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Formula One Racing: Extreme Technology

Formula One, or Grand Prix racing, is widely regarded as the pinnacle of motor sports. It is the world's most expensive sport, with annual team budgets running into the hundreds of millions of dollars. For global awareness it is rivalled only by the Olympics, football World Cup and the World Athletics Championships.

As much as the skill of the drivers, engineers and designers on a Formula One team, it is technology that underpins success in Grand Prix racing. In fact, in addition to such traditional members, each team on the circuit now employs a fully-fledged IT department!

Technology has played a key role in the development of Formula One racing ever since its inception in 1950. Every major innovation and breakthrough in engine design, aerodynamics, boosting speed and road-holding abilities is made possible by teams of engineers and designers taking advantage of cutting edge technology and ever-increasing data processing capabilities.

In the Factory: Car Design and High Performance Computing
The design, engineering and testing of Formula One cars take place off the track in state of the art factories in Europe and across the world. Teams of engineers, designers and technicians work on extremely tight deadlines to design and build their cars before the Grand Prix begins, and then make significant changes and refinements throughout the season. Such extraordinary efforts are only made possible through the use of advanced technology and high performance computing.

The computational requirements of continually modelling and refining vehicle design are vast. During the season, Formula One teams may re-design up to 15 percent of chassis specifications within a two-week period. They rely on affordable high performance servers, such as the Itanium® 2 and Intel® Xeon® processor platforms, which can process huge amounts of data to simulate complex full-

scale design modifications overnight, rather than over a period of days.

A modern Formula One car has almost as much in common with a jet fighter as it does with a conventional road vehicle. Driving at speeds of up to 220 miles per hour, aerodynamic design is crucial – both in pushing the car's tyres onto the track and improve cornering forces; and minimising the drag that gets caused by turbulence and acts to slow the car down.

The drive to improve aerodynamics led to the creation of the now familiar wings on either side of Formula One cars. Race car wings operate on the same principle as aircraft wings, but for a different purpose. Air flows at different speeds over both sides of the wing, creating a difference in pressure that increases the downward drag desired for greater performance.

While in the past teams had to rely solely on expensive wind tunnels to conduct aerodynamic analysis, today they can achieve much faster results by also conducting airflow virtual tests on computers using computational fluid dynamics simulation software. This vastly speeds up design-to-manufacture, vital in a sport in which timing is essential.

Using clusters of high performance servers, Formula One teams are able to run intensive aerodynamic and weight reduction modelling tests, allowing them to improve telemetry data, computational fluid dynamics, aerodynamics and other critical design and performance issues.

The engine and transmission of modern Formula One cars are among the most powerful and highly stressed pieces of machinery in existence. Engines are designed to extract the greatest possible power and performance along with the durability to survive a number of races.

Formula One engines rev to almost 19,000 RPM and consume an amazing 650 litres of air every second. Operating at such massive speeds equates to an accelerative force on the pistons of nearly 9,000 times gravity[1]. It is unsurprising that engine failure remains one of the most common causes of retirement in races.

Design and engineering teams use high performance computers to design, run simulations and model engines to gain the optimum balance between being enormously strong and powerful, yet also lightweight and compact enough to minimise the overall weight of the car and lower its centre of gravity.

Formula One gearboxes are now highly automated with drivers able to change gears through levers situated behind their steering wheels. Technology innovation means that these gears work much faster and more efficiently than the traditional 'H' gate selector, giving the drivers better performance and control.

In order to ensure that technology advancements do not give the richer teams far greater

[1] Official Formula One website, www.formula1.com

competitive advantage than some of their rivals, the FIA (Fédération Internationale de l'Automobile, governing body of motorsports worldwide) has introduced stringent rules outlawing the use of certain technologies such as fully automatic transmission, traction control, ESP-type systems or other systems that would help the driver control the car. Such restrictions ensure that Formula One remains the ultimate test of driver skill.

Trackside: Mobile Technology Provides Greater Flexibility and Communication
Many Formula One teams are now taking advantage of the flexibility and high performance of notebook computers to allow better performance analysis and communications during trackside testing and when racing.

Pit crews and design teams use notebook computers to collect telemetry data on the behaviour of Formula One cars, including information such as oil temperature, downforce and the heat of brakes. Such information can be downloaded from the car's black box at the trackside and analysed by the notebooks, then sent back to headquarters to provide data for future modifications and re-designs.

Some teams are so reliant on notebook computers and mobile technology that they actually use such devices to start their cars at the beginning of a race!

Notebook computers based on the Intel® Centrino® mobile technology platform offer further benefits to Formula One teams through their lightweight design, great battery life and wireless functionality. During the Grand Prix season, engineers and trackside crews can take their notebooks with them while travelling anywhere, finishing the tasks that they haven't had time to complete while trackside.

Wirelessly-enabled laptops and other mobile devices can also allow Formula One organisations to communicate and collaborate more effectively during race situations, allowing marketing, sponsorship and administration executives to access the information during and after races that they need to update partners, sponsors and the general public about results.

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