





Defense

MSC Software is the Defense Industry's Engineering Simulation and Analysis Partner to Design and Develop High-Performance Products

MSC Software





MSC Software

Delivering on time and in budget

are two of the greatest challenges the defense industry faces when developing products of increasing sophistication and complexity. The high cost of developing new products and maintaining current products requires the right tools to bring efficiency to the broad and intricate conglomeration of private and government owned entities working together.

With more than 50 years of partnering with the defense industry, MSC has the precise expertise needed to align the people, processes and technology that help defense companies stay innovative and competitive, while reducing cost and saving valuable time and effort.

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 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 defense and commercial 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





Solutions for **STRUCTURAL ANALYSIS**

MSC Software's scalable structural analysis solutions enable engineers to simulate the behavior of parts, assemblies or full vehicles. Long-trusted technologies help engineers:

...tackle complex challenges:

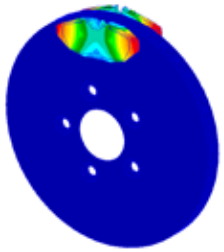
- Analyze structures and their interactions exhibiting linear and nonlinear behavior.
- Conduct rotor dynamic stability studies of turbines.
- Design long-lasting products with durability studies.
- Perform coupled, uncoupled, chained simulations for high accuracy results.

...achieve certification faster:

- Leverage high-performance computing and reusable super elements to perform full vehicle studies.
- Achieve faster certification with computer aided-aeroelastic analyses.
- Validate and design with new and complex materials faster and with confidence.



Pre-Stressing of Fan Blades
(Implicit Nonlinear)



Brake squeal analysis



Model of an unmanned
aerial vehicle

"Considering the magnitude of the analysis challenge and the potential for error in both the analyses and the test, the MSC Nastran results correlation is excellent."

- D.J. Taylor,
Aerovironment



MSC Software





> "The result [*from Dytran*] presents the promising future of… developing strategies to return aircraft to base under a much wider range of damage scenarios."
>
> **- Jong H. Kim,**
> *Agency for Defense Development*



Solutions for **PROTECTION**

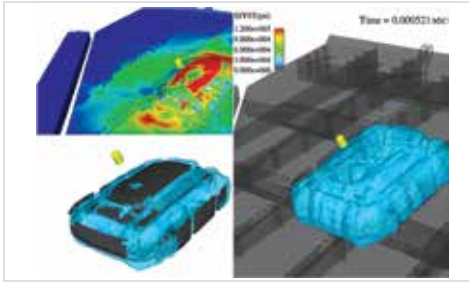
Realistic simulation of high velocity projectile impact is imperative to understand the performance of structural components. MSC solutions support Fluid-Structure Interaction (FSI), designed to simulate effects from explosions, mine blasts and ballistics.

...perform failure studies:

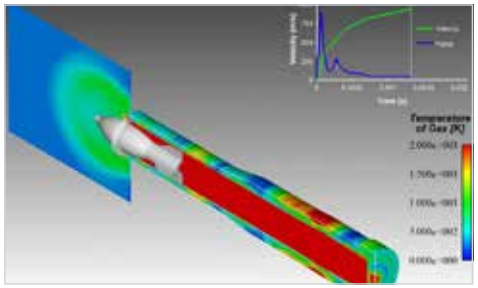
- Conduct catastrophic structure failure studies with fluid leakage or penetration.
- Perform accident investigation.
- Explore the effectiveness of protective gear and analyze design options and new materials.

...anticipate the unexpected:

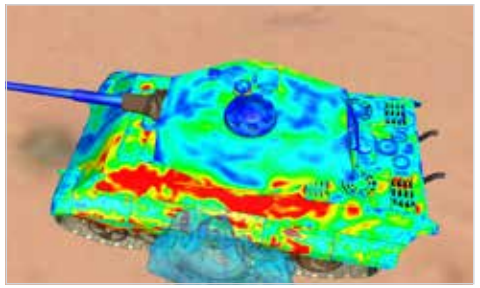
- Perform foreign body impact on single-layered or multilayered structures.
- Analyze the effects of blast, crash and other fast events on vehicles and their occupants.
- Simulate events like bird strike, water landing and vehicle impact to meet certification requirements.



Hydrodynamic ram on wing fuel tank



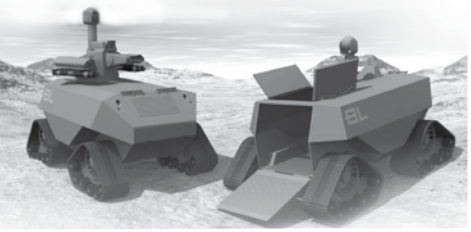
Mortar simulation



Mine blast analysis



> "BLR's extraordinary capabilities and compressed development time is a direct result of the huge number of simulations that have driven the design process."
>
> **- Ronen Veksler,**
> *BL Advanced Ground Systems*



Extend **PRODUCT LIFE**

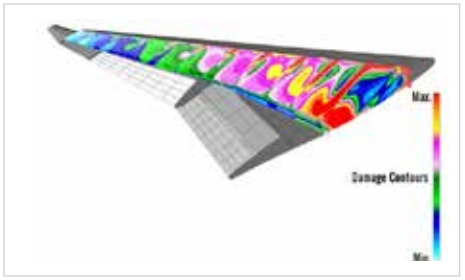
Highly demanding operating conditions demand that products endure. Unexpected failure during service life can be hazardous to defense personnel and possibly the entire operation. MSC's durability technology provides extensive insights into the life of each component so you can:

...build to last:

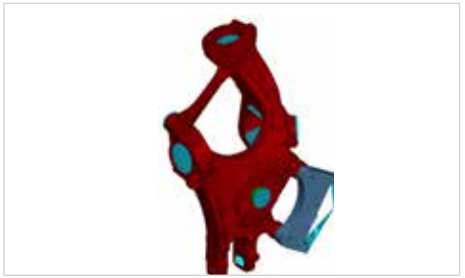
- Simulate fatigue behavior of static, dynamic and thermal events.
- Easily monitor, start, stop and audit your fatigue life analyses for various loading sequences.
- Predict the longevity of welds with various weld configurations.

...optimize more, faster:

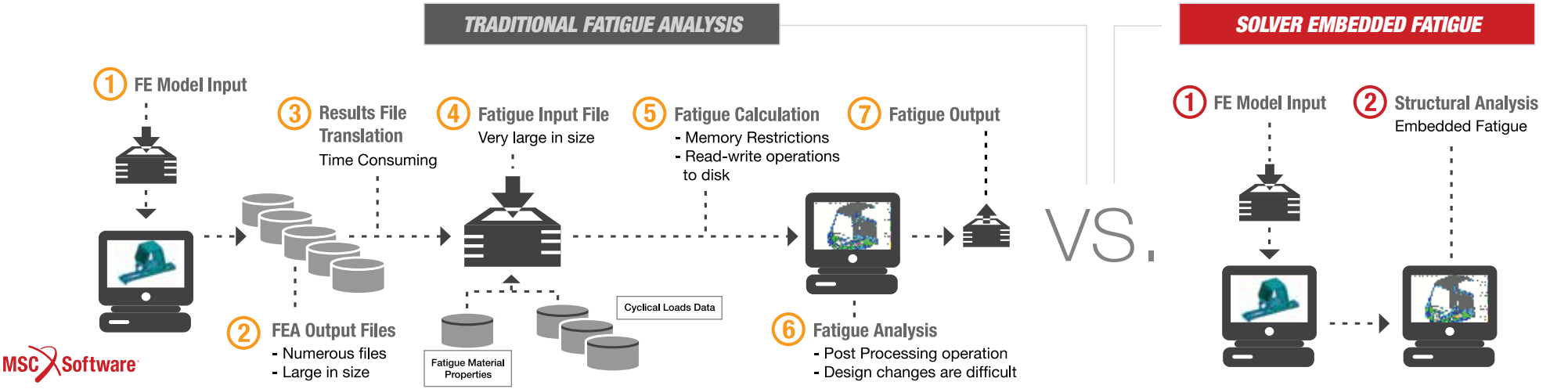
- Perform fatigue calculations faster with Solver Embedded Fatigue Analysis
- Interactively optimize designs for fatigue life.



Composite Wing



Wheel carrier; Fatigue analysis results reduced from 8 hours to 38 minutes







Build **LIGHTWEIGHT STRUCTURES**

> “..using Digimat, we were able to successfully bridge the micro to the macro world.”
>
> **- Dr. Julian Santiago Prowald,**
> *TEC-MSS Structures Section ESA/ ESTEC*



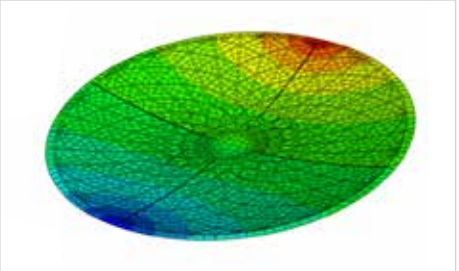
The recent introduction of new classes of materials are helping the industry to meet critical weight reduction, strength and performance objectives. Successful designs with lighter, stronger, customized composites materials require simulation tools capable of addressing their unique challenges.

...understand materials behavior:

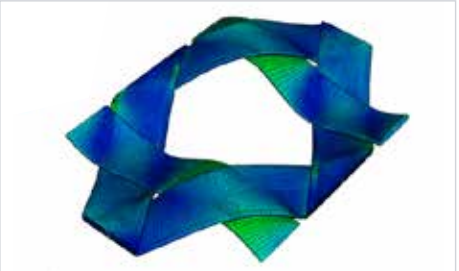
- Investigate and predict composite materials behavior with computational models.
- Account for the manufacturing process to bridge the gap between design and manufacturing.
- Gain insights into composite laminate response, damage progression and failure.

...focus on innovation:

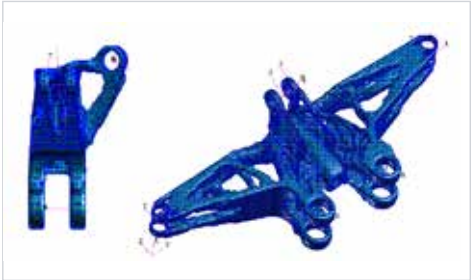
- Optimize laminate lay-up configuration for improved structural performance.
- Reduce weight, cost and time-to-market with high-performance designed composite industrial parts.
- Improve product designs quickly with design sensitivity and optimization studies.



Displacement of the full antenna under thermal load



Stress response of a representative cell of woven composite



Engine Mount
Topology Optimization

MSC Software





> “Actran is the only simulation tool able to accurately model the main physical phenomena for engine nacelle radiation.”
>
> **- Jean-Yves Suratteau,**
> *Airbus*



Optimize **ACOUSTIC RESPONSE**

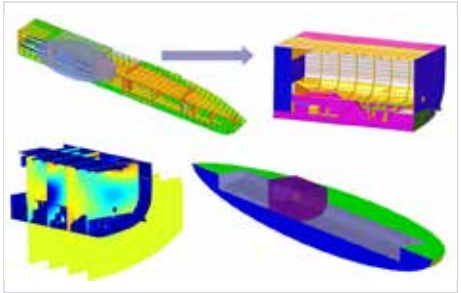
Field vehicles and equipment are often subjected to excessive vibratory loads which can contribute to a variety of acoustic problems. Reduce noise and optimize absorption of sound by analyzing part and assembly interactions of the full system to identify resulting vibration and acoustic responses.

...effectively manage sound:

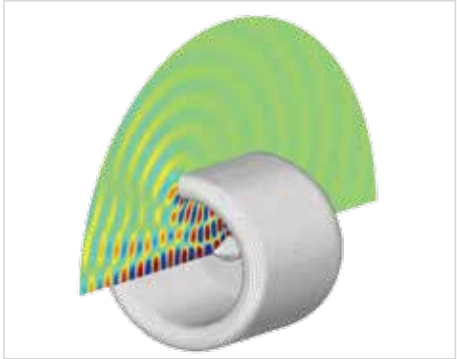
- Analyze sound propagation in ducts, intake and exhaust lines or distribution systems in aircraft or ground vehicles.
- Analyze sound in water, oil or any other fluid.
- Predict the acoustic signature of assemblies with Multibody Dynamics (MBD)-Acoustics co-simulation.

...address acoustic challenges:

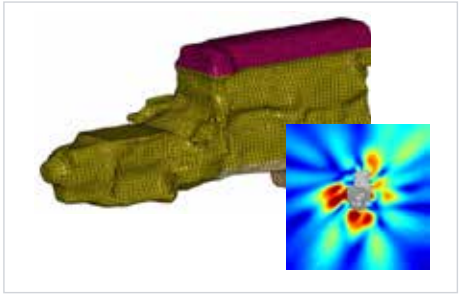
- Analyze and optimize the influence of absorbing materials, such as trim, for sound propagation and vibration.
- Recover vibration results from structural analysis for radiation analysis.



Ship noise radiation into sea



Prediction of fan inlet noise



Powertrain noise radiation

Nonlinear material properties and boundary conditions that vary with local temperatures can be modeled accurately with MSC's products.



Solutions for **THERMAL ANALYSIS**

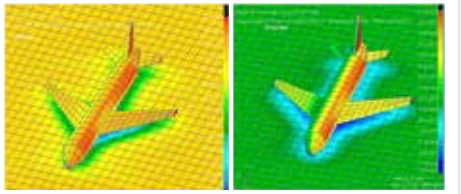
MSC Software's comprehensive thermal analysis solutions help engineers understand the response and performance of the structures subjected to extreme environments and operations:

...design for extreme environment:

- Model all modes of heat transfer (conduction, convection and radiation) and study temperature gradients in transient and steady state.
- Perform fast radiation view factor computations to improve solar panel efficiency.
- Model terrestrial heating for solar loads on aircraft and ground vehicles with solar radiation/orientation data anywhere in the world.
- Enhance aircraft safety by improving its anti-icing performance.

...improve thermal performance and product life:

- Study and improve performance of jet engines, nozzles, and avionics.
- Explore design options to extend life of satellites and aerial vehicles with smarter, efficient solar energy systems.
- Enhance efficiency and operating range of engine components with robust design investigations.
- Improve occupant comfort with faster virtual studies of alternative designs.

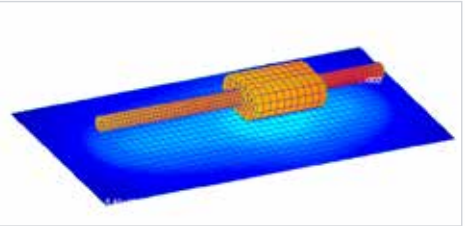


Diffuse Horizontal Irradiance | Direct Normal Irradiance

Aircraft on concrete runway



Thermal model of a satellite



Muffler





Analyze and Validate **FULL SYSTEMS**

> "With Adams, the early identification and understanding of the jamming condition in the gun turret drive saved a considerable amount of time and money in troubleshooting."
>
> **- Zhian Kuang,**
> *General Dynamics Land Systems*



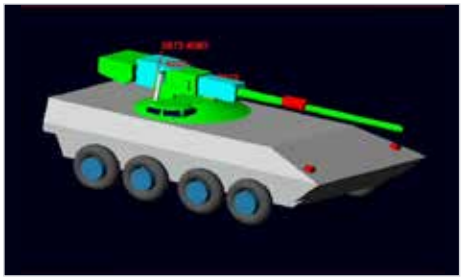
The development of complex mechanical assembles and full vehicles requires insight into the interactions between the various systems and components. System analysis solutions from MSC enable users to study multibody dynamics (MBD) of assemblies and vehicles to quickly and efficiently evaluate designs for improved performance and safety.

...improve system performance:

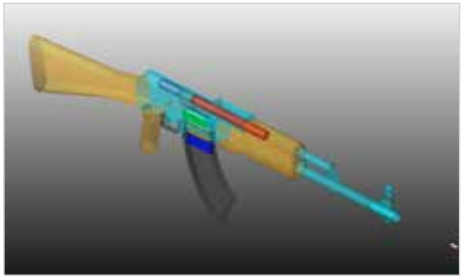
- Analyze rigid and flexible multibody systems for improved accuracy in load predictions.
- Build and simulate tracked vehicles to investigate dynamic mobility, turret and weapon control.
- Conduct durability and life-cycle analysis to learn about product performance and deficiencies.
- Optimize designs with Design of Experiments (DOE) simulations.

...streamline design:

- Identify and address vibration issues early in the design process.
- Integrate control systems for realistic simulations and gain insight into complex system interactions.
- Study the vehicle dynamics under multiple driving scenarios, including *vehicular cornering*, *steering*, *quasi-static*, and *straight-line analysis*.
- Gain insight into systems with complex assemblies and nonlinear materials with MBD-nonlinear FEA co-simulation.



Gun turret
drive system analysis



Assault rifle mechanism



Helicopter crash landing)

Manage **ENGINEERING LIFECYCLE**

> “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*



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.

...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.



Process Management of Vehicle Design



Blade Input Deck





PEOPLE

> With MSC Software's solutions and partnership, we were able to move from physical testing to new virtual test procedures that greatly improved our effectiveness."

- Vladimir Seredokho,
JSC SNSZ.



Expand **ENGINEERING EXPERTISE**

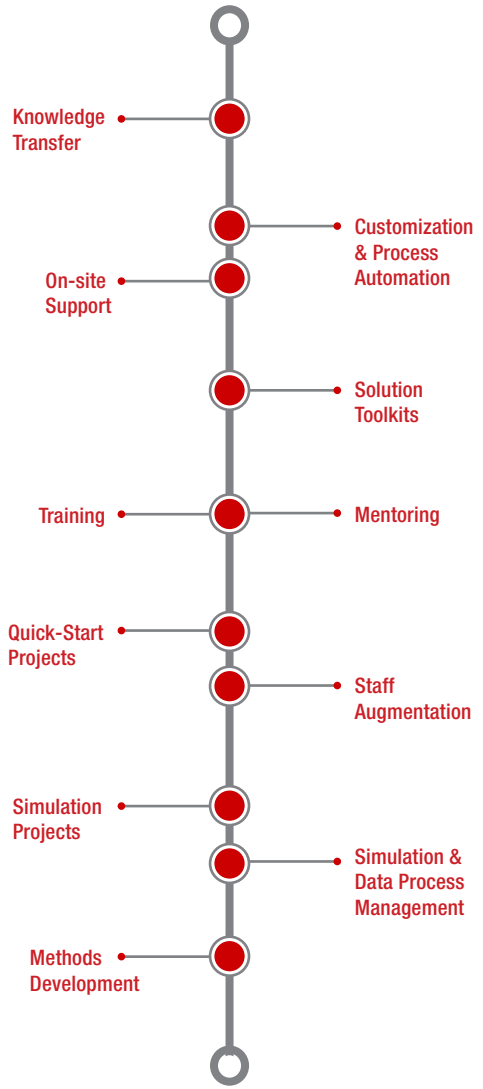
MSC Software's worldwide team of experienced engineers has diverse and extensive knowledge and skill sets specific to the defense industry. We are your partner to guide, advise and help you solve challenges for your precise needs and requirements. MSC's broad range of services include:

...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 Software

MSC Products

Simulating Reality, Delivering Certainty

MSC Apex

Modeler & Structures

Modeler
Structures

Integrated Solutions

Adams

Multibody Dynamics
Simulation Solution

Actran

Powerful Acoustic
Simulation Software

Digimat

The Nonlinear Multi-scale
Material & Structure
Modeling Platform

Easy5

Advanced Controls
& Systems Simulation

Marc

Advanced Nonlinear
Simulation Solution

Simufact

Manufacturing Process Simulation

SimXpert

Fully-Integrated Multidiscipline
Simulation Solution

Solver Solutions

MSC Nastran

Multidisciplinary
Structural Analysis

Dytran

Explicit Dynamics & Fluid
Structure Interaction

MSC Fatigue

FE-Based Durability
Solution

Sinda

Advanced Thermal
Simulation Solution

Mid-Sized Business Solutions

MSC Nastran Desktop

Multidiscipline Simulation
for the Desktop

SimDesigner

CAD-Embedded
Multidiscipline Simulation

Modeling Solutions

Patran

Complete FEA
Modeling Solution

SimXpert

Fully-Integrated Multidiscipline
Simulation Solution

Engineering Lifecycle Management

SimManager

Simulation Process
& Data Management

MaterialCenter

Materials Lifecycle
Management

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