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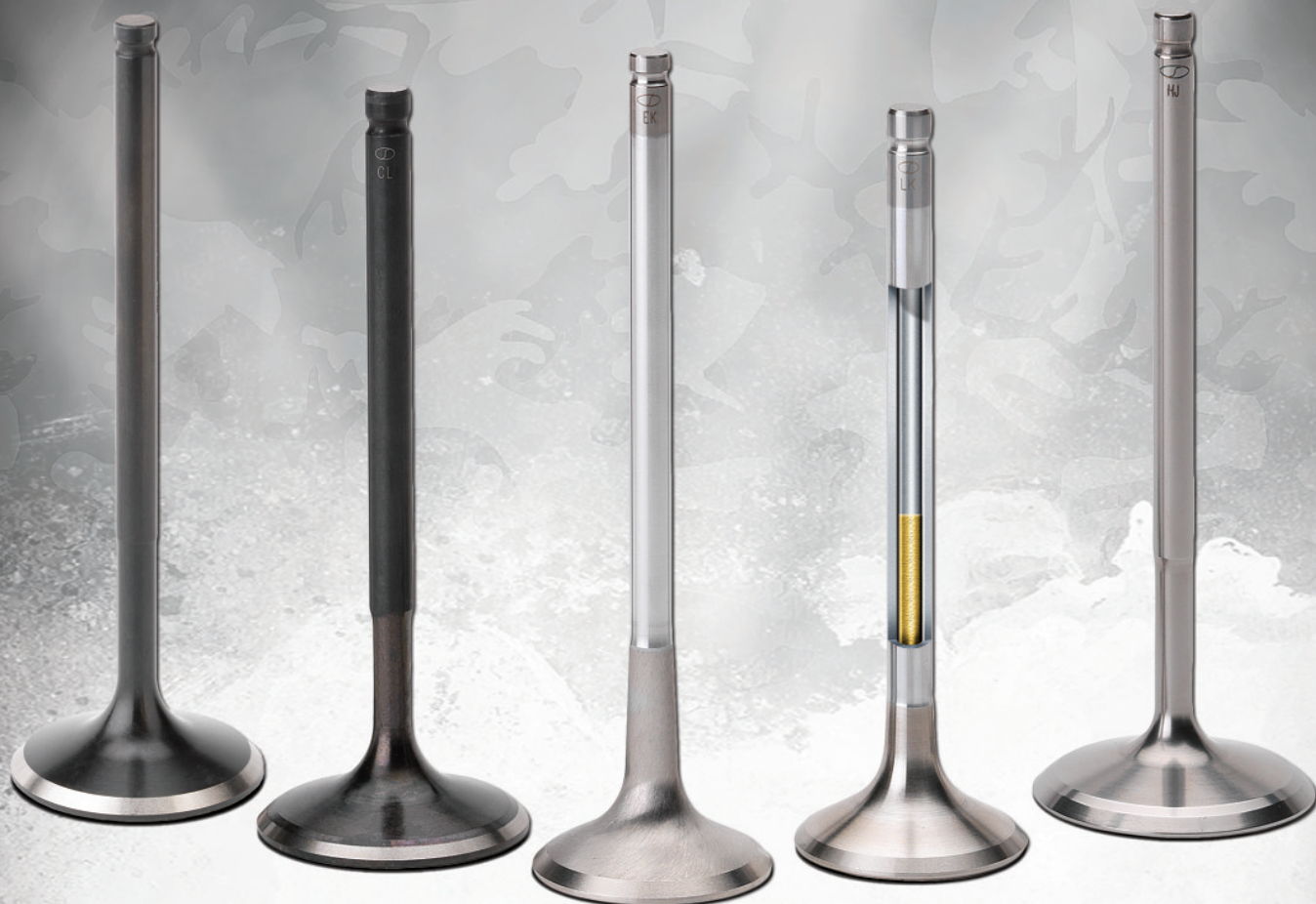
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WING AND A PRAYER

YOU can always spot the pioneers by the arrows in their backs. And right now, Peugeot has quite a few feathered shafts protruding from its lion emblem.

The French manufacturer joined in the merriment when it first launched its innovative 9X8 World Endurance Championship challenger, the wingless wonder. It even gave out little cakes, shaped like a rear wing. 'Here's where the missing wing went!' My, how we laughed.

Nearly three years on, the latest version of the 9X8 has just been launched – complete with a rear wing – and many of the smiles have faded. But some people are laughing. You can hear them now: 'Oh well done, they've just discovered what the rest of motorsport found out 50 years ago – it works better with a rear wing on!'

Yes, the 9X8 endured a torrid, at times almost embarrassing first full campaign. And yes, Peugeot does have 'form' for previous humiliation. Back in 1990 its 3.5-litre 905 sports-prototype was hijacked by the company's automotive stylists, with the resulting racecar so poor that Jean Todt's first act upon taking charge was to bin the car and commission its successor.

The difference this time around is that the rules were deliberately conceived to accommodate each manufacturer's own styling cues. The WEC Hypercar rules were innovative; Peugeot responded with an equally avant-garde design. Both were a breath of fresh air. So where did it go so wrong?

Peugeot points out that the 9X8 was created to technical regulations drawn up in

2020/2021. However, between the design phase of the car and its competitive bow in the summer of 2022, the regulations changed. Where LMH cars were originally to use 31 cm tyre widths front and rear, teams can now take advantage of different sizes – as Peugeot has done with its revised car, choosing to fit 29 cm tyres at the front and 34 cm at the rear.

Where things get messy is Peugeot's indignant insistence that the "structural design handicap" of its original car could – and should – be offset through the Balance of Performance. There is a lingering suspicion that while the car's underbody aerodynamics and 50-50 weight split could spring an upset on smooth asphalt, bumpier circuits or rougher track surfaces betray it, rendering it beyond even the help of BoP.

The 9X8 was a brave concept, harnessing underbody downforce to dispense with the traditional rear wing. Had it worked, it would be the stuff of legend. It didn't – not over a range of circuits – but surely in a sport so often preoccupied with infinitesimally small increments, you have to applaud Peugeot's bravery for daring to be different?

Incidentally, that revised 905, the Evo 1 bis, went on to etch an indelible mark in the Le Mans history books. I hope the 2024 9X8 does the same. **LT**



Mark Skewis
EDITOR

FIA DEAL WITH AVL RACETECH “PUSHING LIMITS OF INNOVATION”

Partnership opening new frontiers as energy transition drives motorsport's regulatory decisions. By **Mark Skewis**

RIGHT AVL RACETECH's vehicle dynamics simulation software is helping to shape the future of motorsport

THE Fédération Internationale de l'Automobile (FIA) has hailed its partnership with AVL RACETECH as “a significant step forward in the development of motorsport technology”.

The governing body has named AVL RACETECH as an official supplier of Vehicle Simulation Software and related services. Its expertise will be harnessed in the field of vehicle dynamics and simulation.

The global motorsport division of AVL, AVL RACETECH's lap-simulation expertise is utilised by the FIA across a range of championships. They include Formula 1, Formula E, the World Rally Championship, the World Endurance Championship and cross-country events.

FIA Chief Technical & Safety Officer, Xavier Mestelan Pinon, said: “The Vehicle Dynamics Lap-time Software from AVL RACETECH unlocked unprecedented simulation capabilities within the FIA Technical Department from which the entire FIA benefits. This software plays a pivotal role in crafting technical regulations of the vast majority of FIA Championships (F1, FE, WEC, WRC...), assists the circuit homologation process and ultimately helps in shaping the

future of motorsport exploring new technologies or boosting the existent.

“As an example, our partnership with AVL RACETECH is currently instrumental in moulding the next generation of Formula E cars. With this cutting-edge software, we're pushing the boundaries of electrification and performance to uncharted territories for electric vehicles.”

Formula E is evaluating the changes that will transform the series with the introduction of its Gen4 chassis, due to test in 2026. It offered a glimpse

of what lies ahead when its GENBETA variant harnessed extra battery power and unleashed some of the potential of its front powertrain to set a new indoor speed record in London last year.

However, with the new car likely to have 600 kW of power available, compared to the 350 kW of the existing car, there are fears the new machines may be too fast for some of the racetracks currently on its calendar. Using AVL RACETECH's simulation software, therefore, could be pivotal in placing the Gen4 in the right performance territory.





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“With this cutting-edge software, we’re pushing the boundaries of electrification”

The Formula E collaboration is merely the tip of the iceberg for a sophisticated vehicle dynamics simulation toolchain that has been developed by between 20-30 skilled coders every day for more than 20 years.

The software incorporates comprehensive models of the whole car and the environment. Each tool can be applied as a standalone solution, or as part of a fully integrated system. Processing power is increased considerably by a cloud-based solution, enabling up to 100,000 laps to be simulated within a very short time.

Invaluable


The software has come in to its own as regulators wrestle with the myriad propulsion options required as the sport navigates its way through the wider energy transition. The ability to vary every parameter in the digital domain is invaluable: not only for reducing track testing and use of energy intensive wind tunnels – the new-generation Formula 2 car ran more than 200,000 simulated laps in its gestation period – but for predicting the outcomes for the introduction of sustainable elements such as hybrid systems.

LEFT The successful Hypercar/LMDh category used in WEC and IMSA was developed with the aid of AVL RACETECH's technology

AVL RACETECH's strategic orientation is based on providing cutting-edge solutions for the development of powertrains and vehicle systems. By partnering with the FIA, AVL RACETECH will be able to further develop its software and simulation tools to meet the needs of the motorsport and automotive industries.

AVL RACETECH's Michael Peinsitt, Department Manager Race Engineering, said: “AVL RACETECH are honoured to extend our partnership with FIA in the field of vehicle dynamics simulation for motorsports applications. Over the past four years, our collaboration has yielded remarkable results, pushing the limits of innovation in that field. Our shared commitment to excellence coupled with our collective expertise, ensures that we will continue to drive progress and shape the future of vehicle dynamics simulation.”

A key supplier for teams in the most respected racing series, from Formula 1 and NASCAR to MotoGP, AVL RACETECH works with customers in more than 17 racing series across the globe in the fields of engineering, testing, simulation and manufacturing.

Earlier this year it completed the delivery of 22 containerized test cell modules to Red Bull Powertrains in Milton Keynes. More than 50 AVL experts helped with the commissioning of the modules, which already play an important role in the development of the upcoming 1.6-litre V6 Power Unit designed for the 2026 F1 regulations. 



Lola's Yamaha Formula E coup

LOLA CARS has announced its return to global motorsport with a stunning coup to take Yamaha Motor Company into the ABB FIA Formula E World Championship.

The multi-year technical partnership is the first of several major projects planned to re-establish the British company as an industry leader in sustainable engineering and motorsport. Its strategy will focus on three areas of electrification, hydrogen and sustainable fuels and materials.

Lola, a brand with more than 500 championship wins to its credit, is working with Yamaha to develop and supply a powertrain to be on the Formula E grid for next year's campaign: Season 11.

This new partnership not only provides an opportunity to join the ABB FIA Formula E World Championship as it moves to the GEN3 Evo platform for the 2024/25 season, but also creates opportunities across global motorsport and in the broader zero emissions transportation space.

"For us, this is more than just an opportunity to return Lola to the track, it's also a fantastic platform for technological development," said Mark Preston, Motorsport Director, Lola Cars Ltd. "Lola Cars has a decorated history of success in chassis and aerodynamic design. This project will allow us to create a unique electrified platform with a software focus at its core to provide a basis

ABOVE Lola Cars is returning to top-tier racing through a technical partnership with Yamaha

for Lola's wider plans in defining the future of motorsport technology."

Best-known in motorsport for its motorbikes, Yamaha did produce Formula 1 engines from 1989 to 1997, coming closest to winning a GP with Damon Hill's Arrows in Hungary in 1997. Recently it has been part of a consortium of Japanese manufacturers exploring various options for achieving carbon neutrality.

"Yamaha Motor Company is accelerating the research and development of various technologies that contribute to sustainability," said Heiji Maruyama, Managing Executive Officer and Director, Yamaha Motor Co., Ltd. "As the technical partner, we hope to acquire more advanced energy management technologies through the highest level of electric racing in Formula E. We also share Lola's new philosophy of sustainable motorsport and we are very pleased and honoured to form this partnership with them."

Tech development

"To be selected by one of the most innovative OEMs in the world to partner on a project of this significance is a testament to the calibre of the team that we have been building at Lola," said Till Bechtolsheimer, Chairman, Lola Cars Ltd.

"The focus of this project is squarely around technological development in which Lola is fully invested. We see the highly efficient 350 kW electric powertrain that underpins the manufacturer's perimeter in Formula E, as a cornerstone technology with exciting applications across many forms of top-flight international motorsport in the coming years."

Since acquiring Lola Cars in 2022, Bechtolsheimer and his team have been developing their programme from a new global headquarters in Silverstone, UK, building on the legacy of the most successful manufacturer of customer race cars of all time.

Founded by Eric Broadly in 1958, Lola Cars has designed and produced nearly 5,000 racecars spanning 400 different model types. **TV**



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THE FIA, the Fédération Internationale de l'Automobile, has been working with AVL RACETECH's vehicle dynamics simulation software for motorsport since 2017.

After the successful collaboration of the past years, we are pleased to announce that our partnership with the FIA is now official!

This agreement strengthens our relationship and allows us to continue developing innovative solutions together.



New Peugeot 9X8 features rear wing

PEUGEOT'S World Endurance Championship challenger, the 9X8, has been redesigned to incorporate a rear wing.

The original car created a stir when it was first revealed, taking advantage of the groundbreaking WEC rules to produce an equally innovative design. The concept was to create sufficient underbody downforce that a conventional rear wing could be dispensed with.

Results have, however, been disappointing. The 9X8 did show flashes of promise amid changeable conditions at Le Mans last season. It also spent much of the opening race of the 2024 season at the front in Losail – ironically its last event. In between, its performances were underwhelming and Peugeot has blamed a change in regulations for having hobbled its avant-garde design.

It says the revised car, dubbed the 2024 Peugeot 9X8, was designed with a rear wing to make the most of rules that allow teams to deploy a more effective tyre set-up using different widths at the front (29 cm) and rear (34 cm).

In its initial version, the 9X8 was designed using a set of specifications that met the technical regulations drawn up in 2020/2021. However, between the design phase of the car and its competitive bow in the summer of 2022, the regulations changed, opening up the potential for improving performance in certain areas.


“We made choices that are no longer the right ones now and this difference in performance was not sufficiently offset by the BoP (Balance of Performance) in 2023,” explained Olivier Jansonnie, Peugeot Sport Technical Director. “The idea was therefore to go back

ABOVE Peugeot has confirmed the 9X8 will race with a conventional rear wing

to a car design that is similar to that of our rivals’ car design, so that it would then be given equivalent treatment by the BoP. This is why we decided to drop the use of identical 31/31 cm tyre widths on all the wheels, choosing to fit 29 cm tyres at the front and 34 cm tyres at the rear. Strictly speaking, it’s not a new car, as it has the same chassis, but there are a lot of upgrades. For the tyres to work effectively, we had to alter the centre of gravity, which meant moving certain components and making others lighter. And in order to have a better aerodynamic balance, we also had to look at redistributing the aerodynamic loads, which resulted in us redesigning approximately 90% of the bodywork components, most notably adding the rear wing.”

Jean-Marc Finot, Stellantis Motorsport Senior VP, reiterated that the regulations had evolved since the 9X8 was designed to have equally-sized tyres. “We had thought that the BoP would be enough to offset our structural design handicap, but this has not been the case,” he said.

“It was therefore necessary to redesign part of the car to adapt it to the new tyre dimensions. Our simulations and initial track testing sessions have shown that the car has more performance. We therefore hope to stay among the frontrunners without however getting close to the BoP limit, with minimum weight and maximum power.”

Although the car retains the same crash structure, Peugeot has used the new homologation to add some performance and reliability upgrades with revisions to the 2.6-litre twin-turbo V6 and its seven-speed gearbox. The car will make its competitive début at the 6 Hours of Imola on April 21. 

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Akkodis ASP Team recently relied on Ferodo Racing TL180 brake pads at the Qatar 1812km FIA World Endurance Championship race!

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How fan survey is helping shape future of WRC

THE FIA has revealed details of how the results of a fan survey will help mould the future of the World Rally Championship.

The reshaping of the sport's top tier now has a clear and positive direction following the approval of the WRC Working Group's proposals by the World Motor Sport Council. With the spec hybrid system to be dropped, the series will increasingly head down a WEC-style Balance of Performance direction.

New rules will use a common safety cell to reduce costs and complexity, and allow manufacturers and tuners to develop cars with their own bodywork based on production models including B-class, C-Class, compact SUV or a Concept Car designed to tight technical criteria such as centre of gravity and aerodynamics in order to equalize performance.

The power output will be targeted at 330 hp, with the engine performance controlled by a reference torque curve for all cars. Engine and transmission will be cost-capped and technology limited to Rally2 equivalence. Aerodynamic efficiency will be limited along with a top speed restriction to reduce development and cost.

As part of the pathway that has now been established – with recommendations

that span promotion, sporting and technical – results of the FIA's WRC Fan Engagement Survey have been a central consideration. Over 11,000 respondents from across the world shared their feedback, providing invaluable insight on several topics including the format of rallies, car types and specification, and further fan focus groups allowed for a targeted review of key recommendations.

Unsurprisingly, the unique nature of WRC shines through, with Rally fans feeling strongly that it is set apart from other motorsports thanks to its format, location and variety, in particular its unpredictability (93%) and the role of nature in the rally's outcome (95%), adding to the excitement.

A huge 98% agree that the WRC should continue to host events across the year to ensure a range of surfaces – snow, gravel, asphalt – which adds to the experience.

But, whilst pleased with the current state of the Championship, fans also shared their thoughts across a range of topics:

When it comes to technical aspects:

- 72% are in favour of regulations to ensure equality for larger base model cars, with 65% agreeing there should be a price cap on cars
- 97% want to see more manufacturers get involved

- Sustainability is on the agenda with 59% agreeing with the importance of using sustainable fuels, but only 23% favouring hybrid technology.

When asked about the format:


- 80% want to see more 'Endurance' rallies in the future
- In the future, fans want formats to remain variable and for the WRC to ensure there is a good balance between shorter events and 'Endurance' rallies
- 87% want to see standardization of on-board cameras to enhance TV coverage.

Looking at the drivers:

- 94% feel that the unique nature of the driver's skills are just as important for success as the performance of the car, with 92% agreeing that the WRC stands apart from other motorsports because of the teamwork between the drivers, co-drivers and the engineers
- Amateur drivers add to the excitement, with 86% of fans stating that they like that they can compete on the same course as professional drivers
- 62% are inspired by the drivers, whilst 68% consider them great role models.

Finally, when it comes to engagement and how fans are watching:

- 92% get their information from motor sport media and 89% from online media
- Of respondents who have attended WRC events, only 29% have done so in the last 12 months, with the main barriers to engagement being distance or cost
- However, 87% of those who watch WRC events have watched one in the last three months, with those who haven't watched it being because of lack of access (50%)
- Just over half (53%) are satisfied with the amount of television/online coverage and fans would like the WRC to expand its coverage of the rallies as much as possible, striking a balance between free and paid for content.

FIA President, Mohammed Ben Sulayem, said: "The impressive response from WRC fans is a clear indication of the passion held for this unique motorsport, and the information they have shared is invaluable as we look to review the championship and set future objectives. Thank you to all who took the time to share their thoughts." 



LEFT With fans wanting more manufacturers involved, Rally2 and Rally1 are being brought closer together

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LEFT A Google Cloud-developed gen AI 'DriverBot' underpinned Jake Hughes' setting of a new indoor land speed Guinness World Record of 218.7 km/h

Formula E to unleash power of AI with Google Cloud tech partnership

A NEW multi-year technology partnership with Google Cloud is to be leveraged to help drive on-and off-track performance in the ABB FIA Formula E World Championship.

The collaboration will involve Formula E harnessing Google Cloud technologies ranging from scalable cloud infrastructure to data and analytics, to generative artificial intelligence (gen AI) tools in the GENBETA Race Car Development Programme.

The generative AI is currently capturing much attention in the motorsport world, with teams and regulators alike scrambling to capitalise on a technology that has been dubbed the new industrial revolution.

Formula E and Google Cloud will build on a relationship that began last summer with NEOM McLaren Formula E Team driver, Jake Hughes, setting a new indoor land speed Guinness World Record of 218.7 km/h. The record was underpinned by a Google Cloud-developed gen AI 'DriverBot' for GENBETA, Formula E's race car development programme. 'DriverBot' harnessed real-time data from the car, alongside historic race data, to help Hughes and his engineers smash the existing indoor land speed world record by more than 50 km/h.

Jeff Dodds, CEO, Formula E, said: "Our

multi-year technology partnership with Google Cloud is clear evidence of the scale of our ambition in establishing Formula E as the world's most innovative, exciting, and fastest-accelerating sport. We began our collaboration by setting a world record and are hugely ambitious about what's next."

The technology partnership will see Formula E and Google Cloud explore three core areas: new technologies in sporting development, harnessing advanced data analytics and generative AI through Google Cloud's data streaming and processing tools; accelerating fanbase growth, analysing massive datasets of fan behaviour, preferences, and demographics to create highly tailored marketing campaigns; and sustainability leadership.

Henry Chilcott, Chief Marketing Officer, Formula E, said: "Alongside the pioneering work to harness the power of gen AI to drive performance in our GENBETA programme, the next stage of this partnership will help us unleash a powerful new phase of fanbase growth by putting the full force of Google Cloud technologies behind our marketing efforts."

Laurence Lafont, Vice President, Strategic Industries EMEA, Google Cloud, said: "Google Cloud is excited to partner with Formula E to bring the cutting edge

of cloud technologies to the thrilling world of electric racing. Together, we'll accelerate innovation on and off track, and build the future of sustainable motorsport."

Given that Artificial Intelligence has made the news headlines for threatening the possible extermination of mankind, perhaps it should be of little surprise that the technology has increasingly become a big-ticket item in motorsport.

The technology's potential to replace physical testing and simulation has attracted the attention of teams and the FIA alike. The governing body is evaluating AI's possible sustainability gains, given that the deployment of deep learning could curtail the use of energy intensive wind tunnels.

Simon Dodman, FIA Principal Aerodynamicist, recently revealed to Race Tech how the governing body hopes to harness Artificial Intelligence as a force for good – potentially benefiting the racing spectacle, safety and sustainability – rather than just stamping on it.

He showed the staggering comparison between a set of slices through a Formula 1 car's wake generated with state-of-the-art Computational Fluid Dynamics and a set driven by generative AI. The CFD took three hours. The other was completed in 11 seconds. **RT**

Progressive braking

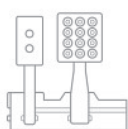


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Audi plans 100 per cent takeover of Sauber Group

AUDI is strengthening its commitment to its F1 entry for 2026 by planning a full takeover of the Sauber Group.

The German manufacturer acquired a 25 per cent stake in the Swiss outfit prior to the 2023 season, with a view to this increasing with further 25 per cent stakes in 2024 and 2025. Originally, this would have taken Audi to around 75 per cent ownership of the team, but priorities have now changed.

Audi plans to take over 100 per cent of Sauber Holding AG. A corresponding agreement has been reached with the current majority shareholder Islero Investments AG, which fully supports the change.

Oliver Hoffmann is set to be the person responsible for the Audi Formula 1 programme overall. Former Porsche and McLaren team principal Andreas Seidl will become Audi F1 Team CEO.

Hoffmann, currently heading the Technical Development division, will be made a General Representative by the Board of Management. The newly

created position will unite all three pillars of the Formula 1 programme: the stake in the Swiss racing team, development of the power unit by the Audi Formula Racing GmbH at the Neuburg site, as well as the strategic steering and activation of the programme by AUDI AG.

Besides the successful launch of the Formula 1 programme, this bundling also aims to strengthen the Audi brand on the global stage and ensure close collaboration between motorsports and series production.

In addition to chairing the shareholder committee of Audi Formula Racing GmbH, Oliver Hoffmann will become Chairman of the Board of Directors of all Sauber companies.

Manfred Döss, Chairman of the Supervisory Board of Audi AG, explained: "The entry into Formula 1 is not only the pinnacle of Audi's very successful history in motorsport, but also as big a sporting challenge as it is a financial commitment. Through the bundling of Oliver Hoffmann's responsibilities and the complete takeover

of the Sauber Group, we are accelerating our preparations for the 2026 season."

As Head of Audi Sport, Hoffmann celebrated international wins and championships in customer racing, in DTM, and in the all-electric Formula E World Championship. Recently, Audi became the first manufacturer to win the Dakar Rally with an innovative electrified drivetrain.

Andreas Seidl began his motorsport career in BMW's Formula 1 programme. As team principal at Porsche, he masterminded multiple world championships and three overall victories at the 24 Hours of Le Mans. From 2019 to 2022, Seidl was team principal of the McLaren F1 team, before taking over as CEO of Sauber Group in 2023.


"We have a clear roadmap for how we want to become competitive in Hinwil as well as in Neuburg," said Seidl. "We have ambitious goals. Realization of them is in progress and will be further accelerated through the complete takeover of Sauber by AUDI AG."

The Sauber Group is renowned for its state-of-the-art wind tunnel – used in recent years by the likes of Porsche, Audi and Formula 1 – and for its expertise with Additive Manufacturing and 3D Printing. However, some technical observers were unimpressed by Audi's plans to partner with the Swiss group, so the German giant's opting for a complete takeover makes a lot of sense.

• **ONE** of Audi's racetrack rivals come 2026, McLaren, has also been in the spotlight. Bahrain's sovereign wealth fund has taken full ownership of the McLaren Group, which builds high-end sportscars and owns a majority stake in the McLaren F1 team.

The Bahraini fund, Mumtalakat, was already McLaren's biggest shareholder. McLaren hailed the move as a "major milestone".

McLaren is known to be looking for new technical link-ups to help it expand its range and in particular work on developing electric vehicles.

The Swedish firm Polestar, owned by the Chinese group Geely, is among those thought to have held talks with McLaren. According to the *Financial Times*, discussions have also been held with Hyundai, BMW and Californian electric brand Lucid Motors. 

BELOW Oliver Hoffmann is set to be the person responsible for the Audi Formula 1 programme overall





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DHL deal steps up quest for greener Formula 1

DHL and Formula 1 have announced a multi-year extension of their partnership. The deal accelerates the transition into a more sustainable era of transport and logistics as Formula 1 looks to reach its Net Zero goal by 2030.

Following the successful introduction of biofuel-powered trucks last year during the European leg of the season, the number of trucks has more than doubled this year to a total of 37 vehicles. Each truck, on average, achieves an 83% reduction in carbon emissions compared to their diesel-driven counterpart.

"We are proud to be the sport's longest-standing global partner, marking DHL's 20th anniversary as the Official Logistics Partner of Formula 1, delivering the race between the races," explained Arjan Sissing, Global Head of Brand Marketing at DHL Group. "Both companies share a strong commitment to sustainability goals and a common vision to make the sport greener and more efficient."

Transformation

During their 20-year partnership, Formula 1 and DHL have experienced significant transformation, notably an expanded calendar, which this year features 24 races and has been rationalized to create a better flow of races in certain regions to reduce freight distance travelled between events. The 2024 season, the longest ever, includes three tripleheaders and five


ABOVE DHL has doubled its biofuel-powered truck fleet

doubleheaders – with Formula 1 returning to China for the first time since the coronavirus pandemic.

The most notable change, however, occurred in 2019 when Formula 1 announced its Net Zero target. DHL's multimodal logistics, incorporating road, air and sea freight, are a key factor in reducing logistics-related carbon emissions.

DHL transports up to 1,400 tons of high-value freight to each race. This includes race cars, tyres, spare parts, fuel, broadcast equipment, and marketing and hospitality equipment. The DHL Motorsports logistics team comprises 100 specialists, with up to half of them working on-site.

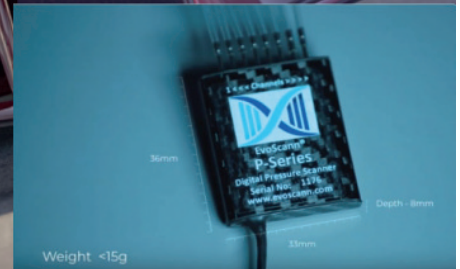
"We are continuously exploring ways to achieve Formula 1's Net Zero goal," confirmed Paul Fowler, Head of Global Motorsports Logistics at DHL Global. "We are delighted to collaborate with a partner who shares our dedication to sustainability and is receptive to innovative green solutions."

In 2017, DHL Group was the world's first logistics company to set a Net Zero target for all logistics-related carbon emissions by 2050. As part of its sustainability strategy, the group plans an additional spend up to €7 billion by 2030 to drive progress towards this goal. The company aims to increase the adoption of sustainable fuels, accelerate the electrification of its vehicle fleet, and construct carbon-neutral buildings. 

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IndyCar review mandates tech updates

AN annual IndyCar review led to a number of adjustments for the new NTT IndyCar Series season with an eye on safety and technical performance.

Echoing the direction of Formula 1, better visibility for trailing drivers during rainy conditions is one point of focus, with LEDs added to the rear wing endplates.

Another development is that of redesigned brake rotors, supplied by PFC, for improved cooling.

Specific to racing on ovals, the 2024 cars will feature the addition of a stronger front wheel bearing retaining nut to match the implementation of the updated rear wheel bearing retaining nut in 2023. The update followed a meticulous review of the incident at the 2023 Indy 500 involving the No. 27 car of Andretti Global and the No. 6 car of Arrow McLaren, which resulted in the loss of the left rear wheel assembly on the No. 27.

A stronger rear retaining ring will be introduced, as will new and stronger rear uprights with wheel tethers mounted to the upright rather than caliper studs. Updates to the rear wing front clevis will also better distribute impact loads into the attenuator.

Beginning with the Sonsio Grand

BELOW IndyCar has made a raft of changes for the new season

Prix in May on the Indianapolis Motor Speedway road course, an updated, lightweight PPG ballistic screen (aeroscreen), will be introduced. It will feature vents for increased overall driver cooling and a top front duct directing air to the drivers' chest. The ducting is 3D printed in rubber to prevent hand injuries in an accident. The updated aeroscreen will only be used on the remaining road courses and street circuits in 2024.

A number of chassis components have been lightened in readiness for the introduction of the new hybrid system after Indianapolis. They include a 3D-printed titanium aeroscreen top frame, which saves seven pounds from the previous model. Additionally, a magnesium gearbox casing and bellhousing, located between the combustion engine and the gearbox, will house the hybrid unit. **RT**



Penske Entertainment

AP Racing to supply entire IndyCar grid with clutches

AP RACING has become the sole clutch supplier for the 2024 NTT IndyCar season.

Each of the 14 teams is running AP Racing's ultra-lightweight CP8278 three-plate, 10-bolt clutch, which has been designed to withstand the demands of open-wheel racing. The carbon/carbon device features a pull-type configuration, while a cushion pressure plate system helps with clutch modulation.

AP Racing says the teams will benefit from increased efficiencies in clamp and release loads, as well as increased wear allowance between

re-shims. The company has also designed a single bespoke slave cylinder to complement the clutch that can be used in different installations to suit the drivers' differing needs.

David Hamblin, managing director of AP Racing, commented: "AP Racing technology has featured in IndyCar for more than 40 years, supplying a range of components to teams up and down the grid. We're delighted to be cementing our relationship, as sole clutch supplier, for the upcoming season." **RT**



Goodyear: we want tyre wear. But not *that* much

LAST month's NASCAR Cup Series race at Bristol descended into chaos with unexpectedly extreme tyre wear – yet provided one of the best short track races ever seen.

Denny Hamlin eventually triumphed in a Food City 500 that produced a track-record 54 lead changes among 16 drivers.

Tyre supplier Goodyear brought a compound it had already used in a previous race and did not expect excessive wear. But instead of lasting a planned fuel stint of 190 laps, most drivers were in trouble after just 40 or 50.

In the immediate aftermath of the tyre management spectacle, there was uncertainty over whether the wear was the result of the tyre, the resin the track had been treated with, or weather conditions.

Goodyear Director of Racing Greg Stucker admitted the company was still figuring out quite what had happened, but was encouraged by the results anyway.

"The drivers have been asking for higher tyre wear to put more control in their hands by way of tyre management, as well as with the crew chiefs to get the balance of the cars right. We tested at Bristol last June and took a step to create more wear and that's what we brought for the September '23 race with good results," he reported.

Stucker explained that Goodyear is focusing on the racing surface to find the cause of the added wear.

Resin suspicion

"After [Bristol], we just need to analyse why the track reacted differently than last fall – was there something different with the track prep, and we know that they applied resin in the corners as compared to PJ1 [another kind of grip-strengthening race surface compound] in the past," he noted. "On Sunday, the wear mechanism was different for some reason. It wasn't a structural issue with the tyre itself – the tread was just wearing to where the grip went away."

Fortunately, the race received rave reviews.

"Overall, everyone agrees that tyre wear is good for racing, and after looking back at this weekend we're taking the positives out of it in that we want to have wear and fall-off," said Stucker. "But maybe just not to *that* level."

"It was a blast. I'm not just saying that because we won. I'm saying that because it was fun to have to do something so unrefined," was the verdict of winning crew chief Chris Gabehart. "Everything about our business gets to be 16th of a round and 10th of an air pressure. If you just manoeuvre this three inches,

you'll be perfect. It was not going to be perfect this weekend ever. I think that made for a fantastic show."

Chase Elliott was one of many drivers with positive feedback. "I had a lot of fun," Elliott said. "The worst thing that can happen is we all get out of the car and Goodyear gets scared to death because of what we're going to say about the tyre and what kind of publicity that gives them."

"The next thing you know, we're racing on bricks for the next 10 years because they're scared to death of having something like that happen again. And no one told us to get out and be happy – it was just a genuine thing. It was fun. A lot of the race was in your hands as a driver as to what you could do."

Even NASCAR's hard-pressed officials could relax after most of the drivers emerged smiling from the Bristol experience.

"There were times in the race, obviously, when there was anxiety around 'are we going to have enough tyres to finish it?'" admitted John Probst, NASCAR's chief racing development officer. "But man, coming out at the end and watching all that, I would not want to change much at all, honestly, just maybe give them more tyres!"

BELOW The action in Bristol was wild as drivers reacted on the hoof to unexpected tyre wear



Getty Images/NASCAR



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Bernard Niclot, ACO Consultant



HOW DID THEY DO THAT?

With maximum power cut and minimum weight increased, Porsche looked the loser when the latest Balance of Performance was issued. So how has its 963 been transformed into the car to beat? **Gary Watkins** explains

THE car was a joy to drive." The words belonged to a smiling Laurens Vanthoor and the subject was the Porsche 963 LMDh in which he'd just won the opening round of this year's FIA World Endurance Championship in Qatar in March together with Kevin Estre and Andre Lotterer. It was a phrase you wouldn't have heard pass the lips of one of the Porsche Penske Motorsport drivers this time 12 months ago. Nor, for that matter, any time before the very back end of its twin campaigns in the WEC and the IMSA WeatherTech SportsCar Championship in North America.

The 963, developed in conjunction with Canadian-headquartered Multimatic Motorsports out of its next-generation LMP2 chassis spine, endured both a difficult gestation ahead of its race debut at the 2023 Daytona 24 Hours IMSA curtain-raiser and a stuttering start in both the North American series and WEC. Fast-forward to season two for Porsche's first top-flight sportscar racer since the 919 Hybrid LMP1, and the German manufacturer has hit the ground running.

A first victory in one of the IMSA enduros, and the most important one at that, at Daytona in January, was followed

by the triumph in the Qatar 1812Km, the maiden win for the car in the WEC – and, it should be pointed out, a first for an LMDh ahead of the Le Mans Hypercars in the confusingly-named Hypercar class. It was in the fight at the Sebring 12 Hours IMSA round, too, on the way to third position in the IMSA GTP field that for the moment at least remains LMDh-only.

“It is not the goal to have the most fancy car, a playground for the engineers”

The Qatar performance was perhaps the most significant, coming as it did in the face of opposition from LMH machinery, the Toyota GR010 HYBRID and the Ferrari 499P, the only winners in WEC last year. The Porsche was on top throughout – both in the race itself and the sessions leading up to it through the delayed pre-season Prologue test and then into the event proper. A Porsche, either a factory car or one of the two customer cars from the British Jota team,

topped every session.

It came in the face of a new Balance of Performance in which the 963 was on paper the biggest loser: in comparison with last November's Bahrain WEC finale, maximum power was cut from 514 to 505 kW, which equated to a reduction of 12 bhp, and minimum weight increased from 1,046 to 1,048 kg.

There has been no silver bullet, however, in this Porsche turnaround. No single development transformed the car: it has yet to take one of the so-called evo jokers allowed to an LMDh or LMH over the course of its lifespan. Rather the upturn in fortunes has been the result of plain hard graft, testing miles out on the track and a natural learning process with a complex hybrid racing car, development of which has been further complicated by the proprietary nature of the energy-retrieval system. Put simply, the new-found competitiveness



and the results that have followed have come with a greater understanding and fine-tuning of the original concept. And for that Porsche needed time.

"It wasn't the case that we introduced one thing, and bam we found half a second," says Urs Kuratle, director of factory motorsport, LMDh, at Porsche. "You cannot say this or that was the working point we had to overcome."

Vanthoor insists that he has always enjoyed climbing into the 963 cockpit. "These cars are naturally fun to drive and I always felt comfortable in the Porsche: I maybe struggled a bit less with some of the issues than the other drivers," says the Belgian. "But the car is definitely better now; we have been heading in the right direction for a while."

There's a keen difference between saying a car is enjoyable to drive and a joy to drive, while the use of the word 'struggle' here is significant. The 963 wasn't the



complete package in its early races in both arenas last year, notwithstanding a first victory at only the third time of asking at the Long Beach IMSA round last April, a 100-minute sprint.

One of the issues facing the new Porsche was braking instability, which was related to the interplay between the fly-by-wire analogue brakes (Bosch's Electronic Braking System) and the rear-

axle hybrid system. As Kuratle said over the course of last season: "If you have a problem under braking into the corner, you are going to have problems all the way through the corner."

There was another fundamental issue with the 963: it wasn't reliable. Witness the fact that PPM failed to get any of the three of the 963s it fielded at last year's Le Mans 24 Hours, six months into its racing ▶



ABOVE & LEFT

Porsche's 963 became the first GTP/LMDh car to triumph against the WEC Hypercar ranks in Qatar's season-opener. Its works cars took pole and the victory, with a customer finishing second

All photos: Porsche AG



“It wasn’t the case that we introduced one thing, and ‘bam’ we found half a second”

career, to the finish cleanly. Unreliable cars, of course, take longer to develop than reliable ones.

“The understanding that we have of vehicle dynamics is completely different to a year ago because we were worrying about reliability,” says Porsche Motorsport vice-president Thomas Laudenbach. With a reliable car finally Porsche is “now worrying about performance”, he adds.

Porsche got the jump on its LMDh rivals by a full six months. The 963 was up and running in January of 2022, whereas the other cars from the first batch of designs built to the new ruleset, the Cadillac V-Series.R, Acura’s ARX-06 and the BMW M Hybrid V8, didn’t hit the track until the summer. But much of that head start was consumed getting on top of the off-the-shelf hybrid system supplied by Bosch Motorsport, WAE Technologies (formerly Williams Advanced Engineering) and Xtrac.

It did much of the donkey work from which the

other manufacturers benefitted. The issues, including those linked to the supply chain, continued into 2023. The hybrid system, with particular regard to the Bosch motor generator unit, continued to evolve through last season and into this.

The focus, says PPM managing director Jonathan Diuguid, had to be on reliability first, and remained so during the off-season. That explains why it opted not to invoke – or rather apply for, because performance upgrades are discretionary – one or more of the five jokers allowed to the car over what for the moment is a five-year lifecycle.

“To know what we want to change and fix we have first to be pretty confident that that’s the area in which we want to develop the car,” says Diuguid. “After one year of racing we had reliability problems and that is what we focused on with the resources within Porsche Motorsport and PPM.

“You are limited with performance jokers and you are limited from a budgetary perspective. We would all love to develop the cars constantly, but that is not the way the formula is built. We knew what we needed to improve from a reliability standpoint, and then we can begin to focus on performance and evo jokers to get us where we need to be in the future.”

Porsche appears now to have a reliable car: it got

ABOVE The new-found reliability was underlined when Porsche scooped an emotional triumph at Daytona this season, the first time it had won the race outright since 1969

RIGHT The 4.6-litre V8, featuring a flat-plane crankshaft and short stroke, could be mounted very low for a low centre of gravity and optimum linkage points for the suspension and gearbox. But vibration from the crank has been an issue



RIGHT Porsche got the jump on its rivals when it commenced testing the car in 2022, but much of that time was spent sorting the teething problems of the LMDh platform for the category as a whole

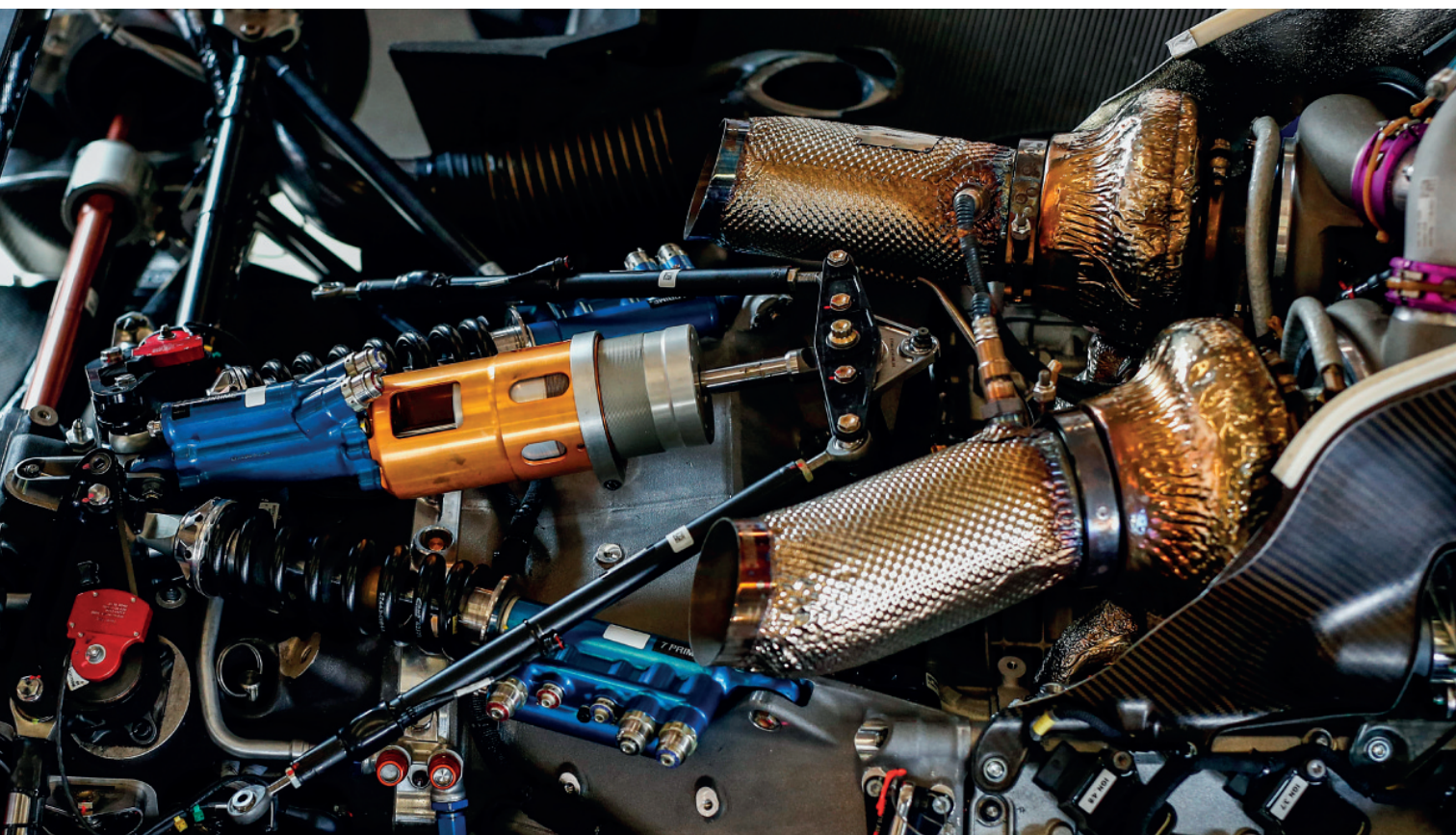


all four of the 963s racing in IMSA, the two PPM cars and the privateer entries from Proton Competition and JDC-Miller MotorSports, through the twice-around-the-clock encounter at Daytona without problem as the car shared by Felipe Nasr, Matt Campbell, Dane Cameron and Josef Newgarden came out on top. And then only one of the five WEC cars hit issues in the 10 hours of the Qatar WEC round.

Turning point

If there was a turning point for Porsche it came last summer after a concerted test

programme in the wake of Le Mans, predominantly in America. The machine that emerged out of it, at Road America in early August and Fuji in mid-September, was what might be described as a much more “together” racing car than what preceded it. Over in IMSA, Porsche came out top in GTP in two of the final three rounds, the Road America and Indianapolis events lasting the regular series distance of two hours and 40 minutes, but significantly not in the last of the enduros, the season-ending Petit Le Mans 1000-miler at Road Atlanta. On the world stage, Vanthoor and his team-mates led for two-thirds of the way at the Fuji 6 Hours in September en route to a second WEC podium and the first gained entirely on merit. ►





LEFT, RIGHT & BELOW Porsche and Team Penske have gone to great lengths to transform the former Porsche Center in Mannheim, Germany, into a high-tech facility for the WEC campaign. Offering 4,500 square metres of usable space, it is to feature a 'Battle Room' to offer operational support at circuits

Then at the Bahrain finale it wasn't the factory Porsche team that led the chase of the Toyota GR010 HYBRID LMHs, but the British Jota team's customer car. It might have made the podium behind the Japanese cars in the hands of Antonio Felix da Costa, Will Stevens and Yifei Ye but for a penalty. More significantly, the last-named driver put in the fastest double stint of the eight-hour race, quicker than any of the six drivers managed in either of the GR010s that finished one-two.

There were electronic developments, which are free under the LMDh and LMH rules, that arrived for those races, including revisions to the traction control system. But the step in performance was predominantly down to what Vanthoor calls a "greater understanding of how to put the car in the window".

"The electronics were part of it, but so too was understanding what direction we need to take to make the car work, so that includes the mechanical set-up in terms of aero and ride height. It was about understanding which direction we had to work, joining the dots if you like. It has been a mix of everything, improving our software and just grasping what the car needs."

There was a revised DTC (Dynamic Traction Control) system that has helped make the 963 a more nimble and lithe racing car. It was actually a simplified version of what went before, explains Kuratle.

"We have reduced the complexity; that is one thing we have worked on," he says. "We have to understand what these systems do for us. We needed the engineers to really understand what the drivers wanted. It is not the goal to have the most fancy car, a playground for the engineers. We had to follow the demands of our drivers."

Vanthoor echoes Kuratle's comments. "Sometimes there can be a difference between theory and reality," he says. "We sort of came together and said, 'We like this, but keep it simple'. We need something we can understand and is aligned to our feelings in the car."

Twin-pronged approach

Laudenbach admits that Porsche made life difficult for itself with what it likes to call its "one-team" approach to the 963 programme. It would have been easier, insists the German who took over the reins of Porsche Motorsport in September 2021 after a six-month lead-in period following his recruitment from Audi, had it gone with an established European squad for its WEC campaign. That appears to have been initially

“It can be easier to look for a quick win, but sometimes you have to invest”

the plan before Penske, whose links with Porsche include winning multiple championships and races with the RS Spyder LMP2 in the American Le Mans Series in 2005-08, successfully lobbied for a dual role.

But Laudenbach, along with team founder and president Roger Penske, are insistent that it was the correct approach, one that is now paying dividends. They reckon that Porsche wouldn't be in the position it is now had it stuck with its original plan.

"It can be easier to look for a quick win, but sometimes you have to invest," says Laudenbach. "It was a long-term decision and I really hope that we can start to harvest. I think it's an advantage



that it is one organisation, even though we have PPM in Mooresville [at Penske Motorsport HQ] and PPM in Mannheim [the new German base established for the WEC programme].” He adds that the performance of both the factory cars and the privateer entries fielded by Jota and Proton in Qatar “clearly shows that we made the right decisions in the way we went, joining the Penske organisation with Roger and taking a global approach”.

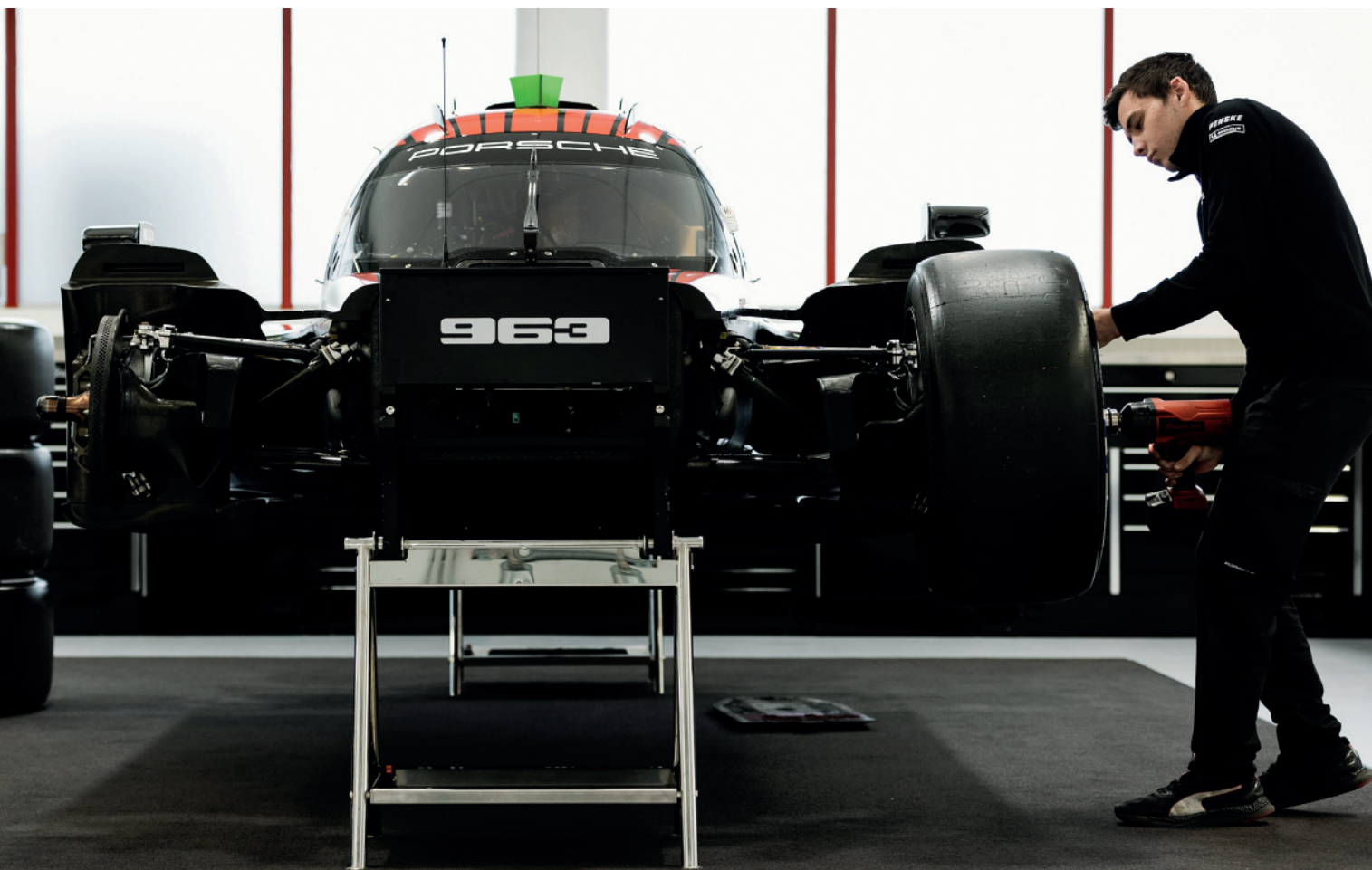
Penske, himself, is even more forthright: “We wouldn’t be where we are today if we had two organisations. There is complete transparency, so if we are working on reliability in the USA, we are working on reliability for the WEC as well, and vice versa. We can be testing in the US and we can be testing in Europe, and we can cross-pollinate.”

There were, however, inevitably some growing pains. The new PPM entity had to grow as an organisation. Both arms of the operation were effectively new. It would be wrong to say that the group that came together to form the IMSA

operation was the same as the one that had run the Acura Daytona Prototype international programme in IMSA in 2018-20. The WEC squad, operating out of new premises in Mannheim, was largely all-new and only came together in the weeks leading up to its first competitive outing at the Sebring 1000 Miles on the undercard of the 12-hour IMSA fixture. It had undertaken only one test as a unit with the 963 ahead of its participation in the pre-event Prologue test.

The new WEC arm of the team was working out of a new facility that was still

undergoing a gearing-up process through 2023. (Now completed, it is due for an official opening this month.) The building process also included the recruitment of Jan Lange from Joest Racing as the new general manager at Mannheim working under MD Diuguid. He has brought with him years of experience with one of the great sportscar teams of all-time: Lange was formerly operations manager on the Audi LMP1 programme at Joest from 2013 until the German manufacturer’s withdrawal from the WEC at the end of 2016 and then worked on its Mazda ▶





Daytona Prototype international IMSA programme and back in WEC as part of the team's link-up with Glickenhaus Racing. Penske credits the arrival of Lange as "a big step".

The facility at Mannheim, part of a Porsche dealership that has been part of the Penske empire since 2008, now includes what is described as an "exact replica of the Le Mans pitlane", or at least a segment thereof. It allows the pit crew to practice stops every day on a special training vehicle. It is worth pointing out the WEC squad wasn't the fully-finished article as a race team in 2023, even by the end of the year. It might have led for four hours at Fuji and ended up on the podium, but it also might have ended up one better than third and split the Toyotas had there not been a bizarre procedural issue.

The #6 Porsche wasn't refuelled after its pre-grid reconnaissance laps, leaving it short for the race and forcing the drivers to employ some aggressive fuel saving to ensure there wasn't the need for a late splash-and-dash. Toyota, always keen to play down its dominance as it swept to the drivers' and manufacturers' crowns last year, was adamant that second position was on for the 963 but for this issue. PPM was less convinced that it could have got among the GR010s, but on the other hand it didn't try to

ABOVE The complexities of an off-the-shelf hybrid system took time to adapt to. But the improvement has come from mechanical setup as well as software development

hide its mistake and then set to work to honing the team operationally between seasons.

Laudenbach concedes that Porsche made life hard for itself twice over with its decision to begin delivery of customer cars in year one of the 963. It was an essential strand of the programme, apt for a car whose type number follows on from the 962 Group C and IMSA GTP contender, one of the great customer sports cars of all time. But it also created additional strain. Had Porsche fully understood the complexities of developing a machine with an off-the-shelf hybrid system, it might have been less ambitious for season one.

"Doing everything at the same time, we clearly learned that this was tough," he says. "It is fair to say that the challenge for us was the biggest one in the entire field and for sure we paid a price. If we had to make the decision again, we would probably do it a year later."

That said, Laudenbach is insistent that the decision to supply customer cars is the right one. He has consistently called for Porsche's rivals also building LMDh machinery to follow its lead and sell cars to independents. Those calls have so far fallen on deaf ears.

Future developments

There is a major upgrade of the 963 in the pipeline, which may or may not count as an evo joker. On the stocks is a new version of the 4.6-litre twin-turbo V8 that has its roots in the 3.4-litre normally-aspirated engine that powered the RS Spyder (a project that Laudenbach headed up before his move to Audi) and bigger-capacity version found in the 918 plug-in hybrid road car. Porsche identified vibration from the flat-plane crank unit as a contributing factor in the poor reliability of the 963, the MGU in particular. A revised engine with a 90-degree rather than 180-degree crank has been designed to alleviate this problem and has been running on the bench for some time.

“A greater understanding of how to put the car in the window”

Porsche had targeted having the engine in its flotilla of 963s at Le Mans, a contingent that will be increased to six with the addition of a third PPM car like last year.

It has now been decided not to rush through on the project and delay the revised engine until after the 24 Hours. That decision was influenced, says Kuratle, by the 963's reliability at Daytona.

"There was a different hybrid version, there was 2.3, 2.3* and now 2.4, and these changes are going in a good direction," he explains. "Our four cars ran



ABOVE A revised engine will further boost the Porsche Penske Motorsport cars' performance later this season

BELOW Porsche's conviction that the 963 should be a customer car arguably hampered development last season but could now be rewarded

with no problems on the hybrid side at Daytona. That fact helped us make the decision."

So did the fact that the rulemakers the FIA and the Automobile Club de l'Ouest wanted – that should probably be insisted – Porsche to run the revised power unit for two races prior to Le Mans in June in order to assess its impact on the Balance of Performance. Because the specification of the engine needs to be set before its homologation, it would have had to be fully validated in time for enough parts to be manufactured to effect the changes on all the 963s in competition sometime in April.

Only one homologation is allowed in LMDh, so all cars must race in identical specification. The customer cars can't be a race behind in terms of hardware. Because Imola on 21 April is on the same weekend as the Long Beach IMSA round on 20 April, that would have meant enough engines being

converted for the nine 963s that will be racing that weekend across the two series.

"The governing bodies set a clear goal, clear targets how we had to implement the crankshaft and it won't allow us to do it before Le Mans," continues Kuratle. "We said, 'Okay it is a challenge and we try to do it', but the risk was too big. We had to decide to concentrate all our endurance runs before Le Mans on the old crankshaft; we would not get enough mileage on the new one."

The plan is still to introduce the revised engine this season, though when has yet to be set. Kuratle suggests that the revised engine will most likely be deemed an evo joker. Reliability upgrades are free but the whole process is by negotiation. Understanding it isn't easy because there is a lack of transparency. Who has been given approval for what is neither in the public domain nor shared between the manufacturers.

The big target for Porsche remains Le Mans. Laudenbach admits that whatever else the 963 achieves this year – and those achievements are already racking up – the programme will be judged on its success or failure on the Circuit de la Sarthe on the middle weekend of June. That goes for the wider world and the people who sign the cheques on the board of Porsche AG. "I can't blame my bosses for making a judgement on one race," he says.

"We want to win races, and if we get one for free, of course you chose Le Mans, no question," he says of a marque looking to move on to 20 wins at the big one in France. "We want to show everyone that we still know how to do it." **TT**





A PERFORMANCE DIFFERENTIATOR THAT IS OFTEN OVERLOOKED

The creators behind some of the world's best-known brake fluid formulations have packaged their latest innovations in an off-the-shelf blend for professional motorsport. By **Chris Pickering**

EVEN if you've never heard of Orthene, there's a good chance you've used the company's products – potentially even entrusted your life with them. Owned and run by the same family since it was founded in 1976, Orthene is now the largest specialist producer of brake fluid in the world.

Some of the best-known brake fluid formulations for everything from mountain bikes to F1 cars start life at Orthene's factory in Harrow near London, before

being sold on by big-name brands. Until recently, the company had never sold under its own name, but that's changed with the new Halo By Orthene brand.

"A lot of the companies we traditionally sell through are brake hardware manufacturers. Their main area of expertise is often discs and calipers rather than fluid. Plus, there can be several tiers of distribution between them and the teams. So, about 18 months ago we set out to establish a more direct link with the end

user to understand what's driving their requirements and where there could be gaps in the market," explains Lloyd Ker, director of Halo by Orthene.

The company reached out to teams right across professional-level motorsport, from V8 Supercars to Formula 1. NASCAR was a key example. The Next Gen cars have a relatively simple braking system, yet they tip the scales at over 1,500 kg fully laden and produce more than 670 hp on the road courses.



ABOVE Very early-stage track testing of Halo P1 with Flying Lizard Motorsports at Phoenix, Arizona

BELOW Breakthrough moment: the magic behind some of the big-name brands for decades, this is Halo By Orthene's first mass-production run of its own Halo P1

"The issues the teams highlighted typically came down to the compressibility of the fluid. What the drivers are looking for is a consistent pedal feel throughout the duration of the race," explains Dan Stafford, chief development chemist for Halo by Orthene. "In NASCAR, in particular, they've got a relatively heavy car and a lot more road courses than they used to, so they were running into issues with long pedals and brake fade."

Opportunity

The brake hardware used by NASCAR teams is heavily prescribed. Next Gen brought substantially larger brake rotors (15 inches at the front and 14 at the rear,

up from 12.7 inches all-round) but the teams are confined to two different options – a thin, lightweight design for high-speed ovals and a thicker one to provide additional heat dissipation on short ovals and road courses. Calipers are spec items with a six-piston design at the front and four-piston at the back.

"Brake fluid can be a real performance differentiator in some cars, but it's often just seen as a commodity," explains Mike Biscoe, chief marketing officer at Halo by Orthene. "NASCAR is a classic example of that. The hardware is largely fixed, so there's not a lot of room there for optimisation from a race engineer's perspective, but the brake fluid is free. And that's a situation that's seen in a lot of other race series too." ►



This is an opportunity that's often overlooked, he says: "It's natural for a race engineer to approach the brake system from a mechanical perspective. We've even heard some engineers talk about having to work around the properties of a particular brake fluid. Our aim with Halo P1 is to bring a chemical engineering perspective to address these issues and unlock that performance."

It's not unusual for racing brake fluid formulations to be six or seven years-old. In fact, one of the best-selling products in the market is said to date back more than 25 years. That's positively glacial in a world where innovation often moves on from one race to the next, so Halo By Orthene is keen to bring new ideas to the market and already has its eye on updates to the newly-launched Halo P1 product.

Compressibility

There have been tremendous changes since some of the best-known brake fluids were established on the market – not just in brake hardware, but in the cars themselves and the way they're driven, Stafford explains: "If you look at a driver of, say, Ayrton Senna's era, they were very aggressive into the corners and then powering out again, because in those days they had a lot more power than grip. Nowadays, it's all about finesse. The way you find the speed is with smooth transitions into and out of the corner. So that makes consistency from one corner to the next and from one lap to the next even more important."

Consistent compressibility over a wide range of

“Our aim is to bring a chemical engineering perspective to unlock performance”

temperatures is hugely important for motorsport brake fluid. Halo P1 is said to have the highest boiling point of any fluid on the market at 341 deg C/646 F. For traditional non-ABS braking systems this allows the driver to accurately gauge and anticipate the amount of slip. On ABS-equipped cars the quickest drivers are often those who can hold the car right on the threshold of ABS intervention rather than relying on the system too heavily. In either case, it comes down to being able to consistently achieve the same level of braking, whether the brakes are stone cold coming into the first corner or roasting hot after a period of heat soak during a pit stop.

"The brake system is often the one thing that starts to go off during the latter part of the races. And it's that element that then starts to undermine the driver confidence. And despite the fact it's just the pedal going a bit longer, the driver starts to question the car and then not perform as well as they could. Almost sub-consciously they start to compensate for a perceived problem, and it undermines confidence in the whole car," comments Biscoe.

Chemically speaking, the approach has been to ensure that the ingredients the fluid is made from are extremely pure. The glycol ethers that form ►

BELOW Team GP Elite's Porsche 992 GT3 R racing – and winning – with Halo P1 in the 24H Series at Mugello last month



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**Vehicle Dynamics
Part 2**

18 January 2025



Bob Chapman/Autosport Image

the backbone of modern brake fluid are primarily produced for industrial products, such as paints, soaps and cosmetics. In those applications, the purity is not generally so critical, and impurities account for around 10 per cent of the liquids as supplied. These impurities include materials with a range of different molecular weights, each of which will have its own boiling point.

Impurity also has a direct impact on the compressibility of the fluid, Stafford explains: “The chemicals in the methyl series are highly polar, and that’s what gives them their incompressibility. In layman’s terms, you can imagine that the molecules repel each other, like the poles of a magnet. If you start inadvertently introducing other series like propyls they’re less polar, which makes the fluid more compressible and less consistent.”

Lubricity

Another key target that the chemists have sought to achieve with Halo P1 is high levels of lubricity. This has always been important in brake fluid, but it has become particularly critical with modern ABS-equipped racecars, and indeed high-performance road cars, where the frequency of the pumps used in the system is getting higher and higher.

“We’re interested not just in metal-to-metal lubricity, but also metal-to-elastomer lubricity,” comments Stafford. “We react a chemical into the backbone of the product, which gives it high lubricity at high temperatures. That’s unique to our fluid, and we’ve come across some GT racing applications where conventional fluid has struggled due to a lack of lubricity.”

ABOVE Running three cars on Halo P1, Flying Lizard Motorsports kicked-off the 2024 Lamborghini Super Trofeo North America season at Sebring International Raceway, supporting the iconic Sebring 12 Hours

The viscosity of the fluid also changes with temperature. Here, the lower end of the range can be just as important as the upper end. Temperatures for the WRC event in Sweden can get down to -20 deg C, and even an early season race meeting in England could be in single digits, making the fluid noticeably more viscous than it would be in Bahrain or Texas in mid-summer.

Halo By Orthene has engineered the Halo P1 blend to minimise its viscosity change with temperature. This is particularly relevant to ABS-equipped cars where there are a lot of fast-moving parts that rely on predictable fluid flow to deliver consistent performance.

Perhaps the greatest technical challenge on the horizon, however, comes from electrification. This can

“In theory, we could tailor fluids for short track and long track, wet race versus dry race, and different atmospheric conditions”

fundamentally shift the braking system’s duty cycle if a lot of energy recovery is used. With an empty battery, a large portion of the braking torque may come from regeneration, but with a full battery, the amount of regen on offer can be dramatically reduced, shifting the emphasis back onto the hydraulic system. On top of that, a powerful hydraulic braking system provides redundancy, in case of an electrical failure.

The shifting balance between hydraulic and ►

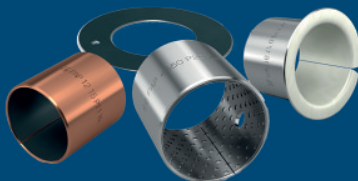


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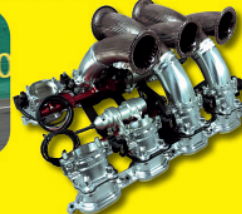


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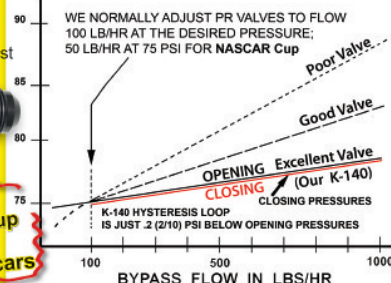
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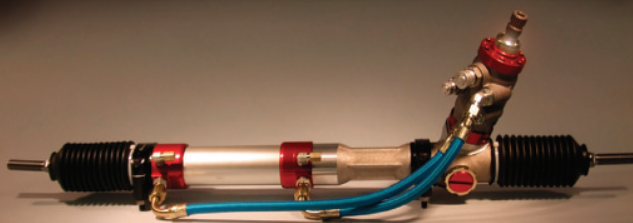
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regenerative braking is typically governed by an accumulator-based brake-by-wire system, and the fluid plays its part here too, Stafford points out: “The fluid is stored in an accumulator at something like 300 bar, but when it goes into the braking system it goes down to maybe 100 bar. This leads to a variable pressure cycle throughout the race, so compressibility is very important. If the fluid is too compressible it could absorb some of that pressure change, leading to inconsistency in the operation, particularly across different temperature ranges.”

Weight is also a major concern. Hybrid systems are starting to become a topic of conversation in GT racing, where one team had apparently estimated that

“Specific density is a property that has caught the eyes of the F1 engineers. We could potentially take 20 to 30 per cent of the weight out”

it could add 100 kg to the weight of the car. It’s not clear whether these weight increases would come with improved cooling or upgraded brake hardware, so it could place greater pressure on the fluid.

More safety

Even the relatively mild hybrid systems used in the British Touring Car Championship are having an impact, Stafford explains: “The new hybrid cars in the BTCC are quite heavy. On a heavy-braking circuit like Snetterton you can get some alarming temperatures that are much higher than they’re used to – certainly on the front-wheel drive cars. With a boiling point that’s 20-odd degrees higher [than a conventional fluid], you’ve got more safety and more consistency.”

The thinking behind Halo P1 was to package the latest innovations in brake fluid technology in an off-the-shelf blend that’s suitable for a wide range of professional motorsport applications. However, Halo By Orthene is also open to working directly with top-tier teams and OEMs on bespoke blends.

“There’s still a lot that you can do with brake fluid,” explains Ker. “In theory, we could produce tailored fluids for short track and long track, wet race versus dry

RIGHT Purity of the ingredients is paramount. This is Quality Control at the Halo By Orthene labs in London

BELOW Series like NASCAR, where the brake hardware is largely fixed but the brake fluid is free, offer opportunities



Getty Images/NASCAR

race, and different atmospheric conditions.”

Formula 1, with its big budgets and endless quest for optimisation, would be an obvious candidate for this bespoke treatment. Here, however, sophisticated carbon-carbon brakes and carefully-optimised aerodynamic cooling mean that brake temperatures are generally under control and higher boiling points may be of limited value. But there are still other benefits that Ker and his team believe they could bring.

“One property that has caught the eyes of the Formula 1 engineers is specific density,” he notes. “We could potentially take 20 to 30 per cent of the weight out.”

When you think how much work would be involved in shaving nearly a third off the weight of any other component on a Formula 1 car, brake fluid’s role as a performance differentiator becomes immediately apparent – particularly when it’s one of few areas where the teams still have the freedom to innovate in virtually all forms of motorsport. **LT**



FALLING INTO THE CLUTCHES OF THE HYBRID ERA

IndyCar's transition to hybrid technology raised a number of questions for the clutch manufacturer. AP Racing provided the answers. By **Chris Pickering**

INDYCAR is on the cusp of a new hybrid era. After a long and troubled gestation, a new push-to-pass hybrid system will be introduced later this year, adding around 60 hp to the 750-or-so of the twin-turbocharged 2.2-litre V6 engines.

It may not be as ambitious as the 160 hp MGU-K found on the current Formula 1 cars, but it still represents a formidable technical shift in the series. And right in the middle of this – quite literally – sits the clutch. Now a spec item produced by AP Racing, it's the point where the engine meets the rest of the drivetrain – without which the cars would never get out of their pit boxes.

generation of 2.4-litre V6 engines. There was talk of a combined output of more than 1,000 hp. Since then, the project has been delayed several times, and the decision was taken in 2022 to revert to a 2.2-litre twin-turbo V6 base engine. However, the concept of a shared hybrid system – common to both the Honda and Chevrolet teams – has endured.

It was the move to a hybrid formula that first prompted discussion between IndyCar and AP Racing about a new clutch design. Then as now, the plan was to mount the energy recovery system (ERS) on the bellhousing. This would limit the packaging volume for the clutch and its associated hydraulics,

means that pushing inwards towards the engine results in the edge of the diaphragm moving outwards and separating the plates.

The key difference between the two is the leverage provided by the different pivot mechanisms. A pull-type clutch provides greater leverage for a given diameter, which ultimately means that a smaller, lighter clutch can transmit the same level of torque. [However, the external hydraulics can be somewhat harder to package.]

"A pull-type clutch is a more efficient design than a push-type, which means you can get a higher torque capacity, a lighter release load, a higher wear capacity or some combination of the three," explains AP Racing's chief engineer for race applications, Jon Grant. "The downside is that the design of the release mechanism has to be somewhat more complicated to pull from the inside outwards. We've got the clutch mounted on the engine, the slave cylinder then has to go over the top of that, mounted to the engine, while the gearbox goes over the top of that."

The installation is essentially identical between the Honda and Chevrolet engines, explains Grahame Smith, chief design engineer for clutches at AP ►

“You can get a higher torque capacity, lighter release load, higher wear capacity or some combination of the three”

AP Racing has been supplying IndyCar teams for more than four decades. In 2014, the company introduced a push-type carbon clutch for the series, which offered a substantial weight reduction over the sintered material that had been used previously. This year, however, marks the first time that the brand has officially been named as a sole supplier to the series, and it comes with a new clutch design for the hybrid formula.

The introduction of the hybrid system was originally due to coincide with a new

so AP Racing's proposal was a 115 mm (4.5-inch) triple-plate carbon clutch with pull-type operation.

In a pull-type clutch, the release bearing pulls outwards on the fingers of the diaphragm spring that are hinged at the far end. This releases the spring load that otherwise clamps the engine to the transmission via a series of clutch and friction plates. A push-type clutch operates in much the same way, but the fingers of the diaphragm spring pivot on a fulcrum, like a seesaw. This





ABOVE The lightweight CP8278 three-plate, pull-type, carbon/carbon clutch has been designed and developed to carry IndyCar into its hybrid era

Racing: “We supply the clutch and the concentric slave cylinder that sits above it to provide clutch actuation. The only difference is a small change in the mountings to clear the ancillary components on the two engines.”

Micro slip

The clutch’s primary role may be transmitting torque to and from the engine, but it also serves to protect both sides of the powertrain. This is particularly relevant in the new hybrid setup, explains Smith: “The clutch acts a bit like a fuse, limiting the torque that can be transmitted between the engine and the gearbox. There were some concerns about gearbox durability if we had sudden torque spikes going straight through from the hybrid system, so we’ve limited the torque capacity of the clutch slightly.”

Clutch slip might sound like something to be avoided at all costs on a 750 hp IndyCar, but carbon clutches are designed to allow for a small amount of ‘micro slip’ under certain conditions, and it actually improves the friction performance.

The degree of slip is tiny – a small difference in shaft speed between the engine and the gearbox

“A small amount of ‘micro slip’ under certain conditions actually improves the friction performance”

seen for a fraction of a second – but it provides essential protection against momentary torque spikes. These can occur during pull-away, when changing gear or potentially when the hybrid system is activated.

These micro slip events generate heat. Again, that might sound like a bad thing, but a certain amount of temperature is beneficial to both the torque capacity and the wear resistance of the clutch plates.

IndyCar races always begin with a rolling start, so once the green flag falls, the only opportunities to get heat into the clutch on the current non-hybrid setup come from gearchanges and pulling away from pitstops.

“One of the challenges of IndyCar is that there can be long periods on the ovals where the drivers go ▶

BELOW A cushioning element comes in near the bite point to avoid damaging torque spikes during major clutch events



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without changing gear and the clutch cools down,” explains Smith. “We have to make sure that the clutch has enough torque capacity to survive those long stints of running cold, which is different to a road course where you’ve got lots of gear changes. We use exactly the same clutch setup at all circuits, so we’ve built in quite a lot of additional torque capacity [relative to what’s required on the road courses] to ensure there’s enough friction when it’s running cold on an oval.”

“The clutch acts a bit like a fuse, limiting the torque that can be transmitted between the engine and the gearbox”

The gearchanges are clutchless, but the drivers do operate a manual clutch (activated by two paddles on the back of the steering wheel) when they pull away from the pits. Unlike previous generations of Formula 1 cars that had one paddle set to bring the clutch to its bite point and another set to release it completely, the two paddles on an IndyCar (and indeed a current Formula 1 car) are functionally identical – they simply provide two alternative options in case it’s hard for the driver to reach one of them.

ABOVE Additional torque capacity has been built in to ensure there’s enough friction when the clutch runs cold on an oval

Perhaps not surprisingly – the majority of people being right-handed – it’s generally the right-hand paddle that gets used.

“The biggest clutch event for the drivers is obviously launching the car from the pit box during the race, because that can make or break a position. So that’s when they want to have confidence that they can dump the clutch without any risk of stalling or spinning the car,” explains AP Racing design engineer Cieran Taylor.

There’s not a great deal of modulation on a hand-operated paddle clutch and the drivers reported that they found the first iteration of the design quite difficult to launch during testing. As a result, AP Racing has built in what it describes as a cushioning element between the springs and the carbon pack to give it a bit more compliance.

“That was something that we had to figure out and come up with some different specifications for the drivers to test,” recalls Taylor. “The friction characteristics change with temperature and the clutch can be very much on or off if you don’t have that cushioning in there. It’s effectively a secondary spring that comes in just when they’re near the bite point. That’s quite important if they’re trying to launch the car at speed with everything going on around them in the pitlane.”

The cushioning element is standard across all teams and drivers, he points out. It’s not supposed to be a performance differentiator, but ►

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simply something that makes the car a bit more manageable – and potentially safer in the pitlane.

“We worked with a range of the teams during testing to make sure we had a package that would work for all of them,” notes Taylor. “The feedback we had from the first race was all happy. They found it an improvement over the previous clutch – better on wear rate and easier to control, which is what we’d hoped to achieve.”

Extended life

Despite careful design to maximise the life of the clutch, the friction plates do still wear. On average, they lose about 0.1 mm of thickness for every 100 km of racing, although that will depend on the conditions. To account for this, shims are placed behind the stack of friction plates to restore the total thickness. Around 0.8 mm of wear or 800 km of racing can be accommodated before each shim is added, allowing the teams to adjust in increments over a total life of perhaps 6 mm of wear and 6,000 km.

The new pull-type clutch design primarily increases torque capacity, but it has also reduced wear. This means it can go further between re-

shimming, reducing the car’s maintenance costs. Although all cars must use the same spec part, it’s up to the individual teams to decide when they wish to re-shim or replace the clutch.

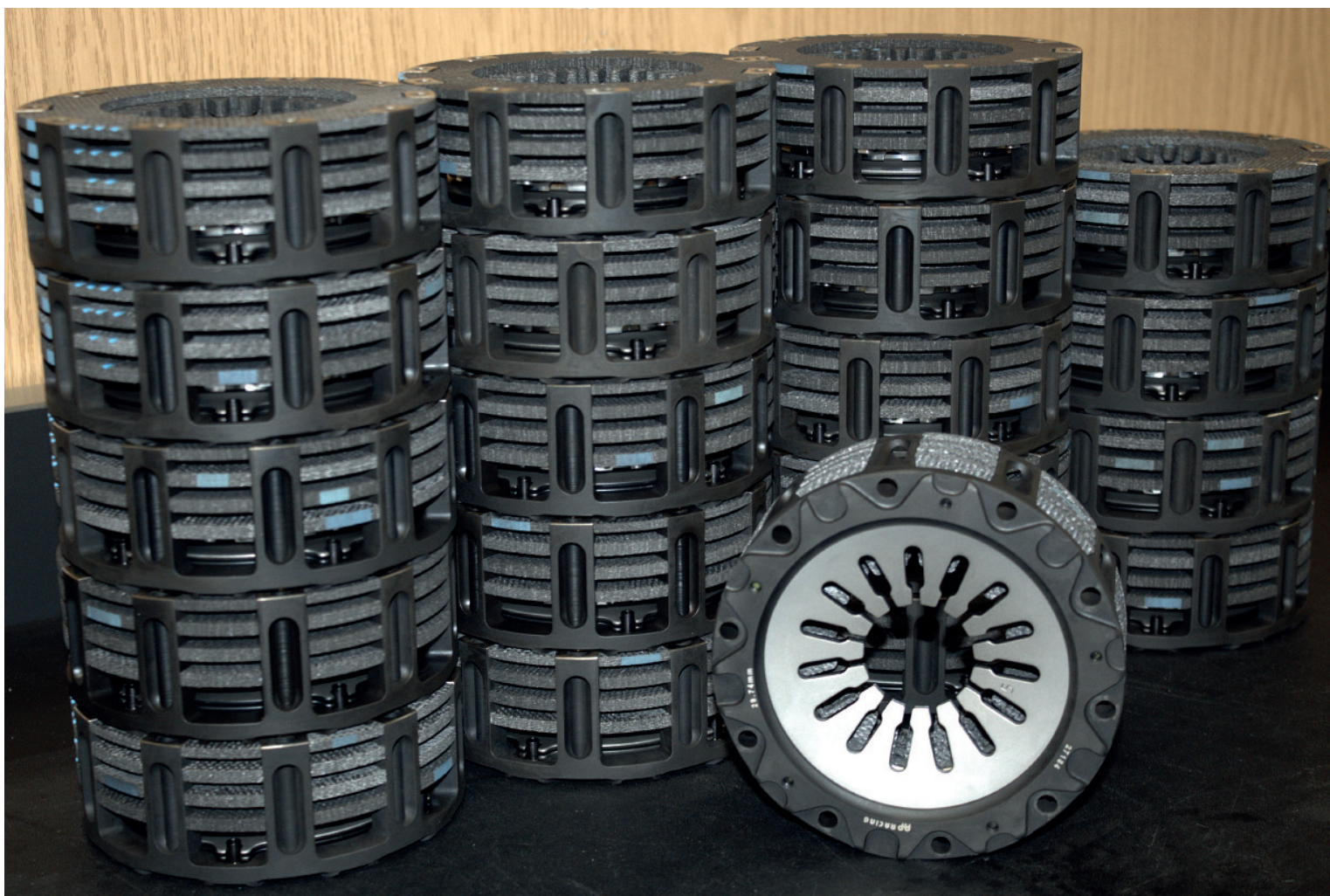
“One of the interesting things that emerged when we spoke to the teams at the first race was that some of them were re-shimming the clutch more often than they needed to,” comments Taylor.

“We used to advise re-shimming the previous clutch every 0.5 mm, but some of them were apparently doing it every 0.3 mm. There’d been situations with the previous clutch where they’d got into an abuse case – for instance, if the driver had ended up in the gravel and was really slipping the clutch to get out – where it’d got too

“Some teams were re-shimming every 0.3 mm. They were really happy when we explained that they can now go to 0.8 mm”

RIGHT IndyCar is racing into new territory this year, with preparations made for the introduction of the hybrid system

BELOW AP Racing has been involved in IndyCar racing for four decades but this will be its first time as sole supplier to all teams





Penske Entertainment

hot and the wear rate had suddenly increased, and I think that made them a bit cautious. They were really happy when we were explaining that they can now go to 0.8 mm, because they can potentially do an extra event before they have to re-shim it."

This isn't just a question of material thickness. As the plates wear, they change the angle of the diaphragm spring, which is also quite critical to clutch characteristics. Re-shimming the plates back to their original position not only compensates for the wear, but resets this angle to its intended setting.

Other aspects of the clutch design have an impact on durability too. Fatigue life and thermal durability are a consideration for the housing material. Aluminium is used in some applications, but it's not always suitable for the heat generated by small carbon clutches and it doesn't necessarily provide the outright strength required to resist the torsional vibrations in a high-output hybrid powertrain. Big-budget applications like Formula 1 tend to use titanium housings, but the fundamental concept of the carbon stack is shared

between the two, not to mention other professional motorsport applications like Super GT and MotoGP.

The carbon-carbon friction materials cover a significant range too, Smith explains: "Some of them are very much focused on frictional performance and not so much on strength. Others are stronger, but don't offer the same frictional characteristics. We put forward a couple of options to IndyCar and given that they don't do any standing starts, they went for the stronger, more durable material."


Hybrid trend

The specification of the IndyCar clutch reflects wider trends across the industry towards lower costs and longer service lives, particularly with the arrival of hybrid technology.

"Formula 1 cars used to have their engine and gearbox separated almost every 45 minutes during the weekend. That doesn't happen anymore under the new regulations, partly due to the fact that the hybrid powertrains are more complex and take longer to disassemble," comments Grant. "We

expect to see the same thing in other series. If the technology becomes more complicated, it makes sense to extend the service intervals so they can fit the clutch and then not have to worry about it."

Of course, IndyCar may have its own curveballs yet to throw into the mix. Officially, the development of the 2.4-litre engines, which have already been tested by Chevrolet and Honda, has been "paused" to concentrate on the hybrid system rather than shelved altogether. AP Racing began developing the clutch under the 2.4-litre proposals and reworked the leverage ratio of the internal pivot points when the decision was taken to stick with the existing engine formula. The friction pack, however, remained the same and would be usable if the 2.4-litre engines were to make a return.

The first step, however, is for the hybrid system to make its race debut on the existing 2.2-litre hybrid cars. As Race Tech goes to press, it's yet to be confirmed when that will happen, but we'd expect an announcement at the Indy 500 in a few weeks, if not before. 

PART 1

“Our philosophy was, ‘It’s a rally car. How difficult can it be?’”

As motorsport powerhouse Prodrive celebrates its 40th anniversary, R&D director David Lapworth offers **Chris Pickering** an insight into some of the company’s best-known cars



Prodrive

FEW companies are as deeply ingrained in the recent history of motorsport – or in as many different categories – as Prodrive. The Banbury-based engineering powerhouse celebrates its 40th anniversary this year.

Like the automotive equivalent of David Bowie, everyone has their favourite era of Prodrive-developed cars – from Colin McRae's Group A Impreza storming past in defiance of team orders in Catalunya in 1995, to the dramatic battle that saw Jonny Adam's Aston Martin Vantage snatch the GTE victory from Corvette at Le Mans in 2017.

To mark the anniversary, our two-part feature on the company begins with an interview with Prodrive's R&D director David Lapworth. Known affectionately as Lappy, he's the longest serving member of the Prodrive team, aside from chairman David Richards, having joined the outfit in the



spring of 1984.

Prodrive was very much in its infancy at that point. The company was first registered in December 1983, but the workshop didn't open its doors until January 1984. Its first competitive outing came that same month at the Qatar International Rally – the opening round of the inaugural FIA Middle East Rally Championship. Richards had already worked in the area, organising rallies on behalf of Rothmans, and it was the sponsorship giant's familiar blue, red and gold livery that adorned the team's 911 SC RS driven by local star Saeed Al Hajri.

“We were within hours of being past the point of no return when the plug was pulled on the Formula 1 programme”

Al Hajri won the event for Prodrive and went on to win that year's MERC. The car, which now sits proudly in Prodrive's foyer alongside the team's Rothmans liveried MG Metro 6R4, was later campaigned by Henri Toivonen in the European Rally Championship.

Lapworth had already worked with Toivonen and several other members of the fledgling Prodrive staff when he was approached to see if he could assist with some of the engineering challenges facing the new team.

“I was given a list, running into several pages and covering maybe 100 issues that they'd identified in the 911,” he recalls. “Porsche hadn't really been involved in rallying very much for five or 10 years at that point. The basic homologation was okay, but things had moved on. In modern terms, it'd be like give us an R3-level car when what we needed was an R2 car.” ▶

ABOVE & LEFT Birth of a legend: Colin McRae clinched the WRC title in a Prodrive Impreza at RallyGB in 1995



Prodrive

Virtually every area of the car was subtly refined, starting with the springs and dampers that Prodrive reworked in conjunction with Bilstein. The reason for going with the 911 was partly because the team was hoping to step up to a 959 when the new Group B car was ready.

“The dream was that, together with the Porsche factory, we could harness the strong relationship with Rothmans to run the 959 in the World Rally Championship, but the project never happened,” explains Lapworth. “By the time we were getting anywhere near to be able to run a 959 in the WRC, Group B was being scrapped. We were two years into the project, and at that point we needed to start all over again.”

ABOVE The company diversified into touring car racing as soon as it got a foothold, enjoying BTCC success with Frank Sytner

Dawn raid

Prodrive may never have had the chance to run the 959 in stage rallying, but the project wasn't entirely without success. Lapworth and his colleagues developed a rally raid version in parallel with Porsche's own Paris-Dakar programme.

Both cars were entered into the Pharaohs Rally in 1985 – Lapworth driving the Prodrive entry all the way from Banbury to Marseilles to catch the ferry to Egypt as it was felt that it would benefit from clocking up some miles before the event. In the end, the works entry of Jacky Ickx burnt out shortly after the start, while the Prodrive car went on to win the event. The following year, Porsche took the project in-house, scoring an emphatic one-two on the Dakar with its works team.

When the 959 project collapsed, Richards swiftly pulled together a deal with Austin Rover to run a Metro 6R4 for Jimmy McRae in the 1986 British Rally Championship. Unfortunately, bad luck was to strike again, and this time the entire Group B category was discontinued, leaving the firm searching for a car to run in the new Group A championship in 1987.

Tragically, it had been the death of Toivonen and co-driver Sergio Cresta (now in a works Lancia) that brought about this shift.

Again, it was Richards' negotiation skills that came to the fore. He persuaded BMW that Prodrive could build a successful rally car out of the Bavarian firm's M3 touring car project.

“It seems mad when you look back at it now. How did BMW let us walk away with a deal? But that's exactly what David did – he sold them the idea that we could



ABOVE RIGHT Where it all began: the Rothmans Porsche on stage in Qatar

LEFT Persuading BMW that Prodrive could build a successful rally car out of the M3 touring car project was a pivotal moment. Here the car is seen en route to its WRC victory in Corsica in 1987



Prodrive

“An active suspension system, estimated to save 0.2 seconds for every kilometre of stage, was run for one event before it was banned”

combine their touring car, our engineering expertise and Rothmans' sponsorship. And it worked,” Lapworth recalls.

Prodrive's engineering team still only numbered half a dozen staff at this point. Lapworth and his colleagues set about cherry-picking all the parts from BMW's existing touring car programme that could be used in the rally car. At the same time, BMW Motorsport produced a revised version of the M3's S14 engine for Group A rallying.

“We developed the suspension, we changed the roll cage to accommodate a co-driver's seat and then we went rallying,” jokes Lapworth. “We won our first World Championship rally with that car in 1987, and we gradually built it up to the point where we were running programmes with BMW in France, Italy and Belgium.”

Enter Subaru

By 1988, Prodrive was contesting the full two-wheel drive World Rally Championship, and it was this programme that caught the attention of Subaru.

“They sent us a Legacy from Japan to compile an engineering report on whether or not it would make a good basis for a rally car. It was the opportunity of a lifetime for us – having a manufacturer approach us to design and develop a car for them – so the answer was always going to be ‘yes’, we just needed to



ABOVE David Lapworth has worked his magic throughout the company's journey

work out how we were going to do it,” Lapworth recalls.

It was to be the first clean-sheet project the young company had undertaken. All the development work on the Group A Subaru Legacy was carried out in Banbury, right down to the gearbox, which was designed in-house.

“Our philosophy was ‘It's a rally car, how difficult can it be?’ We were too naïve to realise how ridiculous that was at the time, so we just set about hiring enough people to design the whole thing from scratch in a ridiculously short space of time,” comments Lapworth.

Although less widely remembered than the Imprezas that followed, the Legacy set the template for Prodrive's rally stardom.

“We learnt a lot through that experience,” says Lapworth. “There was quite a journey between the Legacy that we designed in 1989, the Group A Impreza that Colin [McRae] won the World Championship with in 1995 and the Impreza World Rally Car that we brought out in 1997. But I think we fundamentally got it right – we didn't have to go back to the drawing board and start again at any point. In fact, I think one of the reasons that we hit the ground running with the World Rally Car in 1997 was that ours was very much an evolution of the old Group A car.”

Even at its wildest and most ►

technologically advanced, the Impreza WRC had a direct lineage back to the Group A Legacy that first hit the stages in 1990. Over time, however, that evolution would push the technology further and further.

Prodrive had been experimenting with active front and centre differentials since the beginning of the Impreza era, but the 1998 car was to receive a computer-controlled active differential on the rear too, along with a drive-by-wire throttle. A hydraulically-activated paddleshift system was introduced the following year. There was even an active suspension system, estimated to save 0.2 seconds for every kilometre of stage on tarmac, which was run for one event in 2003 before it was banned. Active front and rear differentials were also banned from 2006.

Too complicated

"The active transmissions and active suspension were great fun to work with. They were both really interesting learning exercises and I think we would have continued developing them if we'd been given the chance," comments Lapworth. "On the other hand, from the early 2000s I started to get a feeling that things were perhaps getting more complicated than they needed to be.

"We were still a relatively small team, and it took

a huge amount of effort to do all the active stuff. The wiring looms, the software ... everything just multiplied. So, I did find myself wondering what would happen if we took everything else we'd learned and just put that into a super-lightweight car without all that complexity. That's something I try to keep in mind today – ensuring that we don't lose sight of the fundamental stuff. Ultimately, it still comes down to kilograms of weight, kilowatts of power and Newtons of downforce."

Aerodynamics was another interesting area. Rally teams had been experimenting with rear spoilers since the late 1960s, and the first wings had appeared on tarmac rally cars in the 1970s, before growing ▶

ABOVE The MINI could have become a serious WRC contender but the plug was pulled early

BELOW Colin McRae at the wheel of a Prodrive Ferrari 550 Maranello. The car was a potent competition weapon but also one of the most beautiful GT racers of the modern era



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Prodrive



bigger and wilder throughout the Group B era. Things were reined back in during the Group A years, however, and it wasn't until the arrival of the more liberal WRC regulations that aerodynamics became a major topic in rallying once again.

"When the WRC regulations arrived, we very quickly saw that we could do more with aero," recalls Lapworth. "It's not transformative in a rally car in the way it is in Formula 1, but it definitely helps. If you look at the sort of trajectory that we were on in the first five years of the WRC format, you can see that the teams have continued to build on that right up to today."

Prodrive worked out that the cars operated at an average of 8 degrees of yaw and routinely went up to 15 degrees or more, so these are the angles that were used during the wind tunnel testing. One of the primary aims was directional stability – it got to the point where the drivers could tweak the wheel immediately before the lip of a jump and land pointing in the same direction.

Tin-tops

Prodrive had diversified into touring car racing almost as soon as it got a foothold. The company ran a BMW M3 in the second half of the British Touring Car

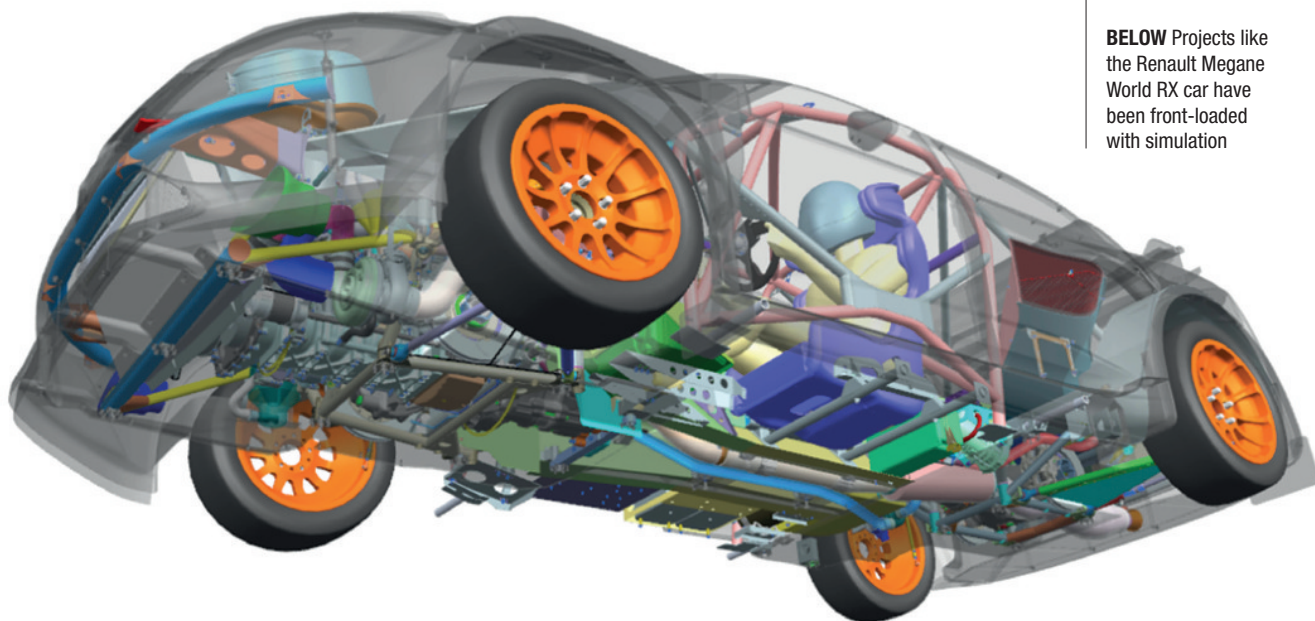
Championship in 1987. A year later, it scooped the championship outright with Frank Sytner, with Class B titles following in 1989 and 1990. By this point, Prodrive was running Subaru's works WRC team, and manufacturer programmes in the BTCC followed for Alfa Romeo and Honda.

The most famous of them, however, was to be Ford. Prodrive took over the project ahead of the 1999 season and set about improving the chassis dynamics while still using the 2-litre Cosworth-developed V6 derived from the 2.5-litre unit in the Ford Probe. In the background, however, the team was developing its own engine for the 1999 season. This was the peak of the Super Touring category's success and the cylinder heads for the new V6 were said to cost as much as their Formula 1 counterparts.

"The Mondeo was the culmination of the experience we'd built up in touring cars," comments Lapworth. "That was led by George Howard-Chappell and Mark Ellis, and its success really came down to an obsession with the detail. It was things like getting the car absolutely as light as possible so we could decide where to put the weight to get the C of G as low as possible... studying the regulations to understand how close we could get to having a flat

ABOVE It might look primitive now, but the Subaru Legacy set the template for Prodrive's rally stardom

Prodrive



BELOW Projects like the Renault Megane World RX car have been front-loaded with simulation

floor and a diffuser, and things like that.”

In the case of the underfloor, Prodrive exploited the freedom to run a flat-bottomed fuel tank, while also ensuring that the aerodynamic surfaces on items like the wishbones lined up to give a close approximation to a flat floor.

“The regulations said that the engine had to be derived from production castings, and if you look at the BTCC V6 that we’ve got on display in our foyer, you’ll see that they are indeed. But those castings were cut and shut to the point where it was a completely different engine re-assembled from bits of Ford castings,” comments Lapworth. “And that kind of approach was

taken everywhere; you know, we literally had guys go into the Ford factory, measure all the sheet metal to find which sheets were on the lowest tolerance and then walk those over to the presses. It was all about shaving a percent or two in every area.”

Le Mans success

Since 1996, Prodrive had supported French businessman Frédéric Dor in his rally campaign. But Dor’s dream as a child had always been to race at the 24 Hours of Le Mans in a bright red Ferrari. A deal was struck with an Italian firm to prepare three Ferrari 550s, but they proved slow and unreliable. After further investment failed to produce any meaningful improvement, Dor approached Prodrive, which was known to be contemplating a GT programme of its own.

The end result was not only one of the most beautiful GT racers of the modern era, but a formidable competition car that would go on to win 69 races, including outright victory in the Spa 24 Hours, and five major championship wins (spread

across LMES GT1, FIA GT and the Italian GT Championship). It was also the last V12-engined Ferrari to capture a class win at Le Mans, with the GT1 crown in 2003.

Work on the 550 GTO (later known as the 550 GTS) was carried out entirely in-house by Prodrive. The suspension was heavily revised, the 5.5-litre V12 was comprehensively re-engineered and enlarged to 6 litres, while Peter Stevens, who had penned the two-door Impreza WRC, styled a carbon fibre aero kit that took the car out to the FIA’s maximum allowable width of two metres.

“The Ferrari was the start of a new era for us, in a way. The touring cars had sort of carried on from the work we’d done with the M3, but GT racing was a significant step up,” comments Lapworth.

In 2004, with the 550 GTS still a dominant force in European endurance racing, Prodrive’s attention began to shift towards a new project with Aston Martin. In time, this partnership would see Prodrive co-developing the Lola Aston Martin B09/60 prototype that won the Le Mans Series ▶

“At the peak of Super Touring, cylinder heads for the new V6 cost as much as their F1 counterparts”

BELOW Many regard the Super Touring Mondeo as the pinnacle of touring car racing



Prodrive



LEFT The Hunter has yet to win Dakar but, given the challenges thrown up by the COVID pandemic, perhaps rates as Prodrive's greatest achievement

BELOW Prodrive has become synonymous with Aston Martin's endurance racing success in the GT ranks

outright in 2009, as well as the less-successful AMR-One that followed. The team's greatest successes, however, have come from GT racing.

Prodrive's first project with Aston Martin was the DBR9, which took a podium on its first appearance at Le Mans in 2005, and again in 2006. Its first GT1 class victory at the French classic came in 2007, followed by another in 2008.

After the AMR-One, the team returned to GT racing with the Vantage GTE, which was a contender straight out of the box, winning the GTE Am category at Le Mans on its second attempt in 2014. Another victory, this time in GTE Pro, came for the same design in 2017 following the last-lap battle with Corvette. Its successor, the Vantage AMR, picked up the GTE Pro victory in 2020.

No regrets

Lapworth says there are no significant regrets from his first four decades at Prodrive: "One of the things I'm proud of is that when you look back, we never made any monumentally stupid decisions. There are obviously things over the last 40 years that we could have done better and differently – it's easy to look back now and for me to identify kind of naive or overly optimistic things that we did at the time – but there are no really big regrets."

There have, however, been missed opportunities. David Richards briefly served as the director of the Benetton Formula 1 team and went on to be team principal at BAR (the Northamptonshire team that subsequently morphed into Honda, Brawn and eventually Mercedes). Prodrive came tantalisingly close to joining the Formula 1 circus in its own right for the 2008 season – rumoured to be with a McLaren chassis and Mercedes engine – but the door was abruptly slammed shut on the entry as the long-simmering 'customer car' row boiled over.

"We were literally within hours of being past the point of no return when the plug was pulled on the Formula

“We'd rather go out having led and set a string of fastest times than coming in a comfortable fourth”

1 programme by Max and Bernie,” Lapworth laments.

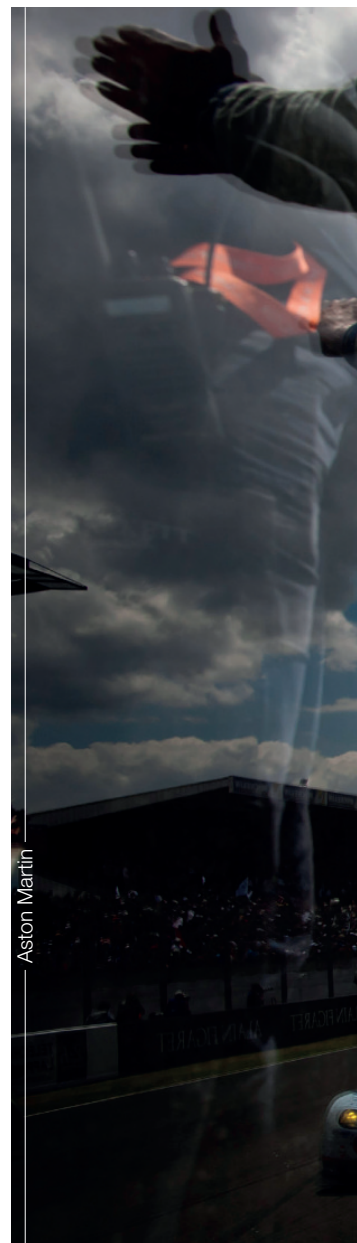
Prodrive's return to the World Rally Championship in 2011 as the works MINI team is another tale of what might have been.

"After Subaru we still had the core team and we were determined to get back in [the WRC], and that happened with MINI," he says. "I think we did a good job, and that car could have gone on to become a serious WRC contender, but the development was curtailed before it even reached its first event. Had the programme run its course, I think it would have opened the door to another programme and we'd probably still be in the WRC today."

And what of the highlights? Looking back, Lapworth says the active suspension car was one of the biggest technological leaps that the company has taken. In general, though, he points out it's more a question of evolution rather than revolution, although the company has never been afraid to take risks.

"We've never been too conservative," he comments. "In sports psychology, you hear people talking about the will to win versus the fear of failure and we've always been motivated by that desire to come first. We'd rather go out having led the event and set a string of fastest stage times than coming in a comfortable fourth with no real chance of a podium."

More recently, he says the first year in the Dakar with the Hunter also stands out as one of the firm's greatest achievements. The project faced a tight budget and a challenging timescale to start with, but its development coincided with a series of COVID lockdowns in the UK,



Aston Martin

making things especially challenging.

"In terms of what a small group of people can do in difficult circumstances, I think that trumps even the active suspension car," he comments. "We managed to get [the Hunter] to Millbrook for testing in October, to Dubai in November and then came away in the top five on our first real attempt at the Dakar. Again, the fundamental concept was sound and everything we've done on the car since then is an evolution."

Experience has given the Prodrive engineers a deep understanding of the sensitivities that different aspects of a car's design have on its performance. That approach is universal, across racing and rallying, he says. However, there's no doubt that the company's rally background stood

it in good stead for the Dakar.

"Recently I caught up for a beer with some old colleagues who are now in Formula 1," says Lapworth. "In that world, the teams complain that Monaco and Monza are too different, so I was showing them photos I had on my phone of the Hunter. In the first one, the car was up to its bonnet in water during a river crossing on a cold, damp day in Portugal, in the next it was flying over dunes at 40 degrees in the desert. You get a similar spread of conditions in rallying from, say, ice and snow in Sweden to dry, dusty gravel in Greece. I think that's what sets the rally and off-road disciplines apart. The fundamental physics is the same."

Formula 1 may be one area of motorsport where the company has

never taken part, but Prodrive has left an indelible mark across a huge range of disciplines. There's much we haven't even touched upon here: the Ford factory V8 Supercars programme in Australia, a title-winning return to rallying with Volkswagen in the Chinese championship, building a bespoke car for Renault in the World Rallycross Championship and running Lewis Hamilton's X44 team in Extreme E to name a few. And then there's the Prodrive Advanced Technology arm and the work it has done on everything from electric aircraft to military vehicles.

Having looked back on the history of Prodrive in this feature, it's over to chairman David Richards for a glimpse of the future in the next part. **TT**



WRC LOSES HYBRIDS TO FIND FUTURE DIRECTION

The hybrid system was portrayed as the poster-child for world rallying's sustainable future. So how comes the sport's key players are relaxed about it being axed? By **Anthony Peacock**

ONE of the criticisms levelled against the modern world in general – and on some occasions, motorsport in particular – is that it's all become a bit too “woke”.

So, it should come as a refreshing change to see a move in the World Rally Championship that's distinctly against the protein shake zeitgeist, from next year onwards.

Gone are the hybrid engines, in favour of proper petrol [well, sustainable petrol, there *are* limits!]. It's enough to make Greta Thunberg cancel her subscription to wrc.com.

But there are many different meanings to the



Courtesy of FIA

word 'sustainability'. And one of them is to ensure the long-term health of the championship, which at the moment, is not where it needs to be. The FIA acknowledged this by setting up the 'WRC Working Group' last year, headed up by the federation's vice president (and former world champion co-driver) Robert Reid, tasked with providing a road map – or should that be pace notes? – to increase the popularity of the sport.

Specifically, the Group's job was to review the current state of the championship, make a list of the key attributes to be retained, and then define a series of objectives for the future.

The people who made up that group had a wealth of experience in the sport, comprising luminaries such as former Rally Australia director Garry Connelly, former

co-driver Ronan Morgan, renowned engineer Xavier Mestelan Pinon, Prodrive founder David Richards, and Andrew Wheatley: previously in charge of business development at M-Sport and now road sport director for the FIA.

Overhaul

Their recommendations were put to the WRC Commission, which has come up with the latest set of regulations for next year – with the headline being the scrapping of hybrids – before a more thorough overhaul in 2026. But while a return to pure petrol might be the most attention-grabbing aspect, that's merely one element within a whole package, which comes into force from next year onwards.

This includes increased promotion, greater freedom given to organisers over

the format of their events, and cost-cutting measures such as personnel limits, increased remote servicing, and restrictions on extravagant hospitality units (Hyundai, in particular, upped the game a few years ago with the arrival of what appeared to be a portable skyscraper).

The technical aspects though are what will make the biggest difference, with the cars themselves set to cost around half of what they used to: €400,000 maximum, as opposed to nearly a million Euros today. Maximum power output will be targeted at 330 horsepower, controlled by a reference torque curve, along with cost caps for engine and transmission. Aerodynamic efficiency and top speed will also be limited. Welcome to the brave new world, where big brother is watching. ►



LEFT It's been action in the meeting rooms, rather than on the stages, which has dominated this year's WRC. The FIA World Motor Sport Council gave the green light to proposals that will radically shake up the sport

It's a bold move, which on the face of it will lead to slower cars, but perceived entertainment is actually far more important. The reduced aerodynamics, for example, might mean that the cars slide more and look faster – as opposed to the on-rails progress that most modern rally cars make on asphalt in particular.

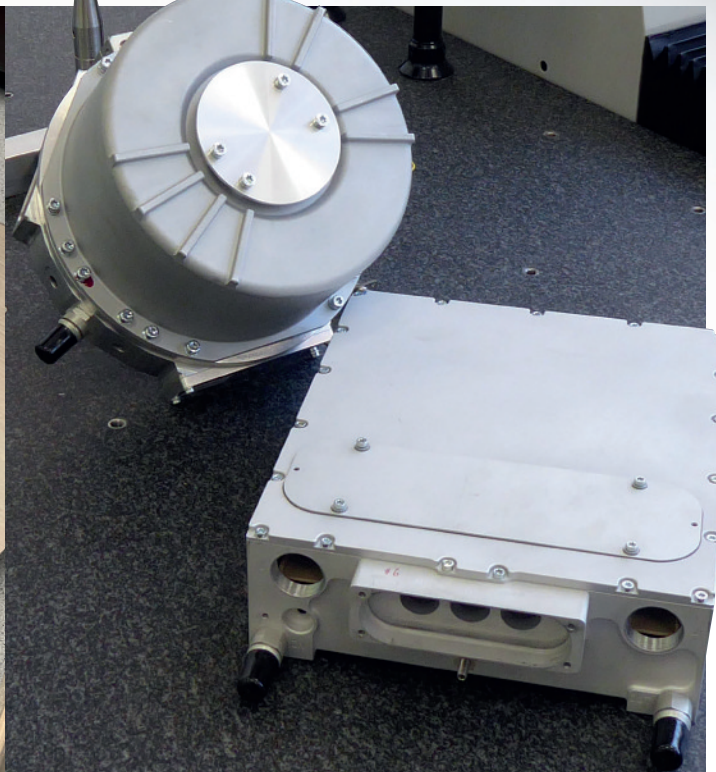
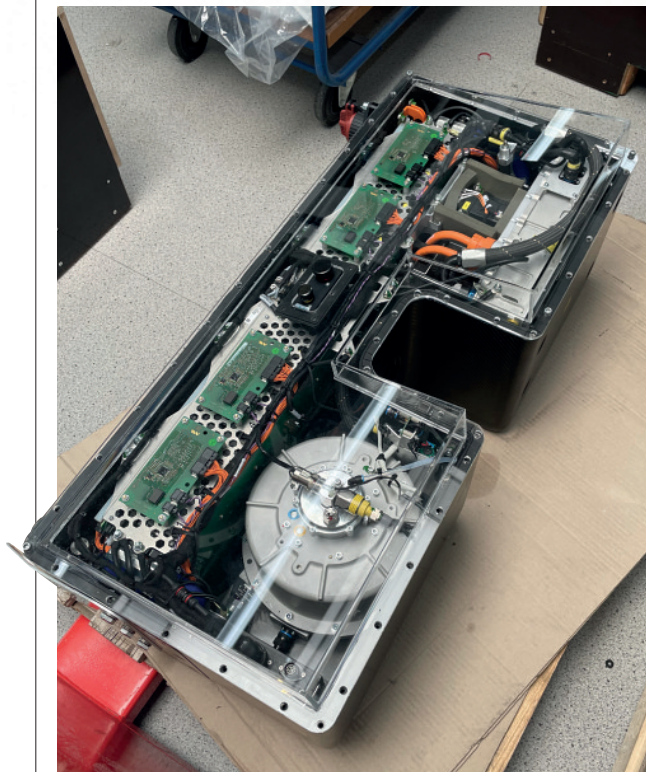
This is something that will only become apparent when we see physical cars up and running (which also gives the FIA the opportunity to tweak the future Rally 1 rules during next year, before the definitive regulations for the next cycle are set in stone from 2026 onwards). Many people still think that Group B cars were the most thrilling in history, but in terms of overall pace through an entire stage, they're significantly slower than modern Rally 2 cars.

Rally 2 revamp

Which leads us neatly to the next point, because the far-reaching impact of this overhaul isn't limited just to Rally 1. Rally 2 cars also get an upgrade from next year, thanks to a WRC kit that gives them a bigger restrictor, optional paddle shift, more aerodynamics, and a bigger exhaust. The inevitable result is a narrowing of the gap between the two categories – with the possibility that this gap will shrink further by the time the final regulations for 2026 are published next year.

One possibility for the long-term future is that there might not be two categories needed at all, with just one class at the top level. Even in the short term, the shrinking of the gap means it's not inconceivable that, under certain circumstances, a Rally 2 car could win a rally overall next season.

It won't happen regularly, but even this year – with





ABOVE & LEFT The motor, inverter and electronics contained within the FIA spec hybrid unit, built by Compact Dynamics and shielded by a ballistic-strength carbon fibre housing, were meant to carry the WRC into a brave new sustainable era

a gulf between the two classes – Oliver Solberg was fifth overall driving a Rally 2 Skoda in Sweden. And on Rallye Monte-Carlo, an ancient Group N car has even won a stage overall in the past. So expect to see more winners when the circumstances are right.

This anomaly is nothing unprecedented however: two-wheel drive, lightweight, Formula 2 cars used to regularly beat the World Rally Cars on dry asphalt events in the late 1990s, leading Colin McRae to memorably opine that his grandmother would stand a reasonable chance of winning the Tour de Corse at the wheel of an F2 Citroen Xsara.

What's happening next year, and the year after, is still an experiment to some extent – but that's been the case for every rule change in the history of red tape. There's no such thing as a right answer: it's more about an evolutionary search for the right direction.

The abolition of hybrids may be seen as a turn-off for some manufacturers, putting a bigger emphasis on private teams instead. But that's not necessarily a retrograde move: Formula 1 only has five (out of 10) true manufacturer teams, depending on how you define them, while rallying certainly wasn't any poorer for Ari Vatanen winning the drivers' title as a privateer in 1981 (courtesy of David Sutton Motorsport, co-driven by Richards) or Sebastien Loeb doing something similar in 2006 (with Kronos).

However, the FIA has kept an electric door open for the future, stating: "At the earliest opportunity, an electric category will be introduced into the WRC, with the FIA technical department charged with establishing suitable technical regulations that could utilise the new Rally 1 safety cell and achieve parity of performance with Rally 1 cars running on sustainable fuel."

Ticking time-bomb

Perhaps the man who is best-placed to comment is M-Sport managing director Malcolm Wilson, with a foot in both camps as a manufacturer-supported privateer.

But, for Wilson, it's not even a question of opinion. He says that M-Sport, which has competed continuously at the top of the World Rally Championship for three decades, wouldn't be present next year were it not for this change.

In reality, it didn't even make much financial sense for the team to be in the top class this year, but so much has been invested in the Puma Rally 1 already that Wilson pushed

“Privately, insiders admit that the hybrid power of the current cars only pays lip service to the idea of environmentalism”

the button – and his decision has been justified by Adrien Fourmaux turning out to be one of the revelations of the season so far, sitting third in the drivers' championship after three events (ahead of three world champions).

The other two manufacturers in Rally 1, Toyota and Hyundai, have been more equivocal in their responses to the news that the current cars won't see out the five-year cycle they committed to. Toyota acknowledges that there's more than one solution to future mobility, while Hyundai has committed its product line more in the direction of electric power. Hyundai driver Thierry Neuville said that the move took him by surprise – a widespread reaction – and that he would have preferred to see more stability by maintaining the status quo until 2026 as agreed, before then moving in a different direction only after consultation with all interested parties. The FIA and promoter clearly concluded instead that this was simply time that they didn't have, perhaps ►



— Getty Images/Red Bull Content Pool —

swayed by Malcolm Wilson's point of view.

While some marketers believe that the momentary retreat from electrification will be perceived as a backwards move, the universal truth is that carmakers cannot completely agree as to where the future of propulsion lies anyway. There's just no 'one-size-fits-all' solution – especially in rallying, where the intrinsic format, itinerary, and landscape of the sport makes full electric power practically impossible to achieve.

€175,000 hybrid price tag

Privately, most rally insiders also admit that the hybrid power of the current cars only pays lip service to the idea of environmentalism: the pure electric range is in the region of 15 miles, and it's not unusual for the competitors to drive just a couple of per cent of the

ABOVE Malcolm Wilson insists M-Sport, represented so well this season by Adrien Fourmaux, wouldn't even still be in the WRC's top-flight without these changes

total route distance (or less) on electric power. So far, the hybrid units haven't been the most reliable things either – despite adding around €175,000 to the cost of each car, give or take a bit.

All these aspects make the current generation of car distinctly unappealing to privateers as well as manufacturers, due to the complexity of running them as well. M-Sport built nearly 100 Ford Focus WRCs when these were the top category of World Rally Car up to 2011, and then sold most of them after factory use. So far, in more than two years of Puma production, they have managed to sell...one. Normally, M-Sport sells between eight and 14 World Rally Cars to private customers every year.

The most compelling argument for change though is the rude health of the Rally 2 championship, which features around eight eligible manufacturers



Newspress

ABOVE There is no need to fear an increased privateer influence. It did the series no harm when Ari Vatanen won the 1981 world title (co-driven by David Richards, one of the authors of the latest reforms)

“People still think that Group B cars were the most thrilling in history, but they were significantly slower than modern Rally 2 cars”

with not a hybrid unit in sight. Like the rest of the WRC, they run on sustainable fuel instead – which Wilson believes is enough to provide the eco message that the sport needs.

“What’s really the concern for new manufacturers is that they believe the entry cost to be in the 70 to 80 million Euro bracket,” he says. “Although it

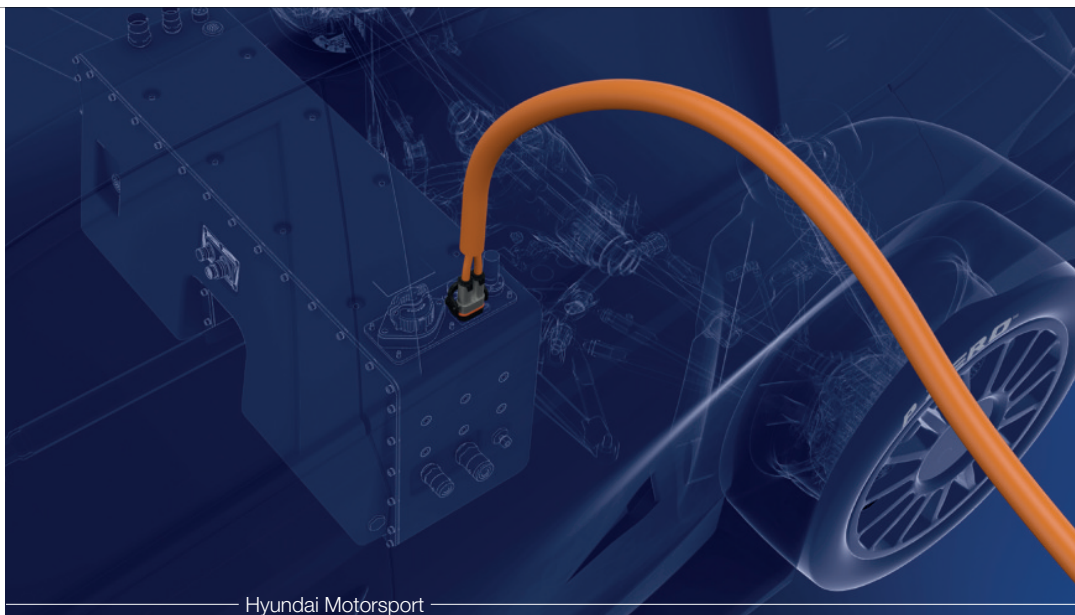
actually doesn’t have to be, given what we do it for. So we have to find a way of making the sport more appealing generally and I think what they’ve come up with is a good way.

“We don’t want to get into a GT3-style situation where we have an actual Balance of Performance, and we don’t need it either, as the current cars are incredibly close in performance as it is, but if there’s a fair way to bring more control into costs, then I’m in favour of it. We’ve been working to get on a much more balanced footing going forward, together with the promoter and FIA, who have also realised that the marketing and the promotion side of the championship needs more investment. All those things are crucial for us to continue.”

While views may differ as to how exactly to achieve this, one benefit that all the manufacturers are in favour of is the better protection that will be offered by the common safety cell. “Your crew is your most valuable asset, and I don’t think you’ll find anyone who disagrees,” adds Wilson. “So it’s just a question of taking ▶



LEFT Technological development in torque sensors means that performance balancing no longer equates to a lump of ballast in the boot



Hyundai Motorsport

LEFT & BELOW

LEFT The loss of the expensive plug-in hybrids (above) is mitigated by the WRC's continued championing of sustainable fuel, supplied by P1 Fuels

RIGHT The use of a common safety cell, something the DTM manufacturers also converged upon when only three remained, will help bring down the cost of future cars



P1 Fuels

the best of these opportunities to improve, while keeping the character of the sport."

Wilson has always been a passionate advocate of levelling-up, but he doesn't want to see Rally 1 and Rally 2 completely converge – simply because Rally 2 is such a profitable business for everyone, especially on the national level (Citroen, for example, recently built its 150th C3 Rally 2) and also because he believes there should always be a premier category as a halo, featuring the very best drivers.

Shared chassis

It's a commonly held view, which makes historic sense. The only difference is that this halo is about to become a lot more affordable, also because it should be possible for Rally 1 and Rally 2 cars to share the same chassis moving forwards (at the moment, they are built up separately).

"If we can get the volume up, it significantly reduces

the cost," points out M-Sport's boss. "I can't explain how much of a difference it makes if you can get up to sensible numbers like we do with Rally 2. Then we should see everything take off again."

Although the improved economics would likely lead to more manufacturers, Wilson doesn't believe they are entirely necessary, which is normal enough, because – as Andretti-related infighting in Formula 1 has shown – existing stakeholders never like to share the pie. But it's true enough that for many years it was just Ford and Citroen in the top category of the WRC, with M-Sport once fielding a record 13 Ford Focus WRCs on the 2008 Rallye Deutschland. For any manufacturer, that's a dream come true.

"Four or five manufacturers would be ideal, perhaps getting some of the people back into the sport who used to be there," Wilson suggests.

Citroen and Skoda are two former top-class manufacturers now in Rally 2 (as well as the existing



Rally 1 entrants, all of whom are also in Rally 2). The biggest buzz right now probably exists around Lancia, which has recently launched the new Ypsilon road car – fitting neatly into the WRC's target segment – complete with a brand-new 'HF' sporting logo. A while ago, FIA President Mohammed Ben Sulayem even spoke about a potential Subaru return. But that's another story for another day.

For now, it's important to keep an open mind and recognise that the value of the sport isn't only measured in seconds per kilometre. Rallying, while historically showcasing technical innovation such as turbocharging and four-wheel drive, has always been (quite literally) about the earthier side of motorsport.

A back-to-basics approach suits the nature of the beast perfectly – and this urgent intervention might just be exactly what's needed to revive the WRC's flagging fortunes. **RT**



Audi AG



LEFT Modifications to the Rally 2 cars will bring them closer in performance to Rally 1 – not that Oliver Solberg required much assistance with an eye-catching performance for Skoda in Sweden

Getty Images/Red Bull Content Pool

THE MISSION TO TURN “FINISH AND LEARN” INTO DAKAR GLORY

Ford has conquered Monaco, Le Mans, Daytona and Bathurst.

Hal Ridge discovers how M-Sport is approaching the challenge of adding the iconic Dakar Rally to the Blue Oval's roll of honour

SINCE the turn of the millennium, M-Sport has been a name synonymous with stage rallying, along with its long-running association with automotive giant Ford.

But, with a requirement for the majority of businesses, whatever the sector, to evolve and diversify, the Cumbrian outfit has also ventured into rallycross and circuit racing. A successful Bentley GT programme opened doors: a contract for a British Touring Car Championship engine followed; so did a deal to support the production and development of Ford's GT3 Mustang powerplants.

Meanwhile, the Malcolm Wilson-owned firm continues to deliver cars for the entire stage rallying ladder. It has also managed to remain at the highest level of the WRC itself with the Puma Rally1, albeit with

substantially less financial clout than the Toyota and Hyundai juggernauts.

But M-Sport has also long harboured ambitions to venture into another new discipline: Rally-Raid.

With support from Ford Performance, M-Sport contested the 2024 Dakar Rally with a Ford Ranger as part of a collaboration with South African off-road specialist Neil Woolridge Motorsport. The entry was a stalking horse for a full-blown return in 2025 – armed with a bag full of know-how on how to tackle an event that's right up there in terms of motorsport prestige with the Le Mans 24 Hours, the Indy 500, the Monte Carlo Rally and the Monaco Grand Prix.

The Ranger T1+ used in the 2024 edition of the event – earmarked as a “finish and learn” campaign ►





ABOVE The 2024 Dakar entry was a stalking horse for the new car that will incorporate the lessons learned for the return in 2025



ABOVE The rigorous test programme was calculated to create worst-case scenarios

“It was a new requirement to deliver a package that could deal with whatever came up next”

by Mike Norton, Ford's Dakar programme leader in mid-2023 – originated from NWM's workshops in South Africa as a Ranger T1, based on a previous generation of Ford's Ranger pickup.

NWM's purpose-built T1, produced en masse for customer racing to the tune of over 45 machines, had won South African overall and class off-road titles. But taking on the Dakar Rally, renowned as the world's most gruelling endurance event, would elevate the project to a new level.

Growing pains

With the fully composite-clad tubular spaceframe chassis Ranger being developed as a T1 then evolved into a T1+ – in which, among other details, larger wheels up by five inches to 37" diameter are allowed, a larger tread width of the tyres permitted



LEFT The carbon-clad spaceframe benefited from M-Sport's WRC experience

car, aimed as much on reliability as performance.

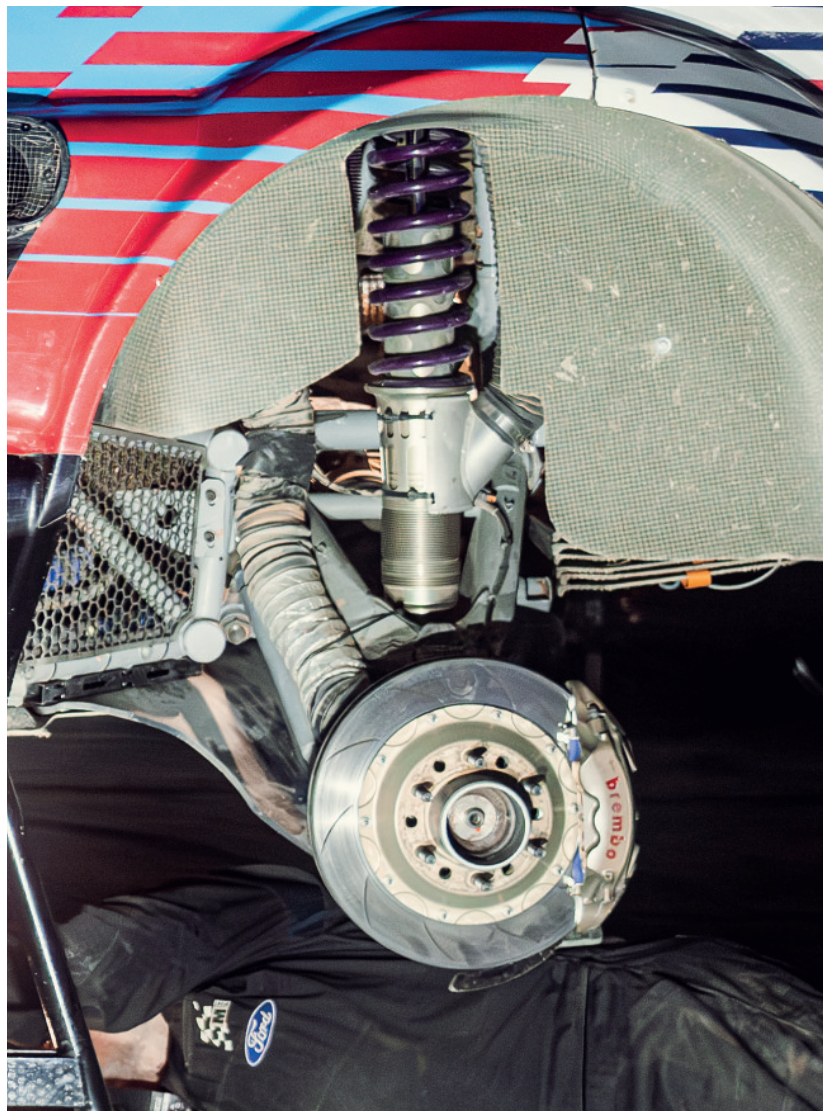
"Chassis durability was an area quite early on that we had some challenges with, but ultimately we ended up with a very robust chassis, with no issues on Dakar or any of the other events that we did," suggests Sprackling.

WRC crossover

Almost by coincidence, M-Sport was involved in two spaceframe concepts in a similar period, albeit for two very different programmes. The Puma Rally1 car, built to FIA World Rally Championship regulations introduced for 2022, was born in M-Sport's Cockermouth workshops, with the spaceframe created under the watchful eye of experienced off-road and chassis dynamics engineer Sprackling.

BELOW The switch to long-term, trusted supplier Reiger for dampers was one of M-Sport's first moves

"There was a lot of crossover," he muses. "I was head of the chassis team on the Puma, so when it came to reengineering the spaceframe on the Ranger, when we had some challenges with the structure, we were able to take the learning from ►



and an increase in suspension travel from 280 mm to 350 mm – the Ranger experienced growing pains.

Having brought the machine to Europe, M-Sport and NWM set about durability testing in private sessions and events to simulate 'worst-case' scenarios, ahead of a maiden Dakar appearance. "We started the project in December 2022; the first bit of testing we did was in Dubai with the old NWM Ranger towards the tail end of that year," explains M-Sport engineer Jon Sprackling. "NWM had a vehicle that they developed from T1 specification and they brought the evolution [to T1+], but it wasn't quite ready for Dakar. That is why we made the decision not to go in 2023 and spent the next year testing and evolving it.

"Take nothing away from what NWM did," he says. "They put a lot of effort into designing the car with the recourses they had, but we recognised it wasn't right where it needed to be, to give ourselves the best possible chance of finishing the Dakar – we had quite a challenge."

Opting to refine rather than redesign for the first attempt at the Saudi Arabian desert-based Dakar, M-Sport focused on a number of key areas with the

the Puma and transfer that over. It was actually quite an easy process because it [the Ranger's durability] was a simple problem to solve. It wasn't like we had massive fundamental issues and we had to redesign the spaceframe. It was relatively straightforward, so the learning we got from the Puma was valuable for sure. We put some extra tubes in, we changed some crossmembers underneath the [480-litre] fuel tank, just to try and make the way the stresses in the chassis go through it more efficiently so it was far more reliable."

While the regulations in Rally-Raid remain tight on safety rounds, the composite bodywork clad chassis are, relative to Rally1 machines at least, relatively free. It's a freedom engineers welcomed with open arms.

"On the chassis side there's a lot of things we can do to try and make the most efficient lightweight car," says Sprackling. "When the FIA decided to go to spaceframe in WRC, that was quite a step change to what they had previously [steel-body production-based shells], so the regulations were

BELOW The first lesson was that the Dakar Rally tests the capabilities of the vehicles and the team far beyond anything the partners had encountered previously



quite tightly defined with what you could and couldn't do on the chassis. Because Rally-Raid has been spaceframe for a very long time, there's a lot more freedom there."

Focus was also put on the suspension of the Ranger, with new arms developed for the double-wishbone setup, attached to uprights that are home to Brembo brake calipers and 14-inch discs, housed inside 17" wheels, clad with 37" tyres. The



LEFT The lessons learned with the WRC Puma proved invaluable

“When we had challenges with the structure, we were able to transfer the learning from the Puma”

changes also included the introduction of Reiger dampers, complete with 350 mm of wheel travel as per the T1+ regulations. Reiger has been a long-term partner of M-Sport in rally and rallycross programmes, and is arguably the go-to supplier of the current era in Rally-Raid.

“We effectively took a known manufacturer with known experience and bolted those onto the car,” says Sprackling, clearly half-joking. “Of course we did lots of development work with Reiger to try and get the suspension as good as we could, but effectively that was short-cutting to a good solution as quickly as we could,” he clarifies.

Cooling focus

Aside from strengthening the platform for Nani Roma and Gareth Woolridge to take on the 5,000-competitive kilometre, 14-day 2024 Dakar event, changes included adaptations to the drivetrain, in areas like driveshaft joints. Cooling was also a major development focus on the Ranger as part of its 8,000-mile

preparation programme.

“We made life as difficult as we could in testing, testing in Morocco in the hottest part of the year to try and get worst-case conditions – going through the dunes in the worst heat for example,” notes Sprackling. “We were really trying to give the car the hardest possible time. All that work paid off when we got to Dakar because those areas that we had challenges with early on were fine.”

Alignment with Ford Performance made for access to OEM facilities to aid the development process, especially on the cooling side, as Sprackling explains: “Ford Performance did some CFD analysis for us. We also used a place called ETL, which is Ford’s hot weather dyno, to try and get some early information about how the car would perform in high temperatures.

“We could simulate altitude there [too], so that was an asset before we spent a lot of money going testing. By the time we got there, we had a fighting chance of knowing what we were up ►



against. The expertise we can draw on from Ford is invaluable: it's a team effort from that point of view – the facilities they've got that we can use at short notice are a great help."

That assistance was in areas new to M-Sport too, despite its long heritage in rallying. For the first time, cars from Cumbria needed to be fitted with air conditioning, usually one of the first elements of a production engine concept to be thrown in the metaphorical engine build bin. Crew comfort was a far higher priority with the intense outside temperatures and endurance durations in the cockpit in Rally-Raid than the WRC.

Into the unknown

In some respects Dakar was also a drive into the unknown, each crew competing with none of the recce or free practice sessions that M-Sport is accustomed to in the WRC to assess the conditions. They also had only an approximate idea of the terrain that would be encountered in the next hours and

TOP The 2024 Dakar run was aimed at testing the team as much as the car

ABOVE Merely to finish won't be enough ultimately, but it offered a solid base to work from

days. It was a new requirement to deliver a package that could deal with whatever came up next.

"In Rally-Raid you may know roughly that you're doing so many kilometres of dunes, gravel or sand, but it's very, very vague," says Sprackling. "You have to design a car that is as well rounded as possible and can take everything that you can throw at it in a predictable way. That's quite different to how you set up a rally car, so that was quite a steep learning curve."

Where the Ranger remained largely unchanged from to the version created by NWM was the specification and orientation of the mid-mounted, twin-turbo 3.5-Litre EcoBoost V6 engine, which delivered 402 horsepower and 600 Nm torque. Limitations in engine development stipulated by the regulations meant that only the exhaust manifold, inlet manifolds, turbochargers and other ancillaries

“There isn't a great deal of performance to gain by changing many things on the engine because you have to conform to a boost curve”

are changed, with the engine also remaining wet sump in the 1,995-kilogram chassis.

The six-speed sequential transmission also remained largely unaltered, the longitudinally-mounted Sadev unit mated to mechanical limited slip differentials. With the exception of Audi's RS Q e-tron, various iterations of the same Sadev transmission remain the unit of choice within current top-flight Dakar T1+ machines.

"There isn't a great deal of performance to gain by changing many things on the engine because you have to conform to a boost curve," explains Sprackling. "With the V6 turbo there's an FIA-regulated boost curve that we have to comply with. We went to the dyno a couple of times to make sure we were exactly on that boost curve, and after that it's just making sure that the engine is reliable at those boost curves for the duration of Dakar."

Raptor takes shape

Ford and M-Sport are building a new car for 2025. The Ranger Raptor will be the ultimate performance derivative of Europe's best-selling pickup, designed for Dakar's T1+ class regulations. Specific details, like the powertrain of choice, are yet to be revealed.

Having ticked the initial learning box this season, merely finishing will not be seen as an achievement come next January. The effort will need more than an outside top-20 result in 2025.

BELOW The limitations of evolving the Ranger from a T1 machine into T1+ placed extra demands on the project

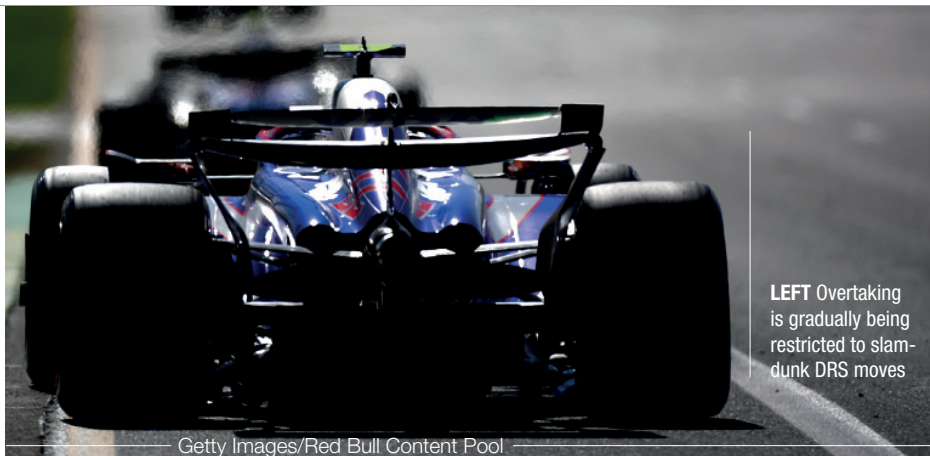
But, the knowledge gained in every area from 2024 will prove invaluable in the quest for victory next year, in what will be an interesting period for Rally-Raid. Audi has completed its chapter in the discipline, signing off with Dakar triumph before switching its focus to a works Formula 1 programme for 2026. But Toyota is an ever-present Dakar force, and Prodrive is putting its recent learnings with the Hunter into an effort with Dacia and none other than rally legend Sebastien Loeb, who continues to crave a maiden victory.

“The knowledge that we gained from Dakar was partly about the car and partly about learning how the team works, the logistics,” says Sprackling. “Dakar is so much a team game: looking at how

we function as an entity as well as about the car. On the car side, we didn’t have a faultless Dakar by any stretch, we had some challenges that we will certainly take as learning points for the new car. We know there are areas where we can improve reliability, performance, we can improve comfort for the drivers and many things. It’s definitely exciting to be going in 2025 where we’re not the only new team that will be on the starting grid.”

The Ford-backed M-Sport and NWM effort has a challenge ahead, but based on how far the project has come, the learning under its belt and what the three parties have achieved elsewhere, there’s no reason to suggest competing at the front isn’t possible next January. **LT**





Getty Images/Red Bull Content Pool

TURBULENT TIMES



With racing deteriorating and the 2026 ruleset soon upon us, F1's regulators have tough decisions ahead.

Sergio Rinland has some suggestions

FORMULA 1 is enduring turbulent times. And not just the kind of turbulence that affects drivers running close to one another.

That was the big problem up until 2022, when a completely new aerodynamic concept was introduced. The new rules reacquainted us with the benefits of ground effect, with a floor shape rather more complex than we were used to by the end of the previous ground effect era at the start of the eighties.

Meticulously researched and simulated, the new design was conceived to dramatically reduce and control the wake that the traditional high-downforce wings used to leave behind. It needed to, because by that point pursuing cars were losing as much as 50 per cent of their downforce when they neared the car in front. Overtaking had virtually been rendered an impossibility without the use of the Drag Reduction System.

For a while those new rules, devised by the FOM-FIA technical team, looked to be so successful that I even began to question the need for DRS: the cars were running so closely together that it allowed for classic overtaking into the braking zones. All the DRS was achieving was that drivers were

now taking fewer risks and instead adding another item to the race strategists' to-do list.

The rules upheaval appeared, to me, to have been successful. Now we were able to enjoy much closer racing in the midfield.

Not at the front? Well, just look at the history of F1 and tell me how many times we had close racing at the front!

Now, three years into the new ruleset, some of the intended benefits have lessened. And the criticism has increased.

Recently I read some opinions voiced by the highly respected Mercedes Technical Director James Allison, a talented aerodynamicist in his own right. James thinks that the FIA has been barking at the wrong tree with its focus on reducing the wake behind a car in its quest to improve wheel-to-wheel racing. Instead of pursuing such complex solutions, he suggested the FIA should have tackled tyre grip.

Can-Am example

I agree with some of his arguments. He is basically suggesting that improving the spectacle is much easier if the cars are 'over-powered' and 'under-gripped'. Cars would be spectacular (remember Can-Am?) and the racing would improve two-fold.

We need look no further than last month's

NASCAR Cup race at Bristol for evidence.

Like F1, NASCAR's Next Gen revolution targeted improved racing. And, as in F1, that became progressively harder as teams got used to the regulations. But in Bristol, where the treatment of the track might have played a role, tyre wear unexpectedly increased dramatically. The result was one of the most spectacular races in decades, loved by spectators and drivers alike.

That was a freak situation but it did highlight a possible avenue to pursue: reduce grip. I have been advocating this for decades, but accept the FIA has to consider the impact of any such actions across the whole racing ladder, from F1 down to F4. Reduce grip and slow lap times in F1, and you could soon be confronted with F2 cars lapping faster than the F1 midfielders.


I'm sure those limitations of the single-seater pecking order were factors behind the FIA's pursuit of wake management. It's not an easy balancing act but, as James Allison points out, all the alternatives should be considered.

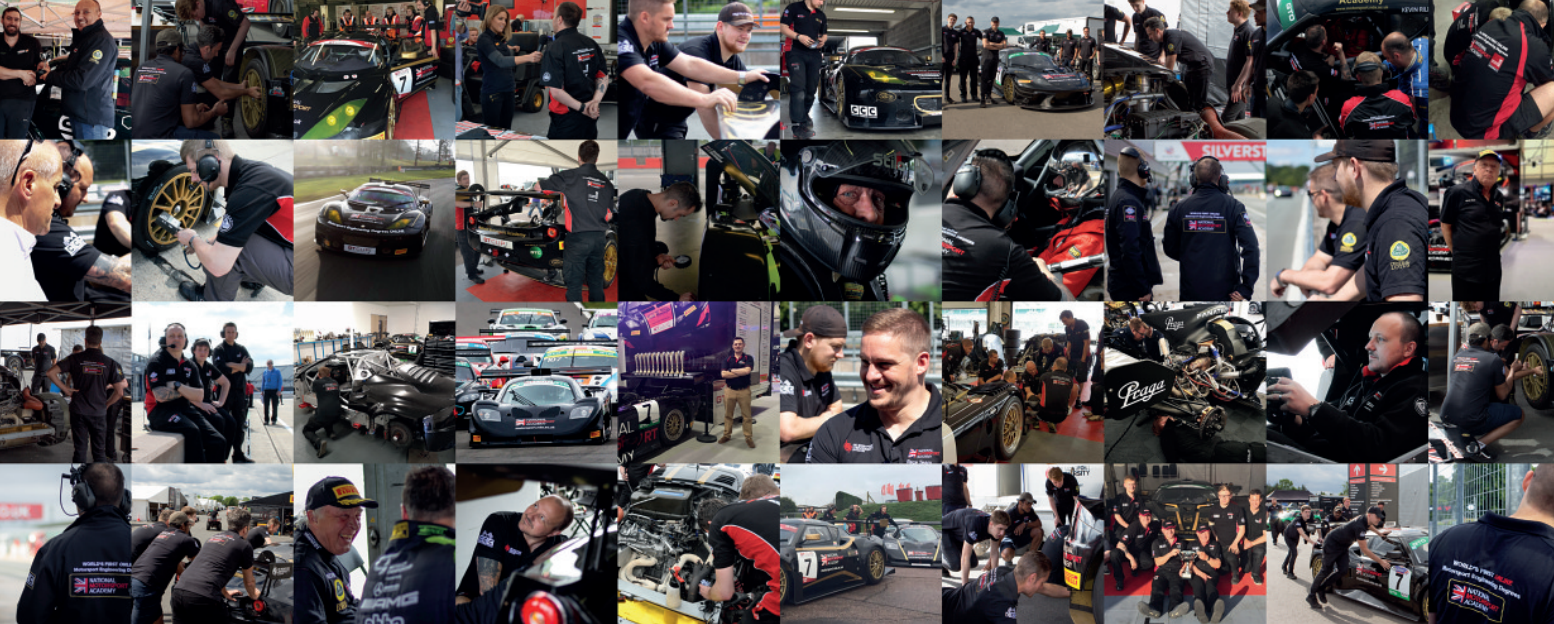
I believe that the current situation where the FIA has a 'virtual' 11th team devising the rules is what the sport has needed for a long time, and is a very welcome development. It reminded me of a proposal for creating a 'virtual team' that I made to the FIA more than 20 years ago: it was rejected with the excuse that they didn't have the necessary funds...

My ideal rules are much closer to the LMH concept. Limit the power and aero performance and let the F1 designers come up with the best concept they can to conceive a car superior to that of competitors running the same power and aero. All we can hope is that Allison can influence the FOM/FIA powers that be to start thinking in that direction.

The concept sort of works with LMH. I say 'sort of' because the devil stuck his tail in by tampering with BoP.

In the meantime, I reckon F1's 2022 regulations achieved their objectives. But when the rules for 2026 are created, they will need to further control downforce to ensure that the '15% downforce maximum loss at 10 m from the car in front' concept is maintained, because current developments demonstrate that the increments of downforce are bringing back bigger wakes already.

Maybe they should consider reducing grip too? They will have to do it eventually... 



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