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
### 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.

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.
# 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

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# Emerging Markets

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

**Mercedes Benz**
Service camp in Nigeria

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# Eco-friendly

Finite oil reserves and growing metro areas require new solutions.

**Energy.gov – US Energy Office**
A 10% reduction in weight can result in a 6%-8% fuel economy improvement

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# Economic Pressure

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

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Simcenter for Automotive Performance Engineering

Performance digital twin – Strength & Durability

Understanding operational loads
Target setting and test procedures
Design optimization and virtual product validation
Physical optimization and validation
Final verification

Performance digital twin
Strength and durability strategies for lighter, stronger and more durable vehicles

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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

Reduce number of prototypes and save time and money

- 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

"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

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

Predicting road loads
Correlating simulation and test
#Reliable Vehicles
Strength & Durability Analysis

Daimler standardizes global durability process
Reduces number of prototypes and saves time and money

LOHR Industrie delivers long-lasting transportation system
Accelerates analysis for welded assemblies

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

FIAT virtually verifies and validates durability
Conducts chassis fatigue analysis with excellent results

More on web

More on web

More on web

More on web
#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

Road Load Data Acquisition
Accelerated Test
Load Data Analysis
Customer Usage
Faurecia Emissions Control Technologies
Building long-lasting exhausts

Conducting efficient RLDA campaigns

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

“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

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

Expanding the number of measurement channels
Designing clean, long-lasting systems
# Emerging Markets
Road Load Data Analytics

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

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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.
Honda R&D Co., Ltd.
Innovation for progressive damage analysis in composite design

Target: reaching 50 percent weight reduction

- 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

“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.

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
#Eco-friendly
Multi-attribute Balancing

WorldAutoSteel
Reduce body structure weight by 35 percent and achieve performance targets
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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.

<table>
<thead>
<tr>
<th></th>
<th>Today</th>
<th>2020</th>
</tr>
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<tbody>
<tr>
<td>Test</td>
<td>65%</td>
<td>50%</td>
</tr>
<tr>
<td>Simulation</td>
<td>35%</td>
<td>50%</td>
</tr>
</tbody>
</table>

### End-to-end Durability Engineering

- **Concept**
- **Design**
- **Validation**
- **Optimization**
- **Release**

**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

- 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

“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

Optimizing structural components for durability performance

- 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

Accurately predicting road loads on vehicle components
#Economic Pressure
End-to-end Durability Engineering

- **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
  More on web

- **Hendrick Motorsports** delivers in time for the next race
  Rapidly designs and analyses high-performing, durable components
  More on web
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Simcenter™ Durability Portfolio
Vehicle Strength & Durability

Simcenter™
Exploration & Analytics
CAE Simulation
System Simulation
Physical Testing
Data & Process Management
Engineering Services - Industry Expertise - Dedicated Support

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

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

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
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
Load Data Mining
Challenges

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
Road Load Data Prediction
Challenges

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
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
Strength & Fatigue Analysis
Challenges

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
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
Durability engineering

Get clear results faster using the digital twin to really understand the reasons of fatigue and engineer better designs.
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
Multidisciplinary Exploration
Challenges

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
Multidisciplinary Exploration with HEEDS

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

Better designs

- 30% weight savings increasing strength & durability
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The new era of durability engineering
Deliver lighter, stronger and more durable vehicles

Simcenter solutions
• end-to-end durability engineering approach
• accelerate time to market
• balance weight, strength & durability
• avoid vehicle recalls
• meet customer’s expectations
<table>
<thead>
<tr>
<th>STRATEGIES</th>
<th>ROAD LOAD DATA ACQUISITION</th>
<th>TARGET SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid excessive warranty claims and unlock your strength and durability potential</td>
<td>Gain a precise understanding of the loads that products will undergo during their lifetime</td>
<td>Set durability targets and correlated test schedules matching the target usage profile</td>
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<tr>
<td>On-demand webinar</td>
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<th>CAE FATIGUE METHODS</th>
<th>UPCOMING LIVE WEBINAR</th>
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<tr>
<td>Perform and speed up durability load data analysis</td>
<td>Optimize design and virtually validate your product performance early on</td>
<td>CAE Structural Analysis March 11, 2020</td>
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Questions?