INTERNATIONAL
JOURNAL OF THE FIA:
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IN SAFE HANDS

HOW THE FIA IS ENLISTING SUPPORT FOR ROAD SAFETY AT THE HIGHEST LEVELS

"I like driving and am always happy to make a little detour to take my favourite 'shortcut'.

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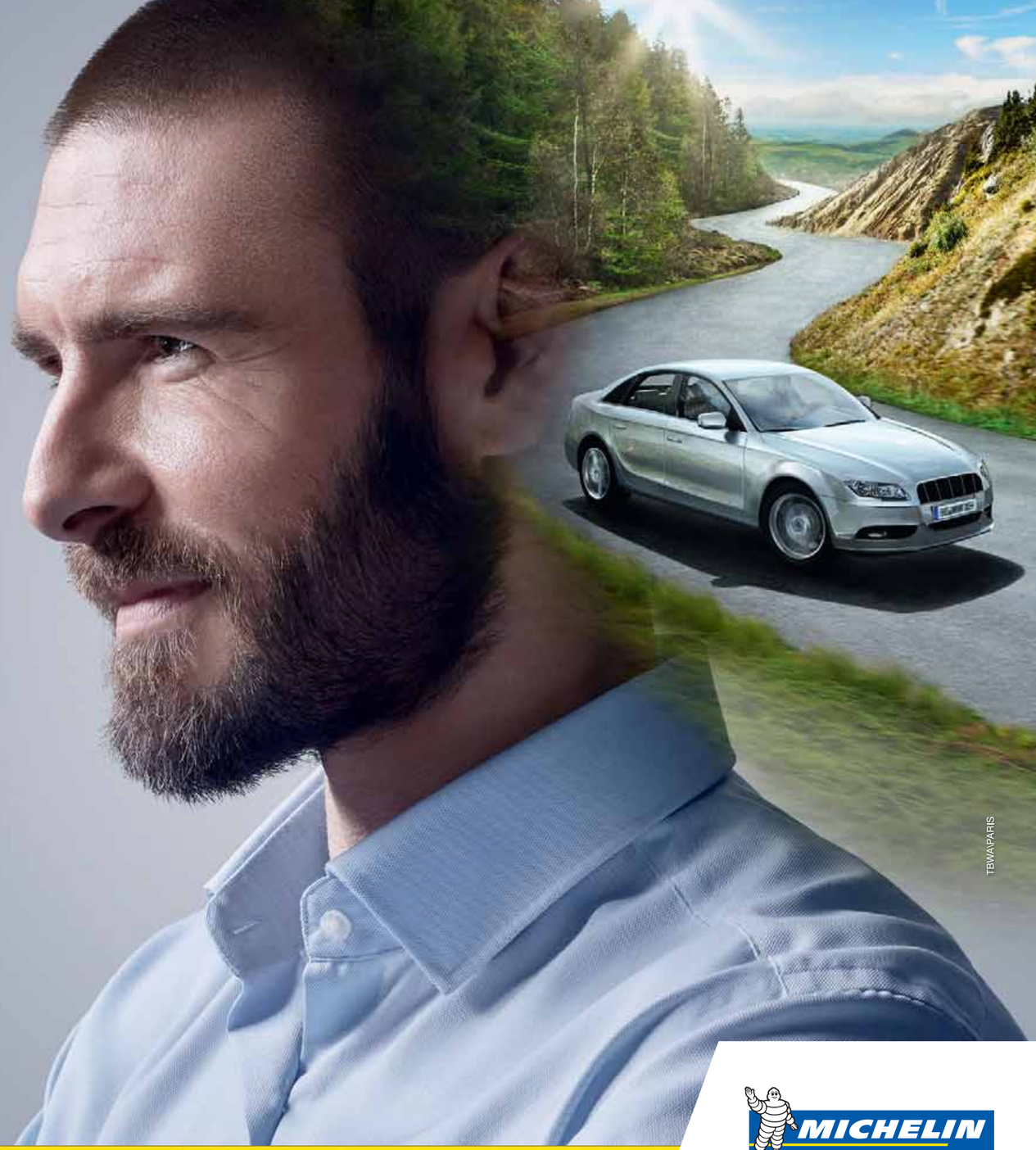

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AUTO

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THE FIA

The Fédération Internationale de l'Automobile is the governing body of world motor sport and the federation of the world's leading motoring organisations. Founded in 1904, it brings together 236 national motoring and sporting organisations from over 135 countries, representing millions of motorists worldwide. In motor sport, it administers the rules and regulations for all international four-wheel sport, including the FIA Formula One World Championship and FIA World Rally Championship.

THE FIA FOUNDATION

The FIA Foundation is an independent UK-registered charity that supports an international programme of activities promoting road safety, the environment and sustainable mobility. It was established in 2001 with a donation of $300 million from the FIA and is governed by a Board of Trustees. Among its activities, the Foundation participates in various UN road safety and environment related partnerships and is a member of the UN Global Road Safety Collaboration.

THE FIA INSTITUTE

The FIA Institute is an international not-for-profit organisation that develops and improves motor sport safety and sustainability. It leads projects that encourage the rapid development of new and improved safety technologies; that facilitate higher standards of education and training; and that raise awareness of safety and sustainability issues. The Institute was established in October 2004 and funds its activities through annual grants from the FIA Foundation.

ALLIED FOR SAFETY

One of the keys to bringing the fight for road safety to global attention is enlisting support at the highest levels.

In this regard, I recently had the opportunity to engage with some of the world's most influential decision-makers, making them aware of the pressing need to tackle the global road safety pandemic. From the great privilege of an audience with Pope Francis to successful meetings with political leaders at the World Economic Forum in Davos, I believe that the work of spreading the safety message at international diplomatic level is progressing well, as you will see in our feature story.

Elsewhere in this edition, safety is also on the agenda in motor sport, as we look at the very real possibility of introducing greater head protection for open wheel racers, through research into several major safety concepts.

Finally, many of the FIA's motor sport seasons are about to begin and with another major auto maker returning to F1 as a constructor we look at the fascinating heritage of motor manufacturers in racing's highest echelon.

Jean Todt,
FIA President

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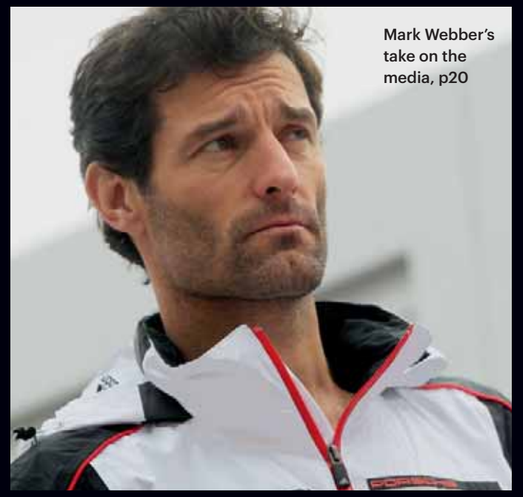
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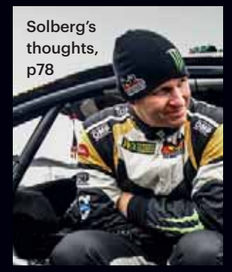
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PETTER SOLBERG
'Hollywood' on his quest for another World Rallycross title and the long, hard road to factory backing

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UP FRONT

Fast Forward

ELECTRIC DREAM?

New electric vehicle manufacturer Faraday Future unveiled its FFZERO1 concept car at the Consumer Electronics Show (CES) in Las Vegas in January.

While the FFZERO1 is not intended for production, much of the underlying technology showcased within its design is set to form the basis of future on-sale models, which will be built at a brand-new, $1 billion, 280,000-sqm factory currently under construction outside Las Vegas.

This technology includes a series of aerodynamic tunnels that allow air to flow through the car and cool its batteries while in motion, and a proprietary engineering platform that could support a range of vehicle types, speed up production timelines and potentially reduce material wasteage significantly.

A fully-adjustable chassis can accommodate strings of batteries that are more easily charged than single units and would enable different battery types to be incorporated into a common platform without the need for re-engineering. The car's four electric motors deliver a combined 1,000bhp, which Faraday claims will achieve a maximum speed of 320 km/h.

Self-drive functionality is also intended, which the company's Senior Vice-President of R&D, Nick Sampson, says will give customers the ability to sign-up to a subscription model that will enable them to order a car to their front door whenever they want it, negating the need for conventional car ownership.

Faraday employs over 720 staff globally and has financial backing from Chinese billionaire Jia Yueting, founder of online streaming service, LeTV.

Autonomous technology will allow Faraday models to self-drive.

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FUTURE MODEL

US-based Faraday Futures unveiled the FZERO1 concept at the CES in Las Vegas and believe their 'subscription' model will change traditional views on car ownership.

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LEADING THE WAY

Sebastien Ogier during Rallye Monte Carlo in January 2016. The World Rally Championship is setting a benchmark by ensuring all events meet minimum environmental standards.

Environmental Performance

SUSTAINABILITY ALL ROUND

By the end of 2016, every round of the FIA World Rally Championship will have to demonstrate a high level of environmental performance, as sustainability has been written into the regulations for all promoters.

As part of a groundbreaking environmental accreditation scheme, and in conjunction with the new FIA Action for Environment campaign, all promoters in the World Rally Championship will now achieve at least the second level of accreditation in the FIA Institute Sustainability Programme by the end of the season.

The Sustainability Programme offers three levels of accreditation: Commitment to Excellence (basic practice), Progress towards Excellence (good practice) and Achievement of Excellence (best practice). To reach the second level or above, events will be audited by the FIA Institute and must demonstrate a range of sustainability policies and initiatives, such as a clear commitment to environmental management and measurement of key environmental impacts.

As part of this process, the FIA Institute provides assistance and guidance for stakeholders to create clear and consistent management procedures to improve their environmental credentials.

Garry Connelly, FIA Institute Deputy President and FIA Environmental Delegate, said: “This is a major global sporting championship with events conducted in all corners of the world, where sustainability of the environment has been incorporated into the sporting regulations. Rallying takes the action out into the world’s natural environment, so this is an extremely responsible move by the FIA, the WRC promoter and the individual event organisers, in making this commitment.”

UP FRONT

AUTO NEWS

In this issue, four new Formula 4 championships are announced, father and son Franz and Alex Wurz win a prestigious international road safety award and the FIA Foundation appoints a new Chairman

F4 South East Asia was launched at Sepang.

FIA F4 CONTINUES GLOBAL EXPANSION

The FIA Formula 4 category continues to go from strength to strength with four new championships, in the USA, South-East Asia, the UAE and Spain, set to start in 2016. The launches bring the number of nationally-based entry-level single-seater championships to a total of 11, spread across four continents.

Organised by the Sports Car Club of America's Pro Racing division, the Formula 4 United States Championship will be contested over five triple-header rounds, starting in May at Lime Rock.

The Formula 4 South East Asia Championship has been created by a group of national sporting bodies led by the Automobile Association of Malaysia (AAM) and including those of Singapore (SMSA), Thailand, (RAAT), Taiwan (CTMSA), Indonesia (IMI) and India (FMSCI). The series will begin in August and is set to consist of six events, with up to 30 races.

In the Middle-East, the Automobile and Touring Club of the UAE (ATCUAE) is rolling out an 18-race, six-event championship to be staged at the Yas Marina and Dubai Autodrome Circuits. The championship will run from October until March 2017.

Finally, Spain's championship, organised by the Real Federación Española de Automovilismo (RFEDA), will consist of seven rounds, running from May to October.

The satellite antennas promise unlimited data.

TOYOTA PLANS TO EQUIP CARS WITH SATELLITE ANTENNA

Toyota is planning to provide vehicles with satellite communications technology that would derive its data from space.

At the 2016 North American International Auto Show (NAIAS), Toyota displayed a research vehicle equipped with satellite communications technology from Kymeta, a US-based company that is the world's leader in flat-panel antenna technology.

Satellites have historically required the use of a "dish" antenna on the ground but Kymeta's satellite antennas remove the need for mechanical components by using software and liquid crystal technologies to electronically track and steer towards satellites. The lightweight, flat profile of the antenna also allows for seamless integration during vehicle assembly or an easy aftermarket installation.

Satellite communications offer several key benefits to meet automotive needs, including the distribution of huge amounts of data to a vehicle; the global deployment of connected vehicles that share common standards across national borders; and more stable and secure communications, particularly in the event of an emergency such as a natural disaster.

"If you believe the car will follow the same data consumption trends as the home, then the most logical path to access this is from space," says Dr Nathan Kundtz, Kymeta's founder and CEO. "Unlimited, inexpensive data taken from space."

PRESTIGIOUS AWARD FOR WURZ & WURZ

Alex and Franz Wurz were recently named winners of the prestigious Prince Michael Award for Road Safety for 2015.

The pair were presented with the award by HRH Prince Michael of Kent for the work their company, Test and Training International, has done in creating a series of comprehensive road-safety driver-training programmes.

Over four million drivers and three million children have received training from TTI, which was founded by former FIA European Rallycross champion Franz Wurz. Its systems have become law in several countries.

Two-time Le Mans 24 Hours winner Alex Wurz said: "I'm proud to have been with my father during the ceremony. He has invented numerous road safety training methods over the past 30 years, which have saved countless lives.

"This award is a great motivation to keep working towards safer roads."

JAGUAR TO SET UP CONNECTED CAR 'LIVING LABORATORY' IN UK

Jaguar Land Rover is investing in a 66-kilometre-long 'living laboratory' project on a stretch of the UK road network to develop new Connected and Autonomous Vehicle (CAV) technologies. The new CAV test corridor, based around the city of Coventry and town of Solihull, will be used to evaluate new systems in real-world driving conditions.

The £5.5m project will create the first route capable of testing both vehicle-to-vehicle and vehicle-to-infrastructure systems on public roads in the UK. New roadside communications equipment will be installed along the route during the three-year project to enable the testing of a fleet of up to 100 connected and highly-automated cars, including five Jaguar Land Rover research vehicles.

This fleet will test a range of different communication technologies that could share information at high speeds between cars, and between cars and roadside infrastructure, including traffic lights and overhead gantries.

Dr Wolfgang Epple, Director of Research and Technology, Jaguar Land Rover, said: "This allows testing of new connected and autonomous vehicle technologies on five types of roads and junctions. Similar research corridors already exist, so this test route is what the UK needs to compete globally.

"The connected and autonomous vehicle features we will be testing will improve road safety, enhance the driving experience, reduce the potential for traffic jams and improve traffic flow."

JLR have spent £5.5million on the analysis.

WRC DRIVERS RECEIVE RED CROSS TRAINING

FIA World Rally Championship (WRC) drivers and co-drivers received first aid training at the Monte Carlo Rally as part of a programme that will enable them to assist injured participants or spectators in the event of an accident during a stage.

The training module has been led by the FIA in partnership with the International Federation of Red Cross and Red Crescent Societies (IFRC) through the Monaco Red Cross. The organisations have been working together since 2014 to create an accredited training scheme for WRC participants.

"It is very important for us," said three-time WRC Champion Sébastien Ogier. "We have done first aid training before, but now it will become more regular. Unless you keep doing these things often, it's easy to forget, so it is so important for us, even though we hope we will never have to use it."

The programme involves a series of practical sessions for all P1 class drivers and co-drivers, which will take place throughout the season. The training will enable them to provide initial care before emergency workers arrive at the scene of an accident.

Ségolène Royal, French Minister of Ecology, recognised GFEI's contribution to COP21

BOOST FOR GLOBAL FUEL ECONOMY DRIVE

The Global Fuel Economy Initiative (GFEI), a partnership of six organisations hosted by the FIA Foundation, was recently showcased as one of the most important actions to reduce emissions from transport at the COP21 Climate Change conference in Paris. Speaking to delegates, Ségolène Royal, French Minister of Ecology, described GFEI as a 'model alliance that should inspire other sectors'.

GFEI announced in Paris that 40 new developing countries are committing to improve fuel economy as part of its 100for50by50 initiative. This brings the number of countries GFEI works with to around 65, in addition to major developed markets, such as the EU and US, which have established fuel standards. This is possible due to significant new funding from the European Commission and FIA Foundation.

GFEI also launched its new 'State of the World' report in Paris, which sets out the latest data on average fuel-economy levels in countries globally, and the progress needed to achieve the GFEI goal of improving average fuel-economy levels by 50 per cent by 2050. Such improvements would result in a saving of 33Gt of CO2 by 2050, equivalent to closing 300 coal-burning power stations.

COP21 provided an opportunity to share these messages with participation in a series of high-level panels including government ministers from Chile, Mauritius, Kenya and Costa Rica. Sheila Watson, Executive Director of GFEI and Director of Environment and Research at the FIA Foundation, emphasised that for fuel economy 'we have the technology, but we need the policy'.

GFEI is recognised as the leading global partnership promoting vehicle efficiency. Following the COP21 agreement on action to limit temperature rises, GFEI will seek to ensure these commitments lead to sustained action to reduce emissions.

NEW CHAIRMAN FOR FIA FOUNDATION

Lord George Robertson has been appointed as Chairman of the FIA Foundation, replacing Tim Keown.

Confirmation of his new role was made at the FIA Foundation Annual Meeting in Paris last December, where he was unanimously elected.

"The mission to make the world a safer place on its roads keeps me involved and motivated," Lord Robertson said. "I look forward to following Tim Keown in the job that he has done and in working with Jean Todt in his new responsibilities as the UN Secretary-General's Special Envoy on Road Safety, as well as all of the Trustees. What we do and what we're involved in, is a noble mission to save lives."

Lord Robertson was the founding Chairman of the Seatbelt Survivors Club, an organisation founded to campaign for compulsory seatbelts in all cars, a founder member of the All-Party Parliamentary Action Committee on Transport Safety, and Chairman of the Commission for Global Road Safety. He has also served as Secretary-General of NATO and in the UK government as Defence Secretary.

The F3 drivers attended Paris training course.

F3 DRIVERS HEAD BACK TO SCHOOL

The FIA recently held the inaugural training course for drivers contesting the FIA Formula 3 European Championship.

The course, which took place in Paris in January, was attended by most of drivers confirmed to race in the championship this year, and will be mandatory for all category rookies going forwards.

Issues such as race procedures, mechanical knowledge, driver safety, anti-doping standards, the international sporting code and the communications structure of the series were covered.

The aim of the course is to ensure drivers are as well-prepared as possible for the challenges of racing at F3 level.

Morgan Caron, FIA Head of Transverse Motor Sport Projects and Manager of the Drivers' Commission, said: "It can have a very negative effect on a young driver if they make the step up to a new category without being ready. It's a big leap from F4 to F3 and conducting a training course like this can play a big role in a young driver's preparation and establish their expectations as they approach the season."

The championship kicks off at the Circuit Paul Ricard in France on 1-3 April with official testing scheduled to take place at Vallelunga at the start of March.

SUBARU CLAIM 61 PER CENT DROP IN ACCIDENTS THROUGH COLLISION AVOIDANCE SYSTEM

Japanese car manufacturer Subaru has released data from a survey of traffic accidents involving its vehicles in its home country showing a 61 per cent reduction in crashes for vehicles equipped with the company's EyeSight collision avoidance technology.

Subaru analysed a range of traffic accident data involving its vehicles from 2010 to 2014, and found that vehicles equipped with EyeSight had 84 per cent fewer rear-end collisions than those without, when measured in terms of accidents per 10,000 vehicles. The adoption of the collision avoidance technology resulted in 62 per cent fewer vehicle-to-vehicle collisions and a 49 per cent reduction in vehicle-to-pedestrian crashes.

The company's system acts as a 'second pair of eyes' for drivers by employing stereo colour camera technology to monitor the road and traffic ahead for potential hazards. Two colour cameras are located either side of the rear view mirror to detect the presence of vehicles, pedestrians, cyclists and other hazards up to 110 metres in front.

The system utilises six technologies to maximise safety: Pre-collision Braking, Pre-collision Throttle Management, Adaptive Cruise Control, Lane Departure & Sway Warning, Pre-collision Steering Assist and Lead Vehicle Start Alert.

EyeSight has made a big safety impact.

AUTO ASKS

QUESTION:

IS MOTOR SPORT MAKING THE MOST OF THE MEDIA?

The international media landscape has undergone a sea change in recent times with a fast-moving digital world impacting on how press and fans are kept informed. Three leading industry figures share their views on how successfully motor sport engages with the media.

The driver

MARK WEBBER

FIA WORLD ENDURANCE CHAMPION

I think motor sport does a decent job in serving the media, but it could do more. I think FOM could do more to broaden Formula One's media reach, unlocking things a bit to get greater exposure, particularly on new media channels and social media.

The F1 paddock is its own little world, but teams are slowly getting themselves out of the 'microbubble' you can fall into when you're there. But there's always room for improvement.

I constantly look at how the Americans do things: in the NFL, baseball and even US motor sport. What can we learn from the way those sports are delivered? Motor sport should constantly be looking at what other sports are up to, what new ideas they have and what new tools they are using.

Motor sport can look poor by comparison. The midweek content on some of the motor sport websites isn't great. Why? Is there enough content? If not, there has to be a way of unlocking good content and delivering it to fans. Having said that, it's tough for media and they aren't always helped by the restrictions of F1.

As passionate professional racers, it's sometimes frustrating that we can't say all we want to. We'd like to say that in a race we had these problems or had certain issues to manage and I think that kind of depth adds flavour to an event. It's depressing that we sometimes can't touch on that. When you have manufacturers involved they want to give the message that the day was smooth. That's how it is. The consumer driving the road car expects that.

I think drivers have to be true to themselves and there is a balance with explaining your profession and still keeping everyone happy. The bottom line is drivers are brands. We are what people relate to. We're a big press dialogue, a big interface for the team because, with all due respect, who wants to listen to a team boss – unless it's a Niki Lauda or a Frank Williams?

By and large, motor sport does a good job. There are some awesome events generally delivered very well. The World Endurance Championship is a good example. It has a few rough edges, but it's healthy and I'm enjoying watching the process. Nobody thinks it's perfect and everyone is open to suggestions for improvement. That's the best way to get motor sport across to fans.

The PR expert

ANDRE DIETZEL

HEAD OF COMMS, VW MOTORSPORT

There's not really much point posing the question as to whether motor sport can be or is useful to the media – it simply has to be. The worlds of sports marketing and the media have changed dramatically in recent years: new content is elbowing its way into the market all the time and is becoming more and more technically diverse. You have to tailor your content to every channel and now it has to work just as well on all platforms, traditional or digital. Established categories such as Formula One are constantly in competition with new sports content that's much more closely based on people's changing media usage behaviour.

At the same time, the content volume continues to increase. Professional productions are up against user-generated content that's often unbeatable in terms of topicality and relevance. If you can make use of both of these worlds, you're at an advantage – and this is something the World Rally Championship has achieved.

The WRC is a tricky format with a multi-day set-up that's hard for some people to grasp, and the entrants are spread over a large geographical area. This makes it less suitable for a typical live TV than football or F1. But the WRC boasts spectacular and diverse imagery that no other motor sport category can offer. Digital media, and in particular social media, represent a huge opportunity for the WRC. Shots that the broadcast cameras miss are taken by fans lining the routes and then shared with the world. Digital communication with teams and drivers is taking rallying's lack of formality into the 21st century. Mobile Internet allows fans to get close to the action day after day after day, wherever they are, and this includes interacting directly with sportspeople on social media.

Motor sport has to serve the media, but the media has changed massively – and continues to. Motor sport must be willing to subject itself to this ongoing process to remain strong enough to keep setting the fans' hearts racing and maintain its status.

The journalist

PINO ALLIEVI

F1 REPORTER, GAZZETTA DELLO SPORT

Just how much help do motor sport journalists get, when it comes to doing their job properly? It's been a topic of discussion over dinner on many an evening, for those whose task it is to explain to the general public what actually goes on at Formula One races, over and above what they can see on television. However, these discussions never seem to produce a definitive answer, as the topic is too fragmented and there are too many sides involved.

If we take the specific case of F1, some big teams are pretty effective and have press officers who understand the specific requirements of the journalists, such as publication deadlines or knowledge of major TV news schedules. But the majority of teams seem to just throw together a PR team, delegating the task of dealing with the media to people who know little of the needs of a journalist and care even less.

In these cases, the head of communications is happy to invite you for a coffee in team hospitality, but doesn't know how to service your needs. As for the team principals, they want to hide from the media and avoid aggravation as much as possible. Then there's the widespread policing of driver interviews, made worse by the fact that virtually no time at all is put aside for them. It's a discouraging policy that has killed spontaneity, with drivers' answers reduced to tired phrases that say nothing. They try to avoid the difficult questions and hide any weak or possibly non-existent personality traits.

Until the nineties, F1 was more accessible and this meant journalists could communicate and inform intelligently throughout the year. That's changed and as a result the sport now has fewer sponsors and less money. An increased presence from TV broadcasters has been a factor in making working practices more formal and restrictive, but this doesn't justify what appears to be an inability or even a resistance to finding a way around the problem.

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Could this be the solution in the quest for improved racing car cockpit safety?

TECH REPORT

Cockpit safety

LINES OF DEFENCE

The FIA has been testing a number of potential solutions to help protect drivers from external objects in Formula One and other open-cockpit championships

TEXT: MARC CUTLER PHOTOGRAPHY: WILL THOM

This is a driver's-eye view of a Formula One wheel assembly hurtling towards him at 225 km/h. At a distance of 20 metres it would hit that driver's helmet in under 0.3 seconds and the outcome would be catastrophic.

Fortunately, this 'driver' is an empty helmet on the track surface of an airfield in South-East England. And the wheel is being fired from a two-metre long pneumatic cannon under strict test conditions.

More importantly, this particular wheel is being deflected over the helmet by a structure that would sit on the front of the monocoque of an open-wheel racing car. The wheel is scraping along a set of intentionally-curved fins that lead the object up and over the driver's helmet.

It is all part of an ongoing pursuit by the FIA and its partners to improve safety for drivers in open-wheel racing cars, particularly from external objects. This project started four years ago but has recently taken on extra momentum following a number of injuries and fatalities in the sport.

"We have tried to accelerate this project in the last 12 months with an aim to have something that we can practically apply on the ▶

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F1 cars for 2017," says FIA safety director Laurent Mekies. "This latest test was set up with that in mind - trying to come out from there with something that we could actually say, 'that's going to be a significant step forward.'"

The tests, which were run by the Global Institute for Motor Sport Safety, the research partner of the FIA Institute, evaluated three potential solutions: a triple-fin on the front of the car; a centre-line roll hoop with three bars that go over the driver; and a halo structure, designed by Mercedes in conjunction with the FIA.

ADDITIONAL FRONTAL PROTECTION

The additional frontal protection (AFP) involves putting a structure towards the front of the car, specifically to protect against objects in the path of the car travelling at high speed.

The first AFP solution consisted of three curved fins on the front surface of the chassis. They fan out, when viewed from above, so from the driver's point of view they appear as three vertical pillars in the lower part of their vision. This kind of solution aims to provide protection during the type of accident suffered by Henry Surtees in Formula Two in 2009, when a detached wheel bounced across the race track into the path of his car, with fatal consequences.

"This first test aims to determine how the rim and tyre respond to the new lower-profile fins," explains Andy Mellor, the lead researcher for the Global Institute on this project. "With this relatively inconspicuous structure we were attempting to impart enough vertical velocity to direct the wheel assembly over the driver's helmet."

This solution was designed specifically to put a very controlled load into the wheel when it impacts the structure just above the nose of the car. It is designed to engage with the wheel at the earliest possible time, to maximise the time duration for imparting the vertical velocity, hence minimising the forces.

A cannon is used to launch an F1 wheel assembly at the cockpit safety solutions

The front edge of the structure is located close to where the nosecone attaches to the front of the chassis. The curvature of the ramp is designed to generate a constant vertical force of around 40 kiloNewtons to deflect the wheel over the driver's helmet.

"With this approach we aim to achieve compatibility with the rim with a design that minimises the reaction loads on the chassis, has the potential to be extremely lightweight and has a low visual impact," says Mellor. "It is designed to work most effectively if the wheel is impacting at a shallow angle but the tests show that even if the wheel impacts the car towards the top of the blades, it can still be deflected over the driver's helmet."

CENTRE-LINE ROLL HOOP

The second concept for testing was the centre-line roll hoop, which aims to offer more complete protection for the driver. It consists of three curved round-section bars that pass above the driver's helmet, from the main hoop behind the seat to the front of the chassis close to where the nose attaches. Each bar is designed to deflect significantly over its entire length, and generate a constant vertical force of 20 kN, (thus 60 kN in total if the wheel engaged with all three bars), to deflect the wheel over the driver's helmet.

During the test the bars work exactly as designed, flexing and redirecting the wheel over the driver.

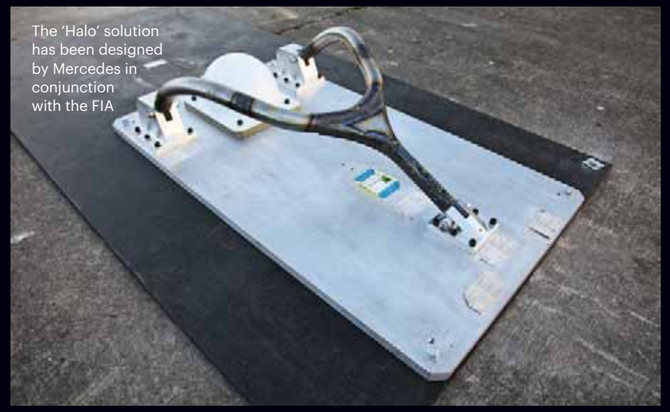
"The big difference here is that the structure extends over the driver's helmet to cover off additional impact positions. This system would also provide protection during the type of fatal accident suffered by Justin Wilson in IndyCar last year," explains Mellor.

For this initial prototype, the bars were made from 20mm diameter steel, but they would be constructed from lightweight composite materials if this concept was taken forward.

"The optimum construction would, likely, be a similar-diameter bundle of uni-directional composite fibres fixed in an expoxy matrix. This structure would be extremely rigid under normal race conditons, but would behave like a cable-car cable during an accident, thus providing a ramp to redirect the wheel over the driver," Mellor says.

The actual materials could be similar to the very high performance fibres used in Formula One wheel tethers.

"During the test the design worked perfectly and the loads measured by the in-wheel data logger were close to those calculated, ensuring there was no fracture damage to the rim," says Mellor.



The 'Halo' solution has been designed by Mercedes in conjunction with the FIA

The Centre-Line Roll Hoop extends over a driver's helmet

The AFP is designed to lift a tyre over a driver's helmet

"WE HAVE RECEIVED GREAT SUPPORT FROM THE F1 TEAMS"

LAURENT MEKIES

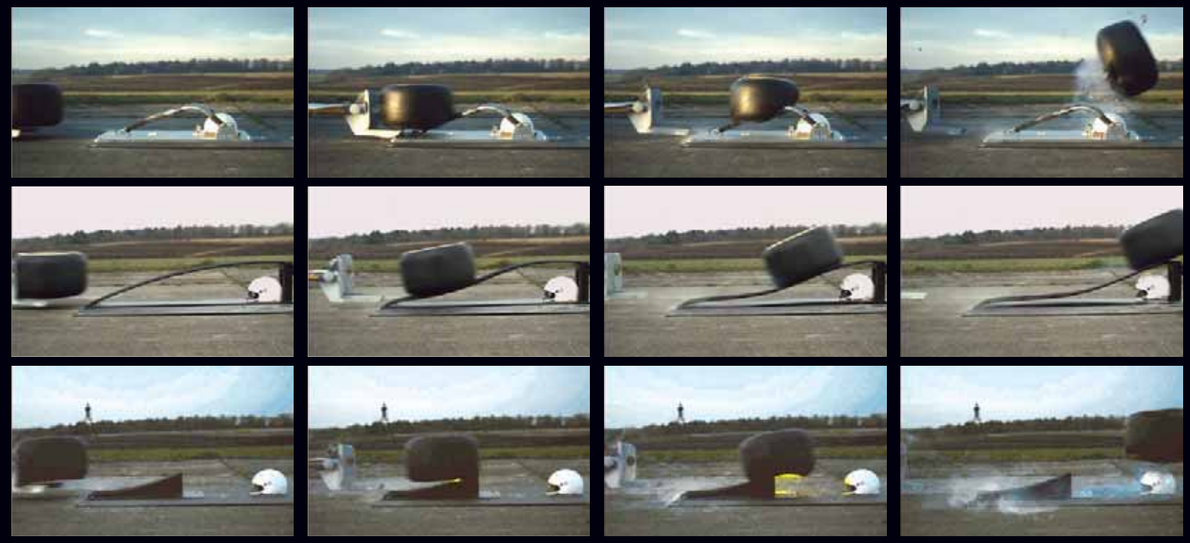
However, while working well for driver protection, this solution has other potential complications; firstly it places the three bars in the driver's forward vision and secondly, it may need to be removed to ensure rapid access during an emergency extrication.

HALO EFFECT

The Mercedes F1 team has been working on a solution that could work from a both safety and chassis-intregation point of view. The design integrates the sloping profile of a centre-line fin with a protective roll bar positioned like a halo in front of the driver.

During the tests, this solution performed extremely well and prevented the wheel assembly from impacting the helmet.

"It's very impressive that although the structure is positioned close to the driver's helmet to provide protection from all angles, it is still able to prevent the wheel from contacting the helmet," says Mellor. "In the very short distance available, a huge amount of energy is absorbed and the wheel is successfully redirected." ▶



Tyres are propelled at 225 km/h during cockpit safety tests

A number of tests were performed on this solution from different angles and heights and it performed well each time. The structure was extremely strong and forced the energy management into the impacting wheel and tyre, deforming the rim in all tests.

This prototype version was made out of steel, but if taken forward it would be optimised using lightweight materials, perhaps adding around 5kg to the weight of the car.

FORMULA FACTORS

With all three solutions working well, other factors come into consideration, such as driver vision, egress and emergency extrication in the event of an accident.

Driver vision is, of course, critical as it is essential that any solution does not introduce an increased risk of accidents occuring.

To this end, the FIA has already performed a number of tests to assess the impact of forward structures on a driver's vision. In August 2013, a forward roll-hoop was fitted to a GP2 Dallara car at Magny-Cours with then-champion Davide Valsecchi at the wheel. The plan was to gain feedback on the viability of placing such a structure in front of the driver's line of sight.

"We need to avoid creating any blind spots as that would introduce an unacceptable additional risk during racing," explains Mellor. "We're looking to achieve a structure that provides a full panorama of forward and sideways binocular-vision, allowing only very small areas of monocular-vision restricted by the structure."

This concept had already been evaluated in simulators at McLaren and Red Bull Racing, and was complemented by the testing in the GP2 machinery.

Valsecchi completed four laps of the circuit with two types of roll-hoop and gave his feedback, which was positive as he did not feel overly hindered during the test. This encouraged the researchers to further pursue the roll-hoop solutions.

For the three solutions in the recent tests, all would pass the driver-vision exam, albeit with some refinement.

In particular, the Halo works well because the only structure in a driver's line of sight is the central part and they are accustomed to strcutures on the centre-line of the car such as fins and sensor tubes. The halo part of the structure is above their normal forward vision.

Another key consideration is egress, or how easy it is for the driver to get out of the car. Again, all of the potential solutions could be configured to ensure appropriate access. The final key consideration is emergency extrication, where the rescue team would be removing a driver from the car. Again, Mellor believes that by working closely with the drivers, teams and medical and rescue experts, appropriate procedures will be put in place

SAFETY STEP

Following the tests, the results were presented by F1 Race Director Charlie Whiting to the drivers and the teams' technical heads. The concepts were received in a positive manner and research will continue to develop the final prototypes, with a view to potential implementation in the 2017 season.

"The good news is that the three structures we tested performed as expected or even better than expected," says Mekies. "On top of that we have received great guidance from Charlie from the beginning of the project, and a lot of support from the teams who provided us with all their calculations and design power, which has made this step forward possible."

The Halo solution has been particularly well-received and is one of the options that has been taken forward. But there is still some work to do. The next step will involve mock-ups of some solutions being placed on current F1 cars during practice sessions to assess their practical viability.

"We are pushing very hard to integrate it as early as possible," says Mekies. "I'm sure it will trigger a few connected research topics, to assess visibility, extrication and some of the other aspects, so I'm expecting some validation testing to be done in the course of the next six months. But we're all trying to make that cut."

In theory, from a regulatory perspective, rules need to be set before 1 March for the following season. But they could still be changed following unanimous approval from the teams or on safety grounds by the FIA.

"The real deadline is the teams' timing to modify their cars accordingly and our capability to assess all the connected issues," adds Mekies. "Design is done very much in advance in F1, therefore if we want to make 2017 it needs to be decided in the next few months. Nobody wants to rush these things but we are all trying to go as fast as possible." ■

AUTO / ISSUE #14

A rally-spec test car dramatically collides with a new safety barrier solution at 110 km/h during tests at Eggebeck Air Base in Germany.

TECH REPORT

Rally safety

HIGH IMPACT

How a simple combination of steel and sand could play a major role in improving competitor safety on closed-road rallies

TEXT: MARC CUTLER PHOTOGRAPHY: BENJAMIN CRAY

The safety cap is filled with sand (above) and fixed to the Armco (left) while the test car is readied for action.

"THE CYLINDER PROVIDES FOUR FUNCTIONS DURING THE IMPACT EVENT"

ANDY MELLOR

The moment of impact as the car hits the safety cap at 110 km/h during the test.

We're standing in a field in the northernmost reaches of Germany as a rally-spec Volkswagen is about to be thrust at 110 km/h into a specially-constructed Armco barrier.

Using a pulley system, the driverless car is shot into the barrier with a dramatic explosion of metal, glass and plastic that is all over in less than two seconds.

The smashed car and buckled barrier do not leave much evidence of safety progress. But it is only when looking back on the slow-motion video of the crash, microsecond by microsecond, that it is clear that this mess is not only the remnants of a highly successful test, but could lead to the implementation of an extremely important addition to safety within rallying.

The test was necessary because rally events take place on public roads – often running in the opposite direction to regular traffic. Many of these highways feature Armco structures that are designed to prevent slow-moving traffic from leaving the road by using metal guards mounted on posts.

While this will protect everyday road users from falling into ditches, they have become a real danger to rally cars, which are at serious risk of the Armco piercing the car into the cockpit and injuring its occupants during a high-speed impact. It was this situation that severely injured Formula One race winner Robert Kubica at the Ronde di Andora rally in February 2011 and fatally wounded Welshman Gareth Roberts, co-driver to World Rally Championship driver Craig Breen, in a similar incident on the eighth stage of the 2012 Targa Florio rally.

In response to these accidents, the Global Institute for Motor Sport Safety, working on behalf of the FIA Institute, is aiming to create a detachable device that is designed specifically to absorb the impact of a crash and, in turn, force an Armco barrier to buckle and bend rather than penetrate the car.

SAFETY CAP

In this test, the car is fired at the Armco installation at 110 km/h and considerable damage is immediately apparent. But the impact has crushed the front end of the car, rather than piercing it, thanks to the experimental barrier protection device. The 0.7 m diameter steel tube stands at just under one metre in height. It weighs 550 kg when filled with sand, which is necessary to increase its overall mass while keeping it deliberately simple and affordable for rally organisers.

Before the test, the cylinder is placed at the end of the Armco barrier ahead of the impending impact. When it makes contact, the front of the car drives the device into the end of the Armco, and the huge forces between the device and the Armco cause the barrier to fold upwards and away from the chassis without penetrating the car. This also avoids any excessive acceleration to the passenger compartment. The violence of the crash leaves the scene unrecognisable, but the safety device has done its job. Had there been a real driver or co-driver inside the cockpit, the acceleration loads would have allowed them to avoid serious injury and walk away into the crisp winter air.

"There is a massive incompatibility between the front of passenger cars and Armco ends that are not protected," explains Andy Mellor, research consultant to the Global Institute.

After Kubica's accident there was an initial project to see what could be done with engineering to make the cars safer. But when the early stages of that research concluded that an unviable amount of protection would have to be integrated within the front of a car, the project switched focus to concentrate on fitting the required protection to the exposed ends of the barriers instead.

"The focus of the study was engineering a mechanism to get the Armco to buckle early enough so that the exposed end didn't penetrate into the car that's just hit it," says Mellor.

To try and create the force needed to cause a barrier to buckle, while ensuring the the excessively-high stresses to the front of the car were avoided, a load-spreading cap was designed before Mellor evolved the concept into a multi-function element – the cylinder – to slow a car. This provides load spreading onto the Armco end and hammers the sharp end of the barrier away from the cockpit.

Mellor explains: "We conducted a number of mathematical simulations to understand how the cylinder configuration could be optimised. The cylinder actually provides four distinct functions during the impact event. Firstly it acts as a momentum transfer device to significantly reduce the speed of the car before it reaches the Armco. The mass was chosen to maximise the reduction in speed over the short time duration of this initial interaction while ensuring safe acceleration levels for the occupants.

"Secondly, it acts as an energy-absorbing device to complement the crash structures engineered into the front of all modern passenger cars. Thirdly, it acts as a load-spreading device to prevent penetration through the front of the car. And finally it acts like a slide hammer to impart the kinetic energy accumulated during the momentum transfer phase directly into the Armco structure. This is what initiates the buckling process."

The cylinder may be placed in front of any barrier with a letterbox-like slot matching the profile of the end of the barrier, thus ensuring it is fully encapsulated as the cylinder moves.

The results of the test showed that the cylinder slowed the car by 36 km/h, from 113 km/h to 77 km/h during the momentum transfer phase, thus reducing the kinetic energy by more than 50 per cent. "Which was exactly as you'd predict, based on the momentum-transfer calculations," says Mellor.

TURNING POINT

There are over 50 major rallying events a year in the most fervent countries such as UK, Italy and France. So there are potentially thousands of corners that would benefit from the installation of this type of device. It was therefore vital that any potential safety solution was also cost-effective so there would be no barrier, be it literal or figurative, to their widespread use.

"At the start we understood that cost and logistics were major factors and we set a target of €100 for the installed product. Any more expensive it could become cost prohibitive," says Mellor.

Every rally organiser could potentially need dozens of cylinders to protect the barriers on each stage of their event, so the study used commercially-available steel tubing that was built to the desired specifications to both slow the momentum of a car and force the Armco to buckle when the impact occurs.

Although the cylinder worked successfully in that it performed all four intended functions in a very controlled manner, there is still work to be done before it becomes a finished product. After the fourth phase, as the Armco buckled, the vertical motion was not sufficiently controlled by gravity alone and the resulting forces caused the cylinder to lift off the ground.

"It would be far more desirable to keep the cyclinder on the ground and this might be a very simple fix," says Mellor. "If we seal the lower end, possibly by welding a cap onto the bottom, then when car impacts and crushes the cylinder, some of the sand will be forced upwards out of the top of the cylinder, thus generating thrust downwards so it will inherently remain on the ground."

This would reduce the risk of damaging the windscreen of a car during the final part of the impact, as the car's speed is finally brought down to zero, and may also slightly improve the response during the first two phases of the event.

Once the redesign is complete, the solution would initially be available to all WRC events, after which it could be offered to the ASNs and National rally organisers. As Mellor says: "There's potential to implement these devices in significant numbers." ■

COVER STORY

Road safety

HIGH-LEVEL SUPPORT

Less than a year after becoming the UN Special Envoy for Road Safety, FIA President Jean Todt has secured support from Pope Francis and business leaders at the World Economic Forum in Davos

TEXT: KATE WALKER

FIA President Jean Todt had an audience with Pope Francis during a visit to Rome in January.

Since being appointed United Nation Secretary-General's Special Envoy for Road Safety in April 2015, FIA President Jean Todt has made it his mission to make road safety a global talking point. During 10 short days in January, Todt succeeded at the highest levels, bringing road safety to Pope and Caesar via a Papal audience and a series of meetings at the World Economic Forum in Davos.

"As I've said, I think that the role of Special Envoy is about crystallising focus around road safety," Todt said following his UN appointment. "In meetings with political leaders I have always emphasised that not only is the human cost of road accidents unacceptable but the financial burden on their countries – where the cost of dealing with the effects often amounts to as much as 1-3 per cent GDP – is something that can be avoided if the right measures are taken.

"However, I know that advocacy by individuals, NGOs and concerned agencies often falls on deaf ears. Therefore, I see my mission as one of unification," he added. "I wish to bring together all stakeholders to lobby for change in a focused, strategic way, speaking with one voice at the highest levels globally. An important part of that message and my mandate will be to encourage countries to sign up to agreed UN road safety conventions, for example on minimum vehicle safety regulations, respect and compliance with internationally harmonised traffic rules. The adoption of these common standards can make a really significant impact towards saving lives."

PAPAL SUPPORT FOR ROAD SAFETY CAMPAIGN

January saw Todt lead a special delegation comprised of Michelle Yeoh, actress and an FIA Ambassador for Road Safety, ▶

Todt wants to make road safety a talking point on a global level.

Christian Friis Bach, Executive Secretary of the United Nations Economic Commission for Europe (UNECE) and Angelo Sticchi Damiani, President of the Automobile Club d'Italia (ACI) to Rome for a private audience with His Holiness Pope Francis. Road safety was the only item on the agenda.

"The ACI has been very happy to offer its full support for the organisation of the private audience with the Holy Father, which was a special opportunity to illustrate to Pope Francis the global scourge of road accidents and its impact in terms of social and health effects worldwide," Damiani told AUTO. "The Holy Father was deeply touched by the information received during the audience. He agreed on the need to increase global effort towards safer and more responsible mobility and on the respect of traffic regulations as being a key factor for the protection of road users.

"The strategic importance of this kind of advocacy cannot be overstated," Damiani continued. "The statistical data shows that reducing the impact of road accidents is no easy task and therefore road safety should become a major issue in the agenda of our governments and global institutions. Of course, the support of the Holy Father offers highly influential encouragement for the cause of road safety and is most auspicious for the success of our efforts."

According to those present in Rome, Todt spoke passionately about the need to foster cooperation between governments and communities in the fight to improve road safety standards around the world before delivering a special screening of "Save Kids' Lives", a dramatic short film by Luc Besson. His Holiness was said to have been moved by the film, and showed his support for the United Nations' campaign by signing the Child Declaration on Road Safety.

"We warmly thank His Holiness for his time today to discuss road safety," Todt said after the meeting. "Road crashes are one of the most pressing global challenges of our time. They disproportionately affect the poorest countries and the most vulnerable in our communities. Pope Francis' support of the #SaveKidsLives campaign will help raise awareness of the 500 children who lose their lives every day on the world's road and help us spread the message that this tragedy can be prevented.

"I also wish to thank President Sticchi Damiani, who facilitated this audience at the Holy See and everyone else who made it possible, especially Archbishop Georg Gänswein," he added.

"The first thing that struck me was the solemnity of the occasion, which came not just from the institution which Pope Francis represents, but also from his impressive personality. He listened attentively and was very kind and courteous throughout the meeting. We also touched on the subject of Argentina and of the drivers from the Pope's birthplace who made that country so

Pope Francis pledged his support to improving road safety.

"GOVERNMENTS NEED TO TAKE THE ISSUE OF ROAD SAFETY SERIOUSLY AND SEE IT AS A PANDEMIC"

FIA PRESIDENT JEAN TODT

important on the motor sport stage, including Juan Manuel Fangio and Carlos Reutemann. Then the conversation turned to someone very close to my heart, Michael Schumacher. This created a special mood and I decided to ask Pope Francis if he would consider dedicating a prayer to Michael: he thought about it for a few seconds and then said that he would. It was a gesture I will never forget."

Also in the delegation was Christian Friis Bach, UNECE Executive Secretary. "We know of the Holy Father's strong commitment to addressing problems of inequality and to addressing problems of poverty, and this is a sign of poverty," Bach told Vatican Radio. "This is still a problem in rich countries, but it's a severe, serious problem in poor countries. So once again, poor people and poor children around in the world are those who are most vulnerable, because countries have not invested in safe cars; they have not invested in safe roads; they have not educated their drivers to drive safely and that they should not drink and drive."

FIRST MEETING OF FIA HIGH LEVEL ROAD SAFETY PANEL

After Rome it was on to Switzerland for the winter meeting of the World Economic Forum, in Davos. Each winter 2,500 of the world's business leaders, academics, politicians, religious leaders and journalists meet to discuss matters of global concern. There could be no better place for the first meeting of the FIA's High Level Panel for Road Safety, launched by the Secretary-General of the UN, Ban Ki-moon last November in New York.

"We want to gain more visibility for this problem," Todt told AFP in Davos, adding that part of the solution could be found in the more widespread use of existing safety technologies. "But the problem is that very few people in the developing world have access to those measures. The average age of a car in Europe is nine years. In the developing world it is 30 to 60 years. Some countries have never heard about seat belts — so we have a two-speed world. Human behaviour is responsible for 90 per cent of road fatalities.

"I want people and governments to take this issue seriously and see it as pandemic, like a health issue."

With support from international business chiefs, religious and community leaders, and global development bosses, road safety is currently high on the public agenda. Davos delegates have discussed a road map for the year ahead, and work to reach the 2020 targets set for the United Nations Decade of Action for Road Safety continues.

Much remains to be done but we are on the right road. ■

Jean Todt addresses the first meeting of the FIA High Level Panel for Road Safety.

Muhtar Kent, Cola-Cola CEO.

Bertrand Badré, World Bank Group CFO and Managing Director.

Elhadj As Sy, International Federation of Red Cross Secretary General.

Luis Alberto Moreno, IADB, with HLP spokesperson Michelle Yeoh.

AUTO FOCUS

FIA World Touring Car Championship

DOING IT THE HARD WAY

José Maria Lopez has swept all before him in winning the past two FIA World Touring Car Championships, but his motor sport career has been far from straightforward, as he explains to AUTO

TEXT: JUSTIN HYNES

AUTO / ISSUE #14

There's a photo of José Maria Lopez, which you'll see on your right, showing the Argentinian clambering out of his Citroen C-Elysée at Thailand's Buriram Circuit Last November. Fists clenched, tears about to stream down his face as the realisation that a second consecutive World Touring Car Championship title is his, it's an image that somehow encapsulates not just his 2015 triumph, but also a will to overcome adversity that has characterised Lopez's racing career since his earliest days on the international stage.

But that comes later. First, there's his second WTCC title to review. The bare stats – 10 wins and nine other podiums from 24 races – suggest that Lopez's progress to his second world crown was more gambolling sprint than forced march, but the 32-year-old is typically speedy in quashing that notion.

"I think I got very emotional [in Thailand] because it was a really hard year in terms of competition," he says. "I had to push a lot and I had to... well, I'm Latin, so I thought of my family. A lot of things go through your mind at that moment because it's something so important. Then you relax, and of course the emotions come.

"I think last year [after winning the title at the first time of asking in 2014] I had already a little bit more pressure because of being champion," he adds. "I was looking at the press coverage and Yvan [Muller, his four-time WTCC Champion team-mate] was kind of saying that my first year was a bit lucky, and that he had a lot at DNFs. I had to show that it was not just lucky.

"But the competition was harder. My rivals worked so hard. I saw Yvan and Sebastian [Loeb, nine-time World Rally Champion] pushing so much harder. I knew it was going to be more difficult. And it was; it was a much harder year for me."

Lopez's season start belied that notion as he rattled off four wins and three other podium finishes in the first eight races to open up a 50-point gap to then closest rival Loeb after the championship's triumphant return to the historic Nurburgring Nordschleife in May.

It looked like Lopez would simply stretch away, but that was without reckoning on Muller's dogged determination. Lopez admits he may have let his 50-point comfort zone dull the senses a little.

"I think after the sixth or seventh race of the season and I was a little bit more relaxed, maybe too much," he says. "Yvan won in Russia and in Slovakia and he caught up a little bit on the championship. I saw that if I didn't keep pushing, he would really come back strong."

For Lopez the defining moment of the season came at France's Paul Ricard circuit, where he rediscovered the pace he felt had been lacking at Moscow Raceway and the Slovakia Ring.

"I was slow in Moscow, so slow!" he laments. "Then I had a jump-start penalty in the second race in Moscow and suddenly Yvan was catching me [in the standings]. We went to Ricard and I qualified third. It was looking not so good again. In the second race, I started from the back of the grid and I had a little bit of an incident with Tiago Monteiro, but in I ended up winning the race. Yvan finished only fourth and after that I think that was the turning point. That race was very important in the championship."

The win in France signalled the end of Lopez's mini-slump and over the next four rounds he reprised his season-opening form, taking four wins and two podiums to seal the title in Thailand before claiming a final win of the season at the last round in Qatar.

That determination not to let opportunity slip harks back, as mentioned, to Lopez's earliest days in international motor sport.

After clinching title number two, Lopez's emotion was obvious.

After early success in karting in Argentina, Lopez moved to Europe and rose through the ranks to a position in Renault's junior programme, being groomed for Formula One. His was a gilded ascent, but one that all too quickly turned to base metal.

"My last two years in single-seaters in Europe were really tough," he recalls of his time in GP2 as a Renault protégé. "I had a lot of pressure from the head of the Renault Driver Development programme. They always said: 'You have to win. You have to win.' But somehow... already at the beginning of the season I knew I was not going to. Super Nova, the team I was with, wasn't a winning team anymore, and a few years later closed down. I knew I had to win to get to F1 ,but I knew also that it would be almost impossible.

"So the pressure was immense and it affected my enjoyment of racing. Getting in the car was a lot of pressure. I couldn't handle it. I don't blame the team. I made a lot of mistakes," he adds. "I was young. I was kind of lost. The combination of all those pressures made me lose my way."

DISCOVERING TOURING CARS

Dropped by the Renault programme at the end of 2006, Lopez, disillusioned with racing, retreated to Argentina.

"It happens to a lot of drivers, talented drivers, that at 22 or 23 you're finished. You spend more than half your life racing and suddenly... it's over. It happened to me. You either go home or you have nothing. I arrived in my country and nobody knew me. At that moment I didn't want to continue. It was so disappointing. After four years at Renault, being so close to F1... it was very difficult.

"But I think the most important thing was the support of the family," he adds. "I had a lot of support from my parents, but I also had a friend who had a team in Argentina who really pushed me."

That friend was Victor Rosso, an ex-racer who had competed in Europe in the early 1980s, sometimes outqualifying Ayrton Senna. Rosso eventually returned to Argentina to become a team owner in the country's hugely popular TC2000 touring car series, where he encouraged Lopez to get back behind the wheel.

"Going back to Argentina gave me a love for racing again. I started to enjoy it again. I got back the confidence in myself," he says. "I spent six months at home and then Victor came to se me. He said: 'You need to be racing. You cannot just sit at home.' He convinced me and looked out for me for the rest of the season.

"I did the final races of the 2007 season. I started to enjoy it and I began to see it from another point of view. I won my sixth race. ▶

"I HAD TO SHOW THAT MY FIRST TITLE WASN'T JUST LUCKY"

JOSÉ MARIA LOPEZ

Lopez won at the 2014 and '15 season finales in Macau (below) and Qatar (above).

"I COULDNT GIVE UP THE CITROEN CHANCE, SO I TESTED WITH JET LAG"

JOSÉ MARIA LOPEZ

Lopez shared GP2 podiums with stars of the future such as Lewis Hamilton (centre).

Then in 2008 and 2009, I won the title. It was a very good for me."

In 2009 Lopez was in the running for titles in three championships in his native country. So effortless was his rise back to the top domestically that Rosso once again began pressing the then 26-year-old to give Europe another try.

"Victor was saying 'you need to go back. You are really strong. I think you need a chance.' They started working with my father on a project and surprisingly it gave me the opportunity of a possibly to be in F1 again. I said, 'why not? I need to try it.'"

Unfortunately for Lopez, that project turned out to be the USF1 team, a haphazard attempt to bring an American team back to grand prix racing during a period when the sport was flirting with budget caps and actively trying to encourage low-cost entrants.

Lopez signed a contract and was even announced as a race driver for the squad for the 2010 World Championship season. Then, all of a sudden, everything went a quiet.

F1 DREAMS IN TATTERS... AGAIN

"It was very painful. We were working really hard and we put a lot of effort into trying to get the sponsorship money raised in a country where obtaining sponsorship is not really easy," he recalls. "Myself, I didn't see it coming. Obviously when I signed, I put my effort in the physical training because it had been a long time since I'd jumped into an F1 car. And that was my focus; my one and only focus. I didn't see everything going wrong.

"I was in training and one day I received a call. I was told that everything had become a bit complicated with the arrangement, so we went to England. We tried to do everything we could but in the end it just wasn't happening. The team broke. It was another really tough moment for my career."

Once again Lopez slipped back into the arms of national competition, but once again, his father refused to accept defeat.

"My father never lost faith and he always would say things like, 'I really enjoy you being here but I think you are more from Europe. You're not really a 100 per cent fit in the national championships." By 2012 he was national champion again, this time in the new 'Super' TC2000 series, and the following year the tantalising prospect of a guest drive at the Argentinian round of the World Touring Car Championship arose. Lopez, in the midst of a 42-race programme, reluctantly accepted.

"I went with no expectations, to race a BMW," he says. "I don't think anyone had any expectations, because the car and the team [Wiechers-Sport] were not winners. But somehow I ended up winning the second race. It was an amazing weekend. Honestly, if I tried a million times to do it again, it would be impossible. But it worked and I won. Everything changed after that."

Soon after the race, Citroen made contact, inviting Lopez to test with an eye to fielding a third car in the 2014 WTCC campaign.

"I did my first test in Valencia and it went well. Then in the end of November they contacted me again to test at Monza," he recalls. "It was the most important test for me because I did very well. I think I managed to be quicker than Yvan, which was amazing.

"There are a few things that people don't know about that test, though," he laughs. "I was racing in Argentina and fighting again for the championship. I couldn't really give up that chance, so for the two tests I left on Monday from Argentina and I arrived on Tuesday. I tested on Wednesday with all the jet lag and everything, and by Thursday I was back on the plane and heading back to race at home. I was destroyed. But it worked out: destiny and a lot of luck."

The rest is history. Lopez won on his Citroen WTCC debut in Morocco, and with a further nine wins across the 2014 season, went on to become the first Argentinian FIA world champion since Juan Manuel Fangio claimed his fifth F1 title in 1957.

This year, then, brings the possibility of a third consecutive crown, a feat only achieved in the championship's past by Muller and Britain's Andy Priaulx. However, with Volvo entering the championship, Honda running a third factory driver and more weight penalties to shoulder due to his Citroen team's huge success, Lopez believes the challenge will be extreme.

"I would not say that afraid is the word, because of course we are not afraid. But we are very cautious because we know it's going to be very tough," he says. "First of all we have 80 kilos of weight, which is not a small thing. Last year, we started with 60, and our competitiors start with zero.

"In the last races of last year we were dominating, but not by more than half a second. So with the weight penalty it's going to be very tough because obviously the competition will improve. Honda will be a threat, especially with Rob Huff, who I consider to be one of the best drivers. Volvo will be a threat. They have done things in the proper way. They started to develop their car a long time ago, so I see them as strong competition. Overall, I think people shouldn't expect Citroën to be in the four at the start of the season."

And even if Lopez is confident that his team will overcome the weight penalty, he is expecting an even sterner test from his sole team-mate this season – Muller.

"Having Yvan next to me is always tough, because even if I've beaten him before, I know he can always strike back. I see how he works and I see how competitive he is. He's still in great shape. I don't see Yvan slowing down. It will be hard."

For Lopez though, the hardship is inevitable. After all it's been that way his whole career and he wouldn't have it any other way.

"I'm very motivated," he says with the kind of firmness you might expect. "I think it's going to be a really tough season, but it's still the dream, isn't it? You have to go for it." ■

Volvo drivers Björk and Ekblom have been busy racking up the test miles aboard the new S60.

AUTO FOCUS

FIA World Touring Car Championship

POLE STAR RISING

Volvo makes a full-time return to international motor sport in the FIA World Touring Car Championship in 2016, and its key players believe a considered approach will in due course put the firm in a title-winning position

TEXT: JUSTIN HYNES

Ask Alexander Murdzevski Schedvin, motor sport chief at Volvo's performance division Polestar, to outline his expectations for the Swedish firm's first full season on the global stage racing for five years, and the response is loaded with a directness that could be considered almost stereotypically Scandinavian.

"Usually, when you try to devise a reasonable target, you look historically at what has happened with different manufacturers in a series," he says of the company's entry into this year's FIA World Touring Car Championship. "In the WTCC and ETCC most of the successful teams have raced with three to five cars for four to eight years and have won the title two or three times.

"What does that mean? In the first year we have to catch up to Citroën, Honda and Lada, as they have raced with the current regulations for two years already and then if you do another 250 laps on the same track, through the same corners, you should be winning," he adds. "We would give ourselves two years to be on the podium often enough to challenge for the championship."

The Polestar boss's map to victory might appear almost glibly straightforward but, Schedvin's studied pragmatism is a reflection of Volvo's methodical approach to its tilt at world championship racing glory – a programme that stretches back almost five years, as Christian Dahl, head of Cyan Racing, the team charged with running Polestar's assault on the championship, explains.

"It's has been a long time in development," Dahl says. "We did a season in 2011 with a Volvo C30, which was an evaluation season, to look at the championship, the cars and the competition and hopefully to do a continuous programme after that.

"Unfortunately it was at the time when the ownership of Volvo was changing from Ford to Geely, so we lost the continuity. But that evaluation was good and we knew we wanted to do it in the future, so [Volvo's] motor sport working group always had an eye on it.

"However, in 2013 we took the decision internally to start looking at the new regulations the FIA introduced," he adds. "Everyone thought it would be a good chance to enter the WTCC early in the new technical-regulations cycle. So in late 2013 we started developing a car in CAD. We began building it in late 2014 and started testing in mid-'15. It's been two years in the making."

The plans solidified into a full challenge last autumn. After six years as Volvo's performance partner, Polestar was acquired by Volvo, with Dahl handing over the performance arm while retaining the motor sport team (rebranded as Cyan Racing) at the core of the operation. The commitment to re-enter the WTCC was also made.

For both Dahl and Schedvin, the decision was a straightforward continuation of the work already undertaken, but also the only obvious marketing solution for the manufacturer.

"When you look at the cars we are going base our performance offer on – mid-sized family car, four cylinders – and you start looking into where there is an internationally-recognised, easily communicable platform, the only answer for us was the WTCC," Schedvin explains. "You could perhaps race in the UK with some alterations, but you are still involved in a national championship and that's not something that you can easily translate to a customer in China. But everybody understands the concept of a world champion. So it had to be a world championship with the regulations based on technology that fits the products we are going to offer. There's only the WTCC.

"When the regulations changed, making the car much sportier, if you can say that – bigger wheels, wider body, faster, looks meaner – all of this made sense to us. If we had created our own ideal championship, with no limitation, we would have ended up with something very similar to what the WTCC is today."

MORE CARS LIKELY IN FUTURE SEASONS

Dahl agrees, adding: "In other series there are so many standard parts used that it's generic for everyone, but in the WTCC you develop your car and compete against other developing teams and other manufacturers. For me, as a racer, that's fantastic."

However, while the preparation has been thorough (WTCC champion José Maria Lopez says: "they have done things properly, they are strong "), the real challenge will come when Polestar's S60 cars begin to set times against their on-track rivals.

"You have to have respect for what the other manufacturers are doing in the championship and Citroën have been fantastic for the past couple of years; they've raised the game," Dahl admits. "Also [at time of writing] we haven't been on a race track where there has been any significant racing or testing with other WTCC cars. However, there are numbers we want to meet in terms of weight distribution, overall weight, horsepower, torque, and I like to think we are reaching our targets. But the level of competition is really high so whether we've done enough for sixth place in qualifying at the first race - or more - is very difficult to decide at this stage."

Charged with making the most of those figure are the team's two drivers, Thed Björk and Fredrik Ekblom. Both step up from the Swedish Touring Car Championship with Polestar and each has been involved in the development of the S60 TC1 car. Dahl believes this continuity will be key to the further development of the car.

Cyan boss Christian Dahl thinks podiums, or even a win, could be possible this year.

> "I'VE WORKED MY WHOLE LIFE TO GET IN A PROGRAMME LIKE THIS "
> THED BJÖRK, DRIVER

"In terms of marketing, maybe it might have been better to have drivers from countries where Volvo sells more cars, but we have a great understanding with Polestar and were able to choose drivers 100 per cent on performance and the relationship to the team.

"We have been very open that we want to run more cars in the future as you have to have more than two cars to be really competitive in the WTCC," he adds. "But first you have to have a good car, so for the development phase the continuity with the drivers is really good for us. We trust in the drivers we have chosen – they know us and we know them. We can hit the ground running because all of that is already established."

Ekblom, a four-time touring car champion in Scandinavia, agrees. "The team is about continuity and many of the key people have been there since it started. I think you'll see some new drivers in the future because if we can make this car competitive, they [Polestar] will add more cars. For now it's Thed and me. Can we do the job? It all comes down to us as drivers. You have to come up with the results yourself when you're on the racetrack. If you don't, they will take someone else pretty quickly!"

Both, though, are determined to grab the opportunity to test their skills at the highest level of touring-car racing.

"When I was really young, I wanted to go to Formula One like everybody else," says Bjork, who last year added a third consecutive Scandinavian Touring Car Championship trophy to his cabinet. "But I didn't manage to go all the way. However, when I arrived at Volvo with Polestar four years ago, I connected really well with everyone at the team. I found new ways to work and to be able to go to the WTCC with them is like a dream.

"I've been working all my life to try to get into a programme like this, and now finally I've done it," he adds. "There are so few projects like this, I would say, as a Swedish driver that you can join. It's like getting to F1. This is the same for me. It's the same feeling."

The feeling will intensify when the season gets underway later this month, which neatly brings the conversation, once again, to expectations, and this time it's Dahl who brings the pragmatism.

"It's always easy to talk in terms of top fives or podiums or wins, but we have a multi-year programme and the most important thing is to get a stable base, make everything reliable so you don't have to chase any technical problems, and then start developing the car for the '17 season as quickly as possible," says the Cyan Racing boss.

"Hopefully we'll get a few podiums at the end of the year and even a win if the reverse-grid and qualifying system works for us. But in the second year we must start to win races out of our own speed, not relying on any reverse grid or anything like that. In 2017 I'd like to win races and then to fight for the championship."

Straightforward, considered and ultimately standard-bearing – ain't that just like a Volvo. ■

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AUTO FOCUS

Formula One

FACTORY FORMULA

As automotive giant Renault re-enters Formula One as a constructor, AUTO looks back at the history of manufacturers in grand prix racing and how they have shaped the landscape of the sport

TEXT: MARK HUGHES

Car manufacturers and motor racing have a star-crossed history. The sport was invented by the manufacturers but eventually came to have a life force independent of them. The history of grand prix racing is criss-crossed by big factory involvement, moving in and out of the sport as ambition and financial necessity have tugged alternately, often leaving a turbulent wake behind.

Motor racing was invented by car manufacturers late in the 19th century to prove the speed and reliability of the new-fangled motor car. By the time of the first grand prix in 1906, the sport was being used by the manufacturers to prove their cars were better than those of their market place rivals – by beating them on track. Technology advanced at breakneck pace and grand prix racing went from strength to strength. Then, in 1909, it simply fell out of existence.

The sport had just experienced a mass manufacturer pull-out in the wake of an economic crisis. Worse even than that, the manufacturers made a pact with each other that they would not re-enter the sport on pain of the loss of a substantial bond they each submitted. Not until 1912 was proper grand prix racing re-established as the factories returned – and again it flourished. The First World War brought further technology advances and once ▶

Renault will this month return to the F1 grid as a constructor for the first time since 2011.

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racing re-emerged these were used by the manufacturers in making their cars yet faster. By 1924 factory teams from Alfa Romeo, Bugatti, Delage, Fiat, Mercedes and Sunbeam were battling it out on the track and a classic season unfolded. Yet just two years later, the French Grand Prix had a grid of just three cars, all of them Bugattis, with only one of them running at the end – the absolute competitive nadir of GP racing. Again, a worldwide economic crisis and a slump in car sales had taken a heavy toll on what had been an apparently healthy sport over a frighteningly short period of time.

For the second time in the sport's short history it had become apparent that something so dependent upon road-car manufacturers was set to follow a classic boom-and-bust cycle. But what happened next was revelatory: in the period 1928-33 grand prix racing, largely bereft of the manufacturers, took on a life of its own.

The way forward in mitigating the apparent fickleness of the car makers had become clear with a couple of key developments: 1) the new wave of permanent circuits created in the early 1920s were replacing the traditional public road layouts on which important races had previously been held, meaning that spectators could be charged an entry fee for the first time. In short, there was money to be made. 2) An increasing number of private entrants had been

Zborowski was the first non-manufacturer entrant in a GP.

Silver Arrows swept all before them in the '30s.

Manufacturers such as Ferrari stablised F1 in its early days.

Renault arrived in 1977 and brought turbo technology.

Brabham's 1983 title came with factory BMW turbo power.

Honda quit F1 due to the 2008 financial crash.

AUTO FOCUS

taking part in the lesser events outside official grands prix. Up until 1924 only factory entries were accepted for official grands prix, but race organisers at the new enclosed autodromes were pushing for independent entries to be accepted to bolster the fields. The first of these was Count Louis Zborowski, who participated in the 1924 French Grand Prix at the wheel of his own 1923 Miller Indycar.

Following the withdrawal of Delage, Talbot and Fiat at the end of 1927, the governing body devised a new, much looser technical formula with the aim of making grand prix participation more accessible to the new wave of non-factory teams that were proliferating in lesser events, existing on prize money offered by organisers, now that the latter could charge spectators. A new breed of independent teams came into existence, with contributions from wealthy pay drivers and component suppliers, who could advertise their part in any success. Scuderia Ferrari – using old hardware supplied by Alfa Romeo – sprung into existence in this way. Bugatti became a specialist manufacturer of racing cars that were sold to anyone who wanted to buy them. Its Type 35 and its derivatives went on to become the backbone of grand prix racing in the period from 1928-33. Emergent manufacturer Maserati fulfilled a similar role on a smaller scale. Emilio Materassi bought from Talbot its 1927 cars and campaigned them under his Scuderia Materassi banner. Several drivers became independents, building up their reputations to become 'guns for hire' to teams and organisers.

A whole new generation of racers emerged, utilising previous technology, but with a hard-hitting racers' edge. Without the engineering innovation manufacturers could draw on it was a time of technical stagnation but competitive intensity that established a brilliant new generation of drivers, with Tazio Nuvolari and Achille Varzi in its vanguard. The drivers became the stars and for the first time the teams for which they drove became almost incidental to the public. Previously, even the most brilliant drivers remained in the employ of the big manufacturers so that Pietro Bordino, for example – widely regarded as the greatest of the early-20s – had to sit out whole seasons in which his employer Fiat did not take part.

The now familiar multiple-event racing calendar evolved during this time, as more races meant more income for these specialist teams – which now relied upon the sport for their existence. It marked a crucial distinction between them and the factory teams. Because these independents would race on regardless, the sport gained a resilience its previously lacked.

Factory teams wouldn't remain absent for long, however. The Nazi propaganda programme of the '30s ensured the return – on the most awe-inspiring scale – of manufacturers participation, in the form of Mercedes and Auto Union. A breathtaking period of grand prix racing and engineering novelty played out between 1934-39 as they unleashed massive resources in their bid to beat each other. The rivalry moved technology into previously undreamed of realms and the speed of the cars exponentially increased from the 1920s-based technology of the 'Bugatti era'. But the specialists continued to survive, albeit in a lower-profile role. Maserati and Alfa Romeo returned to the fray, but were outclassed by the superior resources of the German teams and subsequently concentrated on the smaller voiturette category. When, following WWII, this became the new Formula One, so the 1930s Alfas and Maseratis – together with the new cars of Ferrari, which had become a fully-fledged constructor – formed the backbone of the sport.

NEW ERA, NEW ORDER

Using developments of its pre-war voiturette car, Alfa Romeo dominated the first two years of the newly-inaugurated world championship in 1950-51, but its eventual withdrawal left the sport with a familiar dilemma. Between Alfa's pull-out and the return of Mercedes (plus Lancia) in 1954, Ferrari dominated. Mercedes wiped the floor with the opposition for two seasons before the Le Mans disaster of 1955 saw it back away from top level racing for more than four decades. Lancia had a car potentially as fast or faster, but was struggling financially and pulled out at much the same time, handing its cars to Ferrari, which won the 1956 championship.

Ferrari and Maserati (the latter soon to fall by the wayside) were now a halfway house between the factory teams and the independents, which continued to fill the grids as the manufacturers stayed away from F1 – as they would do for over a decade. It was only the accidental confluence of circumstances in post-war Britain that came to save F1 from a perpetual one-sided Ferrari contest.

The establishment of the post-war Formula 500 (subsequently F3) category in Britain for motorcycle-engined cars led to the fashion of mounting the engines at the rear (so that the chain drive to the rear wheels was short). The dominant builder of these little cars, Cooper, established its business by supplying these mid-engined machines, constructed using bought-in components from wherever they could be sourced. So the 'garagiste' breed was created and in time Cooper came to apply this blueprint to F1, its mid-engined cars winning Jack Brabham the 1959 and '60 world titles. Others quickly followed Cooper's example, most notably Lotus. They – and subsequently Brabham, McLaren and a whole host of others in similar vein – took the Cooper formula of creating a highly specialised car with bought-in engines and gearboxes and improved upon it. Whereas in 1928-33 racing had flourished without the manufacturers through independent teams racing largely obsolete machinery, this time it did so with specialised teams that created their own cars with real innovation that advanced speeds just as rapidly as in the manufacturer eras. Climax and subsequently Cosworth supplied competitive and affordable engines for these teams – changing the complexion of F1. It became a technically specialised endeavour, one in which manufacturers could no longer instantly dominate. Honda joined in 1964 but left, bloodied, after five years of giving best to the garagistes (as Enzo Ferrari contemptuously referred to them).

As the specialists perfected their art over the following decade, it would take a technological leap from a manufacturer to next upset the status quo. Attracted by F1's televisually enhanced profile, Renault in 1977 launched a new era of factory innovation, and competitiveness, with turbocharging. This potentially unbalanced the competitive equilibrium the sport had enjoyed in its factory-free era. Here was an expensive new technology – out of the competence or financial reach of the small specialist teams – with a potentially massive advantage, if ever it could be made reliable. The result though was a rush to compete as other manufacturers such as BMW, Alfa Romeo and Honda saw the publicity value of entry (if in some cases they arrived solely as engine suppliers).

As the governing body fought for control with the architect of F1's commercial success – Bernie Ecclestone – so the fault line of conflicting interests divided the sport, essentially into manufacturers versus independents. The manufacturers did not choose to create the turmoil, but their presence – and the threat they represented to the existence of those relying upon the sport – did just that. Finally, a peaceful solution was found. Manufacturers supplied their turbo engines to existing specialised teams and they succeeded as partners (Brabham-BMW, McLaren-Porsche, Williams-Honda, McLaren-Honda). Even as the turbocharged engine was regulated out of F1 existence, the manufacturers stayed, enjoying the profile of the sport's ever-expanding reach. Yet more came - Ford, Mercedes, Toyota, Peugeot – and by the late '90s it wasn't a question of whether car manufacturers could afford F1 but whether they could afford to stay away. The marketing value placed by the manufacturers upon F1 participation kept expanding and so the sums invested into the teams grew exponentially. From the late '90s to the mid-2000s, many teams quadrupled in size, typically from around 150-200 to 800-1,000 employees, with facilities to match. All of which made the sport vulnerable.

One day the money taps would be turned off, leaving the teams in partnership with the manufacturers far too big. The time of reckoning came in 2008 with the global economic meltdown. Toyota, BMW, Honda and Renault all left within a two-year period (though the latter continued as an engine supplier), leaving just Mercedes, Renault and Ferrari.

However, as the global automotive market has made a recovery so the manufacturers might be thawing towards F1 once more. Mercedes has remained loyal and, now with its own team, it has reaped spectacular benefit with its mastery of the hybrid technology formula introduced in 2014. Honda returned in 2015 as a partner of McLaren and now Renault, seeking more bang for its buck, has once more committed to fielding its own team. Car makers and F1 are sometimes uneasy bedfellows and separations can be messy – but the mutual attraction remains strong. ■

IT WASN'T A QUESTION OF WHETHER CAR MANUFACTURERS COULD AFFORD F1 BUT WHETHER THEY COULD AFFORD TO STAY AWAY

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AUTO FOCUS

Concept cars

VEHICLES FOR IDEAS

Concept cars have long played a key role in showcasing fresh automotive thinking, but while their 'wow' factor may be diminishing, they remain as important as ever

TEXT: GUY BIRD

Inside Honda's Acura Precision concept, shown at the 2016 Detroit Auto Show.

At their best, concept cars represent some of the most exciting and dramatic automotive designs ever committed to metal (and a few other materials besides). Literally 'vehicles for ideas', carmakers create them to gauge public opinion on possible new design ideas, hint at next-generation models and/or showcase new technology. But they don't come cheap – set aside around £1 million to pay for a good one – and with recent commercial realities biting, is their reason to exist diminished, and their 'wow factor' on the wane?

Talk to top-end carmakers' senior designers and opinions vary. Ed Welburn, Vice-President of Global Design at General Motors, was responsible for the look and feel of some 9.8 million new vehicles put on the road in 2015, for marques as diverse as Cadillac, Chevrolet, Buick, Vauxhall, Opel and Wuling. But within the last decade GM was also battling with bankruptcy, so production cars have been the priority. Hits are needed, as he sagely points out: "As much as I love concepts, if one of our incredibly important production cars did not get attention because of a concept car then that's a problem. Most of our focus is on internal concepts now. That's the best way of communicating to the leaders of the company or for any market research."

For other brands – especially those of French or Japanese origin – concepts are at the very core of what they stand for and help them to explore what customers might want in five-to-15 years.

Anthony Lo, Vice-President of exterior design at Renault, has been rushed off his feet during the past half decade with an increasing production line-up, but wouldn't dream of neglecting concept cars.

"In my entire career I've never had to work on so many projects in parallel," he admits. "But being Renault, we have to be the very best-in-class for concept cars too. In 2016 five more cars are coming,

"IT'S FEASIBLE TO BRING A LOT OF THIS STUFF INTO PRODUCTION"

GILLES VIDAL, PEUGEOT

The Peugeot Fractal explored the boundaries of in-car sound.

Alfa Romeo's radical Caimano was first shown at the 1971 Turin Motor Show.

so we have to work on getting the fit and finish right on those, think about some concept cars, and then do the same with the next generation of [production] cars. We are full-on."

Peugeot's Director of Style Gilles Vidal has a similar mindset. His 2015 Fractal concept featured the talents of DJ, film and gaming soundtrack producer Amon Tobin to get the clunks, clicks and other sounds a car can make just so. "We always push our conceptual experiments very far and they can be spectacular," says Vidal. "But what can we do with them? We want to bring a lot of this stuff into production and lot of it is feasible. Sound design is one example. We know how to make good sound within a car now." Back at 2016's Detroit show, Honda's upmarket Acura brand revealed its Precision concept to visually explain how its new production car range's front faces will transform over the next few years. This is a clear example of a manufacturer using a concept to flag-up future aesthetic changes in advance, sometimes to give consumers time to get used to the new look, and sometimes just to get them hooked and delay them from buying something else from a rival brand while they wait for the showroom-ready version.

Concepts that are closer still to production cars – often dubbed 'pre-production teasers' – have perhaps become more numerous in recent years. Quite often these 'teasers' are made after the design for the production car they are promoting the imminent arrival of has been signed off. But as the showroom model isn't ready to ▶

launch, the pre-production teaser steps in to do an important marketing job and keep all eyes on that model.

Many brands are keen proponents of this approach. A good example is the 2013 C-X17 SUV concept and the production F-Pace revealed in 2015 that goes on sale this spring. The production interior is more XF than conceptual, but the bodywork and package has barely changed.

TURNING (BITS OF) CONCEPT INTO REALITY

Technology concepts like to get potential customers used to new powertrains and ways of working the car they might not have considered before.

At this year's Detroit Auto Show, Audi showed a much more conventional-shaped concept: the only thing mildly shocking about the H-Tron quattro SUV was its yellow colour. But it used that shape to suggest that Audi could comfortably house a fuel cell drivetrain able to go 372 miles on one tank of hydrogen with front and rear electric motors in a relatively normal car.

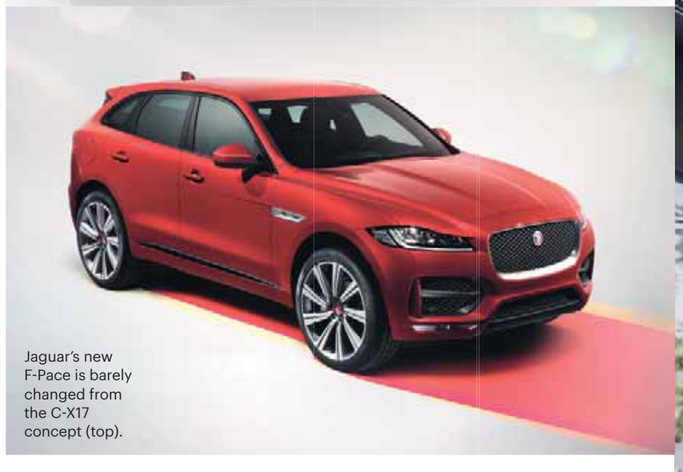
Kia did something similar with its 2016 Detroit concept, the Telluride. Bristling with complex screens within its doors and dashboard, it suggests better future connectivity, passenger well-being and vehicle control are all on the way. Its large SUV shape also perhaps genuinely tested the water to see whether the public would accept such a large vehicle from the Korean brand for possible future production (Kia has nothing of that size in its current road-going range).

In terms of driver and passenger safety, Volvo is a well-known leader and its 2001 Safety Concept Car (SCC) featured many technological innovations – including forward collision warning, 'blind spot alert' and lane-keep assist – all of which were later adopted for production on Volvo's 2008 XC60 compact SUV model and have become commonplace among other car companies' equipment lists within the last five years.

'Wow-factor' concepts that can metaphorically blow the head off your shoulders with their originality and audacity – think most concepts from Marcello Gandini or Giorgetto Giugiaro from their late 60s and early 70s heyday – may be fewer in number than once was. But that's because at the time they were working for independent Italian design houses like Bertone and Italdesign that were using such vehicles as marketing exercises to entice major carmakers to employ such coachbuilders to help design their cars (as in-house design teams back then were often small or almost non-existent). They also helped win contracts to build small manufacturing runs of niche cars that larger carmakers couldn't handle on their normal factory lines.

While classic concepts like the Giugiaro's spaceship-like 1963 Chevrolet Testudo weren't ever intended to be driven off a showroom floor in production-grade specification, those two design greats imagined plenty of incredible cars that did become feasible road cars barely changed from their conceptual forebears. Giugiaro's 1972 Lotus Esprit concept (launched in 1976) or Marcello Gandini's ground-breaking 1971 Lamborghini Countach LP500 prototype that became the 1973 Countach LP400 production car are just two.

Perhaps these latter types of concept – that do genuinely seem to be 'vehicles for ideas', whether aesthetic, technological, or relating to a new kind of package – and that do go on to get made without major changes are the sweetest of all. The 1995 Audi TT Concept that became the 1998 TT mkI is a great example in more recent times. And proof that the tradition is still alive in 2016 came in the shape of the Lexus LC 500 production super coupé unveiled at January's Detroit Auto Show. Put a photo of the LF-LC concept from 2012 alongside it and you'll see more than a family resemblance, particularly on the exterior, but also on some of the interior detailing too.

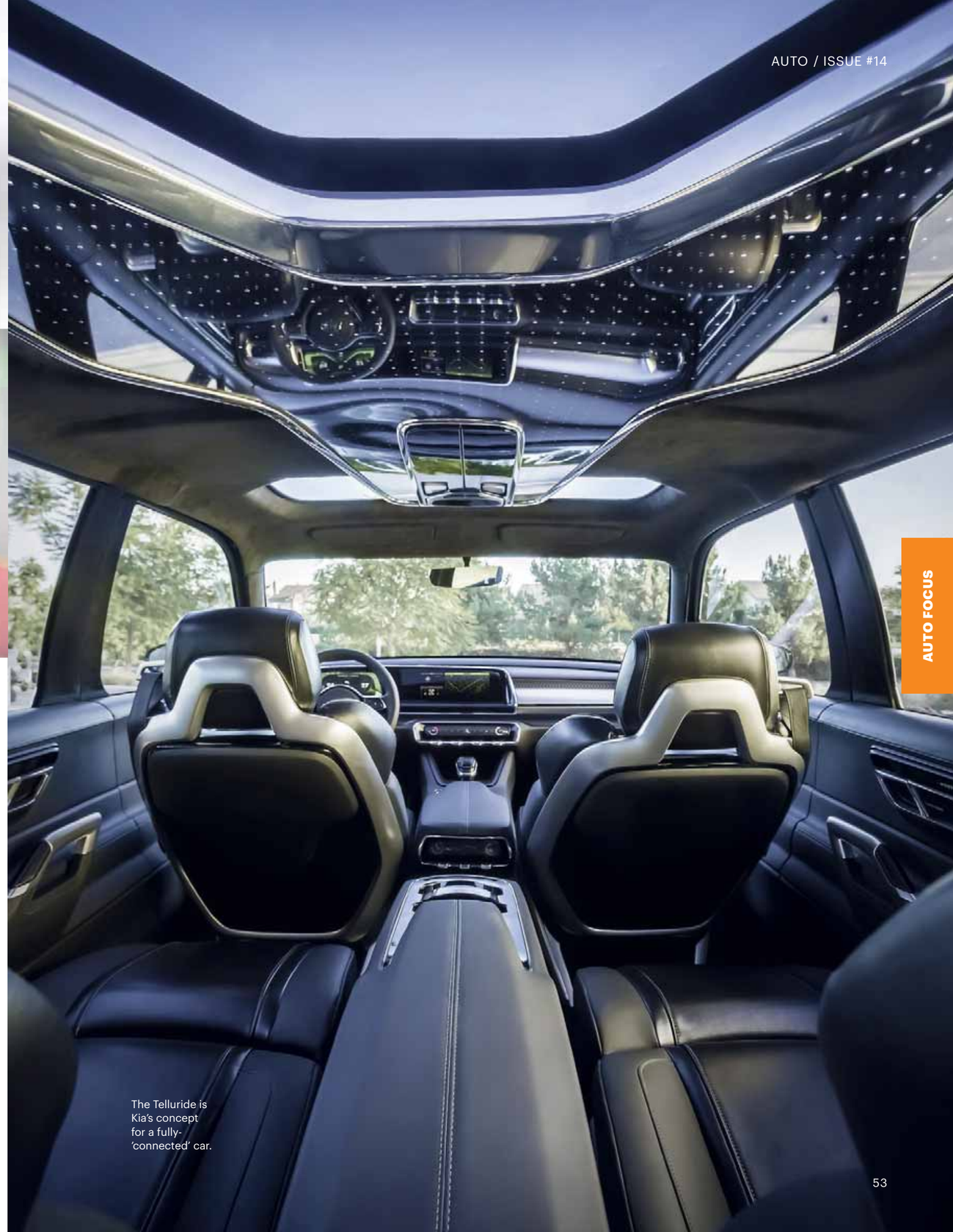


Jaguar's new F-Pace is barely changed from the C-X17 concept (top).

As Toyota Group's Californian CALTY design studio President Kevin Hunter, in charge of the Lexus concept, said so tantalisingly back in 2012: 'The LF-LC is a concept to study, but we never build a concept car just to make a car, there's always strategic thinking behind it.' So it proved.

It's a heartening example, and should be cause for some optimism that by 2020, or even before, we might well see a few of those 2016 Detroit concepts – Acura's for certain and Audi's too – driving around our streets in a similarly exciting form and with equally-advanced technology. ■

The Chevrolet Corvair Testudo was never intended for production.



The Telluride is Kia's concept for a fully-'connected' car.

AUTO FOCUS

Pushing the boundaries

RACING TO EXTREMES

With motor sport taking place in every corner of the globe, cars and competitors are routinely subjected to extremes of temperature, humidity and g-forces, as AUTO found out

TEXT: MATT YOUSON

Often we talk about the global nature of motor sport, perhaps without truly considering what that means. Its ubiquity is both remarkable and entirely taken for granted: wherever there are people and engines, there is racing and rallying. It lends a breadth and depth to motor sport that takes it far beyond the homogeneity of most active pursuits.

This doesn't simply manifest in a proliferation of specialist niches but also in the adaptability of the mainstream: major international series require ingenuity in design to cope with a wide variety of conditions: temperature ranges with a 100 °C spread, altitudes from sea-level to 2,500 m, high humidity, heavy rain and plenty more. On top of the ambient conditions are the design factors: the constructions and rules designed to push machinery and competitors to the limits, with extremes of endurance and circuit layout. Taken together it creates a world of motor sport in which extreme is the new normal.

Temperatures on China's Jixi Rally fall as low as -30 °C

RALLYING IN THE COLD

At one end of the scale, motor sport thrives in the sub-zero world of the high northern latitudes. Rally Sweden is perhaps the best-known of the cold climate events – but below the World Rally Championship there are many vibrant national rally series racing on ice and snow.

The FAW-VW Rally Team recently secured the Chinese Rally Championship title at the Jixi Rally, held in the far north-east province of Heilongjiang. The event took place on frozen lakeland with temperatures as low as -30 °C.

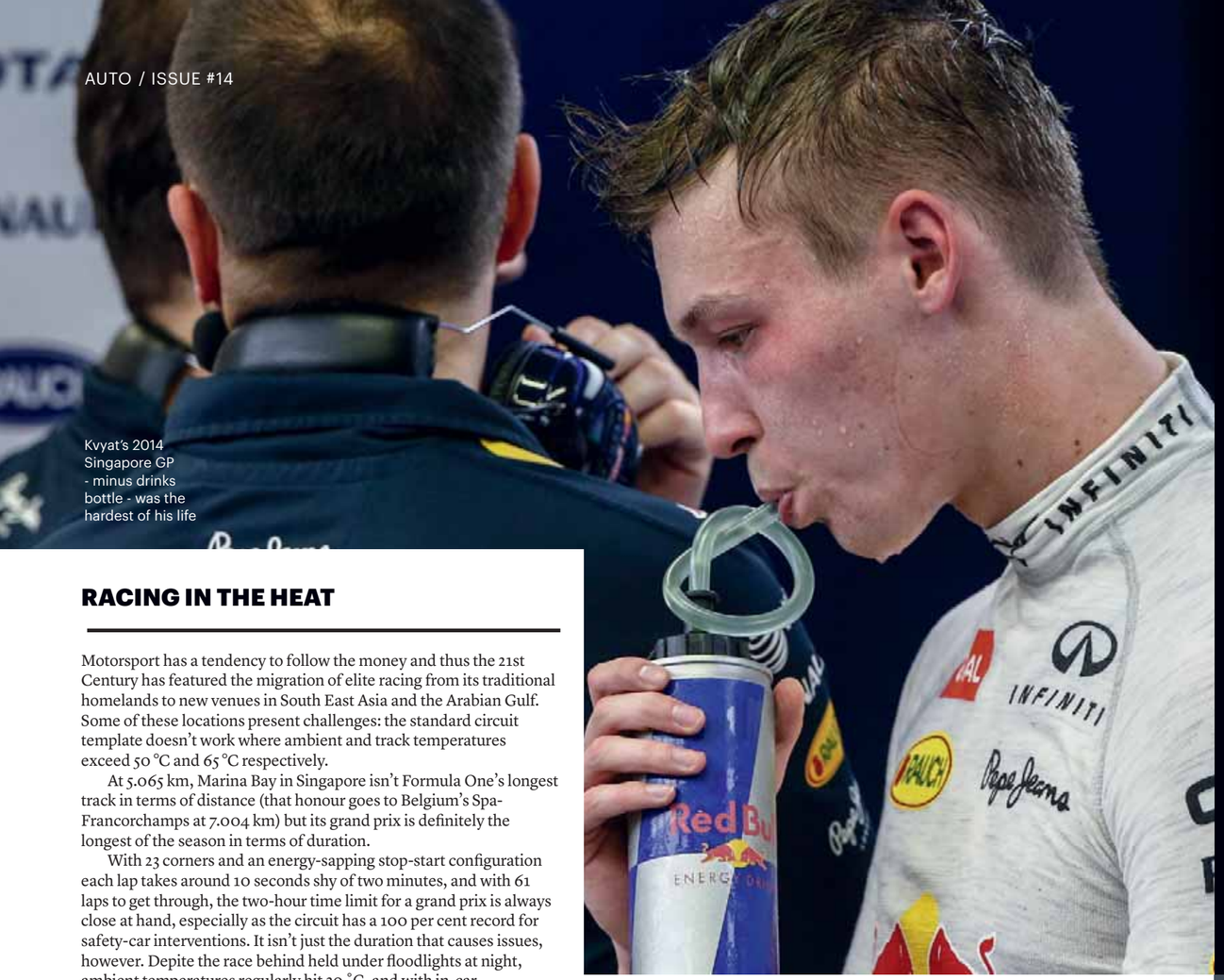
Senior engineer Richard Thompson, who leads the FAW-VW programme at Prodrive, says a rally car should be equally at home in the Arctic as it is at the Equator, requiring only minor modifications to swap from one to the other – but perhaps quite a lot of them.

"It's many little things: we'll reroute breather pipes into warmer areas to prevent them icing over and divert heating to the footwells to keep feet warm. We'll remove unnecessary roof vents and coolers and add heating elements to the side windows – with so much yaw in the car, the driver spends a lot of time looking through them."

How cold is too cold? Thompson argues the limiting factor is not temperature during the stages, but protection overnight. "You get nervous when parc fermé drops below -10 °C. These are dry-sump engines with remote oil tanks, susceptible to low temperature. They use lithium-ion batteries which, when cold, run the risk of not generating enough cranking speed. If a modern WRC car been sitting overnight in temperatures of -20 °C, it isn't going to start."

One WRC idiosyncrasy of extreme cold comes in the road sections. Once running, the cold is not bad on the stage – but when you're cruising along at road-legal speeds, the car feels the chill.

"In the WRC the car has the same basic cooling package for Greece [35 °C] and Sweden [-25 °C]," says Thompson. "You really don't want air intake at -25 °C: it's tricky to map and can cause engine calibration and boost- control issues. Instead, you'll have blanking on the grilles and bleed in warm air from the engine bay to get intake temperature up to 5-8 °C. The cars feature prominent signs to ensure the crew remember to remove the blanking before the start of a stage. Re-fitting the blanks is less of a problem – they notice if the heater doesn't work." ▶



Kvyat's 2014 Singapore GP - minus drinks bottle - was the hardest of his life

RACING IN THE HEAT

Motorsport has a tendency to follow the money and thus the 21st Century has featured the migration of elite racing from its traditional homelands to new venues in South East Asia and the Arabian Gulf. Some of these locations present challenges: the standard circuit template doesn't work where ambient and track temperatures exceed 50 °C and 65 °C respectively.

At 5.065 km, Marina Bay in Singapore isn't Formula One's longest track in terms of distance (that honour goes to Belgium's Spa-Francorchamps at 7.004 km) but its grand prix is definitely the longest of the season in terms of duration.

With 23 corners and an energy-sapping stop-start configuration each lap takes around 10 seconds shy of two minutes, and with 61 laps to get through, the two-hour time limit for a grand prix is always close at hand, especially as the circuit has a 100 per cent record for safety-car interventions. It isn't just the duration that causes issues, however. Depite the race behind held under floodlights at night, ambient temperatures regularly hit 30 °C, and with in-car temperatures often approaching double that figure, the race is one of the season's toughest for drivers.

"It's a hugely long race, the longest of the year and usually right up against the two-hour maximum. Fighting through all of those corners in those conditions for two hours is a real challenge," says Red Bull Racing driver Daniel Ricciardo.

Ricciardo's team-mate Daniil Kvyat knows all too well how the extreme temperatures can affect driving. Racing for sister squad Scuderia Toro Rosso in his debut F1 season in 2014, the young Russian's drinks bottle malfunctioned at the start of the race there and he was forced to battle searing heat inside the car and potential dehydration just to make it to the finish line.

"It was an incredibly tough race, definitely the toughest of the whole year," admits Kvyat. "The loss of the drinks bottle made it very difficult but even if it had not happened Singapore is always one of the season's big challenges.

Six thousand kilometres west of Singapore, a different heat experience greets F1. While the Abu Dhabi Grand Prix isn't hampered by the extreme humidity found in South East Asia, the punishing heat of the Gulf sun makes life difficult for teams and organisers.

Richard Cregan, formerly CEO and now a consultant to the Yas Marina Circuit, at which the Abu Dhabi race takes place, recalls coping with heat was at the forefront of the design brief. "Probably the first thing to consider was the asphalt mix – the aggregate and bitumen that you use. It's not just a case of ensuring it copes with the extremes of temperature but also that it provides a consistent grip level: not just for the showcase F1 race, but for all of the many types of racing that go on at the circuit."

Yas Marina uses the same Greywacke aggregate as the Bahrain International Circuit, providing a stable surface that does not distort in the midday heat of the UAE. Having a viable surface does not, however, guarantee popularity. Yas Marina's big decision in this regard was to install floodlights, allowing its circuit (and dragstrip) to become evening attractions and allow spectators to enjoy racing in the comparatively cooler evenings.

Of course, catering for fans is only half the battle. For a circuit such as Yas Marina, keen to be regarded as a premier test venue, comfort for crews was equally important.

"You really have to think about the staff," says Cregan, formerly the team manager of the Toyota F1 team. "This is why our garages are air-conditioned. People work long shifts and obviously the temperatures in 'normal' garage would limit them – that's why we prioritised building a system to keep the garages at a suitable temperature. In 2009 the first Abu Dhabi Grand Prix was an interesting experience. Generally everyone was impressed and complimentary about the garage design – though we did have one team complaining it was too cold."

RACING AT ALTITUDE

Perhaps the highlight of the 2015 Formula One season was the return to the calendar of the Mexican Grand Prix. At 2.2 km above sea level, the Autódromo Hermanos Rodríguez is, by a considerable margin, the most elevated racing circuit used in F1. It creates a new set of challenges.

The typical effect of altitude is power loss. As altitude increases, air pressure drops so less oxygen is available for combustion. The rule of thumb is that for every 100 m increase in altitude, engine power reduces by one per cent. A normally-aspirated car would therefore have 22 per cent less power at the Mexican circuit than it does at Suzuka.

This doesn't however, affect the turbocharged 1.6-litre hybrid engine type used in F1 today, in which air is forced into the combustion chambers via the turbocharger. It has to work harder in Mexico, and less energy will be stored in the battery pack, but despite this hindrance, the cars remain immensely powerful nonetheless.

"The engine suffers the least," says Paul Monaghan, chief engineer, car engineering at Red Bull Racing. "But all the other air-dependent systems, whether it's cooling brakes, engine or gearbox, are going to struggle. We have to work with less air."

The result is cars more 'opened up' than usual, running the maximum cooling packages usually seen in Malaysia or the Middle East. These create more drag – but the bonus of lower air density is reduced drag so this balances out.

Lower drag also means lower downforce. "Performance-wise the amount of downforce you generate is substantially less," concedes Monaghan. "At altitude I'd expect teams to start with something close to a high-downforce package to compensate. We see some relatively high end-of-straight speeds even with some very large wings."

In the final analysis, Sebastian Vettel's 366 km/h in Mexico was the highest speed recorded during the 2015 season – faster than Monza but without a Monza-spec low-drag configuration. ▶

"IN THIN AIR, THE AMOUNT OF DOWNFORCE PRODUCED IS SUBSTATIALLY LESS THAN NORMAL"

PAUL MONAGHAN, RED BULL RACING

The Mexican GP takes place 2.2 km above sea level, in the thinnest air F1 experiences

The Bathurst 1,000's enduro nature places a premium on driver discipline

THE LONG ROAD...

Not all extremes are imposed by nature. Since its beginning, motor sport has sought to test the limits of endurance for both man and machine. Today, endurance racing is motor sport for the purists. Originally a race of attrition, modern enduros balance speed and power with strategy, mechanical sympathy and human resilience.

The V8 Supercar Enduro Cup is an unusual sequence of races. The eclectic Australian-based touring car series features three endurance rounds towards the end of the season, interrupting the regular flow of SuperSprint and SuperStreet races. According to six-time Bathurst 1000 winner Craig Lowndes, drivers must display a mental agility when it's time to switch into endurance mode.

"It is different," he says. "You have to take out the aggression. Endurance racing is about not taking too many chances and making sure your overtaking moves are clean and precise."

In addition to his Bathurst victories, Lowndes has also won the other Enduro Cup rounds, the Sandown 500 and Gold Coast 600 races, as well as the Bathurst 12 Hours GT race and the Australasian Rally. Beginning his third decade in touring cars, Lowndes says advances in technology have made endurance racing more about the skill and mentality of the driver, than the limits of the machinery.

"Certainly in the V8 Supercar series the cars are a lot more reliable now. Other than set-up changes, we're not really required to make many mechanical alterations to the car for an endurance event. The cars are built for longevity nowadays, so the stress loads of endurance racing are really not that different."

A key tenet of endurance racing, perhaps not so prevalent in sprint formats, is the need for situational awareness. Lowdnes argues this is particular the case racing GTs. "With V8s, the whole field will have similar straightline performance. The Bathurst 12 Hours, on the other hand has various categories. It's very easy to get caught up in an accident going over the top of the mountain and coming up on a much slower car. You have to be constantly aware of who's around you – and you sometimes need to patient. Not something that comes naturally to a racing driver."

"ON THE IOWA OVAL, OUR DRIVERS PULL 4G FOR HALF THE RACE "

JULIAN ROBERTSON, GANASSI

HEAVY G

While there is nothing new in the idea of long-distance racing, there are other ways to push the body to the limit – and perhaps beyond. Technical developments, particularly in aerodynamics, tend to push cornering speeds ever-higher, leading to drivers experiencing ever-greater lateral g-forces.

"Probably the most extreme oval we go to is Iowa," says Julian Robertson, engineering manager of the Chip Ganassi Racing IndyCar team. "In qualifying our peak lateral is 6.3 g and we're over 4 g for over eight seconds of the lap. That may not sound like much but it's a short oval of 0.9 miles [1.4 km]. Our qualifying time is 17.5s. The race is 300 laps and takes around two hours – under green conditions the drivers are pulling more than 4 g for half the race."

The most graphic example of oval g forces at work led to the cancellation of the 2001 Champ Car Firestone Firehawk 600 at Texas Motor Speedway due to concerns over the physical demands of racing on the steeply-banked oval. Twenty-one of the 25 drivers reported some degree of disorientation after practice.

"Twenty years ago the cars weren't fast enough to pull the big g-loads on some of these tracks – but as the cars got better and the engines became more powerful, you started to approach the limits," recalls Robertson.

"Some of the tracks were designed – or redesigned – to suit NASCAR, which didn't have a lot of downforce. To achieve the speeds on the ovals, they needed steep banking. That's not what you want for IndyCar because it makes the loads and speeds go up horrendously. The 2001 Texas race is a case in point: we were running 233 mph in practice – which is ridiculously fast for a 1.5-mile oval that was also very bumpy. The drivers could handle it for short periods – but not long. The experienced guys said they didn't think it was possible to do a 200-lap race without somebody blacking out – so it was cancelled. It wouldn't happen today because the rules are written to restrict us to 210-215 mph average on a track like that." ■

Peak lateral force at Iowa reaches 6.3 g on the 1.4 km oval

AUTO / ISSUE #14

AUTO FOCUS

Autonomous technology

A MIND OF ITS OWN

Autonomous vehicle technology is no longer a fanciful dream of the future, and leading industry figures think it will improve road safety too

TEXT: BEN BARRY

It's 4,466 kilometres from New York to Los Angeles. The trip from the US east to west coast takes in city streets, highways, fuel stations, and whatever the weather throws at you. It's a marathon journey full of complexity and potential hazards. Yet in January 2016, Elon Musk, CEO of electric-car company Tesla Motors, made a bold statement: "Within two years you'll be able to summon the car from across the country," he announced. "So let's say you're in New York and your car is in Los Angeles, it will find its way to you." The electric Tesla will locate the owner via a phone signal, and even, Musk claimed, find somewhere to charge itself en route.

This "summon" function would be an expansion of Tesla's recently introduced Autopilot technology, using cameras, radar and ultrasonic sensors to steer, change lanes, adjust vehicle speed to traffic flow and autonomously parallel park.

Musk qualified the timeframe, saying "maybe I'm slightly optimistic", but it is not wild exaggeration: autonomous cars are the new automotive space race, and Tesla might just get there first.

Engineers from mainstream car manufacturers sound a cautious note, however, even as they push to introduce the technology themselves. The new Volvo S90, for instance, offers Pilot Assist, a kind of super cruise-control system that's active at up to 130 km/h, allows hands-free driving for 30 seconds, and follows stop-and-go city traffic without driver inputs. But at the vehicle's unveiling in Gothenburg, Volvo R&D boss Peter Mertens expressed concern. "You see some OEMs offering autonomous technology and I cross my fingers that something bad doesn't happen," he says. "It would set the entire industry back years."

There is, however, no doubt that full autonomous technology is coming, and coming soon. The big question is when.

Semi-autonomous technology has slowly been creeping into passenger cars for well over a decade, active cruise control debuting on the 1990s Jaguar XK8. Volvo introduced Collision Warning and Brake in 2006, preventing or reducing the severity of collisions. "We started with a medium type of emergency braking with 0.3 or 0.4g," recalls Jan Ivarsson, Volvo Deputy-Director of Safety. "We didn't dare have full auto braking at first."

COMING FORWARDS IN LOOKING BACK

Today, Volvo, VW Group, BMW, Honda, Mercedes, Jaguar Land Rover and others offer full autonomous emergency braking (AEB) with radar, stereo cameras and lidar-based technology to bring the car to a complete stop, often with the maximum available braking force; AEB is proven to reduce accidents by 27 per cent, and now forms part of the NCAP safety rating.

Other semi-autonomous features include blind-spot warning, pedestrian detection, systems that automatically reduce a car's speed to the legal limit, and lane-keep assist, which capitalises on most cars' switch from hydraulic to electric power assistance, a key milestone on the path to an autonomous future. Slowly but surely, the web of electrical systems, cameras and sensors essential to autonomous technology have been connecting and communicating.

Technological innovation is far from the only barrier to full autonomy: legislation plays its part. But that too is changing. A change to UNECE Regulation 46 permits mirrorless cars to be sold from 2017, cameras instead relaying information to the driver via a screen. Not only that, but mirrorless systems could also unlock technology crucial for full autonomy.

At this year's global technology trade show, CES, BMW showed off a prototype i8 equipped with a mirrorless system. A stereo camera is positioned at the top of the rear window – like two digital eyes, it can assess speed and distance – while cameras in slim line stalks replace conventional mirrors. The images are – almost – seamlessly patched together on a 300mm digital screen that replaces a rear-view mirror. It provides an 80-degree field of view to ▶

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"WITHIN TWO YEARS YOU'LL BE ABLE TO SUMMON A CAR FROM ONE SIDE OF THE COUNTRY TO ANOTHER"

ELON MUSK, TESLA CEO

A mirrorless version of the BMW i8 was on display at the recent CES event in Las Vegas.

Volvo will restrict autonomy to highways and one-way streets.

eliminate blind spots, while a ghosted red box with an exclamation mark warns of fast-approaching vehicles.

"The homologation process will take place in 2016 in Europe, 2017 in the US, and no later than 2018 in China," reveals project leader Phillipp Hoffmann. "It won't be an optional system, it will be standard equipment on an all-new car."

So will mirrorless technology help fast-track autonomous cars? "Can conventional mirrors assist autonomous cars?" poses Hoffmann rhetorically. "No. So flip that on its head..."

Further impetus comes from an update to the Vienna Convention on Road Traffic laws, which allows stage three autonomous vehicles on the road from March 2016. Stage two legislation demands that a driver be ready to regain control whereas stage three does not.

MAKING A CAR THINK LIKE A HUMAN

Franz Xaver Weiss of automotive systems supplier AutoLiv comments that "actually, the difference between stage three and stage four isn't so great. We're currently wondering if we just progress straight to stage four now, a fully-autonomous vehicle."

Autonomous prototypes are already on public roads, albeit with test drivers poised to take control if anything goes awry: Google's autonomous fleet has covered in excess of 1.6 million km, Ford boasts the largest autonomous fleet at approximately 30 vehicles, and in 2017, Volvo will kick-start its DriveMe project, where 100 autonomous vehicles will be handed over to volunteers for a pilot trial. The project will be key to Volvo achieving its target of zero deaths in a new Volvo from 2020.

Yet caveats remain: autonomous Volvos will be restricted to one-way roads with central barriers such as motorways and autoroutes, and when the journey switches to other roads, the driver must re-take control. For now, more complex driving scenarios, such as city centres and other urban landscapes, are beyond the capabilities of Volvo and its competitors.

But everyone is working on it. Toyota recently invested $50 bn in the new Toyota Research Institute based at two US locations: one close to Stanford University, California, the other MIT, Michigan. CEO Dr Gill Pratt addressed a packed auditorium at CES.

"Although the industry has made incredible strides over the last five years, we remain a long way from the finish line of truly autonomous cars," he said. "Most of it has been relatively easy, because most driving is relatively easy. Where we need help with autonomy is when it's more difficult."

One TRI autonomous research project is dubbed "Uncertainty On Uncertainty". Pratt explained that predicting the erratic behaviour of, for instance, a cyclist, and therefore programming an autonomous vehicle with a suitable response is a fairly simple task. The tough part is creating a response to the things that are impossible to anticipate.

"Imagine debris falling off a truck," said Pratt. "Should the car think of debris as another car, and avoid it? Kind of, but the debris might break apart, so then it's like lots of cars. Should it think of it as a pedestrian? Kind of, but the debris might initially be moving far faster than a pedestrian. These are really hard problems. Part of our work will focus on augmenting machine learning, and measuring the robustness of systems for scenarios we haven't yet thought of."

According to Pratt, Toyota's autonomous technology is currently mature enough to offer millions of kilometres of autonomous reliability, but he says it needs to be reliable for trillions, based on the idea that Toyotas travel approximately 1.6 trillion km annually.

Car-to-x and connected-car technology will be key to this progress. Car-to-x allows a vehicle to exchange information with infrastructure so that, for instance, an autonomous car and traffic lights could communicate. Connected cars, meanwhile, could warn each other of upcoming hazards: say a queue of traffic around a blind bend, or an emergency vehicle rushing to an incident.

As this technology matures, so the dawn of the fully autonomous car will near. Kia recently announced it would have a full autonomous car on sale by 2030. Tony Harper, Head of Research at Jaguar Land Rover, expects the company to have an autonomous car on sale within a decade, a timescale that is "in line with our competition," he says, with increasing levels of autonomy from 2019. Meanwhile, Franz Xaver Weiss of OEM supplier Autoliv offers that "it will be in the timeframe of 2025 to 2030.'

Whether or not Tesla's plan to introduce fully autonomous technology within two years is feasible remains to be seen, but the consensus is clear: a fully autonomous vehicle capable of handling all traffic scenarios will be on sale within 10 to 15 years.

In the interim, much work remains to be done. As Toyota's Dr Pratt puts it: "We may be 95 per cent of the way to full autonomy, but that doesn't mean the last five per cent will be as easy as the first 95. It's like climbing a mountain, where the final ascent is the hardest. If just a small percentage of the distance Toyotas cover annually is very difficult driving, it's still many, many miles; that's the part we need to address." ■

Dr Gill Pratt heads up the Toyota Research Institute.

Tesla CEO Elon Musk has been a prime mover in new-vehicle technology.

AUTONOMOUS TECHNOLOGY IN DEVELOPING COUNTRIES

There are approximately 1.24 million deaths on the world's roads every year, according to the 2015 Global Status Report on Road Safety. Of those, 90 per cent occur in low- or middle-income countries, despite those accounting for only 54 per cent of registered vehicles.

So while Volvo hopes autonomous technology will help it eliminate fatalities in new models by 2020, the possible gains in developing countries, where older vehicles make up a far larger portion of national fleets, are likely to remain untapped.

Unfortunately, it's not just a case of introducing in-car technology to these nations: multiple cost-, political- and infrastructure-based challenges stand in the way.

Developing countries typically enforce less rigorous vehicle safety standards, for instance. So while autonomous emergency braking became mandatory for new HGVs sold in Europe in 2015, no such legislation exists in developing nations.

Technology is, however, overcoming other hurdles. Much of today's autonomous technology is dependent on cameras detecting road markings to keep a vehicle within its lane, but markings are often of poor quality or non-existent in emerging nations. The new Mercedes-Benz E-class features Drive Pilot autonomous technology that can both follow the vehicle in front and orientate itself to its surroundings using radar- and camera-based assistance systems.

This allows the E-class to navigate its way through roadworks, with patchwork, poorly marked surfaces that can closely mirror roads found in developing nations.

Car-to-car and car-to-x communication will vastly improve the capabilities of autonomous vehicles, but as Tony Harper, Head of Research at Jaguar Land Rover explains: "Initially, autonomous vehicles will have to operate on roads where the majority of vehicles have no car-to-car or car-to-x capabilities." This means the technology being developed today will be more transferrable to developing nations' roads in the future.

Jaguar was first to launch semi-autonomous technology with adaptive-cruise control on the Jaguar XK8 in the 1990s, and its expertise is now being paired with stablemate Land Rover's advanced off-road capability. It could be an effective way of improving road safety in developing nations.

"Giving an autonomous vehicle the ability to operate independent of roadside infrastructure, or road markings, would enable autonomous driving anywhere," says Harper. "At our 2015 Technology Showcase we announced that we have started a context-based sensing research project to look at developing sensors to suit any environment a future autonomous Jaguar or Land Rover may find itself in."

But experts agree that fully autonomous cars are unlikely to hit the roads of first-world countries until 2025 at the earliest. Factor in the challenges of creating technology capable of handling any environment, of that filtering down to more affordable cars, and of those cars in turn filtering through to developing countries' ageing vehicle fleets, and the idea of fully autonomous cars reducing the death toll in those countries remains decades away.

REAR VIEW

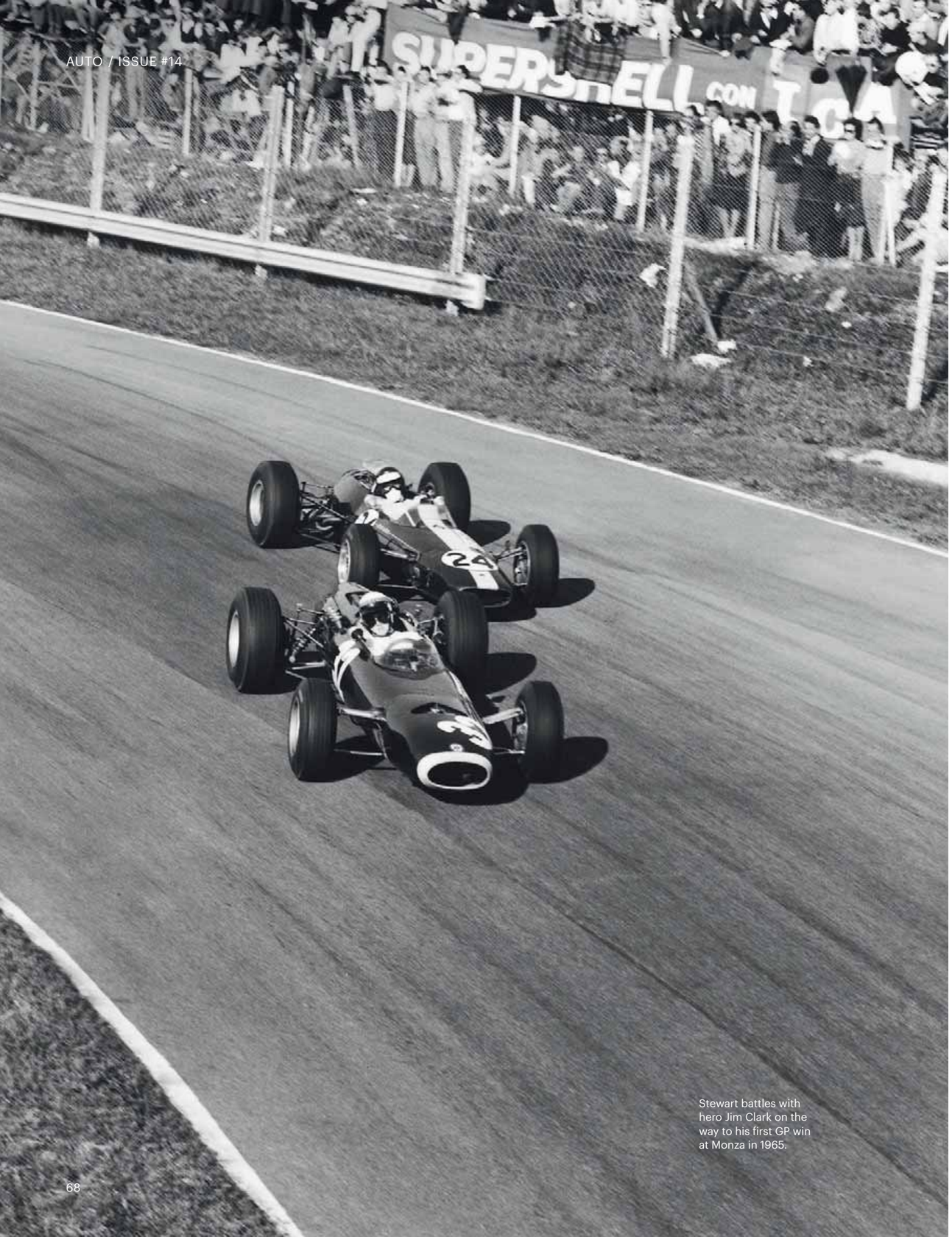
Legend

“Everyone can win at something or other, so I always think that simply winning is not all that difficult. But serial success – that is real achievement.”

Few have made such a huge contribution to motor racing as Sir Jackie Stewart; world champion driver and tireless safety crusader

TEXT: TONY THOMAS

Stewart’s prodigious speed and studious nature helped propel him to victories aplenty.



Stewart battles with hero Jim Clark on the way to his first GP win at Monza in 1965.

"I never thought I was special," reflects Jackie – Sir Jackie – Stewart. "Because of my dyslexia I always realised I had to work harder to be heard."

What a noise he made. Three Formula One world titles, 27 grand prix wins – for 14 years the holder of the sport's record for most victories – F1 safety evangelist; team boss; icon; legend. And happily, too, still with us at 76, a livestream to a different time and place in grand prix motor racing; to those Fujicolour years of flared denim and cloth caps, cobalt Tyrrells, pop-rivet Matras, Elf, Dunlop, Cevert, Uncle Ken; heat-haze Monza in September sun; the Cote d'Azur shimmer of Monaco in Spring.

"It was a very special era," he nods. "So many great drivers and characters, and all so different. There was Stirling [Moss] – he had his accident in 1962 just as I was starting out. I have Stirling's autograph – he was a very good example to anybody. Always immaculate and to me, a sort of model racing driver.

"Then Jimmy [Clark]... so very modest and quiet and so well turned out – not in a flash way but in a very dignified way. Graham Hill, of course, who was more fashionable than Jimmy and more worldly, but carried it off with a great sense of style and humour. He always presented himself well."

A golden period to remember, and at the time says Sir Jackie, "a magic carpet ride."

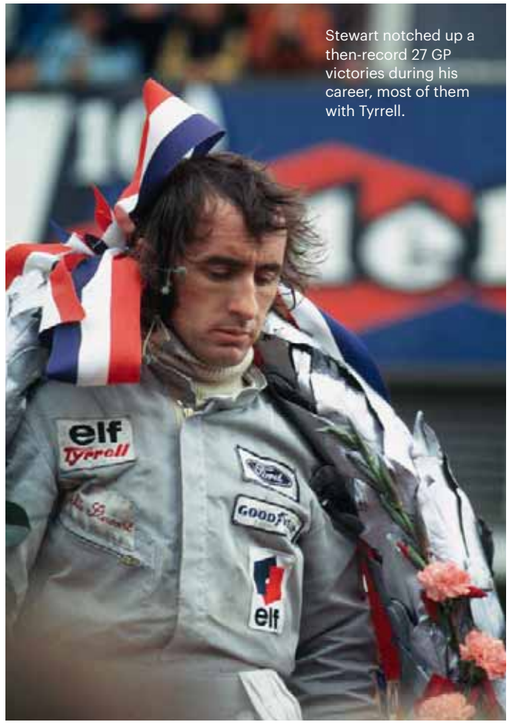
"It was like a kaleidoscope," he says. "And there was so much to learn from. If you were part of that scene then, as I was lucky enough to be, I was around all these people and I can tell you I had my eyes wide open. If you are lucky, you are meeting people that you have never met before and maybe never will again. And you saw them and how they dressed and how they behaved and what manners they have and whether people either liked or disliked them... There was so much to learn from life."

A still-young JYS (or John Young Stewart to give his actual name - Jackie being a nickname that he embraced) had come an awfully long way fast in those turn-of-the decade days when he enjoyed the peak of his F1 success. From Milton, West Dumbartonshire, Scotland, where he'd worked in his teenage years as a forecourt attendant in his dad's garage, to the top step of the Monaco Grand Prix podium (three wins: 1966, '71 and '73) life, then, was super-accelerated, every day being run on permanent fast-forward.

A podium finisher in his second grand prix (third at Monaco, 1965) and a winner by Monza that year, he arrived in F1 somewhat like Sebastian Vettel decades later, quick, composed and ready to succeed. A superstar-in-waiting, he was a near-complete package as a grand prix driver almost from the off, having benefited, he's sure, from a previous sporting career as an Olympic-class 'shot' (as a reserve for GB's shooting team at the 1960 Olympics).

But it was an instinct for how he might parlay god-given sporting talent and hard-won opportunity into a gilded future that set him apart from his peers: "I'd been successful in another sport before motor racing," Stewart says. "So I knew a little bit and I had been watching other people. But motor racing is so much more multi-faceted. When I came down to race from the Borders I thought everybody was more sophisticated, better dressed and richer, so I had to try harder. I saw my own shortcomings."

Itchy ambition wouldn't allow Stewart to settle for a place in the annals as one of the all-time greats. Simply winning wasn't that big a deal to him. He felt compelled to use sporting lustre as a launchpad for a multi-faceted business career after racing. ▶



Stewart notched up a then-record 27 GP victories during his career, most of them with Tyrrell.

"I nearly died of mononucleosis in '71. I was so exhausted I couldn't even pick up my championship trophy - Helen had to do it for me"

"You know, people can get carried away with success and start to believe that they are special," he says. "People are winning every day, at tiddlywinks or bowls, and everyone can win at something or other, so I always think that simply winning is not all that difficult. But *serial* success – that is real achievement. In my career I think I saw probably before most drivers that there was a lot more to the business than just driving, because of the large multi-national corporations that were involved."

TAKING IT TO THE NEXT LEVEL

Opportunities began to unfold early for Stewart, a future revealing itself before him, just as the path to a grand prix victory would so often offer itself up with apparently feeble resistance. He recalls a visit to the 1964 Earls Court Motor Show in London. Stewart was an emerging talent after a dominant season of British Formula Three (catching the eye of F1 team boss John Cooper and future mentor Ken Tyrrell, among others), but he was yet to hit the big time. Having paid his own way for a train ride to London ("and not even first class, I can tell you"), he found himself gazing distractedly at a Ford Zodiac rotating on a turnstile. "It was white, with a red leatherette interior and whitewall tyres. Walter Hayes, of Ford, came up to me – I had no idea who he was – and introduced himself. Then he said: 'Do you like the car? Would you like to have it?'

"I laughed and did a bit of a double-take, but Walter continued: 'I'm with Ford Motor Company and I run public affairs. I would like you to drive some of our cars from time to time. And I will give you this car and £500.'"

So began a relationship with Ford that would last 40 years, peaking, notably, with its backing of the launch of Stewart Grand Prix in 1997. The team's life was short (three seasons) but memorable: there was a podium in only its fifth race (Monaco) and a rain-assisted 1-3 at the Nürburgring in 1999. Fourth in the constructors' chase, behind only McLaren, Ferrari and Jordan, marked Stewart GP as a team going places – so much so that Ford bought it outright and re-branded it 'Jaguar Racing' for 2000. That team's HQ on Bradbourne Drive, Milton Keynes, is still very much in use today as the nerve centre of Red Bull Racing.

Other long-term partnerships have attached themselves to Stewart – notably with Rolex and Moët & Chandon – but it was his years as a TV expert for US network ABC that enabled the successful transition from 'Jackie Stewart, racing driver' to 'Jackie Stewart, do you really have to ask?'

From 1971 (the year of his second world title) to 1986, Stewart shared his insights with a global audience, commentating beyond motor sport when the opportunities arose: in '76 he co-anchored ABC's summer and winter Olympics coverage. He writes in his autobiography *Winning is Not Enough*: "Most sportspeople don't move into television until they have retired, but I didn't see any point in waiting. I was being exposed to a new world and it created more demands on my time, but it was exciting and in many ways as challenging as anything I was doing in motor racing."

The pressures of combining that network schedule with his racing commitments damn-near broke him though. In 1971, he raced to the F1 world title; he contested a full 10-round Can-Am sports car championship (winning twice, to place third in the table); there were touring-car races, chassis-testing commitments with ▶

Sir Jackie's top three victories

In a 99-race Formula One career, Jackie Stewart won 27 of them, taking at least one grand prix victory in every season he raced, apart from 1967. He also raced widely beyond F1, in Can-Am, touring cars, and on US ovals, achieving success in every category. Here, he picks three of his favourite wins.

1965 BRDC INTERNATIONAL TROPHY, 15 MAY, SILVERSTONE
"This was my first F1 win and a difficult one at that. It was a non-championship race, but it still had a high-quality field and was a major British sporting event, with a crowd of more than 80,000. I drove a good race and ran with the leaders – Hill, Surtees, McLaren, Rindt, Brabham... That was a good race.

Stewart writes in his autobiography *Winning is Not Enough:* "The British crowd were becoming increasingly noisy and excited as the new young British driver moved into the lead. Keep it smooth I tell myself... only a few laps to go. In my rear-view mirror I see the world champion John Surtees in his Ferrari. Ahead of me I see his team-mate Lorenzo Bandini. I am concerned. I have to lap Bandini but maybe he'll give me a hard time and let Surtees get closer. Don't get outfumbled. There's a gap, go for it... nice and smooth. I slip past Bandini... open road ahead ... Surtees won't catch me now."

1968 GERMAN GP, 4 AUGUST, NÜRBURGRING
The results sheet says everything about this victory: first Jackie Stewart 2:19'03.2; second: Graham Hill 2:23'06.4. A winning margin of more than *four minutes,* in foul conditions at the most fearsome race circuit ever to be a part of the F1 calendar. "That one was pretty special," admits Stewart.

Stewart writes in *Winning is Not Enough*: "After I won there in 1968, I christened it 'The Green Hell'. I've always joked that if anyone says they enjoyed driving fast around the Nürburgring they're either lying or weren't going fast enough. It's a relief to be out in front and I keep concentrating. I hit a deep river of water and I know I have lost control. The car is hurtling towards a marshal... I feel sure my car is going to hit him, but then by some miracle it finds a little grip – just enough for me to regain control and coax it back into line. I complete the lap and finish the race. Ordeal over."

1971 MONACO GP, 23 MAY, MONTE CARLO
A 25-second winning margin over noted hotshoe Ronnie Peterson... in a car with no rear brakes. "I knew I had a broken axle," says Stewart. "I knew that on the grid, but I had to work around it. It was an 80-lap race, too, so I was in for the long-haul.

Stewart writes in *Winning is Not Enough*: "I started from pole position and held on to first place and gradually established a commanding lead over Ronnie. I missed the rear brakes, on the demanding and unforgiving streets of Monaco, but got by, adapted and was able to complete the victory. Ken Tyrrell told me 'well done' – he clearly recognised how difficult it had been. In all the years I raced for him this was the only time he ever said 'well done' to me."

Goodyear and Ford's vehicle dynamics engineers. That tallied up to 86 transatlantic flights, 725,000 airborne kilometres, 18 full round-world tours. As he criss-crossed the ocean with threads of ambition, he unwittingly wove a straightjacket from which his body demanded release.

"Really... I nearly died that year with mononucleosis. I was so exhausted that I didn't even pick up my world champion's trophy. Helen [Sir Jackie's wife of more than 50 years] did it for me."

Those off-track exertions would tell more deeply in 1972. A stomach ulcer, a compromised F1 campaign (Stewart had to skip the Belgian GP) and second in the points behind Emerson Fittipaldi – although a glance at the table reveals Stewart's strong form at the season's start and end, when fully fit.

THE RACER TURNS SAFETY CRUSADER

"I'm surprised more people didn't see how that year took a lot out of me," he says. "It nearly broke me and I came very close to retiring at the end of 1971. It cost me the chance of a title in '72, but Emerson was driving well and his Lotus was fantastic. I learned a lot that year."

The magic carpet ride, then, would continue: still the giddy whirl of front-line F1 success (a third and final title in '73); still the remarkable social scene: "I remember meeting the NASA astronauts around then. I mean... not everybody gets these privileges. I was very aware of that."

But there were shadows at the fringes of Stewart's existence that even one of such a forceful disposition couldn't dispel. His Tyrrell protégé, wing-man and anointed successor François Cevert was killed in practice for the final race of the year – the US GP at Watkins Glen. Stewart already knew he would retire at the end of the season; he stopped, instead, one race early, unable to continue after the loss of another close friend. Stewart's tally of grand prix starts will always show a poignant '99'.

"There's no question that the proximity of death in racing at that time drove me capitalise on my position while I could," he says. "We saw death up close and personal – and the effects of it on those left behind. That affects your attitude to what you're doing and makes you conscious of trying to make the most of every moment. Jochen [Rindt, posthumous 1970 world champion] was one of my best friends, so was Graham [killed in a plane crash in 1975] and Jimmy [killed in a 1968 Formula Two race]. And Jo Siffert, François, Scarfiotti... Helen and I counted one year and we realised that we knew 57 people who had died in racing – not just in F1. Now, outside my house we have 38 benches in memory of those people who we felt were close enough to us. The memories never go and we learn something from them."

Stewart being Stewart, he didn't simply accept that death should be inevitable in motor sport and he dedicated himself to becoming one of the most outspoken campaigners for better safety standards in F1.

Perhaps that's the truest measure of the man: for all the success beyond motor sport, it's as a racing driver – one of the greatest – that he's best appreciated.

And with just a little nudge, he'll admit it: "There's no doubt that I am where I am today because I am a racing driver." ■

Clark (centre), here with Stewart and Graham Hill, was Jackie's hero and idol

Stewart on Jim Clark

"Jimmy was by far the best driver I ever raced against and I learned an enormous amount from him because we spent such a lot of time together. Both being Scottish, we shared an apartment in London, but he didn't care for the glamour of Formula One. We raced together, went on holiday together and became very good friends.

"If I ever went back to his farm, there was no 'racing driver' there at all, he was a farmer. He'd go out with the sheep, to the sales... he lived a perfectly normal life. Completely unspoiled. Sometimes we'd chat and just not talk about motor racing and that kind of hid his competitiveness, and my goodness there was a competitive fighter inside that humble farmer.

"When I think of how he drove, it was the smoothness more than anything. He was *so smooth* and I would say any driver today should just look back and see how he drove. Look how Fangio drove: there was no spectacular driving by Juan Manuel Fangio; there was no spectacular driving by Jim Clark. And I learned everything from him.

"But I don't think Jimmy realised what he was doing. It was a completely natural thing for him. Whereas for me, watching him, it was like I was seeing the reality of how it could be done better than just driving by the seat of my pants.

"At that time we had 1500 cc F1 cars with skinny tyres, so you had to be smooth to lose no speed in the corners. And I was able to follow Jimmy, sometimes during practice. We spent a lot of time on the track together and I learned how to be smooth watching Jimmy.

He didn't stress a car, didn't stress its suspension by abusing it the same way as some other drivers. So many people think that to drive fast you have to be really pushing and shoving. It's quite the reverse. I learned all of that from him and there are not that many drivers who have been able to do that. Alain Prost is the only other one I know who had the same technique.

"I sometimes wonder if Jimmy really knew how good he was. Because I don't think he did. I just think he thought he had a great car. And he *did* have had a great car, make no mistake about that. So with Jimmy in a Lotus 33 and the grip that it had, there was no competition really. The car was so good, but so was he; he drove a Lotus 30 sportscar faster than everybody else and that was a terrible car. He also drove a Lotus Cortina touring car better than anyone.

I don't think he was aware of his following, despite being on the cover of *Time* magazine, nor of how dominant he was."

PHOTOGRAPHY: LAT, DPPI

Stewart was a world champion F1 driver and winning team boss (below)

FINAL LAP

Freeze frame

THE FIRST LADY OF F1

In January the motor racing world lost one of its true pioneers, Maria Teresa de Filippis, the first woman to race in Formula One

When, in the late 1940s, Italy's Maria Teresa de Filippis was challenged by her brothers to translate her fearlessness on horseback to four wheels, so began a remarkable tale of determination and single-mindedness that resulted in the petite Neapolitan making history as Formula One's first female driver.

"I started racing because of that bet, but when I discovered I liked it – I thought, 'I'll just carry on racing'," she later recalled.

That first taste of racing came at the 1948 Salerno-Cava dei Tirreni, where she finished second overall in a Fiat 500, She was soon battling stars of the age - Juan Manuel Fangio, Alberto Ascari, Luigi Fagioli – in gruelling events such as the Mille Miglia and Targa Florio and by 1954 she was a front-runner in the Italian Sports Car Championship. After finishing second overall she was invited to join the works Maserati squad. Over the next few years she scored a number of standout results, finishing second at the 1955 Pergusa Grand Prix and repeating the position in the 1956 Napoli GP.

Two years later she was offered the chance to race Fangio's 1957 F1 title-winning Maserati 250F at the Monaco GP, but failed to qualify. The setback did not deter de Filippis and a month later she returned to grand prix racing, again in a 250F, at the Belgian GP. This time the hard-charging Italian qualified 19th and on Sunday, 15 June, she became the first woman to start an F1 race, finishing 10th place in a field that included future champions Mike Hawthorn, Jack Brabham and Graham Hill as well as Stirling Moss, Tony Brooks and de Filippis's soon-to-be friend and mentor Jean Behra.

De Filippis would race twice more in F1 – in Portugal and Italy in 1958 – but when Behra was killed in a sports car race at Avus in Germany in August 1959, she immediately retired from racing. "Too many friends had died," she said later. "I didn't go to the circuits any more. The following year I got married, then my daughter was born and family life became more important."

In later life she joined the International Club of Former F1 Grand Prix Drivers, becoming its Vice-President in 1997. She was also president of the Maserati Club. She died in January, aged 89.

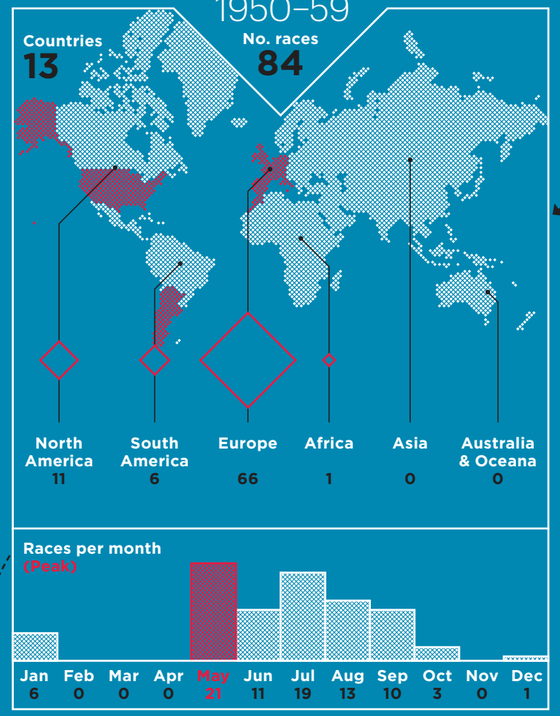
Commenting on de Filippis' passing, FIA Women in Motorsport Commission President Michèle Mouton said: "The loss of Maria reminds us to remember and admire the first woman who ran at the highest level of motor sport, F1. As always, she proved that when one wants something enough, one can do it... and we must continue to encourage more women to follow her example."

Maria Teresa de Philippis only started motor racing for a bet, but ended up making history

Maria Teresa de Filippis at the wheel of her Maserati 250F on her Formula One debut at the 1958 Belgian Grand Prix.

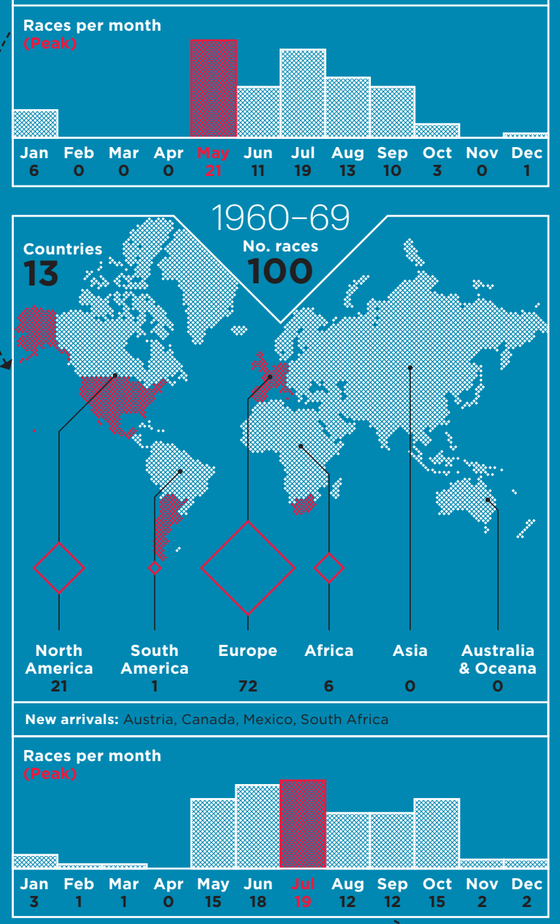
AUTO / ISSUE #14

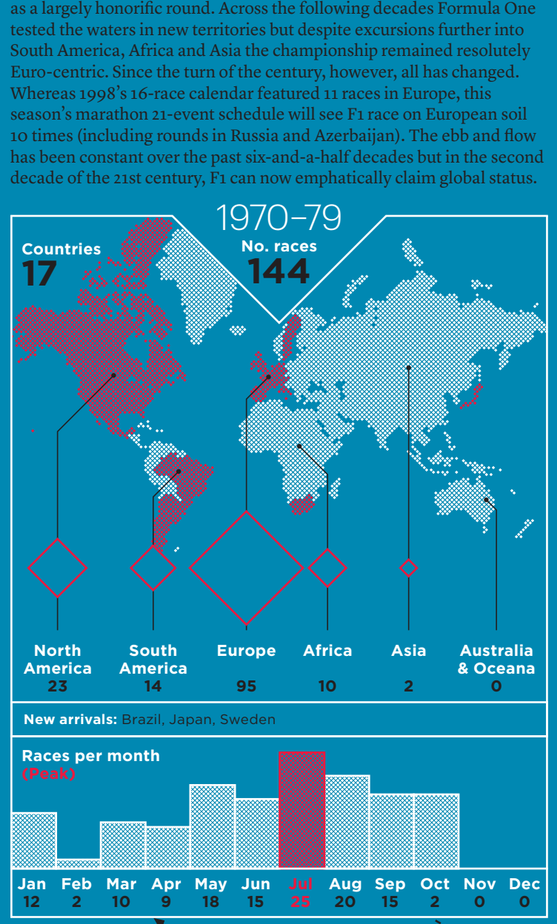
1950–2015 PLANET F1

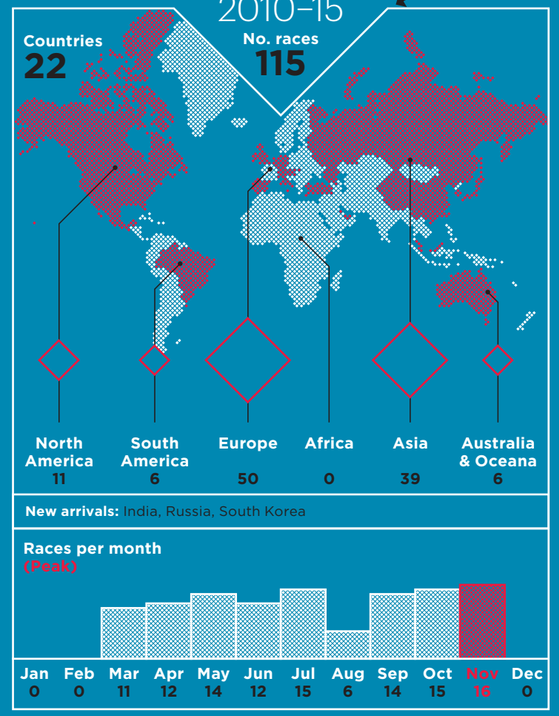


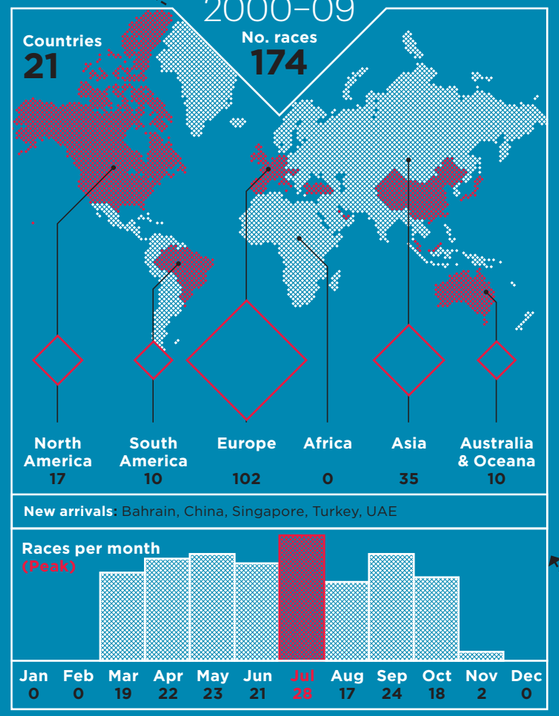
This year sees the FIA Formula One World Championship embark on the most extensive season in its 65-year history. Over the next nine months the series will crisscross the globe taking in races across 21 countries, across five continents.

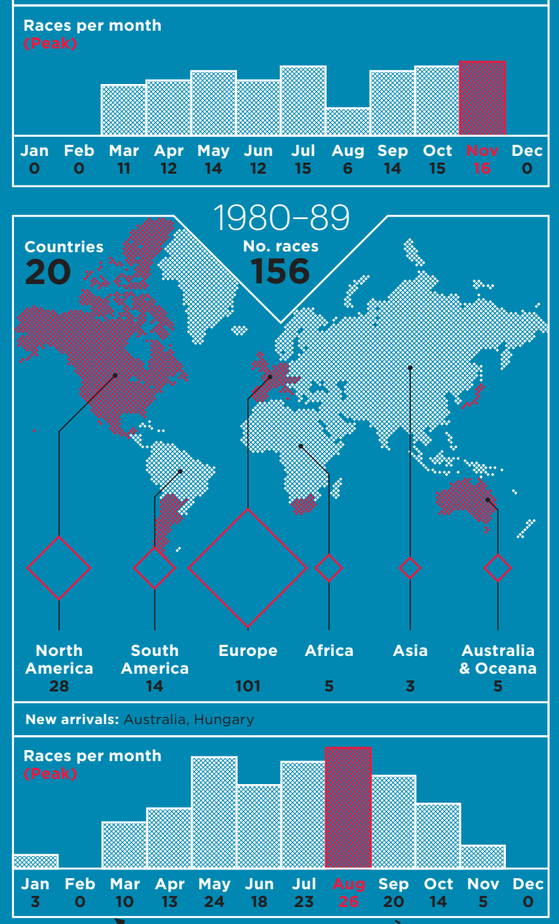
It's a world way from the championship's first season in 1950, with just seven events, all in Europe, and with the Indianapolis 500 included as a largely honorific round. Across the following decades Formula One tested the waters in new territories but despite excursions further into South America, Africa and Asia the championship remained resolutely Euro-centric. Since the turn of the century, however, all has changed. Whereas 1998's 16-race calendar featured 11 races in Europe, this season's marathon 21-event schedule will see F1 race on European soil 10 times (including rounds in Russia and Azerbaijan). The ebb and flow has been constant over the past six-and-a-half decades but in the second decade of the 21st century, F1 can now emphatically claim global status.











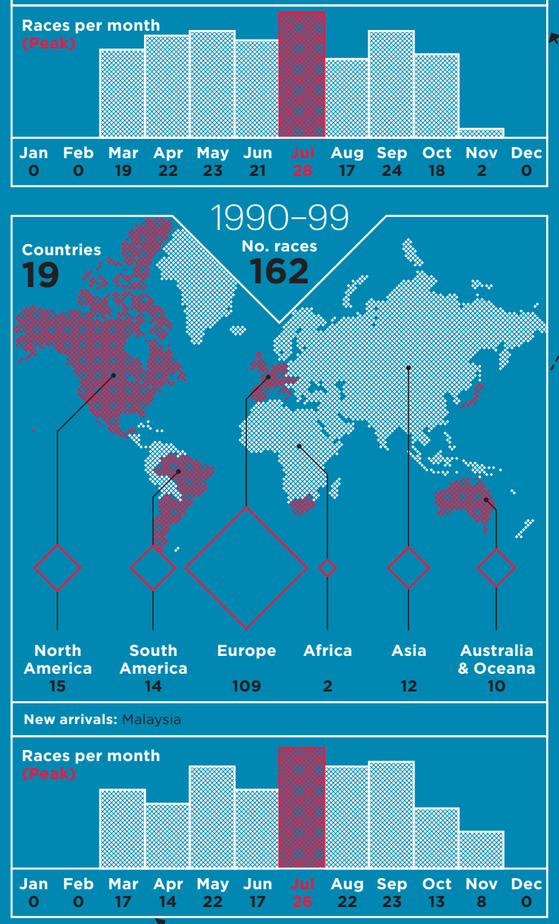


ILLUSTRATION: FRASER LYNESS

FINAL LAP

The last word

HOLLYWOOD WANTS THE WORKS

Petter Solberg, the only driver to win FIA world championships in two categories, on defending his World Rallycross crown and why his other key goal this year is securing manufacturer backing

Q Last year's title win looked a lot tougher than the first. Was it a difficult campaign? Have you recovered yet?
A It's a hard sport. There are so many specialists there that it's always hard. It's not like WRC; there are so many factors involved when you are driving side by side with so many people! I think in general last year was more about strategy driving, taking the long-term view and thinking about the season in terms of taking as many points as possible wherever they came. It wasn't easy - that's for sure. With the Peugeot Hansen team there and Mattias Ekstrom with his Audi, the competition was very difficult. Peugeot took things to a very high level in the second half of the season and I understood that for this year we had to improve a lot. We're testing now, so I'm on the case.

Q You have another year with the Citroen DS3. Do you think you can keep it competitive against rivals with manufacturer backing?
A I have a good development plan that we have been working on over the winter and we started testing early. I'm sure we can get more out of the car without a problem, it's just more testing. But obviously we're working very hard to get factory support for the future. I had an offer from Ken Block to drive for his team in October, but to be honest I don't want to have anyone beside me deciding what I do. I really want to build my own team and secure manufacturer support for it. I travelled to England for meetings recently, so I would say things are looking positive.

Q The series has grown a lot and is increasingly attracting manufacturer input. Is the backing of a works outfit now crucial to a title challenge?
A The series is growing so quickly. Rallycross is spectacular, it's' great for TV, it's easy for sponsors to come to the venues and there's action all the time. In terms of manufacturers? They are now coming in properly, Ford is arriving with a full team, Audi are there and Peugeot too. There's big support.

Q How important is it for your long-term success and your teams that you secure that kind of backing?
A If I'm going to continue, if my dream is to go on then yes, that's the big thing for me to continue to develop. Drive for a few more years and then hopefully run the team myself. That's the plan.

Q There were other things on the table for you this year? You had an offer to compete in the Dakar Rally, but you turned it down. Why did you do that?
A Largely it was because it wasn't possible to do the proper preparation. I normally do things in a very analytical way and there was no real chance to do that. If I had won the world championship in rallycross a little bit earlier then yes, maybe I would have done it. I have possibilities for 2017 but the main thing is to land factory backing.

Q You're heading into a second title defence in a little over a month. Where do you expect main challenges to come from?
A The Ford team will be strong. It's a full factory team. I know how it's set up and how it will work and they will be strong. Peugeot, too, but we will see what happens there. The rumour is that [Sebastien] Loeb is coming as part of a three-car team. They have a lot of good people there, so it will be tough. Motor sport is never easy, and while those are the obvious challengers it will be tough everywhere. Even though some of the other guys are not as well-known, they are real specialists and they are very good drivers. But I'm looking forward to it. I'm always ready.

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