



pro Active

The official industry newsletter of Lotus Engineering

Issue 2

May / June 2004

Design houses



Style versus function



Welcome

In my role as a designer, discussions about style and function are frequent and emotive. The typecast scenario is that engineers regard style as superficial decoration whilst the designers/stylists regard function as engineering criteria which compromises the aesthetic. However, in reality, I can think of no manufactured product that does not include both attributes either through conscious design or subconscious instinct.

Style is used as a tool to differentiate products and vehicles of increasingly similar performance and quality. We intuitively respond to all visual stimuli whether it is the look of a person or the form of a car. The aesthetics form our first impressions by subconsciously creating assumptions about the brand, performance and character of the product that we hope result in desire.

The designer's job of creating beautiful but innovative products is constantly stimulated by changing functional and legal requirements such as the new European pedestrian impact regulations (Protection of Pedestrians 2004 90EC). The latter will undoubtedly drive new proportions and aesthetic solutions that alter our perceptions of automotive beauty, which has traditionally resulted in sports cars with low, sleek bonnet lines. The clearance criteria suggests that this may now be impossible, but function and style are working side by side with many of the industry's engineers developing technical solutions that move mechanical hardpoints and/or offer "active" systems that minimise the visual effect.

One thing is clear - the proliferation of new vehicle types, platform sharing, consumer requirements, package innovation, legal criteria and the increasing fashionability of design will continue to challenge the designer and raise the significance of their role.

It's an ever-present discussion, and I'd be happy to hear from you about where you sit in the debate. Get in touch through proActive@lotuscars.co.uk. In the meantime, I hope you enjoy this design-inspired issue of proActive.

Russell Carr - Head of Lotus Design



Contents

May 2004

news

UK and Germany announce strategic environmental automotive partnership **3**

UK: Land Rover shows off new Discovery SUV **3**

UK: Continental's Ziebart says mild hybrids are "right solution for fuel efficiency gains" **4**

news

CHINA: Government aims for huge boost in automotive exports by 2010 **4**

UK: Petrol direct injection technology the next weapon in emissions battle **5**

features

Squeaky clean downhill racing **6**

Design houses **7**

Graduates in focus **9**

Style versus function **10**

Aston's lucky number **13**



UK and Germany announce strategic environmental automotive partnership

Lord Sainsbury, UK minister for science and innovation, recently opened Engenex 1, the first UK-German Automotive Innovation Forum for Environmentally-Aware Engineering at the UK's DTi headquarters in London, writes Mark Wilkinson.

The event brought together English and German vehicle manufacturers as well as suppliers and members of the research and academic communities.

Over 150 one-to-one meetings were held between participants during the very successful event, covering many subjects, from ecological concerns, through to the possibility of future environmentally-aware motor racing projects. In addition to this, some of the world's leading manufacturers and research organisations presented samples of their own work in the fields of environment, advanced materials and future power sources.

Lord Sainsbury explained that the UK aims to be a "world leader in the move to a low carbon automotive economy" - a statement that ties in well with the UK Energy White Paper's Low Carbon Vehicles Partnership initiative.

CO₂ emissions are of great concern to the UK government - it has already committed to a 20% cut in emissions against 1990 levels by 2010. As road transport currently accounts for 22% of the UK's CO₂ emissions, it is seen as a major target for improvement.

Herr Hans Henning Blomeyer-Bartenstein, minister of the German Embassy in the UK, backed Lord Sainsbury's announcement and called for an increase in the cooperation between the two countries; not just in science and industry, but also in environmental policy.

Source: just-auto.com



UK: Land Rover shows off new Discovery SUV

Land Rover has released first pictures and details of the Discovery 3, the first SUV the company has developed entirely under Ford's ownership.

It will make its public debut at the New York motor on April 7 and sales begin in September. The model will be called 'LR3' in the United States, where Land Rover is switching to alpha-numeric model names, and 'Discovery' elsewhere.

The new 'Disco' introduces three new engines to the Land Rover range - the 2.7-litre turbodiesel V6 from the Jaguar S-type which is expected to be the most popular choice in Europe and won't be offered in the US, a four-litre petrol V6 from the US Ford Explorer for "selected markets" only, plus a new 4.4-litre petrol V8 derived from the 4.2-litre Jaguar powerplant.

This seems likely to replace the same-size 4.4-litre BMW V8 in the Range Rover at facelift time.

Both petrol engines come with a six-speed automatic 'intelligent shift' transmission, also available with the diesel, though this is offered with a six-speed manual as standard.

The Discovery 3 introduces new technology, notably 'Terrain Response', which allows the driver to choose one of five terrain settings via a switch on the centre console. These are a general driving programme, one for slippery conditions (known as grass/gravel/snow) and three special off-road modes (mud/ruts, sand, rock crawl).

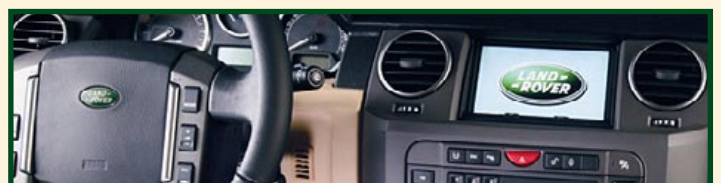
Terrain Response automatically selects the most appropriate settings including ride height, engine torque response, hill descent control, electronic traction control and transmission settings.

The Discovery 3 also has an integrated body-frame structure and adaptive headlights that swivel with the direction of travel.

On-road driving and refinement are enhanced by fully independent suspension all round, using air springs on most models. This is height adjustable, to assist with entry and exit, and to boost ground clearance to help off-road performance.

Like its predecessor, the new Discovery will come with five seats as standard with a third row optional. Both rows now fold flat into the floor.

Source: just-auto.com



UK: Continental's Ziebart says mild hybrids are "right solution for fuel efficiency gains"

Hybrid vehicles may have a future in Europe, but they are likely to be "mild hybrids" rather than vehicles such as the Toyota Prius.

Despite Europe's diesel bias, industry executives believe mild hybrids could make economic sense given tight EU emissions targets.

Meanwhile, several suppliers are playing a key role in their development.

Valeo is launching its belt-driven starter-alternator with brake energy regeneration on a 2004 PSA model.

The starter-alternator generates electricity and can act as a starter motor and crank the engine to much higher revolutions.

Valeo says the unit also enables "Stop-and-Go" operation that switches off the engine during idle, providing up to 10% fuel savings.

ZF Sachs is working on its Dyna-Start starter alternator that will debut on a Volvo model this year. Continental is developing its integrated starter alternator damper (ISAD) technology.

Bosch and Siemens VDO are also working on components for hybrid systems.

The products are based in part on the development of 42 volt systems - but for now are being made to work with 14 volt systems.

Price will be crucial to acceptance, suppliers say. The target price for the total system - electrical hardware, controls, electronics and the energy store - is about €600 in high volume, according to Continental Automotive Systems.

Ninety percent of the potential regenerated energy can be achieved with a 15kW electrical machine, says Wolfgang Ziebart, head of Continental Automotive Systems.

Above that he says, "the weight grows faster than the added value."

"A mild hybrid with a performance of between 10-20 kW is the right solution for a medium-sized car," Ziebart says. "At that level there is a very good cost benefit relationship."

Suppliers estimate that such a system could save about €800 in fuel costs over the life of the vehicle.

Ziebart says a diesel hybrid would be most effective concept.

"At the moment, the diesel hybrid combination is certainly the alternative drive with the lowest fuel consumption," he says.

A full hybrid using an electric motor with performance of more than 40kW "is definitely an expensive concept," he says.

Ziebart says that the concept was developed mainly to meet Californian zero emission vehicle (ZEV) targets. He says the greatest cost benefit is achieved with a smaller, mild hybrid.

The European industry has to make major gains in fuel economy to reach its 140g of CO₂ per 100km emission targets for 2008 - let alone the 120g target for the next decade.

To introduce mild hybrid models by 2006 - and meet the 2008 target - carmakers will need to have prototypes running this year.

Ziebart says there is a danger, though. If the European industry focuses too much on fuel consumption, and the targets are not rolled out in other countries, he says, "we could marginalise ourselves."

Source: SupplierBusiness.com

CHINA: Government aims for huge boost in automotive exports by 2010

China aims to export as much as \$US100 billion in cars and vehicle parts a year by 2010, more than 20 times last year's figure, state media reportedly said.

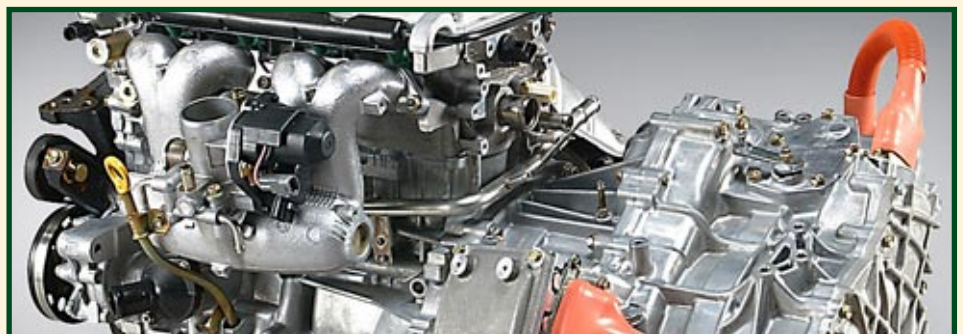
"Our short-term goal is to increase automobile and component exports to \$15 billion to \$20 billion next year," the China Daily quoted Vice Minister of Commerce Wei Jianguo as saying, according to Reuters.

China's automotive exports rose more than a third last year to \$4.7 billion, with \$400 million of that coming from sales of whole vehicles, the newspaper reportedly said, adding that Wei said that, by 2010, China would export \$70 billion to \$100 billion worth of cars and components.

"China is likely to become the component supply centre for international automotive manufacturers in the future," Wei Jianguo reportedly said.

He reportedly added, without details, that the Chinese government would encourage the development of as many as 10 large-scale "automobile and component exporting bases" and allow mergers and acquisitions to create big multinational companies.

Source: just-auto.com



UK: Petrol direct injection technology the next weapon in emissions battle

European suppliers and manufacturers are focusing on petrol engines for the next phase of improvements in fuel consumption and emissions levels.

"The only technology that can accomplish the necessary reduction in fuel consumption - and is also being accepted by customers - is gasoline direct injection," says Klaus Egger, member of the board at Siemens VDO for powertrain.

While Bosch expects demand for diesel to continue to rise to around 50% by 2007, Siemens VDO believes it has already peaked, and could be closer to 40% in four years.

The key factor in the success of diesels has been the evolution of direct injection systems. While modern diesels inject fuel directly into the cylinder, most petrol engines use port injection, in which fuel is inducted into the cylinder by the valvetrain.

A new generation of direct injection petrol (GDI) engines promise fuel efficiency gains of 15-20%.

Models from Renault, Audi and Alfa Romeo - among others - are already fitted with early versions of GDI and more advanced systems will be available from 2005.

But some industry futurists say petrol direct injection has fallen by the wayside. New engines take a long time to develop, and it will be some years before GDI achieves significant penetration.

Technology leaders in powertrain systems have invested heavily in diesel and electric/hybrid systems over the last decade.

Diesel is about 25% more efficient as a source of energy than gasoline. Over 40% of all new cars sold in Western Europe in 2003 were fitted with diesel engines.

Japan's carmakers are pressing ahead with hydrogen/electric power as the solution to that country's unique set of conditions.

Trying to get the best of all worlds

All solutions have drawbacks. While diesel offers improved fuel consumption, other emissions such as nitrous oxides and particulate matter are much more of a problem than with petrol engines.

And for now, the hybrid electric engine faces considerable weight, cost and infrastructure obstacles, especially in Europe and NAFTA.

Cheaper "homogenous" GDI technology will likely find applications in smaller engines, and offers opportunities in downsizing engines for the same power output, resulting in lower carbon dioxide emissions.

These lower cost systems could also "see some penetration in North America, as pressure for improved fuel economy in light truck fleets increases," says Steve Kiefer, Delphi business line executive for engine management systems.

More sophisticated "spray guided" GDI will initially be developed for engines on premium and luxury sedans, those currently with the worst fuel consumption.

"Our rapid switching piezo injectors will be ready for large volume production by 2005," says a Bosch spokesperson. Siemens VDO will enter series production a year later.

Magneti Marelli believes GDI could take over 10% of the petrol engine market in 2008. Executives at Siemens VDO think it will be closer to 30% of the total petrol market, with the high-end technology alone taking 10%.

Bosch believes that with diesel's continued growth, GDI will be restricted to only one million units globally in 2008.

But the single largest power source in 2008 in western Europe will still be low pressure port injection petrol systems. Delphi suggests 25-35% of new cars will be so equipped, while Siemens thinks it will be over 40%.

Luigi Potenza, sales manager for Magneti Marelli powertrain, believes alternative powertrains like natural gas and electric hybrids could account for as much as 5% of the western European market by 2008.

Source: SupplierBusiness.com



Squeaky clean downhill racing

In 1933, journalist Myron E. Scott encouraged youngsters in Dayton, Ohio to organise competitive downhill races for their wheeled wooden crates that he named 'soapboxes'. Sixty-seven years after those humble beginnings, the Soapbox Challenge was introduced to the world's greatest celebration of motorsport. The Goodwood Festival of Speed on the UK's south coast has become a key event in the annual international sporting calendar, with over 150,000 visitors and attended by the majority of motorsport and automotive giants.

Despite the intention that the Soapbox Challenge should be the most light-hearted of the weekend's activities, the competition is fraught, and the rivalry is intense. Racers reach speeds of over 60mph down the steep, narrow, twisty hillclimb course. Good handling is imperative and minimising aerodynamic drag and rolling resistance are primary development objectives.

In 2002 a group of young engineering graduates at Lotus secured the go-ahead to compete and was given a small budget for materials. All of their time, however, would have to be spent outside working hours. Lotus' materials specialists, vehicle dynamics engineers, aerodynamicists, stylists, paint shop operatives and workshop machinists helped the team to design, engineer and manufacture the first Lotus soapbox, and indeed each subsequent racer.

The first Type 119 was a sleek racer in Lotus heritage colours, and proudly sped across the line to win second in the 'roadster' class behind BMW, while overall victory was taken by McLaren's enclosed 'streamliner'. It was a marvelous debut for Lotus in a field of 26 racers.

Last year, with some experience upon which to capitalise, the Type 119B project team significantly furthered the concept aiming to win gold. Windtunnel tests maximised the 119B's aerodynamic efficiency. There was delight in winning the roadster class, and yet frustration in finishing third overall behind two 'streamliners'.

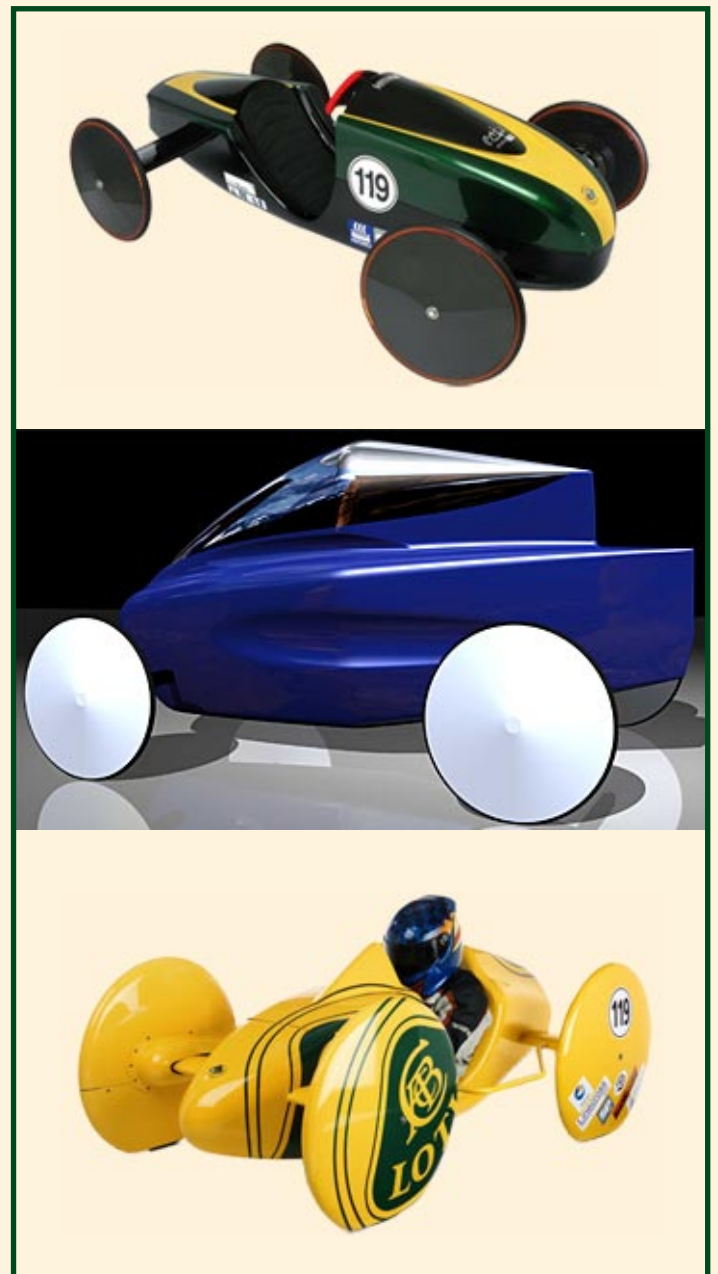
Importantly, the team learned that appearances mattered. Head of Lotus Design, Russell Carr explains, "We were quite conservative in the styling of the first soapbox, as required by the regulations. But we learned that in fact, we could stretch the rules, and to stand out, a bold visual impact was essential. We achieved that with a bright and powerful design statement that caught everyone's attention last year." The efforts were rewarded as the Type 119B picked up the trophy for Best Presented Roadster.

So to 2004, and will it be third time lucky for overall victory? The Type 119C team is raising the stakes this year, with Lotus'

first attempt in the 'streamliner' class. Theoretically, in featuring fully enclosed bodies, this class has the advantage of improved aerodynamic efficiency, and thus the best chance to top the podium.

Only two minutes of dramatic, seat-of-the-pants racing late in June will tell the tale... Watch this space!

Source: Lotus Engineering



Design houses

WANT to know Europe's most fashionable, sexiest cities? Ask a car designer. The time when car makers did what they could in-house and sub-contracted the rest to the well-established Italian houses like Ghia, Bertone and Pininfarina, are finding their roles in the development of new vehicles changing.

They're doing that by opening satellite studios in places that they hope are trendsetters - as well as pretty cool.

Take Volvo and Barcelona, for example. The concept, according to the then Volvo chief designer Peter Horbury was simple. To complement the work already being done by Volvo's main design centres in Sweden and California, you set up a small studio in fashionable places like Barcelona and, to get the Far East flavour, perhaps Kuala Lumpur.

The beauty is that all it takes is a senior stylist on an overseas posting that most would give up their pencils to undertake, and a handful of locally-recruited art college graduates.

Inspired by their surroundings - Gaudi's Barcelona and easy access to Picasso galleries, for example - they soon start to influence the shape of things to come.

The argument is that if Volvo's designers are based only in Sweden and California, they will not appreciate the Latin culture or the narrow streets of southern European cities - all very important, of course, when you are designing cars.

For VW Group it was just down the Spanish coast at Sitges while Toyota chose southern France, close to Nice - and why not? - for M2 its European design centre.

For Nissan, it had to be London. Nissan Design Europe is the newest automotive styling centre, opened in Paddington, London, in 2003.

According to Nissan's head of design Shiro Nakamura, getting ideas from all over the world brings a fresh approach and it is important to be able to design in the markets where you sell cars.

Nissan now has a design studio in Europe, two in the United States, three in Japan and one in Taiwan. Each is important for those markets as well as for contributing ideas for the Nissan brand and to help capture the vital Japanese DNA of its vehicles worldwide.

Nakamura said: *"The 350Z is the same all over the world. It is a good design that works globally, but something like the Altima will only work in the United States because it is a big car with a 3.5-litre V6 engine. In Europe it would be too expensive."*



"Then there is the Titan which is a huge pick-up, but in many parts of the United States it is an every day car used for shopping. In Europe you would use a Micra."

"Some speciality cars can be global, but the Terrano 4x4 for example, is only for Europe and this is the type of strategy we will maintain. Some cars will be market specific and we have a lot of variety which is a strength. But for design this is not easy."

Design identity does not mean a uniformity of design, Nakamura said. Vehicles can look different, but they have to be identifiable as Nissan. *"It is a form language that connects the designs together."*

"Character is what defines vehicles and they have to have their own personality. The Cube and March are very different designs but people know they are both Nissans. We want to make our cars stand out in their segments."

For the European market, Nakamura said that the crossover SUV, already making a mark in North America, is one market segment that is set to grow.

He added: *"We are already good at 4x4 with vehicles like the X-TRAIL, Patrol and now the Murano - although this might be rather big and expensive to sell in great volume in Europe. It will be similar in price to the 350Z, so we definitely need something more affordable and this is where the Qashqai concept comes in - it is an idea we can develop."*

Qashqai, a sports activity crossover concept unveiled at this year's Geneva Motor Show, is the first project to come out of Nissan Design Europe and draws on elements of its London roots in its styling.

NDE was set up in a disused railway storage depot and some of the graphics in the interior reflect graffiti that was on the walls of the building before Nissan moved in.

Feature



This was not the sole reason for choosing London, of course. Nakamura said: *"We did have a design centre in Munich, but if you are going to have a design centre in a city, then Munich is not ideal. We could have chosen Paris or Turin or Berlin or Milan but we chose London."*

"This was not just because we have a manufacturing plant in the UK but because London is a vibrant city. It has culture, architecture, music and it is very cosmopolitan - also many designers want to live there. It is also very easy to recruit good designers because NDE is very close to the Royal College of Art."

"Another very strong advantage is that the UK is actually separated from mainland Europe and so maybe you get a different perspective on design."

One thing Nakamura and his fellow design chiefs at other automotive companies are agreed upon is that having design centres in cool places also makes it easier to attract talent.

One designer said: *"Quite honestly we all want to live in great places - not just because they are great places but because they are full of influences artistically, culturally and in terms of fashion. It can open your eyes to things you may never see or experience in your own country. How can you design for people in other countries if you have never seen them."*

She had a point. For many years the Japanese and then the South Korean manufacturers were forever being berated for being.....well, too Japanese or too Korean.

Japanese designers spread their wings a few years ago and the Koreans are now starting. Hyundai has a design studio in California and now Frankfurt, Germany, to help capture some of those outside influences.

Look at the Coupe, the Sante Fe and the recently unveiled Tucson - it's starting to work.

Apart from southern Europe, California is the design hot-spot. Most of the North American manufacturers have styling centres over there in the sun, as do many European and Japanese manufacturers including Volvo, BMW, Volkswagen, Nissan and, as already mentioned, Hyundai. But then the United States is a huge market - and California a very big market within it.

What about the Far East? Aside from Japan and South Korea, there's little going on. There is some activity in Taiwan but it will not be long before the stylists descend on China.

The burgeoning market there is finally taking off after promising so much for so long. Potential is huge, carmakers are establishing factories as fast as they can, dragging the supplier industry with them.

To make the transition from low cost to best cost, China very soon will need design, research and development capability - so watch this space.

Design studios around the world are encouraged to compete against each other for in-house projects because car makers do not want to limit each one to particular markets. As ever they can also find themselves up against some of those

'outside' design houses in Italy, France, Germany, the UK and the United States.

There is plenty of business for such companies especially as they broaden their own expertise. Companies such as Bertone, Pininfarinam, Lotus and Karmann are now established as vehicle assemblers as well as designers, building special models such as convertibles or sports cars.

They are still in there pitching for design business as well, their input can be invaluable. There is an argument that says that Fiat's trouble began when it started doing most of its design work in-house rather than giving much of its business to the local Turin design houses.

If you want an example, take the Daewoo Martiz, a Bertone design turned down by Fiat and one which went on to take the Italian small car market by storm - at considerable cost to Fiat.

That's just one example of how the big automakers do not always get it right. Ford was another company to invest in a London design studio for its Premier Automotive Group.

It was an opportunity for the heads of design at Ford's classy brands to brainstorm and scan the blue sky for ideas. It didn't quite work out as hoped.

Why did that not work and should Nissan not have taken heed? Unlike Nissan design Europe, Ford's dream factory was just that. It did not have the modelling studios and full mock up capabilities such as those down the road in Paddington.

Source: just-auto.com

■ *Graduates in focus*

My current role is Project Co-ordinator for the new Lotus Exige. Having chosen Project Management as the route to progress my career this has presented me with an ideal opportunity to display management skills and awareness, co-ordinating both the Project Team and Function Groups throughout the business to deliver a product to the client.

Life at Lotus began in September 2000 as a Graduate fresh out of Brunel University, on the Monitored Professional Development Scheme. The flexibility of both the scheme and Lotus' business were quickly apparent, enabling me to gain a broad understanding of the workplace and exert skills away from my Mechanical Engineering Degree.

4-monthly placements including Vehicle Development, Body & Trim Engineering and Logistics saw me working across a wide range of disciplines. Creating a global engine database to be used as a tool within Lotus Engineering, as a member of the Water Ingress Team on the Lotus Elise, GM Project Management of concerns for an engine enhancement and designing packaging and logistics solutions for the Lotus manufactured VX220 Turbo.

Having gained the necessary experience to progress onto the next phase of the scheme, I began a 2-year position of increased responsibility within the Manufacturing Division, which will see me apply for Chartered Engineer Status. This has led me through the cost down programme focused on reducing the bill of materials on the Lotus Elise, to composite design and manufacture, to vehicle project management.

I have been fortunate to have involvement in such a variety of projects, working across many function groups within the business that have helped progress my career through learning they have provided and opportunities they have presented. I have also been able to extend my knowledge through training courses provided by Lotus. The most important aspect of my development however has to be the people, a friendly focused environment always willing to help develop and steer graduates in the right direction.

Source: Marcus Youden, Manufacturing Engineer - Group Lotus plc

The Lotus Monitored Professional Development (MPD) scheme has been accredited by the Institute of Mechanical Engineers (IMechE) since September 2000. This enables Lotus to attract and retain outstanding engineering graduates, attaining a minimum of 2:1 in their chosen degree. The IMechE recently renewed its accreditation of the scheme for the maximum three-year period, which is a reflection of Lotus' continued commitment to developing its young engineers.



■ *Style versus function*

A frequently asked question is should style follow function or function follow style?

No compromise approach

The problem often rests with definition of terminology and personal taste. Function can be viewed as restrictive practicality or inspired added value. To its detractors style is fashionable decoration but to its supporters the subject defines the character and soul of a product through manipulating proportion, line, surface, tactility and colour.

The sense of superficiality comes from the fact that the term is associated with fashion and personal appearance, which can be extreme and transient. However it is equally applicable to architecture which often has a timeless permanence.

Pure style in reality can only ever relate to a piece of art (a Henry Moore sculpture for example) where its function, if any, is to convey an emotion to the viewer. With a car or any consumer product there are inevitably varying degrees of functionality that influence the style, not least the interface with the human form. Equally there are very few purely functional products. There is rarely an absolute with function and therefore human instinct is to try and make it look good. Even in F1 where functional performance is everything the cars each have their own visual character. If there was a functional optimum and form followed function then they would all look the same.

Confusion and polarisation of opinion often arises where one attribute has a disproportionate emphasis to the other. Where the aesthetics dominate it may be viewed positively as stylish, or negatively as overstyled depending on the audience taste. Complication is added by the fact that style encompasses many solutions that range from the purity of the Bauhaus



through to the flamboyance of art nouveau. Therefore the choice of style and the way it is balanced with function often determines the success and appeal of the product within a particular segment.

Marketing

A designer's role is increasingly recognised as an important one in differentiating and marketing a car or product. Style and function is addressed with regard to a wide range of activities from overall aesthetic concept through to material colour and finishes. Subtle interpretation can impart an image of 'sportiness', luxury, quality and even ironically function (Nissan Cube). Many products that are held as intellectually superior because they are function over form have in fact been deliberately 'styled to look not - styled'. The VW group has used style to great commercial opportunity by deriving cars as diverse as a Skoda saloon and the Audi TT sports coupe off the same mechanical platform. Function is present in both due to technical hardpoints but one sells on functional packaging and the other sells on 'must have' style.

An Alfa Romeo sells on its passionate Italian character and the style is a major

component of the brand. At the other end of the spectrum a pragmatic traditional Volvo owner would have seen the same car as being intellectually shallow because style dominates engineering. Research suggested that a Volvo owner used to regard style as low on his list of requirements whereas functional attributes top the list.

In the performance car segment the marriage of technical function and style is a compelling proposition. The pilots maxim that "if it looks right, it flies right" applies on its own terms to motorcycles and boats.

Lotus has always recognised the value of both form and function and built its brand by successfully developing technically innovative but beautiful cars.

History - emergence of style

The automobile blended style and function from a very early stage. They were primitive technical devices but inherited the flamboyance and status of the horse drawn carriages that they were replacing. Personal transport was still a new luxury so functionality was not an issue and style over function dominated between the late 1920's to the late fifties.

Feature

French coach builders such as Figoni and Falashi produced automobiles that put fashionable Art deco style and streamlining in precedence to true function. The objective was to convey a sense of speed and elegance that reflected the new industrial age. These influences can also be seen in architecture, ships and product design of the same period. At the same time General Motors recognised that as the automobile ceased to be a novelty that there would need to be an impetus to sustain new sales. Harley Earls styling division started to create test plane inspired 'style' over function that was to become the hallmark of 1950s American cars. Annual style upgrades were initiated and design obsolescence was born.

In Europe function over form was championed by a group of German designers who emerged from the Bauhaus in the 1920's. They dedicated themselves to pure rational design that suited modern mass production techniques. A philosophy of 'form follows function' became associated with a whole collection of designs for 'living machine' furniture and textiles. Many remain design icons and many designers claim to follow the same rationale. However, though these are designed for function their success is equally due to a unique 'style' which did not happen by accident. The misinterpretation of the maxim was recognised by Frank Lloyd Wright, one of their most famous members...

The era of 'test plane' inspired designs that have little regard for function are long gone but more than ever it remains important for the product to retain 'style'. Style differentiates increasingly, technically competent cars. The design process now requires constant reference to legal criteria, mechanical package aerodynamics, manufacturability, cost, occupant package quality



and brand relevance. The task of satisfying all these whilst maintaining 'style' requires tenacity and skill which is why the term 'designer' has largely replaced the more one dimensional sounding 'stylist'.

Lotus

Lotus has from its inception balanced a desire for style and function both with body design and technical components. Our core values clearly recognise this:

- Unique and dramatic design
- Innovative use of technology
- Performance through lightweight
- Class leading ride and handling

Colin Chapman applied this to both road and race cars. His view as stated in the Lotus engineering policy of 1975 was that exclusivity should be maintained by trend setting styling whilst the *"most elegantly effective and traditionally Lotus solution is the one with the least number of parts effectively deployed"*

Taste splits opinion as to whether the cars of the 1960's were more 'Lotus' and more functional than today's product because the designs appear less frivolous. However this is to confuse functionality with pure or minimalist style. The more sensual style of the Elise 2 has been carefully developed to visually express the dramatic driving experience of the product but also to support the functional requirements of a higher performing modern car. The change is mirrored in racing cars that are no longer the pure cigar shaped streamliners of the 60's but are complex pieces of sculpture that support aerodynamics, cooling and safety.

Style related characteristics have frequently derived from function.

Conclusion

One thing is clear, although functional performance may ultimately be a necessity and justify ownership, the aesthetics inevitably contribute to our initial perception of a product and create desire. In a commercially competitive world the 'style' is often the only way to differentiate two similar products and as with a piece of sculpture it has to promote a set of emotional responses from the consumer that ultimately lead to purchase. Even Volvo, the standard bearers of functionality, recognised that the aesthetics of the vehicle are inevitably the number one reason why many people chose a particular car, and that they could no longer rely solely on their typical academic customer who believed that "the best medicine was the one that tasted worst"

Source: Russell Carr - Head of Lotus Design

Feature

Top exit rad



A unique race inspired feature that functionally contributes to aerodynamic down force.

Coke bottle shape



The shrink wrapped body gives the car an agile, athletic stance but the 'waisting' of the body also assists ingress egress.

Side intakes



Aesthetically these add surface drama to the vehicle and let you know that it is mid engine. Functionally they are essential to cool the engine.

Assymetric wheel size



Creates visual drama and good stance but historically was a functional requirement for all high performance mid engine cars.

Diffuser



Dramatic racecar image that gives the back of the car distinctive attitude and contributes to significant aerodynamic downforce.

Wraparound screen



Gives fantastic visibility, minimises buffeting when the cabin is open and reduces drag.

Aston's lucky number

Christened DB9 rather than DB8 to avoid the implication of a V8 rather than V12 engine, Aston Martin's new sports-come-GT car is not only one of the most technically advanced in the world, but the future of Aston Martin rests on its not inconsiderable shoulders. Jesse Crosse looks at the technical highlights of the 186mph supercar.

The birth of any new supercar brings with it a characteristic deluge of eulogising in the press, but in the case of Aston Martin's new DB9, the enthusiasm is more than justifiable. Not only has the new car met with rave road test reviews - steadfastly refusing to be overshadowed by Ferrari's 612 Scaglietti launched just a few days before - more importantly it ushers-in a new era for Aston Martin which amounts to a virtual re-birth of the company.

Central to the new beginning is what Aston Martin calls its 'VH' (vertical horizontal) vehicle architecture. Vertical, because it will from now on form the basis of every future Aston Martin and horizontal, because it can be applied across the PAG group if necessary. At its core is the bonded aluminium alloy tub which draws on techniques developed originally for the Lotus Elise by Lotus Vehicle Architect, Richard Rackham and his team. Lotus was subsequently invited by Opel to develop a variation on the theme for the Opel Speedster/Vauxhall VX220 and later on, the Aston Martin Vanquish.

Architectural history

Lotus inadvertently started Aston's aluminium ball rolling back in 1996 with the Elise. Since then the Norfolk company has built 17,500 Elises and in recent years has averaged around 2,500 cars per year, with a further 2,000 VX cars for Vauxhall/Opel. Tubs were originally built by Hydro-Raufoss in Denmark before production was moved to a new plant in Worcester during 1999. From there, completed tubs are shipped to Hethel for final assembly. Extruded sections are manufactured by presses exerting upwards of 2,200 tonnes at a temperature of 490 degrees Celsius. However, the large suspension turrets of the Elise are so substantial they are specially produced using a 100,000 tonnes. Sheet material is produced from 100 percent recycled aluminium processed at 900 degrees Celsius on a hotplate, where steel impurities are removed using electro magnets.

The Elise platform was originally designed as a 'step-in' chassis with no doors. As a result, the large chassis rails provided a particular manufacturing challenge due to a fairly large, curved, section and are produced by stretching and pulling the components around a tool. Potential crash damage is catered



for by a design which accommodates the fitting of complete replacement sections. Components are bonded together using a heat-cured epoxy glue applied by robot, which never cures outside the oven and can be stored for years. Once the glue has been applied in minutely metered amounts, the components are assembled on a jig by hand. Some joints are merely clamped, but other major parts are fixed to prevent movement using aluminium bolts driven in by electric screwdriver. It is a simple technique, typical of an operation that is steeped in ingenuity. Other touches include tiny ribs on the surface of the extrusion which maintain precisely the right gap in the compressed joint and prevent the

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glue from being excluded. Once assembled, the chassis is clamped to a jig and cured for 40 minutes at 180 degrees Celsius. That the completed items are robust is beyond question. Original durability testing included 1000 hrs exposure to an acid salt

spray (using a solution of battery acid) at 52 degrees Celsius. Lotus says steel bodies would virtually disappear under such conditions.

With such an impressive technology, it's no wonder Aston Martin turned to Lotus to craft a similar chassis for the Vanquish. The challenge would be quite different this time however. While the Elise and VX220 were rear engine, rear-wheel drive, the Vanquish would be the first front engine, rear-wheel drive car using this architecture, so the transmission and propshaft would need to be accommodated in the middle of the structure. On that score, the Vanquish tub has a carbon fibre tunnel running its length and forming a rigid, structural, backbone, something that was absent from the previous two mid-engine designs. There are also composite crash structures on the front and rear of the tub supporting engine and suspension, still manufactured by Lotus at Hethel.

Feature



Going it alone

With the DB9, however, Aston Martin is flying solo, its aluminium architecture a direct collaboration with Hydro-Raufoss in Worcester where the tubs are manufactured alongside those of the Vanquish. Once complete the two lines part company, Vanquish tubs being shipped to Newport Pagnell and the DB9 components to Aston Martin's new plant at Gaydon. Construction is very similar though and the elements of the tub (which Aston prefers to call a 'frame') joined by adhesive supplemented by self-piercing rivets. Body panels are assembled onto the frame at Gaydon, again using adhesive which is applied by a single robot before being cured using hot air.

Upper and lower C-pillars are joined using an advanced ultrasonic welding technique at a frequency of 20kHz. The high frequency vibration, generated by a 'sonotrode', causes a molecular bond 90 percent stronger than a conventional spot weld. The process is so far unique to Aston Martin and has huge advantages in that no heat is generated, so there's no oxide contamination and most important, no deformation of the materials. The remainder of the structure is of equally lightweight materials. The one-piece windscreen frame (another first) is cast in aluminium, the steering column and inner door frames are from magnesium alloy and the bonnet, roof and rear wing panels are 'superformed' in aluminium before being hand finished. Both the front wings and bootlid, however, are manufactured in composite materials while the propshaft is from carbon fibre.

The front suspension picks up on a cast aluminium subframe, as does the rear suspension along with the transaxle. Wishbones are all forged from aluminium and damper bodies are also made from aluminium. 19-inch alloy wheels, flow formed rather than cast to save around 1kg per wheel, wear specially developed Bridgestone tyres. Brake discs are ventilated and grooved in preference to cross-drilling, a detail which Aston Martin considers adds greater

efficiency and an improved ability to shed brake dust. Unusually, brake calipers are each manufactured from a one-piece casting for improved rigidity. The body's torsional rigidity is immense, at 27 kN/degree, twice that of the DB7 and 25 percent lighter too.

Powertrain

The DB9's engine is a development of Vanquish, quad-cam, 48-valve, V12 which contrary to rumours at the time, was not a hybrid of two V6 Ford Duratec engines. That said, the original V12 did make use of Duratec pistons, connecting rods and valvetrain. The engine originally evolved in two stages. Stage one developed 420bhp but in Stage two Vanquish form, that was upped to 460bhp and 18.1kg removed from the engine internals, more than half of which involved rotating parts such as the crank, camshafts and flywheel. Inertia has been reduced still further for the DB9 and the engine's characteristics modified to make it even more tractable. Maximum power has been reduced to 450bhp at 6,000rpm but 80 percent of the 570Nm maximum torque (developed at 5,000rpm) is produced from just 1,500rpm. Despite this supposed blunting of the V12's teeth, the manual DB9 still accelerates to 60mph in 4.7 seconds and 100mph in a breathtaking 10.8 seconds. As with the Vanquish each bank of cylinders is equipped with its own engine management unit, both of which are integrated with the transmission and drive-by-wire throttles. Overall weight of the engine is a further 11.8kg lighter than the Vanquish version and positioning is well back to help achieve the DB9's 50:50 weight distribution.

Aston Martin has opted for a transmission solution that is at the same time both well tried and radical. Well tried, because the sublimely effective ZF HP26, six-speed automatic gearbox has been in use by BMW and Jaguar for some time, and radical, because on this occasion, the Lepelletier gear train sits inside a transaxle casing specially developed by ZF for the DB9. From the driver's perspective, the transmission emulates an



Feature

automated manual with magnesium 'Touchtronic' paddles for shifting in manual mode, and simple, push-button selection of drive, park and reverse. Software has been developed by Aston Martin to deliver super-fast shifting that is easily a match for most automated manual systems if not for the brutally quick SMG transmission of the extreme BMW M3 CSL. Unlike the CSL, however, the DB9's ZF transmission delivers a high degree of refinement at all times and in fully automatic mode, is naturally far superior to any single clutch automated manual yet developed - essential to ensure success in the US market. Software details include engine blipping on the downshift, something Aston Martin believes is a first on a torque converter-based gearbox. Transmission and engine are connected by a cast aluminium torque tube and drive is via the carbon propshaft which is both light in weight and exceptionally rigid. A manual six-speed will be available in conjunction with a twin-plate clutch, developed by Graziano and claimed by Aston Martin to have the best gearchange action of any manual transmission in the world.

Partners and manufacturing

Electronics naturally include EBD (electronic brake force distribution) ABS and standard DSC while a not-so-common feature is the use of LEDs for rear light clusters. The overall electrical system was developed with Volvo and is based on the Swedish manufacturers multiplex design. Volvo also partnered Aston Martin on safety, providing development and testing resources at Gothenburg. No less than 25 of the 93 prototypes were eventually crash tested. Other test locations included Nardo, Death Valley, Northern Sweden, the Cranfield wind tunnel and Ford's Dunton R&D facilities.



2,200 DB9s will be constructed at Gaydon this year (including a few Volantes from late summer onwards) and 300 Vanquish at Newport Pagnell. Next year, DB9 output will remain at 2,200-2,300, but 40 percent will be DB9 Volantes and the balance, Coupes. In the middle of 2005, the V8 Vantage comes on line at Gaydon of which a further 2,500-3,000 a year will be built, bringing total production to something over 5,000 units. 200 man hours are spent on each DB9 compared to 450 hours for the DB7, yet for the well heeled, the price is a tantalising £103,000-£109,000. With world-class technical architecture and assembly lines now firmly in place, plus its own bespoke engine plant at Cologne, Aston Martin's future looks more than bright; incandescent would perhaps be more appropriate.

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