Redefining rail
How fresh thinking in rail engineering aims to transform the outlook for mass transit, high-speed intercity and long-distance freight operations

Interview:
Ulrich Kranz
BMW’s city-car mastermind plans to revolutionise car design and manufacture

Open competition
Ricardo’s race-proven GT transmission is now available to third-party customers

Clean diesel sensation
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Electric alliances prepare for battle

In a rapidly evolving series of deals and partnerships the world’s leading automakers have been constructing alliances that will secure them competitive positions in the coming decade’s volume markets for electric and low-carbon vehicles.

Daimler and its Mercedes-Benz and Smart brands, which last year took a stake in California EV pioneer Tesla (below), in April announced a wide-ranging tie-up with Renault Nissan, covering small cars as well as electric technology for city vehicles. The following month Toyota, the world’s largest automaker, surprised the industry by also acquiring a stake in Tesla, allowing Tesla to buy the shuttered NUMMI facility in California to build its Model S electric sedan, but with little obvious benefit for the Japanese giant.

A week later Daimler raised the stakes with an electric car development deal with China’s BYD and the planned launch of a joint EV brand for the Chinese market. At the same time press reports began circulating that Daimler was to co-operate on fuel cell EV development with Toyota.

More recently still, Indian car and truckmaker Mahindra announced it was buying the established Indian EV producer Reva, supplier of the compact G-Wiz sold in London and other cities: in the process, GM, which had an electric vehicle development deal with Reva, decided to pull out of the agreement rather than see its technology shared with a competitor. GM, for its part, already has a partnership in place with SAIC of China, to build and market a minivan version of the Chevrolet Volt plug-in hybrid, dubbed the MPV5. PSA Peugeot Citroën has strengthened its electric vehicle co-operation with Japan’s Mitsubishi and will begin selling Peugeot and Citroën branded versions of the i-MiEV in Europe late this year, and Nissan’s Leaf – the first dedicated volume production battery-powered car – already has a long waiting list in the US.

While analysts differ sharply in their forecasts of likely future EV sales volumes, Renault Nissan is installing an annual capacity of 500,000 batteries, Volkswagen is aiming for a 3 percent EV share of its 10m total volume planned for 2018. The very generous EV sales incentives of almost $9000 just announced for key Chinese cities are likely to trigger significant volume boost and thus allow the long-awaited economies of scale to kick in.

EVs: the world’s ‘most efficient’

Gordon Murray Design claims its forthcoming T27 city car will be the most efficient electric vehicle in the world. The 2.5 metre three-seater weighs 680 kg – including its 12 kWh batteries – and will have a range of up to 160 km. Murray estimates its effective CO2 emissions on the UK’s current energy mix at 48 g/km for the combined cycle. Full-cycle CO2 damage will be 42 percent less than the average UK car, notes the company.

Retrofit traction control

BMW is offering retrofit traction control kits for certain models of its motorcycles already equipped with Integral ABS. The ASC system reduces engine torque to improve stability and prevent wheelspin.

EV safety training

GM’s Chevrolet and OnStar brands are sponsoring a programme in the US to familiarise first-responder emergency services with electric and plug-in hybrid vehicles such as the Volt.

Design takeover

Volkswagen group has purchased 90 percent of Italdesign Giugiaro, the Italian design organisation responsible for a host of classic shapes, including the first-generation Golf, Scirocco and Audi 80.

Traffic light phase assistant

Audi is using its home city of Ingolstadt to trial a fleet of 15 vehicles linked via wireless LAN and UMTS to the traffic light network. The system tells drivers what speed to maintain to ensure the next signal is green.
Scania tops truck power league

A new top-line V8 and extra-high pressure fuel injection have allowed Scania to outrun fellow Swedish truckmaker Volvo to claim the title of the world's most powerful truck engine. At the same time the revised engine family meets the strictest upcoming environmental requirements in Europe and other major markets.

The new R730 is part of a modular family of engines with five, six and eight cylinders. Displacing 16.4 litres and using Scania's own XPI common-rail injection system and pressures of up to 2400 bar, the R730 develops 730 hp at 1900 rev/min and, more importantly, torque of 3500 Nm from 1000 to 1350 rev/min. The typical working pressure of the injection system is 1800 bar, says Scania.

The engine meets current Euro 5 norms as well as the tougher standards for Enhanced Environmentally Friendly Vehicles (EEVs); it is pre-prepared for Euro 6. While the top 730 hp unit will appear in Scania's new R-series – Truck of the Year 2010 – other versions will be available as loose engines to outside customers and for non-highway applications, where strict Stage IIIb and Tier 4 interim legislation comes into force next year. All units use selective catalytic reduction to reduce NOx emissions to levels which anticipate Stage IV and Tier 4 final values entering into force in 2014.

Scania R-series truck is the first to benefit from the powerful R730 engine

Favourable industry forecasts

Global light vehicle production will rise by 13 percent in 2010 thanks to rising demand in emerging markets, according to projections by JD Power Automotive Forecasting. JD Power puts 2010 production at 67.7 million units and expects a strong surge to almost 73 m units in 2011, taking the industry back above its 2007 level of just over 70 m units.

However, growth will be patchy, says JD Power, with emerging markets fuelling the expansion and mature, crisis-hit markets such as Europe still likely to show further falls. While the US will recover to almost 12 m units in 2010 and 13.7 in 2011, it will remain well short of its historic highs. On a more structural level, BRICs markets (Brazil, Russia, India, China) will account for a third of total sales in 2010, compared with just one fifth in 2007.

Electric pricing revealed

Mitsubishi has pegged its i-MiEV at over €41,000, before government subsidies, while after tax credits Nissan’s Leaf (right), a slightly larger car, will sell at around $29,000 in the US and under €30,000 in most European markets.

Heavy duty progress

Mercedes recently tested its latest Actros 1844 and its 1964 equivalent, the LP1620, back-to-back over a 1160 km trans-Alpine route from Stuttgart to Milan and back. Measurements showed the modern truck consumed half as much fuel per tonne payload (1.27 litres per 100 km) as the veteran model and emitted 98 percent less NOx and particulate matter.

Michelin Bibendum eco rally

Held this year in Rio de Janeiro, Michelin’s Bibendum rally saw a wide spectrum of vehicles competing for honours. A Honda Insight took the production Intercity ICE class and a lightweight Audi A5 – weighing just 1310 kg – the prototype ICE class as well as overall victory. Audi’s electric e-tron concept car was beaten for a class win in the electric intercity prototype class by a plug-in hybrid Smart, but scooped the design award. Heuliez’s Will took the light urban vehicle category.
You are in charge of BMW’s megacity project, project i. Is this just a single vehicle?

It’s more than just a vehicle. Project i is looking at all the processes within BMW – that includes production, logistics, marketing, distribution, design, architecture, everything.

Is this for all BMW vehicles, or just the megacity vehicle?

We were established at the end of 2007 as a kind of think tank. We have a couple of people in the team from each specific area of the BMW group – one is for marketing and sales, for instance, and another for architecture and design. We have been asked to question how we do business today and, where necessary, we have to come up with answers – what we can change and why we should do it. The objective is to move the whole of BMW a big step into the future.

So the lessons will be learned on the megacity vehicle?

If the lessons are positive, then they will affect the whole organisation. That’s the idea behind it. All this comes under the umbrella of sustainability as this is the target we have to achieve. This will not only encompass a zero emission vehicle: it will also include high-efficiency production systems, distribution and so on.

How many people work on Project i?

When we started we had a core team of about 24 people, but because we have the ability to get experts from all over the BMW network – we take people out for certain tasks and for a certain time – we now have about 180 people working in all these different areas.

Is it one vehicle you are working on, or a platform for several vehicles?

We are talking about a new approach, a new architecture which should open up new ways to do more than just one vehicle. We have a motorcycle division within BMW, which means we are not just looking at four wheels but also two-wheelers, should there be customer demand. The megacity vehicle is the one vehicle that has been confirmed.

Will the megacity vehicle be pure electric, or does the programme include hybrids and other solutions?

What I can say is that this is a purpose-designed pure electric vehicle. It’s not a conversion of an existing vehicle designed for a combustion engine. The idea is to optimize everything.

BMW has said it will be marketed under a sub-brand of BMW. Does Mini count as a sub-brand?

No, Mini is its own brand, as are BMW and Rolls-Royce. It could be something like M – the cars from our M division. We’re thinking of a little bit more than M. No decision has yet been made: we’re still in the concept phase and there’s a team working on how to set up the whole brand and sub-brand.

Will Project i expertise spill over into the mainstream BMW brand? Will there be electric BMWs too?

The megacity vehicle has been confirmed, but we are also working on technologies like electric powertrains as a whole – the power electronics, the battery and the electric motor – so these components can be used in other cars as well. As you know, we are also working in parallel on hybrids, high-efficiency combustion engines and, for the longer term, on hydrogen. In the megacity environment the pure electric drive makes sense, but if you drive longer distances a hybrid would be better.

What are your criteria for a megacity vehicle?

First of all, it’s zero emissions: we have to respond to the new regulations...
that have come up – such as in London where you have to pay a high fee to enter the city limits. These are the things our customers are looking for: they want us to come up with a solution that is a premium car – they’re not asking us for a tiny car but for a decent car with [at least] a couple of seats that they can drive within the city limits without sacrificing anything.

So will this vehicle be the size of a Mini, say?
I cannot tell you the size, but what I can say is that we are talking about a four seater – and a car should of course have a decent trunk so that customers can take some sports gear with them if they want go away for the weekend a little bit outside the city limits.

You have been running a field trial with the Mini E since last year. What has been the feedback so far?
The feedback is very important to us as we feed every idea into BMW and also into the megacity vehicle. We’ve got the biggest test fleet out there, and those drivers give us information on their driving profiles and habits, what range they expect, how often they charge. These are all the things that are necessary to make the right decisions for the megacity vehicle.

Have you had any surprises?
Actually, yes. Before the customers had had the chance to drive the Mini E everybody was talking about the range and having sufficient charging stations all over the city. But after the customers had driven only the Mini E for a couple of weeks this fear was gone. They are quite OK with the range of the Mini E because they can manage their day-to-day business driving to work, doing the shopping and so on. People are quite OK with the range (100-150 km, depending on the outside temperature) and what also surprised us was that though people originally wanted lots of charging stations – almost every mile – they aren’t using these stations. They are charging at home. What they have recommended is to have additional charging stations in offices, restaurants, parking garages – all the places where the car sits for longer than an hour. We haven’t been asked about fast charging or anything like that. [For the customer] it’s quite a steep learning curve until

“...It’s more than just a vehicle. Project i is looking at all the processes within BMW – that includes production, logistics, marketing, distribution, design, architecture, everything”
they experience it and realise they are driving less than 300 km a week and only need to charge their EV twice a week, conveniently at home overnight.

What have the Mini E drivers complained about?
They complain about only having two seats, and they would prefer a bigger trunk. They manage OK, but they would prefer four seats – that’s why we have now introduced the BMW Active E to complete the development of the powertrain, the next step towards the megacity vehicle. With the new powertrain we have been able to package the engine and the batteries without having to sacrifice any passenger or trunk space.

Have you managed to package in the same amount of battery capacity?
We’ve actually got less battery capacity but we get better mileage. We have 32 kWh in the Active E and 35 in the Mini E, and the Mini is 350 kg lighter than the BMW, which is a much larger vehicle – but we’ve got a much more efficient powertrain, power electronics and battery cells.

So is the customer feedback prompting you to install less battery capacity in your vehicles?
It gives us the opportunity to work within a certain range, a certain boundary just to get an idea. We have put the same questions to all our customers driving the Mini E, and we’re getting more or less the same feedback from the US East and West coasts and from Berlin. This gives us the background for our decision on how much battery [capacity] to put into the car. The other point is that batteries are expensive, so the lighter the car the lower the battery capacity needed.

Do you plan to include the ability to swap batteries en route, as proposed by Renault?
For us the battery is an integral part of the vehicle architecture. That means we don’t always place the battery in the same position, so it would be hard to get it out and put another one in. We also have to be careful about weight distribution to make sure the vehicle fits the BMW and Mini DNA. This is key for us. The other thing is that if you have a swapping station you have to have a standard for the battery cells and batteries, meaning there will be no innovation in the future. We are 100 percent convinced that with all the things that are going on in battery development and chemistry and anode and cathode materials there will be more progress in the battery cell: the battery itself is something that we have under control – all the architecture and reinforcements.
that go along with crash performance and battery management, that’s our turf. The latest battery management technology will appear on the Active E: we have fitted a liquid heating and cooling system as we are convinced this is the way to manage the battery cell in a more professional way. This will also give us the chance to decide on power output, reliability and range.

With the progress you have made, would a four seater electric Mini now be possible?

Not as a conversion. Conversions are always hard to do: the Mini is a small car and you have to make sure the battery is safe, performing all the crash tests and maybe even changing the architecture. For us, a conversion is a good way of gaining customer feedback very quickly and getting experience with the techniques, but to introduce a real electrically powered vehicle it has to have its own architecture.

Why did you choose the 1 series Coupé as the basis for the Active E demonstrator?

It’s a sporty car, and as a Coupé it’s the size and weight of vehicle where it makes sense to install an electric powertrain. It also represents BMW driving pleasure DNA in a really good way and it is rear wheel drive – the motor is integrated into the rear axle.

Is a series hybrid with a range-extender motor also part of your programme?

We’re thinking about all possibilities. These are the things we are taking into consideration – it’s so important to get feedback from real customer use of the vehicle. If you then ask the customer what else they need, that’s just the kind of feedback we want to have very early in order to make the right decision. In the case of the Mini there isn’t the anxiety about range: the feedback is so clear that we know what to do. With the Active E and the new developments in battery management we will be able to manage the experience of range for the customer in a different way. Independent of outside temperature we can heat up the battery so the battery chemistry is always in the best performing window; if it is warm outside, we can cool the battery.

What else can your new battery management system do?

While the car is linked to the grid and being charged we can use a remote control to look into the car and tell it to cool down because it is going to be driven in a couple of minutes. This means that all the charge in the battery will be used for driving and not for cooling or heating the battery. You unplug the car and it’s prepared: the battery is in the best possible operating window and the interior has been cooled – or heated.

If it was minus 10 outside, how long would it take for the battery to reach operating temperature?

With the Mini E, which has air-cooled batteries, it would take 8 or 9 km on a cold winter morning. It depends on the current – if you do lots of acceleration and recuperation it would be sooner.

You have a partnership with SGL for carbon fibre. Which parts of the megacity vehicle will be carbon?

I can’t tell you at the moment which parts are carbon fibre, but I can say that we are using a significant amount of carbon material to make the vehicle as light as possible. It is too early to be specific but I can say we are using a different material mix wherever the material makes sense. On the 7 series we already have a mix of aluminium, steel and plastic materials; on the megacity vehicle carbon will be a large part of the mix, not just to cover things. The overall material mix will be quite revolutionary for a volume car, like nothing we have ever seen before. Together with SGL we are developing a fibre that is perfect for automotive use, but of course you have to have a certain volume in order to bring the cost down. Carbon is very strong and stiff, so it’s important what kind of an architecture you use.

If you are looking at a whole lifecycle analysis, is it not tricky to recycle carbon?

It is recyclable: firstly, you can recycle production offcuts. That’s already happening, and we are working with other companies to recycle the hardened material once the resin has been applied. If you want to make sure everything is sustainable you have to look into the recycling process too. SGL is very experienced in fibres and we are already doing the manufacturing in a continuous process with the roof panels for the M3 and M6.

The M3 and M6 are high performance niche models. How much bigger in volume will the megacity vehicle be?

We will see, but it certainly won’t be a niche car.

How much energy is embedded in the carbon fibre compared with other materials?

I’m not an expert in this, but the good thing is that all this can be done with electricity and green power. This is something we wanted to do: the temperatures are not as high as with steel – it’s around the figure for aluminium – so for us it is a very good material from the environmental point of view. If we have clean energy available at a particular location to produce carbon fibre and aluminium, it fits in perfectly with our sustainable environmental message.

Dipl.-Ing Ulrich Kranz, head of BMW project i

Born in Merzig, near Saarbrücken on Germany’s border with France, Kranz began his automotive career as an apprentice mechanic at a BMW dealership; later he attended colleges and Bingen university, where he graduated in engineering, joining BMW AG in its chassis R&D division in 1986. In 1995 he moved to BMW’s Spartanburg facility in the US as head of chassis development, becoming project manager for the X5 in 1998. A series of roles in the R&D division followed, and in 2002 he became head of the Mini product line. Kranz was appointed to launch and lead project i in November 2007.
A career rail industry professional with extensive experience in both main line and metro sectors, Simon Scott joined Ricardo in early 2010 to spearhead the company’s growth in international rail markets. Here he talks to Anthony Smith about his vision for technology-led services providing enhanced value to railway operators, suppliers, regulatory authorities – and passengers.

“We are not talking about minor incremental improvements – we will be looking to make substantial step-change advances for our customers of tens of percent rather than single digits”
While railways are often perceived as being essentially a national, regional or – in the case of suburban and mass transit networks – city-based institutions, there has been an increasing internationalization of the industry in recent years. The formerly nationally based train manufacturing companies have largely been merged into multi-national groups such as Alstom, Siemens, Bombardier, and Hitachi, who compete on a world stage. This process has been mirrored on the operating side of the industry by the emergence of international transport groups such as Deutsche Bahn, Stagecoach Group and Arriva. In many cases these large transport operators are responsible for multiple rail networks across different countries and continents, while some are also multi-modal and include inter-city bus networks and air travel in addition to rail. The size of this increasingly globalized market is substantial, too: according to research reported in the International Railway Journal in 2009, the world railway equipment and after-sales services market was then estimated as being worth €126.5 billion (£196.6 billion) and was projected to grow at an annual rate of 4 percent in the period to 2014.

**Strategic skills input**

In joining Ricardo, Simon Scott has a clear mission to deliver an entirely new range of strategic skills into the international rail industry, including technical consulting, engineering, technology and production work. “We are aiming to make a substantial and positive impact for our rail clients in terms of tangible considerations such as energy efficiency, quality, robustness...”
“In the UK and Europe the downturn is now in full swing and revenues have yet to pick up. However in the US the situation is already showing signs of improving, reflecting that country’s earlier positioning in the economic cycle”

and whole life costs,” he explains. “In this respect we are not talking about minor incremental improvements – we will be looking to make substantial step-change advances for our customers of tens of percent rather than single digits.”

Highly experienced in the rail industry, Scott was engineering technical director at Atkins’ Rail Business with responsibility for a range of significant engineering innovation programmes prior to joining Ricardo. Before this he held a number of positions associated with the London Underground network through Metronet Rail, and had appointments with rail sector companies including Cubic Transportation, Adtranz, British Rail, and Siemens.

So why did he decide to join Ricardo? “What attracted me to this challenge was that I could immediately see the potential benefits that we could deliver within the rail industry by adapting the suite of skills available at Ricardo, such as advanced engineering technologies, mechanical, electrical/electronic systems integration experience, strategic analysis capabilities and state-of-the-art production skills. These have all been developed and honed in the highly competitive industries to which the company is constantly exposed: this gives them a robustness and an applicability that is potentially game-changing when applied in a rail environment.”

Scott is already in the process of recruiting a top-level team of engineers from the railway industry who can help him in focusing the service offering. An internationally experienced chief rolling stock engineer has already been appointed and will be joined by others in specialist areas of expertise such as signalling, information management and communications. “By building this critical mass of rail industry expertise we are now in a position to leverage the resources of the company across a wide range of programmes,” says Scott.

“In addition to Ricardo’s well-proven capabilities in engines, we have the ability to design, innovate and improve upon everything below the solebar of the train; structurally, dynamically, electrically, electronically, and utilising sophisticated modelling of NVH for example. With our power systems expertise we also have the ability to reduce energy costs and improve our customers’ carbon footprint. With the combination of the in-depth rail knowledge of my rail-sector team and the multi-industry skills and capabilities of Ricardo, you name it and we can improve it – and improve it substantially.”

Warranty management

Warranty is an issue for which rail market customers are increasingly willing to look outside the industry for the right solutions. In an environment where rail fleet vehicle assets are utilized for up to forty years, it can be difficult for train manufacturers and operators to update and re-life systems without consulting the original equipment manufacturer. This can act as a considerable constraint on innovation with consequent opportunity costs. With its automotive and power systems expertise in
warranty management, Scott believes Ricardo is ideally placed to assist.
“We can offer the technical expertise to provide an alternative form of warranty management on behalf of train builders, as well as for owners and operators,” suggests Scott. “In some circumstances we can bring our engineering skills and competence into designing the systems so that reliability is assured from the outset such that the constraining influence of warranty on engines or other sub-systems can be ignored. In other circumstances we can offer to take on the process of warranty management on behalf of the customer by bringing new suppliers to the market.”

Recessionary effects on investment
Scott argues that rail industry investment generally lags behind other more mainstream economic indicators through a recession as the trickle-down impact of passengers losing jobs – and hence not needing to make their daily commute – leads to reduced operator revenues. However, the timing of this is linked to the local economy and this in turn tends to provide a smoothing effect for the global industry: “In the UK and Europe the downturn is now in full swing and revenues have yet to pick up. However in the US the situation is already showing signs of improving, reflecting that country’s earlier positioning in the economic cycle.”

While the current worldwide recession is clearly the most severe in living memory, Scott believes that its worst effects have to an extent been offset by stimulus spending on rail investment.

In the longer term, high-speed rail remains something of a booming global phenomenon. “The economic case for high-speed rail has been found to be compelling in those parts of the world that have already invested in it. However, the processes of planning and designing this complexity and size of infrastructure are extremely time consuming. For this reason it is perhaps unsurprising that many such rail investments are being touted across the political spectrum here in the UK as well as around the world. By the time that those projects that make it through planning reach the construction phase and spending on the vehicles, track and signals reaches its peak, the recovery should be well in place, so it is ideal timing for governments to put high-speed rail plans in place now.”

More efficient and effective innovation
One of the key deliverables that Scott believes Ricardo can offer the rail industry is the ability to innovate rapidly and bring technologies to maturity quickly in the form of products that can be marketed.

“Culturally, rail has been a heavily regulated industry throughout the world, and this has acted to an extent as a brake on innovation. Conversely the intensely competitive environment of the industries in which Ricardo has traditionally operated means that the company has high-quality processes in place aimed at pulling forward technology quickly and effectively.”

As a particular example he quotes the Kinergy high-speed hermetically sealed carbon-fibre flywheel concept, which was taken from the initial idea to a working prototype in less than a year. This system (described in detail in RQ/Q4 2009) is ideally suited to high-speed rolling stock in particular, and Scott is already discussing potential applications with a number of train manufacturers.

In complex systems engineering applications too, Scott feels that well-proven development processes such as hardware in the loop modelling and design of experiments methods can be a distinct advantage in enabling train manufacturers to develop new products quickly without compromising robustness.

On-board power
A major focus of the Ricardo rail sector team will be on the engineering of supply for multiple units, particularly as the requirements of Stage 3b emissions regulations come into force in Europe together with Tier 4 Interim and Final in the US. Scott argues that there are some very sound market-based reasons for this focus:

“While the rollout of electrification programmes has been a particular feature of rail industry development worldwide for a number of decades, the business and environmental case for this is increasingly coming under the spotlight. Unless grid power supplies can be guaranteed as
**Track Record**

**Inter-modal low carbon travel in Germany**
Ricardo is working on a project with partners in Germany to explore how inter-modal low carbon transport opportunities for commuter rail passengers can be optimized. The team is looking, for example, at how station car park electric vehicle charging posts could be implemented. Based on ticket information revealing the journey plans of each commuter, this infrastructure might be used as part of a local smart power distribution system providing energy buffering the to grid and perhaps, electrical power to the station. This same knowledge of passengers’ journey plans might also be used through social networking technology to introduce people who otherwise might not know each other but live close together and have opportunities for car sharing. Ricardo’s multiple industry background in rail, automotive (including with electric vehicle manufacturers) power distribution and intelligent transport systems is particularly valuable to this project.

**Integrated cost reduction for a train manufacturer**
Ricardo has engaged with one of the major international train manufacturers to lead a comprehensive cost-down study of locomotive manufacture. Parallel work streams were carried out in both design and sourcing, with full cost analysis including both production and infrastructure. The result of this highly confidential study delivered a headline cost saving of 30 percent reduction in the unit cost of production.

**Indian Railways locomotive emissions reduction**
Ricardo was selected by the Government of India’s Engine Development Directorate of Research Designs and Standard Organisation (RDSO), Lucknow, to provide consultancy on the reduction of current available interim solutions such as diesel-electric hybridization, alternative fuels, and energy storage devices such as high speed flywheels, ultra-capacitors and advanced battery systems, that can provide significant benefits in the medium term. Ricardo has comprehensively mapped the potential technology paths to deliver these solutions and has in-depth experience in the hybridization of power and propulsion systems in multiple industrial sectors.”

**Information management and control**
Scott also feels that Ricardo has much more to offer in the area of signalling where bespoke – and hence expensive – systems have tended to predominate: “We have the potential to bring some significant new innovations to this market using our knowledge of safety-critical, fault-tolerant systems, including, for example, from our work on automotive X-by-wire programmes.”

“We are looking to partner with others who share our vision of providing open architecture based technologies that could significantly reduce costs and increase functionality,” he continues. “We want to create value-for-money signalling control and information flow systems that utilize commercial off the shelf technology; reducing cost and increasing competition. It’s been too long a small supply base, particularly here in the UK.”

**Intelligent opportunity**
Intelligent transport system (ITS) innovations can also hold out the prospect of some very attractive opportunities if systems integration is taken one step further than at present. “Existing driver assistance systems provide information and recommendations, but let the driver decide what action to take based on these inputs. By taking this one stage further and integrating driver assistance systems with engine management, we can allow the driver to retain a high level of control but subject to some very minor constraints – and of course strict safeguards – while allowing the system to intervene and operate the engine in such a way as to maximize its fuel efficiency.”

Scott believes that much more radical improvements in fuel efficiency are also possible with more wide-ranging implementation of ITS technology. By applying concepts similar to that developed in the Sentience project (described in detail in RQ/Q2 2009), for example, a control system’s knowledge of upcoming gradients, weather and alignments could be used to encourage fuel efficient driver behaviours or to prevent those that might be inefficient, unsafe or potentially damaging to the life of the equipment.

“We currently have no holistic picture of a train’s operation and performance,” he concludes. “We want to offer intelligent ways of dealing with it.”

**We want to create value-for-money signalling control and information flow systems that utilise commercial off the shelf technology; reducing cost and increasing competition. It’s been too long a small supply base, particularly here in the UK.**

coming from clean energy sources rather than from conventional coal-burning power stations, the embedded carbon of electrification schemes can be surprisingly high. According to work carried out by the University of Birmingham, the efficiency of an electric locomotive using grid power supplied from coal-burning generating stations is 23 percent, while a diesel locomotive is 26 percent. As a consequence, the use of on-board power in the form of highly efficient, clean diesel engines linked to advanced energy storage concepts is increasingly of interest for new fleet investments on lines that are not already electrified.”

However, Scott believes that there is a strong economic case for a network supplied by both electrified and on-board power based trains, depending upon the nature of the intended route and usage. “Diesel multiple units should be regarded simply as multiple units with on-board power sources. With a vehicle life typically in excess of 40 years the immaturity of technologies such as fuel cell systems that might ultimately replace the diesel engine as a primary source of on board power, need not pose an immediate constraint on innovation. There are many
exhaust emissions from the Indian Railway’s diesel locomotive fleet. The work was based on an Alco 251, 16 cylinder (3600 hp) engine which is currently used in approximately 4000 locomotives of Indian Railways fleet. Ricardo was awarded the contract to carry out the first stage of this study which included a concept feasibility study of the changes required to meet US Tier 2 and international railway UIC 624 emission standards. Based on the analysis, Ricardo prepared detailed recommendations on completion of the programme in mid 2009, aimed at achieving the desired emission targets for this widely-employed locomotive engine of the Indian Railways network.

geographical mapping based on GPS and on charts of track gradients – few if any worldwide take account of the vehicle’s power systems, or the prevailing weather and network congestion. We already have the proven technology on which such a system could be developed in the form of Sentience”.

With such a system the driver would enter the desired route and through the systems’ knowledge of the route details and real-time information on congestion and prevailing weather conditions, on-board systems would be managed accordingly and the vehicle driven semi-autonomously for maximum efficiency. At an individual vehicle level this would give significant potential benefits in energy consumption. A higher-level implementation on a fleet basis might also be used to optimize the performance of different vehicles through network management – for example to reduce congestion at pinch points such as major rail junctions.

While Ricardo has the core technologies readily available for the implementation of such rail ITS innovations, Scott says that he will look to partner with universities and other specialists to optimize the ergonomics of the human machine interface of such a system.

Local clean power generation
Track-side cabinets are commonplace on modern railway systems, housing motors, signalling system components, relays and control systems. All of these require electrical power which is typically provided via expensive cabling: this is a further example of how Ricardo can help in engineering local renewable clean energy systems independent from the grid.

“Our key differentiator is that we are technology-independent and do not rely on a single favoured approach such as wind or solar,” says Scott. “By combining these renewable power technologies and supplementing energy storage, we can avoid issues of intermittency and develop localized uninterruptable power systems capable of handling safety-critical hardware such as signalling, while at the same time significantly reducing the cabling capital investment requirement, and significantly reducing possession times.”

Strategic growth
Just a few months into his new role with Ricardo, Simon Scott is enthusiastic about the opportunities for development. His growing team of rail experts has already attracted significant business both within and beyond the company’s traditional comfort zone of power systems (see ‘Track record’ box). Scott sees his customers ranging globally from train builders and railway equipment manufacturers, fleet and network operators, to governments and regulatory authorities.

“I want Ricardo to become the trusted independent technical partner to the world class organizations in the global rail industry. While the conventional wisdom might indicate that the more liberalized rail markets such as the UK might be more culturally comfortable with the use of external expert support, the more vertically integrated railways such as Deutsche Bahn in Germany and SNCF in France also offer some of the opportunities for improvement as the benefits of life cycle costs and value are all the better realized,” he observes.

“It can be more difficult to break in to such vertically integrated providers who are culturally used to providing their own needs,” concludes Scott. “However, we are not talking about providing marginal improvements. We’re talking about significant improvements such as 30 percent weight savings or 40 percent energy cost reductions – these are compelling benefits for any potential customer.”

Simon Scott joined Ricardo in February 2010 as global rail market sector director. Previously, he had been at Atkins, where he was engineering technical director, rail, with responsibility for a range of significant engineering innovation programmes. Before joining Atkins, Scott held a number of positions associated with the London Underground network through appointments with Metronet Rail, where his final post was as head of fleet, signals, power and depots whole life asset management. Earlier in his career he also held positions with Cubic Transportation, Adtranx, British Rail, and Siemens. A Chartered Engineer and Fellow of the Institute of Engineering and Technology, he has a bachelor’s degree in electrical and electronic engineering from the University of Nottingham and an MBA from the Open University.
Some of the greatest challenges facing powertrain engineers today lie in meeting future emissions regulations for heavy duty, off-highway diesel engines. The years between 2011 and 2014 will see US Tier 4 regulations, and similar European regulations, for off-highway vehicles come into effect, bringing the issue into still sharper focus. Seeking ways to meet the huge reductions needed in NOx (nitrogen oxide) and PM (particulate matter) emissions from heavy duty diesels is high on the agenda of OEMs. Until recently it looked as though the only way forward was to install substantial exhaust aftertreatment systems such as high capacity EGR systems for NOx reduction coupled with diesel particulate filters (DPF) to control PM, or alternatively to move to SCR (selective catalytic reduction) which also deals with NOx.

Yet Ricardo has found another
solution which, for engines rated up to around 23 kW/litre makes it possible to do without expensive, bulky and sometimes fuel consuming exhaust aftertreatment equipment altogether - the Twin Vortex Combustion System. Its use can greatly reduce the cost of meeting the regulations, cut the cost of ownership and also improve reliability. Moving to a new layer of emissions regulations may not seem that significant. But although this appears to be no more than a single step change from Tier 3/Stage 3, when fully implemented the new regulations represent a massive reduction in NOx and PM emissions of around 90 percent. These changes are so stringent they will effectively align emissions regulations for off-highway vehicles with the European EU6 and US 2010 truck emissions standards. The changes for Tier 4 will be introduced in two phases, 'Interim,' which for mid-range, off-highway engines of 56 kW-130 kW begins in 2012 and 'Final', coming into effect in 2014. Similarly, Europe will see a shift from the existing Stage 3A regulations to Stage 3B in 2011 and finally, Stage 4 in 2014.
Further complications – altitude and temperature
As well as a dramatic cut in emissions there are further caveats making the task of meeting these regulations even greater. For example, Tier 4 includes ‘not to exceed’ levels which hold that emissions may not be allowed to drift upwards due to the environment in which an engine is being used, such as at high altitude or in extremes of temperature. The situation is further complicated for engine developers in that certification is engine-based and not vehicle-based, since in the off-road business, ‘loose’ engines are supplied to a variety of vehicle manufacturers, serving a range of industries from agriculture to construction.

Not only is introduction of the new regulations (both US and European) staggered in terms of timescale, different levels are also set based on power ratings of engines rather than their capacity. One of the highest volume bands and a good example to illustrate the options open to powertrain engineers is that occupying the 56 kW to 130 kW range mentioned earlier. There are a number of ways to reduce NOx and PM in diesel engines and the decision as to which option to choose is a difficult one. It must be made early enough for any chosen technology to be production ready when the time comes, while also trying to anticipate what will be the cost, practicality and maturity of various technologies closer to implementation. The point at which they are on the development curve now and where they will be at the point of production, are thus significant factors.

Manufacturers are being forced to choose a path and stick to it in a scenario not dissimilar to the choice faced by the passenger car industry between unit injector diesel fuel injection and common rail some 15 years ago. The first offered high specific power and reasonable emissions control at the time, whereas common rail, while offering the potential for far superior emissions control, was then immature and lacked the pressure needed for higher specific output. In the current case the choices are influenced by other considerations too: an important one for off-road machinery is the need to package any equipment in a way that does not interfere with the vehicle’s function or the driver’s vision.

One option for controlling NOx is SCR (selective catalyst reduction) already popular in on-road heavy duty applications and now the passenger car market too. SCR is a highly effective system requiring the injection of urea into the exhaust stream. It can be a ‘bolt-on’ fix, reducing NOx without the need to redevelop the engine, but it does require an additional tank to carry the urea, plus pipe-work and control equipment. A more fundamental method of tackling NOx and one widely used in all types of combustion engine today is EGR (exhaust gas recirculation). But using a high rate of EGR to meet the new NOx regulations brings its own challenges too, with substantially elevated engine-out emissions of PM needing a DPF and radically increased cooling requirements.

To achieve an estimated 20 percent EGR flow rate with an EGR outlet temperature of 180°C can require an increase in total cooling power for an engine of as much as 40-50% (depending on the power rating of the engine). This would require significantly larger radiators and fans that could pose a significant packaging and cost problem for vehicle manufacturers. And on a still more fundamental level, engineering margins to meet extreme emissions standards must be that much finer, impacting on the production capability of the plants involved. Heavy reliance

“Ricardo’s new Twin Vortex combustion system tackles emissions at source, reducing reliance on exhaust aftertreatment systems”
Andy Skipton-Carter, project director
on EGR to reduce NOx generally increases production of PM in the combustion process and makes the use of a DPF more of a necessity. But most DPFs require regeneration when the engine management system senses they are full through increased exhaust back pressure: the initiation of this process requires the burning of excess fuel. Doing away with a DPF avoids cost and packaging problems and can benefit fuel consumption by between two and three percent. “Ricardo’s new Twin Vortex combustion system tackles emissions at source, reducing reliance on exhaust aftertreatment systems,” explains project director, Andy Skipton-Carter. The system comprises an optimised injector nozzle and combustion chamber design, the use of a high pressure, 2000 bar common rail fuel injection system, a variable geometry turbocharger and cooled EGR for NOx reduction. The system is designed to work without either a DPF or a diesel oxidation catalyst (DOC) on engines rated below 23 kW/l and in higher rated engines, it can be used with an open-wall (not requiring regeneration) DPF. On a typical 100 kW tractor, running costs can be significantly reduced and thanks to reduced PM generation during combustion, oil change intervals can be extended by 30 percent.

Key elements
The secret of the Twin Vortex Combustion System lies mainly in the design of the piston bowl and the injected fuel spray. Key elements are the shape of the piston bowl and its lip, the fuel spray cone and the swirl generated in incoming inlet air. Essentially, the design creates two annular contra-rotating vortices in the piston bowl, one sitting on top of the other. The vortices resemble smoke rings, vigorously rotating about their circumferential centrelines. At their point of intersection the opposing rotations of these rings produce conditions leading to the highly efficient air/fuel mixing which is essential to the reduction of particulate generation during combustion. The geometry of the injected spray, in conjunction with the movement of the air charge, avoids fuel being deposited on the cylinder wall, something which chills the fuel and increases soot formation and fuel dilution of the oil, reducing its lubricating properties and life.

The outer portion of the piston bowl is concave and its design increases the vertical motion of the fuel spray as it approaches the upper section of the piston. The carefully profiled lip differs from the chamfered profile used in conventional designs and which would normally spoil the shape of the main section of the bowl, disrupting the air motion necessary for good fuel/air mixing and low emissions. The result is a thoroughly mixed cloud of fuel and air extending vertically upwards.

Ricardo has already worked with JCB on its £80-million project to develop what is claimed to be the cleanest off-highway diesel engine in the world, the 4.4-litre JCB Ecomax T4. The engine is equipped with a Twin Vortex Combustion System and is undergoing field testing ahead of Interim Tier 4 and Stage 3B legislation coming into effect in 2012. Thus equipped, the JCB engine offers major benefits to its users including lower fuel consumption, reduced cost of ownership, increased reliability and, thanks to the elimination of the DPF system, superior packaging with no compromise in machine design compared to other systems. JCB’s director of engine programmes, Alan Tolley, says: “we believe the T4 4.4 is not only the cleanest engine in the off-highway sector, but also a first in the industry. Until now, it was expected that in order to achieve the Interim Tier 4 and Stage 3B legislation, the fitting of a DPF would be essential. But for mid-range construction equipment the disadvantages of doing so are exhaust back-pressure and increased fuel consumption. Also, if load cycles are light, the DPF doesn’t self-regenerate and forced regeneration burns yet more fuel.”

JCB’s new Ecomax T4 engine

JCB’s new ecomax t4 engine
and avoiding both the cylinder walls and outer areas of the combustion chamber. Achieving the desired effect not only involved careful piston bowl design but also the shape and geometry of the injector nozzles and their juxtaposition with the bowl. Ricardo’s VECTIS and WAVE software suites were used for modelling the in-cylinder fuel and air mixing.

Using advanced design techniques, Ricardo engineers needed to consider only four bowl designs before arriving at the optimum. “It’s the air motion that’s crucial when dealing with particulates,” says Skipton-Carter, “the EGR takes care of the NOx.” An important aspect of the Twin Vortex Combustion System is the use of a variable geometry turbocharger. “They haven’t been widely adopted for heavy duty diesels yet because thus far, the cost has outweighed the benefits,” he continues. “We started development with a passenger car unit, but a heavy duty version was already waiting in the wings at the supplier in anticipation of the forthcoming emissions regulations.”

**Six power bands**

There is a wide range of power bands addressed in the new regulations. The US Tier 4 standards list no less than six different power bands starting at 8 kW and rising to 560 kW at the upper limit. The European Stage 3B and Tier 4 regulations are similar, also covering a total of six bands ranging from 37 kW to 560 kW. Levels for each type of regulated emission (NOx, HC, CO and PM) vary across both engine outputs and dates of implementation of the regulations, so there would be a number of potential solutions using the Twin Vortex Combustion System.

**Real benefits**

The real benefit of the Twin Vortex Combustion System in this context, then, is the potential to allow vehicle manufacturers to meet future off-highway emissions standards without becoming encumbered with external emissions-reduction equipment. This is especially significant when it comes to the supply of loose engines, where the task of fitting external emissions control equipment could become even more complex and challenging in terms of packaging.

However, in the higher power ratings above 23 kW/l some exhaust aftertreatment equipment may still be necessary. Even so, with its lower engine-out emissions of NOx and PM the Twin Vortex Combustion System already offers a hugely cost-effective solution with which manufacturers of off-highway machines developing up to 130 kW can meet Tier 4 emissions without the need for any exhaust aftertreatment whatsoever.
System would still make the best starting point. Skipton-Carter anticipates that even in the Tier 4 Final 56 kW-560 kW band the system will still eliminate the need for a DPF, only SCR being required to reduce NOx emissions. “Depending on the application,” he explains, “people can just add the minimum they need to the Twin Vortex Combustion System to meet requirements.”

That said, advanced engineering development work is still continuing at Ricardo, investigating ways to extend the point at which additional equipment will be needed to satisfy Tier 4 further up the power rating scale. “One way is the use of even higher fuel injection pressures, and we are undertaking development work on a 3000 bar fuel injection system using our Proteus single cylinder engine,” says Skipton-Carter. Work is also progressing on a system to eliminate the need for any aftertreatment for low power density engines.

At this stage, however, Ricardo’s Twin Vortex Combustion System already offers a hugely cost-effective solution with which manufacturers of off-highway machines developing up to 130 kW can meet Tier 4 emissions without the need for any exhaust aftertreatment whatsoever. The benefits are significant cost reductions since on-cost using the Twin Vortex Combustion System compared to a current Tier 3 compliant engine is estimated by Ricardo as being only marginal in comparison to using a DOC or DPF. Fuel consumption savings of between two and three percent are also significant, as is the prospect of reduced servicing costs for many years into the future.
In May this year Ricardo announced the commercial launch of a state-of-the-art motorsport transmission product providing an ideal solution for GT1 and GT2 applications. This six-speed sequential transverse transaxle is designed for use in a front engined rear wheel drive GT application and is provided in an extremely lightweight magnesium non-structural casing. Alternatively, it can be provided in the form of the existing proven internals in a customer-bespoke casing and a longitudinal arrangement is also possible if desired. The racing provenance of this Ricardo product is truly impressive: it has successfully competed with excellent wear characteristics and 100 percent reliability in the 2009 Spa-Francorchamps 24hr race in the GT1 class, and its internals are identical to those of the 2008 and 2009 Japanese Super GT Championship winning cars. Most recently it was used by the British Sumo Power Nissan team in their victory in the Tourist Trophy at the UK’s Silverstone circuit on Sunday May 2, the first win for the new Nissan car in the 2010 FIA GT1 World Championship.

The story of the development of the new Ricardo GT transmission starts four years ago when the company was approached by Nissan Motorsport (NISMO) to develop a gearbox for its SuperGT car. As Iain Wight, Ricardo’s business development director for high performance transmission products explains, the product had some exacting targets from the outset: “We needed to design a very structurally stiff transmission with high reliability to reduce gearbox costs. The longer a part lasts, the less often it needs to be changed – and that had to be coupled with a low weight. So a great deal of analysis went into its design, very closely focusing on a very small gear cluster. It was very lightweight but using our experience and CAE analysis tools including the Ricardo SABR shaft, gear and bearing concept and design package, we knew it would be able to last a Le Mans duty cycle of around 5,000-6,000 km.”

The SuperGT series provides perhaps one of the most punishing environments for competition gearbox reliability. With cars typically weighing up to 1.4 tonnes they generate a great deal of g-force. To combat this they have sticky tyres and given this and the fact that they are driven by highly professional drivers, the gearbox is subjected to some exceptionally extreme loading. Keen to reduce the cost of the series, the Japanese GT Association was acutely aware that gearbox parts were typically being changed on quite a regular basis with consequent impacts on running costs. When NISMO and the two other manufacturers in the series – Toyota and Honda – compared their experiences, the GT Association took the decision to set the regulations to use the Ricardo GT transmission internals as the common standard for the series.

“What we have done with this transmission now is to further develop it with NISMO but also make it available – with their very generous permission – for sale as a product”, explains Wight. “It will be of interest to anybody with a front engined, rear-wheel drive car because it does give a significant performance advantage with the weight all being at the rear. The internals can also be repositioned if necessary so that it can run as a longitudinal box and while the external casing may not suit every customer, the internals will work fine within a bespoke casing that we can design and manufacture for them if required.”
This is an unusual approach for Ricardo to take in the high performance transmission and driveline market. The company typically operates on an individual project basis as its customers are looking for competitive advantage rather than a product that is the same as the rest of the field. Conversely the company also carries out projects for the governing bodies of single make series where development costs are effectively spread amongst all competing teams. As such the Ricardo GT transmission is something of a unique case, as Wight points out: “What’s happened here is that we’ve worked with the Japanese OEM on a very aggressive target both in terms of weight and operating costs in a manner which can only be really effectively achieved when working in partnership with a customer. It’s too risky to do on a speculative development basis as a commercial product, so we have sailed very close to the wind technically and have arrived at a product that is absolutely on the limit. Now it’s proven itself and gone through to validation we have a product that’s had the benefit of that development. Having been adopted by the Japanese GT association we are now in a position to make this highly optimized product available for sale.”

The Ricardo GT transmission has a capacity of 700 Nm torque and in excess of 650 bhp. It has a six-speed sequential dog engagement, with input bevel and spur gear final drive. Its gears are 16 mm in width, straight cut and full form ground, and are manufactured from S156 single melt case hardened steel. With its magnesium casing the fully assembled transmission weighs only 53 kgs (117 lbs), giving it a significant performance advantage against its competitors.

Commenting on the launch of the new Ricardo GT transmission, Mark Barge, Ricardo’s director of high performance transmission systems said: “The adoption of the Ricardo GT transmission by the Japanese GT Association and its successful use by Nissan, Toyota and Honda is testament to its high quality of design and manufacture, extremely light weight, robust durability and extreme reliability.”

Mark Barge, Director of high performance transmission systems

“The adoption of the Ricardo GT transmission by the Japanese GT Association and its successful use by Nissan, Toyota and Honda is testament to its high quality of design and manufacture, extremely light weight, robust durability and extreme reliability”
Consortium aims to develop next-generation low carbon marine energy systems

As the requirements of increasingly strict maritime emissions regulations begin to bite in regional jurisdictions around the world, and with the recent sharp fluctuations in global energy prices, ship energy management and efficiency is a subject which is coming under intense scrutiny. As a company that has long been associated with the development of marine propulsion engines Ricardo is now aiming to help the marine industry grapple with the challenge of significantly improving its energy efficiency. The company believes strongly that advanced marine propulsion systems based on the careful selection of well-proven propulsion, energy storage, after-treatment and waste heat recovery solutions, have the potential to bring significant fuel consumption savings while also meeting the requirements of existing and planned international emissions regulations. The company estimates that by implementing next-generation energy management and propulsion technologies, operational fuel consumption reductions of between 15 and 25 percent are possible compared with conventional existing marine propulsion configurations. However if the potential fuel saving benefits are extremely attractive, the scale of the research and engineering challenge required to deliver them is no less considerable, and arguably beyond the resources available of all but the very largest players in the maritime industry. For this reason Ricardo has announced

New supercharger technology

Ricardo, Lontra and Ford Motor Company have been awarded grant funding by the UK Technology Strategy Board to demonstrate Lontra’s Blade Supercharger™. The team will integrate the unique technology with a downsized engine to create a Ford vehicle demonstrator. The Blade Supercharger™ is a novel variable flow compressor with the ability to meet the boosting requirements of heavily downsized engines. The grant support provided by the Technology Strategy Board will enable the development of the supercharger for Ford’s engine package, and the integration of the boosted engine into a vehicle demonstrator. Lontra and Ricardo engineers will work together to implement the project.

Commenting on the announcement of the details of this project, Jason King, chief engineer in the Ricardo Gasoline Engines Product Group,
the formation of the Ship Efficiency & Energy Storage Assessment (SEEsA) consortium project in which marine equipment suppliers and shipbuilders, as well as vessel owners and fleet operators can pool their resources and collectively contribute to research aimed at enabling the development of significantly improved energy efficiency.

This pre-competitive consortium will investigate energy management of the propulsion and auxiliary power systems and identify potential technology solutions appropriate for the requirements of applications including cruise liners, ro-ro ferries, tankers, bulk carriers, container ships, and offshore facility supply and navy vessels. In addition to meeting existing and future perceived needs, the flexibility of propulsion configurations in the face of potentially changing operating requirements will also be considered.

The work of the consortium will be arranged in a modular format with partners subscribing to a core programme of work which can be adapted and augmented to meet their specific needs. The first phase will focus on assessing the best energy storage solution combined with advanced energy recovery systems for a complete propulsion system under different operating conditions including normal operation, slow steaming and up to three additional duty cycles that the consortium members agree as most relevant to their needs. The prime movers covered will include diesel and gas engines, and gas and steam turbine systems, with auxiliary power systems also including possible fuel cells and Stirling engine applications. The range of energy storage solutions will include conventional and state-of-the-art battery technologies and ultra-capacitors, flywheel based systems, thermal and pressure based storage.

Other novel technologies intended to be included in this investigation are: fuel reforming, liquid nitrogen (LN2) injection in IC engines, and super conducting systems.

The second phase will focus on a more detailed analysis and investigate the efficiency of the sub-systems including engine combustion and air handling methods. Technologies considered will include advanced air handling and combustion solutions, with a view to identifying how future ship operational practice can be optimized as the economic climate changes and legislative frameworks evolve.

While the SEEsA consortium is now formally launched, it will remain open to applications from prospective members throughout the duration of the work. The formation of the SEEsA consortium has already generated significant interest and appears to be extremely timely for the international maritime industry. It marks a new way of thinking about marine energy management and efficiency at exactly the time the industry is having to come to grips with emissions regulation and the systems based engineering that it will require. While emissions control is largely negative in its impact on the bottom line of operational cost, the extension of this approach into the realms of energy storage and management could well start to pay dividends for those with the foresight to join the research and gain early-adopter advantage.

Organizations wishing to register an interest in participating in Phase 1 or in any of the future modules, can obtain further information from marine@ricardo.com.

New organization aims to spur US wind development

Ricardo Inc has teamed up with fellow Michigan-based LMS International to jointly create a new umbrella organization for the marketing of wind energy expertise in North America. The two companies announced the formation of the new North American Wind Energy Innovation and Development Center at the American Wind Energy Association’s Windpower 2010 Conference and Exhibition in Dallas, Texas, on May 24.

The new umbrella organization will enable wind energy equipment suppliers, government agencies, utilities and other renewable-energy stakeholders to draw on the deep technical expertise and facilities available at Ricardo’s Detroit Technology Campus in Van Buren Township and LMS North America’s engineering offices in Troy. Services will include individual component and systems-level design, development and integration, as well as software-based modelling and simulation, and physical testing of both new and legacy systems in the lab or in the field.

“The United States has evaluated what it would take to generate 20 percent of its power needs from wind energy by 2030, and it will require hundreds of new installations, more efficient and reliable turbines, significant cost reductions and upgrades to the transmission infrastructure,” said Kent Niederhofer, president of Ricardo, Inc.

“Developing more energy from sustainable sources like wind is a national priority, and Michigan is one of the few places in the world with the concentration of design, engineering and manufacturing expertise to make it happen,” said Michigan Gov. Jennifer M. Granholm. The incremental investment in wind power generation required to meet that target is $43 billion, or two percent more than the cost of meeting future energy demand with no new investment in wind power. Currently, 36 states have utility-scale wind projects, according to AWEA.
Ocelot receives orders

Team Ocelot – the unique collaboration between Force Protection Europe Ltd and Ricardo plc – received its very first vehicle orders on the same day that the media was invited to experience this revolutionary new vehicle at the UK’s Millbrook proving ground.

Described in detail in RQ Q4/2009, the Ocelot light protected patrol vehicle was originally unveiled at the Defence Systems & Equipment International Exhibition, London, in September 2009, and has since been undergoing rigorous development testing. Offering similar levels of protection to the highly praised Mastiff MRAP vehicle, Ocelot comprises a core automotive armoured spine or ‘skateboard’ onto which a number of alternative, special-to-role pods are mounted. Each of the pods can be easily changed in the field as the need arises and have been designed for roles such as patrol, fire support or protected logistics. Four wheel steering is common to all and the vehicle can be transported in a C-130 or underslung from a Chinook. Ocelot is equally suited to operations in desert, jungle, mountainous or urban environments.

At the ride and drive event, members of the media (including Stuart Birch of the Daily Telegraph, shown above right) were given and in-depth briefing on the development of Ocelot by Ricardo’s global vehicle product group director Graeme Rumbol, and David Hind, managing director of Force Protection Europe. Following this they were given the opportunity to drive one of two prototype Ocelots made available for the day. In addition to providing this first public ride and drive experience, the event was also marked by the announcement by the UK Ministry of Defence that it was to purchase two Ocelots for further extended testing as part of the Light Protected Patrol Vehicle programme. Commenting on this initial order Graeme Rumbol said: “The MoD has already completed a number of their own tests on two of our vehicles so we’re delighted that they are now investing in these vehicles so that they can carry out further trials. Ocelot is building upon our existing long-standing relationship with the UK MoD which has most recently seen Ricardo carrying out extensive fleet upgrades to create the new RWMIK Plus standard of WMK vehicle.”

Just four weeks later on May 25, this announcement was followed with a formal invitation from the MoD to tender for the demonstration, production and support phases of this important UK military procurement programme. “We firmly believe that Ocelot has defined the future for light protected patrol vehicles,” said David Hind, “and are delighted to have received this invitation to tender from the MoD.”

Ricardo employees reach high for charity

Two Ricardo employees – Jo Vicat-Brown and Ben Thornton – trekked to Everest Base Camp in Nepal in aid of Chestnut Tree House, the only children’s hospice in Sussex caring for children and young adults from 0-19 years of age who suffer progressive life-limiting and life-threatening illnesses. The trek, led by Sherpas, included numerous peak ascents reaching altitudes in excess of 5,500m (where atmospheric oxygen levels were 50 percent of those at sea-level), ice-covered pass crossings and crevasse-ridden glaciers, providing stunning views of many of the world’s highest peaks – including Everest itself. Together with matching contributions from Ricardo the pair raised a total of £2,212.00 which was presented to the charity in April. Chestnut Tree House costs approximately £2 million per year to run, yet families are not charged for their care and the hospice receives very little government funding. As such it relies almost entirely on the generosity, help and support of the people of Sussex. For more information or to make a donation visit: www.chestnut-tree-house.org.uk.
SEMINARS & EVENTS
Related to the automobile and clean energy industries

Advanced technology seminars, workshops and training courses

Ricardo is recognised worldwide as a leading authority in the development of the latest power systems for automotive and clean energy applications. While best known for our engineering and consulting programmes, an increasingly popular service is our regular series of seminars and training courses through which aspects of the company’s knowledge and expertise can be shared with customers. These events are typically hosted at Ricardo Technical Centres and are led by some of our most experienced engineers and research scientists.

We constantly strive to develop new seminars and courses reflecting the very latest thinking and most topical areas of power systems technology and product development. We also strictly limit delegate numbers in order to create an environment conducive to discussion of aspects of particular interest to participants. Modestly priced, our Ricardo seminars and courses provide exceptional value for money but are consequently in high demand.

Our current programme of seminars is listed below. Most of these will be hosted at the Shoreham Technical Centre, further presentations may also be made at other Ricardo facilities or at customer sites subject to demand.

Seminar programme:

**Crankcase Lubricants:**
**16 June 2010**
A one-day seminar discussing the features of crankcase lubricants, the latest developments and likely future requirements. Provides an insight into lubricant formulation and interaction with design and materials. Includes discussion of how to formulate lubricants to meet industry challenges.

**Internal Combustion Engine Fundamentals:**
**6-7 July 2010**
Two one-day seminars covering the fundamentals of gasoline and diesel engine combustion and technology. The seminars are aimed at engineers who wish to gain a broad based knowledge of engine technology, and who wish to broaden their understanding of engine combustion, emissions and related issues.

**Automotive Transmission Fundamentals:**
**15-16 September 2010**
A two day seminar covering the fundamentals of automotive transmission technology. The seminar will cover the main types of automotive transmission and is aimed at engineers who wish to gain a broad understanding of transmission technology, applications and future trends.

For more information about our current seminar programme or to discuss individual company-specific training requirement, please contact: seminarinfo@ricardo.com
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