HEXAGON

Brochure

Automotive

MSC Software is the Automotive industry's engineering simulation and analysis partner to drive innovation and speed time-to-market

Industry in transformation...

Government regulations for higher fuel efficiency, consumer demands for safety and comfort, increasing material costs, and global demand are driving the automotive industry to accelerate innovation and time-to-market.

MSC Software's tightly integrated simulation solutions in the design and development processes at all major OEMs and key suppliers make MSC a strategic partner and facilitator to help the auto industry overcome these challenges efficiently and effectively.

Whether you are a small company designing components or a big supplier or OEM concerned with system level studies for multiple platforms, you can rely on MSC to have the right solution, services and support infrastructure to meet your current and future needs.

Technology

- A broad spectrum of Computer Aided Engineering (CAE) software tools to analyze, validate and optimize designs virtually
- Tools to manage complex and comprehensive CAE data to reduce redundancy while increasing innovation and profit
- Technology partnerships with leading CAE and HPC providers so you can achieve higher productivity and higher returns on your software and hardware investments

Processes

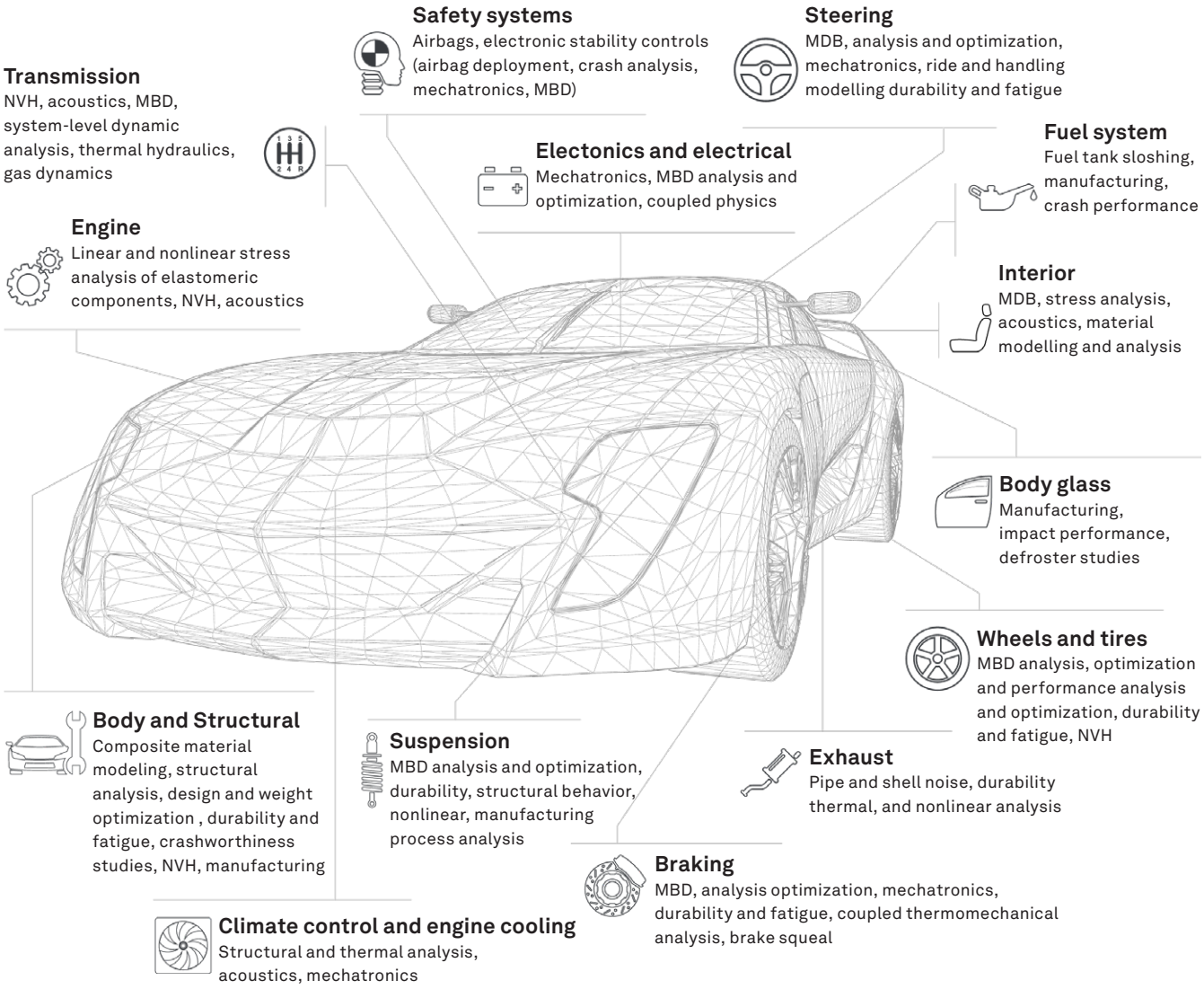
- Customized and out-of-the-box automation tools to improve simulation processes across groups and suppliers
- Optimal CAE methods to incorporate into your development and design process to meet regulations and achieve
- Certification consistently and reliably

People

- More than fifty years of experience partnering with automotive companies to solve challenging problems
- A transfer of knowledge and expertise, customized to your organization so you can operate at maximum efficiency
- Affordable learning through in-person and online structured programs suited to your needs

Simulate

The complete vehicle engineering process



Full vehicle analysis

Minimise risk, maximize return: Explore interactions between components, assemblies systems and manufacturing process to design safer, stronger, lighter, and cheaper.

Integrated multiphysics

Get it right the first time: Test multiple physics simultaneously for high-fidelity results to streamline testing and analysis.

Engineering lifecycle management

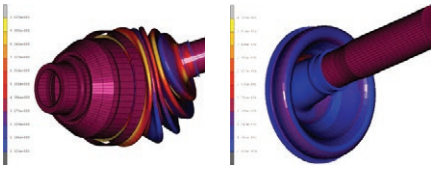
Don’t reinvent the wheel: Track and manage all materials data and simulation data and process to retriveve easily and use for future projects.

Solutions for structural analysis

MSC Software's highly scalable structural analysis solutions enable engineers to simulate components, assemblies and full vehicles. MSC's proven technologies help engineers:

Tackle complex problems with confidence:

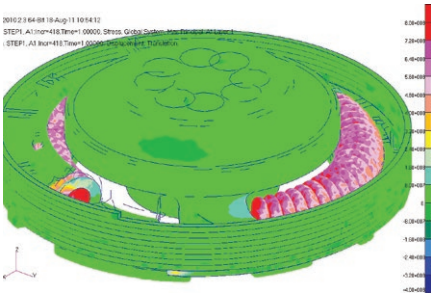
- Analyze structures and their interactions for linear and nonlinear behavior.
- Perform complete assembly analysis of powertrain and suspension components.
- Improve performance of seals and mounts with accurate nonlinear analysis.
- Analyze composite structures subjected to static, dynamic and thermal loads



CV boot optimization

Achieve high-fidelity validation:

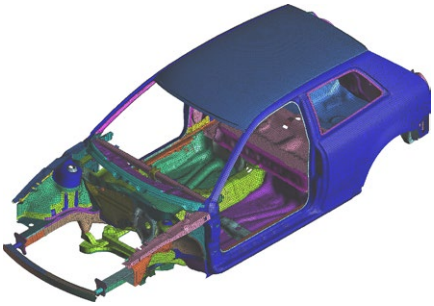
- Obtain system loads for accurate stress analysis.
- Improve accuracy of multibody dynamic studies with modal results from finite element analysis.
- Conduct co-simulation with multibody dynamics (MBD) and finite element analysis (FEA).



TorqFiltr simulation -
Maximum principal stresses

Accelerate analysis of large models

- Perform full-vehicle studies with the help of robust high performance computing and superelements
- Perform faster, parallelized dynamic analysis of large models with Automated Component Model Synthesis.



Structural assembly modeling - connectors

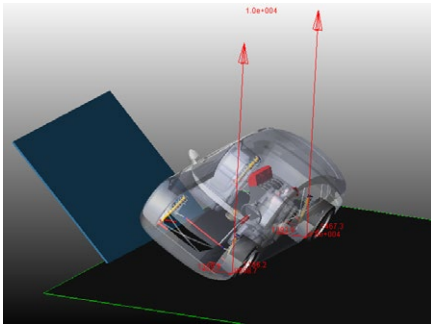
> **"It is difficult to accurately estimate the cost savings we have obtained through virtual product development (VPD) but we are certain that it amounts to millions of dollars per year across our complete product line"**
>
> **Dr. Steve Jia,**
> Litens Automotive Group

Solutions for safety

Testing performance of all of a vehicle's components and systems working simultaneously is crucial for ensuring the safety of its occupants. MSC's solutions provide a complete set of technologies for testing control systems, multibody dynamics and explicit dynamics to simulate various driving maneuvers and vehicle behavior to achieve the highest fidelity crash simulations.

Improve collision-related outcomes:

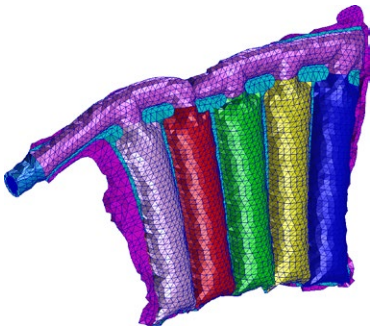
- Gain valuable insight into large strains, deformations and structural failures during crash events involving single or multiple vehicles.
- Model interaction between multiple components and assemblies and the resulting structural and material failure.
- Perform roll stability events to improve predictive capabilities of passive safety simulations.



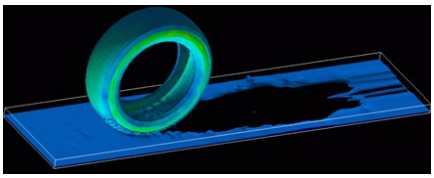
Rollover event - sand bed

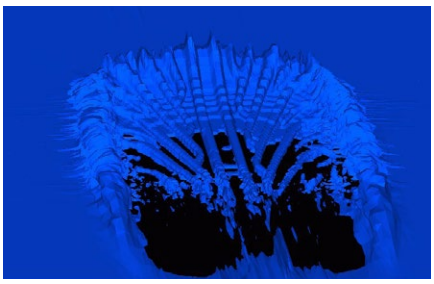
Prepare for the unexpected:

- Study the influence of fluid pressures during events like hydroplaning and gas tank sloshing.
- Analyze the complex behavior of airbags during deployment under various crash scenarios.
- Conduct MBD-Controls cosimulation to evaluate controls strategies for Automatic Braking Systems (ABS).
- Reduce braking distances by optimizing controls algorithms in the MBD environment to meet Federal Motor Vehicle Safety Standards.



Airbag simulation





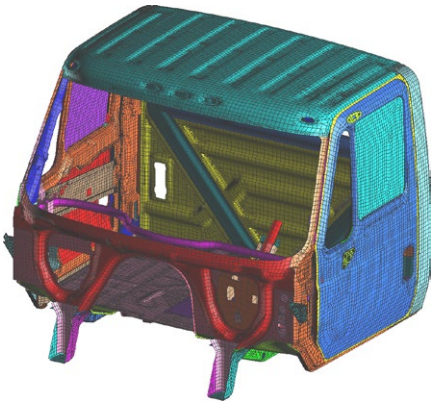
Hydroplaning event simulation

"We use Adams as our primary multibody simulation tool because it has demonstrated the ability to simulate a wide range of very complicated applications with a high level of accuracy"

Ragnar Ledesma,
Meritor

Extend product life

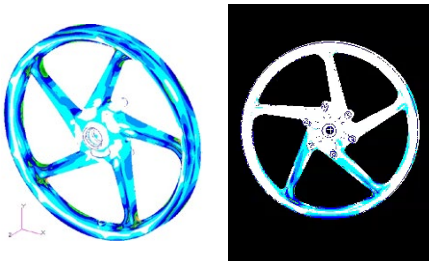
Lightweighting initiatives, as a key mechanism to achieve higher fuel efficiency places durability at the center of design and development of structural elements. MSC's technology enables engineers to perform end-to-end durability analysis in a unified technology platform.



Fatigue Analysis of a truck cab

Conduct end-to-end durability studies:

- Conduct end-to-end durability studies:
- Use solver enmbedded fatigue analysis for faster results.
- Simulate durability duty cycle with virtual test rig.
- Optimize design with fatigue life as a design objective
- Generate road loads virtually for standardized full vehicle durability studies

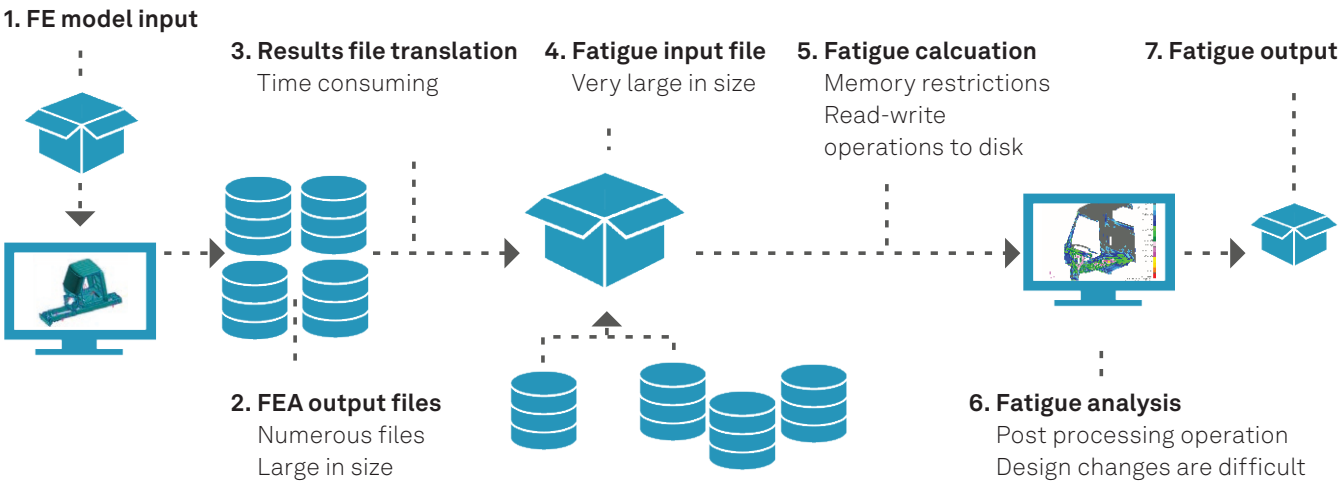


Fatigue anlaysis of a steering wheel

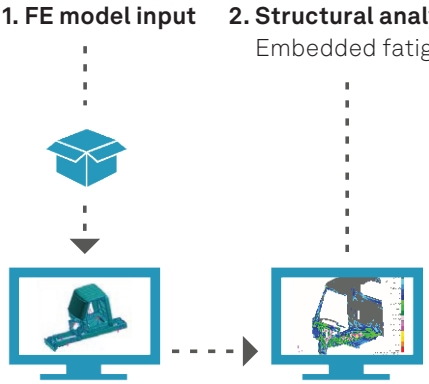
Control disastrous failures

- Evaluate the damage progression, and delamination in composite structures like door panels and dashboards.
- Predict the growth of cracks in structures.

Traditional Fatigue analysis



Solver embedded fatigue



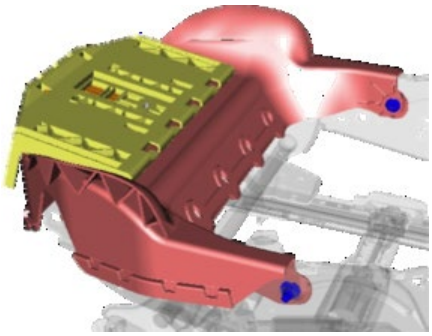
Build lightweight structures

Successful designs with lighter, stronger, customized composites materials require simulation tools capable of addressing their unique challenges. MSC's solutions helps auto manufacturers and suppliers meet weight reduction goals and achieve the required fuel efficiency to reach regulation goals quickly and gain competitive edge.

40% mass saved by metal replacement on engine mount

Optimize designs to reduce mass:

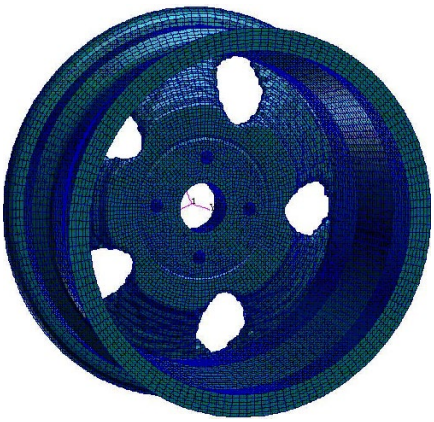
- Optimize shape, size and topology of designs.
- Obtain global optimal solution with state of the art optimization methods.
- Reduce weight without compromising performance using multidisciplinary optimization tools.



40% mass reduction and 50% parts reduction of seat pan

Lightweight with new materials:

- Optimize laminate lay-up configuration for improved structural performance.
- Achieve weight reduction targets by confidently replacing the metal parts with new, lighter, better reinforced plastic and composite materials.
- Analyze chopped and continuous fiber reinforced materials accounting for manufacturing process, local fiber orientation, temperature and residual stresses.
- Predict the nonlinear, rate-dependent and anisotropic behavior of multi-phase materials without extensive physical testing.

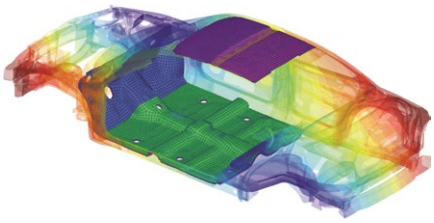


Wheel topology optimization

> **"The ability to quickly and easily look at alternatives at a time when we are not locked into any particular approach makes it possible to meet performance requirements with a lighter suspension that can improve the fuel economy of the vehicle"**
>
> **Anders Wirie,**
> Volvo

Reduce noise, vibration, harshness (NVH) and optimize acoustics

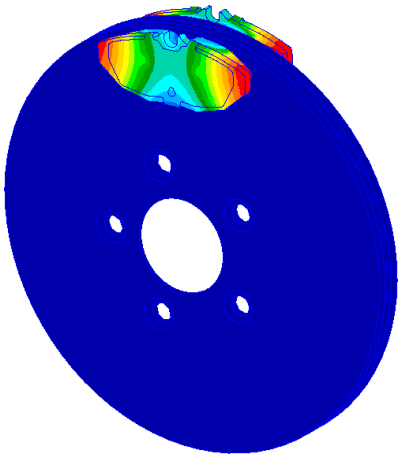
Use of new materials for lightweighting and engine downsizing has a strong impact on the noise, vibration and harshness behavior of a vehicle. Solve interior and exterior NVH problems and meet regulatory environments, while maintaining the desired unique acoustic signature of vehicles with MSC solutions which enable engineers to:



Trimmed car cabin nose

Improve passenger comfort:

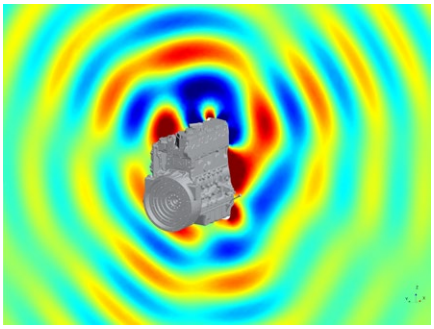
- Study the acoustic behavior of noise sources like engine and exhaust systems, and the transfer path.
- Perform vibro-acoustic analysis of full vehicle models.
- Analyze sound absorption of trim materials inside cabin.
- Study the influence of road surface and wind induced vibrations.
- Use parallelization to get results faster and analyze multiple design variations.



Brake squeal analysis

Reduce pass-by noise and meet regulations:

- Integrate MBD and Acoustics for noise analysis of transmission systems.
- Perform sound radiation analyses of vibrating structures, including powertrain, engine components, intakes and exhausts.
- Couple with third party CFD programs for higher accuracy in flow-induce noise computations.
- Investigate and improve the effectiveness of passive and noise control systems.



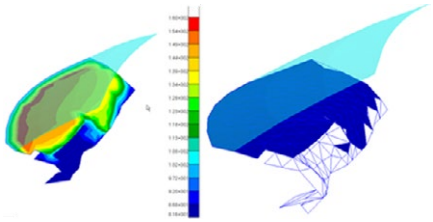
Powertrain acoustic analysis

“We ran the model for different values of desired torque-converter-slip rpm across a broad range of rpm. The simulation showed that 40 rpm slip was the optimal value that would meet the NVH target and would result in the best trade off with fuel economy”

Mario Felice,
Ford Motor Company

Solutions for thermal analysis

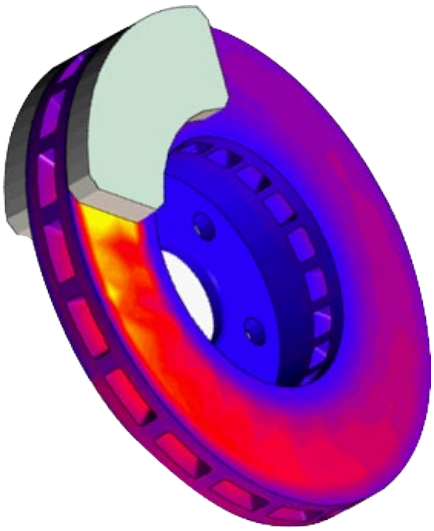
Thermal management of automotive systems plays a critical role in defining the vehicle's operating range, emissions and durability. Engineers use MSC Software's solutions to study the influence of heat transfer in the structural components and assembles, and multiphysics phenomena through coupled analysis to:



Solar heating of automobile dashboard

Analyze and improve thermal performance:

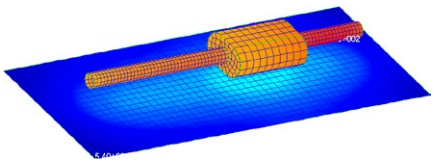
- Analyze thermal performance of exhaust systems and design options to control peak temperatures.
- Study thermal behavior of engine/powertrain with new designs and materials.
- Simulate heat buildup in passenger cabins and examine options to improve cabin comfort



Thermal analysis of a disc brake

Perform coupled multiphysics studies:

- Improve brake performance and life by investigating effects of friction generated heating and influence of all modes of heat transfer.
- Evaluate heat generated by Joule heating in electronic systems and rear window defroster grid. Investigate new grid patterns customized for each vehicle model
- Simulate welding process and study transient temperature gradients and thermal induced stresses.
- Investigate heat generation and performance of battery packs.

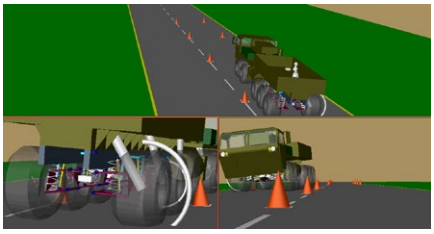


Muffler

> **"With simulation, we can investigate and evaluate the wishes and demands of our customers with the greatest accuracy. We were able to substitute simulations for the (physical) development runs, which was very cost-effective"**

Charles Courlander,
Guardian Automotive

Improve ride and handling

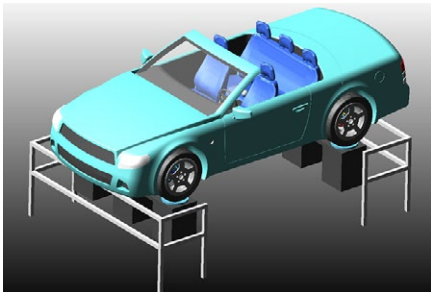


Truck handling analysis

Fast changing market conditions and customer demands require engineering teams to quickly build new models with little room for error. With MSC solutions, development teams can quickly create and test functional virtual prototypes of complete vehicles and vehicle subsystems enabling them to:

Save time and resources:

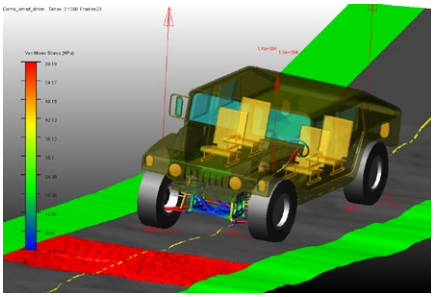
- Analyze vertical forces, static loads, steering characteristics and wheel travel for suspension, steering and full vehicle maneuvers.
- Simulate vehicle behavior on three dimensional roads such as highways, race tracks, test tracks and parking structures.
- Test the design of different subsystems and their influence on the overall vehicle dynamics.
- Perform standard testing procedures for cornering, courses, steering, quasi-static and straight-line analysis.



Virtual SPMM testrig

Achieve higher fidelity system dynamics simulations:

- Study the dynamic behavior of the entire driveline during different operating conditions.
- Explore the interaction between driveline and chassis components
- Integrate control systems into vehicle models for complete system analysis.
- Include tires in the model and simulate maneuvers such as braking, steering, acceleration, free-rolling or skidding.

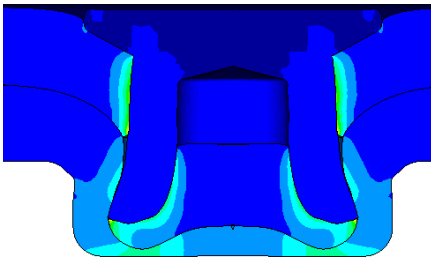


Road loads calculation on a humvee

Before we used Adams/Car we found that only 40-50% of what we tried at the test track turned out to be effective. Since we began using Adams/Car, 80-90% of the ideas that we try on the track succeed”

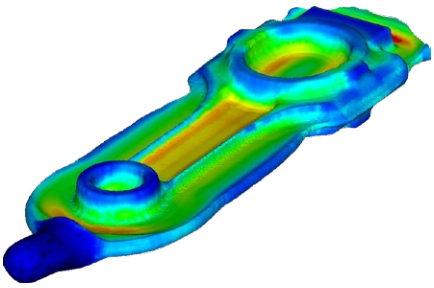
Per Blomberg,
Polestar Racing

Optimize manufacturing processes



Self piercing rivets -
Behavior between two joining points

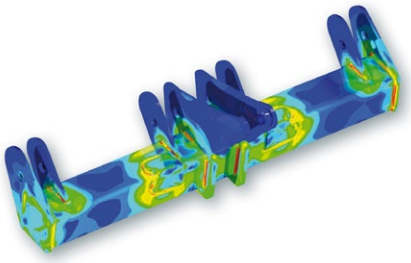
The ability to identify manufacturing issues and maximize manufacturing processes before the first part is forged is critical for saving time and reducing both short and long term costs. MSC's technology analyzes and optimizes complex manufacturing processes to offer valuable insights that improve tool life, save material costs and extend product life.



Forging of a piston rod

Innovate virtually:

- Predict thickness distribution and manufacturing process parameters in forming operations like sheet forming, hydroforming and thermoforming.
- Simulate multi-stage forging and forming operations and adjust process parameters for material savings.
- Predict the forces and final deformed shapes during joining operations like self-piercing rivets.
- Develop custom multi-stage glass forming operations virtually.
- Study the effects of various welding sequences, speeds, heat input and stop times.



Residual stresses after welding process

Improve productivity and product life:

- Analyze tool wear and design for longer life.
- Predict distortions and residual stresses during and after all stages of forming and welding and test alternatives before process implementation.
- Accurately estimate the performance and life of structural components.

> **Forming simulation is essential for us... We reached a situation in which we achieve a 90-98% match between the real product and the virutal layout, based on a combination of experienced staff and simulation"**
>
> **Jurgen Schuler,**
> Neumayer Tekfor Holding GmbH

Manage engineering lifecycle

Organize and preserve valuable knowledge acquired to meet certification requirements and time spent on report generation. Recover this data anytime to save crucial time and resources with a single integrated system that enables you to.

Process management of vehicle design

Pedigree of vehicle design

Capture and reuse simulation knowledge:

- Reduce manual execution of intensive, repetitive simulation tasks and processes through automation.
- Trace processes through Audit Trail of simulation processes, inputs and outputs.
- Search terabytes of data quickly to answer design questions.

Collaborate effectively:

- Manage data in a central, searchable environment with permission based access.
- Configure to support multiple global locations.
- Manage proprietary and public material data ensuring full traceability across the enterprise and throughout the product lifecycle

Efficiently manage projects

- Keep projects on schedule through work requests and workflow notification.
- Generate customized reports faster to meet documentation and certification requirements.
- Integrate multiple tools and applications, including MSC, 3rd party and in-house applications.

> **Product development time has been reduced tremendously (with SimManager). We cut it by 25 percent, which literally took months off the product development process”**

Brian Brander,
TI Automotive

Expand engineering expertise

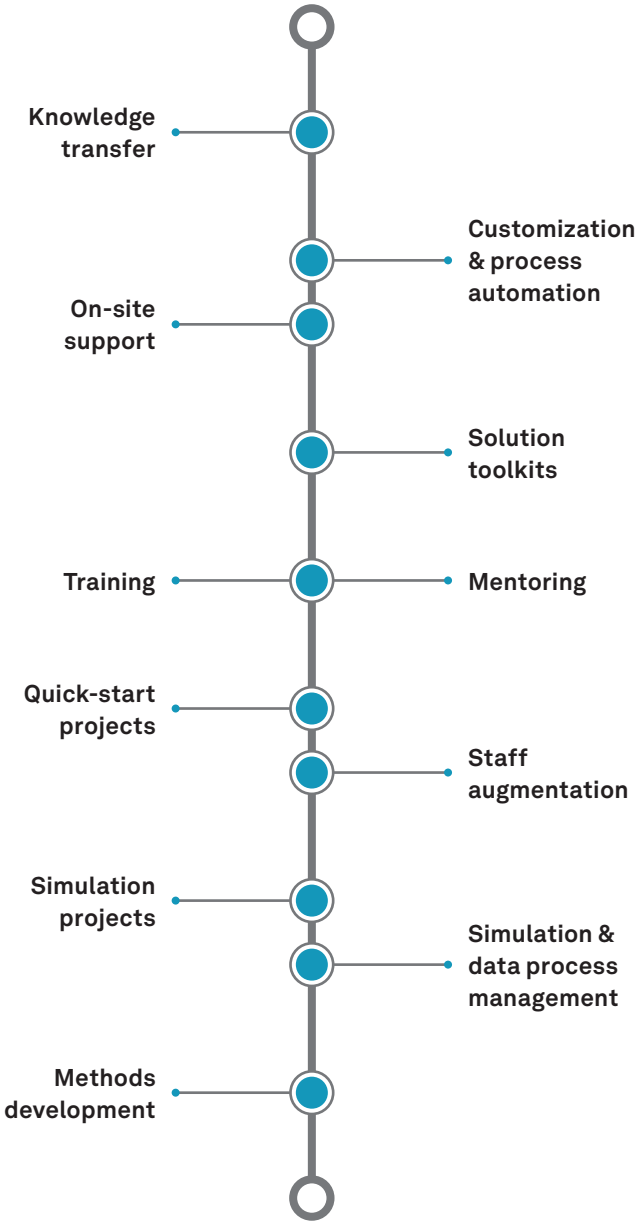
MSC Software's worldwide team of experienced engineers has diverse and extensive knowledge and skill sets specific to the automotive industry. We are your partner to guide, advise and help you solve challenges for your precise needs and requirements. MSC's broad range of services include:

Transfer of knowledge:

- Multiple training options that suit your requirements, from instructor-led classroom setting to online e-Learning.
- Custom training for your engineers to maximize the returns on your software investment.
- Customization and process automation to standardize your simulation process and improve productivity.

Methods development:

- Mentoring on-site or online available for your teams to help them rapidly gain expertise.
- Consulting services to tackle your toughest problems.
- On-site resources to augment your current staff.



MSC products

MSC Apex	Integrated Solutions	Solver Solutions	Mid-Sized Business Solutions	Modeling Solutions	Simulation Process & Data Management
Modeler & structures Modeler structures	Adams Multibody dynamics simulation	MSC Nastran Structural & multidisciplinary	MSC Nastran Desktop Multidiscipline simulation for the desktop	Patran FE modeling & pre/post processing	SimManager Simulation process & data Management
	Actran Powerful acoustic simulation software	Dytran Explicit nonlinear & fluid structure interaction	SimDesigner CAD-embedded multidiscipline simulation	SimXpert Multidiscipline simulation environment	MaterialCenter Materials lifecycle managment
	Digimat The nonlinear multi-scale material & structure modeling platform	MSC Fatigue Fatigue simulation			
	Easy5 Advanced controls & systems simulation	Sinda Advanced thermal			
	Marc Advanced nonlinear & multiphysics				
	Simufact Manufacturing process simulation				
	SimXpert Multidiscipline simulation				

Hexagon is a global leader in digital reality solutions, combining sensor, software and autonomous technologies. We are putting data to work to boost efficiency, productivity, quality and safety across industrial, manufacturing, infrastructure, public sector, and mobility applications.

Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Hexagon's Manufacturing Intelligence division provides solutions that use data from design and engineering, production and metrology to make manufacturing smarter. For more information, visit hexagonmi.com.

Learn more about Hexagon (Nasdaq Stockholm: HEXA B) at hexagon.com and follow us @HexagonAB.