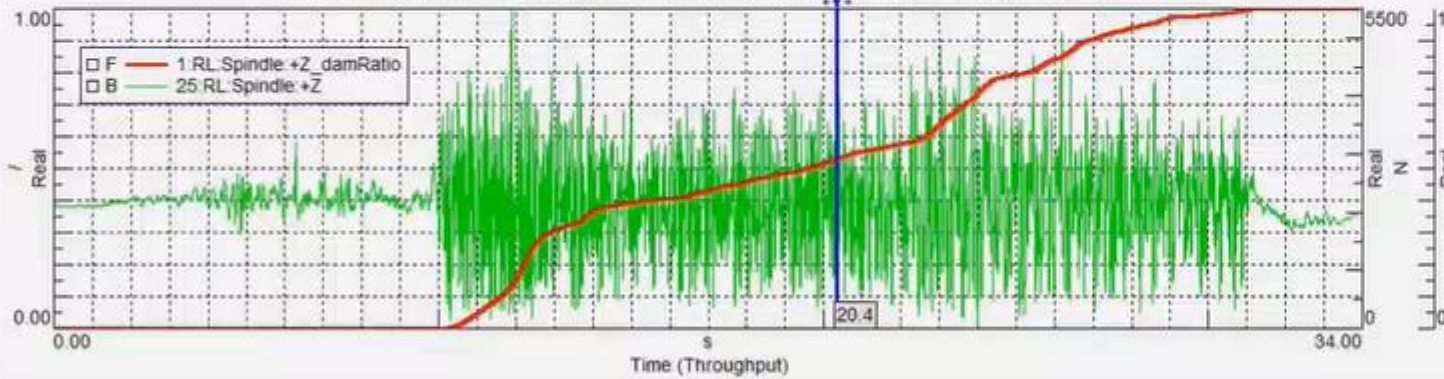
## Correlate test & simulation

Compare test & simulation load data using proven data analytics





Wheel Force and Accumulated Damage Over Time



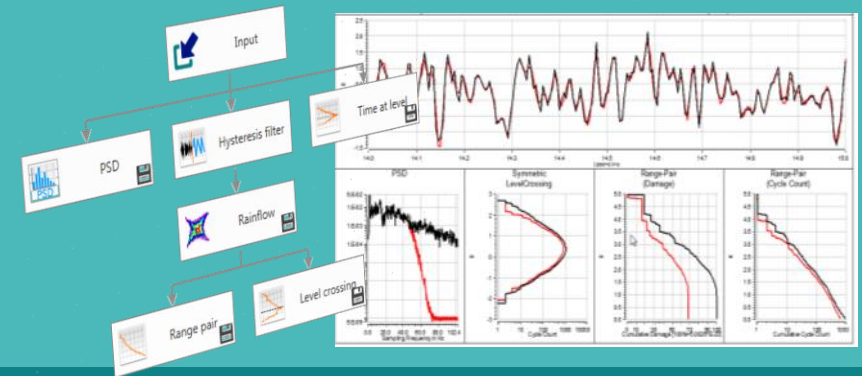
End-to-end durability testing  
Faster and easier load data analysis



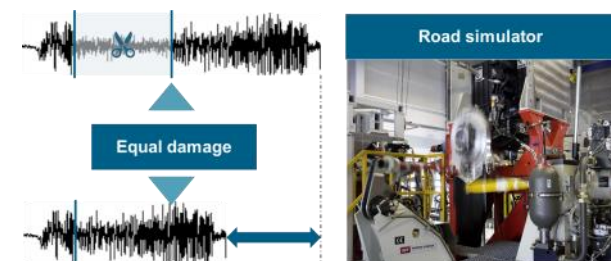
## Gain a precise understanding of loads

- **Innovative load analysis.** Qualify and quantify the durability potential of vehicle loads with innovative load analysis co-developed with leading OEMs
- **Accelerated tests.** Derive compressed load time histories with equal damage and speed up physical testing and validation.
- **Target setting and test schedule definition.** Map (local) customer usage to (global) condensed durability test scenario.

## Innovative load analysis

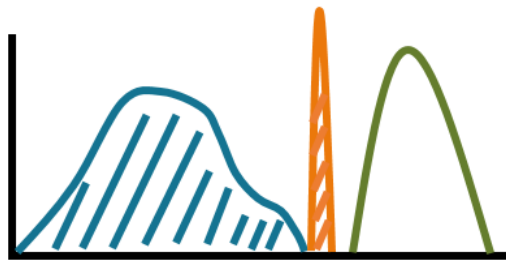


## Accelerated tests



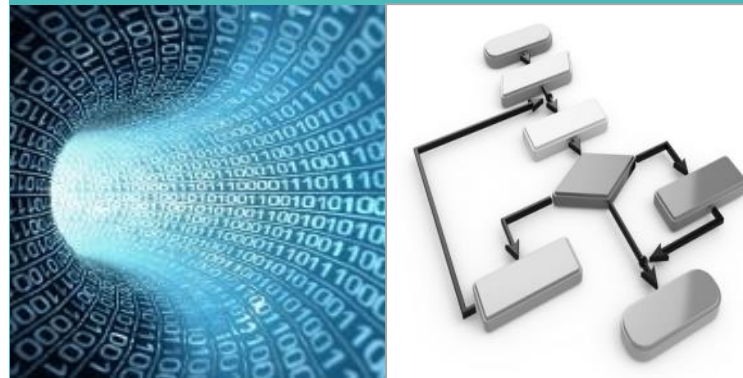
## Customer usage

Develop detailed insight on customer usage



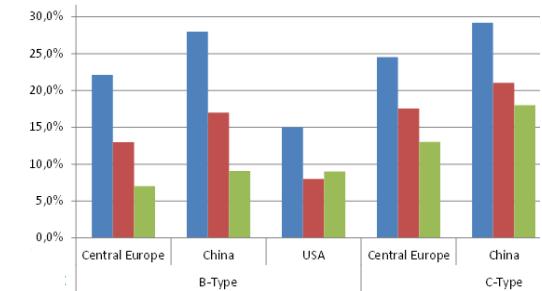
## Big data analysis

Fast and robust large database processing



## Statistical quantification

Getting engineering answers based on large customer data bases

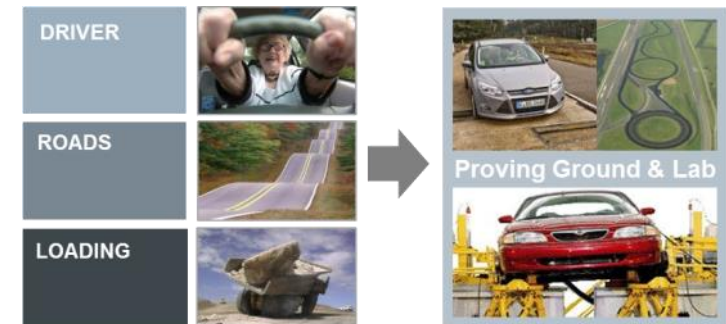




## Define realistic and customer correlated (durability) vehicle targets

- Statistical quantification of customer usage for specific usage subjects based on large data bases
- Fast and robust large database processing for answering engineering questions on customer usage
- Detailed insight on customer profile for objective-oriented product development, e.g., fuel economy, power train optimization

### Customer correlation

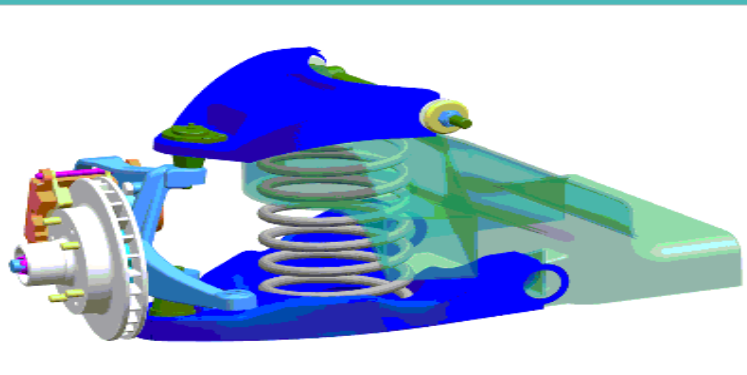


### Data mining



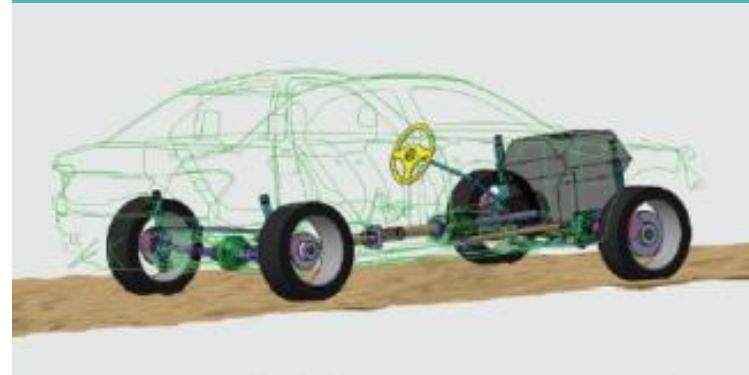
## Need loads

Strength and durability requires component loads



## Full vehicle evaluation

Evaluation of chassis/body requires > 500 inner loads

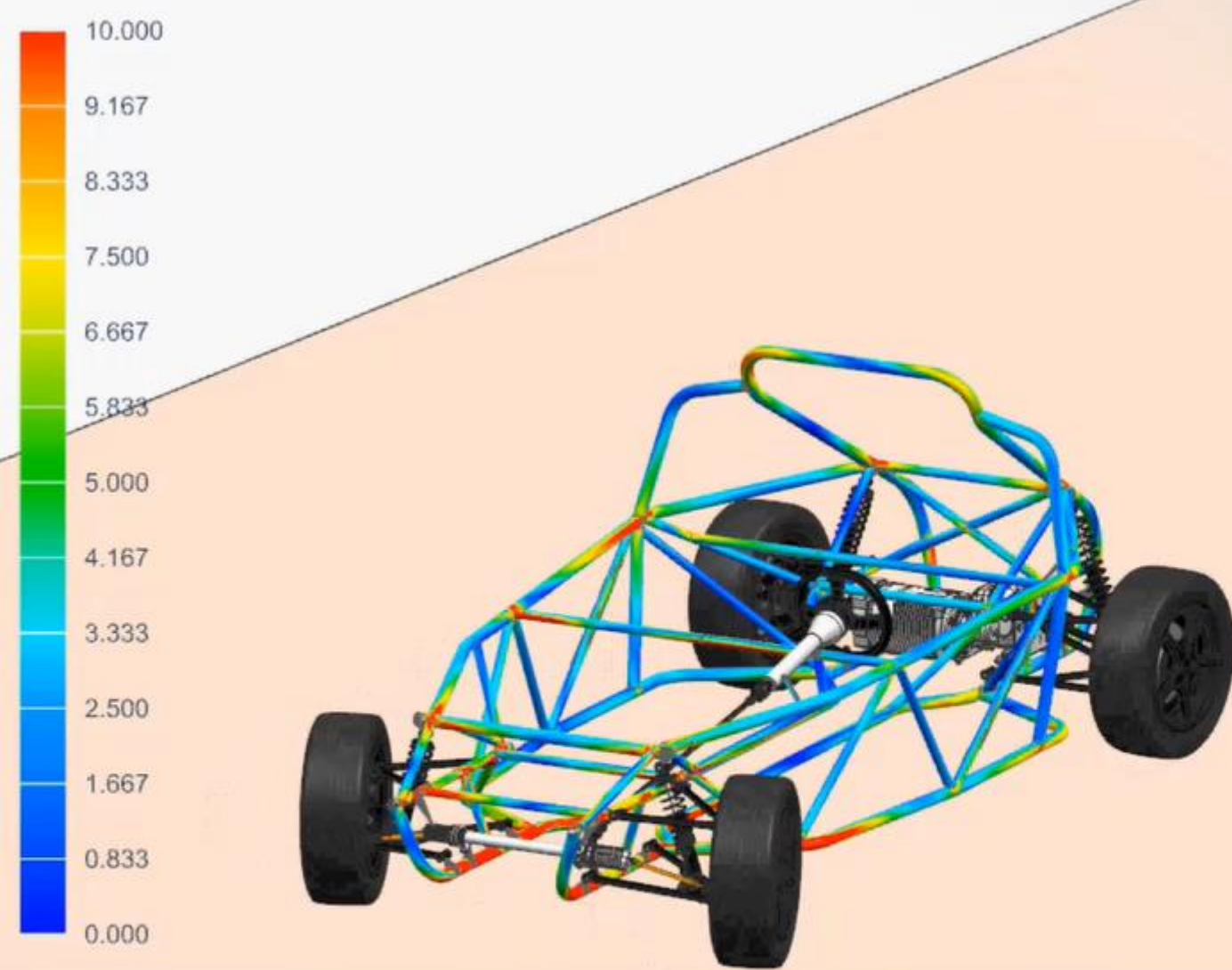


## Limited test resources

Cannot measure everything and everywhere







## Durability engineering

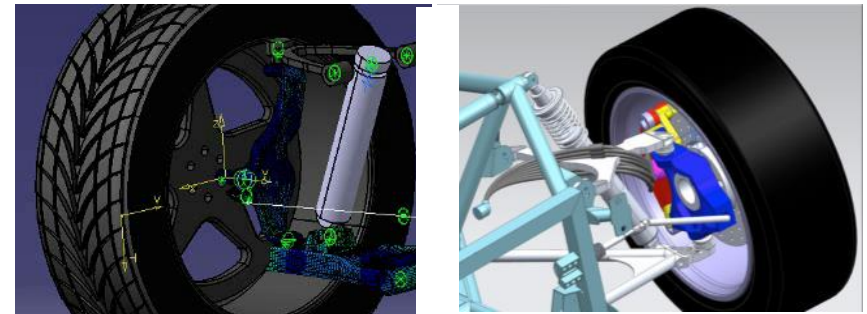
Use Simcenter 3D Motion to accurately model vehicles and subsystems and apply real world Simcenter Testlab load data

# Road Load Data Prediction with Simcenter 3D

## Earlier access to real-world component, subsystem & vehicle loads

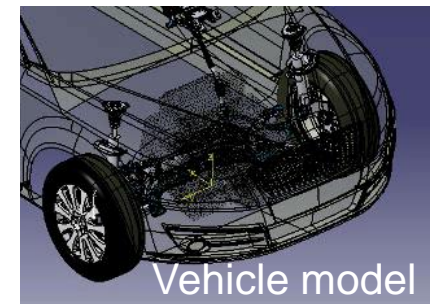
- **Accurately predict component loads** for complex systems with limited test input
- **Multi-body dynamics** software combining full vehicle models with wheel force (test) data or a digital road with driver and tire model
- Enable **virtual validation** of multiple vehicle configurations without physical testing

### Multi-body dynamics software



### Virtual Test Rig

(Limited) test data +

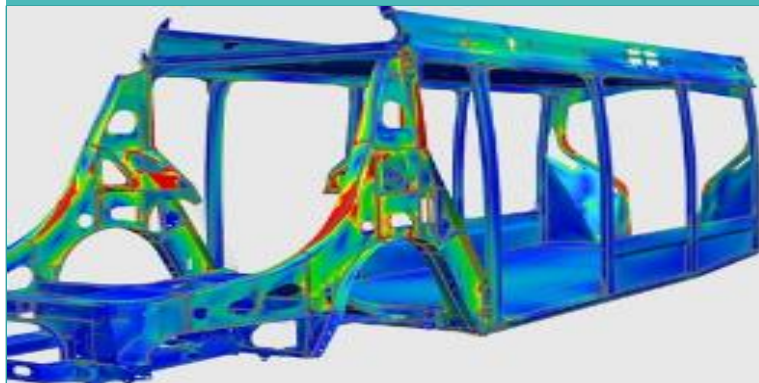


Vehicle model



## Ensure strength

Optimized design under all conditions by advanced simulation



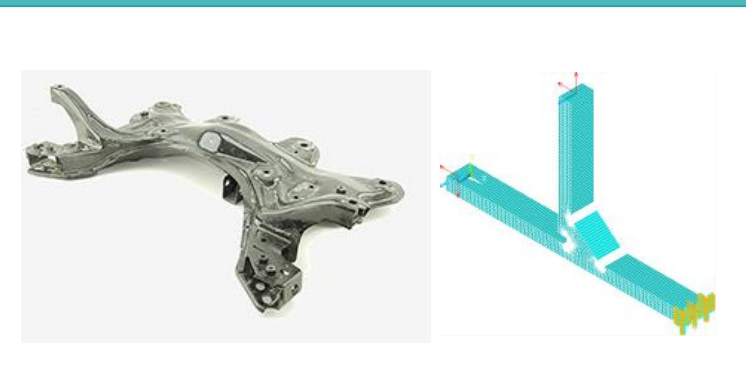
## Durable components

Deliver long-lasting product with limited prototypes & reduced tests



## Welding assessment

Efficient & accurate fatigue analysis of complex weld configurations



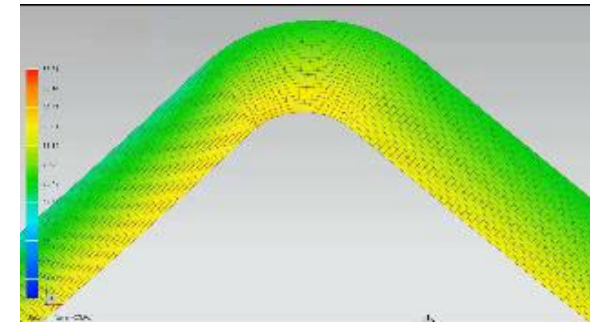
# Strength Analysis

with Simcenter 3D and Simcenter Nastran

## Investigate product performance virtually under all possible operating conditions

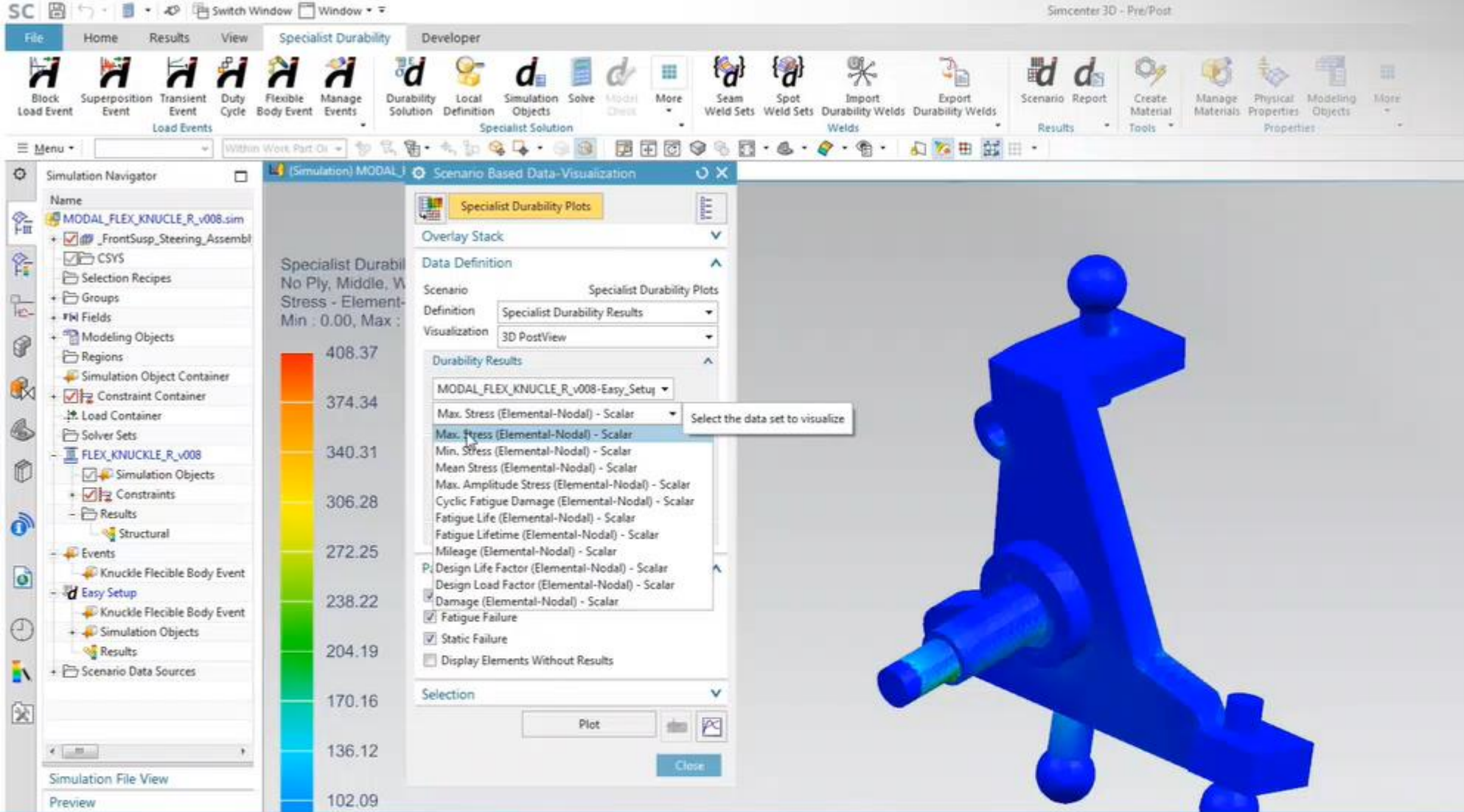
- The **premier FEA solver** for computational performance, accuracy, reliability and scalability
- **Predict behavior** of parts or assemblies with **nonlinear** contact, material or large deformations
- At the edge analysis of **new materials as composite**
- **Integrated topology optimization** helps to develop lighter, yet stronger components

### Composite analysis



### Non-linear stress analysis





**Durability engineering**  
Get clear results faster using the digital twin  
to really understand the reasons of fatigue and engineer better designs



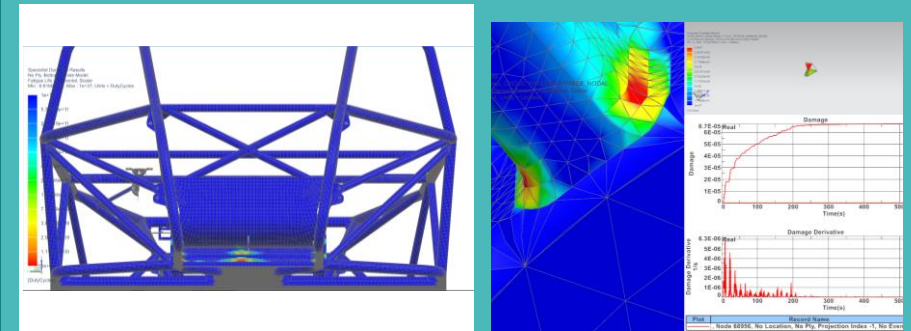
# Fatigue Analysis

with Simcenter 3D Specialist Durability

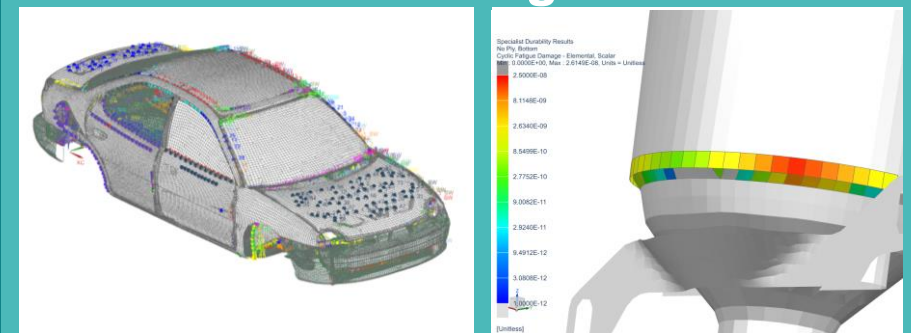
## Virtual fatigue testing - Develop to last longer, not cost more

- Accurately predict the impact of material, geometry and welding by virtual prototyping
- Shorter development cycle by front loading – smarter testing with less prototypes
- Be efficient by combining pre/post, structural and fatigue analysis solutions

### Component fatigue



### Weld fatigue



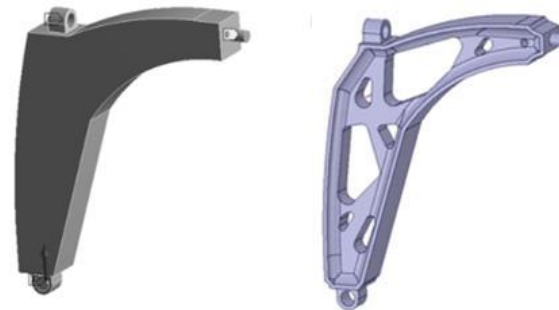
## Conflicting targets

Balance weight, strength and durability performance



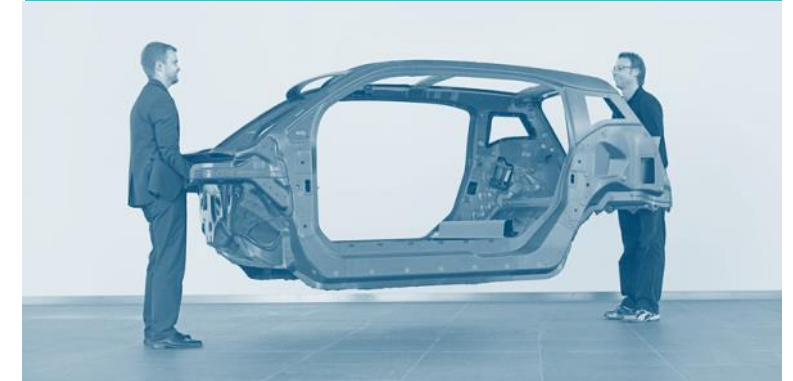
## Lightweight chassis

Design lighter, stronger and durable control arms, wheel rims and sub frames



## Body optimization

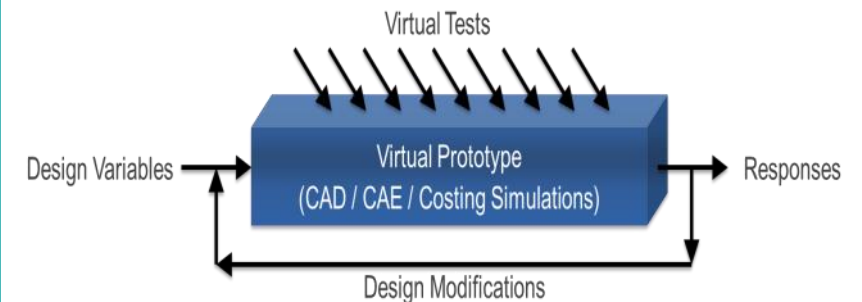
Reduce weight of body-in-white and keep performance



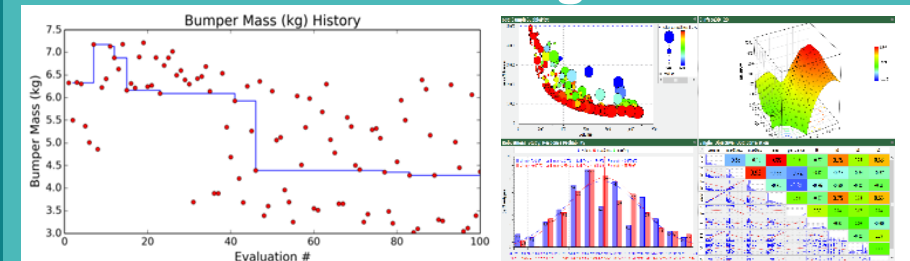
## Discover Better Designs, *Faster!*

- **Build - Process Automation** capabilities to simplify the virtual prototype build process
- **Test - Better access to Distributed Execution and Parallelization** to accelerate virtual prototype testing
- **Explore - The most Efficient Search** capabilities in the marketplace to look for better design alternatives
- **Assess - Insight and Discovery** assessments to ensure reliable product performance

### Design space exploration



### Better designs



30% weight savings increasing strength & durability



# Strength and durability strategies for lighter, stronger and more durable vehicles



- Trends
- Performance engineering
- Deliver lighter, stronger and more durable vehicles
- Key innovation areas
- **Conclusions & wrap-up**

# The new era of durability engineering

Deliver lighter, stronger and more durable vehicles

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## Simcenter solutions

- end-to-end durability engineering approach
- accelerate time to market
- balance weight, strength & durability
- avoid vehicle recalls
- meet customer's expectations

# Strength & durability webinars



## STRATEGIES

Avoid excessive warranty claims and unlock your strength and durability potential

[On-demand webinar](#)

## ROAD LOAD DATA ACQUISITION

Gain a precise understanding of the loads that products will undergo during their lifetime

[On-demand webinar](#)

## TARGET SETTING

Set durability targets and correlated test schedules matching the target usage profile

[On-demand webinar](#)

## LOAD DATA ANALYSIS

Perform and speed up durability load data analysis

[On-demand webinar](#)

## CAE FATIGUE METHODS

Optimize design and virtually validate your product performance early on

[On-demand webinar](#)

## UPCOMING LIVE WEBINAR

**CAE Structural Analysis**  
**March 11, 2020**



Questions?