SIEMENS
Ingenuity for life

Automotive and transportation

Red Bull Racing

Leveraging technology to maintain competitive advantage on the Formula One racetrack

Products

NX, Teamcenter

Business challenges

Develop upgrades to increase speed and reliability between each race

Nonstop development cycle before, during and after the racing season

High volume of updates to be managed efficiently

Work within the Formula One resource restrictions

Keys to success

More design iterations can be made in the virtual environment than could ever be achieved physically

The efficiency of the entire development process

Secure environment of Teamcenter enables downstream disciplines to use design geometry

Data managed using Teamcenter flows directly into the ERP system

Use of NX and Teamcenter enables fast-paced design and development at Red Bull Racing

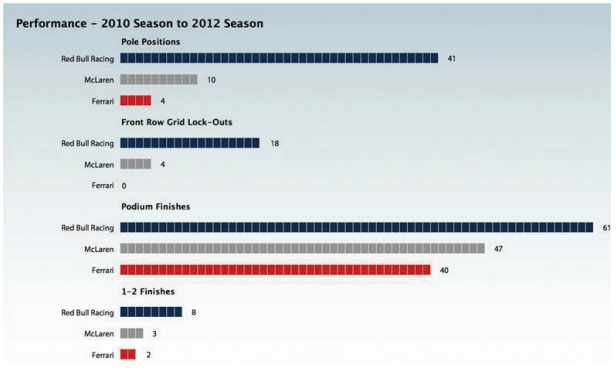
Reliability and speed = performance

"Reliability is at least as important as speed, and to be the best requires a combination of both." That's the verdict of Christian Horner, team principal at Red Bull Racing, a team which clearly exhibits these attributes, winning both the Drivers' and Constructors' Championship titles in 2010 and 2011, and then doing it all again in 2012.

"The frequency of races that started with both cars on the front row of the grid, and race events with one-two finish positions, clearly demonstrates a level of consistency and quality that is achieved with the support of a highly integrated and efficient PLM (product lifecycle management) solution," says Alan Peasland, head of technical partnerships at Red Bull Racing.

Championship Positions

Season	2005	2006	2007	2008	2009	2010	2011	2012
Constructors' Championship	7th	7th	5th	7th	2nd	**1st**	**1st**	**1st**
Drivers' Championship	10th	13th	10th	11th	2nd	**1st**	**1st**	**1st**



This type of success depends on designing and building a competitive car for the first race, and then developing it to perform even better through a series of engineering upgrades for each race during the season.

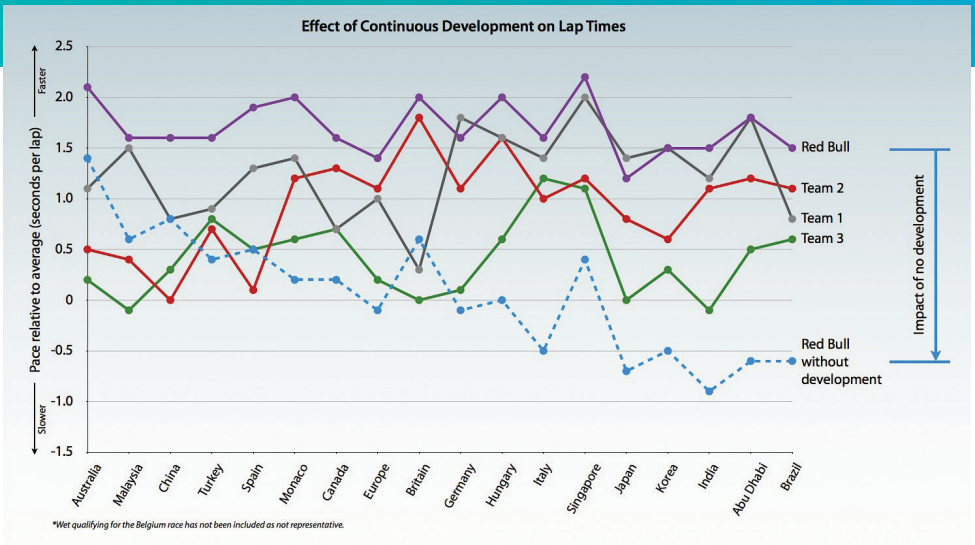
Results

Effective management of design changes, despite significant increases in changes/upgrades

Removed nonvalue-added activity, reduced errors and optimized quality

Early visibility of changes so that all departments can prepare and respond accordingly

Red Bull Racing led the sport in 2010, 2011 and 2012



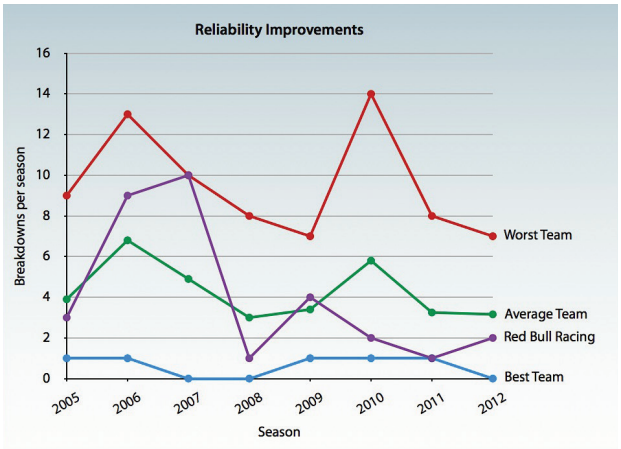
Note: Wet qualifying for the Belgium race has not been included as it is not representative.

"Reliability is at least as important as speed, and to be the best requires a combination of both."

Christian Horner
Team Principal
Red Bull Racing

Improve performance or get left on the grid

Once the season is underway, the focus for everyone is on continual improvement, and the pressure grows as teams vie for points and position. The team at Red Bull Racing is clear about its self-imposed targets: to maintain reliability yet increase the car's speed. In 2011, for example, the team improved the car by over two seconds over the season.



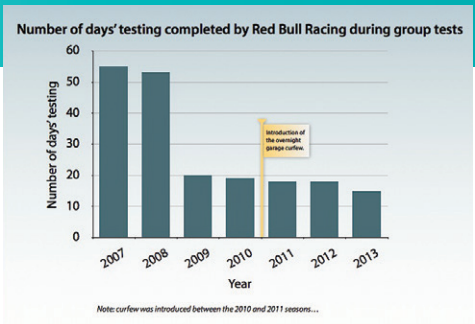
To achieve this, polished performances on the track and in the pits need to be supported by behind-the-scenes teamwork. From concept, through design and simulation, to manufacturing and assembly, development never stops.

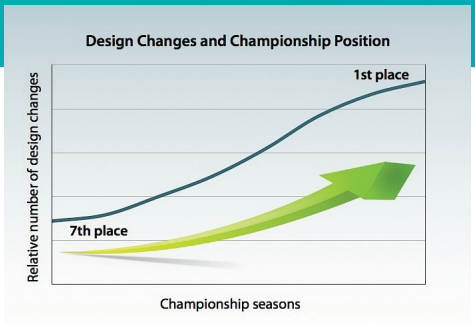
Integration of all engineering processes is crucial, and Siemens PLM Software solutions – NX™ software for computer-aided design/manufacturing/engineering (CAD/CAM/CAE) and Teamcenter® software for complete PLM – underpin the team's engineering endeavors. Together, they form the digital backbone of Red Bull Racing.

Push the limits yet stay within the rules

The emphasis on performance enhancement generates a high volume of updates, and their implementation requires a disciplined development process that is both efficient and predictable. All this has to be achieved during the days between races and coordinated on a global scale. The key is to iterate new ideas, select the solutions that promise the most improvement and develop them virtually as far as possible before committing to manufacturing the physical parts.

Working within the Formula One® resource restrictions is simply another challenge to be addressed. The regulations limit physical testing at the track, headcount versus external spend, and also the total amount of aerodynamics activity, allowing the teams to decide the split between computational fluid dynamics (CFD) and wind tunnel testing. This all further drives the need for very efficient virtual processes once there is correlation and confidence that the virtual processes





match the physical testing done on rigs, in a wind tunnel and on the track.

Interestingly, even if extensive physical tests were allowed, such methods would be too slow to cope with the rate of innovation required to remain competitive. In addition, the introduction of garage curfews reduced the time available to assemble, upgrade and repair cars. In the majority of cases, the first time that the upgrades come together is at the racetrack. It is therefore essential that the pit crew is able to assemble the car easily and efficiently the first time.

Refining the concept

Aerodynamic optimization directly correlates to performance improvement. New parts are created with NX, which is then used to develop the geometry, and then tested virtually in the engineering team's CFD solution or test in the wind tunnel using parts made through the technique of Additive Manufacturing – the process of quickly making the scale model parts in resin by directly using the 3D geometry. Once the aerodynamics department has agreed on the external form, then the part can be released for detailed design and validation to verify that it can be manufactured and will meet the team's reliability and performance criteria.

This is all done using the Teamcenter managed environment, which enables various downstream disciplines to utilize and develop the part definition and the associated details for manufacturing, test, inspection and installation. As a result, the ability to refine complex parts, such as the wiring harness, earlier in the design process eliminates the need for physical mockups.

To maximize the potential performance gain from a design concept, engineers run as many iterations of the design as possible within the time available. Having confidence that the virtual environment in which they are developing a component, assembly or system accurately reflects the physical world during testing on a Friday and Saturday of a race weekend enables engineers to rely increasingly on virtual design iterations and validation. This allows them to do many more design iterations than they could ever achieve physically, and that freedom means that they have greater confidence that they have arrived at the optimal design.

Realizing the design

Since the launch of the team in 2005, the number of design changes each year has significantly increased, relative to the number of designers. Good management of the engineering process is essential to ensure that up-to-date information flows from design through simulation, manufacturing, inspection test, and finally onto the car.

During this process, the full car for an event is available for visualization to everyone on the team, from the factory to the track. At the track, for example, the visualization capabilities of Teamcenter enable updates to be readily seen and understood, can be used as an aid to assembly and problem-solving, and allow workers to suggest enhancements back to the factory. In addition, all data is tracked via Teamcenter, which is used to share the information with the corporate enterprise resource planning (ERP) system, to ensure that the right materials and tooling are available for the latest parts. The accuracy of this shared information and the streamlining of processes have removed nonvalue-added activity, reduced errors and optimized quality.

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Alan Peasland
Head of Technical Partnerships
Red Bull Racing

Solutions/Services

NX
www.siemens.com/nx

Teamcenter
www.siemens.com/teamcenter

Consulting and training

Customer's primary business

Red Bull has been involved in Formula One as a team owner since 2005, quickly establishing the team as both creative and innovative. The racing team won both the Drivers' and Constructors' world titles in 2010, 2011 and 2012.
www.redbullracing.com

Customer location

Milton Keynes
United Kingdom

"For us, the innovation process is relentless, unyielding and publicly demonstrated on the track each race weekend. As an innovation partner, Siemens PLM Software assists us in building on our existing knowledge and technological expertise and goes one step further in our search for performance and reliability. In this industry, success can depend on a fraction of a second."

Alan Peasland
Head of Technical Partnerships
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An early view of the next refinement

Given the increasing number of modifications and new parts, it is also important that everyone involved in the engineering and manufacturing processes has early, comprehensive visibility into changes, so that they can prepare and respond accordingly. Using Siemens PLM Software's solutions, everyone is automatically designing within the context of the next upgrade and doing so within a secure, confidential environment.

Frequently, one can find parts already being machined while NX is being used to update the machining program with the next refinement of the design. The ability to work collaboratively within the PLM environment also means that CAM programmers can commence their tasks at the same time that designers are developing the models, thus minimizing the lead time from design to manufacture.

Designers are also taking full advantage of the NX Advanced Simulation tools to perform stress analysis on parts during the iterative design and development process. The dedicated finite element analysis (FEA) team works in-parallel with the design team, sharing the same 3D master geometry. This helps ensure that critical components meet demanding requirements and are designed in the shortest possible timeframe. The openness of the PLM architecture provides a platform that has enabled custom automation and robust integration.

Manufacturing, for example, automatically provides the whole package of information to the shop floor, including the machining tool paths, tool setting sheets, feedback sheets, tool library information, and validation data for integrated simulation and verification with NX.

A calm and calculating approach

The efficiency of the entire development process is increasing year after year, enabling more updates to be made to the car in a predictable manner. New designs can be reviewed while they are maturing by managers, inspectors and mechanics for planning purposes; by the race team for geometry information debriefs between track and factory; and by suppliers in preparation for fast and accurate turnaround.

"To develop the complex product that is a Formula One Racing Car in approximately a five-month period requires intense activity and an extremely robust and efficient PLM infrastructure, coupled with worldclass talent and highly developed business processes," notes Peasland.

He concludes: "For us, the innovation process is relentless, unyielding and publicly demonstrated on the track each race weekend. As an innovation partner, Siemens PLM Software assists us in building on our existing knowledge and technological expertise and goes one step further in our search for performance and reliability. In this industry, success can depend on a fraction of a second."

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