

Ricardo – HORIBA コラボレーション New Horizons in Japan

Groundbreaking co-operation agreement with HORIBA

Chrysler HEMI[®] V8

Ricardo helps reinterpret an engine legend for the 21st century

Mitsubishi Pajero Evolution

Resounding victory in gruelling Dakar rally for works team – and Ricardo transmission

Racing Diesels

The astonishing 600bhp Ricardo V10 that could make Le Mans

Spring 2003

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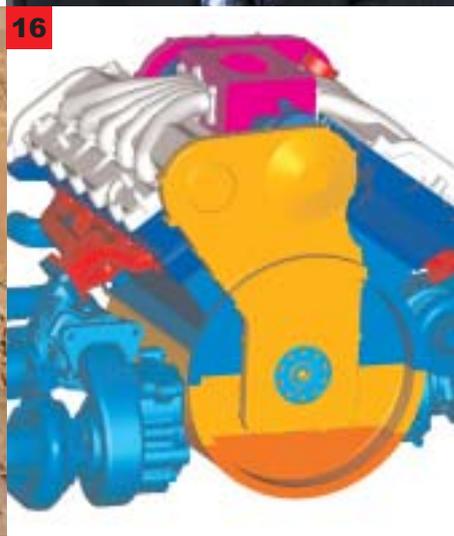
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● in brief

Lexus goes to Japan

More than 13 years after the launch of the brand in the US, Toyota is to introduce its premium Lexus nameplate to the Japanese market. Until now, Lexus models have appeared under the Toyota label in their home market.

GM to promote ethanol mix

General Motors is to encourage the use of E85 ethanol fuel in order to persuade more filling stations to offer the blend, which mixes 85 per cent corn-derived ethanol with 15 per cent gasoline. According to a report in *Automotive News*, just 150 outlets across the US currently dispense E85.

Diesel engines to cost more

The advent of the 2007 US emission regulations will increase the price differential between gasoline and diesel engines, according to Patrick Charbonneau, chief technical officer of International Truck and Engine Corporation, which builds the 6 litre Powerstroke V8 diesel for Ford pickup trucks. Quoted in *Automotive News*, Charbonneau cited the need for more sophisticated injection systems, turbochargers and electronics as adding to the diesel price premium, which currently stands at \$4000.

Renault installs new model in Russia

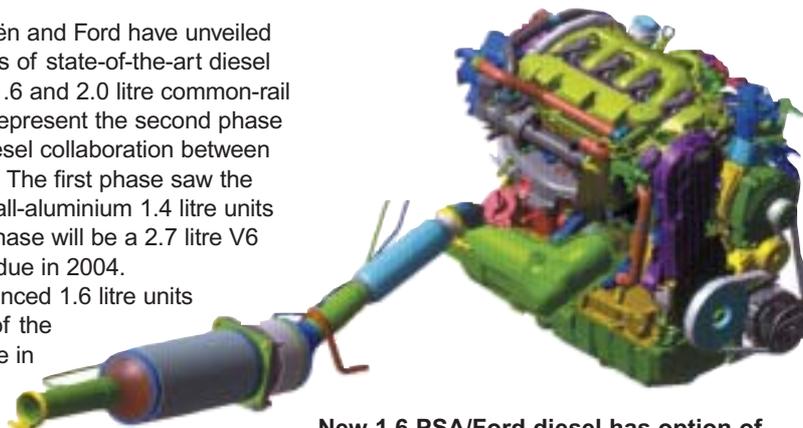
Following several years of holding back due to market uncertainties, Renault is to invest in new production capability in Moscow to build a fresh model for the Russian and Romanian markets. The sedan model will replace the Clio Symbol and will be based on the new Nissan/Renault B platform, which already underpins the new Micra. Production will be 60,000 units from 2005 on; the Russian market currently stands at 1.5m units and is expected to grow at 10 per cent per year.

PSA Peugeot Citroën and Ford announce second range of diesels

PSA Peugeot Citroën and Ford have unveiled two additional series of state-of-the-art diesel engines. The new 1.6 and 2.0 litre common-rail four-cylinder units represent the second phase in the three-part diesel collaboration between the two companies. The first phase saw the introduction of the all-aluminium 1.4 litre units in 2001; the third phase will be a 2.7 litre V6 for larger vehicles, due in 2004.

The newly-announced 1.6 litre units are developments of the recent 1.4. Available in 90 and 110 horsepower versions, they have second-generation Bosch common-rail fuelling, capable of delivering up to six injections per cycle at up to 1600 bar injection pressure. The engines weigh just 120kg and will power more than 37 different Ford and PSA vehicle derivatives; certain versions will carry the PSA particulate filter system to achieve Euro IV emissions.

The larger 2.0 litre diesel is based on the existing iron block, aluminium-head PSA HDi, and uses Siemens 1600-bar injection and six-hole nozzles, again capable of six injections



New 1.6 PSA/Ford diesel has option of particulate filter to meet Euro IV

per cycle. The second of these injections helps reduce combustion chamber temperatures and hence NOx emissions. With the emphasis on driveability and torque rather than peak power, the 2.0 litre nevertheless produces 136 horsepower – 25 per cent more than its predecessor. This engine will be available from launch with the particulate filter.

Both units will be produced at the PSA Tremery plant in eastern France.

GM and Ford finalise transmission joint venture

General Motors and Ford have confirmed details of their joint venture to develop and build high-volume six-speed automatic transmissions in North America. The new transmissions are expected to offer fuel consumption savings of 4 per cent over today's four-speed automatics.

The agreement calls for the common design, development and testing of the new transmission, as well as the joint co-operation with suppliers to develop and purchase components. Each

automaker will assemble transmissions at its respective manufacturing plants. The new transmission will be available "mid to late decade" on front wheel drive and sport utility vehicles, say Ford and GM.

"This world-class six-speed transmission has a simple but elegant design that offers the customer enhanced performance at a very competitive cost," said GM Powertrain group vice president Tom Stephens.

Delphi bullish on fuel cell APUs

Faster than expected progress in the development of its solid oxide fuel cells (SOFCs) has prompted Delphi CEO JT Battenberg III to predict that auxiliary power systems running on this principle will be in general service within the next few years.

Delphi's SOFC auxiliary power unit (APU) will be generating electricity for military applications, passenger cars, heavy-duty trucks and homes sometime during the second half of this decade, said Battenberg.

"One of the key reasons why we've made great inroads in developing this technology is because we have a strong, collaborative partnership with the US government," he added. "We've greatly accelerated the development of a solid oxide fuel cell auxiliary power unit that's both

powerful and affordable. It's my hope that the auto industry, the Bush administration and Congress are committed to keep working together so we can realise President Bush's vision sooner rather than later."

In Europe, Delphi is co-operating with Renault and BMW to develop smaller SOFC units to supplement or replace conventional vehicle batteries. The second-generation SOFC auxiliary power unit develops 5kW, weighs 70 kilograms and occupies 44 litres. "Our new technology represents a 75 per



Mustang concept could be one of the programmes to benefit from Ford's development process realignment



A message from the Chief Executive

The Japanese automotive industry represents around one third of the world's capacity for design and development as well as production. It is also a market in which we believe the demand for automotive technology and engineering services is evolving rapidly. Recognising the need to serve our customers in a manner which is most convenient for them, as well as sympathetic to their language and cultural identity, we have already provided local representation and engineering activity in many parts of the world.

It is timely, therefore, that we now turn our attention to Japan and I was pleased to be able to announce in January of this year the co-operation agreement that Ricardo has signed with HORIBA. This is a significant step forward in the service that we are able to provide and in this issue of RQ we focus upon the strategy of both Ricardo and HORIBA, and the benefits that the co-operation agreement will provide to customers.

Ford reorganises to speed development times

Ford is rethinking its North American product development processes in order to speed up model lead times and reduce the number of platforms by a quarter.

Under the new organisation, Ford hopes to improve productivity by 10 per cent and trim product development times by 25 per cent. "By moving to more flexible, common platforms, we will be able to introduce new, derivative products at lower cost in the future – including several all-new Ford, Lincoln and Mercury products not yet announced," the company said.

As a result of the moves Ford expects to be able to step up the pace of new product introductions as well as improving

quality and saving on costs. The group plans to launch 65 new Ford, Lincoln and Mercury models in North America in the next five years.

The reorganisation abandons the old marque-by-marque structure for product development. Instead, the process will be split across four platform groups: small FWD/RWD models, medium-large FWD/AWD models, SUVs and body-on-frame models and, lastly, pickups and commercial vehicles.

The new product development system will also build on the major investments in flexible manufacturing. The new Dearborn Truck Plant will be able to produce nine models off three platforms, Ford said.

cent reduction in mass and volume over Delphi's first-generation unit, which makes commercial applications more economically viable," said Rodney O'Neal, president, Delphi Dynamics, Propulsion and Thermal sector.

"The potential of this technology is enormous," commented Guy C. Hachey, president, Delphi Energy and Chassis Systems. "On passenger vehicles, it can power a vehicle's heating, ventilation and air conditioning system, as well as other accessories, so a smaller

combustion engine can be used to propel it. For the military, the technology can be used to help power combat and security vehicles. On semi-trucks, it can be used to power air conditioning, heater, TV, radio, computer and other electronic devices during the drivers' rest periods to reduce the burning of diesel fuel, which will cut emissions."

Developments in the field of fuel cell engines as vehicle propulsion systems paint a more mixed picture. Following President Bush's pledge of \$1.7 billion to boost fuel cell

and hydrogen research, a group of US senators is tabling proposals for substantial tax-breaks for buyers of fuel cell vehicles. An industry consortium taking in DaimlerChrysler, Ford, Nissan, PSA Peugeot Citroën, Toyota and several suppliers are developing tanks capable of storing hydrogen at pressures of up to 10,000 psi (700 bar). However, the cost of the drivetrains is still likely to be over ten times that of a gasoline equivalent, with \$2000-worth of electronics and \$2300 in platinum.

"Fuel cells are far from being an affordable alternative to the internal combustion engine, noted Richard Okine, technical director for DuPont Fluoroproducts. He said researchers must improve fuel cell reliability and durability, increase power output, reduce component costs and develop factories to produce them.

Perhaps in response to these pressures, PSA Peugeot Citroën is reported in *Automotive News Europe* as looking for a fuel cell development partner, having reduced its in-house work.

Man on a mission

As CEO of leading test instrumentation maker HORIBA, Atsushi Horiba believes passionately in the environment and society, as well as in technology and profits. **Tony Lewin** asks what drives him, his company and the ground-breaking alliance with Ricardo

On the cover of your annual report and on your website are subjects such as the welfare of the planet, better society, exploring the future... Are these the most important missions of HORIBA?

This kind of mission is important in the way we operate and manage our company. The reason is that we are not only looking at making a profit – we also need certain targets for society and for our lives. Our business is very much related to the environment.

Could you give us an idea of the sizes of your four main business divisions and their contribution to group revenue?

Our analytical instruments and systems division is about a third of our turnover, engine measurement systems just over a quarter and, in 2002, the semiconductor and medical/diagnostic instrument businesses each accounted for just under 20 per cent of our total sales.

Last year was a difficult one for the semiconductor industry. Is this just a cyclical downturn, or will there have to be restructuring? How is HORIBA dealing with the situation?

The silicon cycle is a consequence of the dot-com crash. So we expect that in 2003 we may see some recovery. The automotive business works in a similar way: the policy of our company is to lead by investing – our R&D investment does not depend on the business cycle. In the semiconductor industry, cycles are exacerbated by the lack of investment in downturn. We can emerge stronger than the competition by maintaining investment through the downturn.

Which of your four businesses has the greatest long-term potential?

All of them! Honestly speaking, we feel automotive has such a high market share of the emissions business that it's almost hitting the ceiling. But because of the co-operation with Ricardo and Schenck, we can break through that ceiling.

Which markets – both geographically and in terms of products – will become important?

Asia holds the key. China and India have very high potential. In terms of size it's still the US

and Europe that are the most significant markets for us – but growth comes from the emerging markets. Emerging nations are keen to develop key markets and technologies – these offer good potential for the type of products produced by HORIBA. In automotive, emissions and the environmental area have a high potential. Medical and semiconductor products do too – and in any emerging economy these are key industries.

Most Japanese companies consider it important to have their headquarters in Tokyo. Why are you based in Kyoto?

I like this question very much. Kyoto became the capital of Japan 1200 years ago. It is the centre of Japanese culture; Tokyo is the centre of economics. Kyoto has several universities: it is a centre of academic excellence – 10 per cent of Kyoto's population are students. So we can hire good, young potential engineers. The Kyoto spirit is that we care about quality more than quantity. In Tokyo culture is just about numbers and size. Other innovative, globalised companies such as Nintendo, Kyocera and Murata have also chosen Kyoto as their HQ.

'We expect more powertrain work in the business, and we expect a lot more interest in different types of fuels. The next ten years will be key as far as fuels are concerned'

How can Japan solve its problem of economic stagnation? How do HORIBA's policies differ from those of other major Japanese companies?

At the moment Japanese economy is not so active. The reason is not our technology, nor the people working in the companies – it's the lack of leadership. Large companies' top management capabilities are not globalised. Leadership is key – the capabilities of the people are still very strong.

Does initiative need to come from companies or from government?

Both. We have many good, young politicians – and even the Japanese banks are beginning to

change – the younger generation of management is slowly moving that way.

You have committed HORIBA to becoming a ¥100 billion company by 2005. You have business bases in 18 countries. What do you regard as the most important means of extending business globally?

For the past few years our policy has been to try to improve the infrastructure of the company. We have made acquisitions to give us access to new technologies, so we can now provide any kind of sensor/analyser technology ourselves for any application – semiconductor, automotive, medical. We are seeking to create the infrastructure of a global company in terms of information systems and the training of key managers and personnel. Now the question is how can we now use this infrastructure to really catch up in the market. We have now got rid of our domestic sales trading company and deal directly with the customers ourselves. It's already showing good results. In short, we are ready to reach the ¥100 billion in sales.

Are you looking to move into other markets by buying other companies?

I might be interested in looking for another company that offered a good sales network as I think that we already have a sufficiently capable technology base – and therefore I am looking into even stronger co-operation among the current HORIBA Group companies. Our automotive sales network is good, but we could improve the medical network in the USA and the scientific network in Europe.

Is HORIBA the world technology leader in all its four divisions?

That's a good question. We're quite strong in all of them, and in sensor technology we are probably number one. However, applications and sales is an area that we need to strengthen. We can still make some improvements in our marketing/sales capability. When we achieve this, we can be a real number one.

Turning now to the automotive sector, which area of your activities is receiving greatest interest from your customers?

It's generally related to legislation in automotive. Currently, it's fuel cell, NOx reduction techniques,

'We are not only looking at making a profit – we also need certain targets for society and for our lives. Our business is very much related to the environment'
– Atsushi Horiba

particulate matter filtering, and hybrid cars – automakers are looking for new technology solutions to meet these requirements. We are providing instrumentation and sensor technology in these new research areas.

Does the arrival of new legislation lead to an upsurge in orders?

Generally speaking it may happen – but well in advance of the legislation. Our customers need to invest ahead, so our business is influenced four to five years in advance of new legislation.

Do you plan to enter other areas, for instance crash testing sensors?

The safety market is quite big, and we are quite interested. Although currently we do not have our own direct expertise in these areas, we may be able to provide new solutions in related application sectors such as our infrared sensors.

You have shown a system for on-board vehicle emissions measurement during running. Do you think there will be a trend towards measuring real-life in-service emissions rather than just laboratory measurements?

Yes, I think so. The market has wanted this type of technology for perhaps 20-30 years – to measure emissions under actual conditions. Size and cost have limited this process to the chassis dyno in the past, but there is potential [for mobile systems].

Could you envisage a time when the motorist may be subject to police roadside checks of his environmental monitoring equipment?

[Laughs] I think some high-emitting vehicles should be screened. But, seriously, screening is not directly our business – we are just providers of the basic measurement technology.

How does HORIBA anticipate the advanced research needs of companies in fields such as fuel-cell development? Are you able to build special equipment for particular clients?

Yes. For fuel cells we have already developed some instruments.

Do the extremely low emissions limits being planned in California and Europe pose



problems for measuring equipment?

Yes – it's when the levels in the ambient air are higher than those in the emission gas. You need special equipment to measure this. We already have a state-of-the-art product, which is a super low emission analyser system. So we can provide not only the instrumentation but also the conditions for them [automakers] to research the new requirements for their engines.

Will partnerships between companies increase in importance? What kinds of companies would HORIBA consider partnering with?

With partnerships it is important that a good alliance is achieved. Ricardo and HORIBA is a good case. Ricardo has good technology in engine analysis and development, and we are quite strong in emissions analysis – so it's a combination that provides new fields for both companies.

What is the outlook for the global auto industry for the next decade?

We expect more powertrain work in the business, and we expect a lot more interest in different types of fuels. The next ten years will be key as far as fuels are concerned.

What is your vision of HORIBA's role within that industry?

The basis of our role will be the same, but our approach to the markets must be different. For the past ten or twenty years we have been very technically oriented – we have been providing very technically advanced products. But now we want to become the company which really provides the solution to the customer. The alliances that we have built up with Ricardo and Schenck are very important to our global strategy, because these expanded relationships enable us to work closer with the customers in our expanded market. ■

Welcome to Japan

Thanks to a groundbreaking co-operation agreement with leading test equipment maker HORIBA, Ricardo will soon have a significant presence in Japan. **Tony Lewin** asks Ricardo CEO Rodney Westhead about the background to the accord – and about the challenges of doing business in the country responsible for one in three cars worldwide

The effects of a decade's economic stagnation on the Japanese auto industry have been more profound than anyone could have predicted. Domestic sales may be frustratingly static, but technological innovation has never slowed down. One in three cars produced worldwide still carries a Japanese badge, and those brands are, if anything, even more prominent in the showrooms of the major car-buying nations.

Instead, it's what is behind the brands that has changed: the dramatic shift towards offshore manufacture and, more fundamentally still, all but two of the major automakers coming under the control or influence of big western producers. And Renault's turnaround of Nissan has triggered a top-to-bottom upheaval in the way OEMs deal with their suppliers.

This attitude shift is perhaps the most significant of all, for it marks a public opening-up of a big Japanese player to the full competitive might of the world's automotive supply network.

That means that not only components producers such as Delphi, TRW and Valeo, but also companies like Ricardo, whose business is expertise and intellectual property, also stand to benefit from Japan's growing openness towards external suppliers.

Of course, notes Ricardo CEO Rodney

Westhead, Japanese automakers have never been completely self-sufficient – and Ricardo has been doing business with them since the 1960s. "However," says Westhead, "it has never been a significant part of our business. In very simple terms Japan represents a third of the world's car capacity, for design and development as well as for manufacture. At Ricardo we're primarily interested in where cars are designed and developed — where they are manufactured is less often a concern to us. Yes, we've done a little bit of work with the Japanese for a long while, but they could be a third of our total workload."

Given that Ricardo has been very successful in winning business with carmakers in both Europe and the US, is it simply a question of Japanese industry being difficult to penetrate? In which case, could the existing good relationships which Ricardo enjoys with GM, DaimlerChrysler, Ford and Renault offer a handy back-door entrée to the Japanese companies they are linked with?

In answer to the first point, Westhead is candid in admitting that Ricardo has never been able to put the same amount of effort into pushing into Japan as it has done with Europe and the United States.

"It is absolutely logical that Europe should

have been first and the US second," he says. "But looking into the future, ten years out, Japan should be a very serious part of our business.."

"Have we got any entrées via our Western customers?," he asks rhetorically. "Mazda through Ford? – not really, not yet. Nissan? – we have been introduced to Nissan through Renault and we may make some progress there. Mitsubishi with its relationship with DaimlerChrysler? – we have made our own relationships. Subaru via GM? – no, we made our own relationships there, too."

"It is interesting that while we have contact with all of these companies in the UK and Europe, and we have done very small bits of work for them commissioned by their UK and European businesses, any work of any significance has always been commissioned directly from Japan," continues the Ricardo CEO. "The companies do not have big budgets to spend in Europe on original development. They have some budget to spend on sorting a vehicle for European use but essentially all the development work takes place in Japan, all the budgets are controlled in Japan and we have to go and sell directly in Japan."

The answer: set up in Japan

To Westhead and his fellow board members the



How it will work

- Based in Kyoto, Japan
- Initial team of 10-12, mainly Japanese, targetted to expand to critical mass of 50-100
- Hand-in-glove operation with the customer
- Using HORIBA test facilities in Kyoto
- Covers engineering and development programmes and technical service agreements
- Does not cover software sales or support
- Ricardo corporate presence in sales office within Tokyo HORIBA sales operation
- Advantage of ready-made HORIBA contacts infrastructure

answer was abundantly clear. For Ricardo to grow its Japanese business significantly there was no alternative but to bite the bullet, set up a high level presence in Japan and pitch directly into the principal automakers not as a foreign agency but as a proper Japanese organisation, staffed by Japanese engineers, familiar with Japanese business practices and able to relate on the appropriate level to all tiers of managers in the Japanese corporations.

"There is definitely a language issue," explains Westhead. "You need Japanese. There's a cultural issue, too, and you really do need to be part of it."

For any company it would be a daunting task to set up a Japanese subsidiary from scratch, but fortunately, thanks to a link in an established UK-based joint venture, Ricardo had an ideal partner in the shape of Kyoto-headquartered HORIBA, the world renowned manufacturer of scientific, medical and industrial test equipment. HORIBA would offer expert knowledge of the

'Japanese companies have some absolutely superb technology, but we can still generate and offer them nuggets of capability that they value and are willing to buy'

Japanese market and high-level access to key personnel in the top companies, while Ricardo would be able to expand HORIBA's network of contacts outside Japan and assist the Japanese firm in expanding into the field of technical consultancy.

Accordingly, the two companies announced earlier this year that they had signed an exclusive agreement of co-operation, to work together but to maintain their independence and operate under conditions of complete confidentiality in all business matters with Japanese customers.

"The agreement we have at the moment covers co-operation," says Westhead. "Looking to the future, we wish to extend our business more fully into Japan and HORIBA wishes to examine the potential for extending its business beyond the test equipment market – and HORIBA is also interested in providing a consultancy service. So we can help HORIBA learn about consulting and HORIBA can help us learn about Japan. They provide the Japanese element and we provide the consulting element."

There can be no doubting, either, that the highly respected name of HORIBA does help open doors within Japanese industry. "HORIBA is as well known for its test equipment as we are for our automotive consultancy," says Westhead. "We lack a Japanese dimension, but the car companies in Japan all know HORIBA as a through-and-through professional Japanese company."

However, given that the top Japanese carmakers pride themselves on being innovative, independent and self-sufficient, will even a high-level recommendation from HORIBA be enough to persuade engineers and planners to change the habits of a lifetime and welcome in partners from the outside? And given that Japanese companies are technology leaders in so many disciplines, particularly those centred around engine design, what do they have to gain by bringing in an external consultancy?

Top technology on offer

"Take Toyota," suggests Westhead. "They have absolutely every one of the tools needed to design some of the world's finest cars. But we as outsiders can bring fresh eyes to it; we can bring additional resource at a time when there is more and more demand. The thing that sells cars is new models, so the whole world is striving to bring out new models and there is a big pressure on resource. And one of the things that the Japanese do lack is the same level of diesel capability as they've got in gasoline. Europe, after all, is fast approaching 50/50 diesel/gasoline."

So is diesel the prime pick from the Ricardo toolbox of technologies? Is it the weapon with which Ricardo will make its inroads into – and indeed, some would say, even create – the Japanese market for engineering consultancy?

"As far as Toyota and Honda are concerned, my view is that we should offer them the very best of our best technology," says Westhead. "They have some absolutely superb technology themselves, but we can still generate and offer them nuggets of capability that they value and are willing to buy.

"As for diesel, we are offering it and it is being purchased – but we are also offering and selling gasoline skills. We sell a lot of software into Japan and I think that the appetite for our software, together with the appetite for our technical service agreements, are the two biggest areas – and again they are buying sheer capability. We have software that is better than anybody else's – they buy it. Our technical service agreements expose them to the very best of our technical capability – they buy it."

A particularly big Ricardo research push has been mild hybrids, culminating in the presentation of the i-MoGen concept last autumn. i-MoGen was immensely well received in Japan, according to Westhead. "Honda, Toyota and Isuzu absolutely laid out the red carpet for us so that they could see the car, drive the car and really appreciated us taking it there and were extremely interested in what we had got to offer.

"Some of the controls and the electronics that we deployed in i-MoGen are ahead of anything else in the market – they were absolutely interested in that." Already, there are signs of interest from top Japanese engineers. Yes, the move towards outsourcing development to



Principal opportunities

- Control and electronics
- Mild hybrids
- Supervisor control
- Simulation and modelling
- Light duty diesel
- Transmissions, especially AMTs
- Motorsports
- Vehicle engineering
- Programme management

Software

- Not covered under co-operation agreement
- Sales, distribution and support continue to be handled by Sumisho Electronics Co Ltd

outside partners represents a big cultural shift – but it has been an even bigger cultural move that has seen Mitsubishi, Mazda, Subaru et al taking Western partners and Nissan turning its entire operation inside out. On a more historical level, Japanese industry is well accustomed to changing gear – as it did when it began setting up transplant manufacturing operations abroad in the 1980s and 1990s. The door to co-operation is clearly ajar, if not yet wide open – and in such a globally competitive time no car company can afford not to respect the state-of-the-art technical thinking that engineering consultancies can offer.

"The Japanese are superb engineers," observes Westhead, "and as long as we can demonstrate to them that we have some superb engineering qualities, too, we can gain their engineering respect. But we have to be as good as them to earn that respect." ■

A legend reborn

No engine enjoys greater iconic status among US auto enthusiasts than the Chrysler HEMI®, its reputation forged in the burnt rubber of '60s muscle cars such as the Charger and Challenger. So when Chrysler Group decided to revive the concept for today's buyers, it turned to Ricardo to develop a new HEMI® generation with the same mystique but more power and lower emissions. The result, as **Jeremy Burne** reports, is a skilful reinterpretation of the legend that has already won rave reviews and a place in Ward's Top Ten



The HEMI®. Mere mention of the word is sufficient to launch certain American muscle car enthusiasts into lengthy and ecstatic diatribes on the virtues of this particular engine configuration, as well as the variety of legendary cars of the Fifties and Sixties that were HEMI® powered.

The HEMI® started life back in 1951. There were three HEMI® engines being produced in the Fifties that were all unique – built at different plants for different vehicle lines, only to disappear around 1958. Then in 1964 came the 426 – which dominated the NASCAR race circuit. In 1966, a version of this engine was offered to the public in Dodge Challengers and other Chrysler muscle cars. That HEMI® engine mystique was born in the burnt rubber of such beloved cars as the Barracuda, the Charger and the Challenger.

But the old HEMI® died out with the muscle cars of the Sixties. That is until the Chrysler Group revived this particular engine architecture in a new V8 designed to power its Dodge Ram pickup trucks. A team from Ricardo was heavily involved in the programme from the early stages in development through to production, and is continuing to provide ongoing support as the programme fully ramps up and moves on to other applications.

The 5.7-litre HEMI® Magnum V8 was unveiled at the 2002 Chicago Auto Show to an enthusiastic response, and not just from those suffering from acute Sixties muscle car

nostalgia. Chrysler Group presented a contemporary engine packed with technology that was designed and manufactured using the best available engineering resources, while doing justice to the legendary status of its forebears. The 5.7-litre V8 HEMI® is the most powerful engine offered on a mass-produced light-duty pickup truck, offering 345hp and 375 lb-ft (508Nm) torque. The engine is 10 per cent more fuel-efficient and 27kg lighter in weight than its 5.9-litre predecessor.

Bringing this engine programme to fruition required a new approach – one that had to overcome numerous management and engineering challenges. Bob Lee, Director of Rear Wheel Drive Engine Engineering at the Chrysler Group, was the programme leader and remembers how the decision was made to

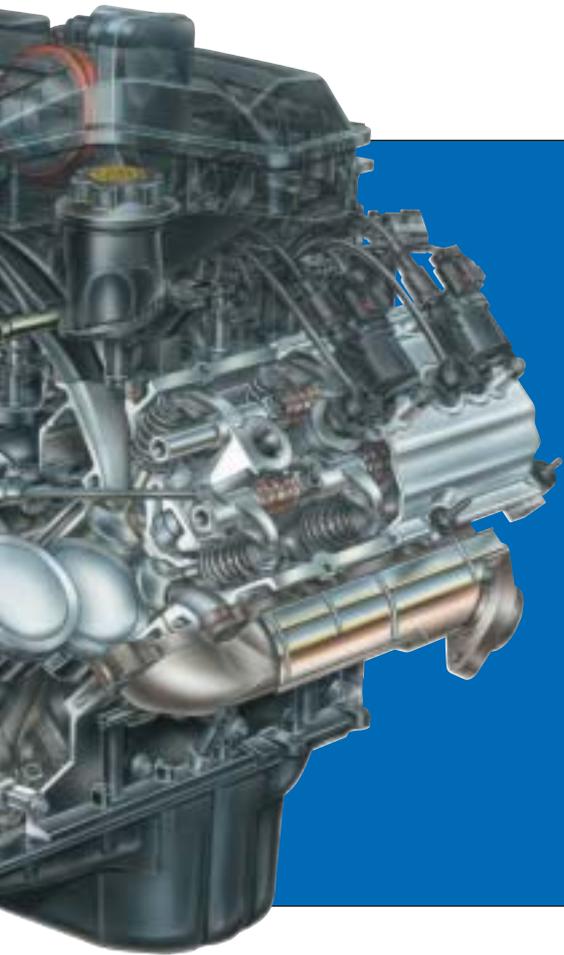
go with the HEMI® architecture: "We set about doing some studies looking into how best to replace the 5.9-litre. After benchmarking a large number of engines for air-flow dynamics, we ended up homing in on the HEMI® architecture for its excellent air-flow, power and economy.

The requirement for more power in the trucks was growing and so was the performance market. Also, the need for emissions reductions was very much on the horizon – so we tried to balance all of those factors, including building in flexibility for future products and cost control. The HEMI® is what emerged as the best balance of all those factors." Bob also reflected that the architecture of the engine was chosen for these technical reasons – the concept to



'It became obvious to me that hiring someone like Ricardo to be our partner is really good for both of us. And getting those folks on site and getting them integrated into the team, that really gave us a combined resource approach.'

– Bob Lee, Chrysler Group



Functional specification

- Maximum power: 345hp
- Maximum torque: 508Nm
- Torque @ 1200rev/min: 412Nm
- Firing order: 1-8-4-3-6-5-7-2
- Maximum speed: 5800 rev/min
- Minimum idle speed: 500 rev/min
- Oil type: 5W30
- 95th percentile demonstrated life: 241,395km

Design features

- Block: Cast iron (deep skirt)
- Cylinder heads: Aluminium
- Valves per cylinder: 2
- Spark plugs per cylinder: 2
- Combustion system type: HEMI®
- Valvetrain: Pushrod (OHV)

Engine geometry

- Configuration: Internally balanced 90° V8
- Displacement: 5654cc
- Bore: 99.5mm
- Stroke: 90.9mm
- Compression ratio: 9.6:1
- Bore spacing: 113.3mm
- Bank offset: 22.4mm
- Block length: 532.0mm
- Block deck height: 235.0mm
- Connecting rod length: 158.5mm
- Piston compression height: 31.0mm
- Rod length/crank radius: 3.49
- Intake valve diameter: 50.8mm
- Exhaust valve diameter: 39.4mm
- Included valve angle: 34.5°
- Combustion chamber volume: 84.9cc
- Intake valve lift: 12.0mm
- Exhaust valve lift: 11.7mm
- Mass: 242Kg

market it as the return of the HEMI® didn't develop until much after the engine programme was under way.

Creating the HEMI® team

Once the concept was agreed, the real challenges emerged. The engineering teams at Chrysler Group were already very busy with two other brand new engine programmes. This meant that there was not a lot of spare resource within the company to dedicate to the HEMI®'s development. Bob Lee: "The very first thing that hit us was that we were already working on two other new engine programmes, and to add a third before we had finished the other two was quite a challenge in terms of resources and skill sets. And that's where Ricardo came in. It became obvious to me that hiring someone like Ricardo to be our partner was really good for both of us. And getting those folks on site and getting them integrated into the team really gave us a combined resource approach."

Bob Lee was confident Ricardo could deliver the necessary expertise – he had already had personal experience with the company. "I had worked with Ricardo in the early '90s on a 3.5-litre four-valve engine. At the time we didn't have a lot of experience with four valves and so we went out to Ricardo and spent a good deal of time with them working on flow characteristics, ports and chambers, really trying to make sure we had the right combustion elements in place.

Ricardo wasn't an unknown factor and was generally known around here as a capable company that we could do things with."

Chris Talwar, director of Business Development at Ricardo, Inc., recalls receiving the initial remit: "The concept for the programme was (for the Chrysler Group) to identify an engineering partner to provide knowledgeable engineering personnel for the duration of the programme through to the

The 5.7-litre V8 HEMI® is the most powerful engine offered on a mass-produced light-duty pickup truck, developing 345 horsepower

product launch. The professionals were to include product engineers, designers and CAE engineers. Given that their newly proposed long-range product plan for the V8s imposed a very substantial increase in workload for the engineering group – and that they had a number of other significant programmes going – they were looking for a complementary resource. They wanted to establish an off-site facility close by that would link people into their systems while leveraging a company whose tools and techniques they could learn from. They needed product engineers with high-level skills in critical areas to tackle the very

challenging valvetrain. At the same time there was a business case and profitability issue that needed to be resolved." Ultimately, Ricardo ended up providing a multi-skilled team of product engineers, CAE engineers and engine designers.

Co-locating the team

Part of the programme's ultimate success was attributable to the co-location of all the team members in a dedicated facility in Rochester Hills, Michigan. Bringing together people from the Chrysler Group, Ricardo and various suppliers into a dedicated facility was partly the result of lack of available space at the Chrysler Group's engineering centres to accommodate the 50 or so people for the programme. But it was also Bob Lee's desire to reap the benefits of having the different engineering disciplines under one roof: "I am so thankful that we had an off-site location because of the synergy between product and process. The manufacturing guy is sitting next to you and you are talking about something, maybe over lunch, and it was very natural to say 'tell me about that process again' – so I think that the synergy was just exceptional."

There was also an interesting cultural blend, not just nationalities but corporate cultures that needed to work together. At any one time there were 15 or 20 people from Mexico in the building, prompting some team members to learn some Spanish. Bob Lee and the Ricardo team leaders put a lot of effort into selecting



'You get down to some of the basics of how teams work – everybody's in the same facility, they understand what the objectives are.'

– Mick Winship, Ricardo

Dodge Ram pickup truck: first to receive new HEMI® power



people with complementary skill sets and making sure the pieces fitted together. The Ricardo CAE team even included an engineer from AVL, one of Ricardo's competitors, who worked effectively as part of the group. Bob Lee had some misgivings about this – "I just thought that people would be insular and protective and maybe it started that way but after a month or two that broke down and I don't think anybody knew, or cared, who anybody was – you just knew what they did and it worked out really well."

Chris Talwar also liked the arrangement: "This was the first programme we really worked like this. The Ricardo culture was to do this with teams in Europe, but this was the first time we put a big programme team out on site in North America. I think the industry has recognized that co-locating the key stakeholders and integrating different cultures allows you to have a 'go-fast' team. The whole team is focused on the engineering programme – the product, the timescales, the technical achievement."

Mick Winship, Ricardo, Inc's manager of Simulation and Analysis, was the Ricardo team leader: "You get down to some of the basics of how teams work – everybody's in the same facility, they understand what the objectives are. People attend the weekly review meetings so communication is good – and it's a lot easier to walk over to the guy in an office ten feet away and work through a problem rather than emailing to somebody twenty-five miles down the road."

Chris Talwar knew that simply having good

engineers on the team was not enough: "The key thing for the team was to operate on a group information and decision making basis. We had two meetings a week including a board review where all the subsystems came together, and all the important stakeholders were co-located, right from the outset – the service guy, the assembly guy, the manufacturing guy, the valvetrain guy and the performance guy were all in the room. If

'It was wonderful having a consultancy like Ricardo on board – we obviously had the benefit of having some very skilled people'

– Bob Lee, Chrysler Group

anything changed they could jump up and say "wait: that's going to affect my system" or just ask "how does this affect my system?" One important thing was that the people we were putting onto the team had to have very strong interpersonal skills. There was a joint interview process for establishing that."

Mick Winship also felt there was value in a co-located team, particularly in terms of marrying product and process: "We had systems engineering meetings where you had product and processes being thought out at the same time. Then you've got advanced quality planning meetings where you do similar things, integrating the suppliers into the meetings to make sure you are covering all the bases together. The fact that this was not only a new engine but also a new manufacturing facility meant that more than ever you had to have good integration between the product and the process.

Tackling the HEMI®s technical challenges

There are two aspects that make a HEMI® unique: the valves are located on a line that's perpendicular to firstly, the crankshaft centre line so they are diametrically opposed to each other – and, in conjunction with the second hallmark, the hemispherical chamber, is what most people think of as a HEMI®. The HEMI® layout gravitated to a high-located camshaft in the center of the V – and that represented a design challenge. Chris Talwar: "For stiffness, the pushrods were very short and fairly

'This was the first time we put a big programme team out on site in North America. The industry has recognized that integrating different cultures allows you to have a go-fast team.
– Chris Talwar, Ricardo



horizontal – they splayed out to each bank and then you had the rocker system where you needed to cross over the engine to operate the valves on the other side. We put a lot of work into getting them right – minimum mass, maximum stiffness – so that you could open the valves as quickly as possible without causing instabilities. Thermal systems were another key area that they needed people for. We had somebody do the front cover, the waterpump, the thermostat and the cooling system interface.”

There were also specific issues with cam bore distortion and challenges with NVH that affected how the team solved problems while trying to meet the targets. Extensive simulation and analysis helped. Mick Winship: “With our simulation hat on we made some big contributions to how the head clamped to the block – there was a significant amount of predictive engineering work to try and solve NVH problems on the front end accessory drive. The objective was to try and have this thing directly mounted so it was an integrated system without brackets and stiffening ribs.”

Valvetrain dynamics were also a key issue – the need for high engine speeds was a

technical challenge for the engineering team. They needed to get performance through high running speeds, good breathing and good idle quality. That meant optimisation over the full operating range. The Chrysler Group team wanted to emphasise that this was an all-new, high tech engine, not a throwback design.

Simply having good engineers on the team wasn't enough: the key thing for the team was to operate on a group decision-making basis

Chris Talwar noted: “We didn't want the design to look agricultural, so we also had to put some styling into the valvetrain's appearance. We used optimisation techniques to strategically lighten and stiffen the rocker elements so now when people look at the valvetrain they think 'well I know it's a two-valve pushrod engine but wow! It looks sexy!' – and it works at high speed.”

Customer Satisfaction

Now that the HEMI® programme is rolling, Bob Lee can look back at the accomplishment. The positive reviews of the engine validate the success of his team's approach. “First of all it was just wonderful having a consultancy like Ricardo on board – we obviously had the benefit of having some very skilled people. There was this hidden capacity that we had: when you wanted to ask a question that went beyond the walls of our site you could call up Ricardo in Shoreham and get input from another 18 or 20 people in just a matter of a few hours or a few days at most. So there was this wonderful capacity to ask some questions that we probably wouldn't have asked previously because we couldn't have answered them – [with Ricardo] we could have those discussions and get a credible answer and have confidence in it. The CAE folks were very skilled – the design engineers, some of whom are still here, were all well acquainted with engines and had worked on many in the past – not just our engines but many others as well. We had a cross-pollination synergy going that was almost like a continuous benchmarking process.”

With the engine's built-in design flexibility, RQ readers can expect to see this engine appear in a variety of future Chrysler Group products, especially those that require significant horsepower and express that legendary “Detroit muscle.” ■

Desert dominator

Mitsubishi's rally team went straight to Ricardo when it needed a transmission for the gruelling Dakar rally. The reward, as **Jesse Crosse** reports, was a memorable victory for Pajero Evolution drivers **Hiroshi Masuoka** and **Andreas Schultz**

The Dakar Rally is one of the most gruelling tests of automotive endurance yet devised. This year's event covered 8,576km of roads, rocks and desert from Marseilles to Sharm el Sheikh, passing through France, Spain, Tunisia, Libya and finally, Egypt. Seventeen separate legs in total, during many of which the teams compete and work in the most basic conditions, with temperatures soaring during the day and, throughout the North African nights, falling almost to zero.

To win for the eighth time with one of two Pajero (Montero in some markets) Evolution cars entered in the event was therefore a particular triumph for the ENEOS Mitsubishi Ralliart team and its crew, Hiroshi Masuoka and Andreas Schulz. Even better, in second position were team members Jean-Pierre Fontenay and Gilles Picard in their classic Pajero. The second, ATS-sponsored, Pajero Evolution driven by Stéphane Peterhansel and Jean-Paul Cottret finished in third place, while the fourth works car, the classic Pajero of Miki Biasion and Tiziano Siviero, finished in 15th place.

A great result for Mitsubishi, then, but the event also signified a moment of triumph for one of the Mitsubishi team's latest technology partners, Ricardo, called in to develop a new, six-speed sequential transmission for the two Pajero Evolutions.

Audi's Le Mans hat trick in 2000, 2001 and 2002 with the formidable R8R 'roadsters' was also enjoyed in equal measure by Ricardo, which supplied the robust transmissions. Ricardo's achievement clearly did not escape the watchful eye of Mitsubishi, whose success in the field of off-road motorsports depends to a large extent on successful manipulation of ultra-reliable technologies.

Although the demands of the 24 hours of Le Mans and 19 days of the Dakar Rally are, on the face of it, quite different, the physical demands on a transmission are not that dissimilar. The Le Mans transmission, with a design capacity of 750Nm, would be subjected to a similar duty cycle to that of the Dakar Rally transmission, which is called upon to transmit far less power.

The Ricardo design team, headed by chief transmission designer, Tim Gee, who also penned the Audi R8R transmission, turned the Pajero's six-speed transmission around in record time. Work began in March 2002 but gearboxes were installed and undergoing testing soon afterwards in August. Mitsubishi and Ricardo engineers communicated easily from the start, the factory team supplying Ricardo with CAD models showing the position and details of the interfaces between drivetrain and gearbox, and also the packaging space. Given those basic parameters, the new and complex gearbox was designed and built from scratch in just five months.

Even by Le Mans standards, however, the Pajero Evolution required something quite out of the ordinary, and the Ricardo engineers found themselves incorporating some unusual features. One such was the power take-off to power a compressor. Dakar teams are constantly adjusting tyre pressures to cope with the wild surface conditions which they encounter. Hard, rocky surfaces and higher pressures at one moment give way to soft sand and ultra-low pressures at the next. The better equipped Dakar cars have integrated tyre pressure control systems fed by compressed air tanks. But tanks run out - hence the idea of installing the compressor. The transmission PTO drives the compressor while the Pajero is flying over sand dunes, or if a high volume of air is needed quickly, while the vehicle is stationary with the engine running at higher revs in neutral. Either way, the result is an endless supply of air whatever the circumstances.

Eric Leclerc is a fairly recent recruit at Ricardo, having joined in July 2002. A veteran of WRC transmissions working for both the Ford and Peugeot WRC teams in the past, Eric was to provide invaluable support to the Pajero teams in the event, looking after and maintaining the new six-speed gearboxes in the most arduous conditions. Eric remembers how well the compressor served the winning car on one occasion, following a severe puncture. By keeping the compressor engaged throughout the stage, the crew was

able to keep the damaged tyre inflated sufficiently to remain competitive long after the auxiliary air tank had run out.

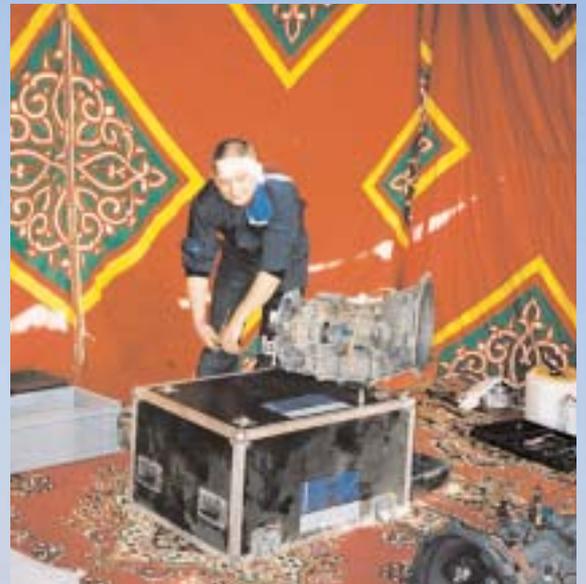
The transmission also has a high/low range select, explains project manager, Richard Gregory. "It's an interesting thing to add into the gearbox, although the regulations don't allow it to be used during the event because it would effectively give you 12 gears. It does, however, mean you can effectively evaluate two different sets of ratios during testing, without changing the gearbox. In addition to that, the transmission has a differential lock so if you get stuck in a dune you can lock the centre differential."

Flawless performance

Another crucial feature of the Ricardo transmission, says Gregory, is a torque limiting device to protect the driveline in the most punishing circumstances, like for example, during landings from the myriad of airborne moments the Pajero encounters during the event. Details are understandably secret, but the role of the device is to absorb the huge inertia carried in the spinning drivetrain during sudden deceleration caused by large rocks or soft sand. The team believes this to be the first time such a device has been used: almost certainly, it played a part in the transmission's flawless performance throughout the event.

Also playing a major part in that performance was Leclerc. It is not the Ricardo style to deliver a component to the customer and then step back, according to business





The winning Mitsubishi drivers Matsuoka and Schultz (above); conditions were arduous, with engineer Leclerc (right) having to service transmissions in a tent within another tent to keep sandstorms out

manager Rob Simmons. "It's essential to do the best possible job we can and that's why Eric's services were offered to the team."

The approach was one of preventative maintenance throughout the 19 days, reflecting the policy of the Mitsubishi team and ensuring the trouble-free service delivered by the transmission during the event. It was far from an easy ride for Eric. Because of the limited space available, he was required to work on all aspects of the vehicle when not inspecting the six-speed gearboxes - so there was little chance to rest.

Most of the work was done at night and Eric soon discovered that the rudimentary working conditions were in stark contrast to

the clinical cleanliness of one of Ricardo's assembly shops. Of course, as a veteran of the World Rally Championship he is no stranger to difficult conditions, and it was a whole lot colder servicing a gearbox in Finland than it was in the desert where the temperature at night at least managed to remain above zero.

No, Eric's biggest enemy was dust, the dense cloying kind - more like cement. Working on a transmission on the back of a pickup proved impossible so Eric took to working inside a tent erected inside another tent to keep the dust away. His only cleaning apparatus was brake cleaning spray and endless rolls of paper towelling. "I have never experienced such extreme working conditions," said Eric who had found the 'warm-up' event in Dubai almost luxurious by comparison - at least there were some toilet facilities at rest halts where team members could clean up. On the Dakar there is nothing and the discomfort is acute.

Lack of sleep did not help. "The only real opportunity for sleep was between 2am and 5.30am because the bike teams worked very late and left early," recalls Eric. Backup teams travelled for six or seven hours between stops and there was some chance of rest en-route. But being crammed into the back of a service vehicle clad in helmet and overalls, with a roll cage for a bedfellow, is not particularly conducive to rest. The longest leg was 800km and in some cases the rally car would be waiting at the other end; in others, the team would await its arrival, ready to start work immediately.

However, the end result was a resounding success as we now know, and Mitsubishi Sport Director Dominique Serieys was delighted. "I am really very happy," he told RQ, "and the transmission was everything I expected it to be." Serieys was particularly impressed because, although it is a six-speed sequential, the transmission is quite different to more conventional race or rally gearboxes. "There is no electronic control, but the drivers had no problem in getting used to the shift mechanism. We will continue to use this transmission on future events," he said. The main job of the Sports Director, added Serieys, is to ensure everything remains under control, so being able to rely on a technology partner for such an important aspect of the vehicle is crucial.

Achieving major tasks in dauntingly short timescales is part and parcel of any world class motorsport project, and the Mitsubishi Sports Director says he never doubted Ricardo would deliver the right result on time. Now the team is looking forward to the next time and hopes for a ninth win - with a little help from Ricardo of course. ■

Jesse Crosse is editor of Automotive Powertrain Analyst



Diesel takes to the track

New regulations will soon allow different fuels in Le Mans racing – and Ricardo is developing a remarkable 600bhp, 1400Nm V10 diesel to prove the point. An intrigued **William Kimberley** speaks to the men behind the racing diesel programme and looks at the sophisticated techniques that could push gasoline off the winner's rostrum

Ricardo is no stranger to motorsport – using Ricardo transmissions, Audi has dominated both the Le Mans 24 Hour race and the associated American Le Mans Series for the last three years, while Mitsubishi Pajero Evolutions equipped with Ricardo transmissions came first and third in this year's gruelling Dakar rally. Ricardo software is used in Formula One and the company has provided engineering support to teams and suppliers in the three US series CART, IRL and NASCAR. However, it is now embarking on a new venture that could turn out to be truly trailblazing.

While diesel engine technology – due in large part to Ricardo – has leapt forward in recent years to the extent that the diesel share of new car sales is growing exponentially in Europe each year, there are still pockets of resistance in accepting it. To counter this, and to promote energy efficient initiatives, different bodies and organisations have put forward various schemes to try and promote alternative powertrain strategies. The Motorsport Industry Association (MIA), for example, is responsible for a UK government-funded study, in which Ricardo is an active participant, to establish if there is a role for motorsport in the development of energy-efficient automotive technology and whether energy-efficient motorsport could be entertaining for the public.

"Our objective with EEMS (energy-efficient motorsport) is to demonstrate to a wider audience that there is the experience in the motorsport industry to develop energy-efficient solutions and that it has a platform to promote it," says Chris Aylett, the MIA's chief executive. "It's important, though, that it is driven by customer – OEM – demand on a given budget and timescale."

This initiative has been given a major boost by the Automobile Club de l'Ouest (ACO), the organising body of the

Le Mans 24 Hour race, which has issued new regulations that come into effect next year allowing diesel-engined cars to compete. This has led Ricardo to investigate the viability of producing just such an engine.

While such a concept almost sounds a contradiction in terms, it is not new. Between 1949 and 1951, for example, Jean and Jacques Delettretz competed in the French 24-hour race in their Delettretz Diesel Special. Unfortunately, they failed to finish on each occasion, either through running out of fuel or engine problems. However, in more recent times a BMW 320d won the Nürburgring 24 Hours in 1998, the first diesel-powered touring car to win an event of this kind, while Volkswagen developed a diesel-engined car for motorsport. Golf TDIs have been competing in various European rallies since 1999, achieving success that year by winning the inaugural Diesel Cup in the British Rally Championship.

Under the watchful eyes of Dave Morrison, business manager motorsport, Matt Beasley, chief engineer diesel product group, and Steve Sapsford, technical manager for racing engines, the Ricardo racing diesel programme has come into being with a view to possibly competing at Le Mans, perhaps even as early as next year.

"The idea evolved out of the MIA's energy-efficient initiative and the ACO's decision to allow diesel engines to compete in the 24 Hours of Le Mans as from 2004," says Morrison, "not in a special diesel category, but in the LMP900 class from which the winners usually emerge. This is because the ACO is targeting the top level of endurance racing from the start." The important thing, though, has been to get the balance right because the last thing the Club wants is for the diesel-engined cars to be either struggling at the back of the field or disappearing off into the horizon.

Benchmark: the winning Audi

The obvious benchmark for power output and maximum torque was Audi's twin-turbo FSI engine that powered the Le Mans-winning Audi R8 in 2001 and 2002. In answer to its 610 bhp and 700 Nm of torque, Ricardo's development 5.0 litre V10 diesel concept engine is expected to produce around 600 bhp and a massive 1,400 Nm of torque. "It will be a substantial structure," says Sapsford, "that brings with it weight and transmission challenges due to the high torque available at engine speeds

Ricardo V10 Prototype Diesel for LMP900

- All-aluminium V10
- 5.5 litres
- 600 bhp @ 5000 rev/min
- 1400 Nm torque @ 2000 rev/min
- Common rail fuel injection
- Design maximum cylinder pressure 200 bar
- Advanced two-stage boosting system
- Engine concept design completed
- Computer-modelled performance predictions completed
- Application – LMP900 Le Mans and ALMS
- Transmission options being evaluated
- Chassis options under discussion with key manufacturers
- Ricardo in discussion with international race teams and potential sponsors interested in collaboration with this unique project

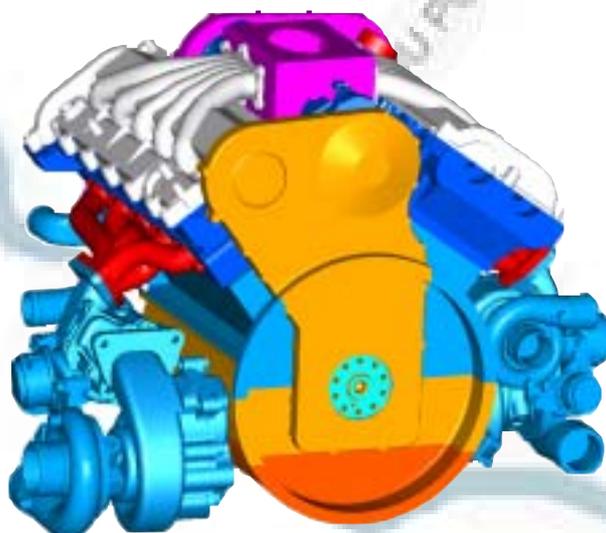




Photo: Automobile Club de l'Ouest

of around 2000 rpm.”

The fundamental advantage of diesels is their fuel economy, and it is this that Ricardo wishes to exploit. “When Audi introduced its FSI engine in 2001,” says Morrison, “it immediately gained an extra lap between refuelling stops, giving it a tremendous advantage over the rest of the field. This is what we need to do with a diesel-engined car.”

“There are two routes to go in designing an engine to meet the regulations”, says Sapsford. “There is either the advanced conventional route, which means refining existing engines by decreasing the weight whilst maintaining a typical diesel engine speed range, or the alternative of designing an engine with the aim of reducing the maximum in-cylinder pressure (Pmax) by running at higher speeds that are more akin to a gasoline engine.”

The weight is a function of the engine architecture, described by Sapsford as principally being a pressure containment vessel. “We can increase power by spinning the crankshaft faster, which then gives us potential for reducing pressure in the cylinder,” he says. “This means we can have a more lightweight structure. However, we can never reduce the weight to gasoline levels as the pistons, which need a bowl in them, have to be more substantial in a diesel.”

While the durability aspects for a racing engine – even one destined to race for 24 hours at full stretch – are less of an issue, that of smoke is highly significant. “Whatever happens, the engine must not smoke,” says Beasley. “Using our advanced control systems to monitor the fuel/air ratio closely at all times, we can calibrate the engine to ensure that this problem doesn’t happen.”

“The development of this engine will be possible because we now have the tools in hand to do it,” says Beasley. “It certainly would have been more difficult a few years ago, but the recent advances in key technologies such as fuel and boost systems have been great enablers.”

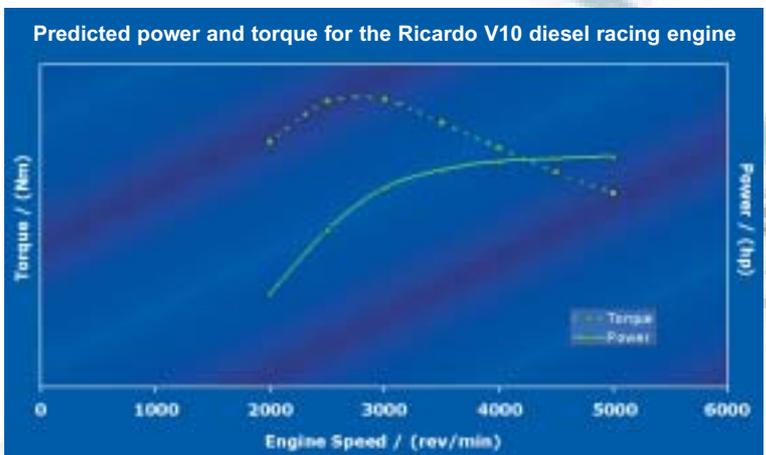
While Ricardo is concentrating on this novel engine, its acknowledged expertise in transmissions and chassis systems means that it could also deliver a fully integrated package. “While we have the capability to design a racing car from scratch,” says Sapsford, “and lever the integration accordingly,

we do have a strong relationship with a couple of chassis manufacturers with this project. This means that if we were to go ahead we would be able to concentrate our full resources on making the engine as competitive as possible.”

Three possible alternative strategies suggest themselves. The costliest solution, without a doubt, would be to develop and build this ambitious concept engine. Alternatively, the Ricardo diesel know-how gained in the programme so far could be applied either to an existing large diesel engine to turn it into a racer, or devoted to converting an existing high-performance gasoline unit to diesel operation. One way or another, however, Ricardo has active options and partners in all three endeavours – but is keeping its cards understandably close to its corporate chest until key decisions have been made.

Ricardo knows what it takes to be a winner at Le Mans and so is taking nothing for granted. But, equally, there’s no denying that it will be a historic moment indeed when a modern diesel-fuelled racer lines up alongside the old-fashioned gasoline runners on the grid at the Sarthe circuit. ■

William Kimberley is editor of Automotive Engineer



Systems integration

Volker Barth took over on January 1 as president of Delphi Europe, Middle East and Africa, following the departure to Detroit of Jose Maria Alapont. **Ian Morton** spoke to him about the technical and commercial challenges facing top Tier 1 suppliers

How do you view the region for which you are newly responsible?

Delphi's main challenges in Europe are continued innovation in technology and the many other ways we add value for our customers such as logistics expertise and aftermarket support. Europe is a great place for demonstrating Delphi's expertise in high technologies and quality manufacturing because Europe's vehicle manufacturers believe strongly in the benefits they bring. The development partnerships we enjoy in Europe prove Delphi's capabilities in these areas, particularly our ability to be extremely innovative and to turn that into a competitive advantage for our customers.

Technologies proving very successful in Europe include electric power steering, common-rail diesel and electric-electronic architecture, and we have many more. We also have exciting advanced programmes with customers, such as the solid oxide fuel cell auxiliary power unit we are developing with BMW and Renault. We are also finding new ways to work with customers such as the innovation plan we have with PSA Peugeot Citroën. Innovations have allowed our business in Europe to grow quickly to 5.3 billion consolidated sales (5.62 total sales) with 48,000 employees. Our revenue with worldwide customers other than GM in Europe is now 75 per cent of our total business, which shows how well our strategies are working.

So Delphi's GM provenance is no hindrance?

Our GM heritage gives us one big benefit. We are car and truck people (not component

people). Many of us have worked as vehicle engineers and in OEM assembly plants, so we know how to develop and build vehicles. This gives us a substantial edge in understanding our customers' requirements. We also have a deep understanding of many specialised technologies, helping us to develop integrated systems that interface well with the vehicle and with systems from other suppliers.

As far as purchasing and competing is concerned, GM is treating us like any other supplier, while independence has brought us access to those customers outside GM who were concerned about working with a supplier owned by a competitor. That prevented us in the past from developing opportunities provided by our broad portfolio. Now we have good growth in new business relationships.

Will Delphi be part of the European drift eastwards?

The requirements of engineering for emerging markets could lead to more technical development activities in these markets. Delphi, with its exceptional footprint in engineering and manufacturing, is prepared for those developments and our European organisation will have the lead. We must continue to expand manufacturing to support our customers as they develop into new markets.

The Tier 1 is increasingly a technology supplier, but where is this leading?

The trend has clearly been for OEMs to rely on Tier 1s to take responsibility for sophisticated engineering, specifying performance parameters instead of developing their own designs. With increasing complexity this will

continue, which is good for Delphi with its breadth of technological competence and manufacturing.

But because of this trend, Tier 1 relationships with lower tiers have to improve. OEMs are right-sizing the number of direct suppliers to a fraction of what it was, so Tier 1s will have more responsibility for the supply chain. Five years ago the typical western OEM had more than 1000 direct suppliers. Today the trend is fewer than 200, which requires Tier 1s to introduce new logistics, training, validation and scheduling with a larger supplier base, and to achieve this globally and transparently.

Tier 1s definitely need to upgrade their competencies in many fields, and partnerships with lower tiers is one such area. Ideally we need to create partnerships that maximise synergies and drive costs down, while enhancing technology, speed to market and customer value. We also have to address social and political requirements based on new global trade pacts and the specific situations in emerging countries.

The reality is less strategic, however. Over-capacity and competition have focused many current actions on the short term. I hope this will change as I believe in value chain optimisation by design and in the benefits of trusting relationships.

Could big Tier 1 suppliers become as powerful as – or more powerful than – the OEMs and set the terms for their relationship?

I hope not. If OEMs feel they are being manipulated or dominated by their suppliers they will revert to the old system, and that would eliminate the many benefits they are increasingly experiencing. Some OEMs have already started to redevelop some specialist competencies in areas where they feel supplier dominance, and this could slow down the creation of extra value and cost savings.

It would not be strategically right for Tier 1s which focus on excellence in technology to have the objective of being as important or powerful as their OEM customers. We will never compete with our customers. Our purpose is to support the OEM by providing the technologies that will distinguish the brand, provide marketing advantage, and make a positive difference for the final customer. There will never be a Delphi-badged vehicle.

Photo: Delphi



The auto industry's move eastwards is exemplified by Delphi's Krakow, Poland plant



Volker Barth

Age: 55

Born: Darmstadt, Germany

Languages: German, English, Portuguese, Portuguese (conversational Spanish).

Has lived in Germany, Japan, US, Brazil; now based in Paris.

Previous jobs: 1974 experimental engineer, Opel; 1975 assistant departmental head of test facility planning; 1980 head of car evaluation, fuel economy and field test; 1984 head of Opel liaison office Tokyo; 1986 head of operational planning GM Europe; 1986/7 executive for metallic products, GM Europe; 1989 executive for advance purchasing and global sourcing GM Europe and director of Opel purchasing; 1991 purchasing and materials director GM do Brasil; 1992 materials director; 1993 worldwide executive director purchasing metallic products GM Corp; 1994 executive director worldwide purchasing ACG (later Delphi); 1996 Delphi president South America (corporate vice president Delphi from 1999). 2003 president, Delphi Europe/Middle East and Africa

What direct competitive challenges does Delphi face?

There are many highly competent Tier 1 suppliers and it's both a challenge and a pleasure to compete with them, as this is the basis for our technological advances and the increasing customer value we provide. As a large company with considerable depth and breadth of technical expertise we face one or two formidable competitors in each area, mostly companies focused on one specialised field. We respect them for their talents and innovations, although we also believe that the breadth of our competencies and the synergies we derive from them help us develop better vehicle-level solutions.

How do you view collaboration with other suppliers?

Our guiding principle is that the vehicle manufacturer is in charge, so any arrangement has to add value for his business. This could involve a range of relationships to suit each customer's preferences in different areas. An OEM might have a strong relationship with a Tier 1 competitor, while Delphi has the specialised technology competence. In a case like this, we are not opposed to a customer-desired and championed co-operation with our rival. The opposite is also true, where we are selected as the system integrator and the customer wants selected product sourced from an incumbent component or sub-system supplier. The customer-desired co-operation will define the tier relationship.

Capital expenditure and over-capacities are other issues, but the final goal is to maximise

customer benefit, so value for money and cost optimisation, utilisation of existing capacities, proven concepts and carry-over utilisation of existing components will increase in the future and drive some of the co-operation decisions.

How do you seek advantage in this situation?

Whether you get an advantage with any vehicle manufacturer depends on a relationship built on performance and trust, just as with any other customer. However, it may be that companies with in-house suppliers are also looking forward to discovering what new suppliers can provide. The key is our competence in technology, quality, service and competitive pricing – which determines our win rate with any customer, be it the former mother corporation, somebody else's former parent, or a more recent customer partner. Delphi is growing its business with the new customer base at double digit growth rate since our IPO. To achieve that in such a short time means we must be offering some very attractive technologies with great support and pricing.

How do you see supply trends developing?

Over the last five years Tier 1 suppliers have taken over more system and module responsibilities, and Delphi has a lot of expertise in managing logistics to add value for its customers. But we must not confuse what are really two sets of benefits – the design and build of highly integrated modules, and efficient supply chain logistics.

A strategy to use modules cannot be based only on logistics considerations or shared

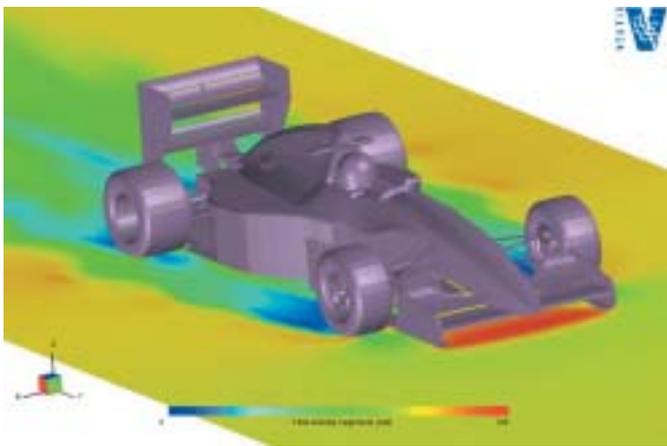
investment risk, as this is to miss the largest benefit of all. When the argument for modules is based on the lower labour and overhead costs to suppliers, plus the simplified logistics for modules compared with complex logistics for components, this advantage will rapidly wear out.

Benefits should be driven by good, highly integrated designs where modules are not just an integration of components, so that synergies between the elements comprising the module can be developed. This requires a supplier with a broad competence and product portfolio, like Delphi.

It is important that the cost should be designed out of a module by having a holistic look at the individual parts and their interactions, eliminating redundant elements and utilising existing structures from others to maximise cross-component integration. If it is not, then modularisation doesn't provide the expected benefits.

However, the development needs to be transparent to the customer. In case a Tier 1 supplier wants to utilise his competence only to his advantage and not to the customer's benefit, it will deteriorate relationships and trust. Recently some customers have experienced this and started to prefer again to define and source individual components. This is counter-productive to the synergistic intent of properly managed modular design and supply, and a step back in the delivery of optimised value. ■

Ian Morton is a contributor to Automotive News Europe



Formula 1 car at 350km/h, showing the effects of the aero packet accelerating air up to 450km/h

Ricardo works with ATI on software

Ricardo Software (RS) has been working with ATI Technologies Inc to test the new high end Fire GL X1 graphics card. The card was tested by RS under both Linux and Windows based systems using the company's software products. "We were interested in this technology as it appeared to offer a cost-competitive approach to using our more graphically

intensive applications such as VECTIS," said RS president, Dr Richard Johns. "There are clearly many factors to be weighed when considering hardware selection, but the results of our tests indicate that this may be an attractive solution for users wishing to use PC platforms as an alternative to more expensive, high-end workstations."

Tarragon acquisition

On February 5 it was announced that the control and electronics capability of Ricardo would be enhanced with the acquisition of Tarragon Embedded Technology Ltd., of Cambridge, UK. Founded in 1996, Tarragon, which will henceforth operate as Ricardo-Tarragon, has grown rapidly and currently employs 52 people and has an annual turnover in excess of £3m (\$4.5m). Its primary business is developing embedded control software and tools for the automotive sector and it serves a client base including many of the leading OEMs and Tier 1 suppliers. The company brings a new software capability to Ricardo, complementing its existing systems engineering, control strategy and electronic hardware design, testing and development expertise.

Tarragon will add the following capabilities to Ricardo:

- Embedded software which, for



example, controls engine management and other real time systems on the vehicle.

- Telematics, which includes onboard GPS location and multimedia based systems.
- Software development tools

Shifting gears

On February 12 Ricardo hosted *Transmission Technologies and Trends*, the latest in its highly successful series of technical seminars. The event opened with a review of the megatrends and technology drivers facing transmission engineering, provided by Lee Sykes, Ricardo DTS technical director.

The presentation started with an analysis of the global trends in the three principal clusters of environmental concerns; Sykes then moved on to vehicle systems integration and issues related to commercial and market needs. He continued by demonstrating the critical nature of transmission engineering in addressing these megatrends. The results of an OEM analysis were presented, showing that the fuel economy benefit of near-market transmission innovations offer around twice

the value for money of similarly near market innovations in engine technology. Moves to increase occupant and pedestrian safety are also of influence, acting to restrict the package envelope available to the transmission and so encouraging technologies which are able to deliver space efficiency. With regard to business trends, Sykes presented interesting data regarding the developing relationship between the OEM and Tier 1 manufacturing sectors.



tion boosts Ricardo electronics



Assistance in Development of the Ford Focus RS

Tarragon Embedded Technology was part of the team that developed the Ford Focus RS. In particular, Tarragon was involved with the new turbo boost control, which is performed by the Electronic Engine Controller (EEC).

Tarragon's expertise relates to the software in the EEC which can monitor and control the turbo boost pressure over 100 times per second.

and consultancy, for example Tarragon's control system model checker, Mint.

- Safety critical redundancy systems, for example 'drive by wire' vehicle control concepts.

All of these are areas of

expertise that Tarragon has developed over the seven years it has been in business.

The acquisition represents a significant increase in the controls and electronics activity of Ricardo, to the extent that this

discipline now accounts for approximately 10 per cent of group head count. Commenting on the purchase of Tarragon, Ricardo CEO Rodney Westhead said: "The acquisition of Tarragon is in line with our strategy to grow

significantly our electronic systems capability. This is an important area of future growth for Ricardo and this acquisition significantly expands our service offering for our automotive clients around the world."

While the manufacturing split is predicted to remain stable at current levels in the medium term, the recent marked growth in the proportion of transmission patents registered within the Tier 1 base indicates an increasingly technology-led agenda.

Following the trends and technology drivers presentation, the main part of the seminar was dedicated to a series of detailed technical presentations comparing developments in each of the major transmission types: manual, first, second and third generation automated manual transmission, automatic fixed-ratio, first and second generation CVTs, IVTs and hybrid transmission systems. Lee Sykes was assisted in these presentations by Tony O'Neill and Rine Pelders, respectively control and electronics manager and transmission engineering manager at DTS. For each transmission type the current state-of-the-art was described and views expressed regarding the technical and market potential for further development.

The final part of the seminar was given over to a market analysis of transmission technologies and the prediction of the likely position and trends prevailing towards the end of the current decade, presented by Steve Clarke, DTS director of business

development. Looking at the three largest markets of North America, Europe and Japan, Clarke outlined the current mix of products in the market and the manner in which this is predicted to develop. In Europe the picture presented was of a sharp decline in the current dominance of manual transmissions to a position where they represent just under half of the market at the end of the decade. The remainder of the market was predicted as including a significant increase of first generation AMT systems across all segments, peaking at around 2007.

Beyond this, second generation AMT (dual clutch) systems gain market share, particularly in the C-D segments. In parallel with the above, growth was also predicted in CVT and other systems for smaller vehicles, as well as marginal improvement of the market share of fixed-ratio automatics. Overall, Clarke predicted that the market in the three geographical areas would be dominated by consideration of installed manufacturing capacity and market acceptance of existing technologies. As such, the European market of 2010 would show particular growth in new technologies, seen as a development of manual transmissions, such as first and second

generation AMTs. Conversely the Japanese and North American markets were seen as being more likely to favour development respectively of new versions of CVT and conventional fixed-ratio automatic transmissions.

Delegate response to the presentation was extremely favourable, according to Steve Clarke. "We knew that this was a highly topical subject for our customers and we were encouraged by the attendance and feedback generated. We plan to host a follow-up event towards the middle of this year focusing upon the North American market and held at our Detroit facility," he said.

The next Ricardo seminar is entitled *Gasoline Engine Technologies for Low CO₂* and will cover aspects such as engine downsizing, VVA systems and HCCI combustion. The charge for the seminar, which takes place at Shoreham on May 8, 2003, will be £500 (+VAT). For further details and information or to pre-register for the event, please contact Dave Read: [e-mail DJRead@ricardo.com](mailto:DJRead@ricardo.com) Tel. +44 (0)1273 794167



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