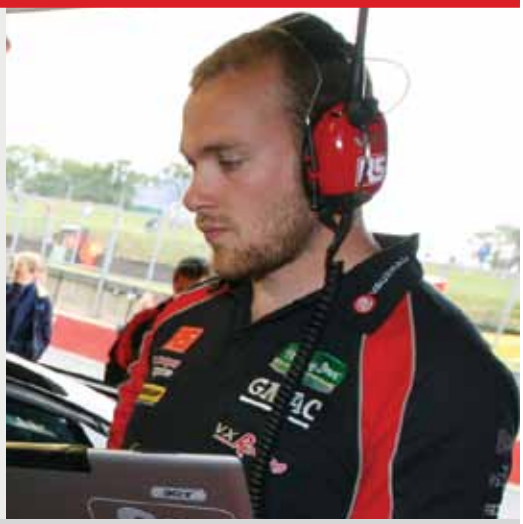
USER CASE STUDY



Triple Eight Race Engineering Ltd.

Customer Profile: Graham Lawrence

Graham Lawrence is a Race Engineer for Triple Eight Race Engineering Ltd. in Greatworth, Banbury, Oxfordshire, United Kingdom. Triple Eight Race Engineering designs, builds and races Vauxhalls on behalf of the UK arm of General Motors (GM). Lawrence and his team are responsible for designing cars that race in the British touring Car Championship (BTCC). In the past, very little simulation was performed. Instead, components were physically manufactured and run on race cars during costly test sessions to evaluate their reliability and optimize their design.

Challenge

2007 saw the start of a new era for the BTCC as the series adopted the S2000 regulations that are used in the World Touring Car Championship. The changes in regulations meant that Triple Eight's Vauxhall Astra Sport Hatch had to be replaced by a Vauxhall Vectra. Lawrence and his team were faced with the challenge of designing a new vehicle to meet unfamiliar regulations from the ground up. There was no time to field a competitive vehicle using traditional build-and-test methods.

Solution

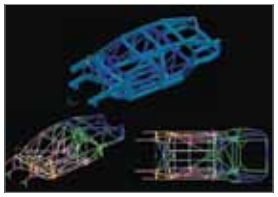
Patran pre/post-processor and MD Nastran multidiscipline simulation software.

Benefit

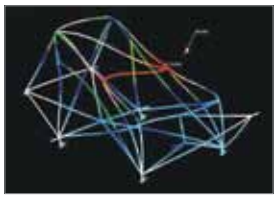
Despite limited development time the new Vauxhall Vectra proved an almost instantaneous success, winning its second race and winning both the driver and manufacturer's title in 2007. 2008 was even more successful for the new car as it won all three championship titles: driver, manufacturer and team.

Case Study

Triple Eight Racing is under continual pressure to improve the performance of its cars to maintain its remarkable record of 100 wins and 310 top-three finishes in 322 BTCC races. Using traditional prototyping methods, the company's engineers would have not had a chance to develop a competitive car from scratch in time for the 2007 season. However, Triple Eight had recently begun using MSC products. Lawrence said the company selected MSC because: "MSC provides a complete solution that encompassed all of our needs when we first adopted it. The software has continued to advance, giving us greater power and flexibility during the four years we have been using it."



Integrated shell and cage design : optimisation for torsional stiffness



Integrated cage and shell design – simulation of lateral hoop test

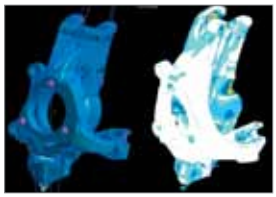
One of the greatest challenges in the design of the Vauxhall Vectra race car was the suspension system. Frequent wheel-to-wheel contact is a characteristic of BTCC racing so the suspension systems must be able to withstand high dynamic loads. Deformation of the suspension system under loading causes camber and toe changes that make the vehicle difficult to control. The durability of the suspension is important because a component failure in this area will most likely force the car out of the race. At the same time, minimizing the weight of the suspension system is critical to vehicle performance.

Lawrence performed multibody analysis of the front upright assembly, an important suspension component, using MD Nastran with a multipoint constraint (MPC) contacts. Lawrence evaluated many different geometries and materials with the goal of reducing stress in order to increase installation stiffness. He used the MD Nastran contact table to reduce the time required to set up each iteration and adaptive meshing to reduce both setup time and run time.

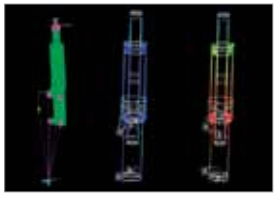
Lawrence also performed multibody analysis on the damper-strut with MD Nastran. He tried different materials and geometries for the inner and outer damper tube and bearings using contact touching bodies instead of MPC contacts. The use of a contact table achieved substantial reductions in design time. Lawrence also tuned the sway bar or anti-roll bar, a suspension component that connects opposite (left/right) wheels together through short lever arms linked by a torsion spring.

"Simulation with MD Nastran played a major role in the outstanding performance of the Vauxhall Vectra in 2007 when we won two out of three championship titles and 2008 when we won all three."

Simulation also played a major role in the design of the integrated roll cage and shell. Lawrence simplified the road car shell into beam elements and correlated them with a physical twist test. The roll cage was connected to the shell with MPC contacts. Lawrence optimized the cage and shell integration for torsional stiffness. "We gained so much confidence in the accuracy of MD Nastran during rig testing that we went ahead and produced the shell and roll cage prior to certification testing based on the simulation results. Our confidence proved well-founded when the vehicle passed certification testing with flying colors. All in all, simulation with MD Nastran played a major role in the outstanding performance of the Vauxhall Vectra in 2007 when we won two out of three championship titles and 2008 when we won all three."



Front upright assembly – Solid FE model and high stress areas



Damper/Strut design – multi-body analysis

MSC Software

MSC Products Used:

MD Nastran

Analysis Types

Solution Procedures

- Linear statics
  - Linear contact
  - Support for very large assemblies
  - Superelements
- Buckling
- Optimization
  - Sizing
  - Shape
  - Topology
  - Topometry
  - Topography
  - Manufacturing constraints
  - Symmetry/cyclic symmetry constraints
- Perturbation analysis
- Noise and vibration analysis
- Interior and exterior acoustics
- Nonlinear statics and dynamics
  - Nonlinear materials
  - Large strain, displacement, rotation
  - Large sliding contact
- Dynamics
  - Frequency domain
  - Time domain
- Explicit nonlinear
  - Fluid-structure interaction
  - Crash
  - Airbag analysis
  - Composite failure
- Heat transfer
  - Conduction
  - Convection
  - Radiation
  - Advection
- Thermo-mechanical chaining
- Structural-acoustic coupling

Materials

- Metal plasticity
- Time dependent and time independent material response
- Viscoplasticity and creep
- Elastomers and plastics
- Shape memory alloys
- Composites
- Powder materials
- Material failure modeling

Performance

- Shared memory parallel (SMP)
- Distributed memory parallel (DMP)
- Automatic component mode synthesis
- Fine tuned solvers for speed and robustness

Patran

Pre-processing

- Standard Geometry Access from
  - Parasolid
  - STEP 203 and 209
  - IGES
  - VDA
  - I-DEAS
- Parametric Modeling Capabilities
- Wireframe and Solid Geometry Creation and Modification
- Mesh Generation
  - Automatic 2-D surface meshing
  - Automatic solid mesher
  - Generalized 1-D, 2-D, 3-D mapped mesher
  - Mesh on Mesh
  - Mesh editing and modification
- Comprehensive Element Library
- Element Property Creation and Edit
- Material Property Creation and Edit
- Load and Boundary Creation and Edit
- Easy Contact Definitions
- Model Visualization and Verification
- Support for multiple FEA solvers
  - Marc
  - Dytran
  - MSC Nastran
  - MD Nastran
  - 3rd party solvers

Post-processing

- Results Access
  - Nastran
  - Dytran
  - Marc
  - 3rd party solvers
- Results Visualization
  - Contours
  - Vector arrows
  - Fringe plots
  - Isosurfaces
  - Data History / Animation
  - X-Y plots
  - Imaging
- Results Templates

Company Profile

Triple Eight Race Engineering was formed in 1996, primarily to design, build and race Vauxhalls on behalf of the UK arm of General Motors (GM) in the British Touring Car Championship (BTCC). A close working alliance has developed during a decade of success and Triple Eight is now Vauxhall's technical partner for motorsport.

In 2001, Triple Eight undertook a development programme for the new Vauxhall Astra Coupé, building it to the latest British Touring Car regulations. The introduction resulted in unprecedented success that saw the team take the coveted Manufacturer, Driver and Team titles in 2001, 2002, 2003 and 2004. The newly established VX Racing brand and Triple Eight became the first BTCC team in history to win the 'treble' four times running.

Triple Eight are also involved in several other forms of motorsport, ranging from the British Rally Championship to the Dunlop Sport Maxx Cup.

The customer division of Triple Eight is also growing. Triple Eight Performance Vehicles launched a limited edition Astra Sport Hatch turbo diesel, which followed on from the 2001 manufacture of 100 Special Edition road cars, in the form of the Astra Coupé 888 which was engineered to translate race-winning experience into phenomenal road car response. The T8 proved to be one of Vauxhall's fastest ever selling road vehicles.

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