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F1 to the rescue

How F1 tech is helping battle virus crisis



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E-sports come to life

WE live in tumultuous times where there is no guaranteed future for anyone or any industry. We have already seen great swathes of motorsport series cut down, postponed and in some cases even cancelled. It is all very depressing and worrying, no matter the spin you try to put on it.

As will be seen from our lead news story, there are a number of motorsport companies stepping up to the plate to help their respective governments in the supply of ventilators, which is magnificent, but what of the racing itself?

One answer has been e-sports for a number of series, including Formula 1. Now I put my hands up and confess that I am completely the wrong demographic, something like half a century separating me from the millennials and Generation Z, but by chance, while channel-hopping at home, I happened to come across the live transmission of the virtual Bahrain F1 race. In fact, it was counting down to qualifying so I decided to stay and have a look.

Many of the names were totally unfamiliar to me, as it included professional sim racers and a former member of One Direction, but there was Sir Chris Hoy, a seven-times Olympic gold medallist, on the grid along with a smattering of current Grand Prix drivers – plus good old Johnny Herbert. On pole position was sports car racer Philipp Eng, racing for Red Bull, who was joined by Mercedes reserve driver Esteban Gutierrez on the front row. The ultimate winner was Renault's Formula 2 Guanyu Zhou, who

started on the second row.

The three commentators were making a good job of keeping us, the uniformed viewers, up to speed, but I found it difficult to take seriously and couldn't help but think that it was all a bit antiseptic, despite the superb graphics. I watched for a bit but eventually decided to sign out, but I was in a minority because the virtual Bahrain GP attracted 350,000 viewers and it was deemed a great success.

Virtual racing is turning out to be a great way to give fans a "fix", but once the racing does get underway, I wonder if it will still retain its popularity.

On a different note, we are fully committed to print, but in the current circumstances we are having to produce just a digital edition for the foreseeable future. For those who have paid for the print edition, your subscription will consequently be extended so you will receive the number of print copies to which you have subscribed.

Thank you for your patience. **RT**

William Kimberley
EDITOR





ABOVE Prodrive's impressive facilities typify the high standards that could be transferred to medical projects

A question of survival

The expertise and can-do mentality of motorsport's top companies is being harnessed in the battle against coronavirus. By **William Kimberley**

FORMULA 1 and motorsport engineering companies have responded to the UK government's call for more ventilators.

One F1 team sent some of its engineers to look at a medical ventilator in London. They returned to base, reverse engineered it and within 24 hours were manufacturing their own version – such is the can-do/will-do attitude of the motorsport engineer.

F1 teams were quick to volunteer their help, given the urgent need to design and

manufacture ventilators. They have spare capacity during the enforced shutdown and some, such as McLaren, have spin-off technology arms that were already closely involved in projects in the medical sector.

Renault's technical chief Bob Bell, Red Bull's commercial development officer Andy Damerum and F1's Pat Symonds are co-ordinating the effort. They are working with former F1 aerodynamicist Mark Gillan, now chief technology officer at Innovate UK, who had appealed for help. All seven

British-based teams – Mercedes, McLaren, Red Bull, Racing Point, Haas, Renault and Williams – have offered to get involved and provide expertise at a time when they have capacity due to the lack of racing.

McLaren, along with the Smiths Group, GKN, Nissan, aerospace company Meggitt, and Airbus are also part of a UK consortium that has been working on plans to produce thousands of Smiths ParaPAC Plus ventilators. The aim is to help the UK Government deliver its ambitious plan of 5,000 additional ventilators within two weeks, with the intention to scale availability to 30,000 over the coming months.

"The teams are working in collaboration with F1, the UK government and other organisations to establish the feasibility of the teams producing, or supporting, the production of medical devices to help in the treatment of coronavirus patients," F1 said in a statement. "All the teams have expert design, technology and production capabilities, and specialise in rapid prototyping and high-value manufacturing, which is hoped can be applied to the

critical needs set out by government.

"Working with Innovate UK, the High Value Manufacturing Catapult team and University College London and UCH hospitals, the teams are evaluating a number of routes to support in conjunction with existing manufacturers and organisations from the aerospace and automotive sectors. It is hoped this work, which is being rapidly progressed, will produce a tangible outcome in the next few days."

Meanwhile in Italy, the Agnelli family – who control the Ferrari Formula 1 team and road car business, as well as the Fiat Chrysler company and Juventus football club – have put in place a series of measures to help deal with the COVID-19 crisis. They include a €10 million donation to the Italian Civil Protection Department, as it deals with the emergency at a national level; and to Specchio dei Tempi /La Stampa (a social assistance organisation which operates in the Region of Piedmont), to respond to



ABOVE Motorsport companies are playing a key role in a consortium that aims to make 30,000 Smiths ventilators available in the coming months

the local health and social needs in the city of Turin and Piedmont.

The family's companies have also sourced and purchased a total of 150 ventilators, alongside other medical equipment from various overseas suppliers, and are preparing for their immediate air transport to Italy to help ease the burden on the health services.


FAST SOLUTIONS

Like many engineering companies in the UK, Prodrive has responded to the UK Government's call for companies to commit to supplying ventilators.

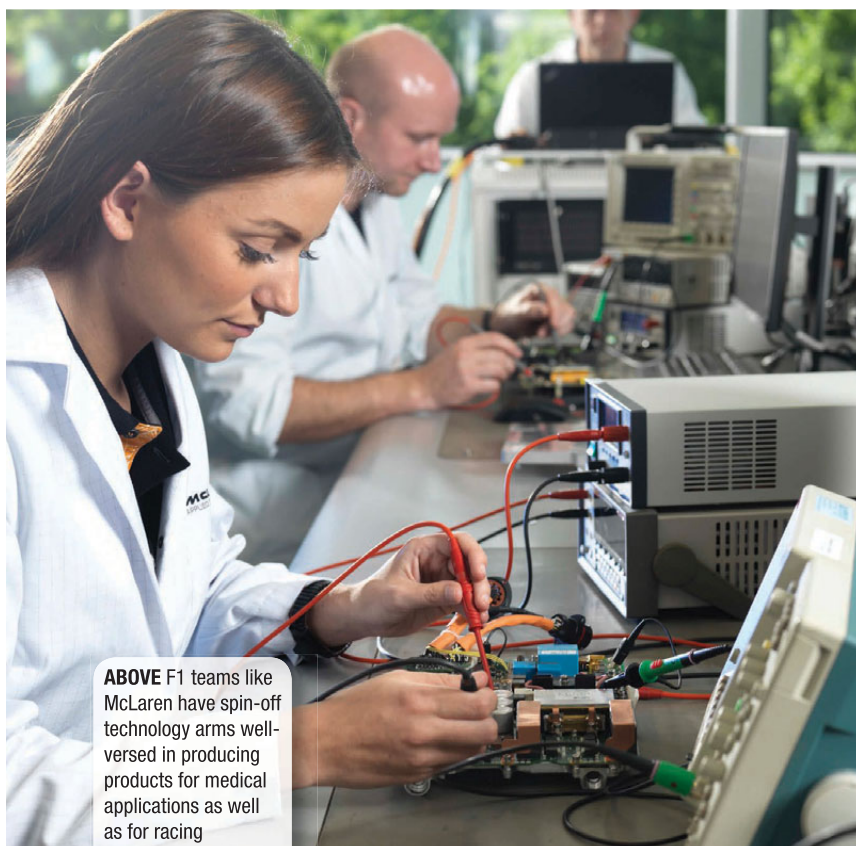
"What we have done following the UK Government's prompting is go to its website where everything it was after for ventilators has been listed, and filled in the relevant documents," said Ben Sayer, Prodrive's corporate marketing manager. At the time of writing, Prodrive was waiting to see if it was being selected out of 1,400 applicants that applied.

"We can tick the capability side as we have every bit of manufacturing on site, including electronics, machining, wiring, fabrication. We can more or less build anything on site. We also have a clean room where some very sophisticated electro-hydraulic systems for a renowned carmaker are currently made, the facility having specifically been built for that purpose. However, it can very quickly be changed over to the manufacture or sub-assembly of ventilators if need be.

"The big advantage for us is that we have the advanced technology business. It is used to doing this kind of work, such as hypercar active aero systems, so we are used to manufacturing hundreds or thousands of units and setting up small production lines where skilled technicians can assemble complex things, which could be needed for ventilators.

"There's the manufacturing capability side and then there's obviously the speed. Motorsport companies are incredibly good at looking at a problem and very quickly finding a solution." 

“Within 24 hours of seeing a medical ventilator, one F1 team's engineers had reverse engineered it and were manufacturing their own”



ABOVE F1 teams like McLaren have spin-off technology arms well-versed in producing products for medical applications as well as for racing



From nothing to 300 face masks per day - in just two days!

Alan Stoddart reports on another success story to help lift the gloom

ANOTHER company that has leapt in to help in this unprecedented time of need is Stand 21. After watching news reports about the lack of supply of protective masks, the company decided that this was a problem it could help solve.

As such, its regular output of safety

equipment such as race suits, fireproof underwear and helmets was immediately stopped. Within two days the company had sourced the correct material for face masks, contacted several hospitals to get their advice on the manufacturing process, made a few samples to be tested, and was making 300 washable


and reusable face masks a day.

"It was a very quick turnaround, but in motorsport you learn how to work quick and well," said general manager Romain Morizot.

These masks are not destined for front line staff in public hospitals, but instead fill another important need, for people in places like retirement houses, private hospitals and for companies where workers need to keep putting themselves in harm's way to carry out essential work. As well as protecting those workers, it also means that the supply of masks for doctors and nurses in public hospitals won't need to be interrupted or shared.

"Our job is usually to protect drivers," commented Morizot, "and what is a driver but a human being, so we thought we should do that at a different level, with a different perspective, and that is why we converted the production line."

In another departure from normality, Stand 21 is also not charging for the facemasks, only asking for the labour costs to be covered to make sure that staff members, who volunteered to keep working despite the pandemic, are able to keep their salaries.

"We wanted to help and give a fighting chance to our medical soldiers; they are extremely important." 



ABOVE & BELOW Racewear specialist Stand 21 is manufacturing face masks after staff volunteered to keep working despite the pandemic





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BELOW The virus crisis has delayed the introduction of F1's rules revamp

New F1 regs delayed for a year

THE 2021 F1 regulations have been pushed back a year.

The move was taken as the sport scrambled to adapt to the impact of the Coronavirus crisis.

An F1 statement said: "Due to the currently volatile financial situation this has created, it has been agreed that teams will use their 2020 chassis for 2021, with the potential freezing of further components to be discussed in due course.

"The introduction and implementation of the financial regulations will go ahead as planned in 2021, and discussions remain ongoing between the FIA, Formula 1 and all teams regarding further ways to

make significant cost savings."

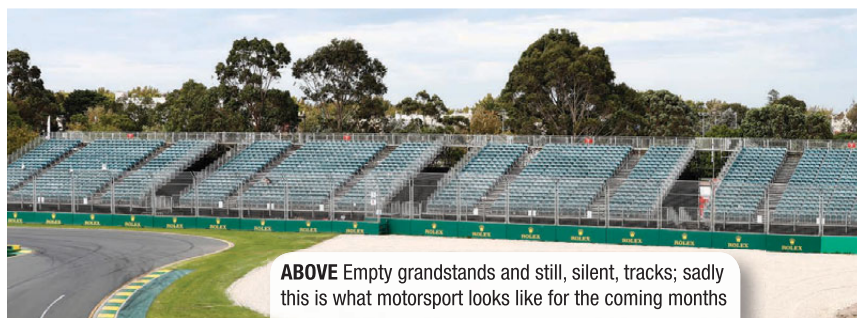
Teams will in theory be required to develop their 2022 cars – under the new regulations – within the budget cap framework. This could potentially help achieve the governing body's ambition to level the growing gap between the larger and smaller teams. It also complicates McLaren's switch from Renault to Mercedes engines, but the move will still go ahead.

Although the decision to delay the radical rules package a season – made in a conference call with the teams – was unanimous, there remained divisions on many other subjects. There

was, however, some agreement about bringing the summer shutdown forward from August to the end of March and April. The teams are making their own arrangements, but each must experience the same period of shutdown.

F1 is working with the teams in an attempt to avoid any redundancies being caused by the delay in introducing the new rules.

It remains unclear when the current F1 season will finally get underway. F1, like other leading industries, has mathematicians trying to model the projected course of the virus, but it is hard to do in such a fast-evolving situation. **IT**



ABOVE Empty grandstands and still, silent, tracks; sadly this is what motorsport looks like for the coming months

Motorsport paused as Coronavirus takes hold

LIKE every other sport and industry in the world, motorsport has ground to a halt amidst the COVID-19 pandemic that has swept the world. Initially singular events were cancelled, including the Chinese Grand Prix, the Sebring 1000 Miles and NASCAR's Homestead Miami round, but soon, series started to announce blanket action.

At the time of going to press, all Formula 1 rounds up to and including the Azerbaijan Grand Prix have been

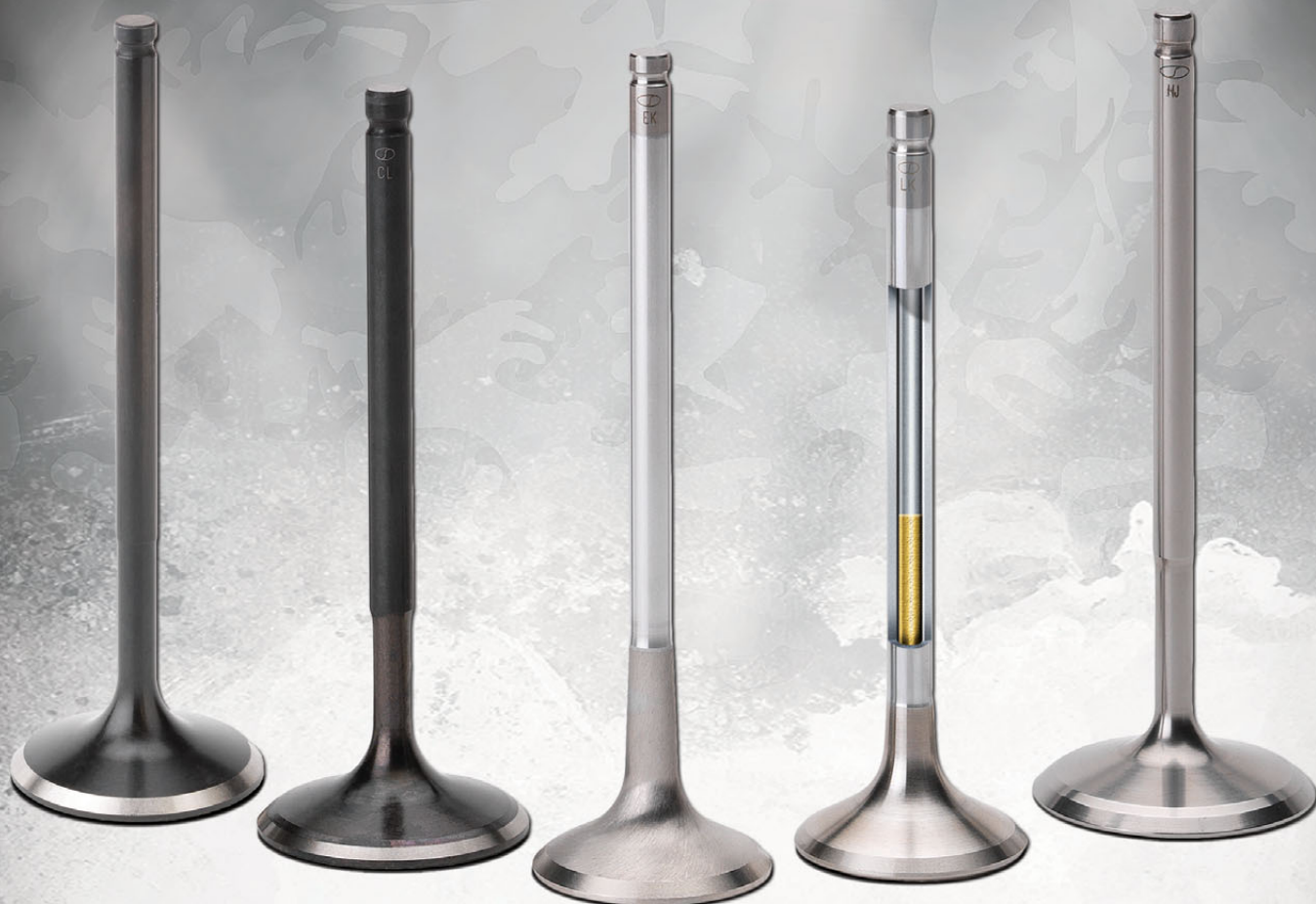
postponed, while the introduction of the planned 2021 Technical Regulations has also been put back a year. The move means that, theoretically, Montreal on June 14, will be the first race of the season, although as yet, nothing is certain. Formula E meanwhile revealed in mid-March that it was temporarily suspending the season. No races will go ahead in March or April, while FE is 'keeping the opportunity open' of racing in May.

The World Endurance Championship

has made significant changes, with the 6 Hours of Spa-Francorchamps cancelled and the 24 Hours of Le Mans put back from its usual mid-June dates to the end of September. Details of knock-on effects, including the series' switch to Hypercars, are set to be announced shortly. IMSA events have been cancelled until the Detroit Grand Prix on May 30/31, although that round is looking in increasing jeopardy. IndyCar has moved the Indy 500 to August 23, although the organisers admitted they were planning for 'all contingencies'. NASCAR meanwhile has formally cancelled events until the Martinsville round on May 9th.

Rally and Rallycross events have been cancelled, with both WRC and WRX postponing rounds for several months, while touring car championships are similarly affected, with the BTCC, DTM, WTCR and Australian Supercars all facing delays, postponements and uncertainty for the foreseeable future.

The only place there is still active motorsport is the virtual world, with F1, NASCAR and Supercars among those gearing up to give fans some action via eSports. **IT**



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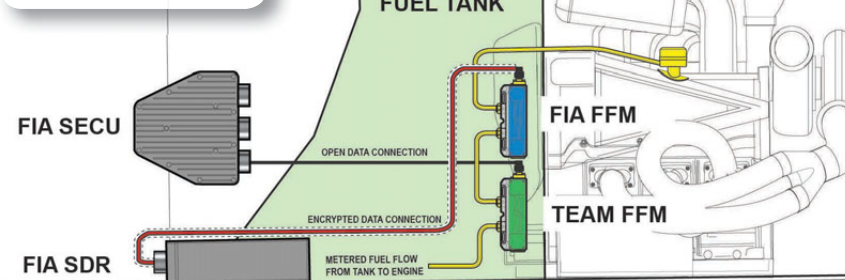
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BELOW The encrypted FIA fuel flow meter will be run in series with the team's own meter



Encrypted sensor extends fuel flow monitoring in F1

INSTANTANEOUS fuel flow limits of 100 kg/hour have been implemented in Formula 1 since 2014, with Sentronics providing the fuel flow measuring sensor since 2018.

These fuel flow regulations came into the spotlight towards the end of the 2019 season, with Red Bull seeking clarification over a potential loophole that could be used to exploit the manner

in which the fuel flow was measured. The loophole would involve a team forcing a greater amount of fuel through the fuel flow meter, at intervals in between each of the meter's 2,200 fuel flow measurements per second, which the FIA declared would be illegal.

To combat this potential exploit, the FIA introduced new measures to improve the policing of fuel flow

measurement, and stipulated that a secondary flow meter incorporating new features would be introduced for the 2020 season, to be mounted in series after the team device already in use.

The new device is an evolution of the FlowSonic Elite which is already used by F1, but incorporates anti-aliasing technology and full data encryption. The anti-aliasing technique randomises when measurements are taken, making it impossible to synchronise any ancillary parts to the measurement frequency, while the full encryption ensures the authenticity of the data and privacy to the FIA.

"This new variant of the FlowSonic fuel flow meter is not only one of the most technologically advanced currently available, but is an important step forward in improving the FIA's policing of the maximum fuel flow regulations in F1," explained Sentronics managing director, Neville Meech. "We're proud to lead the market in solid-state fuel flow meters, and to demonstrate our ability to develop world-class technology in rapid timeframes." **ti**

Revolution Race Cars unveils innovative safety device

REVOLUTION Race Cars has unveiled an innovative 'double-halo' for its latest A-One sports prototype racer. Inspired by the head protection structure mandated in Formula 1 at the beginning of 2018, Revolution's version is the first 'halo' type structure to be developed for a two-seater sports prototype car.

The structure bolts to Revolution's advanced carbon fibre monocoque chassis. This is made with an energy-efficient infusion process and was built to accommodate two people comfortably, making the A-One ideal for driver training and corporate driving experiences. Both the 'double-halo' and the chassis are compliant with the latest FIA Article 277 safety standards.

The unique 'double-halo' gives the Revolution similarly high safety standards to closed-cockpit Le Mans cars but without the complexity of accessibility, door structures and cooling systems that can add unwanted weight.

"We designed the A-One to give more elbow room than other prototype racing cars, making it easy to operate both solo and with a passenger aboard," said Phil

Abbott, managing director, Revolution. "By introducing the 'double-halo' we are giving drivers and their instructors or corporate guests the same level of safety they would expect in a world championship type race car."

The 'double-halo' is an option for drivers in the Revolution UK Trophy, which runs within the Sports Prototype Cup series. **ti**



ABOVE The Revolution's unique double-halo is the first safety device of its kind



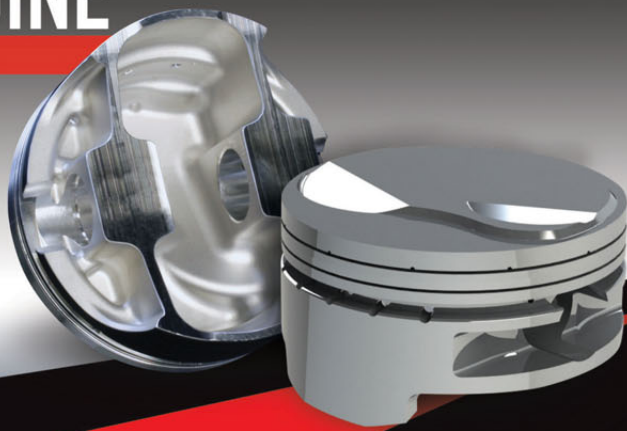
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ABOVE Hyundai driver Thierry Neuville is critical of greater standardisation in the WRC

Neuville questions WRC's new direction

THE FIA has revealed a new Rally Pyramid for international rallying that came into effect from the start of 2020, with the World Rally Cars at the highest level being renamed as Rally1. Rally2 is for existing R5 cars, Rally3 is for a yet-to-be-announced class, Rally4 for JWRC-type machines and Rally5 for what was previously R1, the most basic two-wheel drive machines.

However, with the World Rally Championship heading towards a new rules generation in 2022, where the technical regulations will include hybrid technology, leading driver Thierry Neuville, who competes for Hyundai, has questioned the proposed new look for the series.

The plans, which allow space framed machines to be used to accommodate vehicle scaling, are aimed at reducing cost

while attracting manufacturers with hybrid technology. To achieve that, a number of standardised 'control' components will be used. A control crash structure is planned, along with a common hybrid system and stricter rules on areas such as transmissions and aerodynamics.

With the current top-flight WRC rule set having been introduced for 2017 and been met with high praise from drivers and fans alike, the cars are renowned for being expensive, with seldom privateer entries.

Neuville is concerned that the new rules for 2020 will diminish the spectacle. "I asked my boss straight away if he agreed on this shit, but, it seems like that. Cost reducing, making the car technically less interesting - putting five gears back, no centre diff, less aerodynamic, less wheel travel on the

suspension - I don't see the point, to be honest," he said. "From three years ago we decided to pep up the WRC and give the WRC a new life and it worked very well to be honest, from the promotion side, from the spectacle side - and now we go back to R5-plus. I don't know if I'm really interested to drive these cars but we're going to find out."

It's believed that with the new regulations being formed by a technical working group that includes the manufacturers, WRC promotor and FIA, Neuville's Hyundai team is in support of the new plans. The least funded of the current WRC top-flight outfits, M-Sport, which has limited Ford Performance support compared to the full works Toyota and Hyundai efforts, is also keen on cost reduction.

"Without wishing to sound rude to any of the drivers, they aren't the ones funding the programme. At the moment, there are hydraulic systems on the car that cost around £40,000 and we can still hold exciting rallies and have a product that people want to watch and participate in without that level of cost," said M-Sport team principal Richard Millener. "When you look at where the manufacturers are competing at the moment - principally Formula E - it's all provided for you: you just put your badge on it and go. "We don't want to go down that path, the WRC will always require specialist engineering and the manufacturer's showroom product, but keeping our series accessible to reach that target of four or five manufacturers, although it is not going to happen in the next two or three years, is the right way to go." **IT**

M-Sport reveals aggressive Fiesta for R4

M-Sport, the only current top-flight outfit that has cars in its stall that fit most of the new Rally Pyramid's levels, has revealed the first homologated car for the new structure from its M-Sport Poland arm.

An evolution of the R2 version of the Ford Fiesta, the Fiesta Rally4 has improvements to its 999 cc EcoBoost engine, gear ratios, driveshafts, handling, cooling package and a new aggressive appearance. The R2 Fiesta is currently used in the Junior World Rally Championship, and over the last year M-Sport Poland has produced and sold 110 versions of the car around the world. M-Sport will produce upgrade kits for existing 2019 Fiesta R2 cars to turn them into Rally4 machines. **IT**



BELOW M-Sport's R4 Fiesta is the outfit's first homologated car for the new structure

Williams Advanced Engineering completes ETCR battery pack in seven months

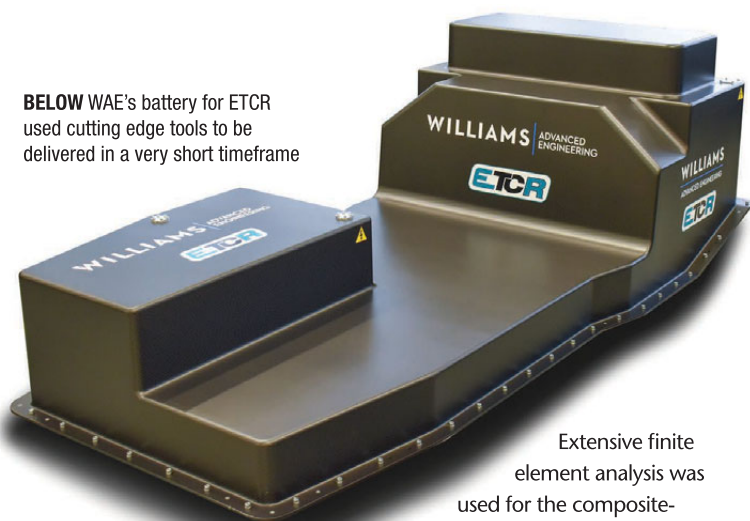
WILLIAMS Advanced Engineering has leveraged its experience of being the sole supplier to a number of motorsport and automotive electrification programmes in the design and manufacturing of a bespoke battery pack for the ETCR series.

The battery will help ETCR to become the world's first ever multi-brand Touring Car series with production cars powered by a common 100 per cent electric powertrain. The cars will both race on street circuits and permanent circuits, with the first event scheduled for the 2020 Goodwood Festival of Speed.

The F1 team's engineering spinoff was appointed by the WSC group in May 2019, after which it took only seven months to complete initial feasibility work to the provision of battery packs for in-vehicle testing.

The result of the work is a 798V battery pack, which provides a peak power of 500 kW and 300 kW of continuous power. It has a 62 kWh capacity and can be recharged in less than an hour from 10 per cent to 90 per cent at 60 kWh. The pack will also allow four 'push to pass' events over the course of a 21-minute race.

BELOW WAE's battery for ETCR used cutting edge tools to be delivered in a very short timeframe



Extensive finite element analysis was used for the composite-made enclosure, which was designed to provide an electrical barrier against electro-magnetic current, and to survive a 50g crash simulation, while computational fluid dynamics thermal analysis was performed at both cell and pack level to model the thermal characteristics of the battery pack in order to optimise cooling and weight efficiency.

"We are delighted to be involved in this exciting programme and to have delivered a fully operational battery in such a short time frame" said Iain Wight, business development director at Williams Advanced Engineering. "We look forward to supporting the series' first event in the UK later this year". **RT**

Supercars could switch to control engine option next year

VIRGIN Supercars team boss Ryan Walkinshaw has suggested that a control engine option could be used to encourage new manufacturers to join the Touring Car series.

The comments follow the news that General Motors is shelving the Holden brand at the end of this year, likely leaving Ford as the only OEM directly involved in the series next season, unless another manufacturer can be brought on board.

According to the Walkinshaw Andretti team principal, that task would be made easier if there was a control engine option that could be used, in the mould of the BTCC and the standard TOCA engine that can be used by teams that don't want to develop their own powerplant.

"What's interesting is that a couple of the manufacturers we've spoken to, when

we talk about the engine, they're like 'we don't care about the engine, we just want the body shape'," he explained.

"The easy solution is to have a category engine, a centralised engine which is based off something - and it doesn't matter what it is.

"The funny thing is it would probably

be a Chevy block or a Ford block anyway, because that's what everyone is used to, but it would be branded Supercars, so any manufacturer can just come in - that's what the British Touring Car Championship does with the TOCA engine.

"There's precedent for that in other categories, manufacturers are comfortable with it in other countries and other categories, so don't try and change everything. Just copy what other people do well. It's simple." **RT**



ABOVE Ryan Walkinshaw has suggested a control engine could be offered by Supercars to entice new OEM involvement

Toyota's Supra GT4 now granted homologation



ABOVE Toyota's GR Supra GT4 has been approved for GT4, and is now ready for racing

FOLLOWING on from the success of the first run of race-prepared Toyota GR Supra GT4 models, which sold out almost immediately, Toyota has revealed that the car has now successfully achieved official homologation in the GT4 category.

The approval comes after intensive technical examinations and track tests by the governing Stéphane Ratel Organisation, which were, in part to

determine the appropriate Balance of Performance which is applied to all GT4 cars in a bid to ensure equal competition.

With homologation now secured the first batch of GR Supra GT4s will start making their way to the first customers, including Ring Racing, which has secured two cars, France-based CMR is set to compete with two cars this year, and Speedworks Motorsport, best known for running a

Toyota Corolla in the BTCC, will race one car in the British GT Championship.

The car itself is based on the road going GR Supra, and developed by Toyota Motorsport GmbH, with the goal of reinforcing the company's focus on customer motorsport. It relies on a 3.0-litre inline six-cylinder engine, that uses Magneti Marelli engine management and a single twin-scroll turbocharger. It has been tuned to 430 bhp, and is mated to a seven-speed version of the original automatic transmission with paddle-shifts, and a mechanical limited-slip differential. In addition, the car has also been given a race spec Akrapovič exhaust system and Ravenol lubricants.

The car uses a front splitter and rear wing made of natural fibre composites, contributing to a weight reduction of around 145 kg. MacPherson struts are used at the front, and a multi-link arrangement is employed at the rear, with KW dampers all round. The car's braking is handled by a Brembo racing package, and the car sits on OZ Racing alloy wheels shod in Pirelli rubber. The driver, meanwhile will be kept safe by an FIA-standard OMP seat inside a high-strength roll cage, and a 120-litre ATL fuel tank. **RT**

Mercedes reveals updated AMG GT4

MERCEDES-AMG has launched an updated version of its successful GT4 racer to mark the tenth anniversary of its Customer Racing Programme.

The updated car features a number of key improvements, to help Mercedes' customer teams succeed on track. Among the changes are an optimised brake cooling around the front axle, as well as

improved engine cooling. The enlarged brake inlet and dimensionally stable airlines will help to prevent the brakes from overheating, improving drivability and considerably reduced brake wear – particularly valuable during endurance races. Under the bonnet, a re-arranged oil cooler helps cool the AMG 4.0 litre V8 powerplant more effectively, while a new

carbon exhaust duct helps deal with the heat from racing.

Handling has also been improved with the use of modified track rods on the rear axle which are similar in design to those used on the new GT3 model, and should also offer significantly improved longevity. The change is set to complement the adjustable double wishbone suspension set up, and give drivers complete and precise control.

"The new edition combines performance, safety and economical aspects like no other car in this segment and has been tailor-made to meet the requirements of the customer teams." Stefan Wendl, head of Mercedes-AMG customer racing, said. "With its powerful V8 biturbo engine, the new Mercedes-AMG GT4 also guarantees plenty of fun away from the major international racing stage, be it during track days or in race series with open classes. The course for a successful future in the GT4 category has been set." **RT**



RIGHT Mercedes' new GT4 runner includes a range of optimisations to help its customers keep winning



ABOVE The change to the wheels used in NASCAR will be significant, but it won't affect racing

NASCAR to use centre-locking wheels from 2021

NASCAR'S switch to its seventh-generation racer will also presage the arrival of several changes which break away from the sport's tradition, including the move to centre-locking wheels and 18-inch aluminium rims.

The new wheels will replace the 15-inch steel rims currently in use, that are fastened with five nuts, with the change being made to bring stock cars in closer alignment to what is used on the road.

"One of our main goals with the Next Gen car is to provide a vehicle that better replicates what our OEM partners sell in the showroom – both in looks and relevant technology. Moving to an 18" forged aluminium wheel helps do just that," explained NASCAR senior vice president of racing innovation John Probst.

"Once the decision was made to go that direction, we tested different lug nut options. With the loads on the larger

wheels, we had to make sure that the wheel would remain securely fastened to the car. The single lug, centre lock design was the best way to accomplish this."

Despite the change to a single centre-locking wheel nut, and a resultant shortening of stops, Probst insisted that the shift would not affect racing.

"The choreography of a pit stop won't change," he said. You'll still have the same over-the-wall crew members you have today, and rules related to when they can enter the pit box are still in effect.

"It will still be important for the tyre changers to be quick off the wall to get to the far side of the car. Hand-eye coordination remains extremely important, you're still trying to get the lug and tyre on and off the car faster than 39 other teams. The overall way a pit stop looks will remain the same.

"In terms of timing, the torque is higher on the single lug, which means they have to leave the gun on longer. In our testing, we've found that it takes approximately half a second to properly tighten this new lug. Today, a good tyre changer can remove five lugs in about 0.8 seconds. So, while pit stops may be a touch quicker next year, it won't be a significant difference." **RT**

Race Winning Brands acquires Manley Performance

RACE Winning Brands, a part of Kinderhook Industries, has announced that it has acquired Manley Performance Products, a company known for its high-performance pistons, connecting rods, crankshafts, and valvetrain components.

The company was founded in 1966 by Hank Manley, has had longstanding relationships with many drag racing icons, including Don Garlitis, Bill 'Grumpy' Jenkins and 'Jungle' Jim Liberman. Manley Performance has also worked with several original equipment manufacturers, including Ford, to which the company supplied connecting rods for the 2003/04 Ford Special Vehicles Team Mustang Cobra.

"We are excited to join the Race Winning Brands team and partner with a group that leads the racing industry in technology, manufacturing, and innovation," said

Manley Performance President Trip Manley. "Our mission remains the same: to manufacture the finest quality internal engine components at competitive prices

and offer unparalleled customer service."

"Our goal at RWB is to lead racers to victory, and we do that by aligning with companies that are the best at what they do," RWB president Bob Brueggling added. "Manley is a natural fit within our organisation and the new partnership is a tremendous opportunity to further grow our performance product lines, together." **RT**



BELOW Manley has built a formidable reputation with its engine components, including its conrods

RACE TECH



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BRYN BALCOMBE,
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In a changing world it is important to get unbiased thoughts from leading suppliers, manufacturers, engineers and trend-setters... The World Motorsport Symposium offers insight into different technologies from many different angles – it is a great initiative by RACE TECH to bring key people into the same room to share information and thoughts – this is extremely important for the continuing development of future energy for vehicles."

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The Davos of Motorsport Engineering & Technology



"It was a pleasure to attend the WMS this year. As always, the quality of delegates and papers was excellent. This combined with the ever-professional running of the event made it a great success."

RICHARD BARDWELL, Director, SHARC
MARK GALLAGHER, Director, SHARC

"We really enjoyed the event and have thought a lot about it during the last few weeks. It is one of the best events of the year to strengthen our network and to be a part of shaping the future of the motorsport industry – very valuable!"

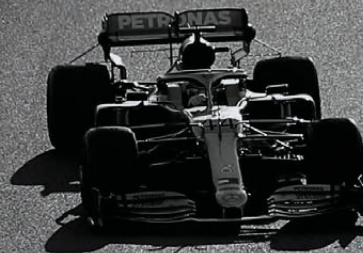
PETER WIRTZ, Customer Account,
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THE *LONGEST* PRE- SEASON EVER

Mauger/LAT



The racing might not have started, but the controversy hasn't stopped! Our **Expert Witness** – an F1 insider – offers an insight into the early exchanges of the 2020 season

THE pre-season analysis is over and we seem to have an unexpected extended period to quietly reflect on what has and hasn't happened. So, let's roll our sleeves up, wash our hands for at least 20 seconds and get started.

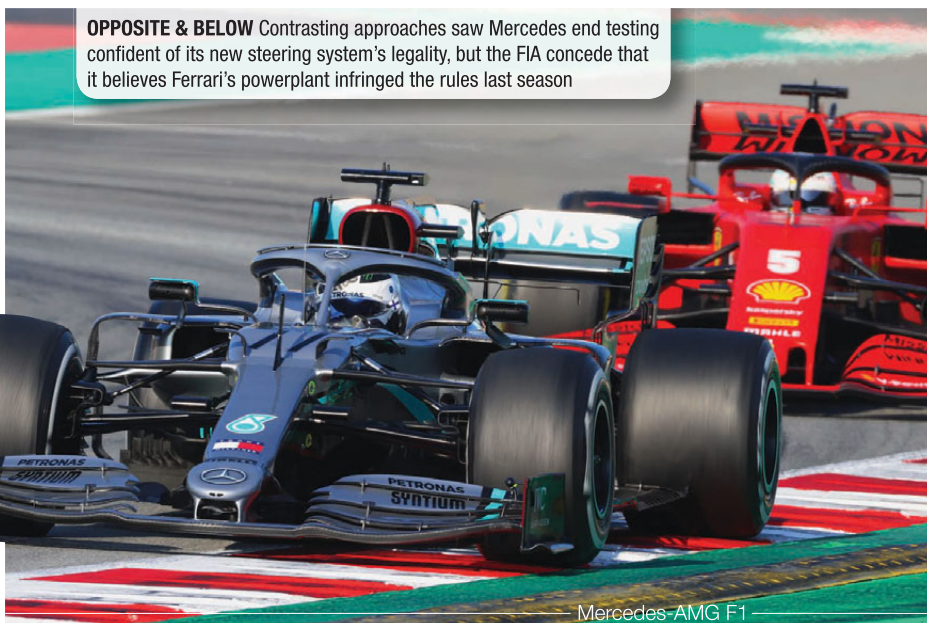
WAS IST DAS?

Normally a large amount of fore and aft steering wheel movement at Barcelona on track in F1 pre-season testing would

opinions out there that it is a significant aerodynamic benefit. In reality, a few millimetres of toe adjustment neither give an aero gain nor change front ride height, which could. If anything, over considerable aero development time F1 cars are desensitised to steer and tyre shape changes.

Typically, on the straights toe is ideally close to neutral to minimise rolling resistance and tyre scrub; in corners or under braking, some toe out is preferred

OPPOSITE & BELOW Contrasting approaches saw Mercedes end testing confident of its new steering system's legality, but the FIA concede that it believes Ferrari's powerplant infringing the rules last season



Mercedes-AMG F1

have the driver frantically trying to realign the quick-release splines or rapidly assuming a brace position. At Mercedes, there was no panic when the TV cameras detected such motion onboard its new W11, for this was the public debut of its Dual-Axis Steering system. Elsewhere, however, the images attracted considerable attention. So what is DAS and what are the team trying to achieve?

First of all, it is changing the toe, the precise steering alignment of the front wheels when the steering wheel is in the straight-ahead position. There are

to gain more car stability. So, a bit like DRS, what if you can do or have both? Or is it more subtle than that?

I think it is. The Pirelli tyres are notoriously temperature-sensitive and therefore have an incredibly narrow operating window, one that varies with fuel load, brake duct management, track conditions, track type and tyre compound. So much so that surface temperatures fluctuate a lot around the lap: too cool on long straights and too hot on long high-speed corners, particularly the left front. The DAS can be an additional tuning tool to keep the ►

tyres in a better window for longer, or on key parts of the track, helping lap time and increasing tyre life.

Described as the “tip of the iceberg” by Mercedes-AMG F1 technical director James Allison, this innovative system was grudgingly much admired by the other teams, partially because it was visible, the implication being there was much more hidden underneath. It also emphasises the strength of R&D depth in a team this size: a project like this could have taken a small team several months of their time to design, test and implement onto the car. That admiration among the competitors will instantly turn to concern, simulation working out how much of an advantage it is worth and, once established, ‘Do we need to implement our own version instead of what we were developing?’ A ‘Trojan Horse’ distraction, or a double diffuser or F-duct breakthrough?

What was clear however was that Mercedes had definitely liaised and done their FIA legality homework, confident of this being deemed a driver-operated mechanical movable steering rather than suspension system.



ABOVE F1 chairman Chase Carey finally bites the bullet and reveals that the GP has been cancelled

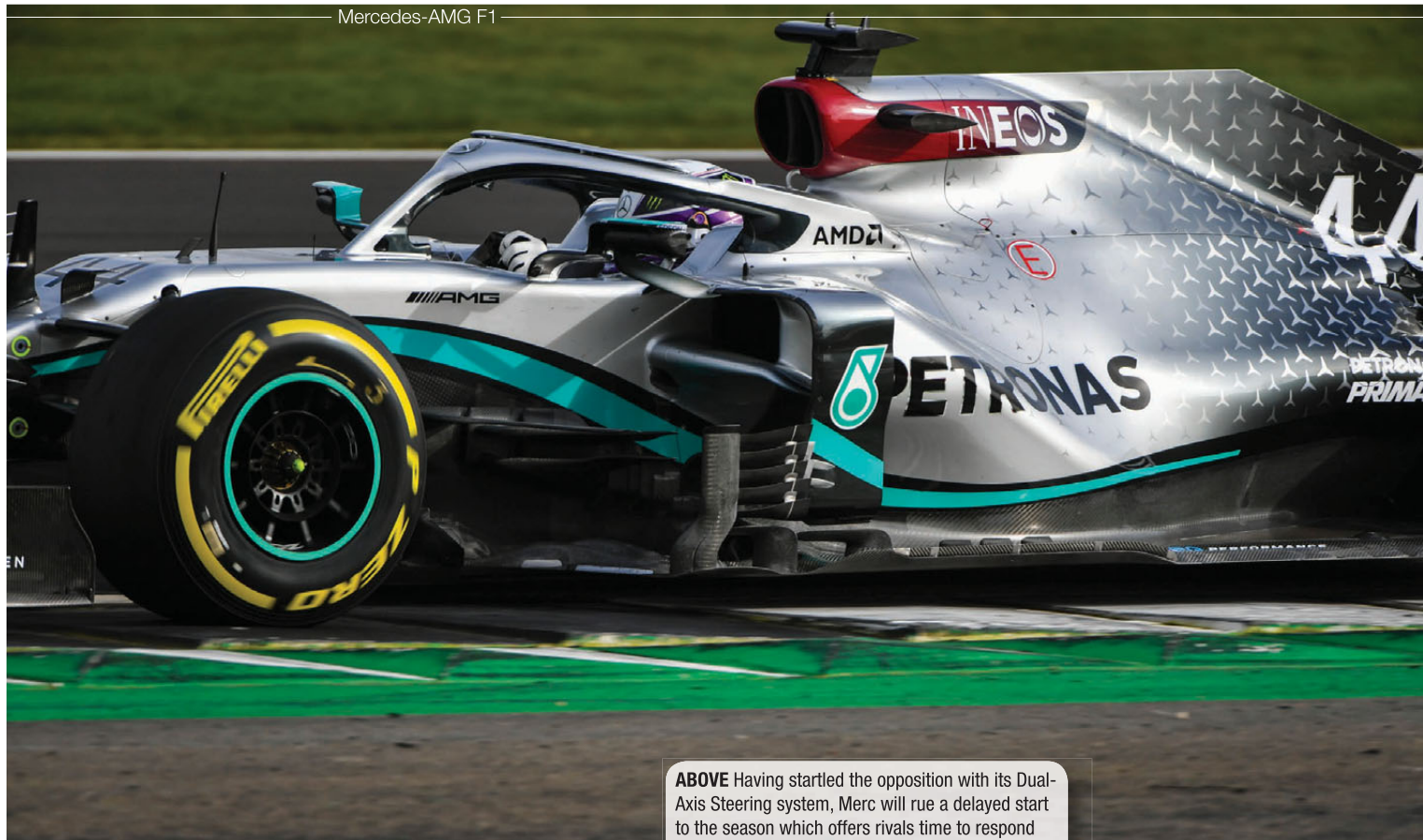
“DAS can be an additional tuning tool to keep the tyres in a better window for longer, or on key parts of the track”

The FIA were quick to say they were happy with it, but not for 2021. I do not believe it would be implemented and race-tested at Barcelona if it was not of genuine benefit, the team also downplaying the system as a strategy. I suspect the one season of use is an FIA compromise imposed back on them. It

will be fascinating to see if it makes the difference in 2020.

We never got into Melbourne track time to see if other teams were actually going to protest it (Red Bull?) or not. We will wait and see if this is the continued approach, or if in these race-delayed times the ultimate form of ▶

Mercedes-AMG F1



ABOVE Having startled the opposition with its Dual-Axis Steering system, Merc will rue a delayed start to the season which offers rivals time to respond



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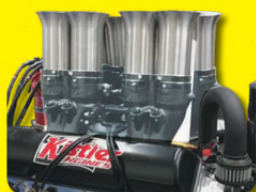
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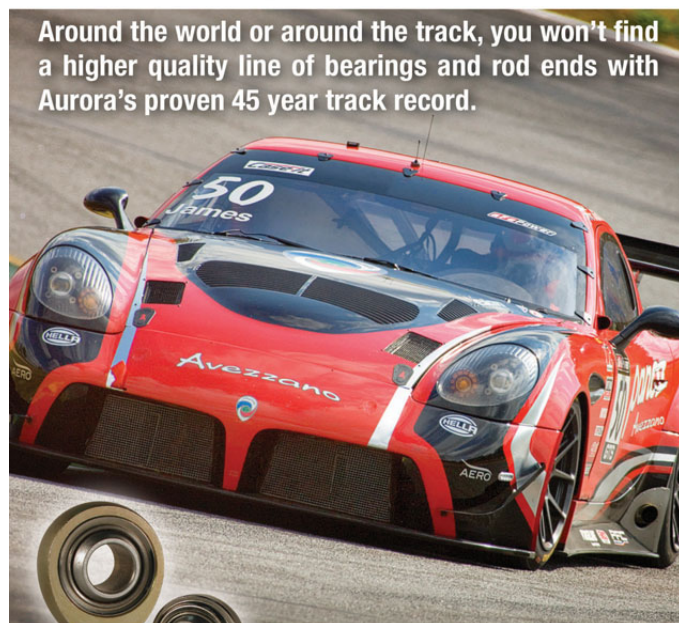
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ABOVE & BELOW Even as Ferrari's mechanics laboured in Melbourne, the controversy over last season's power unit persisted

flattery is deployed and the system is copied by rivals.

Ultimately, what does this innovation say about F1? While a DAS system is not car industry or road relevant, it highlights the lengths top competition environment engineers will go to in order to eke out the last levels of lap time and optimise efficiency.

'FERRARI INTERNATIONAL ASSISTANCE'

Just 12 minutes before the F1 Barcelona test ended, conveniently as many F1 heads, journalists and the FIA had returned home, a brief press release was issued from the FIA. It revealed that their investigations into the 2019 Ferrari power unit had been concluded and there had been a private settlement with the team.

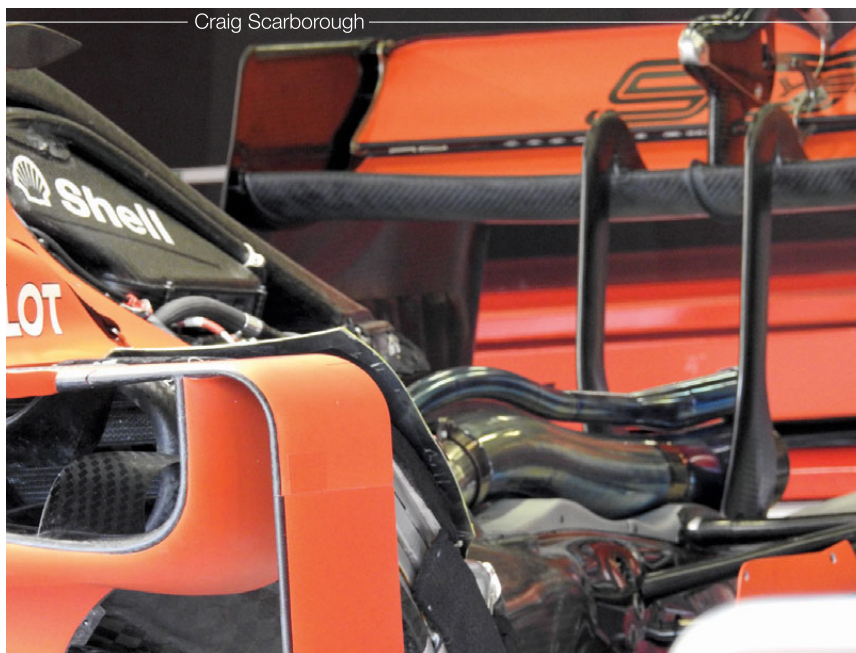
Let us remind ourselves that Ferrari had a distinct straight-line speed advantage and strength mid-season, were accused of 'oil burning' and power unit issues, but that pace suddenly seemed to disappear once the FIA investigation started. Charles Leclerc also failed a declared fuel weight check in Abu Dhabi.

Remember too that Mattia Binotto, their team principal, was a long-term *motoristi* at the team before his promotion. Formerly its Chief Operating Officer, Power Unit, he would be well within his comfort zone to direct an interesting engine interpretation.

While this whole 'settlement' situation

was poorly handled, Ferrari's overall pace at Barcelona was weak, even prompting teams to say their "engine was turned down", an accusation vigorously denied as incorrect. The FIA then tried to clarify the position by saying "it was not fully satisfied" that Ferrari had fully complied with engine operating regs, but could

Craig Scarborough



also not prove its case due to technical complexity – again a position strongly denied by the Scuderia.

Seven rival teams came forward to “strongly object” to this private Ferrari/FIA settlement and the lack of “transparency and full disclosure”. This was a legal position again robustly defended by the FIA.

Do these opposing teams have a point? You walk a fine line as the governing body: you have ‘neutral’ access to confidential IP and consultation with the teams, in both the Mercedes DAS and Ferrari PU cases. The difference is in the former there was a long private dialogue saying, ‘Here’s what we are planning, we believe it complies because of X, Y, Z, please can you confirm our interpretation is legal?’ The latter achieved a performance benefit for a number of races, then was investigated, not for the first time, to be *probably* found to have been overstepping the boundaries, requiring changes to be made.

In summary, Ferrari were pushing the boundaries of power unit use last season. It became obvious, it got investigated and their cars lost pace. So why the outrage now? You could say that Ferrari has ‘previous’ for such transgressions: within the F1 paddock, the FIA has long been described by cynics as standing for ‘Ferrari International Assistance’. The fact that the term reared its head again is not helped by its senior personnel all having worked there. Fair? Perhaps not, but some clarity over what was found and what ‘settlement’ means would go a long way to prevent it.

The crucial issue now will be whether last season’s tricks have been definitively identified, policed and rectified for 2020.

PINK MERCEDES

I have a feeling that Racing Point will be in for a very strong season, when it gets started. This could be due to their new car’s remarkable similarity to a Mercedes, a technical partner, in everything but colour. In pit lane parlance they are not so much the ‘pink panthers’ now; more the ‘pink Mercedes’ given the replication of last year’s Mercedes W10.

Let’s be clear, Haas started this trend with their special relationship with Ferrari when they made their miraculously

“It is only a matter of time before a full customer car is not only on track, but legal”

strong debut, a position defended as being completely within the rules.

The noises coming out of the Racing Point team at Barcelona were similarly defensive – perhaps overly so? It was as if the shape comparison to the Mercedes was so blindingly obvious, they had to protest their stance too much: ‘other teams could have done this and cloned a Mercedes; we have the budget now which makes all the difference compared to before.’ It was as if the pace would come just from budget, not the team’s DNA.

That budget and backer will see the outfit change their name yet again, to Aston Martin, but not until next season.

“CASH IS KING”

Lewis Hamilton has had a few issues in the past with some of his public comments being considered poorly judged. But as the prevarication over the Australian Grand Prix continued amid the Covid-19 crisis, Hamilton was right on the money this time – in more ways than one.

“Cash is king,” the world champion suggested, by way of explanation for a ridiculous situation that saw fans crowding to the gates of Albert Park, even as the teams within were packing up their equipment. With contracts, promoters, TV money and sponsors all in



ABOVE Racing Point’s RP20 unashamedly copies the aero concept of last year’s dominant Mercedes W10. Williams (following) has always maintained that teams must remain true ‘constructors’

They are still a Red Bull partner for now.

This increasingly ‘Noah’s Ark’ approach of teams partnering up, cost reduction and the number of ‘listed parts’ – those still required to be independently created by the teams to be a ‘constructor’, e.g. bodywork – getting ever shorter, suggests it is only a matter of time before a full customer car is not only on track, but legal. Which then raises the issue of which F1 customer car you would buy in an open market and how long would the other constructor teams survive in their current form? Does it matter if F1 becomes a one-make category? Yes, it does.

the mix, it felt very much like the show must go on. It seemed a case of who would flinch first in order for logic, not money or compensation, to prevail. It was actually McLaren who blinked. With team members displaying symptoms of the virus, the team were forced to show the first badly needed signs of what should have been called out originally at the very top level.

In these difficult times, we would all like to be out on track. But if this pandemic teaches us one thing, it will be that health, home, family and social kindness is more important than anything else. **RT**

BODY OF DATA

Following the launch of the first ever guidelines for biometric data usage in motorsport, **Marc Cutler** investigates the ethical and legal implications of how driver data is gathered in this growing field of technology

DATA informs everything in modern sport from coaching and athlete performance to injury prevention and fan engagement. In the past, much of this data was collected manually, but as consumer technology advances so has the means for this to become more automated.

In the US, the National Basketball League (NBA) was among the first to adopt wearable technology, which enables teams to track a player's heart rate, movements, and energy levels. The idea is that it can give coaches greater insight into who needs resting, who needs to be played more, and who might be at risk of injury.

This data enables teams to make better and more data-driven decisions regarding their athletes. But as the adoption of this technology becomes more widespread, the ethics surrounding the collection, storage and use of data has been a hot topic, especially as more sports, including motorsport, start to introduce biometric systems.

This has prompted the FIA to publish the first *Guidelines for the Collection and Usage of Biometric Data in Motor Sport*. The guidelines cover the use of competitor-related biometric data in various capacities such as medical and rescue, human performance monitoring, and for marketing and entertainment purposes.





LEFT & RIGHT Ready for action: The gloves worn by every F1 driver now monitor their vital signs via a flexible 3 mm sensor stitched into the palm area of the fabric. The FIA worked closely with F1 glove manufacturers Puma, OMP, Alpinestars and Sparco to integrate these sensors into fire-resistant clothing for the first time

Dr Pau Mota, FIA Head of Medical and Rescue, explains how the new guidelines aim to ensure that the motorsport sector uses this data appropriately.

"In motorsport, biometric data is there for a wide range of purposes and interests, and the FIA guidelines aim to ensure that we use the data properly from an ethical point of view," says Mota. "For the last

doctors to monitor vital signs, such as oxygen levels and heart rate, as they are dispatched to an incident on track.

Similarly, IndyCar has introduced a 'smart shirt' that embeds an electrocardiogram and chest electromyogram into a driver's underwear. Drivers in F1 and IndyCar are also required to wear in-ear accelerometers,

“The manner in which personal health data is collected and utilised by big tech firms is a growing concern”

two years we've started using real-time biometric data for rescue and emergency situations, but we want to avoid the misuse of this data by third parties and, in addition, protect drivers' rights."

Recently, biometric technology has been either trialled or adopted in top level motorsport, a case in point being the biometric gloves introduced into Formula 1 and Formula E. In these championships it is mandatory for drivers to wear them on safety grounds, as it enables FIA

which are designed to measure the dynamic forces applied to a driver's head during an impact.

And in Formula E, fans are shown 'stress level' information of a driver during a race. Implementing this is one of the challenges that the guidelines addresses, as due to the ethical sensitivity of broadcasting a driver's personal health data, the championship had to develop specific algorithms that maintain confidentiality by demonstrating stress-level without, for ►



ABOVE & INSET Sensors have long been used all over Indycars, but research on the drivers themselves is only in its infancy. NTT Data developed a new technology to analyse wearers' biological information using a smart shirt incorporating 'Hitoe', a functional material that acts as a sensor

instance, showing heart rate.

"In the guidelines we advise that if you want to put the health-related data on TV for entertainment purposes, then you have to code everything so the personnel health data of the driver cannot be identified," says Mota.

DATA PROTECTION

However, in recent years, sports such as the US National Football League (NFL) and NBA have faced legal issues related to biometric data.

It is one of the reasons why teams in the NBA were effectively banned from using biometric technology in player contract negotiations, limiting it to health and

performance purposes in training sessions.

The guidelines produced by the FIA aim to avoid such issues by detailing how biometric information should be protected in all scenarios to ensure that it is used ethically and does not breach privacy laws.

"We reviewed what was happening in other sports and looked to prevent these

issues occurring in motorsport," explains Mota. "Our focus is the use of biometric data for medical and rescue proposes. For the other uses our main goal is to protect the privacy of the drivers and the ethical integrity of the sport".

Using it for rescue applications is particularly important for the FIA, which ►

“Biometric data systems can provide vital information on the competitor's health status: it allows us to plan the medical intervention en route”



ABOVE Information on the driver's vital signs can be extremely useful in rallying, where responders have further to travel to an accident scene

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is now looking to implement it in other motorsport disciplines. In rallying, for instance, where rescue teams can often take a lot longer to reach the driver in the event of an accident, information on the competitor's vital signs can be extremely useful for responders.

"The main field to apply this data could be in rally, where distances are greater and access to the injured competitors is more critical. Biometric data systems can provide vital information on the competitor's health status so it allows us to plan the medical intervention en route," says Mota.

TECH EVOLUTION

The FIA has already published a standard for biometric devices (8868-2018), which defines the design requirements for hardware to ensure it does not reduce the overall safety performance of a driver's safety gear, such as heat transmission and fire protection. The guidelines are different in that they deal with the data generated by these devices, and this document will be regularly updated to ensure that the FIA can keep up with



ABOVE & BELOW Biometric data is increasingly part of professional sport. Above, this wristband is used to monitor NFL players; below, National Basketball League stars were among the first sports players to benefit from the use of biometric data to enhance performance





ABOVE & BELOW Carlos Sainz's accident in practice for the 2015 Russian GP, where his car submarined under the barriers and lost radio contact, was the catalyst for the development of biometric sensors in the drivers' gloves. The information offers an invaluable aid for medics attending crash scenes


“It enables FIA doctors to monitor vital signs, such as oxygen levels and heart rate”

the rate of technology development.

“One of the reasons to define best practice in a guidelines format – and not changing our International Sporting Code – is because technology in this area is developing so fast that we need a document that can be updated any time,” explains Mota. “We plan to update the guidelines regularly, in line with the latest developments in this area.”

The guidelines also give the FIA flexibility from a competition perspective, in case a new innovation comes along that could result in new ethical or competitive concerns.

As this technology develops from both a sporting and consumer point of view, the manner in which personal health data is collected and utilised by big tech firms is also a growing concern. In the case of sport, that data can be even more valuable, with the collection of biometric data from athletes, and the regulations behind it, likely to be a key area of interest for years to come.

View the *FIA Guidelines for the Collection and Usage of Biometric Data in Motor Sport* at: <https://www.fia.com/medical> 

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SELLING ELECTRIC RACING

Whatever happened to Electric GT? **Chris Pickering** discovers that the vision of production-based electric racing on full-size circuits is still being pursued

TWO years ago, the Electric Production Car Series (EPCS) looked like it might just become the Next Big Thing in motorsport. Developed by Electric GT Holdings – led by IT entrepreneur Mark Gemmell and racing driver Agustín Payá – the series had gained FIA approval and had successfully tested two cars based on the Tesla Model S. But soon afterwards, the project faltered due to lack of funding. The team behind it are still pursuing their vision of production-based electric racing. With low-carbon motorsport rapidly gaining momentum, could now be the time to revive it?

The case for an electric production car series has existed for some time. Tesla's Model S had already been around for two years when Formula E got off the ground in 2014. By the time the P100D models came out in 2016 you could buy a seven-seat electric production car that would theoretically out-accelerate the first generation Formula E machines from 0 to 60 mph. Even taking into account the Tesla's considerable mass – 2,316 kg for the current Model S in production form – it made a very tempting proposition.

"The intention was always to create a

credible motorsport environment. We want to race on full-size FIA-approved circuits (even if it requires a shorter layout) with vehicles that are able to perform adequately on those circuits," says Gemmell. "The only car that came close to that at the time was the Tesla, so we used that as our base, although the plan was always to incorporate other makes when the situation allowed."

When it came to fleshing out a specification, the first few steps were relatively straightforward. The FIA safety requirements laid down a framework for things like the roll cage design and the impact protection.

"There are two ways of looking at it," comments Gemmell. "You can either

go for a silhouette formula with your own platform or you can use production vehicles. If you're going for the latter then a substantial portion of the production car has to persist. Some parts are clearly going to have to be changed for racing – you're going to want slicks, adjustable suspension and uprated brake hardware, but the aim was always to retain as much production hardware as possible."

His logic is partly based on the economics and convenience of picking a ready-made platform, but there's also a desire to provide a proving ground for manufacturers to compete against each other: "It takes us back to the very beginning of motorsport, which was all about testing the available vehicles in a comparable manner. You want everyone to be on the same circuit, at the same time and subject to the same conditions."

"When the Porsche Taycan launched last year they took it straight to the Nürburgring and Elon Musk soon responded to say that Tesla would be taking a Model S there. Soon there were unofficial reports that they'd already beaten the Porsche's time, but there were all the usual questions – how did the weather conditions compare? Who was the driver? Were there any other vehicles on the track at the time? If you really want to compare performance, you need the cars side-by-side on the same circuit." ►



ABOVE An e-sports tie in is planned for the series

BELOW The aim is still for a range of production-based EVs to fight it out on the world's best circuits



SPRINT RACES

For all the power and performance of cars like the Tesla Model S and the Porsche Taycan, energy density remains a concern. Part of the solution to that – in terms of the on-track spectacle – would be limiting the duration of the races. “We want to see people going flat out, rather than nursing the car to the finish. You could maybe do 45-minute races, but I think you’d lose the entertainment value,” comments Gemmell.

Instead, the proposed format was for a race duration of 30 minutes or slightly less – equating to around 14 laps – along

“The opportunity to create a truly production-based multi-make series is still up for grabs”

series’ development work. Instead, the initial testing was carried out on the circuit using the fastest road-going Tesla available at the time, the Model S P85+, as a development mule. Only once the team had gathered data with the P85+ was an element of simulation brought in to evaluate the potential benefits of switching to the new P100D.

There had been concerns that the four-wheel drive P100D would be less exciting

Research) at its facility in Barcelona. It consisted of a frontal collision against a rigid barrier – a block of concrete that weighs 130 tonnes, covered with a 19 mm wooden plate – at a speed of 14 metres per second (31.3 mph). The car’s high-voltage battery was active and charged, according to manufacturer and FIA instructions, and an 88 kg dummy was placed in the driver’s seat. In total, it weighed 1,720 kg (representing the racecar at its maximum weight, including the dummy and a 25 kg data acquisition system). The acceleration of the dummy and the vehicle were measured during the test. After the collision, the IDIADA officials also measured the protection against electrolyte spill and electric shock, plus static deformation in different points of the vehicle.

AN OPEN CHAMPIONSHIP

Despite the understandable focus on Tesla – the only real option for an electric GT racer for much of the project – Gemmell is keen to emphasise that the plan was always to open the championship up to other brands as soon as it was practical to do so.

“We’re not wed to Tesla,” he comments. “One of the key requirements would be that the car had enough energy to race. The minimum for that, we think, would be about 70 kWh. We ▶



ABOVE The P100D was subjected to the FIA crash test

with a series of heats for qualifying. Electric GT worked out that this would allow the races to be carried out with little or no restriction on energy usage. And it was also believed to offer a suitable duration for spectators.

“You could argue that 30 minutes is actually too long, when you look at the success of formats such as World Rallycross,” notes Gemmell. “In a typical race, you’ve got a lot of tension in the build up to the start with the grid walk; the start itself and the first lap tend to be the most exciting part; and then the interest tends to tail off until the final couple of laps.”

Soon Electric GT began to firm up its plans for the race format. The work done to validate these proposals came entirely from track testing, with very little simulation used in the programme. This chiefly comes down to convenience; a significant amount of reverse engineering would have been required to gather all the data needed to create a reliable model of the Tesla Model S used for the

to watch on track, but it became evident that the high performance EV market was heading in this direction. A new P100D test mule was built in 2017 and this is the car that was eventually used for the FIA crash test.

The crash test itself was carried out by IDIADA (Institute for Applied Automotive



ABOVE The Electric GT team



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“A charging element could be introduced. One suggestion is that the teams could be given a 10-minute charging window”

would also set a bracket for power-to-weight ratios, but the idea would be to keep these quite broad. A certain amount of performance balancing would be required, but we want to create a platform where the more innovative manufacturers can still reap the benefits.”

That might sound like something of a contradiction in terms, but Gemmell points out that there would be room to engineer a competitive advantage, not only in head-to-head racing but possibly also in other respects. For instance, although the races are intended to be carried out without any pit stops or recharging, it's been suggested that charging time might somehow be factored into the competition.

Recharging, of course, is also a major logistical concern with an electric race series. Electric GT calculated that a giant power bank, holding 6 MWh, would be required. “To get that sort of energy storage would have been very difficult a few years ago, but it's far easier now,” notes Gemmell. “There's a limit to how quickly you can take that energy out to charge the vehicles, so that made us think that we'd have to design the whole day's



LEFT & BELOW
Far from being just a necessary evil, charging could one day become part of the competitive show



events around the charging to a certain extent. You can't have back-to-back events if it takes 90 minutes to charge.”

In some respects, this becomes harder as technology improves and the charging times decrease. The most sophisticated road-going EVs are now capable of charging at 350 kW; if the EPCS was to charge all 20 cars simultaneously at this

power it would add up to a drain of 7 MW. To put that in context, the maximum output for the entire grid at a typical modern race circuit might be 2 MW. “If you want to deliver 7 MW to charge all 20 cars as quickly as possible, you're going to need some very clever electronics, as well as a very big battery,” notes Gemmell.

This sort of ultra-fast charging is not currently part of the plan, but it could open up the possibility of introducing a charging element to the competition. One suggestion is that the teams could be given a 10-minute charging window – perhaps ahead of qualifying or practice – and they would simply have to take to the track with as much charge as they could gather in that time.

The current plan is to use a self-contained power bank, which would allow the EPCS cars to charge at a more modest 50 kW – the same as the Rapid DC chargers that you might find at a motorway service station. This would be composed of three or four shipping containers full of batteries and electronics, designed to accumulate energy at a ►



ABOVE A lot of the basics, such as the OMP safety equipment and the roll cage, are designed to work across a variety of vehicles



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ABOVE The P100D test mule in action

relatively relaxed pace over the course of three or four days before the race.

There are various different ways to do this: either with an energy partner that supplies 100 per cent renewable electricity through the grid or with your own mobile power generation. Electric GT decided to go for the latter, partnering with a Swiss company that has developed a 'solar roof' that can be deployed over the course of an afternoon. The clever bit here is that the solar panels form the roof itself, rather than an additional structure. It's said that 3,000 m² roof would provide sufficient shelter for the fans in the paddock, while also charging the entire power bank completely off-grid.

"We want to be able to supply power to the cars and various bits of infrastructure without resorting to diesel generators," comments Gemmell. "When we first looked into it, it was very difficult to see that happening, but these days 6 MWh is not a stretch by any means. Renault has started using its old EV batteries to supply grid-level storage and they're talking about 10 times that capacity."

This means that the series could theoretically pitch up anywhere that it had

been given permission to hold an event. Race circuits, however, remain the obvious venues – not just because they give the kudos of racing in a 'proper' motorsport environment, but also because they are designed to handle crowds, they come with facilities such as pit garages, and they tend to offer good visibility for spectators.

BUILDING AN ELECTRIC GT CAR

The basic concept of stripping and caging a road-going Tesla has proved to be valid, but there have been plenty of niggling issues along the way. Many of the challenges have stemmed from the numerous electronic modules and sensors around the car. A simple example of this was that the Tesla wouldn't charge without seeing a signal from the electronic parking brake.

"We did look at using a bespoke control system, but it's heavily integrated on an electric car; it would have meant switching out the battery management system, which is really the core of the vehicle," says Gemmell. "As a general rule, the more you change the more you break, and the less that vehicle relates to the buying public."

Preliminary track tests helped to build up a picture of what needed doing. "The first thing we learned was that the brakes weren't up to the job on a circuit. It didn't take more than a couple of laps to warp the discs, but we suspected that would be the case anyway," he explains. The answer was a six-piston competition setup from Alcon, which also provided the hydraulics and the pedal box.

Suspension, meanwhile, comes from Penske with four-way adjustable dampers and an adjustable front anti-roll bar. Pirelli P Zero slicks (or wets) ensure impressive levels of mechanical grip, aided by an aero kit, including a front splitter and rear wing, from Magma.

Not surprisingly, the first thing that the engineers did was to place the Model S on a crash diet. Around half a tonne was removed from the car – partly by jettisoning much of the interior and substituting the normal production body panels for lightweight composite items from natural fibre specialist Bcomp.

Throughout this process, Electric GT has tried to pick solutions that would be applicable to other makes and models entering the championship. The charging

“The intention was always to create a credible motorsport environment. We want to race on full-size FIA-approved circuits”

platform, for instance, has been designed to work with a large variety of vehicles, while the basics, such as the OMP safety equipment and the roll cage, are designed to be universal.

Although not officially involved in the project, Tesla has also lent its assistance at times. “We knew that Tesla wasn’t actively engaging in motorsport of any kind when we began work on the series, but we were rather hopeful that we’d get more engagement from them once we’d pushed ahead and gained FIA approval,” admits Gemmell. “We didn’t get that, but we have had quite a lot of technical assistance from Tesla as an independent supplier; the company’s engineers advised us when we

had some issues with the car and we’ve had assurances that the drivetrain could be repaired by Tesla as long as it’s unmodified. We’ve also had an agreement that we could train people to work on the cars.”

This assistance proved vital when the EPCS sought FIA approval, he explains: “The FIA were basically expecting the manufacturer to be in the room. We explained to them that it wasn’t going to happen, which initially created a bit of a challenge. As we got to know Tesla better, however, our engineering partners at QEV were able to get the information they needed from the manufacturer and translate that into information that the FIA needed for its approval.”


READY TO ROLL

While groundwork carried out for the EPCS has been significant, the project is essentially in limbo at present. “Timing is everything. I’ve been a big Tesla fan, ever since I bought my Roadster in 2011, and I put my name down for a Model S in 2012,” says Gemmell. “When we started the championship it really felt like the electric revolution was about to arrive. It’s really valuable that we’ve got the business to where it is, but there is a sense that it’s waiting for the right investor.”

He says that there are various different ways this could happen. The investment required to launch the series in its existing format with a field of 20 cars and a regional or global calendar is estimated at €15 million, with a lead time of around nine months.

Of course, things have changed a little since the project first began. Plans for the EPCS started coming together in 2015. At that point, Formula E was less than a year old, while its production-based I-PACE Trophy support series was still three years away. Since then, eTCR, Extreme E, the Projekt E rallycross series and others have all emerged. So does that mean the game has moved on?

“At the moment it hasn’t, but at some point it will,” responds Gemmell. “Electric racing is the future and our aim is still to bring production-based cars to the world’s best circuits. The I-PACE Trophy seems to be in Formula E’s shadow a little bit and I’m not sure that those comparatively large cars really work on the Formula E circuits. It’s also very much a one-make championship, whereas the fundamental premise of the Electric Production Car Series was always to open it up to other manufacturers. I think that potential is still there.”

You could argue that the eTCR series will tick that box when it launches this year (followed by a full eight-round championship in 2021). As Gemmell points out, however, those cars will all use the same spec powertrain – as will those in Extreme E and Projekt E. As such, the opportunity to create a truly production-based multi-make series is still up for grabs. Electric GT may yet secure the funding it needs to move forward and make that a reality. And, if not, you can be sure that someone else will. 



ABOVE Mark Gemmell: a huge Tesla fan

RESHAPING THE FUTURE

Anthony Peacock explains the rationale behind the distinctive new look that will mark Formula E's elevation to World Championship status next season

IT'S not every day that you get to see a world championship-winning car for the first time. But that's exactly what the new Formula E Gen2 EVO is, because the all-electric formula was recently awarded official FIA World Championship status: the most serious sign yet that it's moved on from an alternative racing series to the mainstream.

But actually, we didn't get to see it for the first time at all, because the car's world premiere was scheduled for the Geneva Motor Show – which went the same way as the Australian Grand Prix

and Qatar MotoGP. Instead, we'll have to wait until the 2020-2021 Formula E Championship gets underway in Saudi Arabia later this year to see the latest challenger in action.

NEW CHAPTER

It's not a complete redesign of the existing Spark SRT05e, which is halfway through its intended four-year life cycle, but rather a more subtle reshaping of the bodywork to focus on ultra-modernity in Formula E's seventh season. It's not

only the cars that will change: even the championship livery is getting a refresh to reflect the start of a new chapter.

The latest upgrades come in the form of a kit, which will be bolted onto the existing Gen2 car. The end result definitely looks more packaged and shrink-wrapped, toning down the bulk of what's actually quite a large machine when you examine it closely. The structural design changes consist of a new front wing, dorsal fin, and new curved rear wing. With

BELOW The new Gen2 EVO seen on the streets of Berlin. The outbreak of COVID-19 meant the car's Geneva bow had to be cancelled



Photos: Formula E

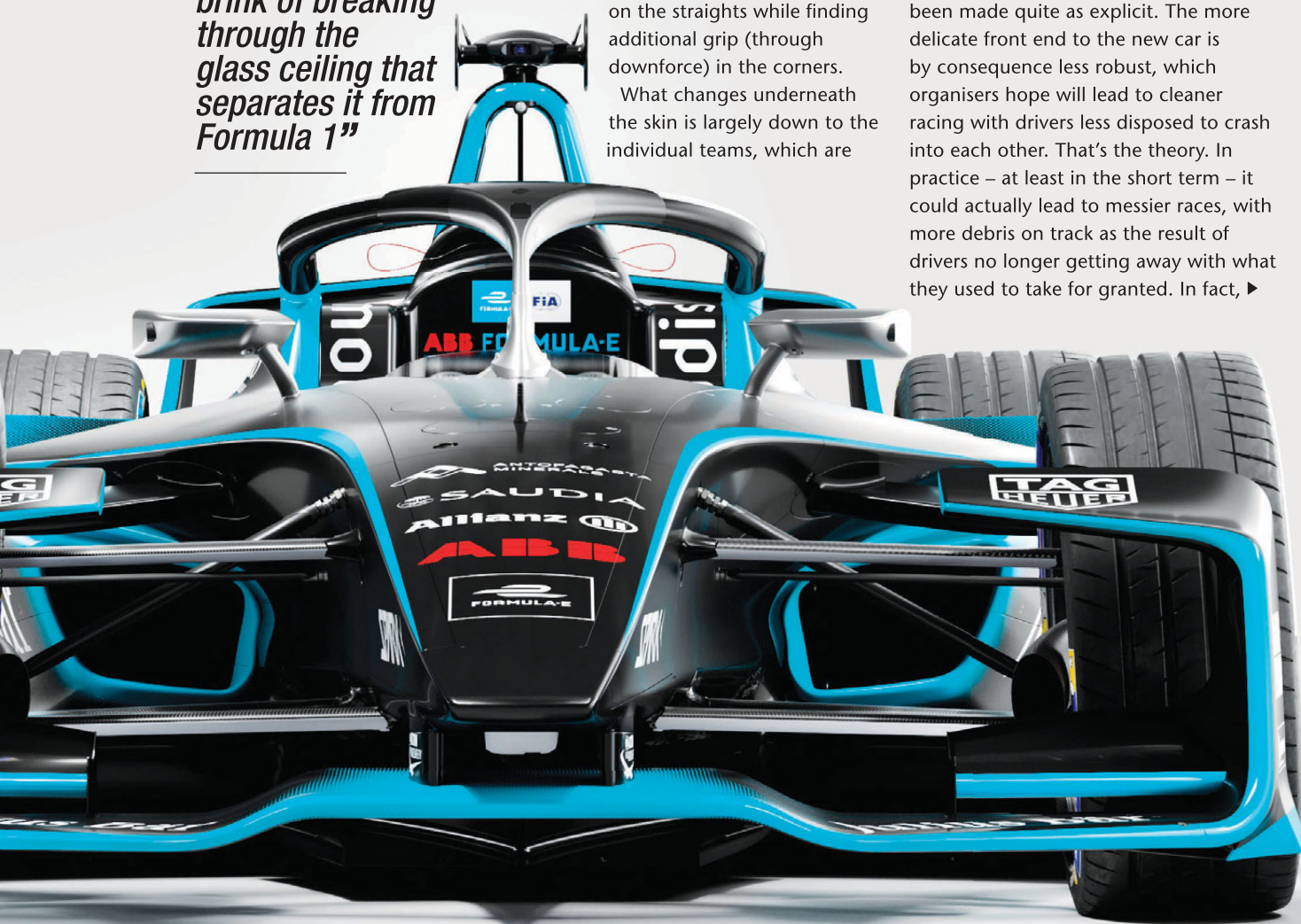
“Formula E is at a significant crossroads, on the brink of breaking through the glass ceiling that separates it from Formula 1”

smooth aerodynamics being a key to the formula's energy-preserving ethos, these changes are designed to help the car punch its way more efficiently through the air, carrying extra speed on the straights while finding additional grip (through downforce) in the corners.

What changes underneath the skin is largely down to the individual teams, which are

free to develop their own parts for the electric powertrain.

That's been the public mission statement. There's also another purpose to the repackaging, which hasn't been made quite as explicit. The more delicate front end to the new car is by consequence less robust, which organisers hope will lead to cleaner racing with drivers less disposed to crash into each other. That's the theory. In practice – at least in the short term – it could actually lead to messier races, with more debris on track as the result of drivers no longer getting away with what they used to take for granted. In fact, ►



ABOVE & BELOW Formula E has provided a glimpse of the all-electric racing series' future



How the world's most famous racing driver could switch to Formula E

BY the end of this year, Lewis Hamilton could have equalled Michael Schumacher's record of seven Formula 1 world championships. While the noted environmentalist has in the past poured cold water on suggestions that one day Formula E could take centre stage, he's recently backtracked.

"We've gone from a V8 and now use a third less fuel than before," Hamilton said. "The developments that are coming forward in the future are going to be really, really interesting. If Formula 1 will be 'FE1' at some stage – probably not in my racing career, but beyond, for sure – I think it's got a really bright future," he added.

Note the 'probably'. Hamilton is currently in discussions to extend his Mercedes contract beyond the end of this season. If, as is likely, it turns out to be a long-term agreement, there could be some element of electric racing involved – even if just in an ambassadorial role.

Mercedes team principal Toto Wolff has confirmed that there would be nothing in Hamilton's way if he wanted to do

it: the decision would be entirely down to the Englishman.

Hamilton has always believed in using his profile to spread the word about climate change, and often says that even the smallest switch in habits can make a big difference. He's changed his diet and travel habits for the sake of the environment. But would he ever change his car?

If he did, there would be one small problem with the concept of 'FE1'. Under the terms of the current agreement with the FIA, Formula E has the exclusive rights to purely electric racing for 25 seasons since it started. This means that the very earliest date that F1 could go electric is 2039: assuming there are no extensions in between.

So if Hamilton ever wants to try electric racing for himself, it's going to have to be with Formula E. Or perhaps even Extreme E: its new off-road equivalent, with an emphasis on social and environmental projects all over the world, which is perfectly in line with Hamilton's own stated priorities. Now that would be an intriguing prospect... **RT**



ABOVE & BELOW Could some element of electric racing, even if only in an ambassadorial role, form part of the world champion's next contract with Mercedes?



Photos: Daimler AG



ABOVE Carnage on the streets of Paris: the hope is that a less robust front end to the new car might discourage drivers from making contact with each other

Bloxham/LAT

there seems to be a reasonable chance of the more delicate front wing getting knocked off and then wedging itself under the car: always a recipe for chaos.

The brand-new shark fin, as well as helping stability through corners, has the added bonus of providing a vertical surface to accommodate sponsor branding: much-needed as costs begin

implications for safety, with several drivers saying they preferred the previous fully-covered design.

CHANGING DRIVER BEHAVIOUR

But is that just because they know they can be more robust with their rivals? The exposed front wheels also lead

speeds are relatively modest, with no long corners on most tracks.

This means that car design can concentrate a bit more on aesthetics: always a priority for the Formula E championship, which prides itself on being futuristic. The DNA of the current car is of very much in evidence with the EVO, but it's been pushed to a slightly greater extreme. Call it the ultimate expression of this particular model, with the emphasis on capturing the imagination of youth that's subconsciously familiar with Luke Skywalker's X-Wing Starfighter (which surely has to have been one of the influences behind the current Gen2 car – complete with the X-Wing at the back?).

Yet there's another Luke – specifically former Formula E champion Lucas di Grassi from Brazil – who's not entirely on board with the latest changes.

"First and foremost, they're not really big changes, so I don't think they will ►

“Paving the way for the future of sustainable urban mobility”

to escalate. The torpedo-like nature of Formula E car design previously precluded flat surfaces, which meant that sponsors sometimes struggled to gain visibility.

Perhaps one of the most striking (and potentially controversial) changes is the fact that the front and rear wheels are no longer fully covered. This has

to increased drag in the new car, but perhaps to compensate there's now a lot less drag at the back, as the rear wing has become notably smaller. It's also a much cleaner design, with a more conventional shape than the current version.

Generally speaking, aerodynamics don't play a massive part in the overall performance of a Formula E car, as top

BELOW The EVO will have a more conventional shape than the existing Spark SRT05e, which is halfway through its intended four-year life cycle



affect performance all that much,” he says. “However, I’m not really sure about the whole concept of making the front of the car weaker. Normally in motorsport, if you make a car weaker, you do this in exchange for more speed. To make it weaker with the same performance to me is a step backwards. I understand that there can be a problem with too many drivers making contact at the moment, but for me how you solve that is by enforcing the regulations. In the end, I think the EVO car looks a bit more traditional than the current one, so in all, I don’t think it’s a good move.”

Predictably, FIA President Jean Todt was a bit more on-message, commenting: “As Formula E transitions to world championship status, we see a further evolution of the Gen2 car with an exciting new look. It’s this progressive approach that has contributed to the expansion of the grid and increasing competitiveness of the championship, which continues to go from strength to strength and which is paving the way for the future of sustainable urban mobility.” Ultimately, these latest tweaks might tick every eco-friendly and socially inclusive box, but what will matter most is how exactly all these changes influence the racing. It should be a bit cleaner after a suitable learning period – which the purists will no doubt approve of – but is that necessarily what the public wants?

A friend recently compared Formula E ▶



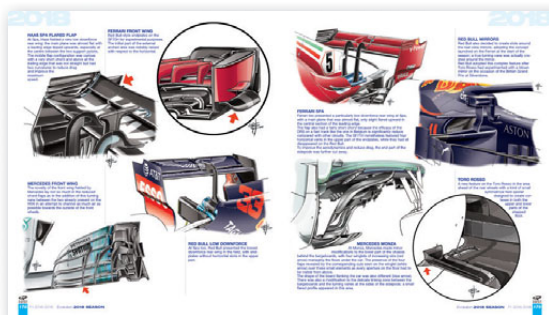
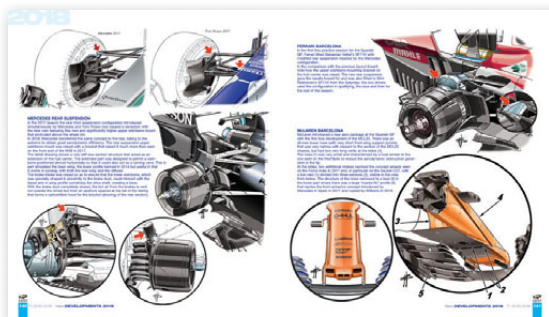
ABOVE Aggressive rear wings and a distinctive fin behind the cockpit mark out the new car

Giorgio Piola

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E in Rome to chariot racing. And we all know how popular that was: second only to throwing Christians to the lions. Given that the latter is unlikely to make a comeback, maybe we should concentrate on the obvious crowd-pleasing recipe that we're already fortunate to have?

HEAD-TO-HEAD WITH F1?

In any case, it's clear that Formula E is at a significant crossroads. The series is teetering on the brink of breaking through the glass ceiling that separates it from Formula 1 as the main destination of manufacturer-backed motorsport. The decisions and promotions that emerge from the next few months and years will be critical in establishing Formula E as the place to be.

And for electric power to be globally appealing, electric racing cars have to look attractive as well – which is why even this relatively superficial restyling has important ramifications. **IT**

BELOW Former champ di Grassi believes the next generation of Formula E cars should be four-wheel drive and feature some form of artificial sound

"F1 might be relevant – but not to the automotive industry!"

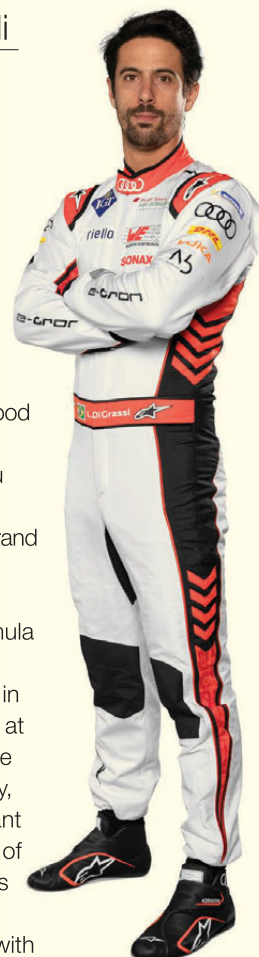
Former Formula E champion Lucas di Grassi's alternative take on F1 vs FE

ACCORDING to Lucas di Grassi, the new EVO doesn't move the Formula E game sufficiently onwards. So what would? The Audi Sport Abt driver has got quite a comprehensive shopping list – which even he admits is hard to put into words – but would definitely require a whole new model rather than just an Evolution.

"First of all, I think you'd want the cars to be four-wheel drive and the drivetrain symmetrical from front to back, to make the cars easier to work on and to make it easier for parts," he says. "You want the battery on the floor for a good centre of gravity, not much aero, and no other gimmicks. You'd want the design to be futuristic and aggressive; you could have an artificial sound, LEDs and even some night races: there's no need to have lights like the Singapore Grand Prix, just 10% of them would do. Above all, you'd want to keep the costs no more expensive than they are now."

And is that the recipe for Formula E to vanquish Formula 1? "Not necessarily," concludes di Grassi. "Both can exist, but Formula 1 has to decide what it wants to be in the future. Long-term, it's not going to be relevant – or at least not relevant to the automotive industry. It might be relevant to other industries in future: the rocket industry, smart materials, or alternative industries. Or does it want to be just entertainment? NASCAR is a good example of a sport that isn't so relevant to technology but provides plenty of popular entertainment."

Formula E though is definitely here to stay – starting with the newest evolution later this year. **IT**



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William Kimberley looks at how a top UK Formula Student team has enlisted the help of specialist companies as it prepares for the 2020 season

OXFORD Brookes Racing has competed in every Formula Student meeting since the series' inception in 1999. It has picked up many awards on the way, including the top UK team for the seventh time in 2019, but is hoping to walk away with the top prize this July. This year the challenge is to win the event overall with OBR20 – its all-electric single-seater.

"Our aim is to develop a platform not only to take on the top Formula Student

teams in the world, but to also serve as a test bed of innovation for electric vehicles and controls software," says Joe Jones, OBR's technical partnership manager.

The team boasts some top talent, including Nuno Nogueira, the team's Aero R&D and Cooling Lead, who grew up in Portugal and is studying MSc Motorsport Engineering at Oxford Brookes. "Being part of OBR is an amazing experience, you learn at such a high pace from different departments,

from the beginning of an R&D cycle right until the end in competition," he says.

"Being in a lead role not only gave me technical knowledge from learning with others and how to transmit it, but also about leading people, something that very few places offer this early in a career. My OBR mission is to achieve R&D goals and to have all projects completed and well documented for next year's team.

"As for cooling, the goal is to have a well-designed air-cooling system for the accumulator with enough confidence to be able to run longer events without worrying with battery temperature and low voltage battery consumption."

F1 INPUT

The team began to focus on aerodynamic validations with OBR18 in 2018, but the step change came a year later with the development of OBR19. "Our current aero development started on OBR18," says James Ganderton, Methodologies Lead at

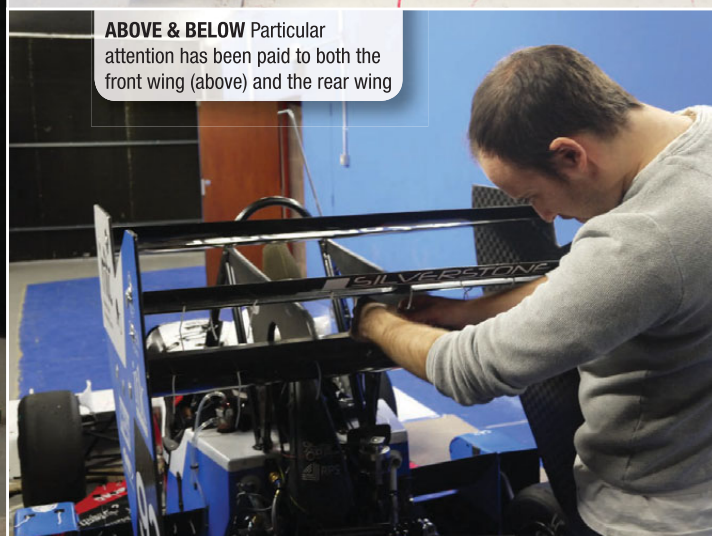
A TILT AT THE TOP



ABOVE The OBR team has made extensive use of wind tunnel testing in the last year or so



ABOVE & BELOW Particular attention has been paid to both the front wing (above) and the rear wing



OBR, including testing, who spent a year at Scuderia Toro Rosso where he worked closely with the wind tunnel, model design, model shop, production, aero systems and aero development groups. "However, it was at the beginning of the 2019 season when we started to develop OBR19 that things took a leap forward. We were invited to MIRA's wind tunnel where we retrofitted pressure taps on OBR18 and did as much as we could to improve the aero performance of OBR19."

A RACECAR'S EVOLUTION

"At this time we didn't have the Evolution Measurement EvoScan pressure scanner, but a different second-hand 16-port scanner from the University. We only integrated the pressure measurement in after Evolution Measurement approached us.

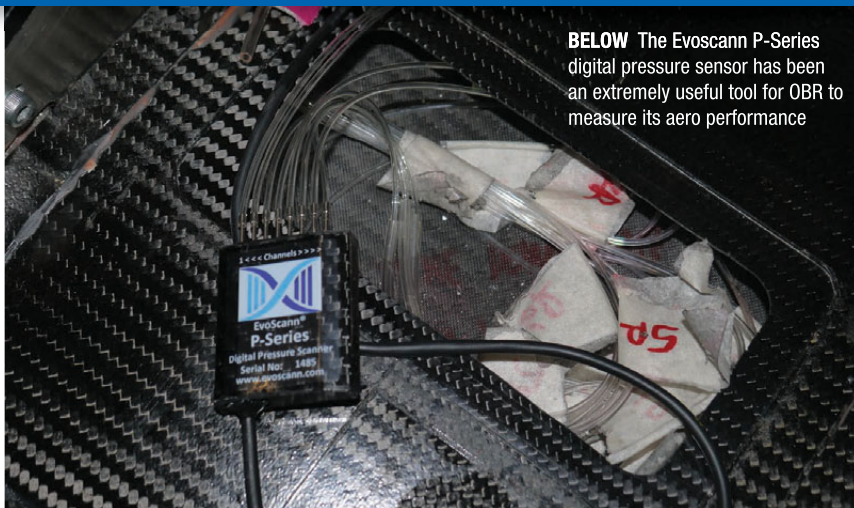
"It's a partnership that has worked ►

very well, although it was slow initially," he says. "What they were after was the data from its sensor so we were trying to implement this while going through our testing regime. We did hit road blocks and so were slower at that point, but now that we've reached the stage of competition where we are able to take the car testing, we can get so much more data and not worry about powertrain issues or anything else that can get in the way.

"Collating all the data and then understanding what we have has been a big challenge for us, but it's something we are learning as we go on and take forward as part of the knowledge base. We are also gaining skills we can apply to aerodynamic testing."

PLUG-AND-PLAY

"One of the things for the students is that they can run the aerofoil or the full car in the wind tunnel and gather data, and they can also gather data when the car is on the track as well," says Iain Gordon, Evolution Measurements' export sales manager. "The big thing is that it's so modular. Teams like to use EvoScann scanners because they can be quickly installed and used in experimental areas of the car and then removed and tried elsewhere. A traditional sensor would be built into the floor and it would be a much more permanent installation. Integration is also a large part of the



BELOW The EvoScann P-Series digital pressure sensor has been an extremely useful tool for OBR to measure its aero performance



BELOW The main focus was collating the pressure tapping data

cost, whereas we are feeding directly into the CANbus system in what is pretty much plug-and-play. It could be a race car, a motorcycle, a truck, bus or a Formula Student car that is being aerodynamically tested.

"The typical Formula Student team

prefers an 8-channel aerodynamic pressure scanner to a 16-channel one. It's an extremely modular product which can be very easily fitted in many locations on the vehicle. It's light and small so can be squeezed into tiny places.

"Evolution Measurement also represents Scanivalve whose pressure scanners are used in wind tunnels where higher channel counts, and features such as purging and dynamic zeroing, are important and where direct Ethernet compatibility is a must.

"I think the big trend right now is because wind tunnels are relatively expensive, and are time-limited in Formula 1 for example; we supply EvoScanns both for validating the wind tunnel and CFD work, and for gathering further live data during track testing," continues Gordon. "For example, the Formula 1 cars that were pre-season testing at Barcelona will have had quite a number of EvoScanns fitted, gathering valuable track test time data. With the number of pre-season test days reduced, every second the car was on the track counted."

Aero development has now stopped on OBR20 as it's all been finalised ►



BELOW The aerodynamic efficiency of OBR20 is crucial as the team grapples with the ramifications of switching from ICE to electric power

Outside support



ABOVE Evolution Measurement's EvoScann pressure scanners have added a new dimension to the team's work

A strong supporting cast is behind the team's new car

THE team has some very loyal sponsors including big names like Santander Universities, Bosch, Solvay, the Manufacturing Technology Centre (MTC) and GKN, as well as smaller innovators in the motorsport space such as Silverstone Composites and RPS Industrial 3D Printing Solutions. The team has also picked up numerous new partners in the last few years.

One is Evolution Measurement, its EvoScann pressure scanners having revolutionised how the motorsport industry measures pressures on-car. 8-, 16- and 64-channel devices are plug-and-play, attaching to, or sometimes fitted inside, aerodynamic surfaces. They connect directly into the vehicle CANbus, enabling quick set-up and minimising the time it takes to get readings for a test campaign. Small, light and rugged, these are used extensively by many of the world's top race teams to gather accurate, fast, aerodynamic pressure data that is essential to enhancing vehicle performance.

Corex Honeycomb is again sponsoring the OBR team for the third consecutive year, the team using Corex aluminium honeycomb in its chassis. This honeycomb is often used in automotive and motorsport vehicles because of its incredibly high strength-to-weight ratio and application in high-stiffness composite sandwich panels.

MTC supplies the car's uprights that are electron beam melted (think 3D printed) from titanium. This allows for aggressive mass optimisation and tight packaging in a part taking the wheel's suspension loads as well as holding torque from the in-hub electric motor and gearbox, and transmitting these through suspension linkages into the car's chassis.

OBR's unsprung mass of the vehicle has increased this year compared to previous seasons, due to the additional weight of the in-hub electric motors and planetary gearboxes (designed by the team, and manufactured by British company Mini Gears). The weight optimised uprights have allowed the car's designers to generate organic shapes in regions that require material, thus optimising the mass of the uprights with respect to overall strength and compliance. **RT**

except for some cooling aspects. "In February we were still developing cooling strategies, but the downforce generating components had been well defined by this stage," says Ganderton.

The team is scheduling its first major test at the end of April. "We are pushing our schedule ahead this year because of the new powertrain as there's a big learning curve," he adds. "Being an electric car, we are having to monitor our aerodynamic efficiency to make sure it doesn't use too much power and run out of energy before the end of the event."

THE TESTING REGIME

It was in mid-January that the team was offered another wind tunnel session. "Using the EvoScann we logged the front wing pressure tapping and using our previous pressure scanner, we logged the rear wing," says Ganderton. "We chose those specifically because the wind tunnel didn't have a moving ground, so the elements were least affected by that. The highest downforce producing components are the side wings, but as they are behind the tyres, which are not rotating as they would in a real scenario, and as we couldn't reproduce ground effects accurately, we chose to go with the front wing ahead of that and the rear wing, which is much closer to freestream."

"Our main focus was the pressure tapping data there, so with processing that and effectively running CFD simulations that mimicked the wind tunnel in terms of its geometry and physical conditions, it enabled us to have a whole suite that mimics the pressure tapping within the simulation and compares all our values."

The wind tunnel test was then followed up a couple of weeks later with a track test at the Bruntingthorpe Proving Ground where the team focused on cornering. "There were four different circles of greater and smaller radii that basically replicated the skid pan event in Formula Student with a high- and low-speed corner," says Ganderton. "We did three revolutions in each direction, trying to maintain the corner radius and keep as steady as we could. We will do a steady-state simulation to mimic the steady-state cornering scenario that we did on track." **RT**

JAMES BOND AND F1: *WHAT'S THE CONNECTION?*

Motorsport engineers are among the best in the business, and, as **Alan Stoddart** discovers, their tools are now being used in other industries

EVERY victory in any modern motorsport series is reliant on a vast number of components operating together to enable each part to reliably perform as designed. For these numerous components to work harmoniously they must be linked to each other, and these connections are critical, with the

individual parts depending on them to perform. What's more, like every single piece of a racing car, this reliability must be achieved while still delivering on the light weight and packaging fronts that are synonymous with motorsport.

Delivering on this brief is TE Connectivity's (TE) autosport product

offering. The range was established in the early 1990s, and evolved organically from the company's aerospace connectors, where reliability and dependability are obviously critical. These connectors, albeit made shorter, slightly lighter and painted black were, in the early days, the company's motorsport range, and they proved a success.

"Inevitably though," says TE's autosport global product manager, Paul Webb, "after a few years people were asking for connectors that were smaller and lighter. Our initial ideas were almost like taking a photocopier and simply reproducing the connectors at an 85 per cent scale and seeing what happened. But what we discovered is that each time we do that we have to learn new ways of making things, or that you can't

“Autosport has functioned as an R&D centre. Connectors have found themselves in some pretty unexpected locations”



ABOVE It's top-flight motorsport, but the technology is useful in numerous other industries

simply read across the connections because the internal harmonics of the connection have altered. So, something that worked perfectly with a slightly larger shell size works differently when you try to make it smaller."

Solving these problems was no easy task, especially given that TE had no prior cases or experience to fall back on, it was all new territory. While theory is well and good, in the end TE resorted to a more robust method of developing the parts: trial and error. It was the best solution because even though the connectors would seem OK and would physically fit together, when placed in a very hot environment and subject to constant, violent vibrations, they might not behave as expected.

FRANTIC PACE

This process of development and experimentation is well served by the frantic pace of motorsport, rather than the relatively slower pace of other industries. In aerospace, for example, the timescales between design and the part appearing on a

plane can be many years; in the world of top-level motorsports, these products can sometimes be turned around in a matter of weeks.

"Autosport is a unique business unit within TE," adds Webb, "because there is no other part of the company that works the way we do. We have our own stock, distribution, development, and internal procedures. That's

necessary for us because the unique demands of autosport require very fast reaction from its suppliers. Products developed for the autosport industry that are smaller and lighter creates the opportunity for them to be used in other industries where product requirements are similar. In that context it is fair to say that autosport has functioned as an R&D centre and has meant that

the connectors have found themselves in some pretty unexpected locations." Frequently, this relies on a ►



ABOVE & BELOW TE's Deutsch ASDD connectors excel in reliability, while remaining small and light





ABOVE Like racing cars, drones need to be small and light, so TE's motorsport connectors were a natural fit

suggestion from a motorsport engineer that has left the world of racing and taken up a job in another industry. When they start working in this non-motorsport industry, Webb explains, one of their first questions is about the connectors that are being used and they would ask: "Don't you know there's a better solution?"

These comments would lead to the ordering of a few connectors, allowing the motorsport engineer's new colleagues to see what they had been missing. "So, it is a process of ex-motorsport people infiltrating the real

world and taking us with them," says Webb. "Of course, outside of motorsport people are often surprised by the initial cost, but the connectors are small and light. If you also account for the fact that these parts are reliable without the need of servicing all the time, you realise they are good value over the life-time of a project. That's why they start appearing in places you might not expect."

One of the first places outside of motorsport was in the signalling systems used in the London Underground, which, like racing cars, demanded a physically

small size of the connectors paired with excellent reliability, even in a very harsh environment. One new challenge for the TE team though was the expected service life. In motorsport applications, many connectors are replaced after less than 10 races because of the constant evolution in a car's design; in the signalling systems for transport for London, however, the connectors needed to last for at least 10 years.

GOING UNDERGROUND

TE autosport began by studying the environment in which the connectors would have to operate. Ultimately, this research showed that the connectors were more than up to the challenges, and all they needed to survive for 10 years was a change in the material used to plate the connector shell because of the high levels of salt that were expected, which could otherwise have caused corrosion. With these changes made a small batch of connectors was delivered to the London Underground, and were put through ►



ABOVE Billions of journeys are completed on the London Underground each year. TE's connectors are part of what makes that possible

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ABOVE TE's connectors are designed to endure in tough environments, an attribute invaluable both on and off track

extensive testing to make sure these parts really could deliver. After they proved themselves they were rolled out across the network. That was several years ago now, and the connectors have since been instrumental in literally billions of journeys.

It's a similar story in the aviation industry. It might be expected that F1-grade connectors would be required in the engines or the control systems, but another place they also end up is in the seats where they are used for connecting up the in-flight entertainment systems (IFE).

At first glance, this might not seem a particularly harsh environment, but not only are the systems used constantly, they are subject to all sorts of abuse that could only come from a life transporting the public. Whether it is unruly children kicking the seat back, people leaning on them or worse, spilling drinks into them, or even suitcases clouting the screens and seats on their way into the overhead bins, IFE systems need to be tough. What's more, while not safety-critical, the costs to airlines of broken systems can be surprisingly high, as customers sat

behind non-functioning entertainment systems demand to be moved, reimbursed or compensated for the dull flights they are forced to endure.

Of course, the other benefit of using products developed for motorsport is their incredibly low weight. In qualifying for a Grand Prix, that might save a driver the thousandths of a second he or she needs to secure pole position, but in the aviation industry, using a fractionally lighter component, in each of the 400 seats of an airliner for many miles a year, for an approximate 30-year service life, adds up to a big saving in fuel.

HOGWARTS EXPRESS

Transport isn't the only industry that TE's autosport connectors have been used in. In order to get those fantastic shots of cars running across dried lake beds for advertisements, or sweeping aerial shots of James Bond's Aston Martin, or of the Hogwarts Express, electric helicopters with rotating cameras in the noses were used. Because these aerial cameras, like racing cars, need to be lightweight, resilient and

reliable, TE's connectors were a natural fit. "People come to us because of the packaging and performance," says Webb, "But there are a ton of different additional features such as small things like the bayonet fitting, which is quick and doesn't need extra tools because you can hear and see it is locked with a click."

As the use of the connectors spreads, so does the interest in using the connectors in other, even more unexpected situations: TE is currently finding solutions for an American fire department, for example.

What might seem cutting-edge today isn't going to be the same in a year's time, resultantly, TE is also looking into new technologies to meet the challenges for the future. One of those newer technologies is 3D printing. "Although this technology has been around for years it's now coming to the level where we expect to see it in production connectors very soon. So, for small batches and particularly challenging solutions, 3D printing is definitely going to be a thing," says Webb. "It is evolving massively, both the materials that can be used and the machine definition. It will definitely come, it is just a case of when." **RT**

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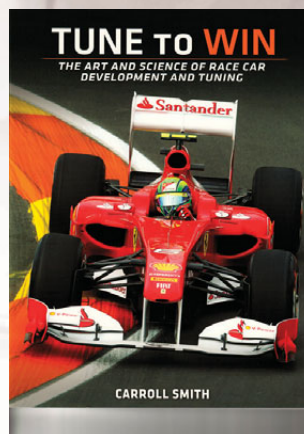
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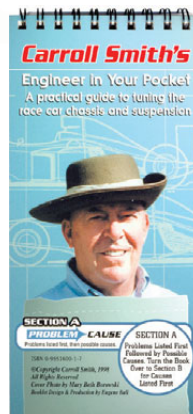
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FROM RADICAL TO REVOLUTION

Phil Abbott, Radical Sportscars co-founder, talks
to **William Kimberley** about his new race car



FOUNDED by Phil Abbott, the co-founder of Radical Sportscars, Revolution Race Cars may not be a familiar name to many, but it is quickly building a reputation for designing, developing and manufacturing sophisticated low-cost sports cars for the amateur/semi-professional driver.

In September 2017, at 62 years old, Abbott had still not had enough. Even after 20 years of success in motorsport with Radical, he decided it was time to create a new brand and a new race car, one that would 'Revolutionise' the club racer market as much, if not more than he did 20 years ago with Radical.

"Twenty-five years ago, I started Radical Sports Cars, since then we've made 2,500 racing cars and I believed this was the next thing that Radical should do. In conjunction with fellow founding partner, Romain Rousseaux, who was a European Radical dealer for many years, we decided to start a new company as we could see possibilities, to re-purpose high-end technology to build a more advanced car."

To be able to start the Revolution, it was vital to find a partner

for the creation of a carbon tub that would keep the overall car costs down. Abbott thought of Dominik Dierkes, owner of DD Composites, with whom he had worked in the past and who is a specialist in resin infusion techniques. It only took Dierkes the time of a dinner at the Autosport show in Birmingham to commit to be a part of the project.

In the early discussions the plan was to find other investors but as the project grew, and not wanting to lose any time for the 2019 season, they all sat around a table at the end of February 2018 and agreed to invest personally and bring the project forward between themselves. The first Revolution two-seater track and race car prototype, a lightweight, 675 kg sports car powered by a dry sump Ford 3.7-litre V6 engine developing 300 bhp, saw the light of day on 25 October, 2018 when it was tested at Snetterton.

EXPERT INPUT

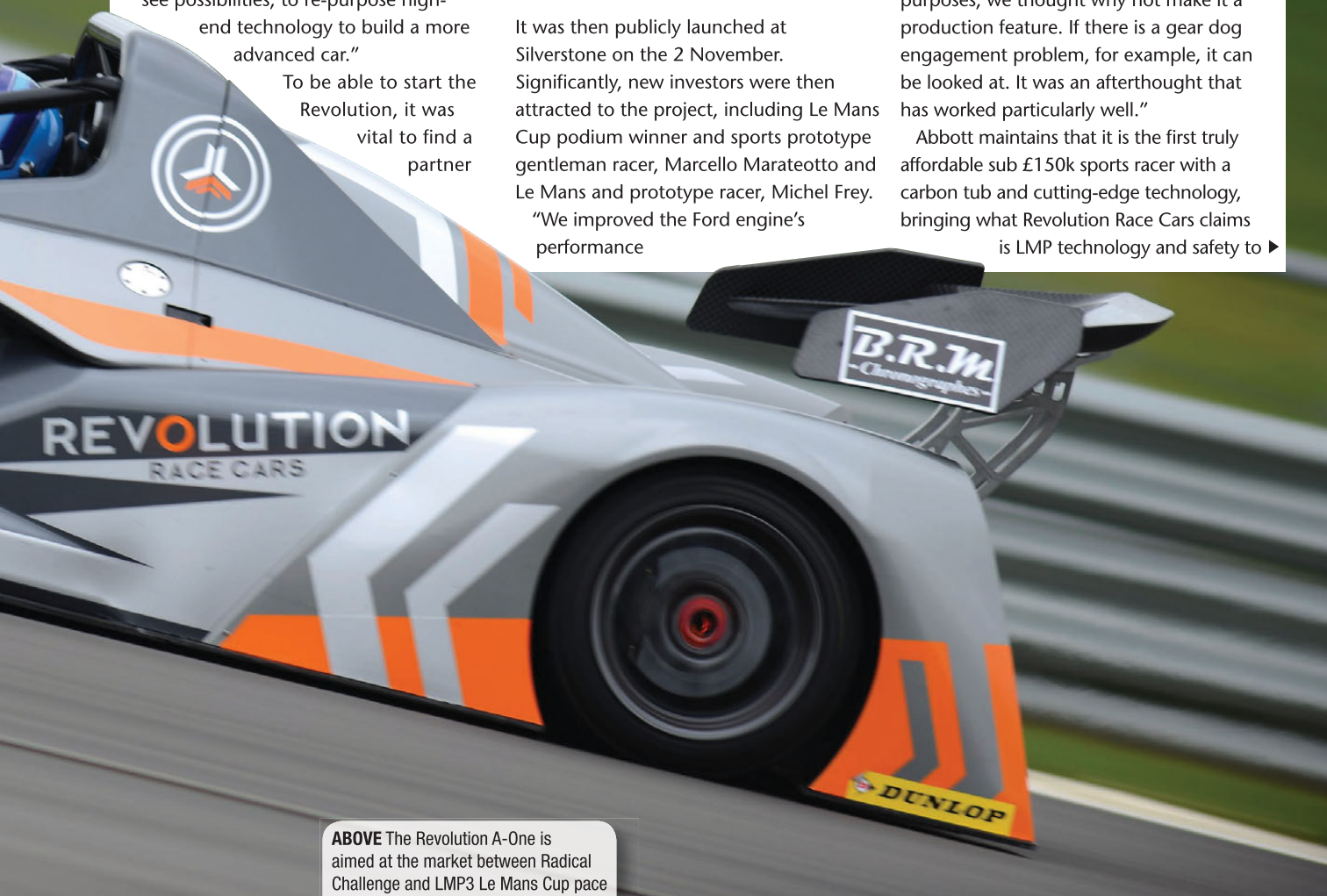
It was then publicly launched at Silverstone on the 2 November. Significantly, new investors were then attracted to the project, including Le Mans Cup podium winner and sports prototype gentleman racer, Marcello Marateotto and Le Mans and prototype racer, Michel Frey. "We improved the Ford engine's performance

here and there so that it has a very good balance and now develops 380 hp and 330 lb/ft of torque. It has a good torque spread from 3,000 to 6,500 rpm, more than 300 lb/ft of torque all the way through. It will do 70-80 minutes on an 80-litre tank of fuel."

Abbott went for a bespoke gearbox from French manufacturer 3MO that produces many production transmissions.

"Its materials technology is really excellent with its transmissions having a long life between servicing," says Abbott. "We've been able to put the diff at the rear of the car although the gear cluster is in the middle. Because it's a bespoke case to us, we've had them put inspection ports in both the transmission and the differential, taking out a plug that's about an inch diameter so that a camera can be inserted that can be plugged into the iPhone. It means that every part can be inspected without getting your hands dirty. Originally devised for our own testing purposes, we thought why not make it a production feature. If there is a gear dog engagement problem, for example, it can be looked at. It was an afterthought that has worked particularly well."

Abbott maintains that it is the first truly affordable sub £150k sports racer with a carbon tub and cutting-edge technology, bringing what Revolution Race Cars claims is LMP technology and safety to ►



ABOVE The Revolution A-One is aimed at the market between Radical Challenge and LMP3 Le Mans Cup pace

the masses. It is also easy to maintain, cost-effective to run with accessible handling and performance so that it can be enjoyed and exploited by all levels of driver, from those wishing to enjoy track days through to those on a career path to Le Mans.

Proven reliability was another key component within this package, its performance matching some of the lowest running costs with 10,000 km or 100 hours between rebuilds. Fitted with a unique exhaust system and fine engine tuning, it also comes with ultra-sharp throttle response and a carefully tuned soundtrack.

With Abbott orchestrating things, there was a group of very talented people reporting to him and bringing the car to life. This included Peter Watts, whose CV included being head of composites at BAR F1, working with Bentley on its LMP1 programme, and working on the Bugatti Veyron as a design engineer and a prototype engineer at McLaren Automotive, and Henry Pang, Jon Paton and Olly Cartledge who had worked on



ABOVE The Revolution A-One features a revised aerodynamic package, including the new innovative 'double-halo' on the 2020 cars

the Gibson LMP2 cars with the guidance of Rob Lewis, founder and managing director of TotalSim.

"We had quite a few months with TotalSim," says Abbott. "We got what we designed then after the first few thousand miles we felt we could do with a bit more front balance. We achieved what we set out in the first instance, but then we thought it would be really good

to push it on a bit more, ending up with around 6 kN of downforce at 110 mph, so it's really nice and planted and very easy to set up. I wanted balancing tools where the driver could understand and adjust things easily because everyone has their own centre of gravity to be able to tune the car to their requirements. We also provide an aero map so there's less guesswork in setting the car up." ►



ABOVE Following this successful winter test and race programme, production of the 2020-specification A-One is now underway

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Abbott also sought the services of Richard Hurdwell, who was chief engineer, active dynamics and virtual testing at Lotus Engineering for four and a half years until 2012 before setting up his own consultancy. "Richard defined all the finite points in space for us," says Abbott. "We told him what we wanted and he looked after all the levers. The Dunlop tyres will run 400 to 500 kilometres and produce really good lap times the whole time. He really knows his stuff."

However, what makes the Revolution A-One stand out is its looks, the result of starting off with a stylist. "There are many unique aspects to our project, but I think one of them was that we used stylist Simon Cox, well known for work that includes the Corvette C7, Isuzu Vehicross, Cadillac Cien, Cadillac Converj, and the Opel Speedster, to start with and then tried to engineer around the styling content."

"Basically, I was just the referee in the middle to get a really good-looking car with a stable aero platform," says Abbott. "However, let's not think of it like a Formula 1 car, but more for the gentleman driver whose big worry is taking Copse at

Silverstone flat. It was then a question of ensuring the aero balance remained stable all the way around high-speed corners at 110 mph (177 km/h) rather than look for a number at high-speed resulting in a brake load which is only seen for a few seconds."

"The long period of CFD development that followed ensured that not only does this car produce more downforce than anything else in its price bracket, but also remains balanced in all situations as drivability has always been one of the concept priorities."

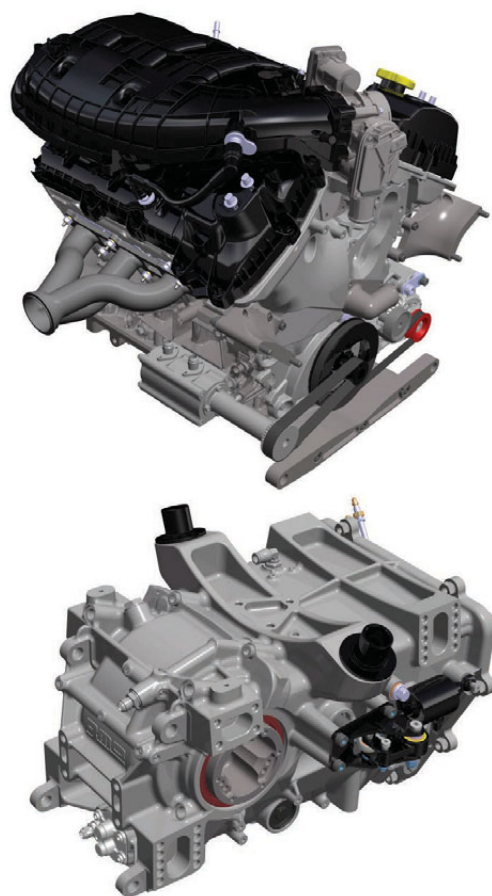
MATERIAL MATTERS

The carbon tub is being manufactured in Germany by DD-Compound utilising a carbon infusion process developed by Dominik Dierkes. Resin infusion is a process where the voids in an evacuated stack of porous material are filled with a liquid resin. When it solidifies, it binds the assembly of materials into a unified rigid composite. The reinforcement can be any porous material compatible with the resin, making it perfect for carbon chassis. A key part of the process is the

evacuation, or removal, of the air from the porous material prior to admitting the resin. The air needs to be removed from the porous material to allow the resin to take its place.

"McLaren uses the process for its road cars as does BMW with the i8," says Abbott. "It consumes 80 per cent less energy in the manufacture of the tub and as we have just proven with all the FIA monstrous crash, squeeze and impact tests, it's every bit as strong as pre-preg, if not stronger. The tooling is also lower cost and it only visits an oven once at 60 degrees post cure whereas a conventional pre-preg tub would visit an autoclave anything between six and eight times in its production cycle at 160 degrees. The energy reduction is therefore incredible and although nobody is going to give us a medal for it today, they might do in the future."

Inside the carbon tub there is plenty of space for two, with class-leading width and elbow room making it easy to operate both solo and with a passenger aboard. Formula 1-style controls, with everything operated from the steering wheel adds to the experience, with an inbuilt display that



BELOW Renders of the engine, suspension and gearbox

BELOW The addition of new dive planes, wing endplates and Gurney flaps give scope for drivers and engineers to trim the car's balance



is ergonomically easy to operate with a Life ECU controlling all the electronics.

For 2020, the company has produced the A-One sports prototype that took four victories in the 2019 UK Sports Prototype Cup in pre-production specification, but has since received several significant upgrades that have been incorporated into the 2020 production run.

The advanced carbon fibre chassis, with full FIA-approved safety features, remains largely unchanged. However, the aerodynamic package has been significantly enhanced with the goal of optimising downforce, steering feedback and balance to maximise the performance of the 480 bhp/tonne Revolution.

The addition of a revised front diffuser and a second rear wing element have made significant gains in grip, with an increase from four to 6 kN of downforce measured in 110 mph (177 km/h) corners. The addition of new dive planes, wing endplates and Gurney flaps give scope for drivers and engineers to trim the balance of the car. The dramatic curved twin-plane rear wing not only provides extra downforce, but also energises the rear diffuser flow to improve downforce further.

"The Revolution A-One is aimed at the market between Radical Challenge and LMP3 Le Mans Cup pace," explains Abbott, "but we are also focused on

keeping to the ethos of ensuring the A-One is forgiving and easy to drive for a wide range of professional and amateur drivers.

"After the first tests, we decided to raise performance levels to be firmly between club-level cars with older safety technology and higher-level LMP cars. Much of our test work has been around achieving pace with a user-friendly feel and feedback. Our test drivers, ranging from LMP3 winners to less experienced club drivers, gave great insight allowing us to sign off the 2020 package with confidence.

"It was also important to ensure the A-One is easy to run by a club-level team. We increased engine power to 380 bhp without compromising the long service life of 10,000 km between rebuilds."

GT3 BEATER

Rob Wheldon, European Le Mans Series LMP3 driver, was one of the first to test the new car in the damp at Silverstone: "This 2020 package is the result of all the work Revolution has been doing over the last year and in more favourable conditions will easily lap Silverstone in less than two minutes." As a comparison, that is faster than the best professional GT3 times in the British GT Championship and close to British F3 pace.

The team also tested at Estoril and

Portimao during January to validate the specification. This European tour also included a debut international race win in the Gedlich Racing GT Winter Series at Ascari, Spain, where James Abbott took victory ahead of a diverse field of GT3, GT4 and Radical entries.

Following this successful winter test and race programme, production of the 2020-specification A-One is now underway that features an innovative 'double-halo'.

The 3.7-litre V6 racer will have its own one-make class within the Sports Prototype Cup. The Revolution Trophy features 13 rounds at six circuits, including three current Formula 1 venues. The headline race is the Spa-Francorchamps double-header at the FIA World Endurance Championship (WEC) in addition to races at Le Castellet as part of a VdeV weekend and Silverstone. The production run is on schedule to deliver a grid of 12 cars for the 25 April WEC support race with further A-Ones to be built throughout the season.

The opening two rounds of the Revolution Trophy take place at Donington Park on Easter Saturday (April 11th) as part of the Sports Prototype Cup, where the Revolution A-One drivers will share a varied grid with competitors in the BARC Radical SR3 Trophy and the new Sports Prototype Open. Race hire and rental packages are available for the 2020 season. **RM**

FIGHTING AN INVISIBLE ENEMY



Sergio Rinland welcomes the news that F1 teams have united to battle a common enemy, rather than themselves

ONLY a month ago we were talking about what motorsport could do to reduce its carbon footprint. As the old proverb says: "Man proposes and God disposes". What we proposed last month seems so irrelevant now.

Not because climate change was irrelevant, but because COVID-19 has stopped the world in its tracks.

Motorsport and Formula 1 are part of these worlds that have had to apply their brakes. Even with the knowledge of events in the Far East (most notably China) and Italy, a month ago we were still preparing for the first race in Australia. Some people were cautious then, but others played King Canute when faced with a tidal wave of evidence.

It is well known that the people in Formula 1 live in a bubble. I know how it is: I lived in that bubble for 20 years! It is the only way when you live in such a highly competitive environment – 100% dedication and 100% concentration, otherwise, you lose.

This is not justification for some of the irresponsible comments, in light of today's reality. Let's park the controversy and see what we, as a community, could contribute to fighting this deadly threat.

In the last few weeks, the press has been writing about politicians saying one thing one day and the opposite the next. The truth is, no one really knows how to tackle this virus yet. The pharmaceutical and medical professionals around the world are working flat out to find a vaccine, a cure and to tend those most affected. The health service worldwide is overwhelmed.

Nobody really knows how long this will

last. The opinions range from two weeks to a year: a wide range of possibilities! We have seen the rate decline and then rise again in China, again with several theories of why.

One thing we know is that, as in situations of war, everyone has to do their bit to help. In war, the whole automotive and aeronautic industry set aside its products to produce weapons.

Right now, we have to win a war against an invisible army, but we know that for the treatment of the most affected the health service needs ventilators to palliate the most severe symptoms of the respiratory system. The UK Government put out a call to arms, for organisations which could help supply

ventilators and ventilator components. Immediately, the seven Formula 1 teams based in the UK – Mercedes, McLaren, Williams, Red Bull, Renault, Racing Point and Haas – put their whole organization forward to manufacture the urgently-needed life-saving equipment.

Other motorsport organizations with design and manufacturing facilities are following suit, such as racewear manufacturer Stand 21 switching to the production of surgical masks. This is great news and shows that even if motorsport lives in a bubble in normal times, when the going gets tough as it is now, it puts its DNA characteristics to the service of society: can-do attitude and speed of technology development.

What will happen when this is all over? People will go back to their normal lives; companies will return to their usual business, but it will not be the same. This is the hardest lesson yet for humanity in the 21st century.

After only a few weeks of the pandemic, a different world is emerging: for the first time we have seen the bottom of the Venice canals as the water traffic stops; people are learning to work on alternatives to travel for business or pleasure; there are less planes in the air, fewer cars on the roads; cities like LA and Beijing are, all of a sudden, free of smog. All these courses of action, which have been advocated by climate activists, are happening now.

When we go back to normal, it will be a different 'normal'. **TR**

“Motorsport's DNA characteristics, a can-do attitude and speed of technology development, can help society”



ABOVE Stand 21 has stepped up to the plate with the manufacture of protective masks

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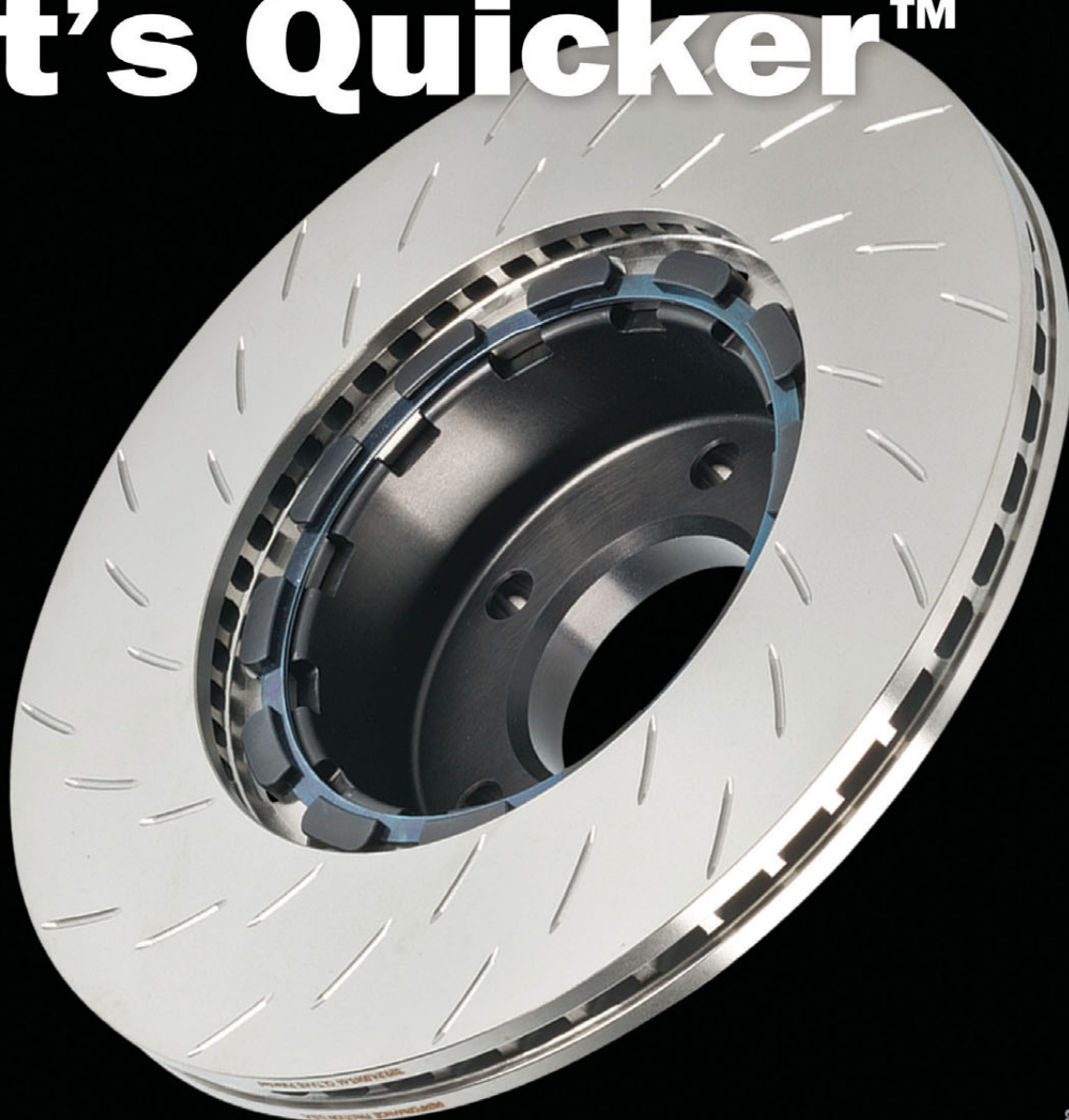


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