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RACE TECH
Motorsport Engineering

Volume 26 Issue 6
Published April 2019
The next issue will be published in early May 2019
ISSN 1356-2975

SUBSCRIPTIONS
Subscriptions from Kimberley Media Group Ltd
841 High Road, Finchley, London N12 8PT
Tel +44 (0)20 8446 2100
Fax +44 (0)20 8446 2191

Overseas copies are sent via air mail
Special offer 12 issues for the price of 10
12 issue subscription UK: £45.00
Europe: €97.50, US/Canada: US$127.40
Rest of World: £75.00
All major credit cards accepted. Cheques and money orders only in Pounds Sterling payable to Kimberley Media Group Ltd.

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Price including post & packing:
UK: £5.50, Europe: £6.50, Rest of World: £7.55
You can pay by cheque or credit card but please note the minimum on Switch & Delta is £14

Race Tech (ISSN: 1356-2975) is published monthly by Kimberley Media Group Ltd.

Cover image: DTM

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Irreplaceable

As I write this, Formula 1 owner Liberty Media is meeting all 10 Formula 1 teams in London to thrash out the future because, as things stand, the contract between the teams and the owners of F1 finishes at the end of next year. As vitally important as the meeting is, everybody knew it was overshadowed by the fact that one person would no longer be involved: Charlie Whiting. He suffered a pulmonary embolism on the Thursday morning in Melbourne, where he was due to officiate as usual at the season-opening Australian GP. It was a total shock for the entire F1 world.

His title as F1 race director really did not do justice to just what he did and just how integral he was in the running of the sport. He was involved in everything, from safety, to technical rules, to sporting matters. According to many, he was doing the job of three people, but such was his work ethic, he just got on and did it.

Racing was Whiting's lifeblood. From a young age, he assisted his older brother, Nick, to prepare cars he raced at Brands Hatch. He began his F1 career in 1977, working at Hesketh, but the job was short-lived as the team folded the following year. He then joined Brabham, which was then run by Bernie Ecclestone, eventually becoming chief mechanic, helping Nelson Piquet win the FIA Drivers' Championship in 1981 and 1983.

He joined the FIA in 1988 as technical delegate shortly before Ecclestone sold the Brabham team, his main responsibility being to scrutineer the cars to ensure that they complied with the regulations, becoming race director and safety delegate in 1997. He was also responsible for guaranteeing that all circuits and cars complied with the continual improvements made over the years with safety. This included overseeing the introduction of the HANS device in 2003, and the Halo that was adopted at the start of last year.

For all this responsibility in ensuring the regulations were adhered to by the teams, he was one of the very few people in the Formula 1 world who was universally liked and respected. During an F1 weekend, he was the go-to person for teams on all matters. His influence, knowledge, and ability to implement, adjudicate and enforce the F1 regulations will be sorely missed.

"I have known Charlie for all of my racing life," said Ross Brawn, managing director, motorsports, Formula 1. "We worked as mechanics together, became friends and spent so much time together at race tracks across the world.

"I was filled with immense sadness when I heard the tragic news. I'm devastated."

Red Bull Racing team principal Christian Horner said of Whiting: "He has played a key role in this sport and has been the referee and voice of reason as race director for many years. He was a man with great integrity who performed a difficult role in a balanced way."

BBC Sport reported that Lewis Hamilton, who had known Whiting since starting out in F1 in 2007, said: "What he did for this sport, his commitment, he really was a pillar. Such an iconic figure and he contributed so much."

The website also reported how Sebastian Vettel had spoken to Whiting on the Wednesday: "I walked the track for the first couple of corners with him. It is difficult to grasp when someone is just not there anymore. He has been our man, the drivers' man. There's the regulation and then us, and he was the middle man. Any time his door was always open. He was a racer, just a very nice guy." RT

William Kimberley
EDITOR

ABOVE & RIGHT The real-time driver safety initiative could pave the way for the introduction of the technology into other motorsport disciplines and physical contact sports

Indy 500 tech partnership a game-changer for safety

William Kimberley reports on the potentially far-reaching implications of a collaboration between McLaren Racing and a neurotechnology company for the Indy 500

IN what would have been unthinkable even five years ago – and certainly in the days of Bruce McLaren, founder of the McLaren Racing team – "brain technology" is going to become part of McLaren's armoury for its assault on the Indy 500.

A recent announcement confirmed that McLaren Racing has entered a technology partnership with a company called MindMaze, a 'unicorn' startup in brain technology, co-located in Switzerland and the UK. MindMaze has already proven itself in the medical field by developing a virtual reality device to rehabilitate the brains of stroke patients, along with creating a microchip that can replicate the way that the brain handles huge amounts of data.

As reported in *Wired* magazine, Andy Ibbott, an energetic and fit man of 46, was preparing for the Marathon des Sables, a six-day ultramarathon through the Sahara Desert, when he had a massive stroke that left him without the power of speech and unable to walk without a stick. Upon leaving the hospital, after six months, in September 2011, he was told that now was the time for him to settle into his new life: one with limited ability to speak or swallow, almost no movement on his right-hand side, and the constant need of support from a walking cane.

His home in Long Buckby, Northamptonshire, was just 10 minutes down the road from a neurophysiotherapy company called Physiofunction. This happened to be one of the first sites in Europe to trial a prototype of a new technology called MindMotion Go, created by Swiss neurotechnology startup MindMaze.

As the *Wired* article says: "After six years, Ibbott regained the movement in his arm. The ability to speak followed. Then he was able to start walking with a stick, and, eventually, he became able to walk without one. On April 7, 2017, he found himself standing where he'd first planned to be back in 2012: amid a cluster of Moroccan sand dunes, at the start line of the Marathon des Sables."

The company and its pioneering neuroscience work came to the attention of McLaren Racing after it did extensive research in this area. The result is the team and MindMaze entering an innovative and strategic partnership for this year's Indianapolis 500.

The event will see McLaren challenge for its fourth victory at the circuit. Its driver, Fernando Alonso, is looking to secure the coveted Triple Crown of motorsport: wins at the Monte Carlo Grand Prix, Le Mans 24 Hours and Indianapolis. If he succeeds, he will be the first to do so since Graham Hill won it half a century ago in 1969.

The technology partnership will see the companies collaboratively design and develop 'MindDrive,' the next generation of safety and performance platforms tailored for motorsport. Using MindMaze's award-winning brain-sensing technology, the product will be capable of capturing and transmitting key neural signatures from the driver to a track-side medical team in real-time in the event of an incident.

The technology will also enable McLaren Racing to gather data and insight on overall driver safety and performance. Together, McLaren Racing and MindMaze will rigorously test MindDrive's functionality during the team's preparations for the world-famous racing event in May. In addition, the MindMaze brand will be represented on the McLaren-Chevrolet and on Alonso's race suit,

> *"A real step in the safety of motorsport"*

along with McLaren team apparel.

"Despite MindMaze being a start-up, it has established itself as a leader in its field" said Bob Fernley, president, McLaren IndyCar. "At McLaren, we are always looking for innovative partnerships and that often leads us to connect with businesses outside of our industry, if we identify technology or approaches that when applied to motorsport could improve and progress our racing.

"After admiring MindMaze's innovative approach to neuroscience for some time, we felt the Indy 500 preparations provided McLaren and MindMaze with a great opportunity to come together, and potentially deliver a real step in the safety of motorsport.

"At McLaren we have the unique capability to test new technologies in our simulator before taking the technology to track. With this partnership we are combining their team's unique expertise in neurology with our understanding of our sport; both companies each work at the highest levels of their respective fields and we're thrilled to be joining forces.

"Human performance is an area we have been increasing our research and knowledge in through the health arm of McLaren Applied Technologies. We believe it's an interesting and relevant direction for this product and we're excited by the potential of using technology to improve driver performance and extending this partnership to other parts of the McLaren business following the Indy 500."

ABOVE Fernando Alonso has a seat fitting at McLaren Racing ahead of the team's Indy assault

ABOVE Victory on McLaren's return to Indianapolis would complete Alonso's Triple Crown

Asked whether he saw further applications of this technology, Fernley replied: "We believe this technology could have potential benefits across all motorsports and other sports where cognitive risk is present, such as physical contact sports as well as occupations with a heightened risk of neurological or cognitive impact.

"The co-developed 'MindDrive' product is in very early stages but we have had some exciting meetings with MindMaze's neurology team, where our immediate focus is for the technology to be applied to driver safety. We are hopeful that in the future it might be of further interest to IndyCar, as well as F1 and other motorsports." RT

ABOVE Porsche's Formula E contender enjoyed a successful track debut

Porsche enjoys successful Formula E rollout

PORSCHE has successfully completed the initial test of its first ever Formula E car, at its Weissach test track in Germany. The marque says that completion of the test is an important milestone en route to a successful works entry in the ABB FIA Formula E Championship for Season 6.

Works driver Neel Jani, who Porsche has confirmed as one of its drivers in 2018/19, was at the wheel for the new car's first few kilometres, which were completed without incident.

"I am very proud to have been behind the wheel the first time our Formula E racing car was driven," said the Swiss driver. "Being allowed to drive the rollout is not only a great honour, it is also very exciting. We're breaking new ground. It was a fantastic feeling for me. Everyone in the team feels it: The project is really gaining momentum now. We didn't push it to the limit during the rollout, but the car made a very good first impression overall. I can't wait to get back to testing."

Porsche's entry into the FE Championship is the manufacturer's first new works entry since it pulled out of the World Endurance Championship in 2017. In total, the company is allowed to complete 15 days of private testing ahead of its debut in Formula E, and will use these to refine and improve the package so as to be able to be competitive from the very first race of Season 6.

"The development of a Formula E car fully streamlined for efficiency and lightweight construction is a great challenge for our team of engineers," added the project's technical leader, Malte Huneke. "Seeing the car in action for the first time gave us goose bumps. Compared with production development, the demands in terms of efficiency and weight of the powertrain in Formula E are on a very different level. Now we will approach the limit one step at a time. This will be essential to make it in Formula E." RT

NASCAR to adjust qualifying following farcical session

NASCAR has said it will make adjustments to the qualifying process after a farce at the Fontana Auto Club Speedway, where none of the cars in the final Top-12 session successfully completed a timed flying lap.

Rule changes implemented in 2019 encourage drivers to preserve momentum and draft with each other in order to post the best time on longer tracks. However, this practice meant no driver wanted to be first as it would be disadvantageous to either go out alone and not benefit from another car's slipstream, or worse, provide slipstream for a rival behind.

After the race in Fontana, NASCAR's senior vice president of competition, Scott Miller, acknowledged it was a disappointment for fans.

"Having the last 12 cars wait until they couldn't get a time posted on the board and making a mockery out of the qualifying is not what we expect for our fans," he said.

"It's an exciting show when they're out there on the racetrack but obviously we have a little work to do on our part to get a little bit of a better format so things like that can't happen.

"I think we will definitely make some tweaks to it," he added "We've been working on a few other things. We really don't want to go back to single-car qualifying, there may not be another way but we want to try to exhaust every possibility before we do that." RT

ABOVE Qualifying at Fontana became such a farce that NASCAR promised rule changes

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ABOVE The Valkyrie from Aston Martin has a lineage that goes right to the F1 grid

The F1 DNA inside the Aston Martin Valkyrie

Adrian Goodsell

ANNOUNCED at the start of March, the Valkyrie, Aston Martin's latest supercar, can trace its DNA and the way it has been conceived straight back to Formula 1. This is due in particular to the carmaker's partnership with Red Bull Advanced Technologies.

The supercar is powered by a clean sheet Cosworth-built 65° naturally aspirated 6.5-litre V12 engine that delivers 1,000 bhp at 10,500 rpm and 740 Nm at 7000 rpm. It is boosted by a battery-electric system developed by Integral Powertrain, which is supplying the bespoke electric motor, and Rimac, the lightweight hybrid battery system, so that it delivers an additional 160 bhp and 280 Nm.

Following the F1 ethos, many key components do more than one job. As an example, both the V12 engine and gearbox casing act as stressed members of the vehicle structure. The latter provides rear suspension mounting points, while also helping provide even greater structural rigidity and eliminating the weight of an additional rear subframe. The battery pack integrates all relevant sub-systems and serves as the carrier for the vehicle's power electronics, while in addition to its Power Boost and Energy Recovery System functions, the E-Motor aids the mechanical performance of the gearbox.

Not resting on its laurels with the success with the Valkyrie project and the Volkswagen I.D. R Pikes Peak car, Integral Powertrain is also in the finishing stages of a two-phase, multi-million-pound CFR 1066 compliant upgrade for its emissions and driveline test facility. It is planned to be operational within the next few weeks. The upgrade will extend Integral's capabilities for the delivery of complete RDE testing services through dyno-based road simulations and comprehensive vehicle emissions testing.

A highlight of the upgrade will be a new cutting-edge 2WD/4WD dyno. Being supplied by Horiba, the latest generation Horiba Vulcan will provide high accuracy and repeatability of measurement results. It is suitable for a wide range of vehicle types, including passenger cars and hybrid cars, in accordance with all international standards.

"This upgrade will put us at the forefront of real driving emissions testing and allow us to offer a wider range of services to our existing and new customers, with state-of-the-art equipment, improved processes, and a dedicated customer online portal," said Simon Mead, Integral Powertrain's development manager. RT

WEC 'Hypercar class' opened to production cars

THE FIA World Endurance Championship has tweaked the regulations for the upcoming 'Hypercar' class, which is due to be run from 2020 onwards, to now include race cars based on road-going machinery.

The changes were confirmed at the meeting of the FIA World Motor Sport Council in March, and state that the 2020 LMP Technical Regulations have been expanded to 'allow a "Hypercar" developed from the road cars sold by the manufacturers to enter, while preserving the previously-approved regulatory format.'

ABOVE McLaren's Senna is one of the hypercars that could be seen at Le Mans under the new regulations

This means that racecars derived from hypercars themselves, as well as those simply being styled after them, as was written in the original regulations, will be able to compete side by side in World Endurance Championship rounds. According to the FIA, this change has been made to "enable additional manufacturers to enter the championship".

The move comes after lobbying from several manufacturers, which already offer road-going hypercars and seek to bring their road and racing activities into closer alignment. RT

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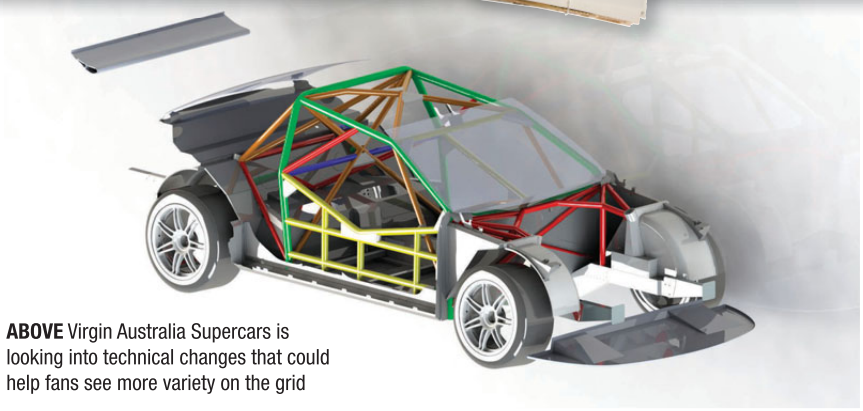

ABOVE Virgin Australia Supercars is looking into technical changes that could help fans see more variety on the grid

Work on next-gen Supercars underway

VIRGIN Australia Supercars CEO Sean Seamer has confirmed that the series' technical staff are undertaking a computer-based study into changes to the category's control chassis.

The current chassis has been in place since 2013, and was designed with four-door sedan cars in mind. Since then, Holden and Ford have both had to adapt their new cars, the ZB Commodore hatchback and the Mustang two-door coupe respectively, to fit on the chassis. It is still, however, a limitation, with Walkinshaw Andretti United unwilling to modify the Camaro to fit a Supercars chassis, despite their desire to race it.

This inability to fit different bodies to the chassis without significantly changing their design is one of the things that Supercars seeks to address in the next-generation rules package.

"The process that we are going through right now is trying to make sure we have enduring market relevance in what we are racing out there, and we have the most opportunity for a different number of marques," explained Seamer.

"We have got about 20 different CAD files that the technical department are working through and dropping those files on the chassis and seeing what changes would need to be made to accommodate the maximum number of vehicles.

"This is a process where we are doing some work right now, but we really need to take this back to our OEM manufacturer partners to get their feedback on what that looks like."

The work has been met with support, with Ford's global racing director Mark Rushbrook praising the direction of the study.

"We have some understanding of where we would like to see it go and maybe when, but I think as Sean went through they are taking the right approach to the study," he said.

"They understand across different OEMs what is best for the future of the series, and then work with partners to work out how to get there and when." RT

ACO and Motul renew Le Mans supply deal

MOTUL has signed a multi-year contract with the Automobile Club de l'Ouest and the FIA World Endurance Championship, extending its relationship with the prestigious global series.

The deal means that the firm will be able to continue to use the ACO's endurance races, on both two and four wheels, to test and develop its range of high-tech engine lubricants.

ACO president Pierre Fillon praised the agreement and said the club was 'thrilled' to pursue the relationship between the two organisations.

"Our flagship races the 24H Motos and the 24 Hours of Le Mans, the FIA World Endurance Championship, our karting circuit and racing driver schools all benefit from Motul's experience and professionalism. At a time of fundamental change for the automotive world, such valuable, solid ties are vital," he said.

"It goes without saying that we are delighted to renew our partnership with the Automobile Club de l'Ouest and the FIA World Endurance Championship, strengthening the bond we formed a few years ago," added Thierry Quilan, Motul's president of the management board. "Like Motul, the ACO has been at the forefront of automotive development and technology for a very long time, but we continually look to the future. We share many common values with the ACO and, more recently with the WEC, as competition is in our blood and indeed in our DNA." RT

ABOVE Motul, which also sponsors Rebellion Racing, has extended its partnership with the ACO and the WEC

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Motorsport world mourns Charlie Whiting

THE world of motorsport has paid tribute to Formula 1 race director, Charlie Whiting, who passed suddenly at the age of 66 after suffering a pulmonary embolism.

Whiting began his time in Formula 1 in 1977, working as a mechanic with the Hesketh team. He then went on to join Bernie Ecclestone's Brabham squad, where he stayed until 1987, when Ecclestone sold the team. After leaving Brabham, Whiting joined the FIA's technical department, going on to become the FIA's technical delegate, and later safety delegate, before taking up the role of Formula 1 race director in 1997. In this role he would oversee the running of more than 400 Grands Prix.

Tributes to Whiting poured in from many organisations and individuals following his passing.

ABOVE The passing of F1 race director Charlie Whiting was marked at the championship's opening round in Australia

"It is with immense sadness that I learned of Charlie's passing," said FIA President Jean Todt. "Charlie Whiting was a great Race Director, a central and inimitable figure in Formula 1 who embodied the ethics and spirit of this fantastic sport. Formula 1 has lost a faithful friend and a charismatic ambassador in Charlie."

Many in the F1 paddock also praised his integrity and ability to act in the best interest of the sport.

"He was a pillar of our Formula 1 family – balanced in his approach, subtle in his understanding and always with the interests of Formula 1 as his main focus," said Mercedes team principal Toto Wolff.

"He was a fantastic ambassador for our sport and a true guardian of its best interests; all of us who were lucky enough to know him will miss his ready smile and gentle humour."

Red Bull's Christian Horner also noted Whiting's ability to "perform a difficult role in a balanced way", and praised the "key role he played in the sport" as its "referee and voice of reason".

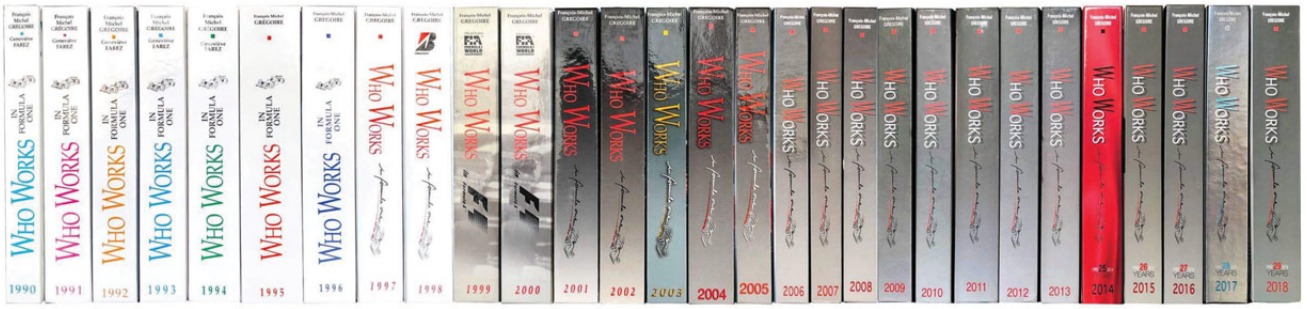
Ferrari's four-time world champion Sebastian Vettel, meanwhile, also marked the role whiting played for the drivers: "I've known him for a long time and he's been our man, the driver's man...there are regulations and then there is us, and he was the middleman. He was someone you could ask anything of anytime." RT

Who Works in F1 celebrates 30th anniversary

WHO *Works in Formula One* is marking its 30th anniversary with the printing of a limited edition, gold-coloured version of the book. The collectable edition, of which there will be only 100 printed, will be signed by the author.

The book boasts links to the Formula 1 community, enabling it to offer "easy and accurate access to companies and individuals within Formula One worldwide."

"For 30 years now 'Who Works in Formula One' has been the standard reference work world-wide to go behind the scenes in Formula One and get to the people making this year's decisions," said the company in a statement. "Our unique 'Who Works in...' format brings together updated, comprehensive data for F1 professionals and fans alike: teams and drivers, cars and engines, team principals and front-line people, engineers, heads of marketing and communication, sponsors, key suppliers, journalists and photographers, TV and radio crews, racing circuits, promoters and organisers, race officials and more." RT



ABOVE This year's *Who Works in Formula One* is the series' 30th instalment

ABOVE Fans will still be able to enjoy Peugeots and Audis battling in WRX despite the withdrawal of manufacturer entries

Peugeot and Audi Supercars remain in World RX

DESPITE the withdrawal of Peugeot and Audi as manufacturer entries in the World Rallycross Championship last season, works-built and backed Supercars will remain on the grid in the series in 2019, which has attracted 16 permanent entries.

Kenneth Hansen, 14-time European Rallycross Champion, has revived his own team, running under the banner of Team Hansen MJP. The squad will run a pair of 2018 Peugeot 208 WRX Supercars, the specification of car built by the works Peugeot team prior to a wholesale upgrade to an Evolution version of the car in the middle of last year.

That earlier car is fitted with an ORECA 2.0-litre engine and Sadev transmission, as opposed to the later version for which Peugeot produced the engine in house.

Mattias Ekstrom's formerly Audi-backed EKS team will also run its latest Audi S1s in the series, which have received updates over the winter months.

New squad, Monster Energy RX Cartel, will race two of the cars, with EKS running Hungarian driver Krisztian Szabo in another 2018 S1 as an individual entry.

Marcus Gronholm's GRX team has also expanded to three WRC-derived Hyundai i20s for selected rounds,and new squad ES Motorsport has completed over 1,000 kilometres of testing with its new Skoda Fabia.

Manfred Stohl's STARD team, meanwhile will run a new Ford Fiesta MK8 from the opening round in Abu Dhabi. RT

BTCC Corolla breaks cover

ABOVE The new Team Toyota GB Corolla has been praised following testing runs at Oulton Park and Calafat

THE new Team Toyota GB with Speedworks Motorsport Corolla enjoyed a successful pre-season test in Spain, with the car's performance leaving driver Tom Ingram bullish about his prospects in the British Touring Car Championship.

The Spanish test followed a problem-free track debut in early March at Oulton Park, where the car built up to completing race-distance runs to prove its reliability and strength.

Team principal, Christian Dick, said the first test of the new Corolla, which is set to replace the outgoing Avensis, was "very productive".

"We have plenty of testing planned and the Corolla looks good straight out of the box, so fingers crossed we'll be right on the pace at the first round.

"We are well aware that the sooner we could get on track with a complete car, the better the package would be for round one of the series," he added. "The early signs are that we are going to be in very good shape, but we've still a lot of work to do."

Following the test at the Circuit Calafat in Catalunya, Ingram added: "The car felt absolutely superb. We didn't really expect to be quick straight off the bat, but by the end of the first day we were already there-or-thereabouts. What was really encouraging was how well the Corolla responds to minor set-up changes. Its stability and braking performance are extraordinary."

The car will make its race debut at the season opener at Brands Hatch on the 6-7 April. RT

ABOVE The Proton Iriz R5 has now been homologated in both left and right hand drive configurations

Proton R5 homologated

THE Proton Iriz R5, built and developed by British firm Mellors Elliot Motorsport, has been homologated in both left and right-hand drive configurations for international rallying.

Featured in RT202, the car made its maiden public appearance at the Goodwood Festival of Speed in 2017, and has since competed in a number of events in the UK, as MEM has progressed with its development. The Iriz uses a 1600cc turbo-charged 4B11 Mitsubishi engine, an Xtrac six-speed sequential transmission, Reiger suspension, Brembo brakes and Cosworth electronics.

Double World Rally Champion Marcus Gronholm, a renowned test and development driver, has also driven the car in the pre-homologation development phase, while the first right-hand drive Iriz R5 has been bought by five-time Irish Tarmac Rally Champion Eugene Donnelly. MEM is planning to have cars competing in international events, such as WRC2 and the European Rally Championship in the near future.

Extreme E hydrogen potential

THE new Extreme E off-road racing series for electric SUV machines conceived by Formula E founder Alejandro Agag could include hydrogen technology after its first campaign.

The concept was launched earlier this year in London and is set to begin in 2021.

Cars for the first running of the series are expected to use a single-make chassis with silhouette bodywork, much like the FIA's concept for electric World Rallycross cars, using batteries and a pair of motors derived from the current Formula E regulations.

"We're going to open the door on Generation 2 of Extreme E to hydrogen," Agag said. "I think hydrogen could be really interesting technology to test in Extreme E. Generation 1 we're going to go with the batteries. But Generation 1 could last one season and then [we'd] go to hydrogen. That's something from the technology point of view that we are looking into."

The new Extreme E series is set to run in five locations around the world that have been damaged by the human race, including places like the Sahara Desert and the Arctic.

Bentley seeks another Pikes Peak record

ABOVE Bentley hopes its Continental GT can bag another Pikes Peak record for the marque

BENTLEY Motors has revealed it is set to take on the Pikes Peak International Hill Climb in June, as it seeks to capture the production car record with the Continental GT.

The attempt follows the marque's assault on the Pikes Peak SUV record last year, which saw a Bentley Bentayga summit the mountain in 10 minutes and 49.9 seconds, almost two minutes faster than the previous best.

Commenting on the Continental run, Bentley's director of motorsport, Brian Gush, said that last year's success, "along with the experience we gained, will prove to be instrumental in preparing for our return to the mountain.

"The challenge to set the outright record for production cars is not one we underestimate, but we are confident in the combination of our W12 engine, the dynamic ability of the new Continental GT and the outstanding skill of [driver] Rhys Millen."

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ABOVE Nicolas Aubourg, Head of Performance & Simulation at the FIA chats to Richard Bardwell, Director at SHARC about their latest technology

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Red Bull

ABOVE Red Bull is renowned for being a 'chassis team' but the design of its RB15 prioritised outright horsepower

What lies beneath...

Red Bull Racing defected to a resurgent Honda after 12 years and 59 victories with Renault, marred by an increasingly dysfunctional relationship. How, asks **Matt Youson**, are things going to be different this time around?

JULY 6, 2008 was a typical English summer day, in that it started off misty, got progressively darker and had a mid-afternoon cloudburst of the sort that turns the Silverstone plateau into a shallow lake. The phlegmatic British Grand Prix crowd hunkered down even deeper in their sou'westers, jiggling their umbrellas in admiration each time Lewis Hamilton rowed past, the opposition distant in both his metaphorical and literal wake.

By the time Rubens Barrichello sculled over the line a minute and 22 seconds behind Hamilton, most of the punters had already dived for whatever shelter they could find. A few may have stayed above ground had they known it would be the last Honda-powered podium for 11 years – but not many.

That gap alone – 3,907 days, if you're counting – lends Max Verstappen's third place at the 2019 Australian Grand Prix a little more significance than would otherwise be the case. But the impact for Red Bull Racing was arguably greater than that for Honda: after 12 years of Renault power, and 59 victories, it appears to have suffered no ill-effects from the transition. Indeed, gains appear to have been made.

While this was Verstappen's sixth podium in a row, the sight of a Red Bull catching and passing a Ferrari in a straight fight raised a few eyebrows. "At least I could have a go at it in terms of top speed," said Verstappen afterwards, alluding to the belief that Red Bull's gamble on Honda has delivered more horsepower to the Milton Keynes team.

It's a belief Red Bull Racing technical director Pierre Waché is happy to confirm: "A lot more," he says with a grin, with the usual discretion expected when an F1 engineer discusses horsepower. He does, however, add that extracting every last ounce of horsepower from Honda's RA619H power unit was the imperative throughout the design process of Red Bull's RB15. For a team widely believed to have built F1's best chassis for much of the last decade, that isn't as straightforward a

Gibson/LAT

ABOVE Not since July 2008, when Rubens Barrichello splashed his way to third at Silverstone, had Honda celebrated a podium finish

> *"Having spent the last nine months talking up the partnership, they're now engaged in playing down expectations"*

Red Bull

ABOVE Max Verstappen is applauded into parc ferme in Melbourne after a performance that hinted at the ability of Red Bull Racing and Honda to carry the fight to Mercedes and Ferrari

decision as it may sound.

Red Bull and Renault are by no means the first team and engine supplier to exit a dysfunctional relationship but theirs is the most recent divorce and thus, the most raw. A strained civility and carefully-chosen words tend to dominate any conversation that compares old with new, and Waché is no exception.

"The main thing is… for us what changed a lot is that we don't have a supplier any more, we have a collaboration and that is a big, big difference. Having a collaboration helps us a lot to integrate the power unit into our car. It gave us the opportunity to make the best integration: we made some compromises on the chassis to integrate the engine, and Honda made some compromises on the engine for our chassis. The process was very good."

Waché makes it clear that, where a compromise had to be made, the requirement of delivering horsepower tended to dominate. This was not an insignificant sacrifice for Red Bull, given the very different geometries of the Renault and Honda power units [particularly the arrangement of the turbocharger and its ducting], and also the implied requirement to alter very efficient packaging – but given that a perceived lack of horsepower has been a Red Bull bugbear since the V8 era, it was perhaps not surprising that this dominated the conversation.

"Every time we had a discussion, at the top of our minds was the thought that we didn't ▶

want to disadvantage the power output of the engine through the way we chose to integrate it into the chassis," says Waché. "We therefore prioritised power output. Had we come across something hugely detrimental to the chassis, then perhaps we wouldn't have done it – but that wasn't the case. We didn't want to compromise Honda's development, and so the main thing for us was to ensure ICE power was as high as possible.

"Ultimately, the philosophy [of the chassis] didn't have to change but we did have to make some compromises to extract overall better performance from the car. Even if we are a 'chassis team', what we want is the quickest car possible. It doesn't matter to us if that comes from the chassis or the engine."

B-TEAM DEBATE

The route to Red Bull Racing's adoption of Honda power has been smoothed by its pathfinders at sister team Toro Rosso running the Honda engine last year. This is currently a ticklish subject in Formula 1, with much debate over the level of cooperation between teams over what is, and is not, allowed. Waché walks the line, arguing that the knowledge gained by Red Bull Racing from Toro Rosso's earlier adoption comes out of its status as a supplier of listed parts – notably a gearbox – rather than anything more significant.

"We were supplying the gearbox to Toro Rosso in the past, and from that we had some information on aspects of the engine and its characteristics, and how it would affect our car and our integration," he concedes, "… but we don't share more information than is allowed. We supply them with some parts that we service. Also, we have influence on the development and integration of the power unit and that will affect them next year as well, but that's the ▶

> *"The sight of a Red Bull catching and passing a Ferrari in a straight fight raised a few eyebrows"*

Red Bull

BELOW The Honda-powered RB15's passing of Vettel's Ferrari in Melbourne will have done much to focus the attention of both camps

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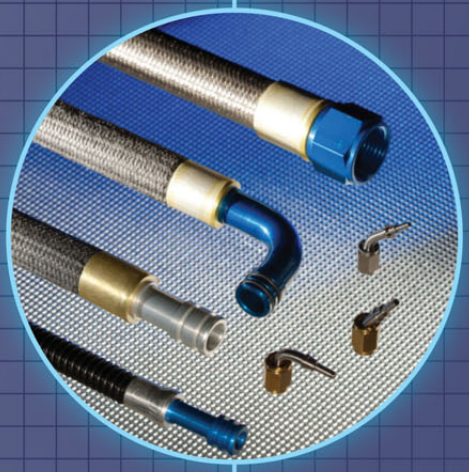

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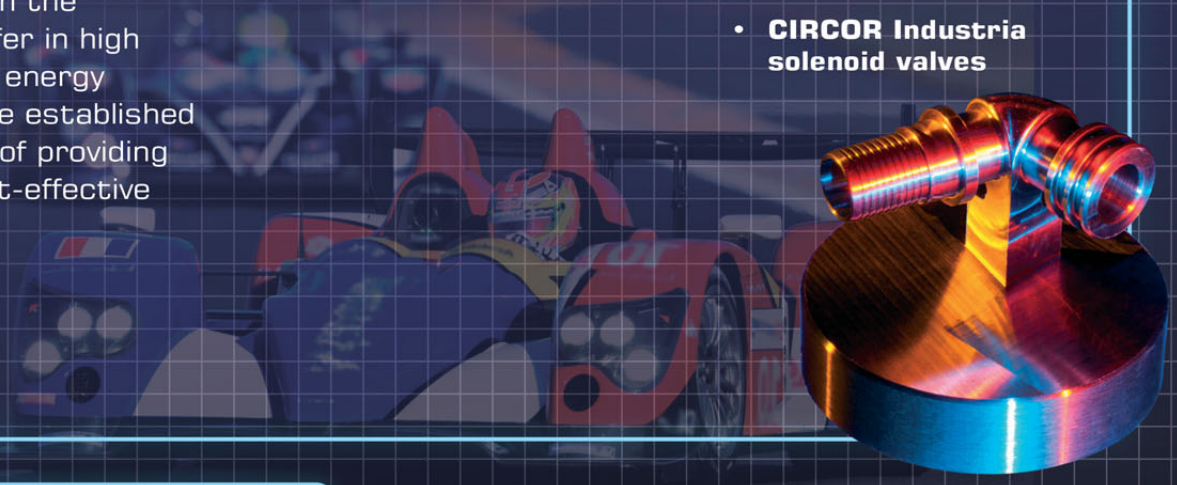

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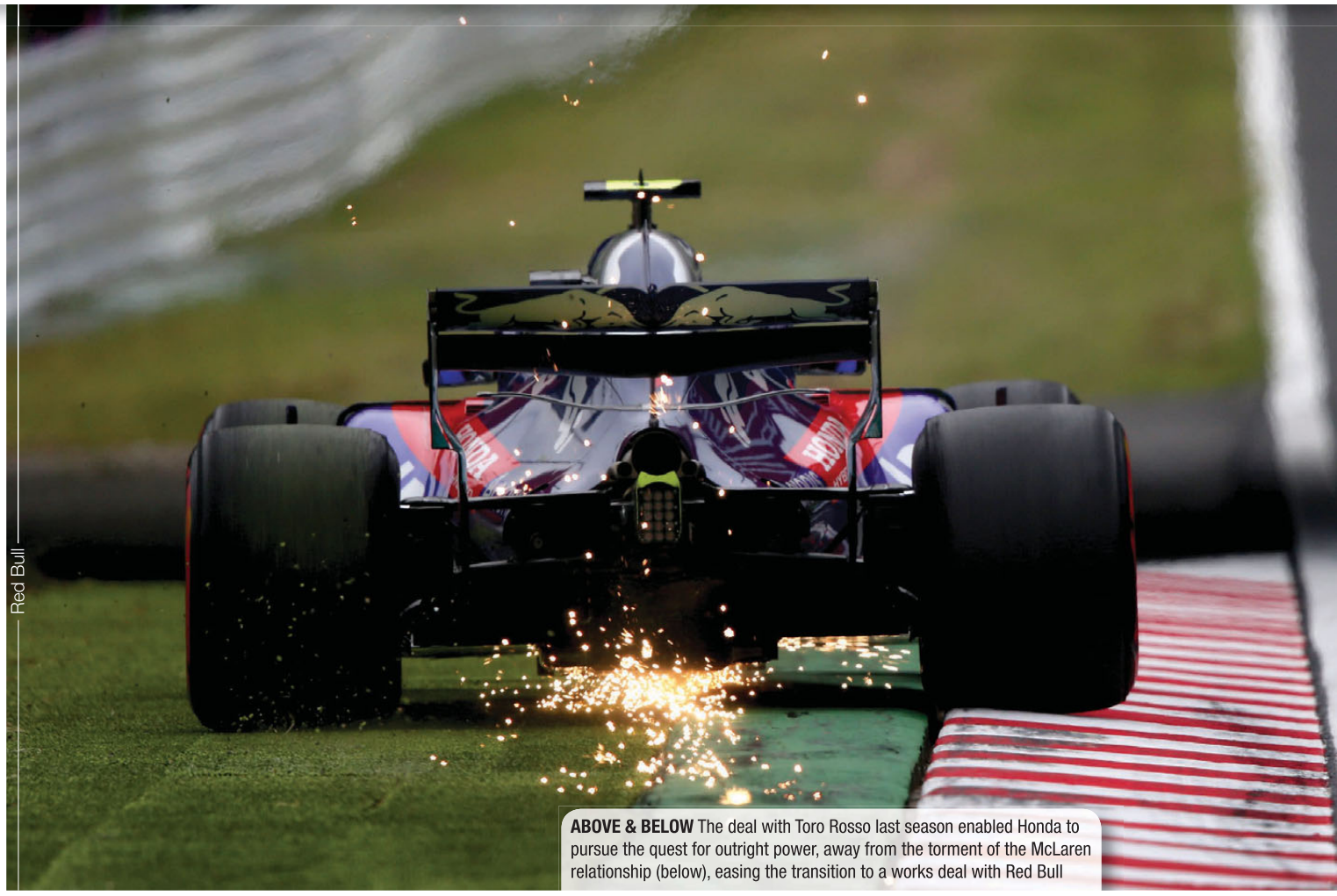
Red Bull

ABOVE & BELOW The deal with Toro Rosso last season enabled Honda to pursue the quest for outright power, away from the torment of the McLaren relationship (below), easing the transition to a works deal with Red Bull

extent of the discussion, no more than in previous years."

One area in which Red Bull Racing has gained from Honda's relationship with Toro Rosso is in the experience of trackside personnel. Since returning to F1 in 2015 with McLaren, Honda has supplied a single team. Doubling up in 2019 required more personnel, and thus Honda decided to dilute its resources between the two Red Bull squads.

HONDA EXPANSION

"We have exactly doubled our number of operational people," says Honda technical director Toyoharu Tanabe. "We have split last year's personnel who worked with Toro Rosso 50-50 between the two teams, in order to evenly distribute team members with previous on-track experience. Then we filled a lot of positions from Japan and also from other experienced engineers. In Milton Keynes [where Honda has a service base for its F1 engines] – for our dyno and workshop area – we hired externally too. So it has been an expansion.

"Japanese people, Japanese culture and the Japanese language are all very different from the European way of doing things. On top of that, some new, young Japanese engineers have joined the team. It's their first time doing a trackside job and they will have a lot to learn in a short space of time. Others are European, some of them have experience trackside and some don't. So overall, in terms of how we run our operation, it is going to be a very interesting first few months of the new season."

The hybrid era of Formula 1 has been characterised by Mercedes refraining from gloating over its engine hegemony and those manufacturers playing catch-up, promising great gains in the near future. Honda give every appearance of having made a substantial gain over the last few months, arguably beginning with 2018's Spec-3 engine, first tested at the end of September, but the sense remains that it is still a manufacturer desperately trying to make up ground. ▶


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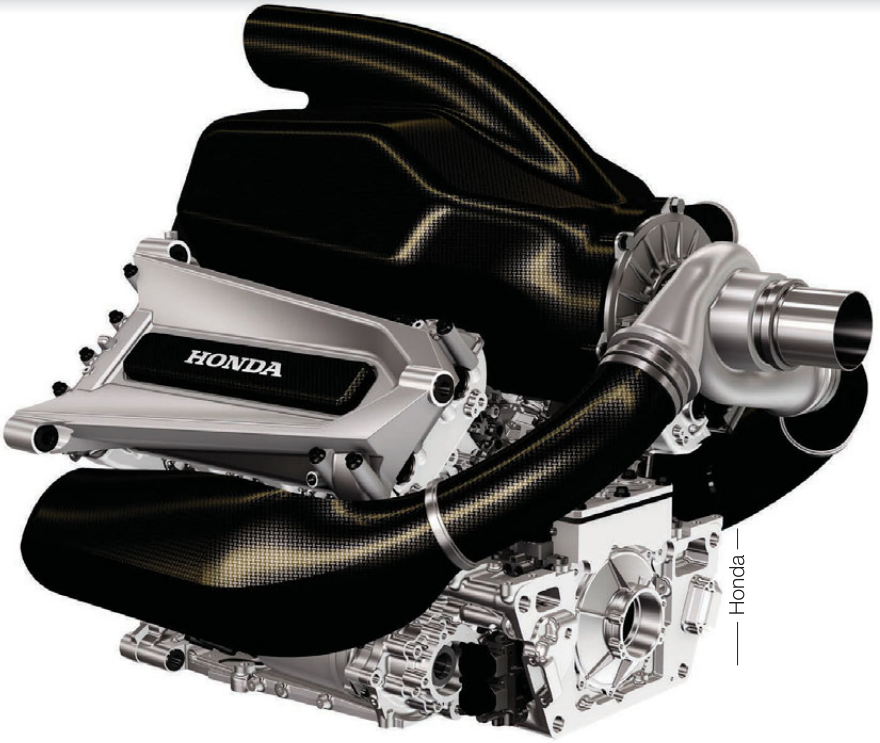
"They have a strong development rate – and the path that they have planned will bring big improvement gains during the season," says Waché. "I'm not a power unit expert, so my main interest is in what it will bring us – in terms of output but also how we can control the power, because driveability is an important aspect of this also. It looks very promising. Certainly I'm delighted with what they are targeting."

HIGHEST SPEED

Greek philosopher and noted sports fan Aristotle once remarked that one swallow does not a summer make, and the sense from both Honda and Red Bull Racing in Melbourne was one of cautious optimism rather than anything more bombastic. Albert Park is a distinctly atypical circuit and a gap of 22 seconds to the winner, in a race run without recourse to safety cars, are both



Honda

ABOVE When the hybrid era commenced in 2014, Honda arrived with such big expectations. That original Power Unit has since undergone more than one complete redesign

Red Bull

ABOVE Dream start: a Honda engineer looks on in the Red Bull Racing garage during winter testing

Red Bull gives you wings…

OPINION is divided on whether 2019 is a good season to be integrating a new engine partner into a leading F1 team, given the aerodynamic reboot also taking effect. On the one hand, it requires resources to be spread thinly across two otherwise all-consuming projects; on the other, it isn't a bad time for Red Bull to be revisiting aerodynamic packaging when everyone else is also having to make wholesale changes.

"It certainly creates some more work, I won't dismiss that, but it's a good part of the car to work on," says Red Bull Racing technical director Pierre Waché. "I think it creates some additional challenges, having a new power unit manufacturer, but given the output of the power unit, it certainly hasn't been a disadvantage."

The efficacy of the new aerodynamic regulations, with regard to overtaking (or, rather, closer racing, as its authors insist) is still a matter of some debate. There is consensus that the more powerful DRS will aid passing, but none on whether or not the rest of the package will affect wake turbulence sufficiently to make a difference.

One area where there is agreement, however, is that optimising front wing designs will be a significant focus for every team.

Waché believes that, instead of the multiple minor tweaks to front wing elements that have characterised the last few seasons, this year will see teams focused on bigger developments.

"When you don't have so much to play with, you play with what you have," he says. "Because the aerodynamics – especially on the front wing – are simplified, how you develop that front wing will hand you more power. It won't be a case of rearranging the many small elements outboard on the wing, you'll be upgrading the full wing."

Lap times from winter testing and the first race of the new season suggest the teams have recovered the projected 1.5-2 seconds lost around a datum lap with the new regs, and perhaps found a little more. "It looks like people have done a good job," concludes Waché. "I would say we are certainly in the ballpark compared to last year." RT

ABOVE Could the timing of the FIA's crackdown on complex front wings play to Red Bull's advantage?

ABOVE Celebrations at Albert Park. Could this mean Honda is finally back in the hunt for victory?

caveats in making any early pronouncements of success. Nevertheless, with both cars home, a podium finish, a successful overtaking move on a rival and the highest speed recorded through the speed trap, there has been a subtle change of emphasis from the camp: having spent the last nine months talking up the partnership, they're now engaged in playing down expectations – which is a nice position to be in.

NOT GOOD ENOUGH

"I'm not sure I'll be happy until we're at the front," concludes Waché. "It's a good car, certainly we haven't made a bad one, but we're not in the business of simply doing better, we're here to be quicker – and we're not the quickest at the moment, so it isn't good enough yet. This partnership has room for development and there's a lot of work on our plate if we're to beat our rivals." RT

THE CAR THAT SAVED THE DTM

ABOVE The halo effect of the Aston Martin brand ensures that the new DTM season starts on a positive note

Alan Stoddart reports on the seemingly impossible race against time to ready the Aston Martin Vantage DTM for the new season

IN July 2017 Mercedes threw the future of Germany's premier touring car category, the DTM, into doubt when it announced that it would no longer compete in the series after 2018. The Stuttgart-based marque said that it was leaving the championship in order to focus its efforts on Formula E.

The news left the series reeling. It had lost a manufacturer who had been a part of the DTM, and its predecessor, the Deutsche Tourenwagen Meisterschaft, for some 30 years. What's more the move left just two manufacturers, Audi and BMW, racing in the competition. This immediately diminished the appeal of the series, and left both remaining teams reconsidering their participation. BMW's head of motorsport, Jens Marquardt, said that the move meant BMW had to "evaluate this new situation", while his opposite at Audi, Dieter Gass, was even more forthright.

> *"90 days to build the car: a feat that had never been achieved before"*

"Following Mercedes-Benz' exit, a minimum of three brands being represented from 2020 onwards at the latest will be a prerequisite for Audi's continuing in the DTM," the company warned in August 2018, after confirming its continued involvement in the championship for just a single solitary year.

By this time, though, the initial groundwork for the car that would save the DTM had already been laid.

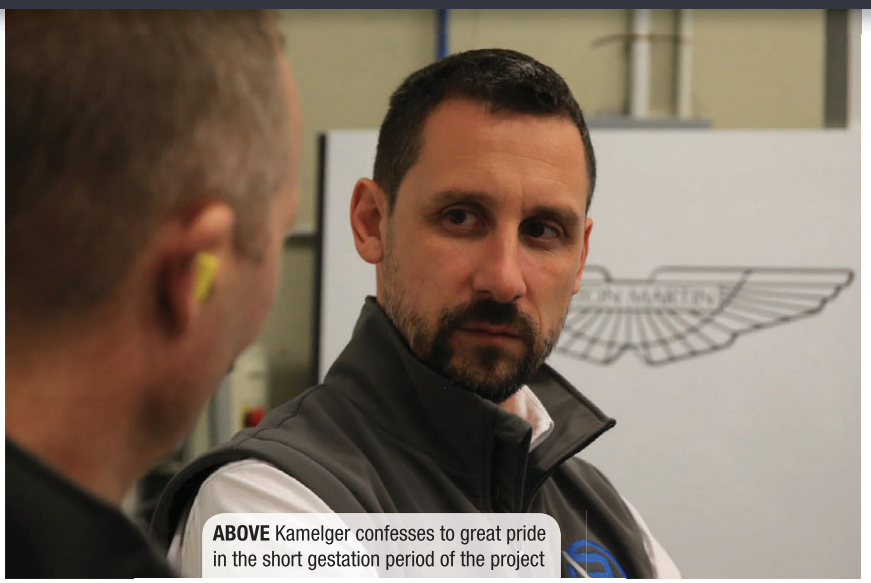
A month before Audi made its statement, on July 26th 2018, which was the week of the 24 Hours of Spa, AF Racing announced a technical partnership with German technology company HWA, the outfit that had helped the Mercedes AMG DTM team bag six drivers' championships since 2000. At this stage however, DTM wasn't a priority for the partnership called Vynamic GmbH.

"DTM was not the reason we incorporated this joint venture," recalls Dr Florian Kamelger, AF Racing's co-owner and R-Motorsport team principal. "Instead we were looking to form a strong innovation partnership between AF Racing and HWA, and use the utmost capabilities of both sides to do spectacular things, one of which was making racing cars, one of which was making small series production cars, and one of which was a project called DTM."

It wasn't actually until more than two months later, in mid-October, when the decision to race in the 2019 DTM season using cars based on the Aston Martin Vantage was made. This put immense time pressure on the outfit, which only had around 90 days to build the car. A feat that had never been achieved before.

Kamelger says that there were two advantages Vynamic held in winning this race against time. Firstly, thanks to the DTM series mandating a lot of controlled components, the team already had the bare bones of a competitive car, hopefully allowing the team to race effectively right from the start. This extensive list of spec parts "makes it quite a bit more straightforward" for a new entrant than if every part was free.

"The other big underlying factor, is that our technology partner in Vynamic, HWA, has been the most successful DTM team ever," he adds. "One of the main components that is regulated, but is still open for development is the engine, so we are running a four-cylinder 2.0-litre turbocharged engine, which is a bespoke Aston Martin engine built by HWA for Vynamic." ▶



ABOVE Kamelger confesses to great pride in the short gestation period of the project

When pressed for more details, Kamelger reveals only that "it is a bespoke block", but nothing more.

"So, a lot of things were laying unorderly on the table," he continues, "and we were lucky to be in a position to structure them and bring them into line."

Astonishingly, despite having to build a new car and a new engine from scratch, R-Motorsport – AF Racing's motorsport division, which holds the entry for the DTM – had the car ready for testing at the start of March. This was crucial in ensuring the new entrant didn't fall behind, especially given that the Aston's rivals, Audi and BMW, had been up and running in Portugal in mid-November. This meant that back when Vynamic's new touring car challenger was still in an embryonic stage, the German competition was already pounding the racetrack with cars tailored to the brand new Class One regulations brought in for the 2019 season. Audi and BMW could spend the winter tweaking and refining their cars, perfecting them for the season ahead, while Vynamic was simply rushing to ensure that there was a car ready to line up on the grid in the coming year.

TEETHING PROBLEMS

Despite this, the March test was productive for the outfit. Kamelger says it turned out to be a very normal testing process, with a planned programme of different things adhered to, and various things checked off and fed back to the factory to guide improvements. In fact, the team was able to respond to the testing data so quickly that it actually started developing modified components at its base even while the test itself was still underway.

Overall it was a drama-free test, adds the team principal. "There weren't even any problems," he states perfunctorily, "there were just foreseen topics on our checklist which had to be worked through.

"We did face issues with vibration and we faced the issues of temperature; all those bits and pieces which BMW and Audi reported after their first test sessions. Fortunately for them, they were able to identify them in November, whereas we couldn't test the car until March. So we did face them as well, but as I said, they were a foreseen issue."

This coolness, however, belies the true significance of the test.

"You can imagine how emotional it was for everybody. Standing there watching the car rolling out of the pits and out of the pit lane, seeing the car passing by for the first time on the main straight... every single little step was like it is for a father to observe the first steps of a little kid.

"All the bits and pieces which came together in that moment, every single member of the team who worked so hard for it, they all stood together for the company. It was very emotional."

ABOVE The team, like the car, has come together in a very short timeframe

"SIGNALLING EFFECT"

As well as being important for Vynamic, the successful test of the new car must also provide some relief for the parent company of the DTM, ITR e.V. which touted the news as a historic milestone when it was announced last year. Not only does the addition of Aston Martin Vantage DTM cars entered by R-Motorsport answer the other marques' calls for a new manufacturer to be brought in to replace Mercedes, as an internationally-recognised premium brand, the Aston Martin name aligns well with DTM's plans for increasingly global growth.

"The decision of a luxury sports-car manufacturer such as Aston Martin is a historic event for our series and a milestone for the international orientation of DTM," said ITR chairman Gerhard Berger following the announcement.

Furthermore, it is hoped that having Aston Martin cars competing in the tin-top series will also have a "signalling effect", encouraging more manufacturers to compete in the championship, adds Berger. It's an option that has been made even more appealing by the alignment of DTM and the Japanese Super GT Series under the new Class One regulations, which enable any new manufacturer to compete against manufacturers in Super GT such as Lexus and Honda, rather than just Audi, BMW ▶

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ABOVE Dialma Zinellia and DALLARA win Racecar Aerodynamicist of the Year, Integral Powertrain win Race Powertrain of the Year & BComp Ltd wins the Most Innovative New Motorsport Product of the Year

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and now Aston Martin.

Aston, for its part, is also invested in the entry into DTM despite AF Racing's tilt not being a full works effort, with CEO Andy Palmer reporting that the "project shows the increasing interest in the Aston Martin brand".

Kamelger says that this high level of support stems from "Aston Martin [being] a company of racers".

"That is everything in highly professional motorsport such as the DTM or their entry in the WEC, either way I am very thankful of their support," he continues.

"I can't go into detail, but there are many ways they support the programme, even though there are not really any parts [of a DTM car] which belong in a street car because so many parts are control parts. We are also still working out more bits and pieces, with the design team back in Gaydon working out how to make the car look even more like an Aston Martin.

> *"A victory for the DTM, as well as for the team"*

"It did make a positive impression on its first outing, though; everybody seemed to be stunned by the new DTM car."

These changes are scheduled to be added to the car as soon as possible, and should be present at the next official DTM test on April 15-18 at the Lausitzring. Another of the priorities there will be tweaking the car's set up and its aero balance, as well as truly getting to grips with its characteristics in different types of situation such as on longer runs, or on qualifying runs.

Kamelger also notes that driveability is another of the facets of car development the team is working on. He says that this attribute is however more subjective given the immense capabilities of the team's four drivers: Paul di Resta, Jake Dennis,

BELOW A launch without a car: that's how tight the timescales involved really were

ABOVE & BELOW The first test of the Aston Martin Vantage DTM inevitably threw up teething problems with vibration and temperatures, issues rivals had encountered three months earlier

Dani Juncadella, and Ferdinand Habsburg. Regardless, "at the end of the day, the easier a car is to drive, the quicker a pro-driver is, so this is one of the things we consider," he concludes.

Having a car ready to race at the start of 2019 given such a short timeframe seemed improbable, an impression reinforced by the lack of a car at R-Motorsport's launch of the Aston Martin Vantage DTM. There, the use of an 'art car' stand-in could be forgiven, but the same trick cannot be pulled again at the first race at Hockenheim. There a real car will be needed, and that will represent a victory in itself, as much for the DTM as for the team.

Just having an Aston Martin on the grid will mean ITR has been successful in bringing another big manufacturer to the championship. It will assuage BMW's and Audi's fears about the viability of the DTM, and it will provide a positive, optimistic opening to racing under the Class One regulations, heralding a time when the DTM and the Japanese Super GT Series, will be able to fairly compete on an international stage. These are significant accomplishments for a car that is yet to make it to a grid.

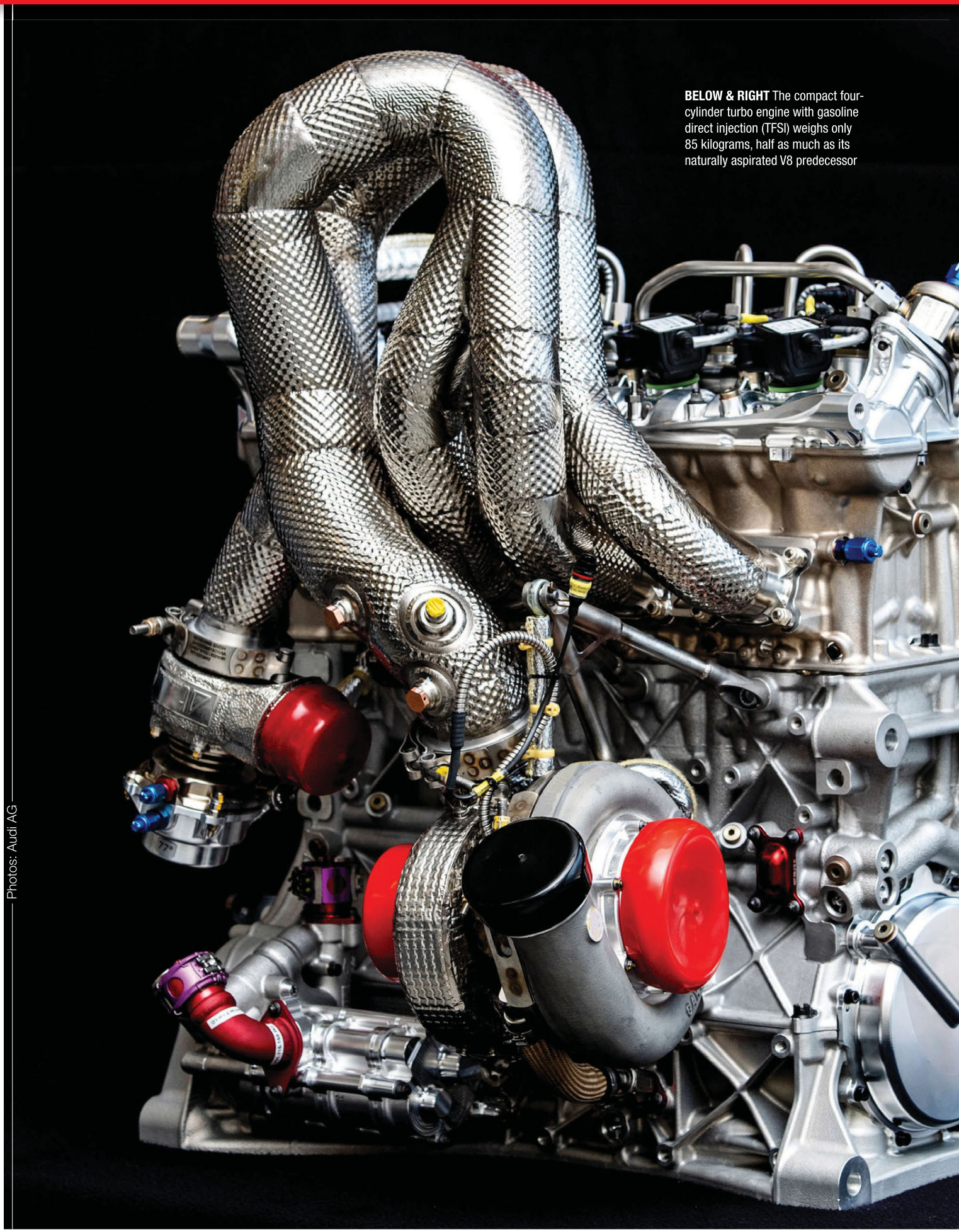
But these achievements are not enough for Vynamic. Being a team of racers, it has its sights set on a more tangible goal.

"Regardless of the fact that we had such a short time frame, with such a lot of pressure on the programme in terms of getting cars ready for Hockenheim, we don't just want to run through the season at the back of the grid, we want to be in the upper third of results," says Kamelger.

"We have such a great, highly motivated team that means we are able to do all these things. Without the team you are nothing... That's one big message of this project: being able to perform in such a great manner, even in such a short period of time, relies on a team that functions perfectly.

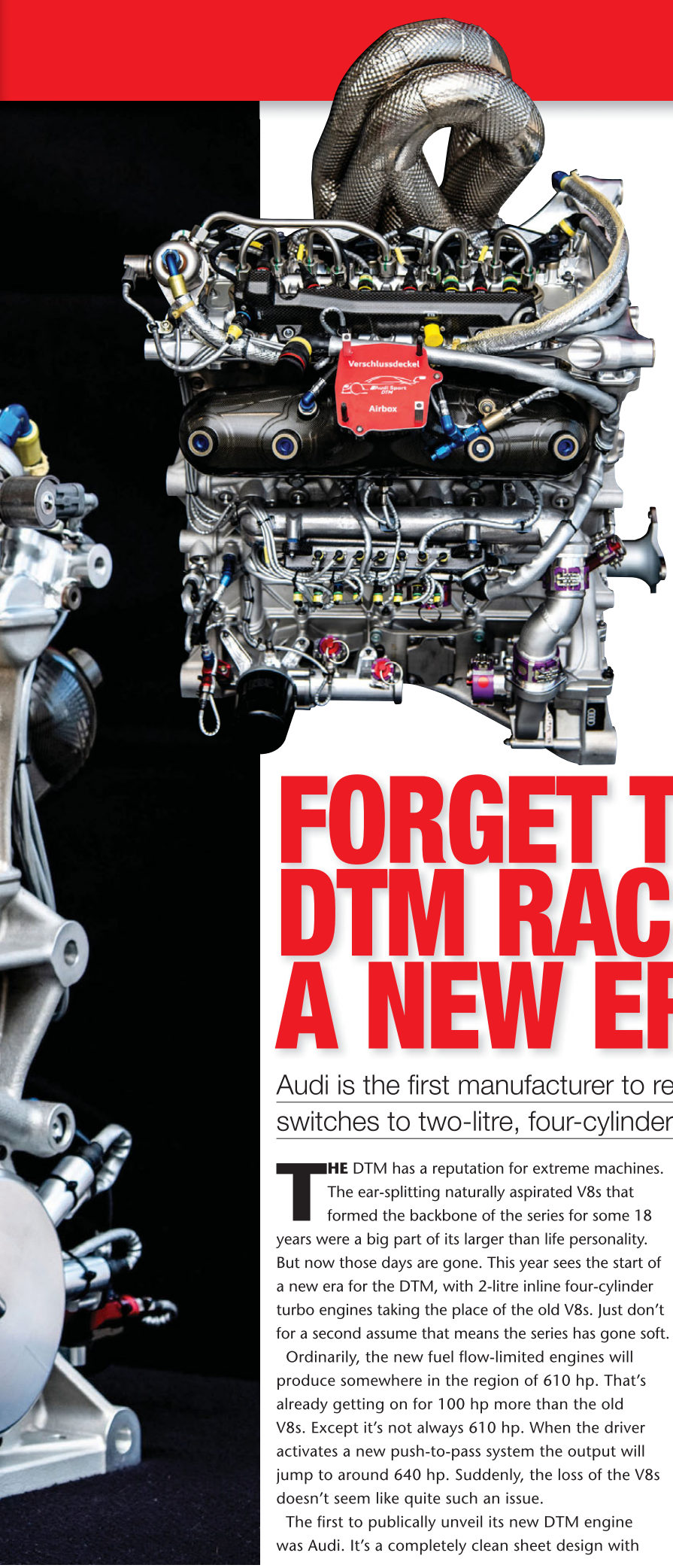
"Otherwise you fall behind." RT

ABOVE The lure of competing on a global platform, through the DTM's alliance with Super GT, was instrumental in Aston Martin's involvement



BELOW & RIGHT The compact four-cylinder turbo engine with gasoline direct injection (TFSI) weighs only 85 kilograms, half as much as its naturally aspirated V8 predecessor

Photos: Audi AG



FORGET THE V8 – DTM RACES INTO A NEW ERA

Audi is the first manufacturer to reveal its new powerplant as the DTM switches to two-litre, four-cylinder turbos. **Chris Pickering** reports

THE DTM has a reputation for extreme machines. The ear-splitting naturally aspirated V8s that formed the backbone of the series for some 18 years were a big part of its larger than life personality. But now those days are gone. This year sees the start of a new era for the DTM, with 2-litre inline four-cylinder turbo engines taking the place of the old V8s. Just don't for a second assume that means the series has gone soft.

Ordinarily, the new fuel flow-limited engines will produce somewhere in the region of 610 hp. That's already getting on for 100 hp more than the old V8s. Except it's not always 610 hp. When the driver activates a new push-to-pass system the output will jump to around 640 hp. Suddenly, the loss of the V8s doesn't seem like quite such an issue.

The first to publically unveil its new DTM engine was Audi. It's a completely clean sheet design with all 2,000-or-so components painstakingly developed specifically for this application. The concept of the four-cylinder formula was first mooted in 2008 and Audi Motorsport began actively working on the project in December 2014. It's a long time coming, then, although the engine itself took around two and a half years to develop – with a gap of around 12 months when the introduction of the four-cylinder formula was pushed back to the 2019 season.

Even with time on their side, the development of the new engine posed a formidable challenge for the Audi Motorsport engineers, explains the team's head of powertrain development, Stefan Dreyer: "The format of the DTM is a great challenge. The long mileage, spread across many events with short runs, is really tough. Plus, the four-cylinder engine's vibration behaviour totally differs from that of the V8. That posed a huge challenge during the development of the engine and also to our dynamometers."

The project began with various concept discussions and an initial set of simulations. Next came a single cylinder test engine, before the first complete prototypes were developed. Throughout the process, a rigorous programme of simulation accompanied the physical testing.

A huge amount of work has gone into the testing process, explains Dreyer, with a variety of static and dynamic rig tests employed before the car reaches the track. These are loosely split into three different categories. First, a single cylinder dyno is used to focus on the combustion process development, investigations into the mechanical efficiency and the first durability indications. This has the advantage of allowing for fast and flexible testing of numerous different configurations. Next comes the engine dyno, which provides an accurate and relatively convenient means to evaluate the complete engine. Finally, there are whole vehicle test benches, where the car can be run with the full drivetrain and subject to representative airflow.

"It's hard to quantify, but I think that we're in a range of 1,000 hours on the dyno," comments Dreyer. ▶

"Every engine subsequently runs on the dynamometer for another two to three hours before being installed in the car for racing. We run a break-in program, a performance check and various functional checks. A DTM engine has to last for a full season. This means that our specialists on the dyno must be one hundred percent sure that the engine they're going to deploy is really top-notch."

The engine that has taken shape through this development process is, of course, radically different to the old V8. In fact, it's quite different to any of the recent projects undertaken by Audi Motorsport. Although outwardly similar to the 2-litre four-cylinder turbo unit seen in the company's recent World Rallycross entry, its development has proved a very different exercise. While the rallycross engine made around the same power from a similar displacement, it used port injection rather than the DTM engine's direct injection setup. What's more,

> *"The vibration behaviour totally differs from that of the V8. You have to rethink things that principally used to work without any problems"*

the rallycross engine was a modified production unit designed to hold together for 300 to 400 km, whereas the DTM engine is a clean sheet motorsport design that's built to endure an entire season of circuit racing.

"This is a true race engine that's designed to last for 6,000 kilometres before the first rebuild – and, ideally, for the same distance again afterwards," comments Ulrich Baretzky, head of engine development at Audi Motorsport.

Direct injection and turbocharging are areas where Baretzky and his colleagues possess a wealth of experience, however. The Audi R8 and Bentley Speed 8 LMP cars that utterly dominated Le Mans from 2000 through to the dawn of the diesel era in 2006 both used direct injection engines. Meanwhile, Audi's history of turbocharged competition cars stretches right back to the iconic quattro rally cars and there are some parallels to the more recent turbo diesel engines too. "Naturally, every engine is different and every set of regulations poses different challenges. But you can spare yourself a lot of mistakes and a few loops by knowing the basic principles," notes Baretzky.

ABOVE Ulrich Baretzky, Head of Engine Development at Audi Motorsport, insists fans will enjoy the sound of the new engines

A CLEAN SHEET

The DTM rules state that the engine has to be a four-cylinder design with a single turbocharger – itself a 'spec' part provided by Garrett. Fuel supply must come from a single centrally-mounted injector in each cylinder, with the rail pressure limited to 350 bar, while all competitors must use the same 102 RON unleaded fuel blend from Aral. Crucially, there is also a maximum fuel flow limit of 95 kg per hour and a maximum boost pressure of 3.5 bar.

The Audi engine is an impressive sight to behold. The block, cast in aluminium by German specialist Becker, is crisscrossed by webs and ridges designed to maximise its strength and rigidity. Elsewhere, the design has been pared right back to ensure that the engine tips the scales as close as possible to the mandated minimum weight of 85 kg (including the turbocharger). That's a substantial saving compared to 148 kg for last year's naturally aspirated V8 and it accounts for the majority of the total weight saving for the 2019 car, which now comes in at under 1,000 kg (dry).

Clearly, halving the capacity and the number of cylinders has also freed up packaging space – albeit with some additional challenges imposed by the turbocharger and its associated hardware.

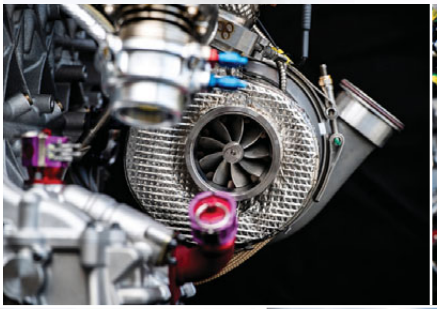
"The V8 had a symmetrical layout with ▶

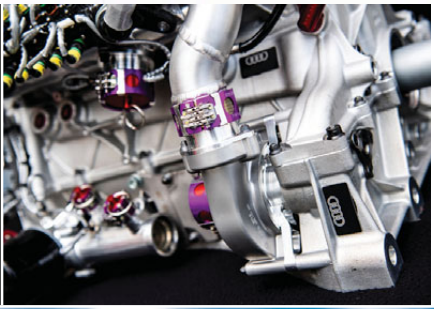
two cylinder banks and two exhaust tracts, while the new turbo engine has the exhaust system and the turbocharger on the right and the intake system on the left," Dreyer points out. "That means the entire front of the car had to be adapted to this new engine concept. For instance, we had to consider the position of the intercooler, the water and oil cooling systems, the pipes, as well as the optimal airflow to the engine."

Unlike conventional production-based touring cars, the DTM machines have long used fully-stressed engines and this year's four-cylinder cars are no exception. This is one instance where the reduced cross-sectional area of an inline engine could actually be a hindrance and the Audi engine is indeed remarkably slim overall. However, the front and rear faces of the crankcase spread out at the base to provide a broad, stable platform to carry the loads from the chassis.

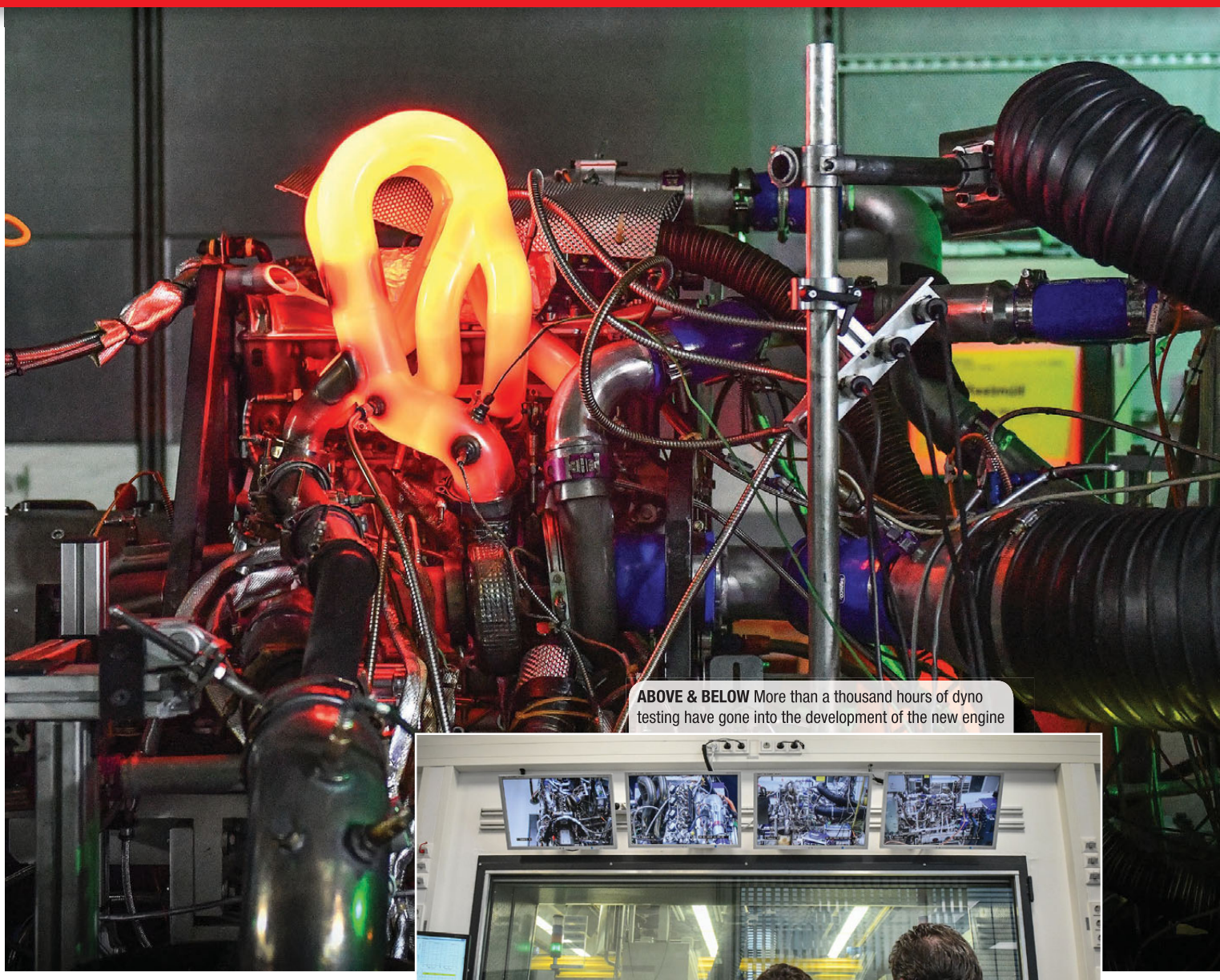
There are other potential challenges when switching from a V8 to an inline four, as Baretzky explains: "The four-cylinder engine per se is not a simple engine. Above all, it's very vibration-intensive. You have to rethink things that principally used to work without ▶

ABOVE & BELOW Each of the roughly 2,000 components of the DTM engine was designed from scratch





BELOW The drivers of Audi's RS 5 DTM will have more than 610 horsepower on tap. The push-to-pass system, which bypasses the fuel flow restrictor, offers a further 30 hp power boost



ABOVE & BELOW More than a thousand hours of dyno testing have gone into the development of the new engine

any problems. We did have a few concerns in that respect, but we managed to get a handle on them by putting in a great effort and a lot of hard work."

Another consideration is simply the magnitude of the forces involved. Although the cylinder displacement remains, the 2019 DTM engines produce around 100 bhp more than their predecessors with half the cylinder count and half the overall capacity. It's fair to assume that the cylinder pressures will be higher as a result, while the rev limit has actually increased somewhat from 9,000 rpm to 10,000 rpm (with the shift point on the Audi engine said to be set at 9,500 rpm).

PUSH-TO-PASS INTRODUCED

When the push-to-pass system is activated the fuel flow restrictor is bypassed, giving the engine another 5 kg per hour of fuel flow. That might not sound like a huge increase – it works out at just over 5 per cent with a directly proportional increase in power output – but it does have a noticeable impact, Baretzky explains: "The engine was originally designed to deliver some 600 horsepower. Now, another 30 horsepower is added for a specified period of time. This massively increases the overall load, even though it's just for a limited duration."

The use of forced induction brings other challenges too. For 2019 the DTM engines will be running an anti-lag system and they also present a more complex calibration task. The control side is handled by a Bosch MS 7.4 ECU, while the same company provides the spark plugs and the car's power management system.

"You have more adjustment options such as charge pressure, charge air temperature and adaptation to the respective environment," comments Baretzky. "Extracting the maximum from the engine is not more difficult as such, but it is more complex [with a turbo engine]. In addition, the engine has a relatively high compression ratio, which makes it more susceptible to knocking." ▶

ABOVE & BELOW Audi's wealth of experience with direct injection and turbocharging technology dates back to the all-conquering LMP1 cars and iconic Quattro rally car

Thermal management also becomes rather different with a turbo engine. On the intake side, the engine now runs a large intercooler, whereas the whole area around the exhaust and the turbocharger is neatly wrapped with a heat shield material from German company Thermisol.

A WHOLE NEW LEVEL

The specific output of the new 2-litre engine works out at around 305 hp per litre (ignoring the push-to-pass function). That's nearly two and a half times the specific output of the old naturally aspirated 4-litre V8. With a turbocharged engine, the difficulty lies not so much in achieving this sort of figure but in doing so reliably, efficiently and with good driveability.

At full load, the new four-cylinder engine actually consumes more fuel outright than the old V8, but when you consider the vastly increased power output it becomes a very different situation.

"Consuming fuel at a rate of 95 kg per hour may sound like a lot, but in an engine that produces more than 610 hp, it really isn't," comments Baretzky. "The specific consumption of the DTM engine is extremely low and now within ranges that used to be typical for diesel engines. In terms of weight and lightweight design – especially in the context of avoiding CO2 emissions – we're pointing out a few approaches that will hopefully find their way into future road-going vehicles, as was the case with the first TFSI for Le Mans and the TDI."

Clearly, one of the principal aims of any racing engine is to maximise the power it can extract from a given quantity of fuel, and that becomes particularly important when the fuel flow rate is limited. However, there's another equally fundamental incentive to reduce fuel consumption in the DTM, Dreyer points out: "Fuel consumption is actually a very important topic in the DTM. The more fuel I can save, the faster and more competitive I'll be, because I have to lug around less weight over the whole race distance. A highly efficient combustion process and low fuel consumption are decisive success factors."

"ABSOLUTE SPECTACLE"

Of course, when Formula 1 switched from comparatively large capacity V8s to downsized turbo engines, the reception from the fans was mixed to say the least. In some respects, the DTM's image is tied even more closely to the raw, uncompromising nature of its technology, so the series organisers' decision to switch to four-cylinder engines must have been fraught with risk. According to Baretzky, however, they needn't have worried: "The fans will enjoy hearing the sound that a four-cylinder engine can produce and I don't think they'll miss the V8s. In the first test in Estoril, I was immediately impressed with how good and aggressive the turbo engine sounds. It'll be an absolute spectacle."

> *"The fans will enjoy hearing the sound that a four-cylinder engine can produce; I don't think they'll miss the V8s"*

Business as usual in the world's most dramatic tin-top series, then? It certainly seems that way. Not only are the new engines promised to deliver the requisite drama, but their additional power and torque – coupled with a noticeable reduction in the weight of cars – should help to take things to a whole new level. RT

MOTORWAY TO MOTORSPORT IN JUST THREE MONTHS

Building a new touring car from scratch is no easy task, but as **Alan Stoddart** discovers, doing so in three months is almost impossible

ABOVE WSR's new 3 Series may look good on track now, but that's only thanks to the team's tireless work

IN early March, BMW launched the seventh generation of its 3 Series. The class-defining small saloon has gone on sale with the usual range of petrol and diesel engines and extensive executive features, including things like gesture-controlled stereos, smart digital assistants and glazing with special acoustic properties.

More interestingly for motorsport fans though, the new car promises to be greatly improved in terms of handling and driveability thanks to it being lighter, stiffer, wider and more aerodynamically efficient. This dynamic prowess not only bodes well for sales reps on the M4 corridor, but it also suggests the new 3 Series is a good base on which to develop a formidable BTCC challenger.

This is exactly what West Surrey Racing, which runs current champions Team BMW in the British series, has sought to do. The shift from the outgoing 1 Series cars to the new G20 330i M Sport was mooted in the middle of last year, when BMW first mentioned that there was a new version of the saloon coming out. The idea stuck. WSR had been running the 1 Series successfully for six years, winning the outright championship twice, as well as the independents', the teams' and the manufacturers' trophies, so, eager for a new challenge, the team decided running the new car was the way to go. This plan was approved by BMW UK on October 1, 2018; the day after the team won last year's championship.

Jakob Ebrey/BTCC


BELOW The design team worked digitally to be able to integrate the spec subframe into the shells

That, however, turned out to be the easy part.

"Because the car was brand new, and not even on the road – it was only launched in the UK on March 9 – we didn't get the shells until the end of November," recalls Dick Bennetts, WSR's managing director and team principal.

"Then, to get some form of CAD, which we needed, took until mid-December, which is when we were actually able to start designing the cars."

This means the team has had to design and build the cars, a project which usually takes five months, in a little over three. Three designers worked on the car, with a special focus given to the front end and how everything would mount to the NGTC-spec RML front subframes, and how the subframe itself would be mounted in the shell. There was also a lot of work involved in designing the interior, with getting things like the layout of the pedal box, the seat, the ancillaries, the batteries and the success ballast box in the correct position, crucial at this stage.

After it had been designed, Willie Poole Motorsport Services was entrusted with the fabrication of the shells, including the installation of the roll cages, having worked with WSR on the 1 Series race cars. After receiving the body shells straight from BMW's factory, WPMS takes off all unnecessary parts that just add weight in the racer, does additional welding work to improve the strength of the shell, and then removes everything forward of the bulkhead to enable the NGTC subframe to be installed. This process usually takes around 600 man-hours to create a shell ready for a BTCC team to build, which means it takes about six weeks to prepare one car. However, for the new 330i, Willie Poole had just eight weeks to do three cars!

EMERGENCY PLAN

After fabrication, the shells were back at WSR to be prepped, then off to the paint shop, a process that meant the final shell didn't arrive back at WSR for assembly until March 14, just three weeks before all three cars will be out racing at Brands Hatch for the season opener. Bennetts insists this timeframe is realistic, although he admits that one of the 1 Series from last year is being kept built up and ready to go as the team's 'emergency backup'.

Helping this tight deadline to be met has ▶

ABOVE WSR used a special tough but light material from Goodwood Composites for the car's bodywork

been WSR's switch to a completely digital design process, rather than sculpting the cars out of clay as they did with their previous runners. After receiving CAD files for the road going car, the team were able to properly analyse and assess the best way to integrate all the necessary racing paraphernalia. It used Siemens NX12 software, which was provided by one its technical partners, One PLM, to design the car. Because WSR's designers were used to other software, One PLM also provided training to ensure that the designers could hit the ground running as soon as the CAD files were available.

RAPID PROTOTYPING

Another firm that helped the outfit design a touring car before the roadgoing car had even been revealed was EY3, which was responsible for the car's motorsport bodywork. Working with rapid prototyping specialist Freeform Technology, which machined all the moulds, meant that Goodwood Composites were able to turn around the bodywork very quickly to help WSR meet its strict deadline.

Despite this frantic pace, however, the new car still has certain expectations to fulfil. Bennetts acknowledges that the closeness of the BTCC grid and the lack of testing time with the car means it is unlikely to go out and dominate in its first race, but he does think that the new saloon will offer other benefits.

"Everyone designs their cars to the max legal width possible, because the subframes and suspension are mandatory" he explains.

"Because the new 3 Series car is wider than the 1 Series, our wheel arch extensions are much smaller, which should help the aero.

"We are really keen to see it on track. The engine is in the same position as the 1 Series because it is fixed by the BTCC subframe regulations and we are not allowed to change that. This means the weight distribution should be better and the aero will be better because of the shape of the new 3 Series.

BTCC Technical Specifications

ENGINE	From manufacturer or Swindon-prepared TOCA-BTCC engine
TURBOCHARGER	Owen Developments
INTERCOOLER	PWR
DRIVETRAIN	Xtrac 6-speed sequential-shift gearbox and differential
CLUTCH	AP Racing carbon clutch
SUB-FRAMES	RML full front and rear sub-frames
SUSPENSION	SPA Penske coil-over dampers
FUEL TANK	ATL
FIRE EXTINGUISHER	Lifeline
WHEELS	Rimstock
BRAKES	AP Racing package & pedal-box
TYRES	Dunlop
ELECTRONICS	Cosworth
PETROL	Supplied by Carless

BMW have spent a lot of time improving the efficiency of the new road car.

"The wheelbase is a bit longer than the 1 Series, so that should be better in high-speed corner stability and under braking too."

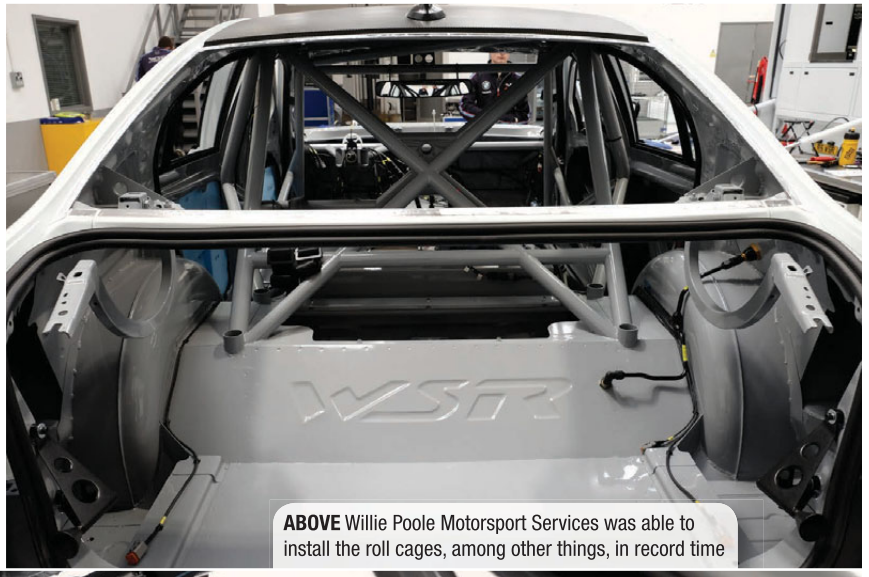
The very hi-tech LED headlight units on the road going 3 Series are, like many modern headlights, quite large. This, combined with the TOCA subframe that cannot be altered, meant there was interference between the headlight units and the larger-than-standard wheels used in the series.

To solve this issue WSR turned to another of its technical partners: Physical Digital. Physical Digital is a 3D optical scanning company that can quickly and efficiently collect physical data that can be used to analyse design issues and reduce tolerances through very accurate 3D measurement. The company is also able to use its scanning tools to reverse engineer components and assemblies.

The company also proved itself invaluable before WSR obtained the CAD files, says Bennetts. "They scanned a pre-production car before we even got a shell. We went to BMW headquarters and they scanned a front screen which meant we could place an order, then get them made, as they have a long lead time."

These kinds of technical partnerships have proved very beneficial for both WSR and the partners themselves. The longstanding relationship with Samco Sport, for example, means that when new hoses were needed for the new build, the company was able to supply them quickly to help WSR meet its very tight schedule. This responsiveness comes from all these companies which supply parts for the new WSR BMW race cars. Whether that is Cobra, which supplies all the team's seats, or Schroth, supplying the team with its harnesses, or McLaren Applied Technologies for alternators and K&N for the air filters. Another new company WSR are using is Goodwood Composites, ▶

> *"We just focus on the job in hand and get the car working"*



ABOVE Willie Poole Motorsport Services was able to install the roll cages, among other things, in record time

ABOVE The car's interior was also planned using CAD

who were enlisted to manufacture all new lightweight bodywork.

"In the BTCC you suffer a lot of front and rear bumper and sill damage, but between EY3 and Goodwood Composites, they have come up with a new solution that is hopefully very good," says Bennetts.

Another advantage enjoyed by WSR was that the championship-winning BMW B48 engine, built for racing by Neil Brown Engineering, could be reused for 2019 with only minimal changes. Bennetts explains this was a pragmatic decision as much as anything, adding that even if more money and time had been spent improving it, it could well have had its boost turned down to ensure parity with rivals.

Bennetts says it is a very clever engine. It is based on BMW's modular architecture, which was first used in the i8. In that configuration it is a 1.5 litre 3-cylinder turbocharged unit. The 330i M Sport, which is to be used in the BTCC, runs a two-litre turbocharged version, and then in the road cars you can get a three-litre turbo, which again is the same engine, just with more cylinders added on.

CLEVER ENGINE

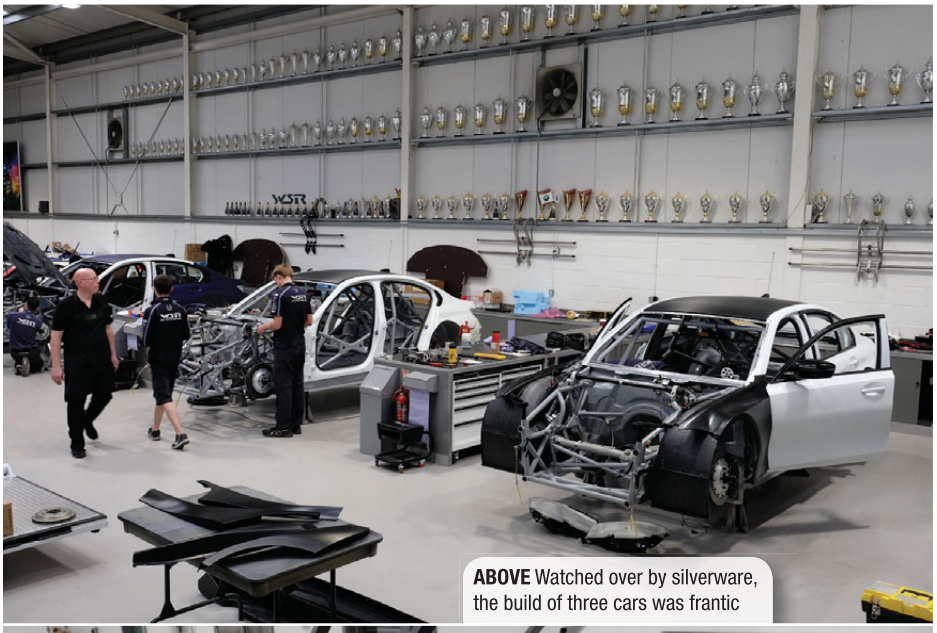
WSR is happy to use it, especially since it is a relatively new all-BMW engine, rather than the previous dated N43 engine that was used prior to the B48. What's more, it's also a very good racing engine, with many parts such as the crankshaft and the valves carried over from the road car, while motorsport valve springs, pistons, rods and camshafts are used.

"Overall, we think there are engines on the grid with more power, but speaking to drivers from various teams, a lot of them would tell you that we've got a very good engine," says Bennetts. "The whole idea for TOCA is to make the engines very equal, and I think that shows they've done a pretty good job of that.

"We just focus on the job in hand and get the car working because in the BTCC the biggest variables are different weather conditions, different track surfaces, and the three different tyre compounds that every team has to use."

Because of the very short timeframe for testing and development, WSR is maintaining myopic focus on the goals it hopes to achieve in the first few rounds.

"Reliability, no accidents and do the best we



ABOVE Watched over by silverware, the build of three cars was frantic

ABOVE During the build parts were constantly on hand ready to be installed on the cars

Jakob Ebrey/BTCC

ABOVE The outgoing 1 Series was a championship winner, but the new 3 Series might still hold some advantages

> *"Reliability, no accidents and do the best we can"*

ABOVE The car Colin Turkington's title defence rests on

can," states Bennetts succinctly. "I've been in motorsport long enough to know that you are not going to come out and be on pole position with a brand-new car.

"So, we will focus on aero and setup," he continues. "The rear wing is set by TOCA in the MIRA wind tunnel so we only have a small window of adjustment, then it's a matter of getting the aero balance right and making adjustments where we are allowed to do so.

"Being a brand-new car, the BTCC regulations allow you to run a car for half a season before the team has to homologate it, which allows a team to make small aero adjustments.

"Ultimately," concludes Bennetts, "If we can give our three drivers reliable cars and just clock up some miles to learn about the new car, we should be looking good for the second half of the year." RT

ABOVE ExxonMobil is actively using renewable resources in its racing formulations

WHY SUSTAINABLE MOTORSPORT IS NO MYTH

Alan Stoddart discovers that lubricants formulated from renewable resources are already clocking up victories, and that Balance of Performance regulations don't always stifle innovation

THE Rolex endurance classic lasts for 24 hours, which is a long time for a single race, but for some companies, that 24-hour period is just one small part of a much longer process. Such is the case for ExxonMobil, which has had very close relationships with both the Corvette and Porsche GTLM teams for many years.

Having these longer partnerships means that ExxonMobil is able to constantly, and continuously evolve its offering over many years to develop and deploy the absolute best products for racing. Some of these unique technologies developed by racing could then ultimately end up in the road cars factory-filled with Mobil 1. Interestingly, points out ExxonMobil's global motorsports technology manager David Tsurusaki, this evolution of product technology is still very valuable despite some series' balance of performance restrictions.

"The balance of performance can limit a team's ability to take advantage of performance improvements, but we have ▶

found it also offers us the potential to find performance gains. If we identify an improvement that's significant enough, then that gives the team an opportunity to look at beefing up other components thanks to the performance gains from the lubricants."

> *"There is a lot of discussion about electric vehicles, but we are investing a lot of time in continuing to make the internal combustion engine friendlier to the environment"*

QUICK TURNAROUND

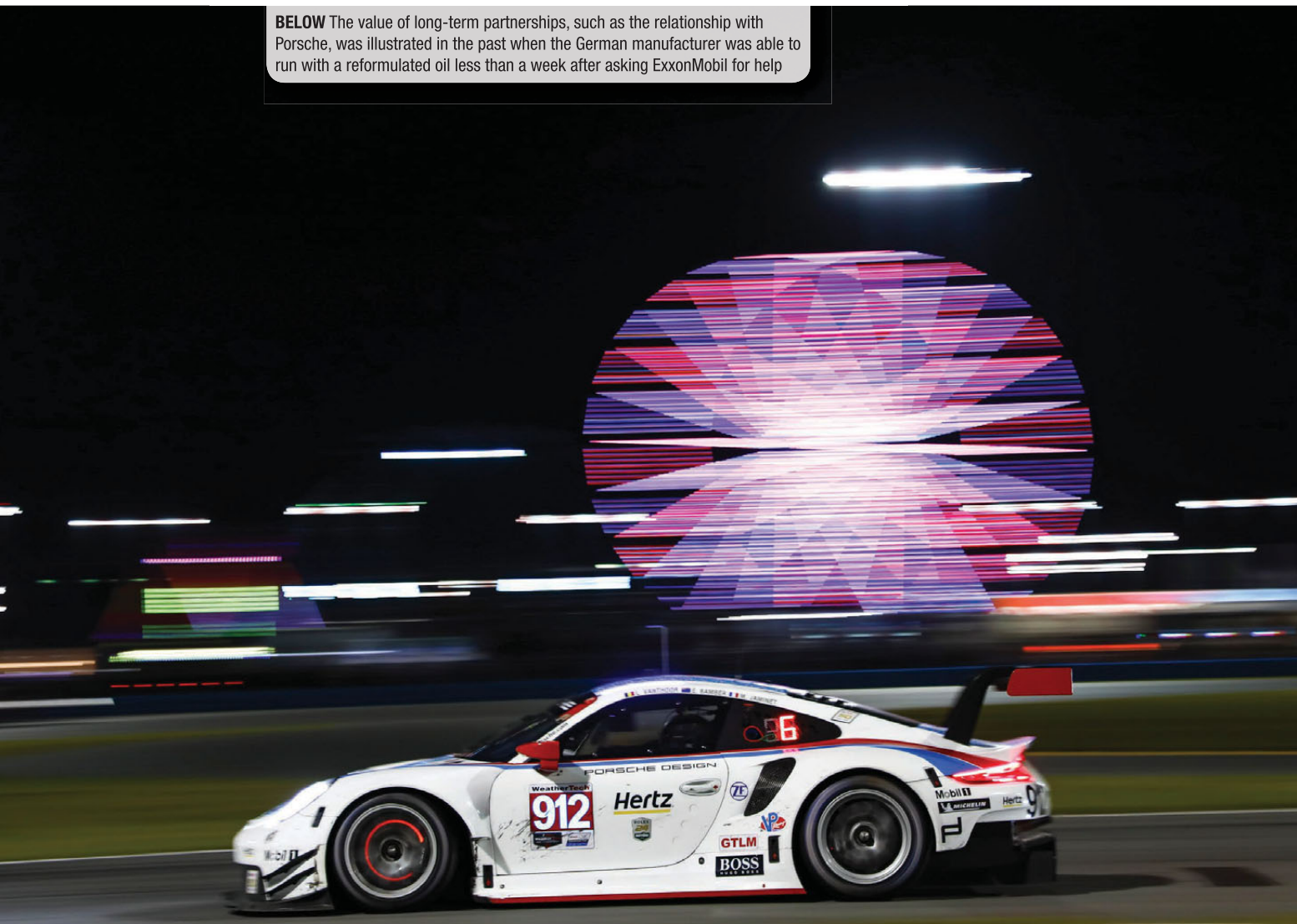
Despite the process of development of Mobil 1 technology being continual and long term, the closeness of the relationship it has with the teams does also mean it can react quickly when required. In one instance several years ago, Porsche was experiencing some unusual wear ahead of the Le Mans 24 Hours. It turned to ExxonMobil, which was able to make changes to its gearbox oil that not only improved performance, but did so in such a short timeframe that Porsche was running with the reformulated oil on track less than a week after asking ExxonMobil for help.

More often than not, however, changes and improvements are far more forward-looking. One of the projects that is currently in development, for example, is the manufacture of lubricants from sustainable components.

"There is a lot of discussion about electric vehicles, but we are investing a lot of time in continuing to make the internal combustion engine friendlier to the environment," Tsurusaki explains. "One of the things we have always promoted is the ultimate performance of Mobil 1 products which enable our customers to go further and use those products longer. So we have continued in that fashion and in motorsport we have looked at, and in some cases are actively using, renewable resources in our racing formulations."

Although Tsurusaki is currently unwilling to offer specifics about the products, he insists that sacrifices to performance haven't had to be made to create a more sustainable engine oil. He even goes as far as hinting that professional racing cars using these lubricants have already earned numerous pole positions and victories in multiple race series.

With ExxonMobil's record of developing road products in motorsport, its lubricant technology has the potential to massively reduce the effects modern automobiles have on the environment. Motorsport, through events like the Daytona 24, really could help future automobiles decrease their environmental impact. RT



BELOW The value of long-term partnerships, such as the relationship with Porsche, was illustrated in the past when the German manufacturer was able to run with a reformulated oil less than a week after asking ExxonMobil for help

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POWER BROKERS

Everything moves rapidly in F1, including the rate at which ideas become reality. **Alan Stoddart** talks to Shell's F1 fuel development manager

TECHNOLOGY that bears only a passing resemblance to anything you might actually come across on a public road abounds in Formula 1. From MGU-Hs in power units that are able to make use of energy from exhaust gasses which would have otherwise been wasted, to the complex brake-by-wire systems and carbon-carbon brake discs that slow the cars from around 200 to 90 mph in just 50 metres, F1 features some ultra-exotic technology.

Fuel is a little different though. Although it is tirelessly refined to optimise it for any given race car's engine, F1's technical regulations stipulate that the fuel still has to be 'petrol as the term is generally understood'. This means that it needs to be comprised of 'compounds normally found in commercial fuels', and not utilise any of a number of specific 'power-boosting chemical compounds' which are prohibited. In short, F1 cars run on petrol that is chemically very similar to what comes out of the pumps on every garage forecourt.

Shell, which has long been involved in F1 and even powered Scuderia Ferrari in the inaugural F1 World Championship race, went as far as demonstrating the similarities between its commercially available Shell V-Power Unleaded and its Shell V-Power race fuel in 2011. In the test Fernando Alonso used the F60 from the 2009 season. He first completed some reference laps using racing fuel, before the car was drained and refilled

ABOVE Vettel and Leclerc battle in Melbourne. More than 200,000 fuels had been tested in the build up to the start of the season

Hone/LAT

with Shell V-Power road fuel. Not only did the car run faultlessly, the lap times were comparable, with the regular fuel having only a 0.9-second deficit to the race fuel. What's more, although acceleration was slower with the regular Shell V-Power petrol, it actually went on to record a higher top speed.

With race fuel being tied so closely to road fuel, how then do fuel suppliers like Shell continue to innovate and bring improvements?

"We are always looking at what we can do next and what we can improve," says the company's F1 fuel development manager Benoit Poulet. "Those things can be either on the technology side or they can be from the working efficiency side, which is also paramount in the Shell Innovation Partnership."

This manifests itself in Shell's ideas pipeline, which draws on the expertise and insight of engineers from around the world, with fresh insights often to be found from fresh pairs of eyes. These ideas are also shaped by the incredible level of data sharing between Shell and Scuderia Ferrari, which gives the oil company access to enormous amounts of information about the current performance of Ferrari's engine. Shell, however, is also privy to Ferrari's future plans and internal targets to ensure that whatever is being developed at Maranello is able to fulfil its potential by using perfectly optimised petrol.

This means that not only will Shell be able to offer smaller evolutionary upgrades throughout the season, it will also be able to make more significant improvements to coincide with bigger engine developments, such as is used at the first race of season.

"We were testing the fuel being used in Australia in June last year. Thanks to the longer development loop, I know that I can put really complex ideas into the fuel improvement because I know it offers enough time to tackle really big challenges," Poulet explains.

He highlights that it isn't as simple as bringing one idea to bear at once however, with the level of planning enabled by the closeness of the partnership with Scuderia Ferrari enabling different tracks to be worked on simultaneously.

"It can be that we are making a development for the one grand prix we are working on, but, at the same time we can be working on game- ▶

> *"21% of the 2018 Ferrari power unit's lap time gain was delivered by Shell's fuel and lubricants"*

ABOVE Shell's V-Power race fuel plays a key role in providing the power behind Ferrari's glory

Shell

changing methodology in the background," he says. "That's what we could do last year, we were able to locate a massive increase in power.

"Then we were physically able to tune a lot of the fuel behaviour in the engine. We were able to feed lots of data into Shell's simulator and test more than 200,000 fuels before selecting the best fuel for Australia."

By operating in this way Shell is able to offer evolutionary refinements in the short term, while delivering huge, generational changes in the petrol that may only come to fruition after two years of development.

The results speak for themselves though. Because of the closeness of its partnership with Scuderia Ferrari, which grants it access to all the data, Shell is able to see exactly what contribution it is making at the outfit. That figure is impressive, with 21 per cent of the 2018 Scuderia Ferrari power unit's lap time gain delivered by Shell's fuel and lubricants.

The technology at Shell's disposal is one of the things that facilitates this incredible pace of development, with the aforementioned simulation capabilities key in being able to properly analyse the best course of development. The simulation allows Shell's engineers to develop fuels while taking into account the parameters within which they have to work. Teams are restricted to using 100 kilograms per hour of fuel, which places a limit on the amount of possible energy that can be utilised by the team, while the other consideration is how efficiently that mass of fuel can be used to rotate the crankshaft.

MOLECULAR MANAGEMENT

"These two things are connected in all types of gasoline molecules," Poulet notes. "The molecules which provide the highest number of joules per kilogram are often the ones which are prone to cause a knock event, which is essentially ignition that is happening in a non-controlled way, and the only way you can react to the knock event in an engine is by retarding your ignition, but this is a really inefficient way of using the combustion and the pressure.

"This can be helped with fuel, but the molecules which are good at preventing knock are also of lower energy. So, myself and some of my colleagues at Shell are analysing and evaluating this complex trade-off using the simulations."

Even away from the obvious concern of ensuring that Ferrari is able to extract the maximum performance from its engines, Shell is working in the regulations in other ways to offer Ferrari an advantage. For example, the maximum amount of fuel allowed in 2019 is specified as 110 kilograms, but the regulations make no mention of any volumetric requirements. With this being the case Shell and Scuderia Ferrari could start to identify whether the engine could perform as required with a higher density fuel, as being able to use a fuel of a higher density means that it would occupy less space, which could potentially allow other avenues of development such as in the car's aero, or lower the car's centre of gravity.

"This is just one of many connected parameters. It isn't just about delivering one tiny thing, it's about improving the whole product," explains Poulet. "It is never one property that is pushed to the maximum that gives the best overall performance. It is a combination of many different things, and there is a lot of compromise, which is why my clever colleagues and our work are needed."

As well as simulation, Shell also uses an engine test bench that is becoming increasingly comprehensive. This ranges ▶

Shell

ABOVE The facilities at Shell's disposal, of which the Track Lab is just the tip of the iceberg, help facilitate a remarkable pace of development

from a single cylinder that helps the fuel supplier understand the intricacies of the combustion event itself, to other benches with a full V6 engine, connected up to parts of the drivetrain and cooling parts such as radiators to more thoroughly investigate and analyse a power unit's performance as it would be in the car itself, helping the team to understand the interplay between different components and systems.

Despite the tireless work that goes into perfecting Shell's fuel for Scuderia Ferrari's V6 turbo hybrid engine, road relevancy is still a priority for the team, and the 2011 road fuel demonstration that involved a V8 non-turbocharged engine would still be possible today despite the change in architecture. This stems from the regulatory framework, which is inspired by the E10 petrol specification in Europe that uses up to 10 per cent ethanol by volume, and requires F1 fuel to contain a minimum of 5.75 per cent bio-components. This means that at least 99 per cent of the molecules that are used in Shell V-Power race fuel for Scuderia Ferrari are of the same types as those in Shell V-Power road fuel being used around the world, so there is a direct transfer of technology from racing to the road products.

However, the transfer of technology also goes the other way, with ideas also being gathered and developed on road fuels before being implemented in the race fuel.

"My colleagues did huge amounts of work before 2017 on the development of Shell V-Power with Dynaflex technology," says Poulet. "It's a breakthrough fuel technology that includes a new friction modifier which helps any parts that are in contact with fuel to have less friction losses, which makes them more efficient.

"The technology has been implemented in Shell V-Power for F1 since the start of the 2017 season, and has been developed to cover the new Ferrari and our customers around the world at the same time, so that's an example of ideas and development going the other way, towards F1."

This synergy between road and race fuels also means that Shell can use Formula 1 as a test bed to refine technologies that affect the wider transport world. This is helped by the FIA, which is engaging with Shell about the challenges of making a fuel that best balances innovation, road relevance and future sustainability. He also sees it as among the best places to make steps in development in this space.

"An idea can make its way to reality really quickly in F1. We are really happy to work alongside the FIA to establish what could be done within the Formula 1 series to really shape the path to CO2 emission reduction," Poulet notes.

BELOW F1 cars run on petrol that is chemically very similar to what comes out of the pumps on every garage forecourt

"At Shell there are a lot of people helping to understand the best direction for future transport. We have a network of scientists dealing with these issues. Shell is definitely an energy company welcoming any change which improves sustainability, and brings us closer to our ambitious target in reducing CO2 emissions."

The first race of the season may only have been one solitary weekend in an ever-busier calendar, but for Shell and its Track Lab team it represented both a culmination and a continuation of its aim to deliver "perfectly efficient products" to its customers. The opening race shows both what is possible after a full development cycle, but also stands as a starting point for Shell's innovation that is yet to come. RT


Shell

BELOW Benoit Poulet leads the team of fuel scientists and engineers, splitting his time between Maranello and the Shell Technology Centre in Hamburg

"A fuel of higher density would occupy less space, potentially allowing other avenues of development such as with the car's aero"


Pirelli

Schumacher, Hamilton, Alonso... *Illey?*

In his career as a Head of Aero, **John Illey** worked with a star-studded list of Formula 1 World Champions. But can he harness any of their qualities when he swaps the wind tunnel for the steering wheel?

From Formula 1 to IndyCar, and world rallying to GT racing, I have been extremely fortunate to be technically involved in motorsport, my passion, for my whole career. But was this always my ultimate ambition? Not quite...

Many of Race Tech's followers will know me from my role as co-chairman of the annual World Motorsport Symposium. Throughout the always enlightening, sometimes challenging, discussions that take place there, we always have one eye on the future. Yet the original dream – now finally become reality – that fuelled my career was, I confess, nothing visionary but instead will be all-too familiar to many of you.

NATURE OR NURTURE?

With my father working in the motor industry, I have often wondered if my key influences were genetic or environmental, almost certainly both. However, I can clearly remember a turning point in 1971, aged three, going to Silverstone and seeing my first car races. A purple Ford Anglia I was supporting spun at Woodcote on the last lap, letting a pale blue Hillman Imp through to win. Completely hooked, I knew then exactly what I wanted to do and that ambition has never gone away. 'I want to be a racing driver' was never going to play well with the careers advice at school, though, was it?

Prior to deciding my O-level subjects, somebody dared to query my objective: "What would you do if it doesn't work out?" This had never occurred to me before.

A long pause. "Well," I suggested, "I suppose I would do something on the technical side." And so, with a blend of hard graft and good fortune, this backup scenario came to pass.

Ignoring potential issues as I became an adult – size, weight, driving talent and funds – I dabbled in karting, shoehorning myself into a 100 National as a student, with limited events and success. A big brake failure shunt at Shennington reminded me that I should allocate more time to prepare my machinery properly. I briefly tested a 250 National that suited me much better and I recall smiling for a week afterwards.

Seven days after graduation, though, I was employed in motorsport and the commitment, hours and focus became completely technical. Yes, there were still a few chances to have a go – some corporate karting outings, plus the Renault F1 and McLaren Racing karting championships, which, not surprisingly, were very competitive – but work always took priority.

Then in 2012, Jon Tomlinson, a long-time friend and aero colleague at multiple F1 teams, said I should really come along and have a go at a Track Day in a FunCup car that he had started driving. The series, run in the UK by Paul Rose's JPR organisation, has been around for a while, using a single-seater WRT 740 kg spaceframe chassis, 1800 cc VW engine and sequential gearbox, though it is most distinctive for its silhouette Beetle bodywork and high rear wing. The endurance format series is remarkably close, with very tough competition, the European series getting together for the epic 25 hours of Spa which

features over 120 cars on the grid.

These initial, tentative steps for me were with ever-present competitor Neil Plimmer coaching in a modified two-seater version of the car for training, before trying Jon's JPR-hired race car solo in the afternoon. Very tempting and enjoyable, but how to fit it in around everything else?

Five years on, Jon having established himself as a series regular in Julian Thomas's top Racelogic car, winning races and the championship, he reminded me that I had still never got around to racing. This coincided with a significant birthday in 2017, my family kindly clubbing together to get me my ARDS (Association of Racing Drivers Schools) test to get my racing driver's licence. I was also now working for myself, so could manage my own diary and priorities. The perfect storm, perhaps, for overdue race driving potential?

Jon and Julian kindly recommended I contact Team 7 Racing, Jay and Kate Shepherd's highly professional and super-friendly FunCup customer team, to see if I could finally do my first race. Jay is also an ARDS instructor, pro driver etc, and as they have a two-seater training car the first steps were to get his expert advice and coaching during a couple of track days at Donington Park. Apart from some biblical weather on one occasion (six inches of ▶

> *"Four-wide into the chicane and guess who is on the very outside"*

ABOVE 48 years after deciding he wanted a career as a racing driver, Iley finally gets his big chance

Vince Todd

standing water at the Old Hairpin), this proved essential for learning not only the fundamentals, but also the 'throttle on early to maintain the momentum' style of a fast-cornering FunCup car.

Finding space and availability mid-season for a long-awaited debut was not so straightforward though. As I had the most – if limited – experience at Donington, it seemed logical to aim for the last round of the 2018 series there in October. To that end I helped the team from the garage and pit wall in the three preceding rounds to learn more about the cars and series.

Using some of my feedback, we revised part of our rear wing geometry, strictly within the regulations – a case of you can take the aerodynamicist out of F1, but you can't take the F1 out of the aerodynamicist? The move created both attention and controversy, with clarifications hastily made to potentially outlaw them in the 2019 regulations.

Overall, this modification seemed to go well – if not with the officials.

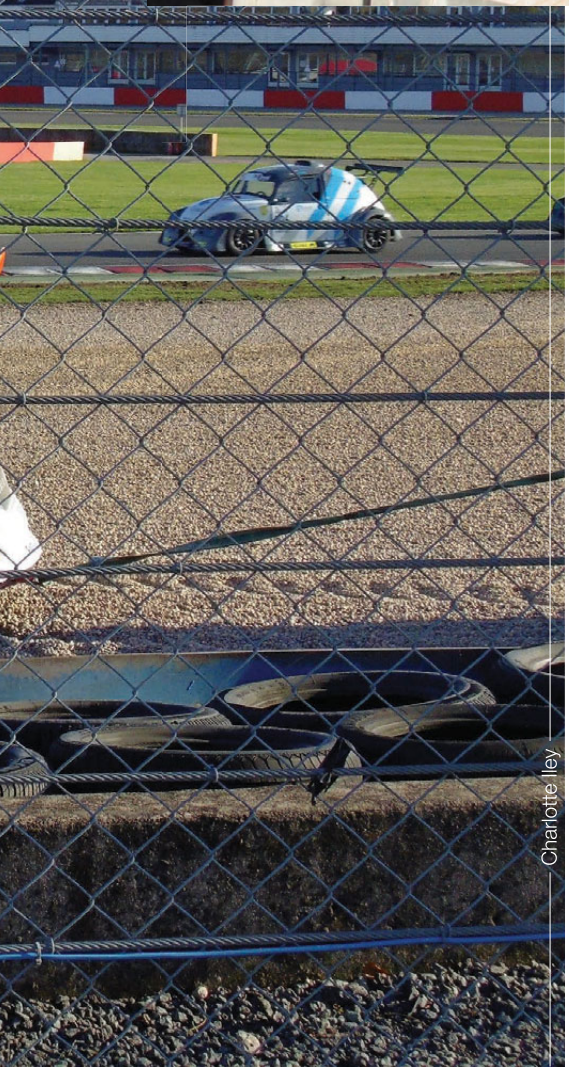
TIME TO HIT THE SIM

Being of a competitive nature, I also started learning tracks and training on a virtual home simulator system, using predominantly Donington and a car, weight, rear-wheel drive combination as

ABOVE & TOP Don't worry John, it's not like your entire family is gathered and watching on the other side of the fence… A bottle of Château Redgate? In a nice touch, the team later presented the debutant with a fitting memento of the day (top)

Leo Allen

ABOVE Wheel askew, the battle-scarred car is returned to the paddock after its brush with the kitty litter



Charlotte Iley

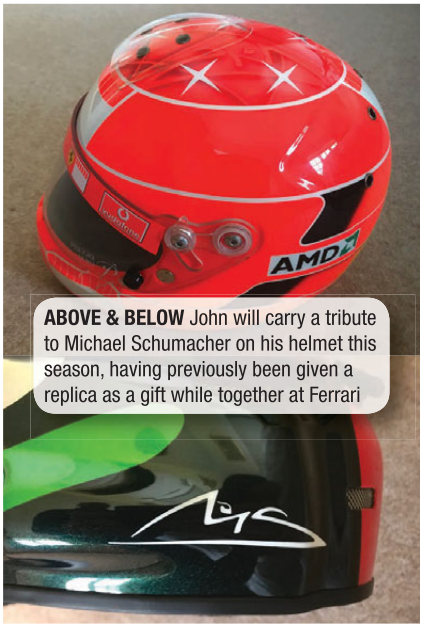
> *"An F1 car would be lapping 35 seconds quicker"*

close as I could to the actual car. I also added one further track day, but this time including some race car seat time. It was a little different to the two-seater, as it's lighter, has a straight shift gear lever on the right rather than paddle shift on the wheel, and also requires clutch use on down-changes, but all fine once you get used to it.

As the last round approached, I went through a practical mental checklist of race kit, paperwork and budget to make sure everything was in place. A bit like packing for a holiday, along with the dawning realisation it was actually happening. The meeting was run by the BRSCC, with testing on the Friday, qualifying Saturday morning and the four-hour race in the afternoon. A minimum of two drivers per car are required, teams typically running three. The race was composed of 6 x 40-minute stints with five mandatory 10-minute pitstop windows for as-fast-as-you-can driver changes and refuelling, making good team strategy and pit work essential. I would be sharing #195 with car owner Jon King and team owner Jay Shepherd. No pressure then.

The Friday was good, cold but dry. With only 30 or so laps in the race car previously under my belt, it was mainly about car and track acclimatisation, running in very close proximity with other FunCup cars for the first time, just starting to push some braking zones and apex speeds. Each car is fitted with the Racelogic VBOX system, enabling you to study your laps, data and videos after each stint. This is where someone of Jay's experience is so useful.

His baseline time and how, in theory, to ▶



ABOVE & BELOW John will carry a tribute to Michael Schumacher on his helmet this season, having previously been given a replica as a gift while together at Ferrari

achieve it, is quickly and easily established. The hard part is then capitalising on that knowledge to put theory into practice and chipping away at approaching that standard yourself. Running on the National layout, I set a 1m 26.0 lap at the end. This was respectable as a novice, but still a couple of seconds away from Jay and the regular frontrunners.

LEADER OF THE PACK?

Saturday was to prove considerably more eventful. Qualifying is not as usually thought, but merely to check your car and ensure all your drivers can complete three laps each. No grid positions are decided: FunCup relies on a random grid, drawn in this case out of a helmet. The only constant is that the winner of the previous race must start last.

We would begin the race from P9, in the pack amid a grid of 28 cars. For the full baptism of fire, it was also decided I would start. This prompted some consternation for Julian Floyd, the Clerk of the Course, ▶

ABOVE The addition of angled, aerofoil-shaped spacers to the rear wing alarmed the technical powers-that-be

Move over, Lewis? Not quite...

Having enjoyed and endured the highs and lows with some of the sport's greats, how is it to trade places?

AFTER working in F1 teams with World Champions like Michael, Lewis, Jenson, Damon, Fernando and Kimi, poring over their data and trying everything to give them the best developments to do even better, sitting behind the wheel of a race car for the first time is an immensely valuable revelation.

I can drive a car and, annoyingly, have plenty of knowledge of what is required to drive a racing car quickly, but that is very different to being able to put it into practice. It's the same with the technical side: any group of people can build a race car, but not many can build a properly ultimately quick one.

It's a massively steep learning curve. Those initial track day laps are about learning track layout, watching out for marshal signals and other – particularly much faster – traffic, learning some lines and initial braking points. Your brain is saturated just covering the basics. As you acclimatise, it starts to become more natural, your lines get imprinted, your peripheral vision, adaptability and awareness gradually expands. It takes seat time, confidence and plenty of practice.

The challenge, I am still discovering, is all about fine margins and consistency. Two seconds off the pace at Donington is a good start for a complete novice, but it is the last second, just as with the technical side, that is really, really hard. Take a closer look, though, and you can see I am on the brakes maybe five metres too early, staying on them too long, not perfectly managing the weight transfer, slower through the apex and throttle application, almost everywhere.

Then the following lap and lap time is too different: similar problems and trends – even at this slower pace, I am making beginner's mistakes. An F1 car would be lapping thirty-five seconds or 40% quicker, with the requisite exponential increases in skill and reflexes required.

A top driver is able to walk that tightrope edge, braking at the absolute 99.9% point to within a metre, dancing on the limit of adhesion through a perfect arc, using each centimetre of track and kerb, then hard on the throttle, ridiculously early. Then do it again and again and again, with ease, with plenty of capacity left to race, think about strategy, change car settings, manage the temps, tyres, read gauges etc.

To capture the essence of the difference between my efforts and those of the drivers I have worked with, a good analogy is perhaps that of the amateur golfer: it is that one shot in his round of a hundred-plus, that is half-decent, that makes him go out on the course the next time. It's the opposite for the pro: the one shot during his below par round that he is angry about because it landed 25 feet from the pin, instead of within six feet. That's pretty much what the current difference feels like to me. RT

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who asked "Are you sure?" at the end of the drivers' briefing. He was, however, somewhat pacified when it was clarified that our car was actually starting P9, and that it was another of the team's cars that would be sitting on pole!

STRANGELY LONELY

After the grid walk, I am strapped in and say goodbye to family and crew as it is cleared. A radio check. It's strangely lonely sat in there, watching the boards and lights with the engine ticking over. I thought I would be nervous or at least have an elevated pulse rate, but I can honestly say it feels very normal, like waiting patiently at a level crossing for a train.

We move off on the formation lap for our rolling start and I keep position while getting some heat into the brakes and tyres. The start's OK. I should be closer to P7's back bumper, but not easy through the chicane two-by-two when the front row go early.

Those first laps of pack racing are a real education. The slipstream is really important. You can't see the racing line any more; it's full of cars. The pace is slower and erratic; you are all getting in each other's way.

I do fine for four or five laps, losing a spot or two here and there, but then the quick regulars behind me exploit my lack of racecraft: four-wide into the chicane and guess who is on the very outside? Not really sure what to do here after eight miles of race experience, I go straight on, over the gravel and kerbs and re-join, having lost places and confidence, quietly cursing and shaking my helmet.

A couple more minor issues and apart from two cars that have had their own more serious dramas, I have fallen off the back of the pack and a gap has opened. There is no ▶

ABOVE It's the opening stint for Illey. No pressure, then?

"The most comprehensive risk assessment in the history of mankind?"

Aerodynamicist Mark Handford reflects on his former colleague's defection to the racing driver camp

WHEN we all worked at HRS John told us the tale of how he once ill-advisedly used a power drill on an item while clasping said-item firmly in his lap (Health and Safety wasn't something we knew much about back then). The outcome was somewhat inevitable but he assured us that after he had conducted a slightly panicky "damage assessment"… well, there was no cause for alarm. After that formative experience we assumed that John would only ever proceed with risky pursuits after considerable "due diligence".

So, his maiden appearance as a racing driver, 48 years after deciding it was the career for him, surely demonstrated one of the most comprehensive periods of risk assessment in the history of mankind.

But, seriously, I suspect that once John has learnt to relax, he will demonstrate the sort of attention to detail, hard work and iterative refinement that has characterised his professional career. Even if he's not quick straight out of the box, I'll bet he uses his considerable 'nous' to eke out those final few tenths of a second.

The only thing I would caution John about (other than to steer clear of the power tools) would be not to underestimate the huge build-up in Brownie points that his lovely wife, Clare, is going to be accruing… Good luck John! Hope you enjoy every moment of your new career.. RT

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> *"I have plenty of knowledge of what is required to drive a racing car quickly, but it's very different to put that into practice"*

slipstream any more, but I *can* see where I am going. Come on John, pull yourself together.

I start to: 27.2, 26.5, 26.3, 26.8, 26.2. I am back on the tail of the pack. I pass two cars, my first overtakes! There are six cars in a train in front of me. I am actually *racing*. Confidence, pride and belief return. And then, of course, I fall.

Too much kerb at Coppice. I loop-spin 90 degrees, stalled, in-gear. No-one collects me. Er, neutral's there somewhere. Restart the car would be good. Time (35 seconds lost that lap) ebbs away. So does everything else...

Going again. The very next lap yellow flags and a car in the gravel at McLeans. Bits are on the track. I back off and *just* collect up the car on the oil that's down. I get through Coppice okay then get to the chicane. But there's no grip: clearly plenty of oil down here too. Straight on over the gravel, no kerbs, more experience, more time lost. The track is still slippery and there are yellows at McLeans while they clear up. I now have to start watching my mirrors carefully as the leaders begin to come through.

The times come back to 1.27s, but I am now too busy trying to get out of the frontrunners' way. Another messy chicane results. It's not easy, but thus far I have had no contact. The FnS car is stationary on the grass at Starkey's with only the spokes left of its right rear wheel – a pit window safety car. I'm called in. It's been an all-action 38 minutes, but it feels like a month. Jon King takes over.

MY FIRST ACCIDENT

A lap down (my fault), I climb back in for stint three. The track is much clearer, but my morale and confidence has dipped. 1.27s, but also some 1.28s, but I keep my nose clean and no problems, so actually a much more effective stint. Except... I get the pit-in radio call on the start/finish straight. I confirm, turn into Redgate flat in third gear, and the front left hub fails. Still trying to steer while skittering across the gravel, I am having my first accident,

Charlotte Iley

ABOVE Will his legs really fit in there?

Vince Todd

ABOVE Some of those lines from 'The Racing Driver's Book of Excuses' suddenly don't seem so lame from this side of the fence…

into the tyres, exactly where my family are watching! I forget to let go of the wheel, as a pro would, but am physically unhurt.

A large forklift, some excellent work by both marshals and team, and the car is back out with Jon King at the wheel. Surprisingly few laps have been lost. This is endurance racing.

Enough for one day, surely? But Jay very kindly offers his stint five to me, literally getting me back on the horse. It turns out to be an important move. The confidence is still not great, now mostly 1.28s with a couple of 1.27s, but I avoid a Redgate sandwich and even a 'team-mate' sending it up the inside at the Old Hairpin.

CONTACT SPORT?

I have still never touched another car, just the tyre wall at Redgate and the kerbs and gravel at the chicane early on, which probably contributed to the hub failure. We finish, 21st and two signatures towards upgrading my licence are secured. As the surviving cars return to the paddock, bearing battle scars that testify to a particularly feisty end-of-season encounter, they are welcomed by applause from the pits and an impromptu guard of honour.

My racing duck finally broken, I hope to come back wiser, better prepared and stronger, but know more than most that there is little substitute for car and seat time to get that crucial feel and confidence. My respect has only grown for the FunCup regulars, some of whom have as many as 17 seasons under their belts. It appears that I have a little catching up to do. I look forward to it. RT

ABOVE Practising driver changes. Saving vital seconds here can build a bigger cushion of time to blow with mistakes out on the circuit!

Charlotte Iley

ABOVE I'm going out *again*? Really?

Vince Todd

ABOVE The FunCup car's single-seater layout places the driver in a central position in the cockpit

Vince Todd

AGAINST ALL ODDS

Hal Ridge speaks to the architects of an ambitious project that has twice overcome the odds to finish the gruelling Dakar rally raid

ABOVE Developed by SsangYong Motorsport in Spain, the new Rexton DKR combines a dune buggy body style with the muscular design features of the SsangYong Rexton SUV

IN the same way that Aston Martin taking the Vantage GT racing is the perfect fit for the British marque's luxury performance image, SsangYong's biggest foray yet into motorsport – cross-country rallying – is the ideal calling card for a South Korean manufacturer best known for producing Sports Utility Vehicles.

SsangYong Spain heads up a cross-country programme that has now contested and finished the gruelling Dakar rally twice in the last two years.

The project was formed in 2015 and success quickly followed, the marque winning a category title in the Spanish Off-Road Championship with a two-wheel drive machine in its maiden campaign. Subsequently both four-wheel drive and two-wheel drive challengers have been adorned with the brand's emblem, but in the last two years its focus has been a two-wheel drive buggy – firstly branded as a Tivoli DKR, then as a Rexton DKR – to compete in the famous off-road endurance Dakar event.

To say the programme is run with a modest budget and infrastructure compared to other works, or works-backed, outfits from Peugeot, MINI and Toyota in recent years is a substantial understatement. Nevertheless, a sensible step-by-step approach is returning reward.

The brand dipped a toe in the water of four-wheel drive cross-country competition with a brace of campaigns in 2016, but missed out on the Spanish title. During that time SsangYong driver Oscar Fuertes did win Baja Spain though, and, as a result, claimed a free entry into the Dakar. That's when the project really took off.

Taking costs, reliability and competitiveness into consideration, SsangYong Motorsport opted to return to a two-wheel drive racer, created by specialist Spanish rally raid outfit Herrador Motorsport. The firm built the Tivoli DKR for 2018 that finished 32nd, then the Rexton DKR for the South American-based Dakar earlier this year. At the conclusion of the brutal 11-day, 3,000-kilometre marathon, which included 63 hours, 14 minutes and 19 seconds of competitive driving, the SsangYong team finished 33rd overall and third in the T1.3 category, for two-wheel drive petrol-engined cars. That was even with losing the windscreen after an incident with a truck on the fourth stage, the crew having to contend with the resulting dust and air pressure issues until the problem could be eased.

PEOPLE DIDN'T BELIEVE WE COULD FINISH

Using experience of running a wide range of off-road vehicles for over 15 years, the Rexton's 'buggy' two-wheel drive chassis is of steel tubular spaceframe construction, built in-house at Herrador's Valencia workshops, and covered with a fully-composite body. Now plans are underway for a return to the prestigious event next ▶

ABOVE & BELOW The Rexton DKR's interior. A new MoTeC programmable switch allows engine mapping changes in real time while eliminating all fuses and relays to enhance electrical reliability

year, with a full evolution of the machine.

"We were really late to start building a race car after winning [Baja Europe in Spain] but we did it in record time, in under four months. Normally it takes around a year and many people didn't believe we could finish the race because it was very tight and we didn't even have time to test, but we made it to the finish line. That was a big boost for the project," explains SsangYong Spain press and racing manager, Inigo Trasmonte.

"For 2019 we had to choose between developing the car and also having an assistance truck during the race, or going there with two cars. We took the hard decision to go with one car but it proved to be the right call. It's a very happy story for us because it's been so much work with a small group of people."

Suspension on off-road machines is arguably one of, if not *the* most critical consideration. While the Rexton uses a pair of dampers at each corner, unlike Peugeot's 3008 DKR, which used a pair of coilovers all round, this machine has a conventional coilover accompanied by a bypass shock absorber, with each damper engineered for its own area of function. Both are supplied by King Shocks.

"I've been working with King Shocks for 20 years," explains Herrador Motorsport general manager, Javier Herrador. "Their factory has a tuning department that every week goes to test different suspension. I learnt a lot from that concept, so I decided to make something similar but for the best performance for what we need in terms of geometry and suspension travel and weight to suit FIA rules.

"It's a mix between the best points of those cars and our experience in Europe. ▶

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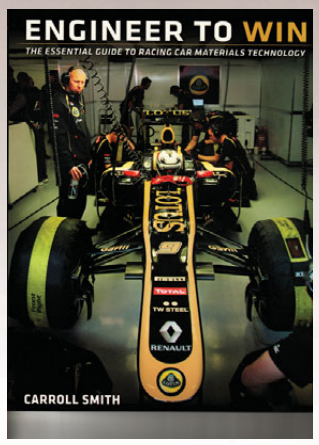

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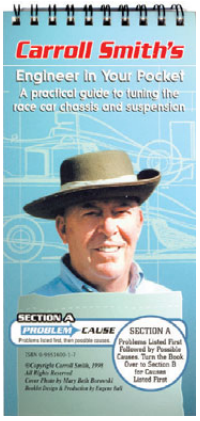

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ABOVE & BELOW Greater suspension travel and a weight break are among the compensations for running in two-wheel drive trim

The two dampers are because the coilover is sensitive to the speed of the wheel movement, to cope with the different kinds of terrain, and the bypass shock is sensitive to the position of the suspension in relation to the distance and speed of the travel, to be softer or harder. We have millions of combinations in terms of tuning and the behaviour of the suspension."

While Herrador's machines have more conventional double A-arm wishbone suspension up front, the Rexton has trailing arms at the rear. "It's just a personal decision," muses Herrador. "There are different points of view. For me the buggy rear suspension must be trailing arm. It's heavier than the double-arm system, but it's much stronger. In 10 years, we've never broken a rear arm in any conditions. We've found this setup to be softer, more comfortable and more reliable."

Suspension travel is free on two-wheel drive cars, in a regulatory bid to achieve parity with their four-wheel drive rivals. As such, this machine boasts half a metre of wheel movement, while four-wheel drive racers are limited to 275 mm. ▶

> *"It's a very happy story for us because it's been so much work with a small group of people"*

BELOW The spare wheels and 400-litre fuel tank hang out at the rear of the chassis to achieve the preferred weight distribution

Too soon for electric challenge

DESPITE SsangYong launching a concept of a new electric SUV, called the e-SIV, at the Geneva Motor Show, it's seemingly unlikely that SsangYong Motorsport will enter cross country events with an alternative energy-propelled machine in the near future.

Another Spanish outfit has already completed the Dakar rally with an electrically-driven car, the ACCIONA 100% Ecopowered featured in RT197. While on that occasion the machine needed to be recharged by fossil fuel-powered generators at each service halt, SsangYong Spain press and racing manager Inigo Trasmonte doesn't think an electric machine would be appealing until it could be totally sustainable.

"If we had an electric effort it would have to be sustainable 100%, electric 100%. At this moment I don't think we're in a position to do this," he explains. "I think we should focus on something more traditional right now to ensure a good continuation of our successful story." RT

THUNDERING V8

The Rexton's engine, a thundering 6.2-litre V8, sits in the rear of the chassis, over the rear axle. "We have 35:65 front to rear weight distribution," says Herrador. "Like on a motorbike, if you move your body at the rear when you have the rear wheels driven you then get grip. If you put your body on the front of the bike you lose traction; it's exactly the same here." With more inspiration taken from American machines, the spare wheels and 400-litre fuel tank also hang out at the rear of the chassis.

Up front, only the battery is where an engine would be found in a Rexton available to the consumer from a roadside dealership. It

ABOVE The 6.2-litre V8 sits over the rear axle

is joined by an oil cooler for the hydraulically-operated power-assisted steering.

The rack is connected to a bespoke upright at each corner – the same component used all round to help with spares required on the road – housed inside the 17" wheels, shrouded by 37" Yokohama tyres. Part of Yokohama's involvement in the programme is that street-legal rubber is used to help with the brand's product development.

For the new evolution of SsangYong's off-road machine, ahead of another planned assault in 2020, the braking package is being improved after the Wilwood setup used until now was shelved. "We thought that with the dimensions we had it would be enough, but our drivers said they wanted the brakes to be better," reports Herrador. "For the new version of the buggy, which we are finishing in the next few weeks, we have different discs and callipers from AP Racing. We went to the maximum size that the rim allows in terms of diameter and thickness."

As with the uprights and dampers, the same 332 mm discs and six-pot callipers are used at each corner to aid the spares package, although he admits the front brakes could be smaller.

Power is delivered to the rear wheels via a Sadev transmission system. The concept originally utilised a transmission based on Fortin casings from America with Hewland internals, but that has now been ditched in favour of Sadev's more bespoke six-speed sequential system, with mechanical rear differential. "We had a problem that the reverse pinion was too small [with the Hewland arrangement], because they are making parts for circuit racing and there they don't need a strong reverse gear," observes Herrador. "We had a lot of problems with reverse, but Sadev has products especially for this type of vehicle."

Via the triple-plate AP Racing clutch, the transmission is driven by the 405 horsepower V8 motor, based on a General Motors LS3 block. Regulations state that the engine has to be based on a mass-produced unit, but after that it is free. Therefore, the internals and ancillaries are all sourced from various suppliers, or made in-house, before construction, although Herrador himself is cautious of giving away much detail.

The engine does enjoy the use of a bigger air intake restrictor than its four-wheel drive cousins, another aspect of the regulations aimed at balancing performance, using a table created between the FIA and ACO based on engine capacity and minimum weight. The Rexton's restrictor size varies between 37.2 and 39 mm depending on the altitude, while ▶

ABOVE Only a battery and oil cooler for the power steering sit where the engine would normally be found in a showroom model

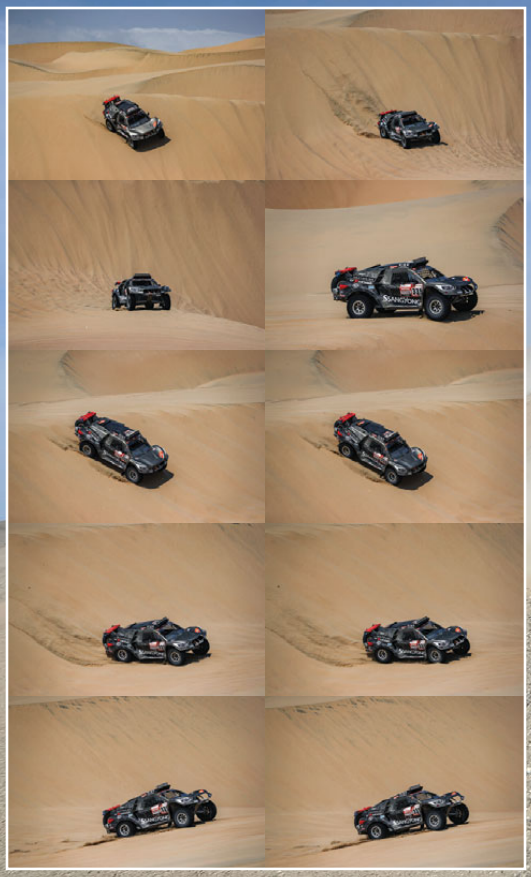
ABOVE The use of Yokohama's street-legal rubber aids the brand's product development

ABOVE & BELOW For the smaller outfits like this, the Dakar remains one of motorsport's greatest adventures

the four-wheel drive version is fixed at 37 mm.

The engine's management is provided by MoTeC, with the driver and navigator LCD displays courtesy of Aim, ahead of the crew's Sparco seats and harnesses. In the most recent versions of the Valencia-built machines, a fly-by-wire throttle is used. The wiring harness is built in-house, as is the mapping of the engine.

Aside from the increased suspension travel and intake restrictor, one of the key advantages of running a two-wheel drive buggy over a four-wheel drive machine is the weight break, based on the aforementioned calculation. In its current guise, the 4x4 version of the Rexton dune racer would need to be 600 kgs heavier, and as Herrador points out, "in competition, everyone looks for lower weight and the



ABOVE & INSET The crew made good time over the soft sand

relation between the weight and power is very important for any kind of motorsport."

A key area of development in the new 2020 evolution will be even more weight saving, with a target of being over 100 kilos lighter than the 2019 version. "We've changed the suspension geometry, mainly to have better anti-squat and anti-dive [characteristics]," he says. "We've also changed the centre of gravity and roll centres, and the position of the drivers so they are 10 cm higher in order to have better visibility in the dunes. We are sure we now have a car that can get a top 10 placing in the Dakar without any doubt."

> *"If the average speed is higher, we have a better chance for a good result"*

A recent meeting with Ssangyong's president and the chairman of the brand's owners, Mahindra, at the Geneva Motor Show could result in increased support for the project. Either way, the eagerness to continue an already ambitious adventure is evident.

"The target for the first two years was to finish the race and it was great because we did that. But our target for 2020 is that we really need to improve," admits Herrador. "We don't have the millions of [Euros] investments to fight for the win but we need to aim for a higher position, maybe top 20. If the race happens in Saudi then it's very positive for us because it's a faster race. If the average speed is higher, we have a better chance for a good result, and if things go well then you never know." RT

TOP 10 TARGET

From the technical perspective, the project appears to be heading on a positive trajectory, but as Trasmonte admits, the team and brand needs commitment from the Dakar's organisers about the 2020 event as soon as possible. "We want to go again, it's almost 100% decided, but they will change the location of the Dakar [for 2020] and they are messing around with confirming the exact place," he says. "There is speculation about it being in Saudi Arabi, and rumours about other Latin American countries.

"We should know already where the race will be held by now. It not only affects the logistics and costs but also sponsors. We really need to know everything before we can complete the programme, because if we go to sponsors it doesn't sound serious. I'm a bit disappointed by that, but we are really working to be there."

ABOVE & TOP An ambitious weight saving target headlines the full evolution of the buggy planned for the next Dakar assault

ABOVE Formula E does a great job, but does the whole of motorsport really have to go the EV route?

TALKING DIRTY!

Sergio Rinland reflects on the future of mobility and motorsport

FOR many years we have been working hard on researching ways to reduce pollution to our planet, to curb climate change and, most critically, to clean the air we breathe in our cities.

Last month we applauded the launch of the Extreme E series, planned for 2021. It is a great idea and an ideal way to use motorsport to highlight the need to look after our planet.

Slowly but surely, the mobility industry (automotive and other) is finding its way forward. Battery Electric Vehicles (BEVs) are being identified as the ideal mobility for cities, where low speeds and constant stop-start behaviour play to the strengths of EVs. There is no doubt that the big urban centres have to clean up their act (and their air) for the wellbeing of their inhabitants. It is unacceptable in this day and age that people have to breathe harmful gases and particles as the sacrifice for the very mobility they need to go from A to B inside their cities.

On the other hand, despite the big efforts from the automotive industry to increase range from 200 to 300 to 500 km in one battery charge, this is consuming most of their investment capital. Is that a good way to spend their money? They have a massive investment in the development and manufacturing of Internal Combustion Engines (ICE) going back more than 100 years, which they would like to protect, but nowadays, ICE has become a dirty word: gasoline engines are emitting too much CO2 and diesel engines too much NOx. So is there a compromise we could find?

ALTERNATIVE FUELS

There is a lot of R&D and investment in the development of alternative fuels which suck CO2 from the atmosphere, hence reducing their carbon footprint in the overall balance. It's a good solution for open spaces, but not that great for cities where people will breathe CO2 from the exhausts before it could be captured to create more fuel. Therefore, as we have suggested, BEVs are the solution for cities. ▶

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A couple of years ago I was involved in a project to develop hybrid HGV trucks for long-haul transport. We found that HGVs in Europe account for only 4% of the whole vehicle fleet, but contribute to 40% of pollution (CO2 and NOx). So, that is a big area to tackle to reduce the pollution from mobility. Are electric HGVs the answer? We didn't think so, if to transport 28 tons of goods, we need to have four to six tons of batteries, to do about 300 km (not much when they run about 750 to 1,000 km per day). It reduces the payload by about 20% and involves too much time lost charging the batteries during the day.

SERIES HYBRID SOLUTION

The solution we found was a Series Hybrid powertrain with a generator either running on gas or renewable fuels. Hydrogen fuel cells are the ultimate solution, but are still too far away to be considered as an economical way for transporting goods in a short-to-medium term. The pollution created by these vehicles (offering about a 40% reduction compared to current HGVs) would be on open roads; they would be motorized purely by electric means when entering populated areas. This was a compromise we believed would be acceptable.

Could this also be the right solution for long-distance car travel? We believe so. If we make cars that can do 800 to 1,200 km with one tank of fuel and a full charge in their batteries, it would make for good and relaxed touring. Just as with the HGVs, when entering urban areas they could run purely as an EV.

> *"ICE has become a dirty word"*

Where am I going with all this analysis and what part would motorsport play in all of this? We already have Formula E and, in a couple of years' time, Extreme E. These two serve the R&D and marketing needs of the automotive industry for EVs very well, but what about the sporting and entertainment needs of motorsport spectators and participants? Do they need also to be electric? The growing belief of the motorsport fraternity is: 'not necessarily'.

We already have Parallel Hybrids in F1 and LMP1. Soon this influence will extend to rallying and touring cars (as a consequence of what the OEMs are commercialising). What about the rest? Does the whole of motorsport contribute that much CO2? Only a tiny percentage if we compare it with HGV trucks! Do we really need to cannibalize motorsport and forget the 100 years-plus of ICE development?

If the fuel and automotive industries used motorsport to develop and promote the use of ICE with these alternative fuels in open areas (Silverstone? Spa? Monza? Nürburgring? Le Mans?), we could enjoy the sport we love for many years to come. And this comes from a guy who has been working in EVs for more than a decade and earns a living out of it! But pragmatism has to prevail. RT

ABOVE Extreme E, the off-road arm of Formula E, will highlight the plight of the planet

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