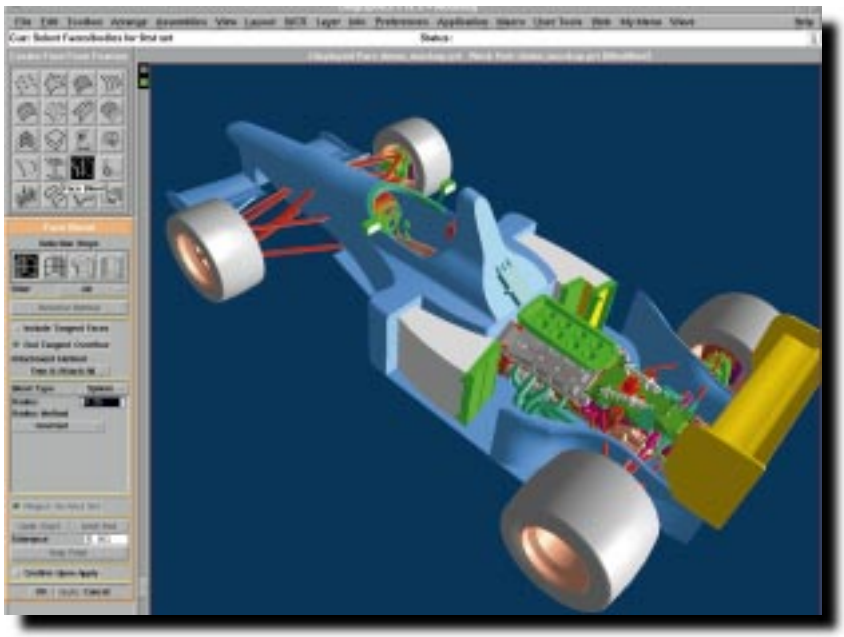
IT's winnin



THE PARTNERSHIP BETWEEN HIGH-PROFILE TECHNOLOGY SUPPLIERS AND CAR MAKERS HAS BECOME THE UNSEEN DRIVING FORCE BEHIND THE **GLAMOROUS SPORT OF MOTOR RACING**. PAUL TRUEMAN TRACKS THE CHANGES

g formula

▲ THE MERCEDES, MCLAREN'S CAR, DOMINANT AT THE START OF THIS YEAR'S F1 CHAMPIONSHIP
◀ THE RACE DESIGN TEAMS USE CAD TO MODEL THEIR CARS

IF YOU STOPPED THE AVERAGE MAN in the street and asked him to name the most important contributors to a Formula One team's success, he'd probably say the driver, the engine manufacturers, and possibly the tyre suppliers. Chances are, though, that he'd forget the other most important factor in creating a winning team – bleeding-edge technology supplied for next to nothing, in some cases, by global IT brands.

Over the last ten years, IT has transformed nearly every aspect of Formula One racing. Some changes are well known, such as the conception and design of components on CAD/CAM workstations. Others have been less widely feted, like the ability to race hundreds of additional practice laps over a Grand Prix weekend from the comfort of a team's R&D lab thousands of miles away from the track.

Thirty years ago, you might well have found legendary racers like Stirling Moss and Fangio underneath their cars minutes before the race, tinkering with the front axle. After all, who else was as familiar with the car? But 30 years ago, Moss won the British Grand Prix with an average flat-out speed of 87mph. Nowadays, drivers rarely take corners at less than 110mph.

Long-established teams like McLaren started using CAD in the late 1980s. Nowadays, for new teams on the block, such as Stewart (former world champion Jackie Stewart's fledgling team), the drawing-board is no longer an option.

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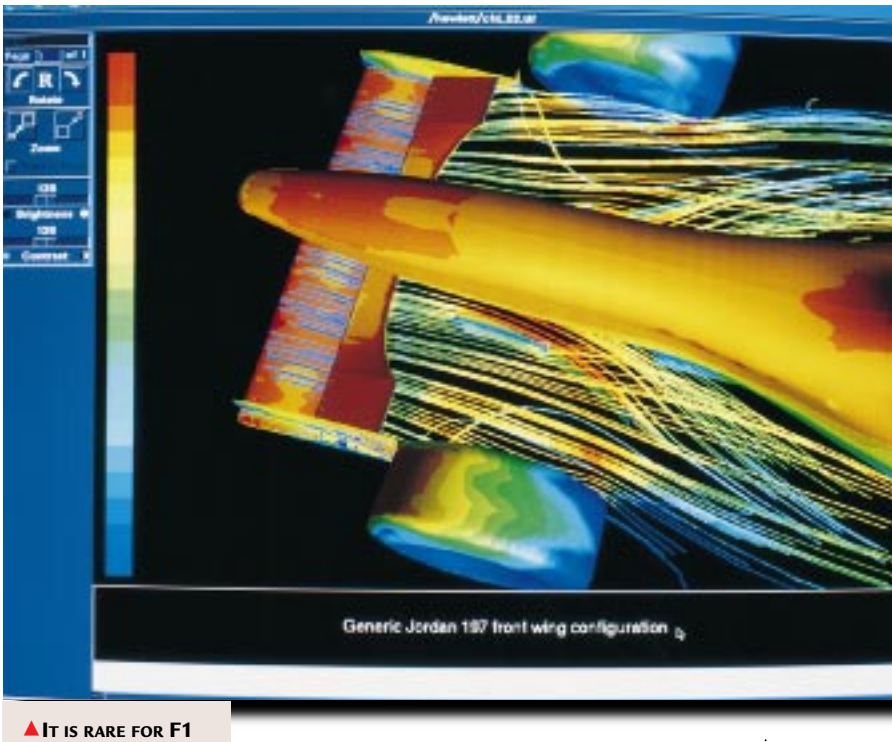
Stewart's engineers work in partnership with Hewlett-Packard and use its K-Class workstations running CAD software supplied

by Unigraphics Solutions. Using HP's 64-bit RISC 8000 processor, along with an average 1.5Gb of RAM and 17Gb hard drives, these processing monsters are worth around £35,000. In a relatively modest team like Stewart, ten designers specialise in areas such as aerodynamics, suspension, chassis and transmission, and another ten all-rounders provide the specialists with back-up if they need it. Communication is essential and the Assembly Navigation Tool in the Unigraphics CAD software gives them communal use of virtual space, creating the file structure that links together the relevant design sections. All the individual design schemes are visible on the system from day one, and as the designers fill in the details, the car gradually takes shape.

HP has the strongest links in Formula One with the Jordan team, supplying all its research and racing hardware. Fully integrated CAD/CAM enables Jordan's designers to model their components using an application called Ideas from SDRC Technology. This not only allows full 3D modelling of the finished component, but can also generate machining on the CNC tool-cutting machinery on the factory floor. Engineers can decide whether to go ahead with the manufacturing process after they have run Finite Element Analysis software, which tests the component as a moving part in the car and subjects it to stress tests. If it performs well, cutting paths are designated according to the 3D model. Depending on the complexity of the design, a prototype can be produced the same day, and engineers can hold a component drawn up on the screen in the palm of their hand within a few hours of finishing the design. In a sport where designs for the next season's car are begun well before the end of the present one, such speed is crucial.

Probably the most processor-intensive CAD task is Computational Fluid Dynamics (CFD). CFD simulates on screen the way a fully modelled 3D car will respond on the track, acting as a virtual wind tunnel. The Stewart designers also test a less than half-scale model of their 1998 car, the SF2, in their tunnel in San Clemente, California. Equipped with a rolling road, the tunnel can produce speeds of up to 140mph, and the Stewart team spent 1,300 hours in it designing their first car, the SF1. All the design teams use CFD in tandem with real wind tunnels because it is less expensive and time-consuming than physical testing.

"Aerodynamics is probably the single biggest differentiator between the teams, given that we all have pretty similar engines," says Dave Morgan, the HP racing IT specialist who works on a full-time loan basis with Jordan. "If you consider that a difference of 8-10 horsepower is a significant amount, but that you would need that much just to make roughly a 1/10th second difference in lap times, you see how important it is to airflow-test the cars so thoroughly."



▲ **It is rare for F1 drivers to take corners at less than 110mph in a race**

Engineers can hold a prototype in their hand within hours of designing the car on screen

▲ **Sensors all over the car relay information back to engineers in the pits**

Using CFD, the Jordan engineers "pressure-tap" the car to diagnose the aerodynamic flows over it. Components are designed and modelled using the Ideas package, and then machined to the 40% size that Jordan uses for its wind-tunnel car. Morgan says: "At the moment, there is only so far you can go on the screen."

With several gigabytes of RAM, quadruple processors and a 60Gb hard drive, if you were to buy the V-Class server from HP you would need around £250,000 in the bank. But as well as the jaw-dropping specifications of the systems used in the conception of these cars, you still need sensors to measure their performance on the track. "There are only about 100 factors and components on the car that you can measure during a lap," says Gary Morgan, the HP specialist working with Jordan. "But from the raw data the sensors produce, we can calculate and extrapolate up to three thousand values."

The sensors measure everything from engine temperature to the height of the chassis off the road and the pressure on the car's suspension. "Fundamental values are those like the temperature of your engine oil, fuel temperature, and pressures on the gearbox and brakes," explains John Digby, head of research and development for the Stewart team. "There are numerous strain gauges on the car, feeding us raw data all the time. We use both linear and

rotational potentiometers to convert the mechanical movement into an electronic signal that the car can transmit."

There are three ways the engineers can get their hands on the data being gathered by the on-car sensors: real-time telemetry (RTT) that transmits data constantly between car and pits during the race; burst telemetry that dumps a larger amount of information at a set point on the track, usually as the car passes the pits; and in-car data acquisition that is downloaded after the race by connecting a landline to the car.

The Stewart team monitors 32 RTT channels on a constant UHF radio link from the car to a receptor on the pit wall. "Most of those channels are dedicated to sending data from certain sensors," explains Digby. "But there are a few that we can reconfigure during the race, should the data we receive indicate a particular problem." In recent years, FIA (Fédération Internationale de l'Automobile), Formula One's governing body, has taken steps to reverse the progress made in the communications technology. Three years ago it outlawed "active suspension", the practice of using UHF radio signals during the race to alter the car for every bend of the track. It was thought that this would give teams with the most advanced comms set-up an unfair advantage over other teams. Now UHF can only be a one-way car-receptor, and the car can only be reprogrammed until the last qualifying lap, using a land-line. There are other restrictions on UHF: teams transmitting on high frequencies need to apply for a licence for each race, and their frequencies must be nowhere near those used by the various countries' emergency services.

Trackside teams usually have two engineers monitoring the RTT and burst transfer data.

▼ **F1 pit teams are fiercely competitive with one another**

They do not have the time during a race to do much more than monitor the car, and the importance of RTT was borne out to dramatic effect in the fourth race of the season in San Marino this year. Leading at the halfway stage by nearly 25 seconds, David Coulthard looked in no danger from the chasing Michael Schumacher. From lap 40 though, Coulthard's lead was gradually eroded and commentators assumed that McLaren's team director, Ron Dennis, was looking worried because of a probable brake problem. What no-one outside the McLaren pits could have known was that Dennis had instructed Coulthard to slow down because telemetry revealed that his oil cooling system was malfunctioning due to debris build-up. Without that knowledge Coulthard would have lost the race; in fact, he won by four and a half seconds.

Aerodynamics is probably the single biggest differentiator between the Formula One racing cars

The off-site resources of a race team feature increasingly heavily during a race weekend. In the days before the race, the teams are usually

▼ **The drivers are the focus of attention, but they don't win races on their own**

How do they do that?

On each lap, as the two Stewart cars pass the pits, their cars dump 50 microwave radio channels of data acquired during the lap, 32 of which have the same configuration as those monitored in real-time, with an additional 18 channels measuring whatever else the engineers deem important. Once transmitted into the pits, there are a variety of ways to transfer the data. The Jordan pits have a 10Mbit/sec IR link from the receptor dish on the pit wall to their two NT servers, and these then pass on the data to the engineers via a Cat5 cabling link using an Ethernet 10BaseT 10Mbit/sec connection. Jordan used to run a Unix OS on their pit system, but the telemetry software from Tag requires Microsoft's NT platform. Apart from the two HP Kayak high-end servers running NT in the pits, there are four PCs used to analyse the data, as well as 20 notebooks on-site for race analysis and NT workstations with P233 processors and 128Mb RAM.

▲ PART OF THE SPONSORSHIP APPEAL FOR COMPANIES IS THE GLAMOUR OF F1

allowed just an hour or two on the track to calculate their final settings and adjustments for the race, with strict FIA limits on the number of practice laps allowed. But by taking advantage of both the telemetry and telecommunications technology at their disposal, the race teams are able to sidestep the regulations and race as many laps as they deem necessary. The Jordan trackside team transmit their telemetry to their research facility located at their factory near Silverstone, from which the team of research engineers there can set up an exact model of the car and track.

"You can never really predict the comms setup available to you at the track until you get there. We use a variety of comms, from GSM mobile phones to ISDN, and even standard phone lines," says Morgan. "We send large megabyte files down the lines, but it's the luck of the draw as to how advanced a country's telecom carrier is."

A full-size model of the Jordan car is put on the simulation rig in the labs, with the engine, suspension and chassis settings replicated using the telemetry gained from the practice laps. The track is defined by the suspension data received from the drivers' best lap times, and the tyres replaced by servo-mechanisms that replicate the bumps and track surface. Four servos are also placed over the car to simulate the downforce operating on it during the race. Engineers tweak the settings until they arrive at the optimum settings, then transmit the configuration to the team at the track, who analyse the data and alter the cars' settings accordingly.

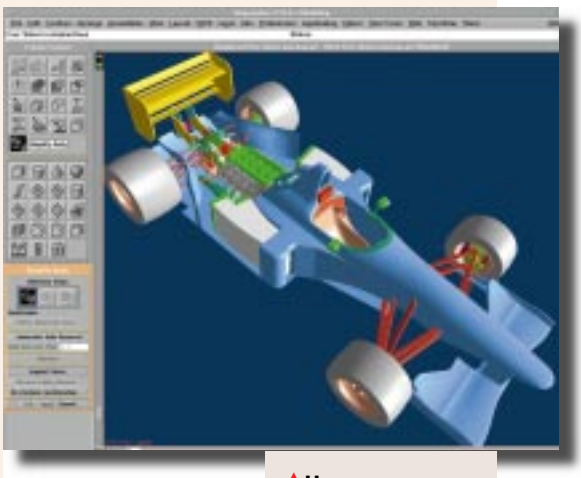
For all the influence on the sport of the fantastic technology at the disposal of the teams, it is still the drivers and their skill that will ensure the future of Formula One. FIA has shown its commitment to keeping the sport competitive by outlawing technology that might be seen to replace driving skill. It seems safe to assume that the sport will continue to strike the right balance between automation and individual brilliance, because the governing body knows that it isn't the hardware on display that millions continue to tune in for, but the drivers who risk their necks every fortnight. ❑

Solution providers

Hewlett-Packard's relationship with Jordan is a neat example of an IT phenomenon – solution-based selling. The term "solution provider" describes companies that supply not only the computer hardware, but the support infrastructure as well. HP's partnership with Jordan began in 1995, and HP spent the following season transforming the way the team worked, from installing Jordan's first internal email system to supplying the hardware needed to design and run the cars, as well as an on-site IT specialist. Jordan not only needs the technology, but also the guaranteed 24-hour, 365-days-a-year technical support.

"It's not merely about box-shifting," says HP's Geoff Banks. "It's what happens when it goes wrong, and in a Formula One year you can never take your eye off the ball." But what's really in it for HP? People often talk about the benefits of Formula One sponsorship, with logos being seen by millions, but in effect that's just the icing on the cake. It would be naïve to think that a company would pour up to £10 million a season into a racing team, simply for a small logo on the side of a car that whizzes by potential customers at up to 200mph. Formula One is a great advertisement for these IT companies in itself. Glamourous and exciting, it is also the most technologically demanding sport in the world. And not only does HP get the chance to invite top-level corporate types to schmooze the race away; it also gets to strengthen ties and angle for deals with the other sponsors of their race team. HP is keen to stress that, with Jordan at least, it is not in it for the money. Gary Morgan, Jordan's on-site IT specialist from HP, says: "We're not there to make a profit or loss from Jordan. The team receives a value from us in terms of hardware and support, and they give us a value back in terms of hospitality and PR." Jamie Snowdon, an industry analyst for Input, says: "How can you get a sexier example of your ability to provide global round-the-clock service than supporting a Formula One racing team that moves base every two weeks?"

▲ HP NOT ONLY GUARANTEES HARDWARE BUT ALSO SUPPORT



▲ HIGH-END WORKSTATIONS ARE USED TO CREATE THE 3D MODELS