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AD INTERVIEWS: DR ANDREW BROWN JR, EXECUTIVE DIRECTOR AND CHIEF TECHNOLOGIST



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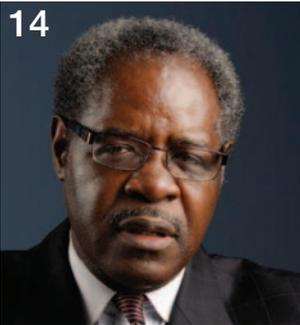
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SAE International

Winds of change promise warmer front



Detroit can be a grim city to visit in January. Sub-zero temperatures, fanned by winds whipped up across the Great Lakes, emphasise even further the economic and human tragedy that has blighted the city. Derelict buildings, whole neighbourhoods left abandoned like some post-apocalyptic film set, with only the wind moaning in the background.

And there have been times in the past few years when the atmosphere within Cobo Hall, where the annual North American International Auto Show (NAIAS) is held, has been just as bitter and mournful.

This year was different. For a start, the weather was almost warm and evening sunsets bathed the art deco skyscrapers with a fiery glow. It almost made Detroit look attractive.

And that warm confidence was reflected in the halls and amongst the manufacturers, both local and the importers. As well as by Delphi's Dr Andrew Brown Jr (page 14)

That most conservative of organisations, the German Association of the Automotive Industry (VDA), predicts a 5% increase in light vehicle sales in the USA to 13.4 million this year.

When the average age of the American car is 10 years, compared to seven in Germany, there's plenty of room for more sales.

Increasingly, the American consumer is turning to hybrids, diesels and down-sizing: technological attributes that are second nature to the European supply community and ripe for exploitation by them.

So, it will be interesting to see how the new Ford Fusion (page 20), with its down-sized engines, fares. It will spawn the next-generation Mondeo this autumn, but much of the technology and engineering philosophy behind the car originated here in Europe. And since it is also the first fruits of the One Ford policy, its impact beyond the USA and Europe could be even greater on both consumers and the supply chain.

Ian Adcock, Editor in Chief

Multi-function torque convertor



Although this technology has been around for about five years, according to Jeff Hemphill, chief technical officer for Schaeffler Group North America, the cost/benefit ratio counted against it then. Now, with increasing fuel prices, the situation has been reversed.

Essentially, it allows the auto's torque convertor to be disengaged from the engine,

which is then shut down, using the stop-start function to restart it. With an open torque convertor, this could lead to a 3-5% improvement in fuel economy, but, if extended to a coast down facility, there could be an additional 2% improvement. It also overcomes low speed turbo lag inertia in radically downsized engines, according to Hemphill.

Pendulum swings Schaeffler's way

Schaeffler showcased new technologies aimed at improving fuel consumption, reducing emissions, and eliminating noise, vibration and harshness. Described as a simple pendulum by Prof. Dr.-Ing Peter Gutzmer, Schaeffler's chief technical officer, it consists of a plate or plates, depending on the mass needed, located on roller pins within the torque convertor for automatics and in the dual mass flywheel for manuals. Employing similar

principles found in a cuckoo clock, the weight and distance the pendulum moves depend on whether you're trying to eliminate second order frequency in 4-cylinder engines or third order frequencies in 6-cylinder units.

As OEMs downsize, combustion events become more aggressive, leading to increased vibration and driveline resonance. This, he says, can reduce cyclical irregularities in second order phase of a four-cylinder by 50-60%.

Innovative folding roof

CTS roof systems has developed an innovative folding roof that combines the best of both hard top and canvas for the latest generation Porsche 911 cabrio.

Conventional cloth folding roofs have a number of inherent problems: thermal and sound insulation is often inadequate, the tops become distorted over the roof spars, especially at speed, and there can be security issues.

The new CTS system combines the best of both metal folding and canvas roofs. It comprises three folding magnesium panels, set in an aluminium frame, over which the cloth roof is stretched. Unlike conventional cloth roofs, this retains the profile of the fixed head coupe, while it is padded on the underside for additional insulation.

The three panels, together with the glass rear window, fold Z-like into a shallow tray at the rear of the car, no more than 12cms deep, with the final magnesium panel doubling up as the tonneau cover.

The roof can be operated at speeds up to 50Km/h and takes just 13 seconds to raise or lower.

Big claims for thermal management module

A 20% improvement in warm-up times and 4% improvement in fuel economy are just two of the claims that are being made by Gutzmer for this Schaeffler system, in which the standard on-off thermostat is replaced by a digitally controlled intelligent one.

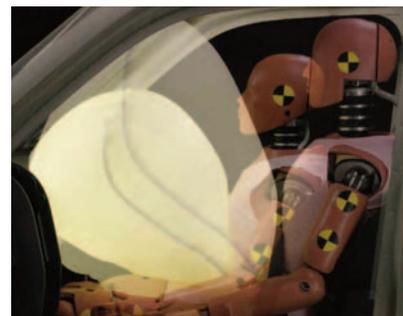
By receiving multiple inputs from around the powertrain, the system can determine which part of the engine and/or transmission can be quickly brought up to operating temperatures. "It would be up to the OEM to determine what that strategy is," says Gutzmer.

Adding that, while this technology is currently available, the next step would be harvesting waste heat and storing it, in order to release it into the powertrain for even quicker warm-up, although this is likely to be at least five years' away.



TRW's dual airbag

TRW's dual contour passenger airbag is capable of adjusting both the airbag pressure and size to help tailor protection according to occupant size and other variables of a crash.



Lightweight chassis technology revealed

ZF displayed its interpretation of a lightweight chassis, combining aluminium, magnesium and glass-reinforced plastic materials, plus high strength steels. Use of lighter materials offers clear advantages. Although control arms are manufactured using aluminum, not steel, the ZF Group provides complete assemblies in lightweight design. The company's lightweight suspension strut wheel carrier concept weighs half that of standard steel-aluminium modules.

These modules are manufactured with GRP, high-strength steel and aluminium. To compensate for high bending stress, ZF engineers used an upside-down design for the aluminium cylinder tub, reducing the amount of weight and materials required. This approach, called 'structure optimisation', is an important part of ZF's lightweight design approach.

ZF's SMiCA (Sheet Metal integrated Control Arm) is the new baseline for lightweight chassis technology solutions. The control arm requires no rivets or screw connections, making it lighter than conventional sheet metal control arms. Moreover, it requires less installation space and allows for more freedom in chassis design.

In its lightweight damper, the wall strength of the aluminium tube varies and is reinforced in certain areas to maximise its effectiveness, while the outer part is kept as thin as possible, with the varied wall thicknesses the result of 17 manufacturing steps.

By producing its lightweight brake pedal from fibre-reinforced composite materials and injection moulding, ZF has introduced a pedal that weighs half that of a standard steel pedal.

ZF also displayed a new rear axle with guiding transverse springs made of glass fibre reinforced plastics. Besides offering a weight reduction of 12-15%, compared to a conventional steel rear axle, the transverse spring assumes wheel guidance, bounce and roll suspension responsibilities.



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Moulding revolution

A production technique that combines injection moulding and thermoforming in a single process could soon be used to make semi-structural automotive components.

The three-year Spriform project, whose partners include Lanxess, KraussMaffei and Audi, was set up to develop potentially faster ways of making lightweight structural components for mass production. "I expect to see parts made using this technology within two years," says Nicolas Beyl, director of technology at plastics machinery company KraussMaffei.

He says that a number of semi-structural parts – such as instrument panel carriers, seat backs and front end carriers – could be made by first thermoforming a heated plastic sheet into shape, then overmoulding (or 'back injecting') structural elements on top of this.

The aim of the Spriform project was to combine these two techniques in an automated fashion, making it suitable for mass production.

"This is not difficult in a pilot plant, but it is hard to do it as a stable, serial production process with automation for 300,000 parts,"

says Beyl. One reason why the technique has taken off is the emergence of 'organic sheets', in which glass or carbon fibres are impregnated with polyamide. These light, stiff sheets are thermoformed into shape, inserted into a special injection mould tool (designed by Georg Kaufmann), then back injected with ribs or other structural features.

"You also need to mould a seal around the edge of the sheet, where the fibres are exposed." He says the technique could produce parts with a cycle time of around 1 minute – a fraction of the 10 minutes it would take using a method like resin transfer moulding (RTM).

Audi is already using 'organic sheets' commercially, in a front end system that is made using thermoforming and injection moulding. "In this case the sheets are thermoformed, then cooled, and then back injected afterwards."

The 'integrated' technique has several advantages. "First, it replaces two steps with a single step, which saves money," he says. "Also, if you back inject directly onto a heated sheet, the bonding is much better."



Excellent resistance

Ensinger's range of polyamide imide semi-finished goods (PAI) now includes TECATOR 5031 PVX, which contains graphite and PTFE. The additives give the material excellent abrasion resistance, as well as good sliding and friction properties. It can be used in applications up to 270°C, and is resistant to conventional solvents, lubricants and fuels.

10-speed auto on the way

Hyundai let slip that it's developing a 10-speed automatic transmission in-house. This follows on from its own 6-speed transverse and eight-speed longitudinal 'boxes, also developed in-house. Prototypes of the 10-speed auto are currently being tested, although it's unlikely it will appear much before 2014-2015.

Nexeon battery deal

Nexeon has begun collaborating with a global OEM, with a view to optimising the company's technology for electric vehicle applications.

The agreement, which is said to be worth 'several million pounds', will see the two co-operate in the development and evaluation of Nexeon's silicon materials. These are designed to replace carbon as the anode of Li-ion batteries. Silicon has major advantages over carbon for vehicle batteries, being capable of delivering a significantly greater power-to-weight performance, as well as more energy between charges.

Flat panel radio launched

Continental's new flat panel radio is the first for a car without any mechanically operated storage system, using only digital interfaces such as Bluetooth, SD memory cards, MP3 and USB.

Vehicle passengers can use the Bluetooth interface to make hands-free telephone calls or stream digital music to digital end devices via the remote connection and then listen to it through car speakers.

With its smooth chrome finish, the flat panel radio is about the same size as a postcard, measuring approximately 18 cm wide and 10 cm high. It weighs around 1.3 Kgs less than a traditional car radio and, with a minimal depth of around 4 cm, improves vehicle interior design options by allowing engineers more freedom when locating the radio in the fascia.

Its ergonomic controls are functional and include a large dot matrix display that provides artist and song title information. The telephone keypad also allows pre-set radio stations to be programmed and accessed intuitively.



Shorts

New CEO for CLEPA

Peter Tyroller, CLEPA president, has announced the appointment of Mr Jean-Marc Gales as the new CLEPA CEO, with effect from 2 April.

Jean-Marc Gales is currently a member of the managing board of PSA Peugeot Citroën and executive vice-president brands. He has spent most of his career in the automobile industry, notably with Mercedes-Benz, Volkswagen, General Motors and BMW.

Green manufacturing

As part of its 'Think Blue Factory' initiative, the Volkswagen passenger cars brand has set itself clear targets for the environmentally sustainable positioning of all its plants. By 2018, the environmental impact of all Volkswagen plants is to be reduced by 25%. This applies especially to energy consumption, waste volumes, air-borne emissions, water consumption and carbon dioxide emissions.

BASF invests in Sion Power

BASF has invested €39 million to acquire an equity ownership position in the privately held Sion Power, a global leader in the development of lithium-sulfur (Li-S) batteries, based in Tucson, Arizona.

This equity partnership expands upon an existing joint development agreement that BASF Future Business GmbH established with Sion Power in 2009 to accelerate the commercialisation of Sion's proprietary Li-S battery technology for electric and plug-in electric vehicles, and other high-energy applications over the next decade.

Quicker door production

Phasa (Plastic Hot Air Stake Assembly) has enhanced the performance of its specialist plastic component joining machines, with high-performance new versions employing a key servo-based motion control system, in place of a pneumatic actuator. The servo enables several seconds to be shaved off the assembly time of complex car door panels, increasing productivity significantly.

Eco tyre developments

Momentive Performance Materials is collaborating with Sumitomo Rubber Industries on the development of the Enasave Premium tyre, which earned the highest rating (AAA) for rolling resistance under Japan Automobile Tyre Manufacturers Association's (JATMA) labelling system.

Enasave Premium is the world's first tyre to use Momentive's NXT 45 silane, a coupling agent for silica-based tyre tread compound and an excellent candidate to consider for improved dynamic and physical properties, including rolling resistance and wet traction.

Smartphone access

Valeo is using MirrorLink technology to give drivers access to their favourite mobile applications via the dashboard. MirrorLink lets drivers use the vehicle's on-board control, display and sound systems, thus making the most of the centre console, which is wider and more manageable in a car than a smartphone.



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Audi Active Safety

Audi is developing a raft of new safety technologies for future generations of its cars, aimed at reducing accidents with other road users and pedestrians. Using fully networked systems, its aim is to eliminate as much human error as possible, says Christian Hilpolsteiner head of development, pre-sense systems who claims that 90% of all accidents are due to human error. He also adds that the technology is being developed in-house by Audi engineers before it will be put out to the supply community for tender.

Most of the systems rely on a combination of camera and 24 or 77Ghz radar technology although, increasingly, Audi is developing high resolution 905nm wavelength lasers. However, these are considered not to be sufficiently robust and are “two generations and 5-7 years away.”

Traffic jam assistant

This takes driving assistance a stage further in slow-moving traffic at speeds upto 60Km/h. Based on adaptive cruise control with stop and go functionality, combined with new lateral guidance it will autonomously steer the car and maintain a preset distance to the traffic ahead, slowing, speeding up and stopping as necessary, without any driver input.

It uses a combination of a pair of next-generation 77Ghz radar sensors, as used for adaptive cruise control, each with a 21° span and 250mtr range, with a wide angle mono lens behind the windscreen, plus a prototype wide angle laser that covers a distance of 80-100 m, scanning at four different heights.

Eight additional ultrasonic sensors monitor the zones immediately to the front and corners of the vehicle. Under development for three years, it's



described by its engineers as being in the “transitional” stage prior to production. Target application is the next generation Q7, due in three years' time.

Ian Adcock writes that the automated braking could be quite abrupt, not having a human's ability to blend the throttle and brake inputs, but, no doubt, this will have been cured by the time it reaches production.

Following a car at speeds up to 60Km/h, without making any input, feels quite uncanny and, whilst assessing the system on a closed test track is one thing, I can foresee all sorts of liability issues being raised that will need to be sorted before it becomes a production reality.

Audi is developing a laser-based rear fog light. When viewed from a following vehicle, a triangular beam is projected onto the road surface. At 30 m, it is roughly the width of a car. In adverse weather, it reflects off the rain or fog droplets, without affecting following drivers' vision.



Pre-sense city

This uses a combination of infra red and a camera with photonic mixing device (PMD). Developed in part by Audi, the PMD uses a single lens, but, importantly, measures each pixel to build an electronic image to

accurately detect stationary or moving objects, irrespective of light or weather conditions and their distance relative to the vehicle. An infra red pulse is also emitted and, by measuring the time difference between it being transmitted and received, then combining it with the image, it's possible to build up an

accurate 3D image. The system can detect pedestrians at distances upto 20 m, as well as perform full emergency braking at speeds upto 65Km/h. It also pre-tensions the seat belt and primes the airbags according to the predicted severity of the accident and the relative position of the occupants.

In a further development of this technology Audi is developing an Active Emergency braking system for speeds in excess of 65Km/h. Its centerpiece is a forward facing laser with a 905nm wavelength and 140° view used to build up an occupancy grid where the car is always at its centre.

Once an emergency situation is detected an audible warning is sounded, if the driver fails to respond partial and, finally, full emergency braking at 11 mtrs/sec² is initiated. Vehicles following are pre-warned with flashing brake lights whilst the windows and sunroof are closed if necessary and the seat belts and airbags are primed.

Springing back into fashion...

It's been more than 50 years since foam replaced the bulky, heavy springs that have been utilised in car seats since the time of Henry Ford. But now, it seems, the pocket spring could be on the way back.

Tiny, lightweight springs may yet create a revolution in automotive seat construction by reducing weight, potentially contributing to improved fuel efficiency and CO₂ reduction for smaller vehicles, and freeing highly prized 'real estate' space in small cars.

A partnership between interiors supplier Johnson Controls, the world's biggest supplier of automotive seating, and Harrison Spinks, a 170-year-old mattress manufacturer, based in Leeds, UK, which produces the world's smallest pocket spring, could see a major shift in seat construction, thanks to the incorporation of a miniature coiled steel spring into car seats. The spring would be used to replace seat foam – the current material of choice for the seat suspension – enabling the production of seats with an overall thinner form and mass.

"We have been talking to our customers for a while now about helping them make their seats thinner," explains Scott Donegan, director for business and product development for JCI's Seating Group in North America. "For the rear occupants, if you make the seats thinner, then you can create more legroom. We have gone as far as we can go, making conventional seats thinner and still have comfort. You can only go so thin with urethane form, so we have been looking for alternatives."

For now, this new way of designing seats is being considered for the seat back. The springs – as little as 10 mm in height – would be arranged horizontally on top of a rigid seat back structure to provide the seat suspension system where the occupant load is perpendicular to the coil spring.

Due to their small size, the springs are able to contour to the shape of an occupant, as well as distribute a person's weight more evenly. "There are around 200 car seat springs enclosed

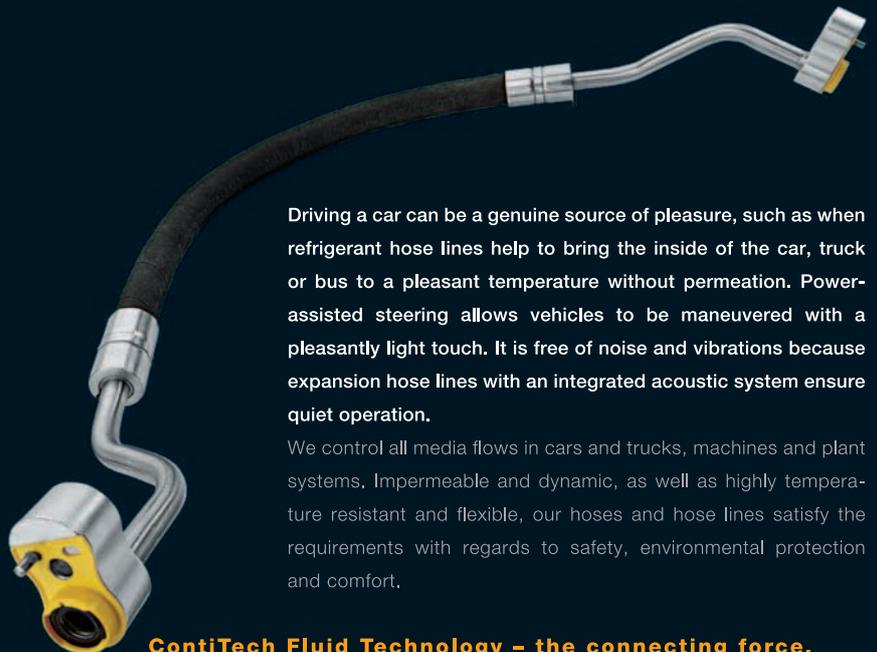
in the rear seat back in a grid format," explains Darren Marcangelo, commercial director, Harrison Spinks Components. "They are an optimum size to achieve the comfort and the pressure-relieving properties required, yet are still small enough to offer the advantages of mass reduction. So far, we are using a moulded thin shell that the pocket springs lay on top of.

"Harrison Spinks' product is unique, because all of the independent springs are captured in cells between two sheets of very thin polypropylene sonically welded together. When an occupant sits in the seat, each spring reacts independently to the occupant. On the rear seat, there is typically a hard back already, so we use that as the reaction surface for the springs."



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Blower Bentley

Not a supercharged one, but Crewe's own development of the twin-turbo, four-litre V8 announced by Audi last autumn. In the Bentley tradition of effortless acceleration, it develops 660Nm from 1,700 to 5,000rpm and 373kW at 6,000rpm.

However, the engine has several unique features to it, including the wiring harness, and it does without the Audi's active engine mounts and Active Noise Control.

"Bentley had issues with that approach, especially if you're buying a high end audio system. An audiophile wants pure sound; he doesn't want that underwritten by the strange behaviour of a counter-active mechanical accompaniment," explains Paul Williams head of powertrain engineering. "We spent a lot of time modeling the response of the mounts, two engine and one tail mount, to eliminate the difference between the V4 and V8 modes. People said it couldn't be done, but we achieved it." The switchable engine mounts effectively reduce secondary engine vibration and firing order vibration by 16 and 12.6dB, respectively.

Bentley's biggest change to the engine is the induction system. Although the pair of twin scroll IHI turbos are the same as on the Audi (45mm compressor wheel and 47mm turbine), plenum pressure is now increased to 2.2bar and, unusually, the induction air is throttled before it goes through the intercooler, with the air mass calculated before it is cooled. "We've a unique Bentley air path that flows backwards, with far lower pressure losses than the W12, for instance," says Williams adding that the exhaust system runs "very" high temperatures. "So the energy we can put into the turbos is very high, on top of that have a very small intercooler with a very low volume of air so response is quicker. It's difficult to get flow through a compact system but the advantage is that you don't have to deal with a big mass of air."

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.

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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.



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Safe, green and

General Motors spun Delphi off as an independent supplier in 1999, but after six years it filed for Chapter 11. In October 2009, it successfully emerged from bankruptcy as a fitter, leaner business.

Ian Adcock recently caught up with Dr Andrew Brown Jr, its executive director and chief technologist, to discover where the business goes in the immediate future

When Delphi was created out of GM's various component and supply divisions, it was a sprawling conglomerate that incorporated just about every facet of automotive technology. Nowadays, it is focused on what executive director and chief technologist Dr Andrew

Brown describes as three "mega trends: safe, green and connected."

That transformation wasn't by chance, he states. "We did studies and research and asked: 'What are going to be the challenges for our customers and markets in the future? What are the products, technologies and processes that are going to be important to the OEMs and

consumers?' And the answers were all around, being safe and safety, green fuel economy/emissions, all of that, and connectivity. Today's focus is more on markets and value propositions, and consumer needs and requirements, as opposed to creating technology."

In the past, explains Brown, it was the reverse: Delphi would have developed the technology and then searched for customers. "We have transformed ourselves to have more of a focus on these mega trends, and what the consumer and regional needs are around them, with the objective of developing the right product technology, with the right quality, at the right cost, at the right time." But were he and his fellow directors confident of emerging successfully from Chapter 11?

"We had no doubt that we were going to get through the bankruptcy.

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"When the industry first started talking about active safety, we had these dreams of collision avoidance and preventing the accident happening. Back in 2000, we had the idea that the vehicle would drive itself, but we weren't ready for it. Now we have active safety systems that are enabling us to provide integrated safety systems to avoid the accident. We now have lane departure warning, lane keeping, active braking, vehicle-to-vehicle communications through the use of Blue Tooth technology. Societies and governments around the world are now talking about

connected

But we said, once we've got through that, 'what's going to be the future? What should we be focused on?' Trying to answer that question drove us to say: 'All right, we don't necessarily want to focus on the technology, so much as providing solutions.' And those solutions can only be provided, if you understand what drives the market, what drives the consumer."

Their market research revealed some commonalities, but with regional differences, "There was a consistency of dynamics around emissions, fuel efficiency, safety, those sorts of things. Yet, within the regions, there was some variability. For instance, here in the States we have a very strong focus on ethanol from corn that the rest of the world didn't have and wondered why we were taking food from our people to make fuel. It didn't make sense [to them]."

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cane stock, ethanol is a key strategy, "I mention that to indicate that solutions are going to be driven by resources and needs in each of the regions," says Brown, adding: "You can't take a European or North American solution to India, China or Brazil and expect it to work. It may work, but only if you've first done the homework to truly understand the needs and requirements of the markets."

He talks of Delphi's 'Innovation for the real world' tag line, emphasising 'the real world'. "Innovation for the real world is more than just a mantra for us; it's a focus in the company that says: 'Are we creating the right product technology for the market at the right costs, that's affordable?'"

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Photographs: William Pugliano

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But, I ask him, if vehicles become autonomous, then where does the responsibility lie, if all else fails and there’s still an accident – the driver(s), the supplier, the OEM?

“Right now, the OEM is responsible for the safety system in the vehicle, so they control that architecture and dictate how that’s to be done. The question is what are governments going to do and require? I think, as a tier one, we don’t control the other dimensions of that safety system. For instance, what if the OEM gives part of the system to one supplier and other parts to another supplier? Neither of those is going to take responsibility, because they didn’t design the entire system. So there are a lot of questions that, in time, will be addressed.

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But he puts a twist on the economy arguments. “Did you know that transportation, at least in the USA, uses almost a quarter of the oil consumed in this country? So it’s the last large segment for fuel consumption reduction and, if we can make a dent in that, that will translate into fewer oil imports and improved fuel economy.

“There’s a new trend developing in

the auto world that is beginning to address medium- and heavy-duty vehicles. Because, generally, there haven't been any regulations relative to those vehicles. What regulations on the emissions side deal just with the engine? I am talking about fuel economy, safety, which we're beginning to see in European safety systems on medium duty vehicles. We're seeing here in the USA requirements on fuel consumption and CO₂ reduction - that's one trend that's newly developing and, over the next five years, expect it to expand very quickly."

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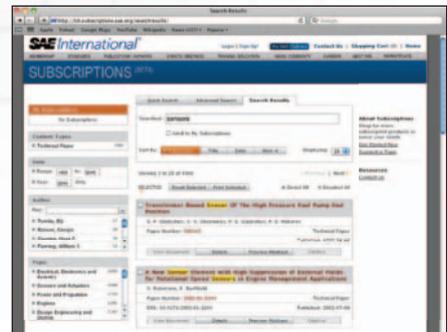
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A milestone for AWIM – two decades in the making



2011 was a time of celebrating SAE International's A World In Motion (AWIM) programme. The year marked the 20th anniversary of when this educational curriculum was first introduced to elementary school-aged kids around the country.

The two decades since that beginning have seen tens of thousands of AWIM kits distributed to thousands of elementary schools, middle schools and, now, high schools. They also have seen countless acts of collaboration between industry and academia, as business leaders have supported this programme. And, most importantly, the past 20 years have seen millions of children impacted by the value of science, technology, engineering, and maths (STEM) education, and inspired to continue learning about these crucial skills.

But what is the true value of the AWIM programme? At its most basic level, it helps to make learning fun. Students use their hands, minds and imaginations as they design a vehicle, and then compete in fun and challenging activities.

The beauty of AWIM, though, is that it doesn't stop there. On account of how the programme is designed, it brings together industry with academia; it enables private industry engineers to work with school teachers in a way that enhances the

learning experiences for everyone involved.

AWIM is about dedicated teachers who know and understand the importance of STEM skills for students of today and tomorrow. And AWIM is about engaged professionals who want to share their knowledge and skills, in the hopes of stoking the learning fire of today's youth.

The AWIM programme, in essence, mirrors a well designed and well implemented engineering plan—there is a stated goal and a plan to reach that goal. In this case, the goal is to teach young children about STEM skills, and the plan is to do it in a way that is engaging and fun.

The other element that AWIM so aptly brings to the forefront is the importance of corporate support in any learning initiative. The millions of students reached through AWIM over the years would not have been possible without the generous support of some of the leaders in mobility engineering. Those companies that have made significant contributions include General Motors, Ford, Toyota, Caterpillar, Nissan, John Deere, Robert Bosch, Honda, Denso, AVL North America and Navistar.

Such companies set an example for all others to follow...and hundreds have.

Finally, the AWIM programme

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stands as a testament to the importance of cooperation and collaboration. For the past few years, SAE International and the National Society of Black Engineers have worked together to engage inner-city and underprivileged youths in Washington, D.C., Oakland, CA; San Diego, CA; and Columbus, OH, in the STEM skills, using the AWIM curriculum.

AWIM truly is the complete package. It not only helps SAE International fulfil its mission to inspire the next generation of engineers and scientists, but it does so in a complete fashion. At a time when introducing students to hands-on experience in science, technology, engineering and maths is critical, AWIM is leading the way in classrooms across North America and around the globe.

focus@sae.org

FUSION/MONDEO..

Ford's Fusion, Mondeo in Europe, is the brand's most important car so far this century. Ian Adcock and Paul Horrell report from its launch in Detroit

The latest Fusion/Mondeo is the first car to be wholly created under the 'One Ford' strategy. The Blue Oval's management is gambling that buyers of mid-sized cars such as this have essentially the same requirements, whether they hail from Baltimore, Brisbane, Beijing or Brussels.

As such, the cars can be engineered on a global scale, hugely reducing engineering and development costs. It's a strategy that Ford has been pursuing since the original Mondeo was launched back in 1993, although it's fair to say that car had so many overlays and local, specific-to-market, engineering demands that it hardly qualified as a global car.

Models such as the latest Fiesta and Focus have, however, principally been engineered in Europe and subsequently honed for the North American and other markets.

"What's different about Fusion/Mondeo," explains Barb Samardzich, vice-president product development Ford of Europe, "is that we have team leaders who take on a global responsibility, located at our various engineering headquarters."

So, while safety was led out of Dearborn, USA, as was much of the bodywork and petrol engines, vehicle dynamics and diesel engines were led by engineering teams from Merkenich, Germany and Dunton, England.

"If you take vehicle dynamics as an example," says Samardzich, "it's a very defined Ford DNA and, although the standards were originally set in Europe, we now consider them to be global standards, rather than just European."



"Likewise with design, which we consider as having a kinetic design influence that originated in Europe, it is now a global design language."

Previous attempts to develop a 'global' car were thwarted by local requirements, especially, in crash and impact, but these are steadily being



... 'ONE' TO WATCH

One Ford Fusion/Mondeo engineering, led by Barb Samardzich (left) and Desi Ujkashevic (below), amongst others.



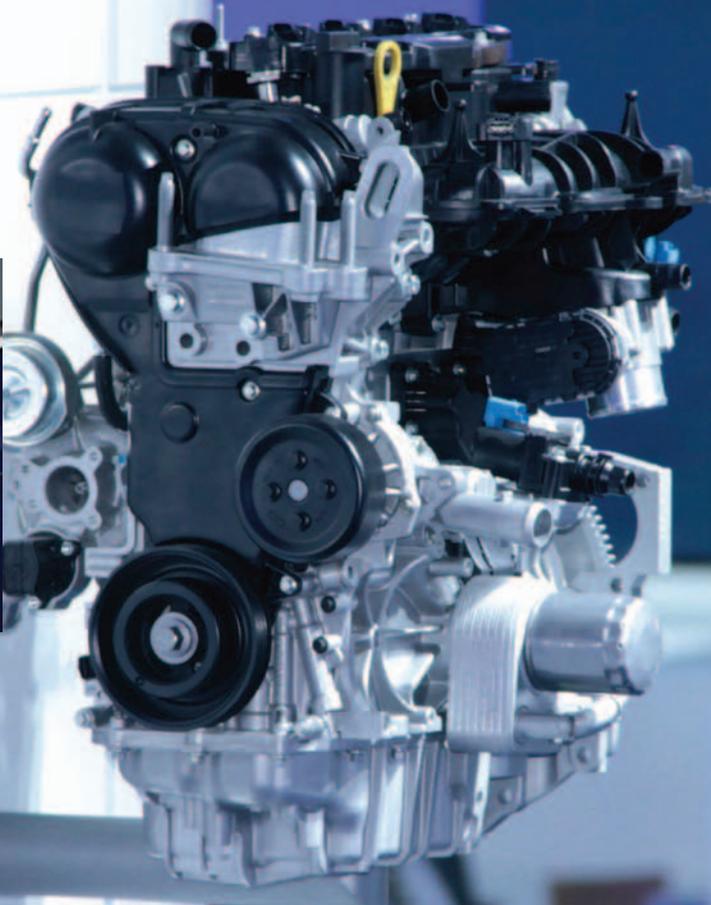
2015, initially there will be just three: the saloon seen in Detroit, plus a five-door hatch and estate car that will debut in Paris later this year.

“If you start with the fundamental premise that it’s going to be a global product and will be compliant in all regions, you need to undertake due diligence, in terms of understanding the effect requirements like rear latches for the hatch and wagon will have. Then you can quickly make a decision as to where you do need unique panels and you do that up front, so you’re not compromised. We did those vehicles [the hatch and estate] in parallel; we just didn’t do the saloon and overlay, because that’s what drives inefficiency.”

One of the biggest challenges Ujkashevic and her team faced was delivering world-class stampings, and unapologetically admitting they targeted Audi’s A6 for fit and finish. “To me, what’s more important is the perception of margin that’s driven by

minimised, explains Desi Ujkashevic, director global design technical operations and EU body engineering, “It was four to five years ago when regional requirements really drove the development of unique top hats. If you think about pedestrian protection, it’s becoming more global over time. Our pedpro requirements have evolved quite a bit and were gradually phased in, so we had an element focused on head impact, then we got to upper leg etc. And, as we go beyond 2012, most of the requirements are becoming very similar.”

Although there will be 10 models spun off the same underpinnings by



Wind cheating door mirrors (left), EcoBoost engines (centre) and improved interiors are key features of the new Fusion/Mondeo.

the edge radii. We're able to take all of our panels, metal and plastic, to world-class execution.

"We used Audi as a benchmark 3.5mm gap on the doors. The Fusion/Mondeo is absolutely equivalent and we did that because it's one of the global features of the job. Our team is focused on how do we deliver world class on a global basis." To ensure that, the American-built Fusion, for example, has laser welded roof joints, falling in line with Ford's established European practice.

One Ford is certainly a bold move – only time will tell if it was the right one to make.

EcoBoost to the fore

As with many cars now, there's a base engine and then more expensive, but smaller, turbo unit with similar power, but better economy. Here, those roles fall to a 2.5 litre, with a projected 127kW, and then a 1.6-litre 'EcoBoost' with similar output, but best-in-class, non-hybrid EPA economy.

Topping the output range is a 2.0 EcoBoost, available with all-wheel drive. In Europe, there will be 1.6 to 2.2 diesels, too. According to engine and market, there will be a choice of manual, TC auto and DCT transmissions, all with stop-start.

Ford insiders also concede that a one-litre EcoBoost, presumably the 88kW version, is undergoing field trials at its UK, Dunton, engineering centre.

Wind cheater

At 0.28, the Fusion's Cd is 10% better than the current Mondeo, with all models using active grille shutters. Chief engineer Adrian Whittle says that this was the starting point for the aerodynamic work, as it "changes the airflow completely". Full underbody shielding means it's efficient to drive a large proportion of the airflow under the car where it has low drag and more predictable, symmetrical flow, improving stability.

The underbody shields are made from sound-dampening material to cut tyre noise and reflected road noise. Meanwhile, the side mirrors have moved from the quarter panels to the doors, their shape reducing their drag contribution from 0.15 to 0.09.

There are two key changes versus the previous European CD platform: adoption of EPAS and a new rear suspension. The column-mounted EPAS is supplied globally by ZF. It's 'prudent' not to narrow the supplier base too much, says Whittle. 'We have a competitive advantage, in making EPAS that's fun to drive, partly

because the components are rigid and partly because of the company's expertise in programming," he adds. Torque vectoring in the ESP helps, too. Fitment of EPAS also enables optional lane-keeping assist and active parking.

The new isolated multi-link rear suspension is claimed to give similar precision to the Mondeo, but better longitudinal plushness, although there is more emphasis on ride in the US Fusion, whereas European Mondeos will highlight dynamics, with BMW's 3-series the benchmark.

Whittle says that Panasonic's ANC was part of the programme from the start, because they wanted to remove balance shafts from the hybrid's engine, but still wanted to make the hybrids as refined as the regular petrol version. Having added it to the suite of technologies on the platform, they decided to use it on some of the higher-powered diesels as well.

Whittle says it cuts noise overall by 0.5 to 1dB, but importantly it is tuned to work on the frequencies the human ear finds unpleasant. Also, it adds some performance sound on acceleration, replacing the hard-to-package resonator-box 'symposers' that Ford has previously used in the induction system.



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Gearing up for CHANGE



Tony Lewin reports on the most significant news from the recent CTI symposium

The annual CTI Symposium on Advanced Transmissions in Berlin presents the ideal opportunity to test the temperature of the global driveline business in all its enormous breadth – everything from electric drives and the design of clutch bearings to the importance of having the right gear ratios for traffic conditions in the rapidly emerging market of India.

Most notably, there was talk in almost every quarter of the need to increase the gear ratio spread in everyday transmissions from today's 5 or 6 to at least 8, possibly 10, with the ratio count likely to increase, too.

The second focus to emerge was that of maximising efficiency at every stage of every process within the

driveline. With some form of hybridisation likely to become a near-universal feature by 2020, energy now flows twice through every transmission, first under acceleration, and then when slowing down and recuperating kinetic energy. This means any parasitic losses impact twice as hard on the overall energy balance.

Will CVT stage another comeback?

A strong theme to emerge from 2011's symposium was that CVT can and will challenge other transmission types for overall efficiency honours.

Shigeo Ishida, until recently CEO of top CVT maker Jatco, surprised delegates when he stated that his firm's new CVT for 2012 would be

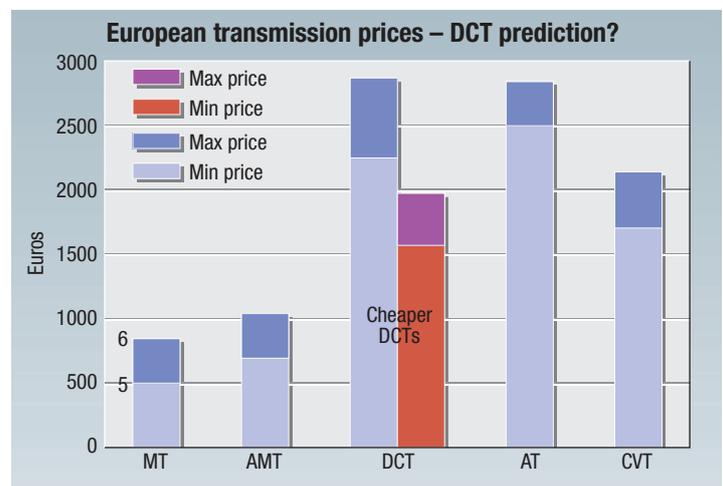
90% efficient and that, in recent Japan-mode emissions tests, it had equalled the efficiency performance of a wet clutch DCT. The CVT8, aimed at medium and large FWD vehicles of up to 350 Nm torque, retains the innovative auxiliary transmission of the smaller CVT7 for Micra-class models and claims a 10% improvement in fuel economy, thanks to its wide ratio span of 7.0.

"The key issue is to develop the engine and transmission together as a complete package," observed Ishida, pointing to the improvement in the new-generation Nissan Micra from 161 g/km CO₂ to 115 g/km as evidence.

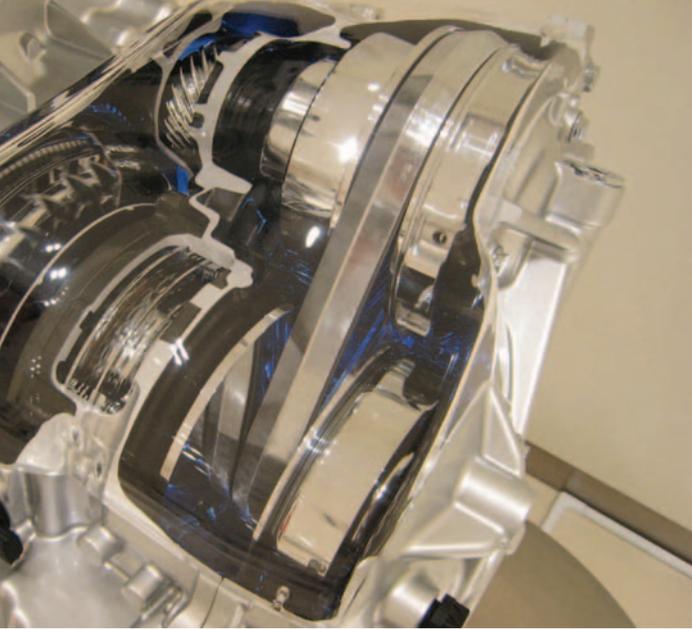
Revealing that Jatco would soon be producing more than half of its transmissions in emerging markets,



Oerlikon Graziano's novel eDCT transmission.



Greys depict minimum/maximum price, as does orange/purple.



CTI review

Getrag expects a 10% range improvement, using this gearbox (above).

Jatco claims 90% efficiency for its new CVT for 2012 (right).

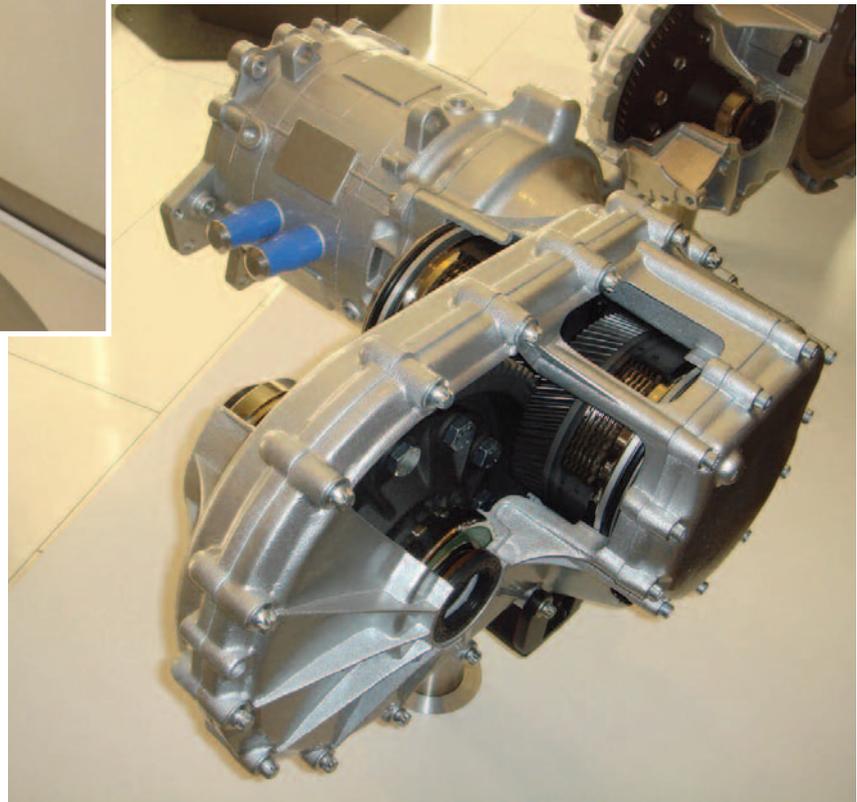
Ishida forecast an annual output of 3 million CVTs and 2 million ATs; remarkably, Jatco now has manufacturing technology that allows both CVTs and conventional ATs to be made on the same line, at the same time.

Many in the transmissions hardware world had feared that the widespread adoption of electric vehicles could put them out of business: the wide torque spread from zero to maximum rpm of electric motors threatened effectively to render the gearbox and clutch redundant. Yet the past year has brought the realisation that such simple, single-speed drives impose uncomfortable compromises in efficiency, most notably when it comes to the most customer-sensitive aspect of EV performance – the issue of the driving range available on each full charge of the traction battery.

Multiple gears

This and several other issues point towards the need for multiple gears for maximum EV efficiency and performance; this also applies to electric assist axles, if they are to be able to operate over the whole of the vehicle's speed envelope.

Dr Uli Blessing, from Getrag, anticipated a 10% increase in mileage with a two-speed transmission, while Alex Tylee-



Birdsall of Drive System Design made the case for a three-speed drivetrain as an enabler not only for greater efficiency, but also improved packaging through the use of smaller motors, lower in torque and cost.

As perhaps the most dramatic extension of this idea, Oerlikon Graziano showed, both in hardware and as a technical presentation, its eDCT transmission. As its name implies, this unit has some functional similarities with a conventional DCT – except that the C in this case stands for 'clutchless'.

In place of the clutches, explained Simone Bologna, senior designer at the Italian company, are twin electric motors; these allow torque interrupt-free shifting between the four ratios.

The choice of four ratios, said Bologna, was made on the grounds of efficiency. The normal 90+% efficiency of an electric motor can drop to 60 or 70 at lower rpm and simulations had shown that an overall improvement of 18% could be obtained through a multi-speed approach. Further gains are available

through two distinct operating modes: fast-shifting power, where two gear pairs are engaged, as on a conventional DCT, and slower-shifting economy, with just one gear pair meshing. The configuration also allows for both motors to be used at the same time.

AMT-plus could threaten DCT

That was the provocative view of Ford transmission specialist Dr Patrick Kelly. Even with DCTs still firmly positioned in the premium segment at a typical on-cost of €2,300, AMTs have failed to seize the opportunity to fill the gap between MTs and DCTs. Kelly argued that the lessons learned from DCT, such as electronic clutch actuation and microslip control, could be used to provide partial torque fill and speed matching. This, though necessitating the addition of a small electric motor on non-hybrid versions, could give customers a much lower cost way of achieving the automation and shift comfort of an AT, if not the fast-shifting performance feel of a sophisticated DCT.

Charging ahead

A new generation of supercharger design could be the key to future petrol and diesel engine applications, as Andrew English discovers

Think of a supercharger and what springs to mind? A dragster's V8 with a pirate's chest of a supercharger, sucking through red throttle butterflies as big as a squid's eyes? Or a 1920s 4½-litre Blower Bentley, with the huge polished eponymous induction machine mounted between the dumb irons?

"We're trying to change that big-horsepower, big-engine image," says Grant Terry, business development manager for the world's largest supercharger manufacturer Eaton.

Superchargers? While the motor industry is introducing new families of twin-scroll, turbocharged engines to the market, it seems almost anachronistic to be writing about powered forced induction.

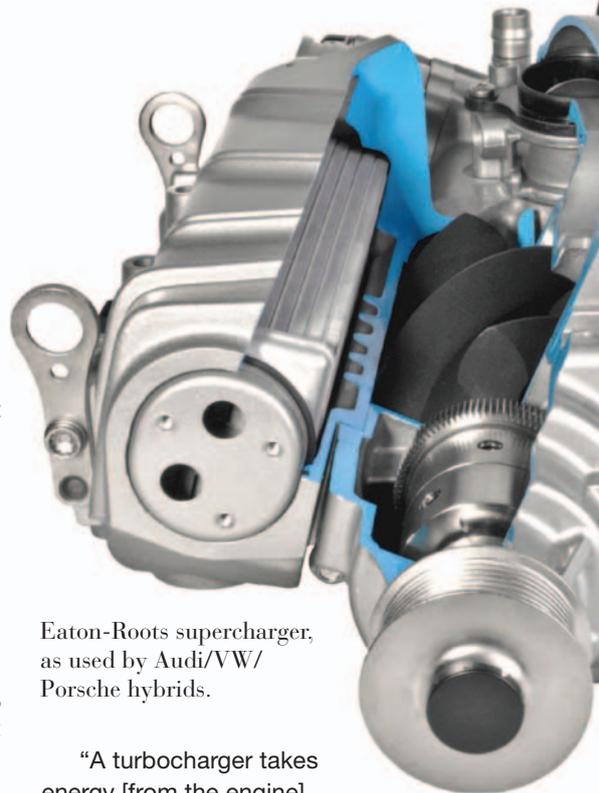
"A turbo gets its power from the exhaust gas," explains Roland Ernst, a Ford powertrain engineer, "where

you have to drive the supercharger via the front-end accessory drive and the amount of energy it uses to compress the air is immense."

Indeed, on a top-fuel dragster the supercharger will consume about 748kW. Even on the experimental one-litre supercharged Ford engine (Ford 1.0-litre Zetec RoCam), which Ernst helped to design a decade ago, it consumed between 11kW and 12kW at peak revs.

"It produced 71kW at 6,000rpm," says Ernst," but the engine was working a lot harder, maybe to 82kW, though the supercharger took all that power."

While the supercharger's parasitic losses are upfront, a turbo's are hidden and include the obstruction to the exhaust flow, which increases back pressure, forcing the pistons to pump air into the exhaust manifold.



Eaton-Roots supercharger, as used by Audi/VW/Porsche hybrids.

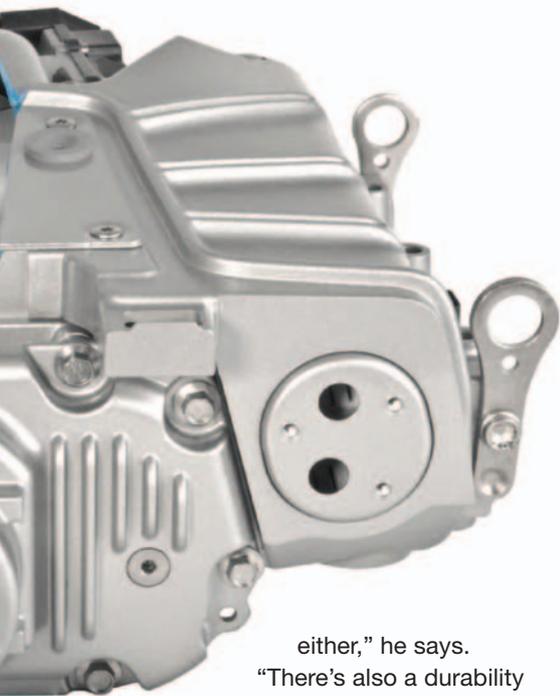
"A turbocharger takes energy [from the engine] to create pressure across the turbine housing, at the cost of exhaust back pressure, plus you have the problem of residual gas in the combustion chamber, which can lead to knocking," says Anders Kolstrup of supercharger makers Rotrex.

"On a steady-state economy map, a turbo has a 2-3% advantage in efficiency," says Eaton's Terry, "but, if you properly match the gears and engine revs, with a down speeded engine and lower gear change points, you can get better fuel economy with a supercharger." He also points out that modern stop/start systems aren't friendly to a turbocharger, which requires high temperatures to operate at peak efficiency. "It's not just efficiency,

Eaton supercharger, as used by VW.



Forced induction – supercharging



either,” he says.

“There’s also a durability issue.”

There’s also the dreaded turbo lag, amounting to two to three seconds of delay on even the best examples, where a good mechanical supercharger is boosting within 700m/s.

It’s the changes that forthcoming emissions requirements will make to conventional engines that are opening what supercharger makers collectively call ‘a window of opportunity’.

“It’s about fuel economy and emissions,” says Nick Pascoe, CEO of Controlled Power Technologies - CPT. “Car makers want to improve both, but are mindful of cost.”

Pascoe explains the alternative routes of hybridisation, electrification, and downsizing and down-speeding engines, using the existing 12-volt electrical architecture. It’s a well rehearsed speech and so it should be. CPT has just sold its interest in

an electric supercharger system, acquired from Visteon eight years ago, to tier-one supplier Valeo.

Known as Variable Torque Enhancement System (VTES), CPT’s electric supercharger technology has been steadily developed to become a highly efficient, short-burst booster of smaller capacity, low revving engines.

What’s happening here is that, as engines get smaller and rev slower to meet emissions regulations such as the EU’s 2015 130g/km corporate average CO₂ requirement, or its 2020 figure of 95g/km, there are consequences, in terms of driveability.

“You ride down the torque curve,” says Pascoe, “but you end up with torque holes at the bottom of the rev range. A turbocharger can help, but we are talking about engine speeds of 1,000 to 2,000rpm where turbos don’t really work.”

And it’s not just a case of making smaller turbos, either, because, as Pascoe puts it: “If you do that, the efficiency drops and the cost rises – remember, the turbo might get smaller, but the clearances remain the same.”

Those holes make cars very hard to drive smoothly away from rest and the Valeo/CPT VTES electric direct drive centrifugal supercharger fills that torque hole with a less than one second burst of boost. Using conventional 12-volt electrics, it takes about 2kW from the battery,

but adds 13-14kW to the engine.

It also adds up to 50% in torque at the critical 1,000 to 1,500rpm range,” says Pascoe and electrical supercharging has a lot of adherents. Grant Terry admits that Eaton is working on its own system and even Ford’s Roland Ernst gives it a partial thumbs-up.

“I like the idea of electric supercharging,” he says. “Depending on how far downsizing goes, it would be a consequent next step to manage low-engine-rev torque holes, especially if it is a plug-and-play solution that can be used with different architectures.”

Nor are these torque holes mysterious science-fiction singularities either. “Some cars and transmission combinations are already exhibiting these phenomena,” says Andrew De Freitas, product director of supercharging and auxiliary drives for Rotrak, a joint venture owned by Torotrak, the toroidal transmission specialist, and Rotrex. The aim is to develop a continuously variable drive for Rotrex’s centrifugal supercharger, based on the principles of the old Hayes/Perbury transmission.

The centrifugal supercharger is a more efficient design and more compact than the more numerous Roots type, but, as the air flow rate increases at the square of input shaft speed, a centrifugal blower needs to be geared to restrict boost at high engine speeds, which means, at low



De Freitas: “We are aiming to better the costs of a two-stage system, such as the turbocharged and supercharged Volkswagen TSI engine, but provide the same sort of performance.”

Forced induction – supercharging

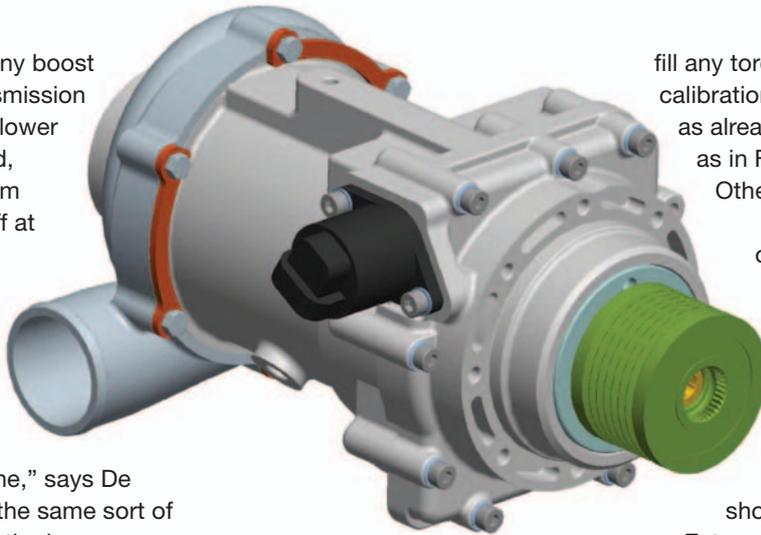
revs, there is hardly any boost at all. A variable transmission allows a centrifugal blower speed to be regulated, providing high low-rpm boost, but backing off at high rpm.

“We are aiming to better the costs of a two-stage system, such as the turbocharged and supercharged Volkswagen TSI engine,” says De Freitas, “but provide the same sort of performance.” Unlike the low-power, short duration CPT/Valeo electric supercharger system, the Rotrak drive transmits about 17kW and doesn't require a turbocharger to fill in the top end of the torque curve. “People want that low-end torque and we are making a petrol engine feel like a diesel to drive,” he adds.

Key similarities

In appearance, a centrifugal supercharger is very similar to a turbo and some parts are almost interchangeable. That similarity has not passed the attention of Ed VanDyne, who has developed the SuperTurbo – what amounts to a hybrid turbo/super charger, where the turbine blades are powered with exhaust gases or directly with engine torque. The Colorado-based company is working with a leading OEM for a high-volume new car application for the SuperTurbo, with the first programme planned for Europe.

These are the tip of the iceberg, and the list of new superchargers and control technologies at the 16th Supercharger Conference in Dresden last September reads like a boost-pressure phone directory. Not all of the ideas will make it to market, but they're adding to a considerable buzz around this branch of forced induction, whether it's the compact supercharging technology of Meta GMBH or the super-precise



Pre-production image of Rotrak's variable drive supercharger.

actuators from Swiss company Sonceboz, used in the wastegates for turbochargers, and superchargers, including those from Eaton. “The actuators offer super precise, super robust and super reliable control of the bypass valve,” says Sonceboz's marketing chief Fabien Noir. What that means is a boost curve that more closely follows the engine's knock point for more power and torque.

Sonceboz is also working on an electronic supercharging system, although Noir says that it is behind CPT, in development terms. As befits the industry leader, Eaton's R&D takes it in all directions. Its work on an electrical supercharger is helped by its experience making superchargers for fuel cells over the last decade. Yet Terry still reckons there are some issues which won't go away. “We've had to address a lot of durability issues in fuel cell applications,” he says, “but how to drive a supercharger with 12 volts is still an issue.”

And car makers aren't overly enamoured with the idea of handing over millions to a tier-one supplier to control an issue they might be able to solve themselves. Ford's Ernst reckons car makers will attempt to

fill any torque holes with careful calibration of the valve timing, such as already exists on engines such as in Ford's Ecoboost range.

Others aren't so confident.

“I don't think any amount of valve timing will get over some of the low-end torque problems that car makers will have in the future,” says Rotrak's De Freitas.

Nor is the mechanical supercharger exactly showing the white flag either.

Eaton already provides superchargers to the VW Group in its TSI engine and the Audi V6 used in a hybrid system for Audi, VW and Porsche. These might be old-school, Roots-type mechanical superchargers, but, as Terry says, in Eaton's Twin Vortices System (TVS) specification they are still highly competitive, as proven when VW Group management drove a blind test of the Audi V6 in bi turbo and supercharged form, and preferred the latter engine.

Defining factors

“There's a place for most of this technology,” says Terry. “It's not a one-size-fits-all world and the right set-up will depend on a lot of factors, including the brand's qualities, the duty cycle, useage and so on.” And just when you think you've seen it all, he tells you about the work that Eaton is doing on supercharging modern diesel engines, and some of the promising results in Nox and particulates reductions in throttle transients.

“The turbocharger is continually playing catch-up in a diesel,” points out Terry, “but a supercharger can put air into the engine at exactly the same time as the injectors are putting in fuel.”

And if superchargers can take back the market for forced induction for diesel engines, is there nothing they can't do? Watch this space.

48 volts could be the enabling technology for mild hybrids

“When 42 volts was first mooted back in the late 90s, the auto industry thought that was the direction it was heading. But once it had done the maths, the cost difference of about €1,000 between that and conventional 12 volts made it clear there was no real benefit for the investment.

“The great advantage of higher voltages is reduced resistance losses and, because it’s a square law, that’s significant. Walking up from 12 to 24 volts gives a big benefit, but going up to 48 volts doesn’t double that, as the curve starts to level off. Things have changed since then: in the past six to eight years, the electronics have advanced markedly and are now very, very good value, and switched reluctance machines are now competitively priced. The problem with rare earth magnets is the supply end cost; machines without magnets, which is principally what a switched reluctance machine is, are very cost effective, hence a lot of demand.

“Other factors that have pulled it forward is that there is now a Verband der Automobilindustrie (VDA) specification and key customers in southern Germany, and a few other competitors, are seriously interested in the technology.

“As far as we’re concerned, 48 volts is all about regeneration; with 48v, potentially you have up to 10kW regenerative power going back into the storage system that may not be just a battery and that gives you very tangible improvements in CO₂ and fuel consumption. The costs have remained about static, but, if you’re getting a 10-15% improvement, as some claim, then it’s worth the additional €1,000.

“That’s motivating our customers and that’s manifested in us with our Integrated Starter Generator for very fast stop-start generators, combined in the same unit with very high efficiency and power regeneration.

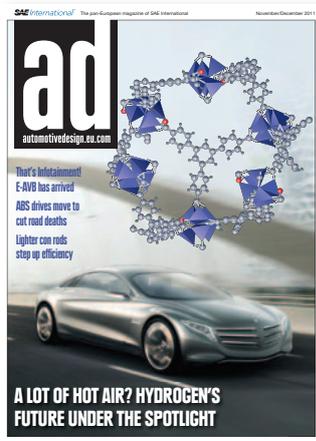
“There would be twin power systems associated with higher power density cranking and heated windows, for instance, on the 48v rail, but then a DC to DC converter that drops down to 12 volts for the legacy systems that aren’t massively power hungry, but are cost effective at the lower voltage. The issue then is that the DC to DC converter that sits between those two systems is quite expensive, so everybody is trying to engineer the best possible performance from an air-cooled system, because it’s intrinsically cheaper than a water-cooled one.

“Lithium solutions, which would be ideal, in terms of mass and size, are still prohibitively expensive. A solution might be enhanced lead acid batteries. Admittedly, there’s an issue with sulfation. But, if someone can make a significant materials breakthrough in the next 12-18 months, then we could see the first vehicle launches in 2014-15, based on where we are today – we have customer vehicles with that potential.”

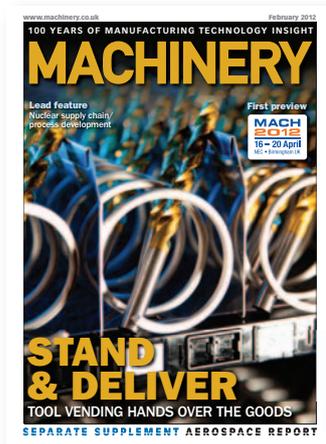


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CONCEPT CARS

Show
stoppers
from
2011



A glimpse of the

The Automotive Design editorial team reviews some of the significant concept cars that have appeared at the 2011 motor shows

The ideas and reasoning behind the concepts are as varied as the cars themselves: many are pure fantasy, designed to draw admiring glances from the public, debate amongst industry peers and, of course, garner as much publicity as possible for their creators.

Others are thinly disguised production cars, often reverse engineered and created from a design that has already been signed off, but which is too early to be revealed in all its production glory. They're built to draw traffic into showrooms and prise deposits from eager customers.

Yet others explore fresh themes, as designers try to recreate brands and marques. Think Kia and Renault. Meanwhile, other brands like Audi and BMW slowly evolve, morphing into a new style language.

If there's one common thread that runs through them all, it's technology. Much of it is pure sci-fi and fanciful, but increasingly we're seeing plenty of near- and medium-term systems, especially in the fields of connectivity, that will play a role in our future.

At the same time, we have to be careful here. With its stringent testing requirements and lengthy development times, the automotive industry is out of sync with that of electronics and, equally, that industry isn't geared up to meet the needs of the automotive sector. Add into that legislative requirements and it would be best not to hold your breath, waiting for some of the more outlandish ideas to emerge into reality.

However, perhaps one of the most enjoyable aspects of these ideas is when you look back on them in 5 or 10 years' time and think: "They couldn't have been serious." But many of them are.

Although the theatrical chutzpah and over-the-top presentations from the Big Three that had been a key part of Detroit for the past couple of decades had, mercifully, been abandoned, there were still a few meaningful concepts to be seen. It was very much a green themed show, with hybrids to the fore.

Porsche 918 RSR

Show stopper and technological tour de force, this is Weissach's take on responsible supercar motoring. Twin 75kW electric motors drive each front wheel and are now linked to a flywheel, rather than batteries, that sits beside the driver. Under braking, energy is recouped and stored in the flywheel, which spins at 36,000rpm. The main motive power comes from a twin-turbo 3.4-litre V8, originally

Fact or fiction? Elements of Hyundai's Curb, likely to make production.



future?

Long term, the Porsche 918 RSR hybrid technology could be a production reality.



developed for the Porsche Spyder LMP2 race car, but updated to develop 419kW at 10,300rpm, boosted to 572kW when the twin electric motors kick in. Moreover, a six-speed sequential gearbox is used, rather than the seven-speed PDK seen previously in the RSR version, from which this car is developed.

Hyundai Curb

Aimed at the Nissan Juke sector, which is showing strong sales in Europe, the Curb is powered by the Korean's 130kW 1.6-litre Gamma engine, complete with

stop-start, and their own in-house designed and manufactured dual clutch transmission, driving the front wheels.

The exhaust vents serve a dual purpose. They pop out to reveal a bike rack, while the roof also features pop-up roof rack towers. Curb has a lighted clam shell rear hatch, also opened via touchpad for loading gear, and a third rear access door for easy passenger ingress and egress.

Inside, a large acrylic screen with multiple zones allows information to be passed between passengers, all via a touch screen that stretches from

Kia are using the KV7 to evaluate novel LED systems.



the gauge cluster to the centre stack controls, across the instrument panel and all the way into the back seat. The steering wheel itself is an opaque surface, with a monitor showing through. There are also monitors in the back of the headrests. The driver has a Heads Up Display (HUD), provided by Continental, with navigation, while passengers search for their favourite channel on Pandora. The screen can also display vehicle diagnostics, download apps and act as a video phone, all with a single touch sensor control strip, provided by Methode.

Kia KV7

Conceived as a modern-day 'activity MPV', the KV7 was designed by Kia's California design team to challenge the notion that MPVs are strictly for family transportation.

The design team is evaluating several LED lighting concepts for future production vehicles, including a continuous line of LED fog lights that spans the entire front end of the vehicle, and directional turn indicators on the outside mirrors and the rear of the vehicle that pulse in the direction being signalled.

When the KV7 concept's push button start is engaged, the entire front dash moves more than 150mm towards the driver, bringing all of the controls within easy reach, including



Rolls-Royce 102EX concept

the large multi-use display that integrates infotainment, climate and navigation systems in one interface, all of which is controlled by a trackball mouse, mounted in the dash.

Rolls-Royce 102EX Concept

A one-off, insists the manufacturer, this concept was actually engineered by Lotus Engineering. It is powered by Axion Power packs, containing 96 Dow Kokam lithium-nickel-cobalt-manganese-oxide cells, weighing a hefty 639Kgs and producing 71kWh, driving a pair of 145kW AC motors from a Tesla sports car. These are mounted over the rear differential, which is turned through 90°, so the drive goes downwards.

Despite all those batteries, its range is only 199Kms. The big drawback is a 20-hour recharge from a UK domestic supply, although this shrinks to eight via a three-phase system, using an experimental induction wireless charge process.

Ford Focus BEV

This new UK-based BEV demonstration fleet is being created partly with public funding from the UK government's Technology Strategy

Board (TSB), which promotes innovative industry-led projects that reduce CO₂. The BEV research programme aims to test the technology's suitability and to gain greater insight into customer charging behaviour.

In Germany, Ford announced its participation in the cognE-mobil Project. This initiative will research the impact of electric vehicles on urban air quality, traffic safety and the electricity supply infrastructure. Scientists will then scale up the results to examine the true benefits that an electric future could deliver for German cities.

BMW Vision ConnectedDrive

This two-seater roadster, interior is divided into three layers - comfort, infotainment and safety - each with a corresponding light installation. Each layer is defined by a colour, rhythm, motion and texture and, through the transparent surfaces, the path taken by the information can be seen via fibre optic lighting.

The layering principal in the BMW Vision ConnectedDrive requires individual components to perform a number of roles: the headlights and

rear lights, for instance, with their integrated sensors monitoring the traffic and external environment, feed information directly to the driver, allowing him or her to take appropriate action.

Nissan ESFLOW

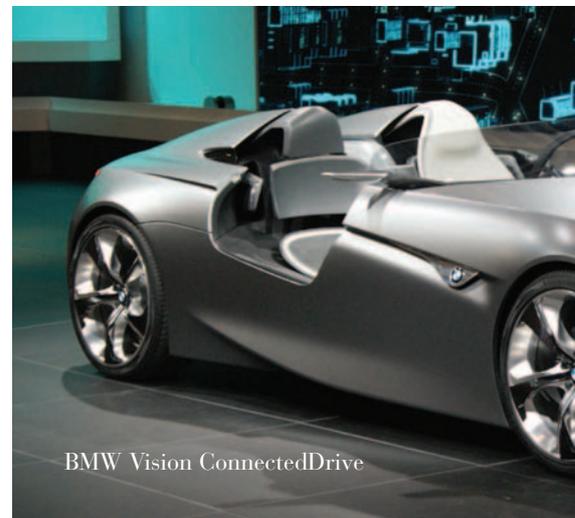
Using technology pioneered in the Nissan Leaf, the EV sports concept's powertrain unit, which employs the same technologies installed in the Nissan Leaf, is tuned to offer a sporty driving experience. Power for the motors comes from the same laminated lithium-ion battery packs used in the Nissan Leaf, but, in ESFLOW, the packs are located along the axis of the front and rear wheels, with its aluminium chassis built around the powertrain.

In ESFLOW, the seats are sculpted into the rear bulkhead as the fly-by-wire steering and pedals adjust electrically to the best spot to suit each individual driver's size and preferred driving position.

MINI Rocketman

Today's Mini is anything but, when compared to Alec Issigonis's original. However, the 3,419mm long Rocketman is meant to address that, with its 3+1 seating arrangement.

The three-door hatchback has



BMW Vision ConnectedDrive

Concept cars

unusual double hinged doors and a split tailgate, plus a 350mm extending boot drawer, and is built round a carbon fibre spaceframe for lightness, delivering a claimed 3l/100kms

Rinspeed Bamboo

This electric powered fun car is full of clever ideas, ranging from the canopy-like inflatable roof, developed by Swiss company Tecnotex. It is covered with water-resistant 'Skai Neptun Caleri', with nano coating supplied by Hornschuch, while thread made from genuine bamboo produced by Schoeller from Bregenz is used in the interior.

The innovative 'Identiface' screen-based section, developed by Daimler subsidiary MBtech in Stuttgart, replaces the radiator grille, which is mostly redundant on an electric vehicle anyway. Thanks to its Internet connectivity, Identiface can display the occupants' Facebook pages, news from around the world and the manufacturer's logo.

smart forspeed

The two-seater has no roof or side windows and features a low wind deflector, instead of a windscreen, in the style of a classic propeller aircraft.

Powered by a 30 kW magneto-electric motor installed in the rear,



MINI Rocketman

there's also a boost function that provides an extra 5 kW of power for a short time. The smart forspeed is powered by a lithium-ion battery that delivers 16.5 kWh of electrical energy. A fully charged battery is sufficient for 135Kms, while quick charging from 0-80% takes just 45 minutes.

Suzuki Regina

The shape encompassed elements from the 2005 Mercedes-Benz Boxfish concept, bits of Bertoni and Lefèbvre's 1955 Citroën DS and perhaps Louis Bionier's Sixties Panhard 24. Regina is based on Suzuki's new 'weight reduction' platform, tipping the scales at just 730kg, using a steel structure, which, according to chief engineer Minoru Sasah, is capable of passing world-wide crash tests.

The subtext here is the Japanese Kei class regulations, a tax-break class of small displacement engines. Previously confined just to Japan, it looks as though these bonsai cars could break out into world markets before too long, with Suzuki claiming that the Regina presaged its new "global compact architecture".

With an 800cc turbo petrol engine

feeding a continuously variable transmission driving the front wheels, the Regina surpasses the current Kei class limit of 660cc, but it is claimed to achieve about 3.1 l/kms in the low-speed Japanese JC08 test cycle, with carbon-dioxide emissions of 70g/km in the NEDC test cycle. That is partly thanks to the highly efficient aerodynamics, with a drag coefficient claimed to be some 10% better than Suzuki's current small models.

"In weight, it is just over 100kgs less than an equivalent Suzuki production model," says Sasah. "In the near future, we will be thinking of commercial applications."

Toyota Fun-Vii

This was the concept that got the internet world all of a twitter, but closer examination revealed that it was somewhat less than the sum of its parts. This three-seat wedge uses the connectivity of the next generation of 4G mobile telephone to connect to the internet. Controlled by the latest in capacitance-screen technology, with flexible organic light emitting diode screens as body sides, the Fun-Vii could be unlocked with a simple hand gesture and will display

downloaded pictures on its body panels. "It's a four-wheeled smartphone," says Akio Toyoda, Toyota president.

"We imagined using a flexible screen on the body sides," says Yoshihiro Sawa, Toyota's advanced design manager, "but we can't make it at the moment. We have no realistic idea about how it could be done."

The idea, though, is to appeal to young people, who are increasingly turning away from driving in the burgeoning suburban mega cities of the Far East and South America. "We turn the thinking on its head," says Sawa. "This is more like an electrical device, with some power plant attached."

Toyota FCV-R

The FCV-R is a medium-sized saloon, fuel-cell concept and a strong indication of how the company's first commercially available, hydrogen fuel-cell vehicle will look when it is commercially available in 2015. There are some decisions to make before then, however.

Yoshimasa Ishiguro, deputy chief engineer on advanced vehicles product planning group, admits: "We are still trying to decide on volume, price and how we would introduce this vehicle."

The concept saloon had highly aerodynamic coachwork. Interestingly, this is partly because good low-speed aerodynamics are crucial in achieving efficient electricity regeneration, which improves urban fuel consumption and range.

"We put it in a wind tunnel, and checked and checked again," says Hiroshi Kawahara, Toyota's general manager of advanced design, although he admits that the wind-cheating effect would have been better with a higher boot line.

At 4700mm long, the FCV-R is quite a big car, although it needs to be. It has twin 689bar hydrogen



tanks, one mounted under the rear seats, the other under the boot floor, with a second battery mounted behind the fixed rear seats and the fuel cell mounted flat between the front seats.

"This is a concept only," says Ishiguro, who states that there are significant updates on Toyota's fuel cell under the skin, with a special treatment to the cells to enable them to be purged more readily and therefore improve the cold starting capability to near to minus 30°C. He claims that the fuel cell stack's durability has tripled, it is twice as compact and the driving range has doubled. But "cost reduction is the key challenge", he says, "so we have decided that, for the next generation vehicle, the target should be cost first."

He says that, at the moment, such a vehicle as this would cost somewhere in the region of £85,000 (€100,000) in the open market, but "we are trying to get this lower".

Asked where all the hydrogen will come from to fuel these new generation fuel-cell vehicles, Ishiguro says that Japan's steel and chemical industries produce enough hydrogen as a by-product to fuel about 5 million vehicles a year.

Mazda Takeri

This handsome concept is generally agreed to be the Mazda6 replacement, slated for launch early in 2013. Quality and design were top notch and underpinning the concept was Mazda's SkyActive technology, which sees diesel and petrol engines sharing common blocks and compression ratios, bowl-in piston combustion chambers and up to 1,600 Kms off a single tank of fuel.



Concept cars



Volkswagen Cross Coupé

Nissan Nismo/Pivo 3

Nismo version of the Juke crossover and the battery-electric Leaf model, with 600kg taken out of the kerb weight. The aim is to establish the Nismo brand alongside those of Mercedes-Benz's AMG and BMW's M Sport divisions.

In the 'out there' department came the Pivo 3, which was conventional to look at, although its electric four-wheel steering allowed

this 3m vehicle to perform a U-turn in just 4m. This really is a driverless taxi. You just travel to your destination, climb out and Pivo will drive off, find a parking space, park itself and start recharging its lithium-ion battery – well that's the theory. When it's time to go home, you call up your Pivo on your mobile 'phone, and it will come and collect you. Again, most of the technology to allow this to happen is already possible.

Honda micro commuter concept and EV-Ster

Micro Commuter Concept (MCC) is part of Honda's commitment to reduce its cars' average CO₂ output by 30% by 2020, based on 2005 emission levels.

Powered with a 3.3kWh lithium-ion battery, it delivers a maximum range of 59Kms.

Totally connected with smart 'phone technology, this Honda will download destinations, appointments and so on, and display these on the dashboard.

One smart move is an auxiliary 'loop' battery that powers ancillaries, such as the air-conditioning, but which can be removed when you reach your destination and used to power a tiny electrical scooter.

The EV-Ster is a battery-electric, two-seat sports car, based on an all-new platform (made partly of carbon-fibre for this concept), which is rumoured to underpin a forthcoming production model, based on Japan's Kei-class sub 3,400mm and under 660cc regulations.

The EV-Ster has a lithium-ion battery, with an output of 59kW and a range of about 160Kms.

Don't expect the production car to feature the twin joystick steering system of the EV-Ster or that it will come to Europe, as the high value of the Yen means that making small cars for export in Japan is a non-profit making enterprise.

Volkswagen Cross Coupé

According to Klaus Bischoff, director of Volkswagen design, the Cross Coupé previews the new look for all future VW sports utilities, including the 2014 Tiguan replacement.

It is one of the first uses of VW's latest modular transverse matrix architecture (aka German Modularer Querbaukasten - MQB), which is a transverse, front engined, front-drive architecture, sharing components and sub assemblies, and capable of being used under everything from superminis to compact family hatchbacks. It will underpin everything from the forthcoming VW Up/Seat Mii/Skoda Citigo city cars to the latest Audi A3 and this year's VW Golf replacement.

The basic relationship between the pedal box, engine and front axle remains the same, but the wheelbase, track and external dimensions and design can be changed.

Honda and Toyota have used a similar design/engineering strategy for years and the Fiat Group is about to use its similarly conceived Alfa Romeo Giulietta architecture in the same manner under the forthcoming Dodge Dart, which debuted at Detroit in January 2012



www.contitech.de

Channelling all media flows

Hanover, January 2012. ContiTech Fluid Technology develops and produces a broad range of components and systems that make cars both more sustainable and more comfortable. As development partner and original equipment supplier, the company channels the full gamut of media flows in the auto and many other key industries. The product range extends from hose components through to complex line systems. The development and production of perfect-fit connection technology likewise demonstrate the company's systems expertise. The customers profit from this one source, capable of offering the full complement of fluid solutions. This business unit of Hannover, Germany-based ContiTech AG scores, moreover, with its wide-ranging material and process competence, extending from rubber technology through to plastics technology.

Customised all-in-one solutions that transport the media required to guarantee that the engine is supplied with fuel are also an element in its product range, as

are innovative solutions for exhaust gas management. These include heatable hose modules, developed for 'Selective Catalytic Reduction' (SCR) technology, as well as hoses and hose lines for particulate filter systems.

The optimum integration of hoses, tubing and fittings enables ContiTech Fluid Technology to produce tight connections for AC units. So the revamped ECO AC product range, made up of air conditioning lines and internal heat exchanger, make air conditioning units more efficient. The weight and amount of refrigerant used have also both been reduced. The components are suitable for both the refrigerant R134a and the new refrigerant R1234yf. Whether it's hose material sold by the meter, molded hoses or complete line systems with integrated functional parts – also for heating and cooling circuits – the components and complex modules developed meet the most exacting requirements, in terms of flexibility, pressure and temperature resistance.

Charge air hoses and lines have to

withstand ever higher pressures and temperatures. ContiTech develops and produces solutions that meet the most demanding performance requirements for tricky clearance situations. In response to direct customer orders, ContiTech additionally develops specific solutions for hydraulic and electro-hydraulic power steering. In the case of brake and clutch systems, the product range runs from pressure-resistant and thermally stable rubber hose lines through to compressed air brake line harnesses, with a practical plug connection – all tailored to the customers' specific needs. What is more, ContiTech Fluid Technology develops and manufactures all types of intake hoses for use in supplying air to the engine, as well as pneumatic pressure hoses for controlling automotive power units.

With over 13,000 employees, ContiTech Fluid Technology produces hoses, curved hoses, hose lines and tubing at 29 locations all around the world. In 2010, it realised sales of approximately €1.12 billion.

Below left: Using the inner heat exchanger (IHE) developed by ContiTech increases efficiency by around 5%. It uses a simple thermodynamic effect to further cool down the refrigerant, without increasing energy consumption. Below right: ContiTech has expanded the plant in Waltershausen into a center of expertise for plastics. Photos: ContiTech



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Playing it Safe

2011 was the year the car industry showed it wasn't going to innovate its way out of recession and instead confirmed how conservative it really is. So says Prof Dale Harrow, head of programme vehicle design at Royal College of Art, in conversation with Ryan Borroff

“I realised, looking back, that 2011 wasn't a golden year for concept cars. We did see some interesting concepts – alternative micro cars, like Audi's Urban Concept, Opel's RAK e and VW's Nils concept, for example – but, on the flip side, the market was being driven by very conventional premium cars. It seems an odd situation. You get the sense that the industry doesn't really quite know where its bread's buttered at the moment or what it needs to be doing.

“We've seen manufacturers announcing new green initiatives and new platforms, and some of these ideas are becoming a reality with the first proper [alternatively powered] production cars coming through...cars like the Chevy Volt and the Nissan Leaf. But now there seems to be an acknowledgement that's only going to be a small part of the market; that we're not going to have this revolution overnight. And I think this was reflected in concept car design. Meanwhile, companies were [careful] with money, so they weren't being very adventurous with the concept cars. At the same time, the emerging markets were coming



“I did get the sense that retro design is definitely on the way out. The Mini brand has been extended absolutely as far, and probably beyond, what it should be.

on stream and saying: ‘We'll take your conventional stuff’. So [overall] it's been quite a conservative year for car design, I think.”

Harrow says 2011 was the year it became clear that any idea the car industry could begin the transition

from conventional cars and into some new transportation method with alternative vehicles began to lose momentum. Instead, Harrow argues that the automotive industry appears to be more interested in providing conventional products to emerging markets.

“The sad thing is, you get the sense that the car industry is thinking: ‘Why bother investing when there's a market out there that will take as many premium products as it can [deliver], and it's more profitable?’ Ultimately, this could lead to a lack of innovation. People had hoped that the growth of these new markets would provide enough confidence and funding to get some of these bigger development plans [underway] to provide the sort of transport we need for an increasingly urbanised environment and an ageing population.”

“I did get the sense that retro design is definitely on the way out. The Mini brand has been extended absolutely as far as, and probably beyond, what it should be. Now, it seems, the trend is to go back to a purer understanding of what automotive design can produce and I think VW – with the Up! – is a really good example of this.”

www.protolabs.co.uk

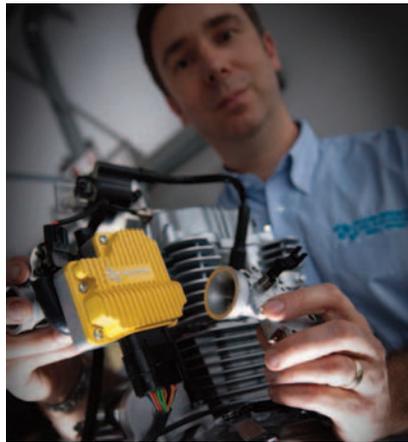
Proto Labs helps Scion-Sprays to win €4million order

When it needed fully functioning prototypes for an affordable, engine management system to impress a potential customer, Scion-Sprays Ltd, based at the Hethel Engineering Centre for advanced manufacturing, near Norwich, chose the award-winning, rapid manufacturing services of Proto Labs®.

Founded in 2002 by Jeff Allen (a former Chief Engineer at Lotus Engineering) Scion-Sprays grew out of research into the electrostatic atomisation of fuel. In the process, Jeff (who is now the firm's Technical Director) came up with the idea of a small, low-cost, constant volume displacement pump, to control fuel flow rates. As



Richard Hoolahan, Scion-Sprays' Manufacturing Manager, says, "That pump proved to have greater market potential than the original research because of its efficient, clean-burn credentials and its simplicity." So with backing from an 'angel' investor, who saw both the business and the environmental benefits of the technology, Jeff and a small team set about developing Scion-Sprays' innovative engine management system called Pulse Count Injection (PCI) and with the help of rapid prototyping services First Cut®



and Protomold® from Proto Labs, is now moving out of development and into production.

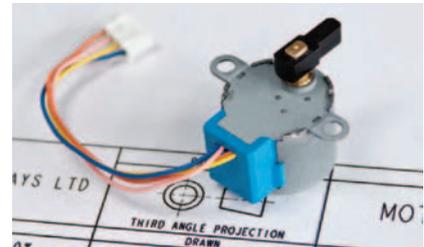
By 2006, Scion-Sprays had produced its first working PCI prototype, which in turn led to the development of a fully integrated Quantum Fuel Injection (QFI™) system. The modular design of the QFI system includes a throttle body, PCI technology, sensors, idle control and ignition.

It was while developing a prototype of its QFI for a prospective European customer in the early part of 2010 that Richard Hoolahan turned to Proto Labs. "I needed about 15-20 pre-production QFI systems for customer-testing, which meant they had to be fully functional and made from similar, if not the same materials that would be used in actual production units. I used different rapid prototyping services to produce less critical components," he says, "but chose Proto Labs for the

throttle crank and the stepper motor arm because there could be no compromises in the mechanical qualities of those parts."

Richard contacted Proto Labs using the company's two interactive, online quotation systems: ProtoQuote® and FirstQuote®. Both systems let him upload his 3D CAD models and then within hours sent back an accurate quote – not an estimate.

"I was very impressed with the process," says Richard, "It was so easy. Online quoting systems rarely work as advertised, but this time they did. The Proto Labs systems gave us a complete price based on our CAD models; a price



that was updated instantly when we changed the quantity or material, so we knew what we would pay for what we wanted."

The machined parts were delivered within three days of Richard accepting the quote: "And that was their standard delivery – they can do it even faster if we want. The moulded parts took slightly longer but that is because tooling manufacture is required. Nevertheless, they were with me in a matter of days, not months, like other suppliers."

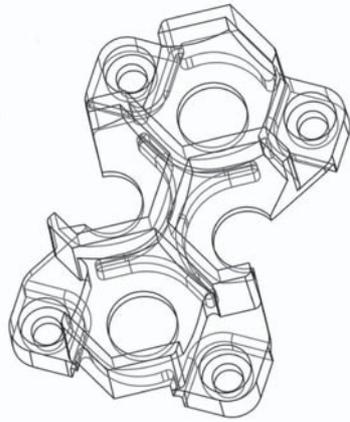
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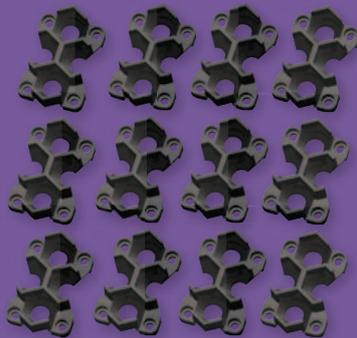
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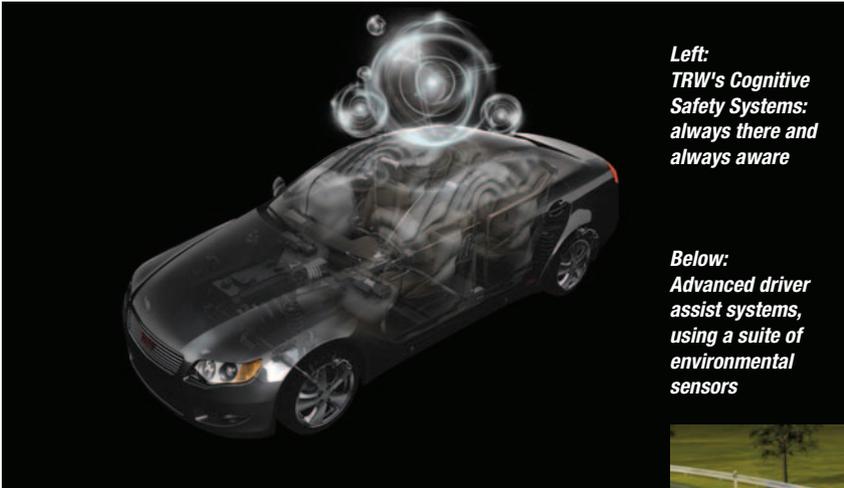
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The safety everyone deserves



Left: TRW's Cognitive Safety Systems: always there and always aware

Below: Advanced driver assist systems, using a suite of environmental sensors

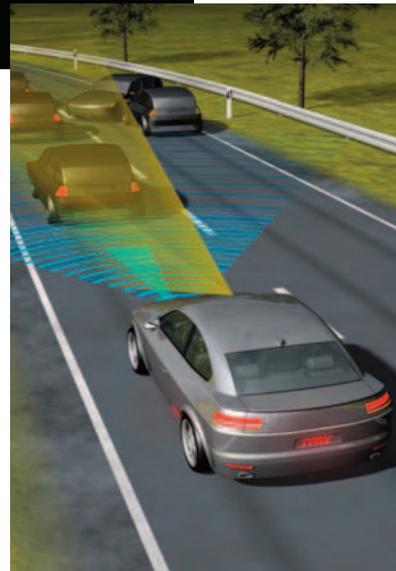
Automatic Emergency Braking, Lane Keeping Assistance, Safety Domain ECU, Adaptive Airbag and Seat Belt Systems.

Green Thinking

To help automakers meet their CO₂ emissions goals, TRW offers a range of fuel-saving and hybrid-enabling technologies, including electrically powered steering, slip control boost – a fully integrated electronic stability control and brake actuation system – and light-weight components.

Smart Thinking

TRW is developing cost-effective technology that helps protect drivers and passengers everywhere. Modular systems designed to make the latest safety systems affordable across the globe and integrated technology, scalable to any vehicle class. Technologies include Scalable Airbag Control Unit, TRW's modular ESC family, mid and short range radar sensors, and



TRW Automotive is the global leader in automotive safety systems. The company designs, develops and produces a broad array of active and passive safety products – braking, steering & suspension, occupant safety systems and enabling electronics.

TRW is constantly seeking ways of ensuring it can deliver advanced systems for the complete range of passenger vehicles – not just the luxury segment – for every market in the world. TRW has more than 60,000 employees across more than 180 locations in 26 countries.

Portfolio

As well as its active and passive safety systems, the company produces body control systems, engineered fastening systems, engine components, commercial steering systems and aftermarket replacement parts.

Cognitive Safety Systems

TRW uses the term 'Cognitive Safety

Systems' to describe how "we put the thinking" into vehicle safety systems. By creating more intelligent systems, we aim to raise safety to a higher level than ever before.

TRW looks at Cognitive Safety Systems under the headings of: Advanced Thinking for safety; Green Thinking for fuel efficiency; and Smart Thinking for value.

Advanced Thinking

TRW is making cars smarter to help keep people smarter. Seamlessly integrated technology that senses, analyses, anticipates and acts in response to ever-changing conditions. Examples include

modular airbag kits.

TRW has the broadest portfolio of any safety supplier and is committed to help protect drivers, occupants and other road users all over the world. Its team of more than 5,000 engineers are working to deliver the safety everyone deserves.

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