

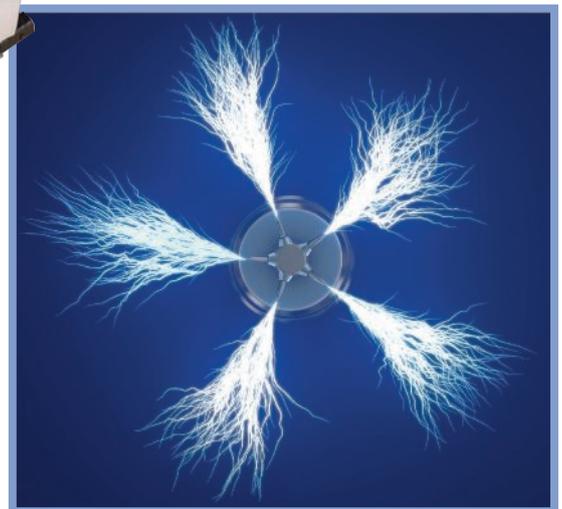
INTERVIEW:
CONTINENTAL'S
CONNECTED
FUTURE STARTS
HERE

EXCLUSIVE:
TULA DSF TESTED

FOCUS ON:
SYNTHETIC FUELS



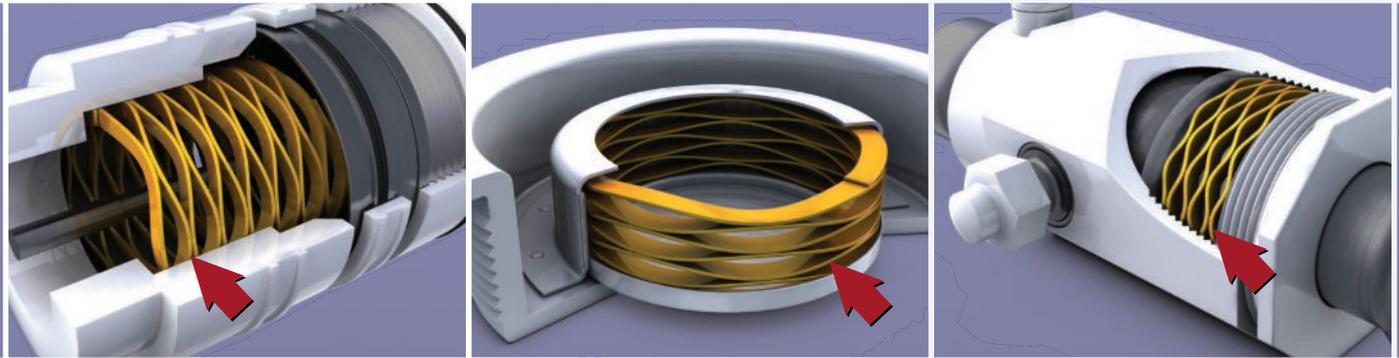
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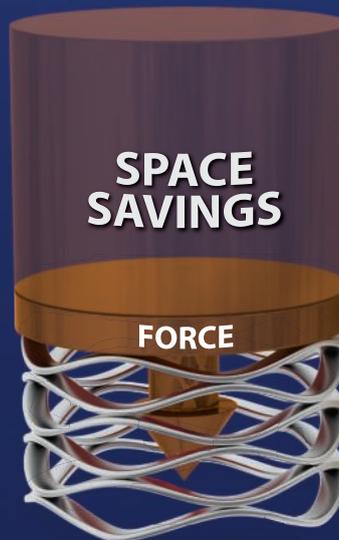


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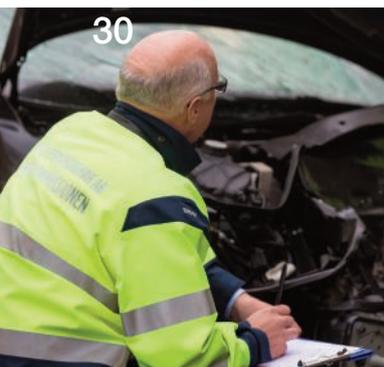


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Editor in Chief: **Ian Adcock**
iadcock@automotivedesign.eu.com
Sub Editor: **Brian Wall**
bwall@findlay.co.uk
Editorial Director: **Kevin Jost**, SAE International.
Kevin.Jost@sae.org
Managing Editor: **Jean L. Broge**
Senior Editor: **Lindsay Brooke**
Associate Editor: **Ryan Gehm**
Custom Electronic Products Editor: **Lisa Arrigo**
Contributing Editors: **Kami Buchholz, Stuart Birch, Jack Yamaguchi**,
Contributors: **Steven Ashley, Dan Carney, Terry Costlow, John Kendall, Bruce Morey, Paul Weissler**
Art Editors: **Martin Cherry, Neil Young**
Illustrator: **Phil Holmes**
Production Manager: **Nicki Mckenna**
nmckenna@findlay.co.uk
Director, Global Sales and Marketing: **Scott R. Sward**
ssward@sae.org Tel: 001 610-399-5279
Circulation Manager: **Chris Jones**
cjones@findlay.co.uk

Advertisement Sales
Publisher: **Joseph T. Pramberger**
joe@techbriefs.com Tel: 001 212-490-3999 ext 5505

Belgium, Benelux, Denmark, Finland, France, Ireland, Italy, Netherlands, Norway, Scandinavia, Spain, Sweden, UK
Chris Shaw
Tel: +44 (0) 1270-522130 M: +44 (0) 7983-967471
chris.shaw@chrishawmedia.co.uk

Austria, Czech Republic, Germany, Hungary, Poland, Switzerland
Sven Anacker
sa@intermediapartners.de
Tel: +49-202-27169-11 Fax: +49-202-27169-20

Japan
Shigenori Nagatomo
Tel: +81-3-3661-6138 Fax: +81-3-3661-6139
nagatomo-pbi@gol.com

USA
Global Sales Manager: **Marcie Hineman**
Marcie.Hineman@sae.org Tel: 001 724-772-4074
Print Advertising Coordinator:
Lori Patterson
Lori.Patterson@sae.org

Automotive Design
Tel: 00 44 (0)1322-221144
Fax: 00 44 (0)1322-221188
www.automotivedesign.eu.com
ad@automotivedesign.eu.com

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Rebalancing the blame game



The elephant in the room at the Aachen Colloquium (page 20) was, undoubtedly, the revelations about VAG's cheat software affecting some diesel and now, apparently, certain petrol engines as well.

A good number of senior engineers that I spoke with, off the record, as well as directors at some of the big engineering consultancies, were unsurprised by the revelations. To them, blame lay not just at VW's door, but that of bureaucrats who had drafted poor legislation and a general media that views the motor industry as the whipping post for all the pollution problems that concern us today.

While suppliers and OEMs are confident that Euro 6.2 with Real Driving Emissions will win the pollution argument, try telling your neighbour about the emission issues they cause with their oil-fired central heating, compared, for instance, to a modern diesel car. They won't hear of it.

And while all of this is going on, there's yet another scandal that has barely affected European OEMs – so far. The US recall of potentially some 19m vehicles fitted with faulty Takata airbags with ammonium nitrate propellant, and alleged “misrepresented and manipulated test data”. That last bit sounds familiar, doesn't it?

Yet the difference is that the Takata issue has barely rippled the pages of the European popular media. Effective PR or ignorance? I suspect the latter, but isn't it about time the automotive sector, from the representative bodies to the OEMs and supply chain, actually started being more proactive about the huge strides the industry has made in strangling pollutants, compared to other industrial sectors and products?

Elsewhere, *Automotive Design* was granted exclusive access to Tula's demonstrator Dynamic Skip Fire cylinder deactivation system (page 6) – and you can also learn what Volvo has in common with Ferrari and Porsche on page 32.

Ian Adcock, Editor in Chief

Firing on all cylinders - well, at least some of the time!

GMC's 2010 Yukon Denali SUV, with its 6.2-litre V8 (313kW and 624Nm), is the very antithesis of the direction in which European vehicles are heading – downsizing with direct injection and turbocharging – but it is an ideal demonstrator for the Delphi-Tula Dynamic Skip Fire technology, as *Automotive Design* discovered

on a recent exclusive drive. To recap, DSF employs digital signal processing (DSP) to randomly deactivate one or more cylinders in real time to fire only the number of combustion events required to deliver the torque or power demanded at that moment. This ensures every combustion event happens at the optimum

high load, or unthrottled, for maximum efficiency, resulting in upwards of 20% or even 30% improvement in fuel economy.

Depending on load, it can, like conventional cylinder deactivation, cut half the cylinders, but DSF's differentiator is that it can fire every 5th or 9th event, depending on load or torque required. It also takes into account cylinder and/or exhaust temperatures, so neither cools excessively, resulting in emission spikes as they are reenergised or the need for a given set of cylinders to be re-ignited, if they have been dormant for any length of time under part load.

Mating Tula's electronic software with Delphi's De-AC lifters and De-AC rocker arms is key to implementing this for petrol and diesel, as well as any engine configuration or capacity. In this installation, a lost motion lifter is used with an oil control valve; in other systems, it would be a lost motion roller finger follower.

As a function of the single stage oil pump, the V8 idles, and launches in first gear, on all cylinders and, although a two-stage or electric oil pump would allow DSF, conventional stop-start might be a more efficient solution.

A fascia-mounted digital read-out displays an animation of the V8's cylinders, depicting which are and aren't activated. Although there are brief periods when two will function simultaneously for nearly all the time, it is a blur of scattered firings across all eight cylinders. While decelerating or coasting downhill towards traffic lights with no throttle, all eight shut down, during which time a 20% fuel saving was displayed.

Despite the Yukon's body-on-frame structure, there was no discernible feeling of cylinders cutting in or out, achieved by Tula programming the system so it functions outside of the Hertz (Hz) range passengers would find discomforting.

There was only a marginal change in intake noise during the switch-over process, but nothing that couldn't be easily dealt with during a vehicle development programme. Nor was there any delay during either tip-in or lift-off, the process being completely transparent at all engine speeds and loads.

Although the Yukon is currently being demonstrated to European OEMs, Delphi and Tula are building a more representative demonstrator, based on a European four-door saloon powered by a 1.8-litre turbocharged GDI engine, that will be commissioned in 2016.

Skip Fire in Real World Situations

HIGH TORQUE: MERGING ONTO THE FREEWAY



Doing the math

SKIP 0 FIRE 4	+	SKIP 0 FIRE 4	+	SKIP 0 FIRE 4	+	SKIP 0 FIRE 4	=	SKIP 0 FIRE 16
------------------	---	------------------	---	------------------	---	------------------	---	-------------------

EQUIVALENT TO 4.0 CYLINDER ENGINE

When you need full power from all cylinders, Dynamic Skip Fire takes a back seat and lets your engine take off to get you moving.

MEDIUM TORQUE: MODERATE TRAFFIC



Doing the math

SKIP 2 FIRE 2	+	SKIP 3 FIRE 1	+	SKIP 2 FIRE 2	+	SKIP 3 FIRE 1	=	SKIP 10 FIRE 6
------------------	---	------------------	---	------------------	---	------------------	---	-------------------

EQUIVALENT TO 1.5 CYLINDER ENGINE

When you just need a little power to move you, Dynamic Skip Fire starts purposely skipping cylinders with each revolution, saving you fuel.

LOW TORQUE: LOW SPEEDS



Doing the math

SKIP 3 FIRE 1	+	SKIP 4 FIRE 0	+	SKIP 3 FIRE 1	+	SKIP 3 FIRE 1	=	SKIP 13 FIRE 3
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EQUIVALENT TO 0.75 CYLINDER ENGINE

When moderate power is needed while just coasting along, the system can even turn off all cylinders in a revolution.

iStream T25 comes on stream

Gordon Murray's revolutionary iStream T25 city car has taken a further step forward with the unveiling of new partners Shell and Geo Tech, the aim being to launch a prototype in spring-summer 2016.

Running under the code-name T25S, in deference to Shell, the three-seater is a quantum advance over the original. Working as part of the engine development team, Shell is developing low viscosity engine lubricants typically in the range of 0W-12, and even less, for minimal friction loss in the engine. However, this has only been achieved by working in harmony with the engine development team at Geo Tech.

Headed by ex-Honda and Ferrari F1 engine boss Osamu Goto, Geo Tech has focused on reducing mass and internal friction of the base Mitsubishi 3-cylinder 660cc, 55kW engine. As the T25S weighs only 570Kgs and has a CD figure below 0.3, less engine power is needed, so it has been de-tuned to 36 kW at 5,500rpm and 55Nm at 4,000rpm; although there are hints at a 'unique' torque curve.

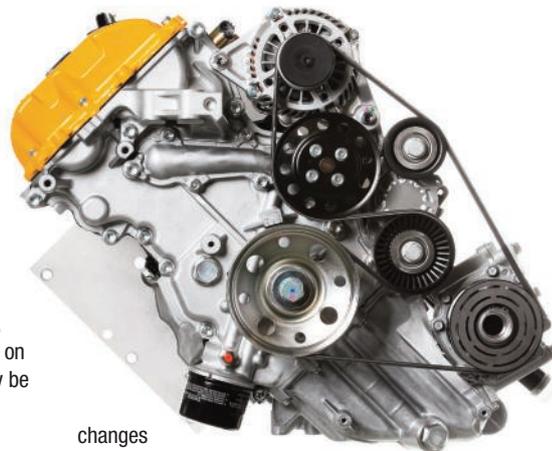
Central to the engine development has been liberal use of Diamond Like Carbon (DLC) coating to the pistons, pins and tappets. Amongst other modifications that were included: 30% shorter piston skirt, two instead of three pistons rings, 'beehive' variable rate valve springs and finally 9% longer con rods.

Although the original automated manual gearbox has been replaced by a five-speed Getrag Dual Clutch Transmission (DCT), apart from using a more efficient lubrication, no other modifications have been made to the transmission. According to Shell's technical manager for innovation, Robert Mainwaring, budget restrictions meant the team focused on the engine, "although the transmission may be addressed at a later stage".

Mainwaring is confident the T25S will achieve 2.82l/100Kms, but, more importantly, that its whole lifecycle running costs over a four-year period, including depreciation, will only be 26p per mile.

For its part, the Gordon Murray Design team, led by design director Andy Jones, has honed the original concept. While he concedes that sub 0.3 Cd is not ground-breaking, he says that the car's bluff front, tall aspect and overall short length mitigate against achieving a better drag coefficient. However, relocating the radiators from behind the front bumper to the rear heel board has delivered genuine aerodynamic gains, as well as improved engine cooling and heat dissipation.

The plan view of the T25S is now more 'waisted' than the original; it has a covered-in under floor and will benefit from upcoming



changes in legislation to allow rear view cameras to replace door mirrors.

However, the big breakthrough in the iStream assembly process is adopting a new Toray-developed carbon-fibre technology that allows panels to be moulded in 100 seconds.

As these aren't stress-bearing components and are 'A' class finished, it allows them to be fitted at the end of the car's production run, making assembly of the interior and installation of awkward items, such as seats and instrument panels, easier, without the risk of damaging the bodywork. "OEMs now see this assembly process as a realistic means of producing limited edition: 50,000- 60,000 cars a year."

He admitted to GMD having signed up two OEMs, but refused to be drawn on when any iStream products might reach the market.

JLR's 'POLAR 3' concept looks chillingly good

Jaguar Land Rover is developing a new eight-speed dual clutch transmission (DCT) with two reverse ratios for its Land Rover off-road vehicles. Codenamed 'POLAR 3', the concept's wide ratio spread of just over 17 between the top and lowest ratios – 20 is theoretically possible – means drivers wouldn't have to master changing between high-and low-ratios while on the move. "POLAR 3 enables seamless entry to the correct gear for any environment," claims a spokesman for JLR's Powertrain Research team.

Feasibility studies on a pure manual transmission began in 2010, with the upgrade to a DCT starting in June 2013. JLR is working with Drive Systems Design for the manual and Ricardo for the DCT, although no partner for the 'boxes' industrialisation has yet been announced. POLAR 3's gear train layout offers many potential advantages, most notably the wide ratio spread in one unit, as it can cover the range normally associated with both the low and high range of a Land Rover, improving its leading off-road attributes with seamless access to the correct

gear for the environment, with additional control features. Modelling predicts a much greater capability than a normal range DCT could achieve within the performance limits of a clutch.

The two reverse ratios come naturally from the architecture layout, but designing these for a low reverse ratio to suit Land Rover off-road loading and towing requirements means it can meet all customer requirements, while the higher reverse ratio is designed for normal usage.

As the transmission technology gives access to such a significant ratio spread, 'POLAR 3' can actually generate the output torque requirements for the most extreme off-road events, says JLR, without challenging the torque capacity of current four cylinder petrol engines. The unit displayed in Aachen is designed for a 600Nm diesel, but, as a research property, this was deliberately over-designed so functionality could be demonstrated without concern for durability. Further design studies are looking at optimising weight and packaging. Currently, wet clutches are used, but the developments in this field around 'moist' or

'damp', where the cooling flow is variable, ensure that extreme off-road manoeuvres can be maintained, with drag levels significantly reduced from a continuously wet design.

POLAR 3 has the ability to work with Land Rover's Terrain Response. The extra control the clutch pack gives adds a greater degree of control to the transmission, coupled to the ability to select the right ratio for the situation. For example, the distance and speed profiles can be directly controlled, instead of having to factor in the torque converter characteristic and using the brakes. Matched with the low range, this allows precise vehicle control, which, in turn, means Land Rover can further refine the features of its current terrain response and other technologies.

Although principally designed for all-wheel drive, the flexibility of ratios means that a similar layout can be used on rear-wheel drive, with the potential to modularly remove certain parts, such as the front drive, while the concept lends itself to both hybridisation incorporating an electric motor and 'sailing' capability.

All-plastic engine soon to be tested

Solvay is taking a leadership role in the development of the Polimotor 2 all-plastic automotive engine to be tested in a race car next year, demonstrating the company's advanced specialty polymer technologies in light-weighting through metal replacement.

The collaborative project will ultimately set the stage for innovative breakthroughs in future vehicles. Automotive engines are typically the single heaviest part in a car. Polimotor 2 aims to develop an engine weighing 63-67 kgs; or about 41 kgs less than today's standard production engine.

"The Polimotor project is yet another pioneering opportunity for Solvay Specialty Polymers to bring its innovations to the forefront and to expand its lightweighting offerings," said Augusto Di Donfrancesco, president of Solvay's Specialty Polymers Global Business Unit.

"Through this partnership, we will further challenge our boundaries, showing all the more that our high-performance polymers are solutions in reducing weight and lowering fuel consumption, and that they are a key contributor in diminishing CO₂ emissions."

In Polimotor 2, Solvay will replace up to 10 metal engine components – including the water pump, oil pump, water inlet/outlet, throttle body, fuel rail, cam sprockets and others – with parts made from seven of its high-performing thermoplastic materials.

The Polimotor 2 four-cylinder, double-overhead cam engine will ultimately be installed in a Norma M-20 concept car in 2016 for racing at Lime Rock Park, Connecticut, USA. Solvay contributed a major role towards the success of the first Polimotor engine, conceived by US engineer Matti Holtzberg in the early 1980s.

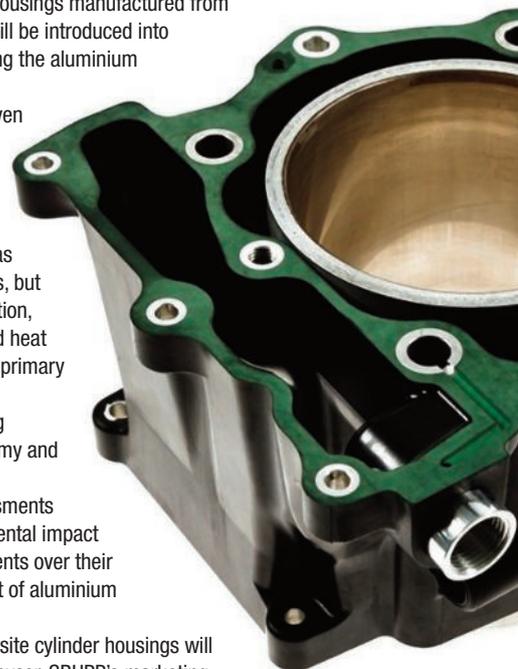
In a second development, SBHPP High Performance Plastics predicts

that by 2020 the first cylinder housings manufactured from polymer composite materials will be introduced into passenger car engines, replacing the aluminium components currently in use.

SBHPP's research has proven that glass fibre reinforced phenolic cylinder housings manufactured using the injection moulding process deliver the same performance as die cast aluminium components, but offer a significant weight reduction, lower engine noise and reduced heat radiation. Weight reduction is a primary objective for automotive manufacturers under increasing pressure to improve fuel economy and reduce emissions.

In addition, lifecycle assessments demonstrate that the environmental impact of phenolic composite components over their entire lifetime is lower than that of aluminium alternatives.

"In 3-5 years' time, composite cylinder housings will be a reality," said Hendrik De Keyser, SBHPP's marketing and technology officer. "We believe this composites technology will first be adopted in small engines up to 1.6 litres. Implementation in

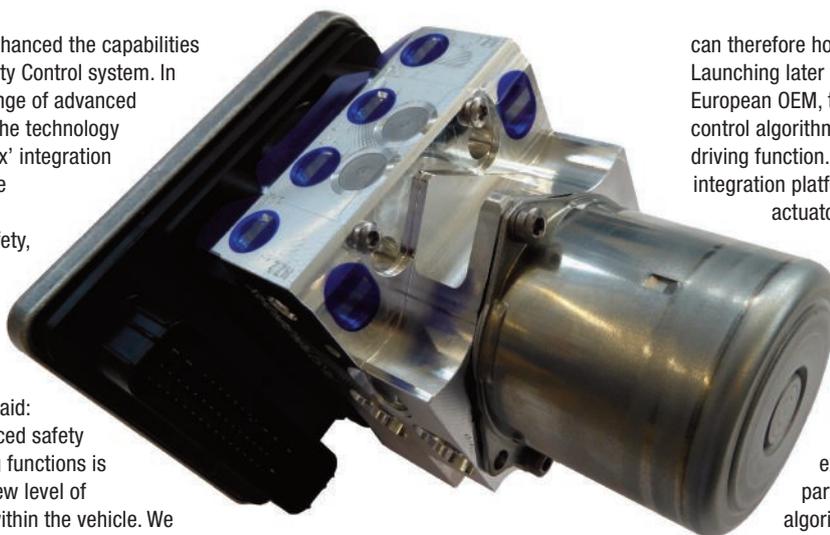


ZF TRW enhances Electronic Stability Control system

ZF TRW has further enhanced the capabilities of its Electronic Stability Control system. In addition to its wide range of advanced braking functionality, the technology can act as a 'black-box' integration hub – hosting software algorithms to control automated driving, safety, chassis and drivetrain functions.

Manfred

Meyer, global vice president, ZF TRW braking engineering, said: "The fitment of advanced safety and automated driving functions is demanding a whole new level of software integration within the vehicle. We need to consider clever ways, in terms of where and how we host the increasing number of functions. Utilising central 'processing hubs' – such as our ESC - is key and can help to reduce the amount of physical ECUs in the vehicle environment, as well as simplify



electronic architecture."

ZF TRW has developed its advanced six piston premium ESC technology (EBC 460), which now offers one of the most powerful microcontrollers in the automotive industry and

can therefore host considerably more software. Launching later this year with a major European OEM, the ESC module will host the control algorithms for an advanced automated driving function. Also, it provides the integration platform for enhanced chassis actuators – for example, the centre clutch, rear axle steering, electric park brake and drivetrain – helping to achieve the maximum comfort and sophisticated control of all vehicle dynamics. Meyer continued: "Our ESC provides a powerful execution platform for third party software components and algorithms, with the most demanding safety integrity levels (ASIL-D) combined with the very latest industry software standard (Autosar).

"It can enable a wide range of enhanced vehicle functionality far beyond the scope of typical ESC systems."

higher performance and higher displacement engines will follow." SBHPP has been developing thermoset composite parts for the automotive industry for more than 20 years. Recent work has involved a cooperation with the Fraunhofer Project Group – New Drive Systems, in Karlsruhe, Germany, during which SBHPP manufactured a proof of concept composite cylinder casing for a single-cylinder 650 cc engine.

A 55% glass fibre reinforced phenolic was used, in combination with integrated metal inserts and a metal cylinder liner. The optimised injection moulding process developed resulted in a cycle time of 90 seconds.

Compared with an aluminium part, the composite casing delivers a weight reduction of up to 20%, with manufacturing costs approximately 10% lower for a production run of anywhere up to 30,000 parts a year. For higher production volumes, this cost reduction becomes even more significant.

Acoustic tests confirmed a significant noise reduction for the composite cylinder casing, compared with the aluminium reference part. In addition to that, thermal tests verified reduced heat radiation from the composite part to the surrounding environment. Thermosensors mounted on the exhaust, drive and inlet side of the composite part showed a significantly lower temperature than sensors on the aluminium component.

SBHPP is now planning to work with engine suppliers and automotive OEMs to take this concept to market. It also plans to develop a more complex multi-cylinder composite-based engine, with the ultimate aim of introducing an all-composite engine. This is envisioned in the virtual engine concept, a small, scalable engine architecture with two-, three-, or four- cylinders using SBHPP compounds and composite materials. This engine is designed for use as primary engine for passenger cars or as a range extender for electric vehicles.



Silent Core cuts drive-by noise

Quieter tyres that minimise distraction noise and in-cabin drone have been developed by Falken Tyre. While cars are getting quieter, tyres can still generate a notable amount of drive-by noise. Air inside the cavity vibrates and resonates, causing vibrations and sound to be transmitted through the vehicle into the cabin.

Falken Tyre, together with its parent company Sumitomo Rubber Industries (SRI), has developed a patented solution called Silent Core, which

reduces noise, thanks to a layer of innovative ether-polyurethane foam material applied to the inside of the tyre carcass. Absorbing sound, the double-humped foam layer can achieve drive-by noise reductions of up to 10dBA, compared to standard tyres, and can also decrease cabin noise by up to 4dBA.

Testing to date has shown that tyre performance is unaffected, with Silent Core lasting the tyre's lifetime.

Silent Core is currently undergoing a pilot phase with an automotive manufacturer.



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News in brief

ASDEC honours

The University of Leicester's Advanced Structural Dynamics Evaluation Centre (ASDEC) has been recognised as making the most important contribution to UK business of any research commercialisation or knowledge exchange activity in 2015.

The facility consists of a laser vibrometry test rig, which is unique in the UK and one of only three in the world that are commercially available.

ASDEC employs the newest and most effective way of measuring vibration, laser Doppler vibrometry (LDV). This depends on very accurate measurement of the deflection of laser beams as they strike a vibrating object. The reflected laser reveals the deflection of the target. Reducing vibration is the aim of design engineers across multiple industries, a goal often obstructed by the difficulty of obtaining good measures of vibration as it happens.

Series of firsts

The electromechanical camshaft phasing unit developed and produced by Schaeffler is about to be used for the first time in volume production in a series of Japanese engines. The use of electromechanical phasing units, instead of the current standard hydraulic systems, allows the camshaft to adjust more quickly and accurately to the prevailing engine operating conditions. This reduces consumption and harmful emissions, while simultaneously increasing comfort during stop/start operation.

Theta-FiberCell covers

To support OEMs in reducing vehicle emissions and noise, Autoneum has extended its broad range of lightweight and noise-reducing components to include multifunctional engine covers made of Theta-FiberCell. Compared with conventional plastic engine covers, those made of Theta-FiberCell are more than 50% lighter, equivalent to a weight reduction of up to 1Kgs per vehicle. At the same time, they absorb engine noise contributing to improved acoustics in the passenger compartment and enhanced driver comfort. Theta-FiberCell can withstand temperatures of up to 200°C and is highly resistant to engine vibrations.

Stahl's centre of excellence springs into action

Stahl's new automotive centre of excellence in Waalwijk, the Netherlands, focuses on developing high-performing and sustainable solutions for car interiors, varying from smart surfaces that change with temperature to special haptics for a pleasant touch.

The centre is equipped with state-of-the-art machinery to cater to the needs of the automotive industry: there is a unique coating, lacquering and printing line, including a full scale vacuum forming machine to produce full door panel skins. Also, it has two unique squeak and rattle testing machines for seating and trim materials, and weather strips.

"Due to our thorough in-house testing, we are able to develop the new technologies and state-of-the-art products our clients are looking



for – technologies reducing the interior's weight by using lightweight leather or solutions for problems that cause frustration among consumers, like scuff marks and stains on seat material or squeaking and rattling seats," explained Stefan Buri, global marketing director automotive.

First thermoplastic oil tank for dry sump engines



The world's first thermoplastic oil tank for dry sump engines has been developed by Hummel-Formen. The reservoir weighs around 2.6kg and is made from Ultramid A3WG7, a BASF polyamide 66 with 35% glass fibre reinforcement resistant to oil and thermal aging. The tank is 59% lighter than previous steel or aluminium constructions and has an improved, multi-functional oil separation system integrated into the tank installed in the new Mercedes-AMG GT.

The oil reservoir has an ingenious geometry, comprising 10 different, injection-moulded polyamide parts, joined together with 13 further elements like sensors, sieves, covers and screws to form one component – effected by vibration welding and snap-in mechanisms.

By optimising the available space, different functions could be integrated: apart from storing oil, it deals with crankcase ventilation, including oil separation; allows the filling and changing of oil, as well as controlling its level and quality; and slows down and filters the incoming oil.

The Ultramid used is oil and corrosion resistant, and thermally stable up to 180°C (for short periods, even up to 240°C). It also contributes to vibration and

acoustic behaviour, because of its high damping and stiffness, and is quieter than metal versions. PA66 also withstands the required burst pressures.

As well as being lighter, quieter and more compact, it can be fitted in the middle of the engine compartment, below the fender. The refined internal structure, with various elements and functions for the integrated oil separation, would not have been possible with metal.

Since the Mercedes-AMG GT was also developed for the race track, it requires dry sump lubrication. As such the tank is configured so that the pressure oil pump is always able to reliably suck in oil, even in extreme driving situations while cornering at high speed or heavy braking.

Simulator partnership ensures the human touch

MTS Systems Corporation has engaged UK simulator software specialist rFpro for its new vehicle driving simulator (VDS). rFpro's low latency and high bandwidth technology, combined with its high definition road modelling, provides the engineering quality and immersion for realistic evaluation and testing by a human driver of ADAS (Advanced Driver Assistance Systems) and vehicle dynamics.

MTS' new, state-of-the-art lightweight all-electric simulator, combined with rFpro's software, offers a cost-effective, turnkey solution for vehicle manufacturers and tier one suppliers to re-introduce a human test driver into the model-based engineering process.

"The availability of a turnkey driving simulator solution with cutting-edge dynamic performance from a leading global supplier is a game-changer for vehicle development," said rFpro's technical director Chris Hoyle. "It offers customers a low-risk system fully compatible with existing vehicle modelling tools, such as



Dymola, SIMPACK, CarMaker and CarSim, and extends the reach of real-time 'driver-in-the-loop' simulators into key areas of active safety, vehicle dynamics and autonomous testing."

One option available with the MTS VDS is mechanical hardware-in-the-loop (mHIL), which runs physical systems alongside virtual models in real time. This allows a human driver to evaluate steering system feel, or the ride and handling behaviour of different dampers, long before a prototype vehicle exists. Used in combination with the library of worldwide road surface models in rFpro's Terrain Server tool, the

effect of every surface change at the contact patch of individual tyres can be experienced.

According to MTS, the unprecedented speed of rFpro's audio and visual cueing is a key contributor to overall system performance.

"In order to bring to market the next generation of dynamic platform performance, we required software that was equally capable," said Professor Mark Gillan, director – MTS Motorsports Technology Group.

"With rFpro, we found a proven solution with low latency, high bandwidth and exceptionally high definition graphics, essential for closing the loop through the driver quickly and providing the necessary realism."

Traditional driving simulators typically introduce latency of between 100 and 250 msec. The combination of stiff, lightweight, all-electric platform hardware and rFpro software delivers the virtual testing experience faster than the threshold at which humans can perceive latency for the audio, visual, haptic and vestibular cues.

Castrol behind "most significant oil change innovation" ever

Castrol has launched Nexcel, which it describes as "a new revolutionary technology that marks the most significant oil change innovation in automotive history", in the Aston Martin Vulcan track car. Road cars fitted with Nexcel are expected to go into production within five years.

The system is said to offer manufacturers and drivers three key benefits in performance, servicing and sustainability:

- Castrol has demonstrated that Nexcel delivers a reduction in carbon dioxide (CO₂) emissions on modern engines. Moreover, the technology paves the way for a new generation of precision-engineered engine oils delivering further engine performance and CO₂ benefits
- Nexcel makes the oil change quick and clean for workshops, allowing them to offer more flexible and convenient service options to customers
- Oil cells are collected after use, avoiding wastage of old oil, which can be refined back into high quality lubricant.

Nexcel has been tested on a range of engines, from small city cars to high-powered racing engines in the most extreme of conditions. It functioned smoothly, even under severe braking of up to 1.8G, the

equivalent of a vehicle travelling at 100km/h stopping dead in 1.6 seconds. Additionally, the system oil flow has been tested at up to 600 litres a minute – that is between 10 and 20 times greater than would be seen in a conventional passenger car engine.



Tata Steel expands hot-dip galvanised coatings range

Tata Steel has expanded its range of MagiZinc hot-dip galvanised coatings with a Full Finish variant. As a result, the benefits of the zinc-magnesium coatings – such as considerably higher corrosion protection and improved press shop performance, with less downtime – are now also available for automotive outer panels

Complex-shaped outer panels, such as bonnets, doors, body sides, fenders and tailgates, are parts where the benefits are particularly noticeable. MagiZinc Auto's 25% lower zinc abrasion significantly reduces zinc adhesion, as well as tool pollution, extending press operating time by 30 %. Previously, the processing of zinc-coated parts had to be frequently interrupted for tool cleaning and maintenance to ensure the desired high quality level. Corrosion protection provided by MagiZinc Auto is twice that of conventional zinc coatings and has excellent resistance to stone chipping, enabling a reduction in coating thickness.

These benefits make Tata Steel's innovative coating of zinc alloyed with magnesium and aluminium a cost-effective and sustainable alternative to conventional steels.

Tata Steel is currently working on combining MagiZinc with its optimised steel surface technology Serica. Along with the benefits of the innovative zinc-magnesium coating, this combination will enable vehicle manufacturers to improve the paint appearance of their outer panels and lower their costs. Serica is notable for a guaranteed low waviness of less than 0.40 µm at 5% strain after forming and was specially developed to achieve an outstanding paint appearance for outer panels.



GKN Driveline has developed a new family of lightweight constant velocity (CV) joint systems that enable rear-wheel drive platforms to save more than 4kg of weight.

The new VL3 CV joint increases torque capacity by up to 27%, with no increase in packaging size. Available in four sizes, the VL3-33ISM variant now has a torque capacity of 3300Nm in a package previously capable of delivering only 2600Nm. The VL3 CV joint system can also maintain performance, while reducing package size by approximately 7%. Overall, the sideshaft system offers weight reduction of up to 4.2kg per vehicle set.

With a plunging distance of 18mm, the VL3 can be used for a rear constant velocity sideshaft for medium working angles, with low axial forces and minimum backlash. It uses a Monobloc Tubular Shaft and Face Spline connection to the wheel hub to achieve significant packaging and weight advantages, as well as noise, vibration and harshness (NVH) behaviour benefits.



Johnson Controls invests in new vibration test system

Johnson Controls has expanded its test capabilities in Burscheid, Germany, with a new hydraulic high-frequency vibration test system, investing around €2million in the system. Equipped with six axis, the state-of-the-art system enables comprehensive comfort and durability tests – over a driving distance of 100,000 km (62,000 miles). Installation in a special climate chamber allows the simulation of different weather conditions.

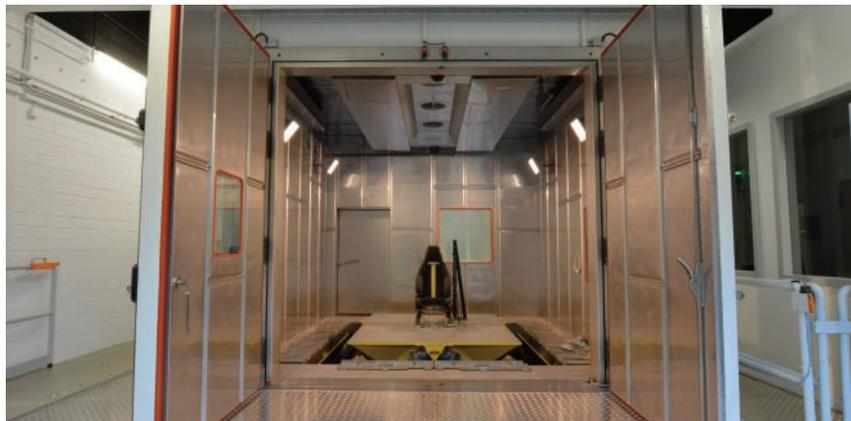
"With its range of high-performance functions, the new shaker is unique in the automotive supplier industry," maintained Dr Detlef Juerss, group vice president and general manager product group seating components at Johnson Controls.

"The 200Hz system is a milestone in our development and quality assurance, and underlines our goal of manufacturing the best

automotive seats in the world." With a maximum frequency of 200Hz, the test system shakes test specimens for several days, pushing complete automotive seats or individual components and modules to simulate the entire lifecycle of seats over a driving distance of around 100,000 km (62,000 miles)

The shaker also enables comfort checks with lower motion frequencies. Live test subjects literally 'take a seat' in the system for this and provide their subjective impressions of the test seat, while sensors collect further objective data. This enables an exact determination of whether cushioning is comfortable or not, and how the overall 'feel' is experienced.

To complete climate tests, the new six-axis shaker has been installed in a chamber that can simulate temperatures anywhere between -40°C and +100°C.



Federal-Mogul Powertrain eliminates sealing challenge

Federal-Mogul Powertrain has overcome an increasingly common sealing challenge on turbocharger outlet flanges where the gasket comprises multiple layers by developing a new manufacturing process that eliminates the sealing issues that can occur when welding dissimilar materials. "There is a known product quality challenge arising from the use of turbocharger gaskets made from a number of layers," explained Thorsten Schäfer, global engineering manager rigid heat shields, Federal-Mogul Powertrain.

"When stainless steel and aluminium-coated steel are welded together, a reaction can occur that compromises sealing integrity in the finished part. A recent design optimisation opened the door for this new welding manufacturing process, thereby eliminating the issue."

The turbocharger outlet flange gasket comprises a thick steel distance layer that is aluminium-coated for corrosion resistance and to reflect heat, sealed on both sides by functional stainless steel layers, each with a sealing bead. To avoid handling multiple separate parts, all three layers are welded together, but this can create issues with sealing uniformity, with the aluminium coating reacting during welding, creating bubbles that generate high spots on the sealing face, leading to variations in contact pressure.

Federal-Mogul Powertrain's solution is to have three holes blanked out of the distance layer and three dimples created in both of the sealing layers. This ensures accurate location of the separate components, allowing the functional outer layers to be spot-welded to each other directly through the dimples, without affecting the material in the distance layer, uniting the whole assembly.

Federal-Mogul Powertrain believes it will also be equally effective for many other applications where functional gasket layers are combined with a coated distance layer or heat shield, on both petrol and diesel engines.



Connecting in Frankfurt

September saw the biennial IAA (Frankfurt Motor Show) rise to new heights, with 219 world premieres and 1103 exhibitors from 39 countries.

A significant show within the show addressed the megatrend of connectivity with the theme, 'Mobility Connects'. The dedicated exhibit called New Mobility World held over 180 exhibitors, and 46 production and prototype cars.

According to the VDA, one quarter of all new cars have an Internet connection and, two years from now, the figure will be 80%. The German automotive industry alone will invest €16-18 billion over the next 3-4 years in connected and automated driving R&D.

The large German suppliers, Bosch, Continental and ZF, among others, demonstrated how connectivity and automation can vastly improve road safety and passenger convenience in the future. Bosch exhibited connected car technology that can see ahead—farther than any sensor, and with much more up-to-date information than any map—to navigate around traffic jams, accidents and construction zones. The company says its electronic

horizon technology will make automated driving safer and hybrid vehicles will know when to convert braking energy into electricity to extend their range.

The technology can also regulate particulate filter regeneration, based on route data. The electronic horizon's navigation software will know that an urban area is approaching and could charge its battery in preparation to pass through a full-electric, zero-emissions zone.

Continental showed a test vehicle with adaptive cruise control, combined with elements of its similarly themed dynamic eHorizon technology. The Connected Enhanced Cruise Control test vehicle combines the accuracy of road maps and vehicle sensor data on such things as lane-keeping, routing, curve radius, road slope and traffic congestion.

It effectively enables the vehicle to 'see' around corners.



Aggregation and analysis of the data provided from various sources is performed by a scalable backend platform created in cooperation with IBM.

The new ZF/TRW combination exhibited its first joint development effort in the all-electric and connected ZF Advanced Urban Vehicle, which has semi-automated functions intended to enhance comfort/convenience, safety and efficiency. Its PreVision Cloud Assist function, like the other two companies' offerings, provides Internet connectivity to aid maximum range and driving safety by storing data in the cloud on vehicle position, current speed, and lateral and longitudinal acceleration. If the driver follows the same route again, the assistance function can throttle back torque early on before entering the bend, without mechanical braking.

Keen to establish recurring after-sale revenue streams, all major automotive OEMs and their supplier partners are investing in connected-car programmes.



focus@sae.org

Electronics arms race heats up

The automotive supply chain landscape is undergoing a massive transformation. Dr Elmar Degenhart, chairman of the executive board, Continental AG, tells Ian Adcock how his company plans to be right at the forefront

Continental's €600 million acquisition of Elektrobit's Oyj's automotive division, together with its 1,900 software engineers, was confirmation, if any were needed, that the supply chain landscape is undergoing seismic changes. Clearly, as the big players battle for dominance in a sector where electronics and software in vehicles, along with the ability of cars to connect with smart 'phones and other portable communication devices, this is rapidly becoming a new business model.

Add to that sophisticated car-to-car and car-to-infrastructure communications and the advent, albeit some decades off, of autonomous driving, and the old business model of tier ones supplying OEMs with oily bits suddenly begins to look arcane.

The Continental purchase also included Elektrobit's 51% stake in a joint venture with Audi AG, which includes products like head-up displays (HUD), voice-recognition and on-board entertainment systems.

"We need to have systems integration capability; at the end of the day, we're talking about software competence that Elektrobit is focused on," says Dr Elmar Degenhart, chairman of the executive board, Continental AG. "At the moment, we

have more requests from customers to carry out systems integration work than we can handle ourselves.

"We will continue to grow organically, but about a year ago we realised it would take too long to build up those capabilities and capacities to fulfil all our customer requirements. So we then tried to do a step-change to acquire a software company. Elektrobit is a highly specialised software integrator, working with other manufacturers

start-up in Silicon Valley taking care of intelligent transport systems; it's a new business model for us selling software without hardware. We hired a top manager from Google and, by the end of next year, our target is to have about 200 employees and be generating profit in the next few years. Is it good enough to let this group grow organically or do we have to give more support with merger and acquisitions also? Time will tell."

Degenhart claims that Continental is one of the few tier ones that "can play the systems portfolio from left to the right. There is Denso, Bosch, ourselves and ZF, with its acquisition of TRW, is trying to enter the same level. But I would like to say that,

and suppliers. We believe we can create a lot of synergy in the next five years by letting our divisions work with Elektrobit more intensively than in the past," he states.

THE RACE IS ON

It is clear from what he then adds that the Hannover-based tier one is determined not to be left behind in the electronics arms race. "We have a

with regard to the completeness of the portfolio between these three or four and the next companies, there's a chasm."

Backed up by a Frost & Sullivan report identifying the product



Dr Elmar Dagenhart

CV

Born January 29, 1959, Dossenheim, Germany.

1979-1987: Air and space technology at the University of Stuttgart Diploma: 'Diplom-Ingenieur'.

1992 Ph.D: Thesis on mechanical engineering in clean room technology, employed at the Fraunhofer-Institute for manufacturing engineering and automation IPA. Head of department handling and industrial robot systems.

1993-1998: ITT Automotive Europe GmbH director operations brake systems North America.

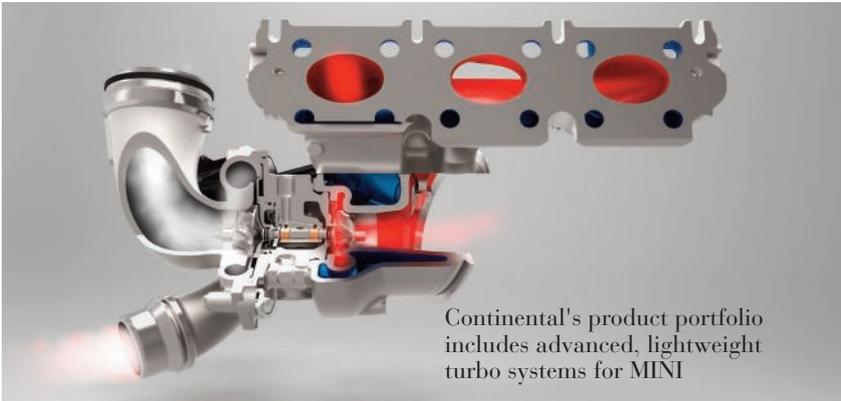
1998-2003: Continental AG executive vice president electronic brake systems. Member of the management board of Continental Teves AG & Co. HG

2004-2005: Robert Bosch GmbH president chassis systems.

2005-2008: Keiper Recaro Group chief executive officer.

2008-2009: Schaeffler Group Automotive president.

Since August 12, 2009: Continental AG, chairman of the executive board, additionally responsible for corporate communications, corporate quality and environment, Continental business systems, automotive central functions.



Continental's product portfolio includes advanced, lightweight turbo systems for MINI

segments that will grow most rapidly in the next five years and comparing Continental's portfolio with its major rivals, Degenhart says the analysts concluded that Continental is in the leading position with "no white spaces", compared to its rivals.

"That's why we believe we can outperform the industry, in terms of growth. The average growth rate of the market will be 2-3% to 2020.

"If you take €34.5 billion sales last year and assume that we will achieve our target of €50 billion by 2020, then extract the automotive sector as part of that €50 billion, you conclude that we outperform the market by 4%," he continues.

"This growth and our performance is not only by volume, but especially by innovative technology that allows us to bring more value into the vehicle – innovation is of no value, if you can't industrialise it."

MEGA-TRENDS

Continental, which spends about €2 billion – or 6% of sales – a year on research and development has, reveals Degenhart, identified three mega-trends that all five divisions will contribute towards. "Efficiency is important. If we don't get the vehicles cleaner, we will kill the planet, so it's a joint obligation between our customers and suppliers to focus on that."

Continental is focused on both petrol and diesel with turbo charging, management and hybrid systems. And although he forecasts that the relative share of internal combustion engines will decrease in the future, the absolute number will increase over the next 15-20 years.

"The only game-changer to alter this scenario in the next 5-10 years is if somebody arrives with a battery cell that fulfils some strange requirements: First, the range would have to be

greatly extended, so the energy of the cell would have to be tremendously enhanced with a range of 500-600kms. Secondly, the cost would have to come down significantly. Currently, we operate at a range of about €350-400 per Kw/h, so that would have to come down to €100; we need an infrastructure to provide charging stations in a way that would be convenient for the drivers. If you have to do this on a dark winter's night, the vehicle is dirty, you have to



plug into a connector somewhere in your house – that isn't convenient. We need contactless charging technology... these things will take time."

PREVENTING FATALITIES

With more than a million annual road fatalities and more than 15 million injuries yearly, safety – unsurprisingly – is Degenhart's second mega trend. "We've only had the technology available for a couple of years to prevent fatalities completely. It's our obligation to industrialise these and make them affordable not just for luxury cars, but also small ones; what we call 'Vision Zero'."

Finally, there is information management and connectivity. "We have to bring the Internet into the car and connect the vehicles to the infrastructure for safety, comfort and connectivity." However, as he warns, customer acceptance and a



Curved Organic Light Emitting Diode instruments displays are lighter and more efficient

willingness to pay for these new technologies differ.

“Safety and information management is consumer driven. We know from surveys that buyers are willing to spend money, if it can be proved that safety is enhanced and information management can be brought into vehicles, whereas efficiency is purely driven by regulations and drivers aren’t really willing to spend more for hybrid technology. From their standpoint, it



doesn’t enhance the vehicle’s functionality.”

Intelligent transport solutions provide Continental with a “rich opportunity” to expand the business beyond delivering hardware to entering the service sector with software as a business model, “and that means licences,” he points out.

There’s a need, according to Degenhart, to distinguish between services that make cars more attractive – ie, bringing the Internet and other links that are available on portable devices into cars and traffic management to prevent delays. Enabling this will be autonomous driving, in the long run, but before then both the supply chain and the OEMs will have to negotiate financial agreements with the Googles of this world as to who owns or earns from this increase in connectivity.

“Today, there are some 3billion Internet users around the world online

for about 30 minutes a day. The Internet industry judges its earning power at about \$2 an hour, so that makes a market of roughly \$3billion per day; most people use the Internet at work and privately. The biggest white spot left is vehicles.

BILLION-PLUS VEHICLES

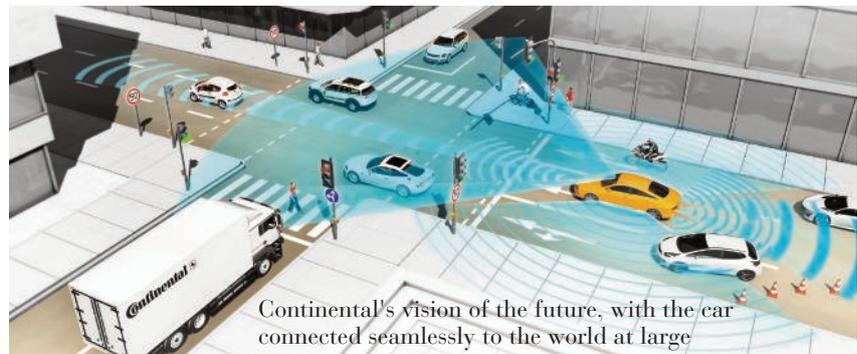
“With more than a billion vehicles on the road, we know the average driving time is about an hour, giving a theoretical potential of a billion user hours. That’s a huge interest for the IT industry.” Even if you make a more conservative estimate of upwards of 200 million user hours a day, it’s still a massive market and it will be a fascinating process to see who profits from it: the providers, OEMs or the supply chain.

“If the Internet companies are only interested in providing services, that might go against the interest of our customers, depending on the data being harvested, as some OEMs might take issue with that. They don’t want to give away the

It depends on what you’re talking about. We’re open for collaborations with the Internet industries, as long as they aren’t starting to compete with us on our home turf.

“The collaboration and intention of the Internet industry is not black and white, and we will see business areas where co-operation makes sense and others where it definitely wouldn’t be in our interest.”

In summing up, Degenhart says, that while his company has to support all three megatrends in parallel, there’s a second challenge. “Fifty years ago, our customers used to roll out new models step by step over a 12-15-month period. New models now have to be rolled out in 3-6 months worldwide, which is a huge logistics challenge for them and us, because it’s no longer accepted that safety technology is introduced at the top and then takes 5-7 years to cascade down to smaller cars. It has to be done in a shorter time frame, especially if it’s safety relevant. That means requirements with regard to scalability



data generated by the vehicle itself. That is their core business; they want to stay in control of that.

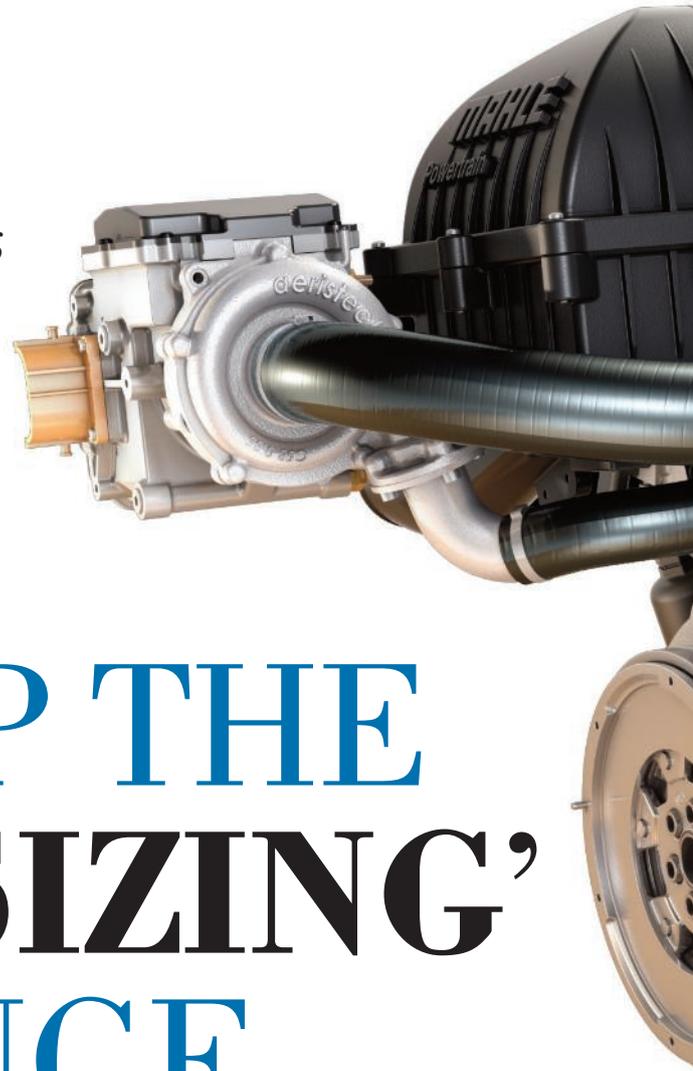
“If you’re talking about data generated by the driver, this is different again. But when you’re talking about services that come as a benefit to the vehicle behaviour or the driving situation, our OEM customers might also want to be a service provider there,” he points out.

“We believe this might be a business opportunity for the suppliers.

exist from the first day of development.”

When Continental AG acquired Siemens VDO Automotive AG, many predicted a severe bout of indigestion at the very least and, for a while, as the global economy wobbled and the automotive industry headed into a downturn, it seemed that would indeed be the case. But the business has pulled through and, seemingly, is now in rude health and set to challenge the global leaders.

With VW's 'Dieselgate' reverberating in everyone's minds, this year's Aachen automobile and engine technology Colloquium was particularly pertinent. Ian Adcock reports on the most significant technologies and presentations



SIZING UP THE 'DOWN-SIZING' CHALLENGE

While many OEMs prefer to call it 'right-sizing' – for instance, Porsche's description of its new three-litre flat-six – 'down-sizing' is very much seen as an enabler that will allow petrol engines particularly to meet future emission levels, without compromising power and performance.

However, as Dr, Mike Bassett, head of Mahle's hybrid product group, explains, making the engine smaller in itself isn't the universal cure many think it to be, as it brings its own limitations and demands.

"As we step down in size, the specific power output and brake mean effective pressure (BMEP) required to maintain equivalent performance to that of the original engine increases drastically. As the

level of downsizing increases, the relative sizes of the bearings have to be enlarged to cope with the higher specific output of the engine, resulting in increased engine friction on brake specific fuel consumption (BSFC). As a result, the estimated effect of CO₂ reduction for the 'friction corrected' case peaks at around 75% downsizing. Engine detonation has to be mitigated as well, by reducing compression ratio, but that's detrimental to part load fuel economy."

To get beyond current state-of-the-art gasoline engines, 120kW/l and 24bar BMEP multi-stage charging systems are required, says Bassett. Mahle's target was 160kW/l and 32 bar BMEP. "It's close to where optimal downsizing lies and is relatively easy to achieve."

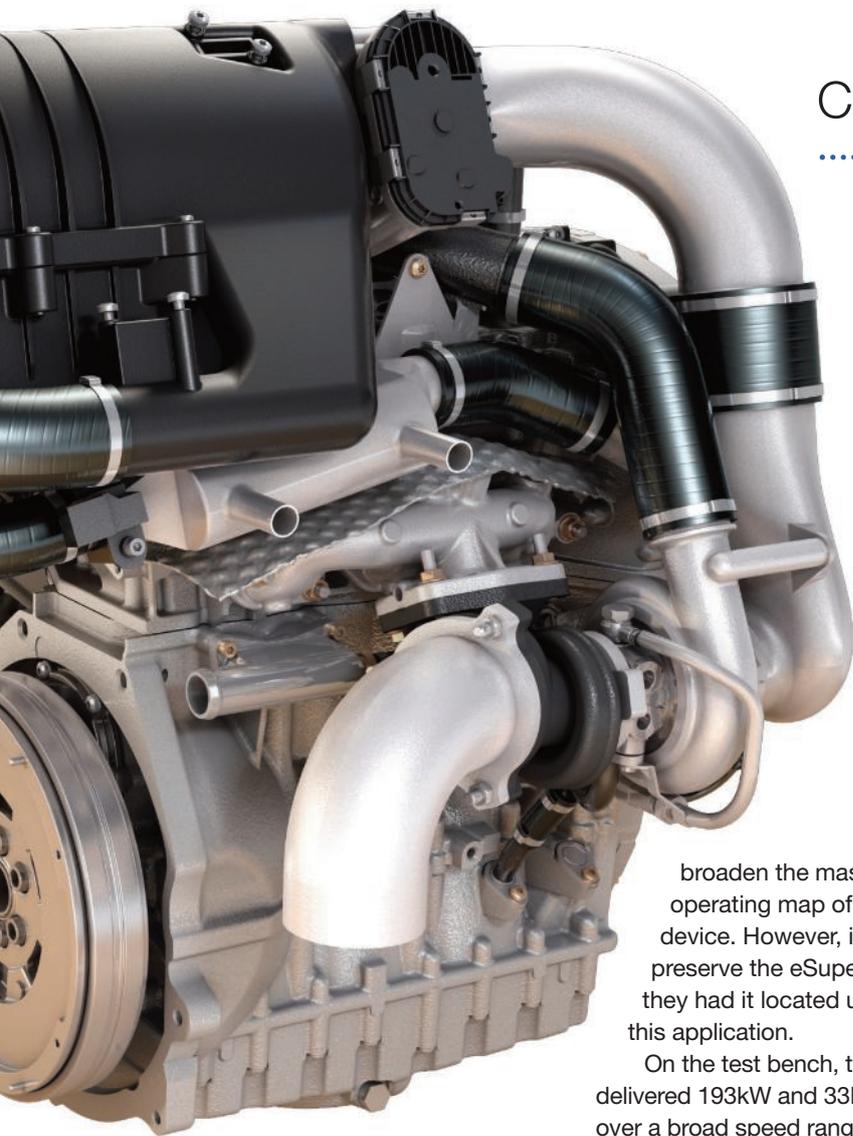
The original engine was developed

some seven years ago and has since been subjected to ongoing development to reduce frictional losses, part-load management to push the technological boundaries.

It has an unusual configuration for a 1.2-litre down-sized engine, with an



Aeristech's water-cooled 48v eSupercharger runs at 120,000rpm.



Cover story

vehicle running with the engine by the end of 2016.

VCR SPARKS STRONG REACTION

FEV revealed that its variable compression ratio (VCR) con rod, first seen 12 months ago, is now undergoing extensive trials in diesel engines, as well as spark ignition.

Far more radical was IAV's take on VCR, whereby the cylinder head moves vertically to vary the compression ratio using a combination of eccentric cams on either side of the block and the CR itself to move the head.

For IAV this is "only one solution as to how we can manage this", explains Axel Seiffert, responsible for the company's diesel engine concept development. "Our main idea was how can we get from 80kW/l to 110 and one solution is VCR."

The rather complex solution was arrived at to provide engine stability, without affecting the connecting rods and piston movement, to minimise friction in the moving components.

"We only move the mono head, which includes the cylinder liner and

broaden the mass flow operating map of the electrical device. However, in order to preserve the eSupercharger, they had it located upstream in this application.

On the test bench, the engine has delivered 193kW and 33Bar BMEP over a broad speed range and 90% maximum torque in 1.2 secs.

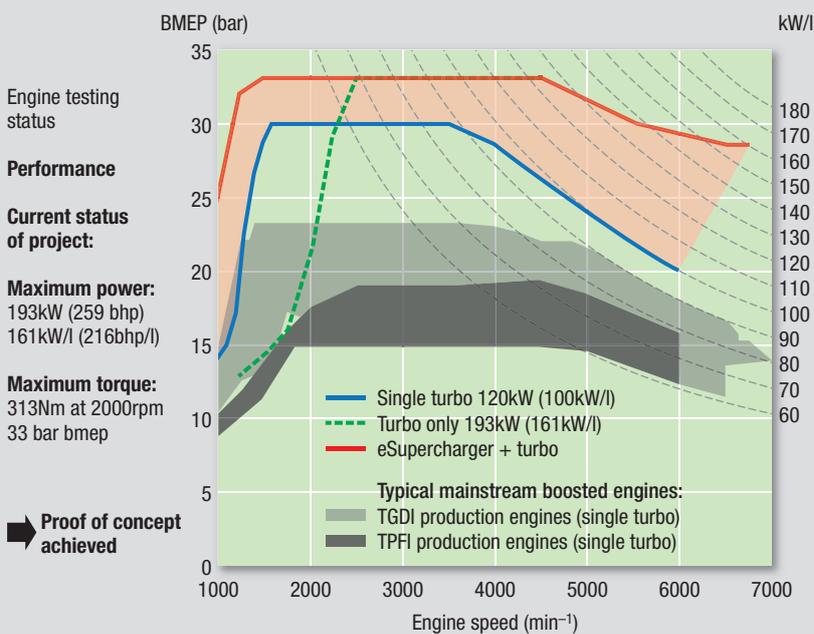
Mahle plans to have a prototype

83mm bore and 73.9mm stroke for good fuelling around the valves, injector and spark plug for good knock resistant, states Bassett, with 9.3:1 CR; using a single stage turbo, it produces 120kW and 30bar from 1,600 to 4,000rpm.

However, to achieve 160kW/l high boost pressure over a wide operating range with good transient response from any engine speed. Mahle chose Aeristech's 48v eSupercharger, running at 120,000rpm, water cooled it uses permanent magnet and greased for life bearings. One benefit of this system is that it can run consistently at 5.6kW and transient power of 8.6kW for rapid transient boost.

Bassett believes the best location of the eSupercharger is downstream of the main compressor, as high pressure air from the turbo helps to

Dynamic downsizing for gasoline engines



Credit: Mahle

head, lifting the upper part from the crankcase to adapt the CR to the operational point,” he explains. That can range from 11:1 for full load to 20:1 under part load. “We also want to increase thermal efficiency by using a higher compression ratio, compared to around 16:1 for diesel.”

IAV believes this strategy could lead to quite aggressive downsizing from a three-litre V6 diesel to an in-line four; although the majority of the energy that is required to move the head up and down by 5 mm comes from electric step motors acting on a sophisticated knee lever kinematic.

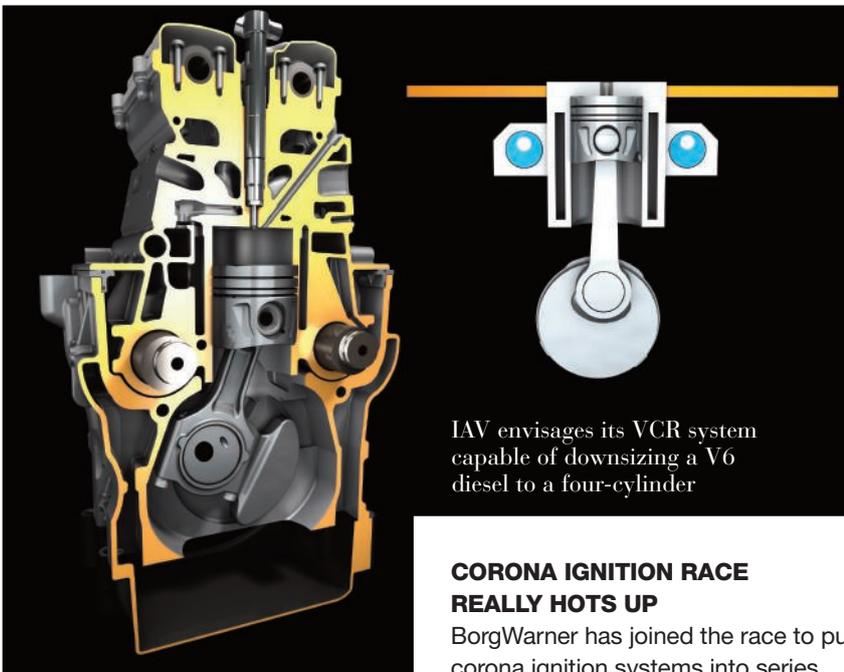
only 300-400 bar injection pressure is used, rising to 2000bar.

IAV claims a fuel saving in the region of 4%, with a further 6% attributed to downsizing with equal power output. If compared to an engine with the same displacement, VCR can help to increase power output in the range between 20% to 40%, depending on the injection nozzle layout.

Seiffert admits a four-cylinder version of the engine would be a “little” heavier than a non VCR four, but still less than a V6, while friction is reduced by the loss of two cylinders.



Borg Warner 'EcoFlash' ignition system allows higher EGR rates, as well as very lean mixtures



IAV envisages its VCR system capable of downsizing a V6 diesel to a four-cylinder



For increasing loads, a CR of 20:1 would be reduced stepwise to 11:1 to control the maximum cylinder pressure, allowing for a further increase of the specific power.

The piston bowl has also been re-profiled, compared to a standard Omega-shaped bowl, to optimise air utilisation under variable top dead centre position of the piston. “We maintain the same spray shape and cone angles and same number of (8) hole in the injector nozzle,” adds Seiffert.

At engine speeds close to idle,

CORONA IGNITION RACE REALLY HOTS UP

BorgWarner has joined the race to put corona ignition systems into series production. It's 'EcoFlash' technology started out as a collaboration with Renault before BorgWarner took over the project in 2013. “We now have a big number of potential customers,” claims Alexander Schenk, manager global R&D corona ignition emissions systems.

The system delivers 500 millijoules (mJ) energy – that's five times greater than a conventional spark ignition system. The big advantage is that you're able to ignite mixtures with very high exhaust gas recirculation (EGR) rates or very lean. In one test, according to Schenk,

BorgWarner doubled the EGR rate from 15 to 30%, without any detrimental running problems. “This system gives engine designers greater freedom to expand limits and realise combustion processes currently limited by conventional ignition systems.”

The development programme is currently transferring from the development phase into production, with both automotive and non-automotive customers for stationary gas engines.

“We create very high homogenous electric field strength in front of the electrodes that generates the discharge; the streamers don't reach the electrical ground potential,” he adds. “That means lower currents



BOOST FOR MINIMISING TURBO LAG

“Many OEMs are interested in minimising turbo lag, so the eBooster is the perfect device to reduce that lag and enhance transient response,” says BorgWarner’s Dr Jürgen Adam, business director eBooster Turbo Systems. “It’s a combination of fun to drive, CO₂ reduction and the chance to downsize.”

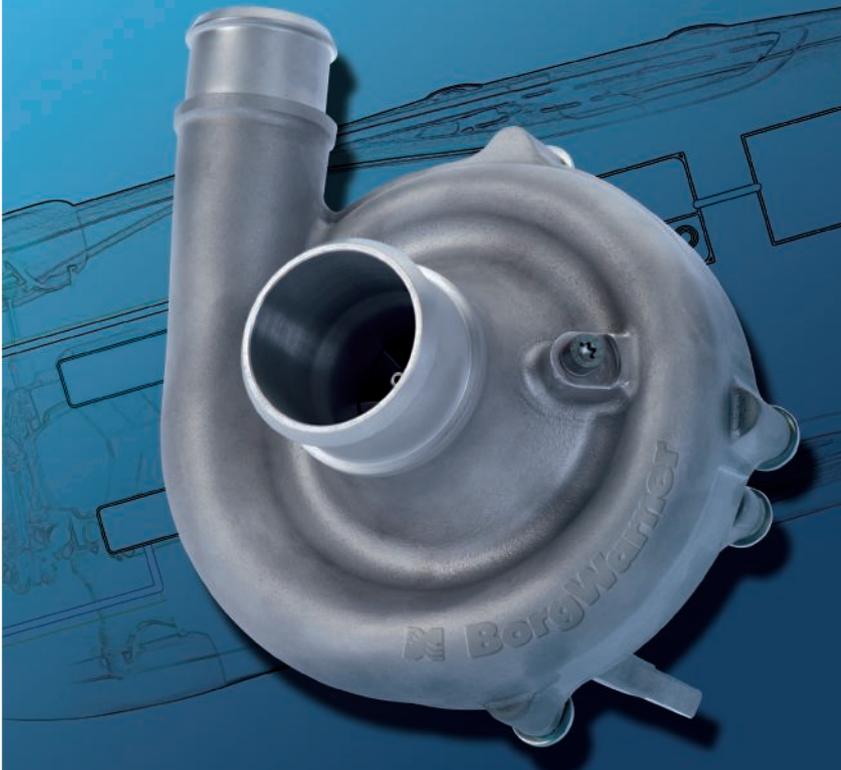
BorgWarner’s eBooster owes its compact size to the integrated electronics, with a permanent magnet motor inserted in a water-cooled housing.

“In the first step, we have 48v models, but BorgWarner is developing 12v applications where it sees a ‘good future’ for applications on engines up to 1.6-litres. The response time from 12v and 48v is ‘similar’ for both: 0.26 seconds for 48v and 0.28 seconds for 12v.”

Location depends on the individual OEM, says Adam.

“It can be placed before the turbocharger, between the turbo and air cooler, and also after the air cooler. It runs at 70,000rpm, which demands a different design and trim of the blades required by the lower rotational speeds.”

With two development programmes underway, he says series production will start by the end of 2016.



and less heating up of the electrodes, so the energy transfer from the plasma to the gas is more efficient, as we don’t heat up the electrodes so much. Also, the discharge form is more voluminous and this

dramatically increases the combustion process, achieving a very precise ignition cycle. The ignition phase of the combustion happens very quickly, with rapid pressure increase and good repeatability.”

In tests, OEMs are claiming a 10% benefit in CO₂ emissions, up to 90% NO_x reduction in lean-burn, depending on how the engine is driven. Soot has also been reduced ‘significantly’ under high injection pressure strategies.

At the moment, it is designed as running off a 12v system, boosting that to 270v. So, if the input voltage is higher at 48v, it would help drive down the size of the convertor and its cost.

Although the system is inherently more expensive than contemporary ignition systems, it enables packages to reduce CO₂, especially when the penalty for not meeting CO₂ per gram levels from 2021 onwards is taken into account, as it becomes more cost effective.

“The advantage of our system is that it has two ignition parameters: the ignition voltage that corresponds to the size of the corona and ignition duration. For transistor coil ignition, you can only choose the duration; the voltage depends on the pressure in the chamber.

“We think that we can realise different diagnostic functions because of the electrical values we provide to the combustion chamber specifically voltage, current and the phase shift between them.

“If we get data from the ECU early enough, we can anticipate what the combustion will be and then we can prepare the ignition for each combustion event.”

Larger engines benefit more from EcoFlash, as more volume is needed in the combustion chamber to develop the corona; it should also assist, if the compression ratio or intake boost is increased dramatically to get closer to knocking behaviour, thanks to its improved accuracy.

Schenk expects the Miller Cycle engine to benefit, as EcoFlash is not so dependent on charge motion to achieve improved combustion.

BorgWarner expects the first application in the 2018/19 timeframe.

MAZDA TARGETING MAJOR EMISSIONS CUTS

Mazda believes it can achieve around 25% improvement in real-world fuel economy with which an internal combustion engine (ICE) vehicle will attain electric vehicle (EV) -level well-to-wheel CO₂ emissions.

That is the prediction of Mazda Europe's research and design chief, Ichiro Hirose. With future growth of vehicle sales set to rapidly expand in non-OECD countries, Mazda believes it is unrealistic to expect these countries to install sufficient environmentally-friendly power generation to support large fleets of EVs. It is better then, Hirose argues, that improving ICE efficiency will have a broader impact across the globe at more affordable prices.

Although no official timetable for the technology progression has been announced by Mazda, insiders suggest that 2020 is being targeted to coincide with future emission regulations.

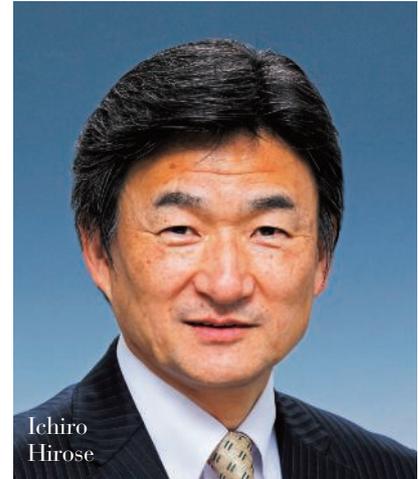
Reducing internal losses from the exhaust, cooling, pumping and mechanical for both petrol and diesel will be essential, he says. Key to achieving this is a common

architecture (CA) strategy introduced with the first-generation Skyactiv engines with common characteristics across a broad range of cylinder capacities, with minimal calibration development. For example, to achieve common ignition and valve timing, combustion patterns need to be identical. For a common air-fuel mixture, gas-exchange behaviour, including transient condition, needs to be common.

In a second step, the plan is to increase compression ratio further to 18:1 and adopt lean burn. Then heat insulation on combustion chamber walls will be applied as a third step to further improve the ICEs efficiency; in order to drastically improve thermal efficiency, homogeneous lean burn is imperative.

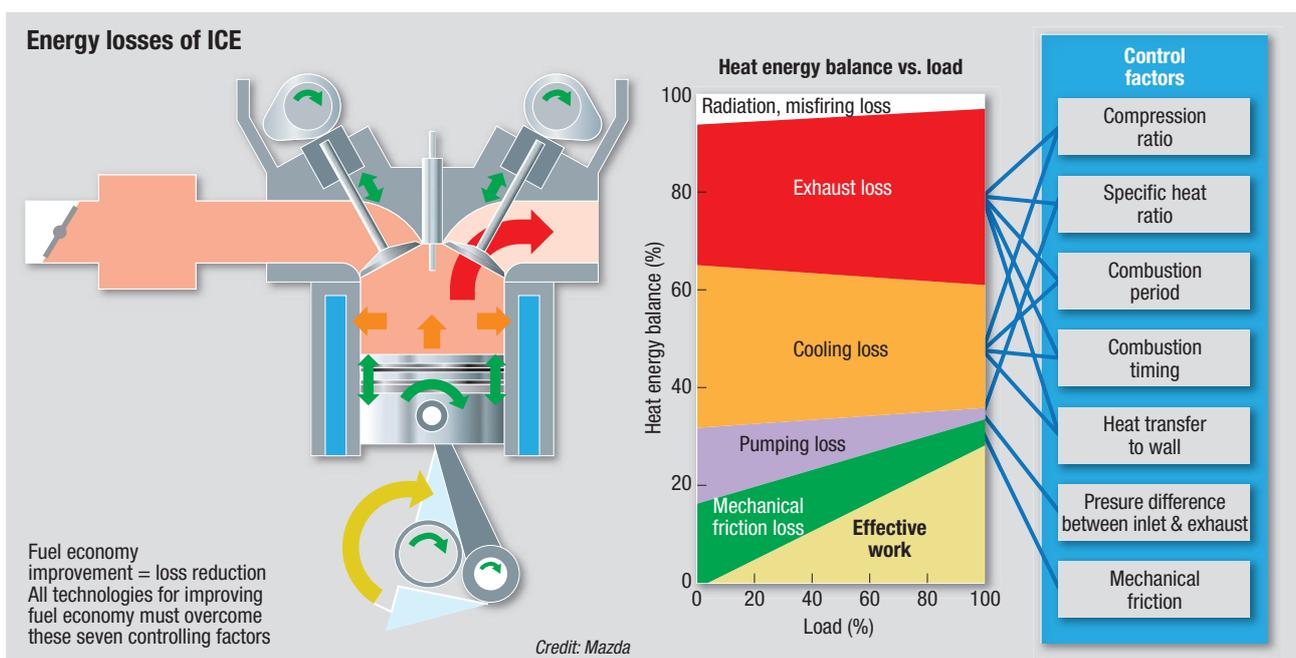
Mazda's second step engine will achieve improved brake specific fuel consumption (BSFC) from light loads shown. Poor BSFC is seen only in a very low load region, which is small enough to be covered by regenerative braking energy alone. This enables the use of a small motor and is effectively reducing hybridisation costs.

In conclusion, Hirose states: "If ICEs realise more homogeneous lean

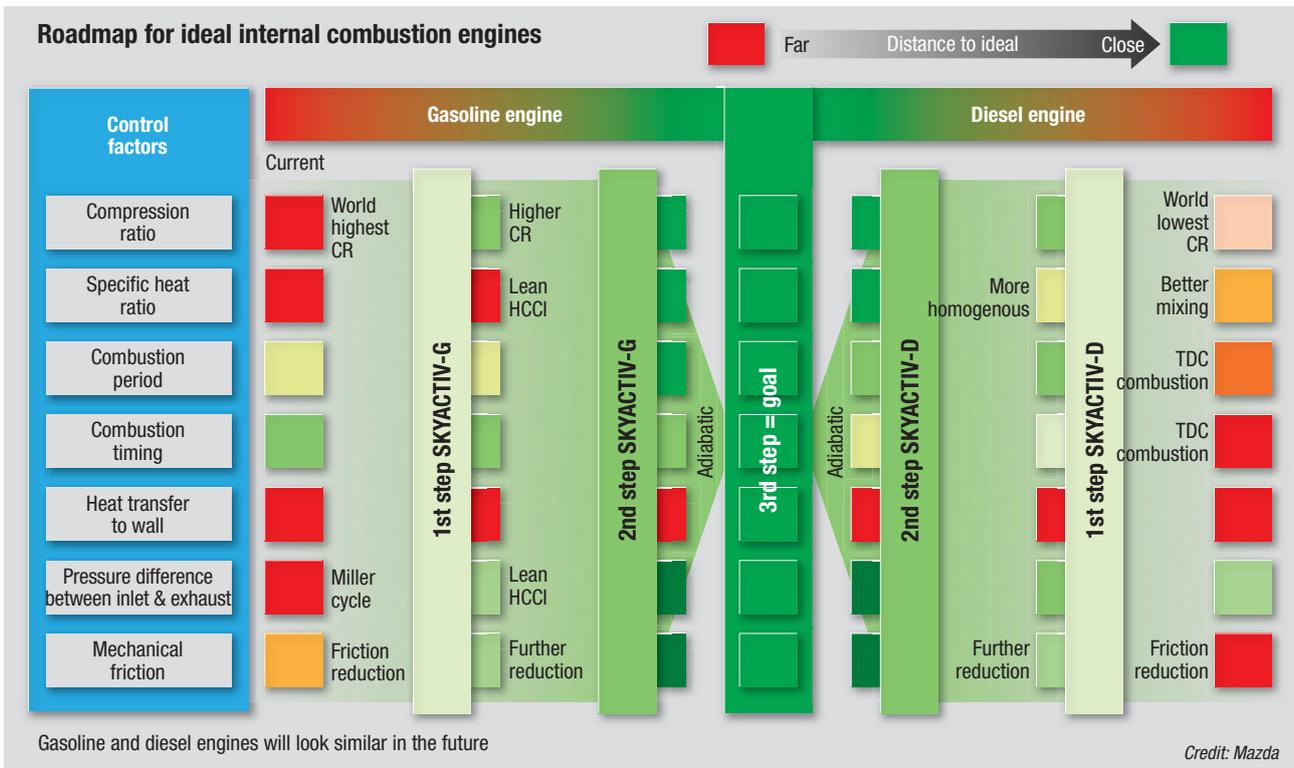


burn, adequate heat insulation and ideal compression ratios, it will be possible to achieve approximately 25% improvement in real-world fuel economy – with which an ICE vehicle will attain EV-level well-to-wheel CO₂ emissions. When an HEV is combined with a drastically improved ICE, it may also be possible to even outdo a current EV in CO₂ emissions.

"With the aforementioned ICE technology innovation and 'Monotsukuri Innovation', Mazda intends to pursue development in such a way that every Mazda product will realise EV-level CO₂ emissions."



Cover story



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 Phone: +81-265-56-5423 Fax: +81-265-56-5427
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DOUBLE COUPÉ

It is rare these days for manufacturers to resist the temptation of previewing concepts ahead of motor shows. By the time the doors open to the media and public, every angle and detail have been scrutinised by the press, especially the instant news electronic media. But two manufacturers from the same portfolio pulled off eve-of-show reveals.

The first was Bentley at Geneva with its svelte two-door coupé EXP10 Speed 6 that will sit alongside the Continental 2+2 coupé. “This is not ‘Continental Lite’ or a cheaper model than we have already,” emphasised Rolf Frech, member of the board for engineering.

Although it isn’t based on a particular platform, Frech said Bentley “oriented itself” on the MSB platform that would underpin a future Continental, as well as the next-generation Porsche Panamera. “The idea behind the car was ‘what is Bentley’s future?’ So we thought we could widen the range with a driver-

oriented luxury sports car.” It would be powered by Bentley’s four-litre V8, but developed into a plug-in hybrid. As to what precise battery and electric motor will be used “depends on what technology is available at the time”, said Frech, who confirmed that it would be a front-mid engine layout, with the electric motor sandwiched between the V8 and the transmission.

Frech added that both rear-wheel and four-wheel drive are under consideration. “This platform offers the possibility of a ‘hang-on’ system and maybe there are derivatives that could make the car more agile with rear-wheel drive.

“When we go for these concepts, we are already thinking about derivatives”, was all Frech would say when asked about the possibility of a convertible version as well. But if you consider how Bentley has developed its Continental range, then that, surely, sets the template for the new addition to the Bentley line-up.

Although it was well received in Switzerland, the car will be clinicked

Porsche Mission E is seen as a challenge to Tesla, but shuns blistering acceleration for range



around the world in Bentley’s major markets before a decision is finally taken, but Frech would not be drawn on when that might be. “This is not a concept car, but one where all the technical hard points have been engineered. Maybe the roof will be a bit higher, but, basically, these are the car’s proportions.

“We’re talking about 1700-1800Kgs. It will be a hybrid aluminium-steel structure; but, thinking about lightweight structures, it would be more oriented towards carbon fibre closing panels.”

Automotive Design's Ian Adcock reflects on some of the concept cars from 2015 that caught his eye

COUP!



The final decision will be determined by production numbers. Frech voiced confidence that carbon fibre production techniques will have sufficiently improved by the time the car is launched for it to feature a substantial amount of the material.

ELECTRIC... ECLECTIC

Even more of a surprise, however, was Porsche stealing everyone's thunder at Frankfurt with the totally unexpected Mission E electric – or should that be eclectic? – four-door coupé.



Audi's Q6 E-Tron quattro shares its hefty battery pack with the Porsche Mission E, but little else

Look beyond the fantasy combination of conventional and suicide rear doors, and there's serious engineering content, as you would expect from Weissach: the electric motors develop 440Kw, powered by a battery pack supplied by Korea's LG and Samsung with a 1000Nm split 33-66 front to rear. As is becoming the norm, the cells are located at floor level for a low centre of gravity, although the designers have integrated a novel foot well trough for rear-seat passengers to allow them more leg and head room.

Permanent synchronous motors, one for each axle, drive the car, with a brake energy recovery system developed from that used in its Le Mans-conquering 919 sports racer.

The pragmatists at Porsche have resisted the temptation to chase Tesla's headline-grabbing, and pointless, acceleration claims and top speed, instead opting for more real-world figures of zero to 100Km/h in 3.5 secs and a governed 200Km/h Vee max – still quick enough; as is the

experimental, at this stage, 800v charging system that recharges 80% of battery capacity in 15 minutes.

UNIQUE – AND HEFTY

One would have thought, given all the group's trials and tribulations, that a little resource and finance saving would have resulted in Audi and Porsche collaborating on their electric vehicle concepts – but not in the least.

Apart from sharing battery supplier and charging technology, Audi's Q6 E-Tron quattro, also seen at Frankfurt, is a unique engineering development.

It is underpinned by an evolution of the MLB platform shared with the next-generation Q5, but suitably tailored to house the battery pack and electric motors.

Audi has opted for a trio of electric motors, one at the front and two at the rear, combining to produce 800Nm and 375kW.

Nevertheless, the Q6 E-Tron betrays the shortcomings of all contemporary EVs: when put on the scales, it weighs a hefty 2.2 tonnes,



All the fun of the seaside with Citroën's concept. All that's missing is a modern Jules et Jim

thanks to its 650kgs battery pack. A novel charging system that combines DC for rapid charging and AC for slower charge will deliver enough electricity, so Audi claims, in 50 minutes for a 300-mile trip.

FEMME FATALE?

If the prospect of an electric Porsche seems incongruous, then a cross-over styled, all-wheel drive, Aston Martin EV perhaps ought to have been code-named 'Mary Shelley', rather than DBX, but that's what the Gaydon-based sports car maker unveiled at Geneva.

All the styling cues are descended from the current range of coupés but, unlike them, this model has four seats, as well as all-wheel drive. It is, thankfully, a better looking car than the ill-fated Lagonda SUV from 2010, but many observers at the show felt the concept was rushed in its execution.

New Aston CEO Andy Palmer wouldn't be cornered into admitting DBX would make production, beyond saying the marque had to have more appeal to female buyers and needed a product in the 'DBX space.'

SURFING THE FUTURE

Citroën went back to the future with its homage to the Méhari faux off-roader from the late 1960s.

Based on the C4 Cactus, this concept – like its inspiration – makes do with front-wheel drive for its beach buggy, surfing aspirations. Lopping the roof off any car is never a good idea for torsional rigidity, so it must be hoped that Citroën has made a better fist of this than it did of the C3 Pluriel that was no stiffer than wet cardboard.

Still, it has some intriguing design points: floor drainage holes to let water out, external door hinges, neoprene seat covers, steps carved out of the rear quarters to access the back seats and a roof that inflates into a two-person tent... that seems more concept novel than production reality.

CROSSING THE LINE

As if to demonstrate that no segment is safe from the relentless march of the cross-over, Nissan unleashed its Gripz concept at Frankfurt with design cues harking back to the iconic Safari rally-winning Datsun 240Z.

Despite it being powered by the Leaf EV's electric motor, with a petrol

engine acting as a generator, and that its 4100mm overall length is within a smidgen of the current Juke, Gripz is unlikely to make it into production. However, with Nissan's smaller crossover due to be replaced in 2016 expect to see design cues like the V-shaped grille, hockey stick lights, and some of the surfacing toned down and turned into reality.

Nissan's current sports cars are



not setting the world alight. Could they be reinvented as a sporty cross-over? Stranger things have happened.

COOL RUNNINGS

It's not just the OEMs that let their designers' thoughts run riot. Suppliers can also surprise by stretching the boundaries, which is precisely what EDAG achieved with its 'Light Cocoon.'



Aston Martin electric-powered DBX is a signpost to what an Aston with broader appeal might look like with a four-seater interior (far right)



The spaceframe structure has been created using additive manufacturing techniques and is covered in waterproof material supplied by outdoor clothing specialists Jack Wolfskin.

Additive manufacturing has also



Exaggerated styling of Nissan's Gripz points to future small crossovers - perhaps

been used to create the LED headlights designed in EDAG's new light laboratory.

In cooperation with Laser Zentrum Nord, EDAG has developed a hybrid manufactured housing for an electric vehicle's on-board charger, which is more than 50 % lighter than a comparable cast housing. The concept is designed to additively produce only the functional elements relevant to efficiency. At the core of the housing is an ultra-light cooling structure, produced using the selective laser melting (SLM). With its cooling channels specially adapted to the heat transfer of the electronics, the aluminium component achieves a high level of cooling capacity. Filigree fins locally inserted in the cooling channels, which cannot be produced using conventional manufacturing methods, maximise efficiency and cooling capacity.



Jack Wolfskin material may be a step too far, but the real potential is in the use of additive manufacturing in EDAG's Light Cocoon

Mazda Koeru.



Concept car or production preview?

Relieve Mazda's Koeru cross-over concept of its 21-inch wheels and you have a car that's street ready. Maybe some of the exterior chrome detailing might disappear, which would be a shame, and the interior treatment is likely to be less radical; but, come Paris, or even Geneva next year, and who knows what the Japanese manufacturer might be unveiling.

While Mazda was being coy about its 'concept', Seat's 20V20 will hit the showrooms next year. Based on VAG's MQB platform that can be found under Golfs and Audi TTs, it is the Spanish marque's first proper venture into this sector.

It already has a reputation for LED headlights, so expect these to stay – and it would be nice to think that the interior, featuring a trio of TFT, will make it into production.



Seat 20V20

What is the best route for the UK to achieve its targeted 80% reduction in greenhouse gas emissions? *Automotive Design* weighs up the options



“On the fuel side, most of the focus on future developments is on CO₂,” explains professor of automotive propulsion at Bath University, Chris Brace, “so, if you have a sustainable source of fuel or lower CO₂ lifecycle for the fuel, that is where most of the effort goes. So, that’s increased amounts of renewables of all sorts.

“From my perspective, the most exciting is the work that Audi is doing with E-fuels. It’s only pilot plants at the moment, but it works – that’s a decarbonising measure, although it won’t have any intrinsic effect on emissions. But my view is that the after-treatment that we know how to do will fix the emissions and air quality problem, and it will be back to the CO₂ challenge. So synthetic fuels using renewable electricity are really exciting,” he states.

The Automotive Council’s roadmap presents a scenario of ‘drop-in’ renewables and ‘power to gas’ components in a significantly reduced carbon fuel chain of liquid fuels distributed, stored and performing in broadly similar terms to today’s fossil based products, as providing a highly practical means of moving towards a more sustainable future for transport. It will, however, require fuel specifications and standards to be defined at the minimum of an EU and, ideally, a global scale.

“The energy and fuels roadmap sets out what we believe to be the most plausible and attractive pathways for the UK to achieve its targeted 80% reduction in total

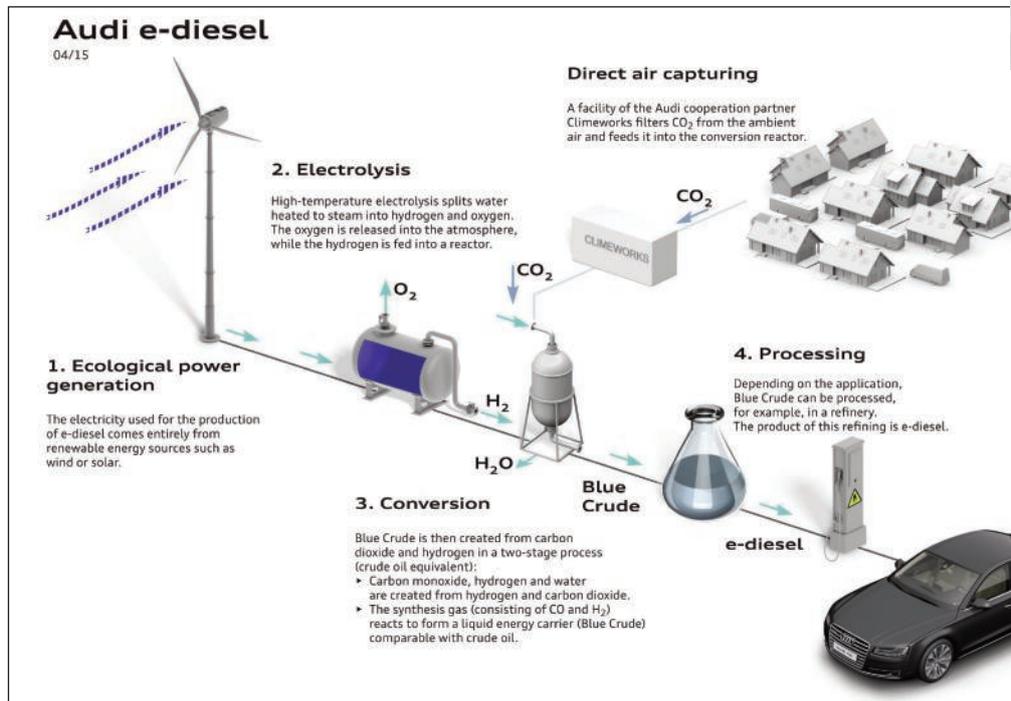
greenhouse gas emissions,” says Ricardo chief technology and innovation officer Professor Neville Jackson. “This vision cannot, however, be realised without coordinated efforts on the part of industry, government and regulators. By combining the views and opinions of experts drawn from an extremely wide range of stakeholder organisations and industries, we believe that we have been able to demonstrate that the result is indeed achievable, if the right economic, policy and regulatory conditions are put in place.”

THE ‘E’ FACTOR

Earlier this year Audi, along with its technical partner, Global Bioenergies,

announced that ‘e-benzin’ is being synthetically produced without the use of petroleum. It is 100% iso-octane and, therefore, has an octane rating of RON 100. Because Audi ‘e-benzin’ contains no sulfur or benzene, it burns very cleanly, which enables engines to use high compression ratios for enhanced efficiency. Audi will now test the new fuel in the laboratory and in test engines. In the medium term, the company and Global Bioenergies aim to modify the process, so that it requires no biomass, instead requiring just water, hydrogen, CO₂ and sunlight.

Reiner Mangold, head of sustainable product development at Audi AG, emphasises that Audi has taken a broad-based approach to the



sustainable future



through hydrotreatment process from vegetable oils or animal fats (HVO). Their introduction, it is claimed, would translate into immediate improvements in air quality and, in the case of HVO and BTL, the decarbonisation of transport fuels.

Gas-to-Liquids (GTL) fuels are produced from natural gas, using the Fischer-Tropsch process in sites near gas reserves around the world. Companies that are involved in GTL production include Shell, Petro SA, Sasol, Petronas, Chevron, Mitsubishi, Qatar Petroleum, NNPC, Calumet and Oxford Catalysts/Velocys.

Hydrotreated vegetable oil (HVO) is a renewable diesel fuel made by a refinery-based process converting vegetable oils to paraffins. Animal fats are also suitable for feedstocks.

As they are hydrocarbons, they largely meet conventional diesel fuel requirements, apart from ester specifications. Properties of this non-ester-type, bio-based, fuel are very similar to GTL and BTL.

Biomass-To-Liquids (BTL) uses biomass such as woodchips as feedstock to gasification and the Fischer-Tropsch process. While the technology is less advanced than GTL or HVO, several new BTL plants are being developed, supported by NER300 funding from the EU.

BTL needs further investment for development, but has the potential to use sustainable biomass resources in Europe.

With the current debate over conventional diesel fuels intensifying, it seems inevitable that alternative forms of liquid energy will play an increasingly large part in powering vehicles of the future.

development of CO₂-neutral, non-fossil fuels. "Global Bioenergies has demonstrated the viability of the 'e-benzin' production process. That is a big step in our e-fuels strategy."

Audi is already producing larger quantities of 'e-gas' (synthetic methane) on an industrial scale for its customers. Other research projects with various partners are dedicated to 'e-ethanol', 'e-diesel' and 'e-benzin'.

Global Bioenergies S.A. operates a pilot plant for the production of isobutene, the starting material for Audi 'e-benzin', in the French town of Pomacle, near Reims. Isobutene is produced from renewable raw materials, rather than the usual petroleum.

Another project partner, the Fraunhofer Centre for chemical-biotechnological processes (CPB) in Leuna, Saxony-Anhalt, uses hydrogen to transform the gaseous isobutene into liquid iso-octane. Global Bioenergies is building a demonstration plant at the Fraunhofer Centre that will begin producing larger quantities in 2016.

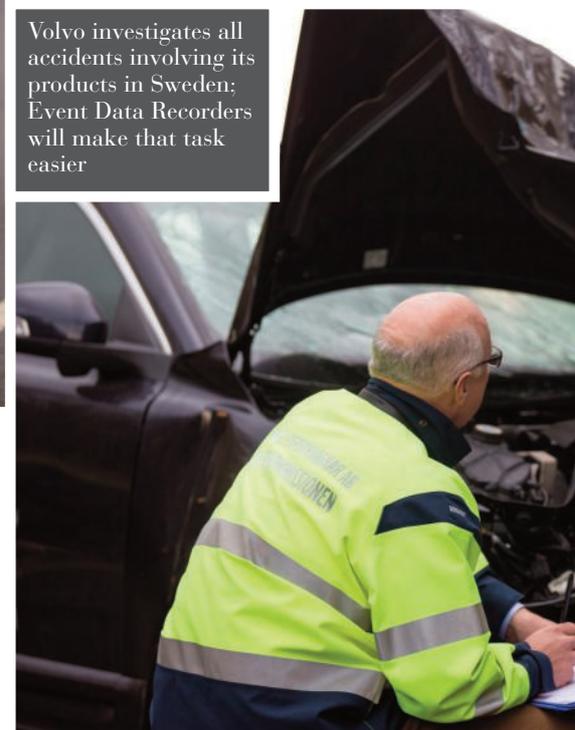
PARAFFINIC FUELS

Paraffinic fuels are competitive, fully fungible and available today. Paraffinic Fuels are a new generation of cleaner transport fuels with near zero sulphur and aromatics, made through the Fischer-Tropsch process from natural gas (GTL) or biomass (BTL), or



If vehicles eventually talk to each other and to infrastructure stations, as expected, there's going to be a ton of data about traffic and road conditions, writes Terry Costlow

Volvo investigates all accidents involving its products in Sweden; Event Data Recorders will make that task easier



NO HIDING PLACE

Information technology and automotive companies feel some of the information that emerges from 'conversations' between vehicles and infrastructure stations has a lot of potential value, though what exactly it's good for remains uncertain. It's widely predicted that vehicle-to-vehicle/-infrastructure (V2X) technology will be required on all vehicles, due to its significant role in improving safety. If that occurs, all

vehicles will eventually be subject to the transmission of their speed, direction and other information. These transmissions are mainly for safety, but the wealth of real-time information will undoubtedly be useful for something else.

"There's real value in accumulating data at intersections and on the freeway," says Hideki Hada of Toyota Motor engineering and manufacturing's integrated vehicle systems department. "You

can collect billions of pieces of data for things like real-time traffic information. Somebody will make good money by aggregating data."

However, cellular signals are already being used for real-time traffic information. That concept will undoubtedly improve vastly in the years it will take before a large percentage of vehicles have V2X transmitters. Still, IT companies are already exploring ideas that will help them justify building large systems

Focus on Accident Recorders

“We’re making huge investments into connected cars as part of our cloud services strategy”

Richard Nash



that focus on transportation data. There may not be one killer application for data, but many minor usage models may exist.

“We’re making huge investments into connected cars as part of our cloud services strategy,” states Richard Nash, solution architect for intelligent transport at IBM. “We’re trying to string together different ideas to see where there are use cases in various domains. In some areas, they’ll be collecting enormous

amounts of data. The trick is to sift through it to find the four or five items that have some business benefits.”

The big-data techniques used to analyse trends in consumer fields can be used to glean useful information from data sent by cars. If V2V does become a standard feature, there will be no shortage of data to analyse.

“Big data plays are all about finding the needle in the haystack,” points out Joe Averkamp, senior director, technology, policy and strategy, at Xerox. “A lot of the data is just not interesting. You quickly get up to petabytes and start talking about exabytes.”

RTA DATA

Much of that data will enable accident researchers, such as those at the UK’s TRL, to glean more information on how and why road accidents happens.

TRL is leading the way in the download, analysis and interpretation of electronic data captured by vehicles during collisions. As the number of vehicles on European roads with Event Data Recorders (EDRs) grows, TRL is providing a unique service for the download and analysis of collision data for road traffic accident investigations.

Following the development of integrated EDR systems in US-manufactured vehicles and the expansion of EDR requirements in the US market to include imported vehicles, an increasing number of vehicles on European roads now have an embedded event data recorder within the vehicle’s electronic systems.

With the introduction of modern safety systems on vehicles, such as antilock braking and stability control, traditional sources of evidence for collision investigation (particularly tyre marks) have been eroded, leading to increased uncertainty in some aspects of accident reconstruction.

Using Bosch’s Collision Data Retrieval (CDR) tool, the TRL collision investigation team is able to connect to and extract crash data from electronic control units within a vehicle involved in a collision. The downloaded data can provide detailed information about pre-impact vehicle movements and collision severity, which significantly assists the in-depth investigation of an incident.

DATA EXTRACTION

By extracting EDR data with the CDR tool, TRL can offer access to the best evidence for accident investigation and reconstruction within both a legal and research context. Its expertise in this area is underpinned by a team fully trained in the download and analysis of EDR data, and whose research and expertise with collision data from vehicles extends into other forms of vehicle data access, download, analysis and interpretation. As part of its research activities, TRL is also advising the European Commission on the future benefits of EDR deployment within the wider European fleet.

As an example, the CDR tool was deployed in an investigation for the UK’s Thames Valley Police. A 55-year-old man was prosecuted for causing death by dangerous driving when his Chrysler 300 ploughed into the back of a queue of traffic on the M40. The 70mph (112Km/h) impact killed a passenger in the vehicle in front of him. The driver became the first in the country to be prosecuted using evidence recovered from his airbag by a Collision Data Retrieval (CDR) tool.

Although some might find more than a hint of ‘big brother’ about the data that the state can glean from cars, never mind the numerous mobile devices that most people carry with them and use without a second thought, if the information helps to reduce road fatalities, then surely it has to be a good thing.

Achieving **TOP** GRADE

VI-DriveSim is a turnkey solution from VI-grade that provides engineers with a complete set of innovative, integrated driving simulators for a new-generation approach to system-level simulation, allowing companies to bridge the gap between virtual prototyping and testing. VI-DriveSim provides the ability of 'feeling' the simulation results in a totally immersive environment, starting from early phases of the development process. And Volvo becomes only the third manufacturer after Ferrari and Porsche to install such a system.

Employing a patented 9 degrees of freedom (DOF) platform, VI-DriveSim is available in two configurations: static and dynamic. In the static format, users can drive a virtual vehicle model based on VI-CarRealTime, visualising vehicle behaviour on a wide screen with high quality graphics, while sitting on a fixed cockpit that does not move according to car manoeuvres.

The dynamic configuration provides motion feedback to the driver, thanks to an innovative moving platform with reduced overall

dimensions and large travels. The new machine architecture, called Driver in Motion, and its kinematics has been designed, for the first time, to implement in the best possible way the motion cueing technology that has been developed and tested by VI-grade since the year 2008.

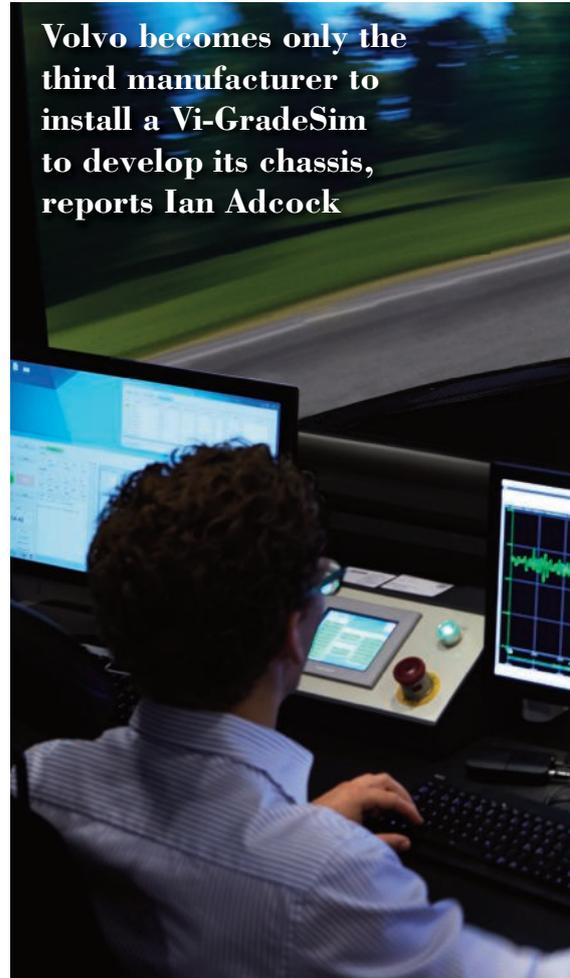
HOVER FACTOR

The system is based on a 16-ton plate with air bearings, described as "like a Hovercraft" by vehicle dynamics concept engineer Carl Sandberg, connected to the floor by three large actuators that deliver more lateral, longitudinal and yaw degree of freedom.

"We move the complete hexapod, upper frequency motions with the hexapod and the lower frequency motions of those three extra degrees of freedom with the tripod in the bottom," he explains.

This results in higher gains in lateral motion, and in braking and acceleration; and, most importantly, it gives as much yaw angle as possible. "The yaw degree of freedom, once you start operating that with a hexapod, locks up other DOF very quickly. It's much easier to represent

Volvo becomes only the third manufacturer to install a Vi-GradeSim to develop its chassis, reports Ian Adcock



The simulator's biggest benefit is trying new concepts "within days" and that takes months off developing physical models

the car's balance. As soon as you lose control, you have enough gain to feel what's happening when the car starts to rotate."

Volvo used 3D-Mapping to get both the visual and point cloud data for the imaging with 5mm resolution in both longitudinal and lateral. That data is transferred to the road surface and then surrounding that is a virtual image of the environment. The laser

Question time



centrifugal force under cornering. But you still get an input from steering actions or inputs from the road surface; or lose grip. You feel the changes and the car's stability, but it still needs some driver training as to how the car feels in reality, compared to the simulator.

"I am still doing a lot of physical testing and chassis development to keep this link between the two very close. It's important both for me to develop the simulator technically as good as I can, but it's also important to gain trust from the simulation and physical engineers."

Also, Volvo used the simulator in conjunction with a development mule code-named Costello. Based on a Ford-derived platform of the current S80, but fitted with an integral link independent rear suspension and double wishbone front set-up, it was powered by a tuned version of the current five-cylinder turbo engine, and made extensive use of lightweight carbon fibre body panels to imitate the new car's power-to-weight ratio and weight distribution.

also captures a grey scale image of the road surface. Winter testing is still in the development phase. "Ice can be quite a challenge, as it differs; whereas, in the virtual world, it's quite constant, unlike the real world. We're working with the University of Chalmers and Gothenburg's VTI research on snow model tyres."

CLOSED LOOP

The simulator's biggest benefit is trying new concepts "within days" and that takes months off developing physical models. Effectively, there is a closed loop between the physical and virtual models, so that, as the engineers home in to launch models, the importance of the physical testing increases and the CAD work diminishes. "The last few per cent is not what we aim for, but the preceding

95%," says Sandberg. "It does require some training," he admits, adding that it does help, if the test driver has some video game experience. "But what is important to remember is that the simulator is not trying to be reality, but a representation of reality.

"And so far in our simulator, we have focused on chassis hardware, suspension, and the important parts of body flex to create the correct balance and primary ride to start with. Secondary ride is under development, because of tyre models primarily.

"As we have very limited physical space on the simulator, compared to the 22kms long Nordschleife race track or our own Hällered Proving Ground, it means we cannot represent static accelerations when developing the chassis, so you won't have

Carl Sandberg



Richard S. Chung, vice president industrial design/
craftsmanship, Yangfeng Automotive Interior Systems

Teams deliver against global assignment

“The timeline for the new interior is 2025, so we gave the assignment to our three global teams located in the USA, Germany and China for each to develop its own topic.

“First from North America was autonomous driving; for Europe, research showed that ‘A’ and ‘B’ segments would have the largest role, an economical interior, yet with a lot of customisation; and, by 2025, China will be the biggest market for luxury cars.

“We presented our findings to our major customers and were really pleased to be told that we were right on target, and decided to combine the best of the autonomous vehicle with China luxury, because we felt there was a synergy between the two and defined IDI6 project brief.

“The theme we picked for it was ‘Premium Freedom.’ Today, we spend 90% of our time driving and 10% listening to music etc, but by 2020 the driver will spend 85% of their time not driving. How do we convert that into a more productive process? So we wanted to provide more amenities and functions, allowing the driver to relax, shop or work.

“We have 33 new features in the interior, comprising 18 in the interior and 15 in the seating, defined as 30% exploratory, and the balance ready for our customers’ next vehicle cycle.

“Two technologies are game-changing for the freedom segment: one is direct back forming of leather whereby you place the leather into the tool and choose to have a slush artificial skin or leather, allowing the OEM to reduce investment in tooling, as only one tool is required to accommodate the finish. Essentially, we have automated the manual process of wrapping leather.

The second is sculpture leather, combined with injection moulding, traditionally that couldn’t be done, because of the heat and pressure. But our process – which is still under development – allows that.

“We also have ambient lighting that can be functionally co-ordinated with other autonomous features.

“There are convenience items, like the glove box that walks away from you, so occupants don’t bang their knees, and a pressure-sensitive interface that turns any surface into a switch or button. Here, we use it on the heated arm rest.

“If you choose the autonomous driving mode, the steering wheel and column retract and the seat tilts 80°, simultaneously turning inwards towards the centre of the car and the other occupants, allowing a more natural interaction between them.

“We’re aiming at between 5 to 7 seconds for the seat and steering wheel to resume their command mode, so the driver can take control.”



“We presented our findings to our major customers and were really pleased to be told that we were right on target”

IMPROVE INTERIOR PACKAGE DESIGN, INCREASE VEHICLE SAFETY, AND ENSURE INTERNATIONAL COMPLIANCE WITH THE SAE H-POINT MACHINE

A three-dimensional manikin that provides the physical representation of driver H-points, the **H-Point Machine (HPM)** is used to define and measure vehicle seating accommodations. Offering a deflected seat rather than a free seat contour as a reference for defining seat space, it is a vital tool in the design of interior packages.

Available through SAE International, the HPM is used in conjunction with SAE Standard J826 and is currently referenced in various federal and international regulations including NHTSA's FMVSS in the US and ISO standards. Utilized in testing for compliance to such regulations involving impact/crash, head restraint, or vision, it is the required safety certification tool for vehicle production in many countries around the world. Additionally, those who need to locate seating reference points and torso angles as reported by manufactures employ the SAE H-Point Machine.

And for advance design and research applications, the **HPM-II** is available, which includes reformed shells for a consistent and reliable fit in bucket seats, an articulating back for lumbar support measurement, and the ability to measure the H-point without using legs resulting in simpler installation.

Is one SAE HPM enough? *If your company tests and certifies to FMVSS 202a, it might not be.*

NHTSA's head restraint regulation is now fully in effect. That means, in the US and Canada, front—and now rear seats—must meet FMVSS 202a. NHTSA is also encouraging the EU and UN ECE to adopt similar regulations.

To meet FMVSS 202a, a head restraint measuring device is attached to the SAE HPM. It is recommended in revised SAE Standard J826 Nov 2008 that a separate and unique HPM and HMPD for head assessment be used to eliminate any measurement variability that the HRMD may introduce.

Ensure North American compliance and be prepared for changes in EU/UN ECE regulations. Consider a second, dedicated SAE HPM—one for conventional HPM measurements and one for head restraint assessments.



View video at
store.sae.org/ea/hpoint.htm

Contact:

SAE International Customer Service Phone:
+1.877.606.7323 (U.S. and Canada only)
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