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In this issue: Industrial design • Sensors • Light curing adhesives • Hydraulic buffers

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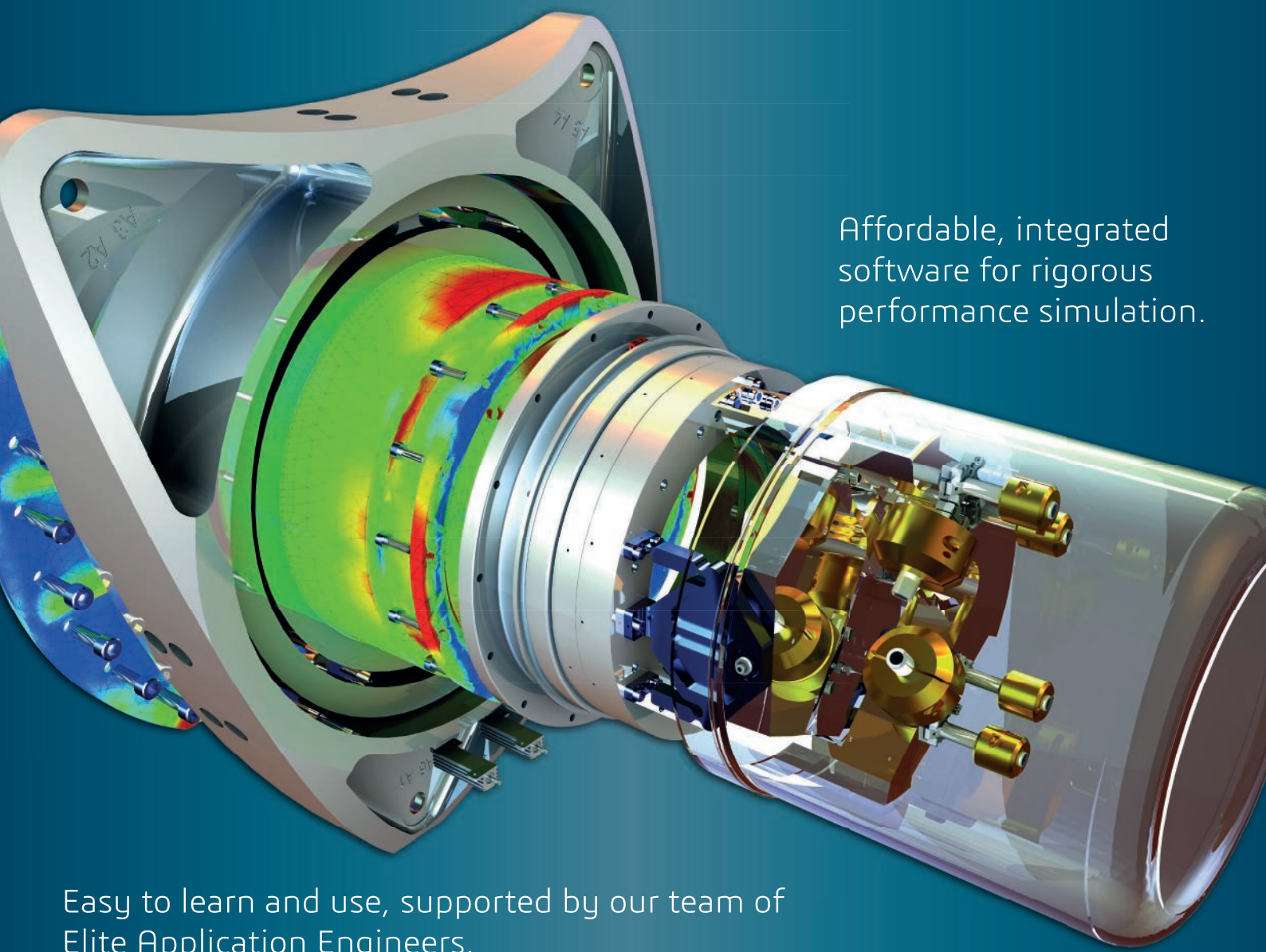

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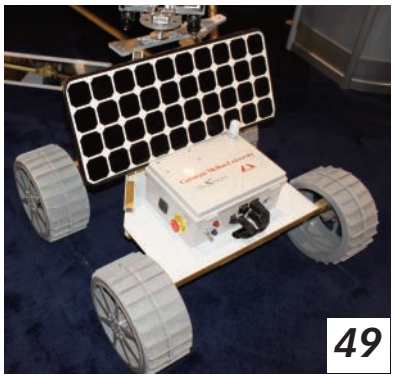

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The pragmatic vote

Tim Fryer, Editor (tfryer@findlay.co.uk)

This will be the last issue of *Eureka* before the General Election on May 7th 2015, after which, it is fairly safe to assume, we are in for some form of administration change – even if it is another coalition. Are we likely to see the Conservatives and Lib Dems partnering again? Probably not, but in a political climate in which principles seem secondary to pragmatism, you can't rule anything out, nor anything in.

Even if principles seem to have gone out the window, there still needs to be that pragmatic reason for someone to claim your vote, no matter how cynical you might be about modern politics. Undoubtedly, this will be labelled on several occasions as 'the most important General Election in a generation'. This will be because, at some point in the campaign, we will only have 24 hours to save the NHS, the Armed Forces, the police, the education system – in fact most things except overseas aid, which is ring-fenced.

No matter which politician says such things, it is obviously not true. Irrespective of who is at the helm on May 8th, all main departments will continue with their current counter-balancing mix of inefficiency, dedication and hard work, and they will continue to lumber on.

So who should you vote for?

Perhaps the place to start is closer to home, with the products that you are designing at the moment. Ask yourself what impact each of your parliamentary candidates might have over the next four or five years. As a consequence of that candidate's actions, are you more likely to see your product being manufactured in your constituency. Or to be manufactured in greater numbers? Or will a wider range of your designs be made? Or maybe an offspring recruited as an apprentice to work on such projects?

If the answer to any of the above is positive – in this age of vanilla politics from magnolia politicians with beige policies – then maybe that is differentiation enough to earn your vote.

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Hydraulic clamping saves time and space

How can hydraulic bushes improve over their traditional, mechanical counterparts? The ETP range has the answers.

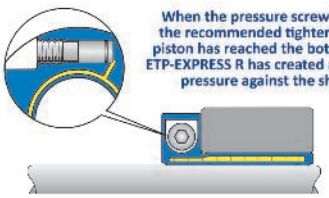
Everyone in every industry needs to save time and space while improving performance. Given this, the traditional mechanical clamping bush suffers a number of key disadvantages.

The first of these is that these traditional methods of connection rely on bolts to secure the shaft. This is problematic enough when installing them, but even more so when maintenance or adjustment are required and the bush has to be removed. In these situations, the securing bolts need to be undone painstakingly, half-turn by half-turn.

This process is time-consuming and laborious in the best of conditions, but in demanding environments, the time and difficulty involved become truly critical issues.

The bolts used in such devices also pose significant problems in terms of design. This is because they require that any machine or installation that incorporates them must allow space not only to accommodate them, but also for the operator or technician to access them for maintenance or adjustment. This can add significantly to the machine's footprint and can lead to compromises in other areas that reduce the efficiency or performance of the design.

ETP's hydraulic bushes allow quick, easy and precise screw mounting in a multitude of applications by virtue of using a single screw for mounting and dismounting of the hub, thus ensuring an extremely quick and easy service interval time due to easy adjustment of the hub. This is achieved by the application of the principle of pressure propagation in liquids.



When the pressure screw is tightened to the recommended tightening torque, the piston has reached the bottom of the bore. ETP-EXPRESS R has created a uniform surface pressure against the shaft and hub

ETP products apply this principle by using a hydraulic pressure medium (usually an inert wax or paste composition) confined in a double-walled sleeve. This is pressurised using a flange containing one or more screws and a piston with seals for the pressure setting. The moderately-high pressure is distributed evenly along and around the hub and shaft, with the double-walled sleeve expanding uniformly and giving an even contact pressure against shaft and hub – thus effecting locking. The self- contained nature of the products means that this procedure can be repeated many times.

Regardless of whether hubs are being removed or repositioned, mounting and dismantling can be achieved in just a few seconds rather than tens of minutes that might normally be taken.

While all ETP products are customisable, they are available in a number of varieties. These include:

ETP-Express, which has only one screw for pressurising and is therefore suitable when there is a need for the fast and accurate repositioning of the hub.

ETP-POWER, a hydraulic connection that consists of a double-walled hardened steel sleeve filled with a specially-developed pressure medium and a flange for higher torques and stresses

ETP-TECHNO, whose outer and inner diameter and the side of the flange towards the hub are accurately machined for excellent concentricity.

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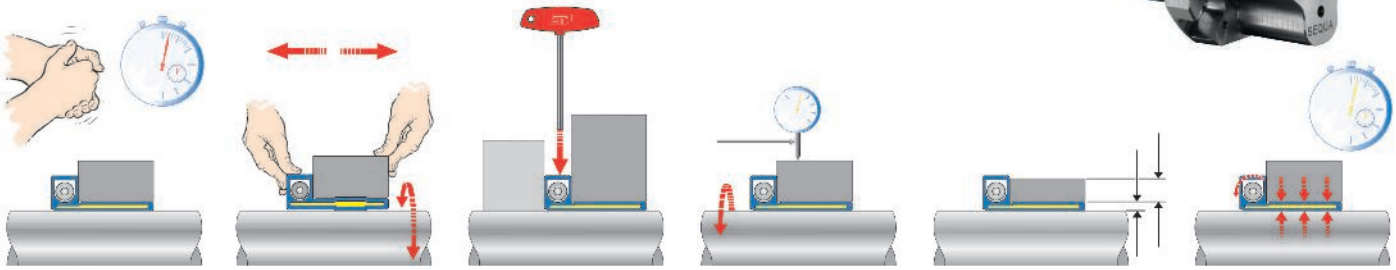

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NEWS

CAD in the cloud

A new company aims to disrupt the CAD market with its cloud-based service. A beta version of the OnShape CAD system was launched last month following six months of pre-production testing. It is now open to everyone to try out as it is both free and, because it is cloud based, requires no software download.

Use of the service remains free until the designer has more than five projects on the go at one time, at which point they can join the Pro Plan, which for $100 a month gives unlimited access.

Darren Henry is part of OnShape's marketing team and he stressed that this was a mechanical design tool, not aimed at designing complete cars or aerospace projects, but instead is: "Ideal for machine building in the industrial environment, machine parts and packaging equipment design is a sweet spot, but also consumer and medical products as well as students. However, the biggest thing is that it really opens the door to collaboration."

Everyone on a design team sees and works on the same master CAD data at all times, avoiding confusing checkouts, file copies, and overwriting each others' work.

As existing CAD files can be imported into OnShape, it is suitable for teams wanting to collaborate in real-time who do most of their design in different packages.

While the initial focus has been on the advantages of a true cloud-based model, the product itself has a number of features that will appeal to certain designers.

"One of the great features is inbuilt version control," said Henry. "You can go back and pick up on any iteration without having to be disciplined about storing versions along the way. Another thing is that we can create mated parts very easily – other CAD packages are not set up to do this."

Boeing president puts focus on STEM

Sir Michael Arthur will be speaking at STEMtech, a conference for STEM (science, technology, engineering and mathematics) education, that is taking place in London on 29th April.

Sir Michael Arthur, president of Boeing UK and Ireland, will speak to teachers, policy makers and employers to discuss the predicted technical skills shortage in the UK and what is needed to boost the engineering talent pipeline.

"Boeing in the UK is proud of its strong record in encouraging young people to study STEM subjects and we are looking forward to showcasing our innovative Schools Build-a-Plane Challenge at the STEMtech conference," he said.

Digital content gets fresh new look

The digital partner of this magazine, **www.eurekamagazine.co.uk**, was relaunched during March with a fresh new look and a host of new features. Our recent reader survey (and we thank all those who responded) showed that the majority of our readers prefer a printed rather than a digital magazine. However *Eureka* online is designed to be complimentary to the magazine rather than an alternative, with unique and constantly updated content. We also intend to develop the site further in coming months with new sections targeted at the design engineering environment. Please do take a look and your feedback (please email the editor at tfryer@findlay.co.uk) will be very welcome.

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NEWS

McNamara joins Williams

Williams Advanced Engineering has appointed Paul McNamara as technical director. He will be responsible for overseeing the overall technical management and delivery of the company's expanding range of projects in the automotive, motorsport, energy, defence and civil aerospace sectors. Before joining Williams, McNamara worked as an executive director at Shanghai Automotive Industries, working for much of the time in the Chinese operation as part of a team setting out future product direction.

Energy conversion

Wave Energy Scotland has announced four competitions, with a combined budget of £7million, to fund development of innovative energy conversion schemes applicable to the wave energy sector. Registration for entry is open until 15 May 2015. The competitions are part of its programme for secondary energy conversion technology.

More horsepower with 3D printing

HTW Motorsport has used 3D printing technology to improve cost and workflow efficiencies, as well as increased on-track performance, for its formula-type race car, said the printing and manufacturing company.

Derived from a student project at the University of Applied Sciences in Berlin, Germany, the collaboration uses FDM and PolyJet 3D printing technologies to design and produce engine parts for different cars.

Each year, these cars participate in the global Formula SAE competition, where teams design, build, test and race small-scale formula style cars, which are also judged on their design, fuel economy, acceleration and endurance.

The team used Stratasys' photopolymer Digital ABS material to meet criteria required to 3D print final parts of the airbox (or intake chamber) on its BRC14 race-car.

Patrick Harder, team engineer, HTW Motorsport, said that 3D printing of complex parts is the fastest and preferred way of manufacturing race-ready airboxes. "As a university project, having access to Stratasys' [Objet500 Connex multi-material 3D Production System] printing technology offers us a massive boost," he said. "This has delivered proven, quantifiable benefits on the BRC14's airbox system, with a comparative increase in horsepower of around 10% versus the system we used two years before. We also enjoyed an increase in torque of almost 12% over the same timeframe. The role of 3D printing is fundamental, as it allows us to create a functional prototype which then becomes part of the final race vehicle."

Tougher than bulletproof vests

Researchers at UT Dallas have created structures that stretch to up to seven times their length, while remaining tougher than Kevlar, the material used to make bullet-proof vests. The structures exploit the electromechanical properties of specific nanofibres to absorb up to 98joule/g. Kevlar can absorb up to 80joule/g. Researchers hope the structures will one day form material that can reinforce itself at points of high stress, potentially for use in military airplanes or other defence applications. Researchers twisted nanofibre into yarns and coils and then stretched the twisted nanofibre. They found that the electricity generated by stretching the twisted nanofibre formed an attraction 10 times stronger than a hydrogen bond - one of the strongest forces between molecules.

TECH BRIEF Right-angle gearboxes for servo motors

The SK range from Vogel are right-angle gearboxes suited to servo motors. Whilst in-line servo geared motors will generally use planetary gearing, the SK uses a ground hypoid gearset to give similar levels of performance but with a 90º output. Hypoid gears deliver high efficiency at 94 to 95%, and offer other features to suit servo motors such as low inertia, low backlash and high input speeds. Hypoid gears resemble bevel gears except that the shaft axes do not intersect. They look like a cross between worm and a bevel gearset. Tooth contact is progressive and smoother than spiral bevel gears with a large contact area leading to lower noise levels and a long life.

The Vogel SK has a pair of hypoid gears fully supported on the input and output shafts giving a range of ratios from 3 to 10. Rated output torques in three sizes run from 40 to 150Nm with a standard backlash of 4 to 5 arcmins measured at the input shaft. Maximum input speed is 7500 r/min on an intermittent basis and noise levels are little lower than planetary gearboxes.

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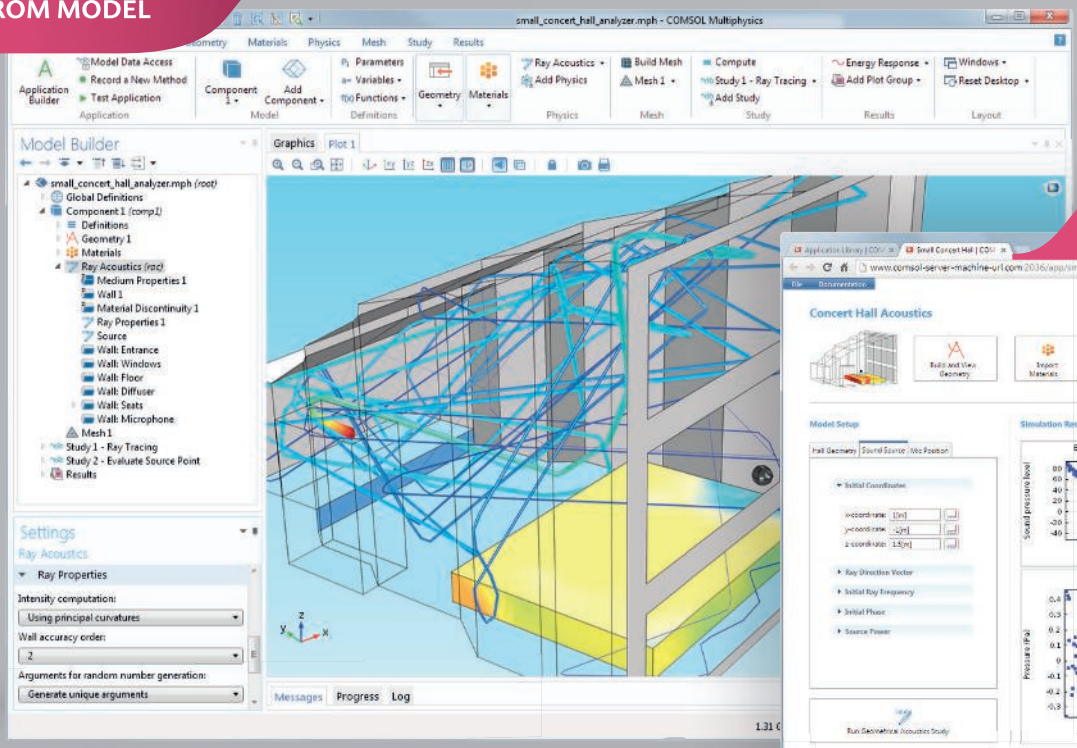

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NEWS

Sapphire case gets 3D experience

As part of its incubation program, the FashionLab - Dassault Systèmes' innovation laboratory dedicated to luxury - has renewed its collaboration with the designer François Quentin to introduce a 3D experience during BaselWorld 2015. This season, Quentin wanted to add a sapphire case to the design of the watch MTV 4N-01. The concept was to display the movement of this exceptional timepiece with transparency.

Quentin worked closely with the FashionLab to develop this new model, using Dassault Systèmes 3D design software. The aim was not only to manage the impact on visual effects, but also to calculate the impact generated on the shape of the case.

The project became live in two steps: the first was dedicated to the design of the new case in 3D, based on the new material (sapphire) and the impact on the overall shape of the case. The 3DEXPERIENCE platform on Cloud was used to imagine, design and build this new version of the watch. My Product Portfolio on Cloud technology enabled fast deployment and integrated 3D digital continuity to cover all stages of development of the watch.

The second step was to validate the effects of transparency, while maintaining a reliable rendering quality. For that, the FashionLab and the designer combined forces with the company's NVIDIA experts in visual computing, to adopt a high-performance tool dedicated to graphic quality and faster calculation time.

"It was a real technical challenge because a sapphire case requires hundreds of hours of processing. It was therefore essential to digitally validate the shape before starting manufacturing. In addition, 3D modelling of transparency is a real challenge because it brings calculation complexity", said Quentin.

Thierry Rouf, 3D Expert at the FashionLab by Dassault Systèmes explains: "The Visual Computing Appliance tool provided by NVIDIA is materialised by a 3D calculation server installed in our office near Paris. Through this physical calculation platform and the developments in our 3D CATIA design software, we will be able to remotely and dynamically view, in photorealistic quality, all components of this new watch."

£15m of metal casting at Brunel

The UK government has awarded £15million funding to Brunel University, London, to fund a second phase of the new Advanced Metal Casting Centre.

This next step will focus on processes and innovations that work in the laboratory but fail to achieve their potential on the factory floor. Funders agreed there is compelling evidence that the casting industry has neither been able to conduct high-level research and development by itself nor has it been previously supported by adequate academic research in UK universities.

The funding will complete the AMCC's range of factory-level metal casting / processing facilities and establish supporting research facilities for developing advanced metallic materials.

It will also underpin component performance testing and create a suite for process modelling and simulation.

Prof Zhongyun Fan, professor of metallurgy, and founder and director of BCAST at Brunel University, proposed speeding up industrial implementation by providing evidence of successful transition to the demands of factory-scale production.

Solution to last month's Coffee Time Challenge

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In the March issue we asked you to come up with ideas to improve the management of water on a building by building scale. Without increasing our carbon footprint (i.e. using any external energy source), we wanted something that would provide clean water that could be shifted around to where we wanted it – for example a water tank in the attic.

The solution is called Hydromentum and is provided by Water Powered Technologies. It describes itself as a 'zero energy rainwater recovery system'. Rainwater is collected from a roof and goes through Seradisc filtering before it flows into a lower level tank. The real innovation lies in these lower tanks, where the company's Papa zero energy pumps are located. These pumps use clever fluid dynamics in the water flow to pressurise (and intermittently depressurise) the water so that it can be lifted or moved to a location where it can be stored for future use.

So not only is water recycled and conserved without using any energy, but there is also a suggestion that if deployed on a reasonable scale it could reduce the severity of flooding.

For more information on Hydromentum go to: **www.waterpoweredtechnologies.com**

BEEAs entry now open!

The search for industry's finest is underway for another year as we have opened entry for the British Engineering Excellence Awards (BEEAs) 2015. These awards recognise the very best projects, individuals and companys in the UK engineering sector - those that can combine expertise, innovation, inspiration, practicality and plenty of hard work.

The categories for 2015 are:

- Consultancy of the Year
- Design Engineer of the Year
- Design Team of the Year
- Green Product of the Year
- Materials Application of the Year
- New Product of the Year (Electronics)
- New Product of the Year (Mechanical)
- Small Company of the Year
- Start Up of the Year
- Young Design Engineer of the Year

All details about the Awards, past winners and how to enter are on the website: **www.beeas.co.uk**

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NEWS

Record breaking 3D bike

Renishaw has been featured in the 2015 edition of Guinness World Records for manufacturing the world's first 3D printed titanium alloy bicycle frame. The project was completed in collaboration with British bike manufacturer Empire Cycles.

The original design for the 3D printed bike frame was supplied by Empire Cycles and Renishaw initially arranged to topologically optimise and manufacture the bike seat post bracket. When this proved successful, Renishaw agreed to embark on a project to additively manufacture the entire bike frame. The final result was a strong, functional bicycle frame that was 33 per cent lighter than the original.

"The metal 3D printed bike was a remarkable project that stirred the imagination and enthusiasm of our engineering team," explained Robin Weston, Marketing Manager of Renishaw's Additive Manufacturing Products Division.

TECH BRIEF

Configurable servos reduce build costs

Standalone and multi-axis servo drives from Parker Hannifin, meet the needs of material forming, textile, paper, converting and plastics machinery and food and packaging industries, said the company.

The Parker PSD series has been developed specifically to be compatible with all geographic areas and is claimed to be the most compact multi-axis servo drive available today.

The single cable DSL feedback system is claimed to provide lower cabling and installation cost. The encoder feedback between drive and motor is fully integrated into the motor power cable, and thus a separate feedback cable is not needed any longer.

The servo drives are available with different power rating and form factors. At present these are the PSD-S, a standalone version that can be connected directly to the mains supply; and PSD-M, a multi-axis system where each power module can supply up to three servo motors.

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NEWS

Aircraft motor is five times more powerful

Siemens researchers claim to have developed a record-setting power-to-weight ratio electric motor that weighs just 50kg and deliver more than five times the output of comparable drive systems.

The motor delivers a continuous output of about 260kW and has been specially designed for use in aircraft. The power-to-weight ratio means that larger aircraft with takeoff weights of up to 2 tonnes will now be able to use electric drives for the first time.

New simulation techniques and sophisticated lightweight construction enabled the drive system to achieve a unique weight-to-performance ratio of 5kW/kg, reports the company. The electric motors of comparable strength that are used in industrial applications deliver less than 1kW/kg. The performance of the drive systems used in electric vehicles is about 2kW/kg. The new motor performs at rotational speeds of just 2,500RPM to drive propellers directly, without the use of a transmission.

Bloodhound panels excel at ballistics

The design and build of the Bloodhound Supersonic car is in the final stages before heading to South Africa to challenge for the world land speed record.

Morgan Advanced Materials has conducted specialist ballistic testing on the panels it has provided to form part of the driver cockpit.

The lightweight composite armour panels are fitted to the carbon fibre 'monocoque' – a rigid cell in which driver Andy Green will sit. It is shaped to provide optimum aerodynamics and air intake.

Located at both port and starboard, panels will protect the driver from shale or debris from the ground or the solid aluminium wheels.

The Bloodhound Team validated the ballistic testing at Morgan's Coventry site. Testing consisted of a 20mm fragment simulating projectile, representative of the largest section of wheel that could potentially detach during the run. Aiming to withstand an energy rating of 22kJ – equivalent to a cricket ball travelling at 1,175mph – the projectile was to be fired at 980m/s (2,000mph); faster than required.

The panels contain millions of woven glass fibres. At the point of impact, the layers will begin to fray as they absorb the energy. As each fibre breaks, it takes energy away from the projectile, to stop it penetrating further, risking injury to the driver.

Conor La Grue of the Bloodhound team added: "As the panel has been designed with a slight, yet complex curvature, it has performed better than expected under this robust testing. It has exceeded the targets set, proving its performance at 29kJ energy rating, which is an important box ticked in the final stages of preparation. In the end, the projectile was fired at 2,300mph meaning we can go into trials and eventually the record attempt itself with the confidence that Andy will be safe from high-speed projectiles."

TECH BRIEF

3D scanner edits and redesigns

ZMorph's 3D toolhead when added to its 3D personal fabricator will replicate real objects as well as allow scanned objects to be edited and redesigned.

The 3D printer has removable and interchangeable toolheads that allow the user to print in a range of materials. The process of getting the dimensions of the object and moving them to the software is simple, fully automated and takes only seven minutes.

Users can replicate and edit the properties of the object, for example, change the size and the required material. As well as accurate 3D print quality, it also supports the user in the proper preparation of the model. The Voxelizer software identifies parts of the object, which may be susceptible to destruction after printing and automatically recommends strengthening the sensitive areas of design. Special algorithms mean that filters can be applied to modify the smoothness and thickness that is important in strengthening or speeding up of the printing process.

Events

MANUFACTURING & ENGINEERING NORTH EAST 2015
8-9 JULY, NEWCASTLE

NORTHEAST MANUFACTURING & ENGINEERING

FAST EXHIBITION
22 APRIL
SILVERSTONE
The FAST Exhibition is a valuable resource for design engineering professionals seeking fastening and bonding answers, inspiration, ideas and solutions. A visit provides face-to-face access to a portfolio of the UK's leading fastening and bonding experts, all of them experienced problem-solvers at the design stage.

ENGINEERING DESIGN SHOW
21 - 22 OCTOBER
COVENTRY
Now in its fourth year, this show caters specifically for design engineers, offering best practice learning and practical design ideas for visitors through comprehensive conference and workshop sessions. The Engineering Design Show will once again be co-locating with the Electronics Design Show and Embedded Design Shows.

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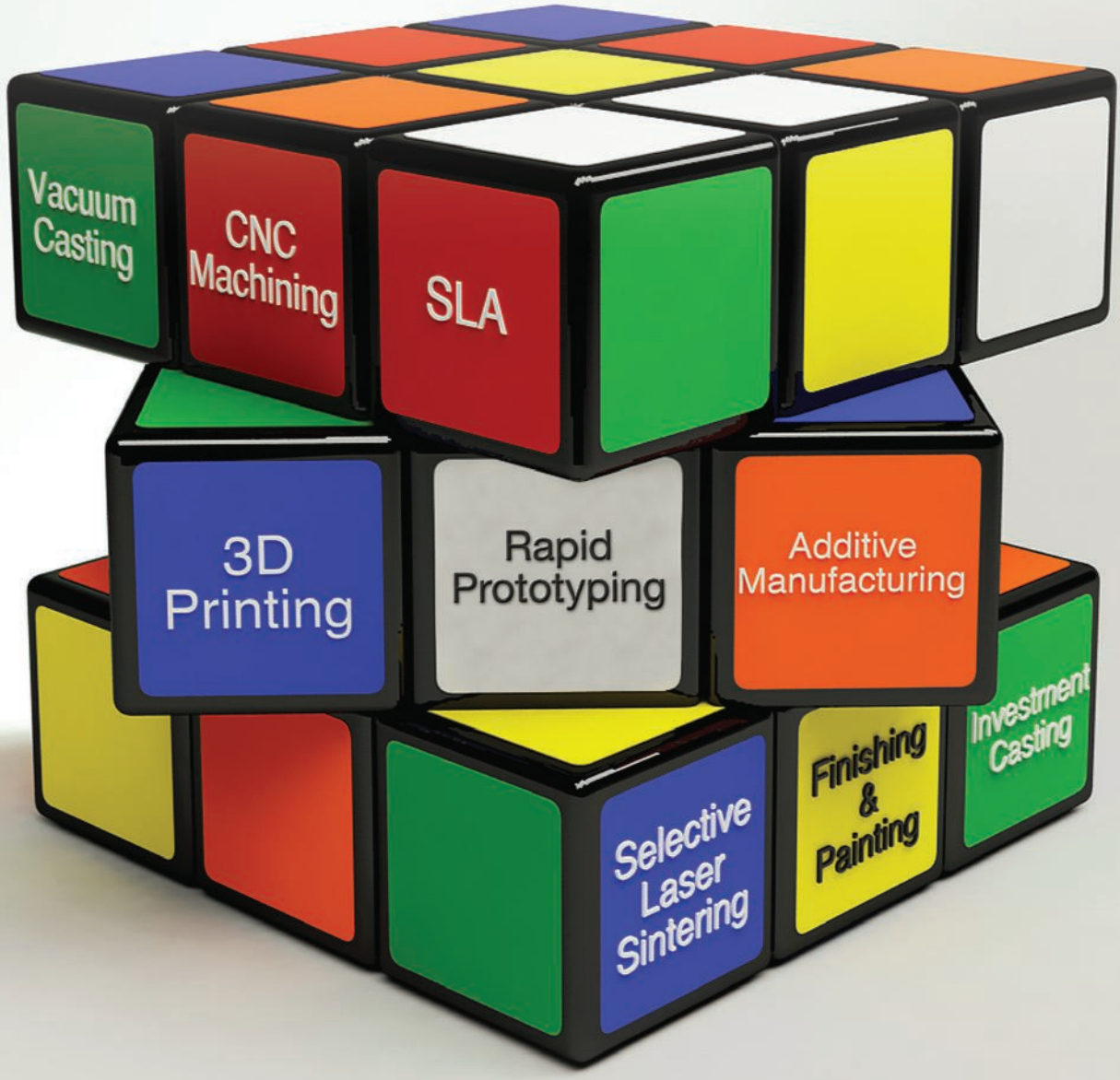

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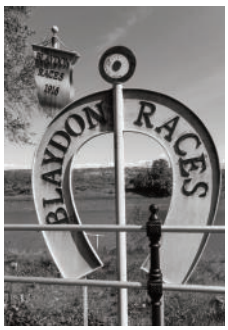
Technology built on industry

In the build up to the launch of the Manufacturing & Engineering North East event in July 2015, we asked John Pullin to look at how the past has influenced the present to make this such a vibrant region for the technology sector.



The Scotswood Road, heading westwards along the north bank of the Tyne from Newcastle city centre and immortalised in the Geordie anthem Blaydon Races, used to contain in its 600-plus addresses more than 40 public houses. The pubs were testament to legendary Tyneside thirst, and the names of some – the Forge Hammer, the Blast Furnace, the Hydraulic Crane – testified to the industries that generated that thirst.

The past economy of the North East of England was built on heavy industries – coal, iron, ships, big electrical machinery and engines, armaments. Today's industries in the region reflect different economic times in which many older core industries have moved to lower cost parts of the world or simply melted away.

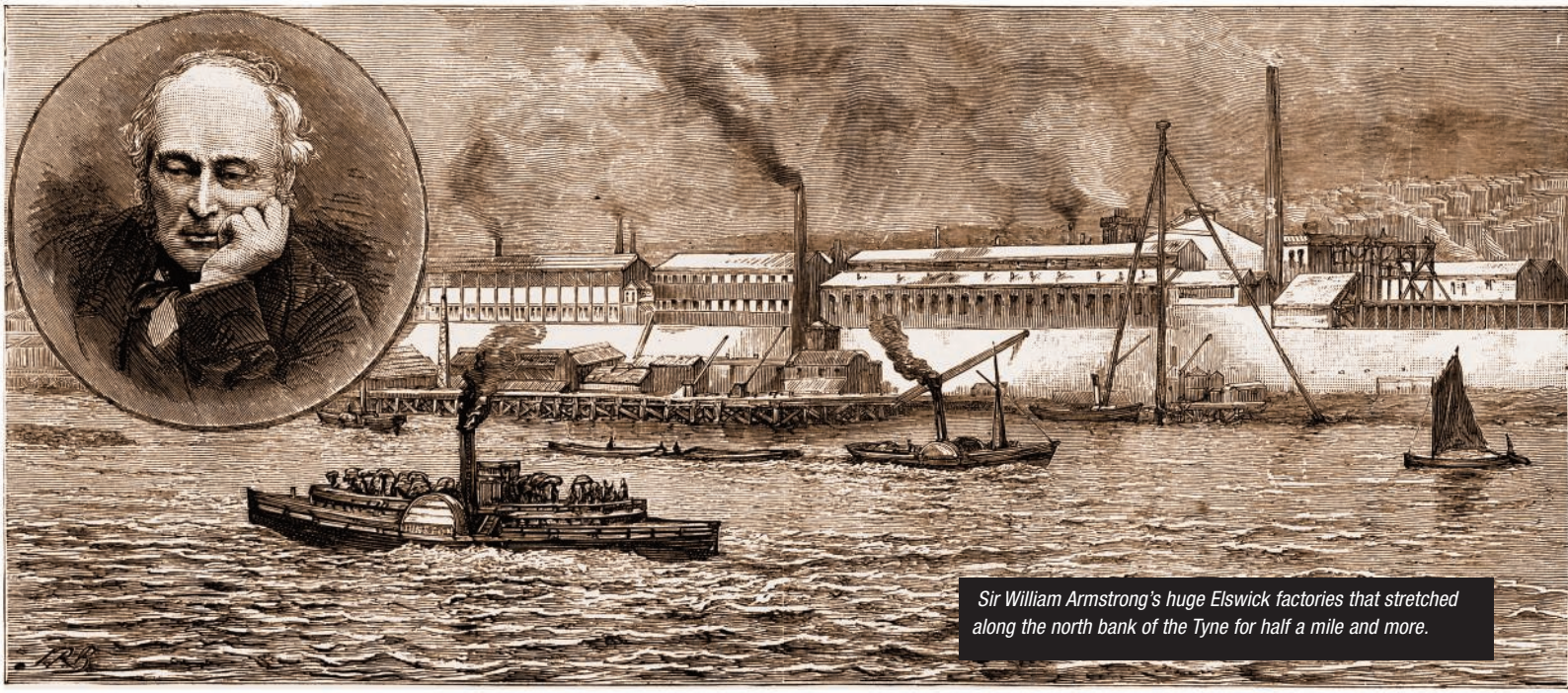
Yet links to the heavy engineering that made the region world-famous are still strong, and behind international names that now populate the regional economy are often lines of continuity stretching back to engineering pioneers and a common inheritance of engineering skills and of 'getting things done'.

In fact, there is a neat congruence to some recent industrial developments in the North East. The region that spawned the original railways in the early 19th century is now to host the UK's brand-new 21st century train plant which Hitachi is building at Newton Aycliffe. The area that provided maritime power to generations of merchant and naval ships is now at the forefront of a different kind of marine power: the drive towards offshore renewables such as wind, tide and wave power as a significant component of the UK energy mix.

Within new industries, there are parallels with the past. Districts that had some of the most productive and intensive coal mining are now home to Nissan's Sunderland plant, which has consistently been the most efficient carmaking plant in Europe for a decade and more.

Nissan executives have always been open about the factors that not

(L-R) London's Tower Bridge uses Armstrong's technology; in 1936 the men of Jarrow marched for jobs; and todays trains will soon be made again in the North East, building on the legacy of George Stephenson and his Rocket. Photographs: Alamy and Martin Cherry.



Sir William Armstrong's huge Elswick factories that stretched along the north bank of the Tyne for half a mile and more.

only informed the original choice of the North East as the destination for the European manufacturing plant in the 1980s, but then helped it to achieve world-class standards and to lead the group to put more and more new models into the site. They talk of good logistics and access to air, road and, especially, deep water port facilities – essential for a factory seen from the outset as supplying the whole of Europe.

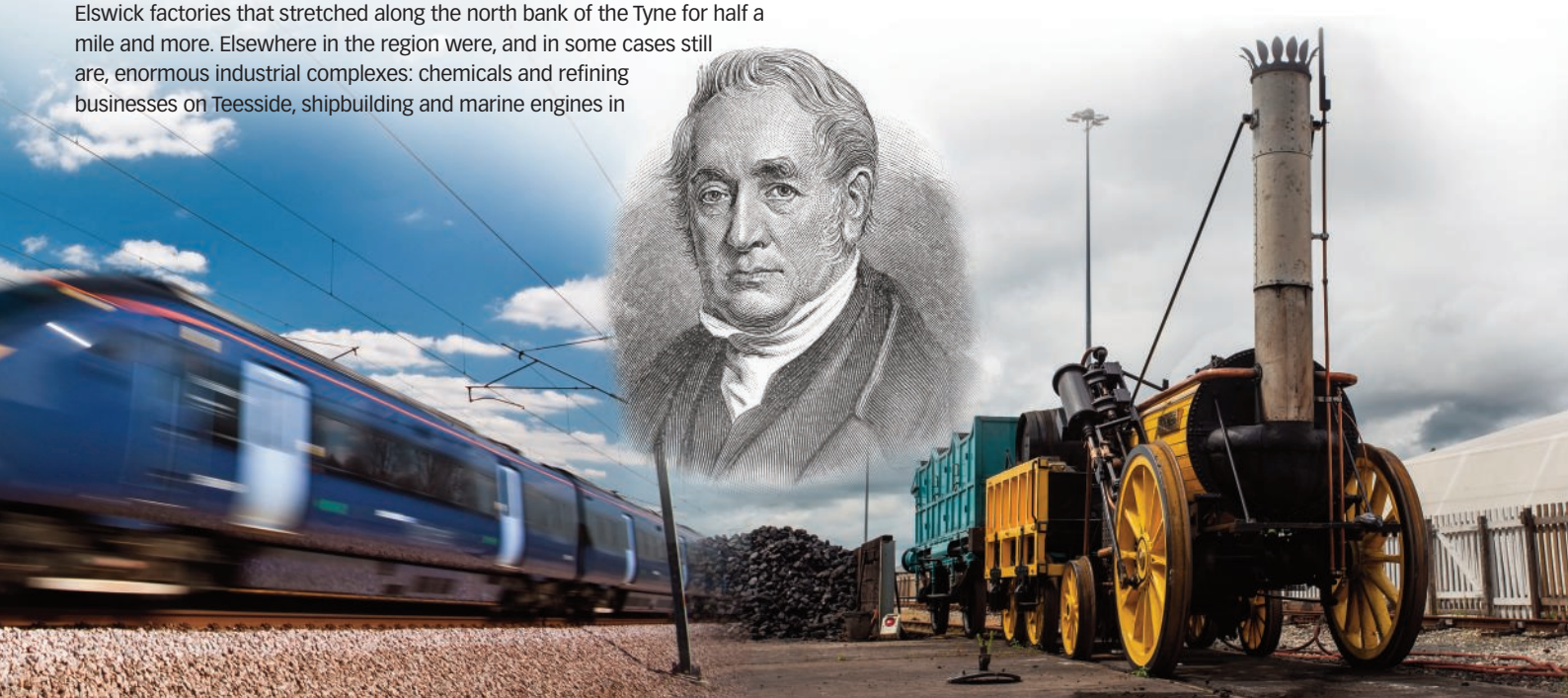
But they also talk about workforce attitude. "We were actually continually winning new models, and a lot of that was down to the 'can-do' attitude of the people," said John Cushnaghan, former managing director of the plant. Japanese executives speak warmly about their delight at how quickly the plant went from drawing-board to production and at quality levels achieved ever since.

They should not have been surprised, for there are common threads that unite the industries of the past and the present in the North East. One of those threads is sheer scale. The North East has always been a place for big companies and big factories. The Scotswood Road pub names all relate to the technologies used in Sir William Armstrong's huge Elswick factories that stretched along the north bank of the Tyne for half a mile and more. Elsewhere in the region were, and in some cases still are, enormous industrial complexes: chemicals and refining businesses on Teesside, shipbuilding and marine engines in Sunderland, iron and steel, mining in both pits and open-cast.

Historically, there was often a down-side to the scale of companies and plants in the North East: when economics change and formerly lucrative industries decline, the region suffers badly.

The Jarrow march of the unemployed to London in 1936 in the Great Depression symbolises the effects of mass job losses as basic industries contract or move away.

More recently, shipbuilding seemed just to melt away from the shipyards of first the Tees, then the Wear and finally the Tyne – replaced for a while by other large-scale fabrication work for industries such as North Sea oil. Coal mining now appears to be going the same way. Big industries leave big holes if they disappear. But they leave behind a legacy of infrastructure, from transport links to employment history, that is geared to the needs of the big-name global groups and attractive to them. Siemens is one of the global groups that is putting a lot into industrial training in the region.



A second related thread is that the North East as a region has long been a powerhouse for the economic development of the UK as a whole – and further afield. This goes back many years. In Tudor times, one reason why London was able to develop as a pre-eminent urban and commercial centre was that its citizens didn't need to go out gathering wood or digging peat for fuel, as they had a regular supply of sea-coal from Northumberland and Durham, brought down the coast in barely-seaworthy tub boats.

There are monuments to North East engineering and ingenuity across the globe. Sydney's Harbour Bridge is built of steel from Teesside. London's equally iconic Tower Bridge works because, when the locals couldn't fathom how to do it, they called in Tyneside entrepreneur William Armstrong, who had an answer for most things.

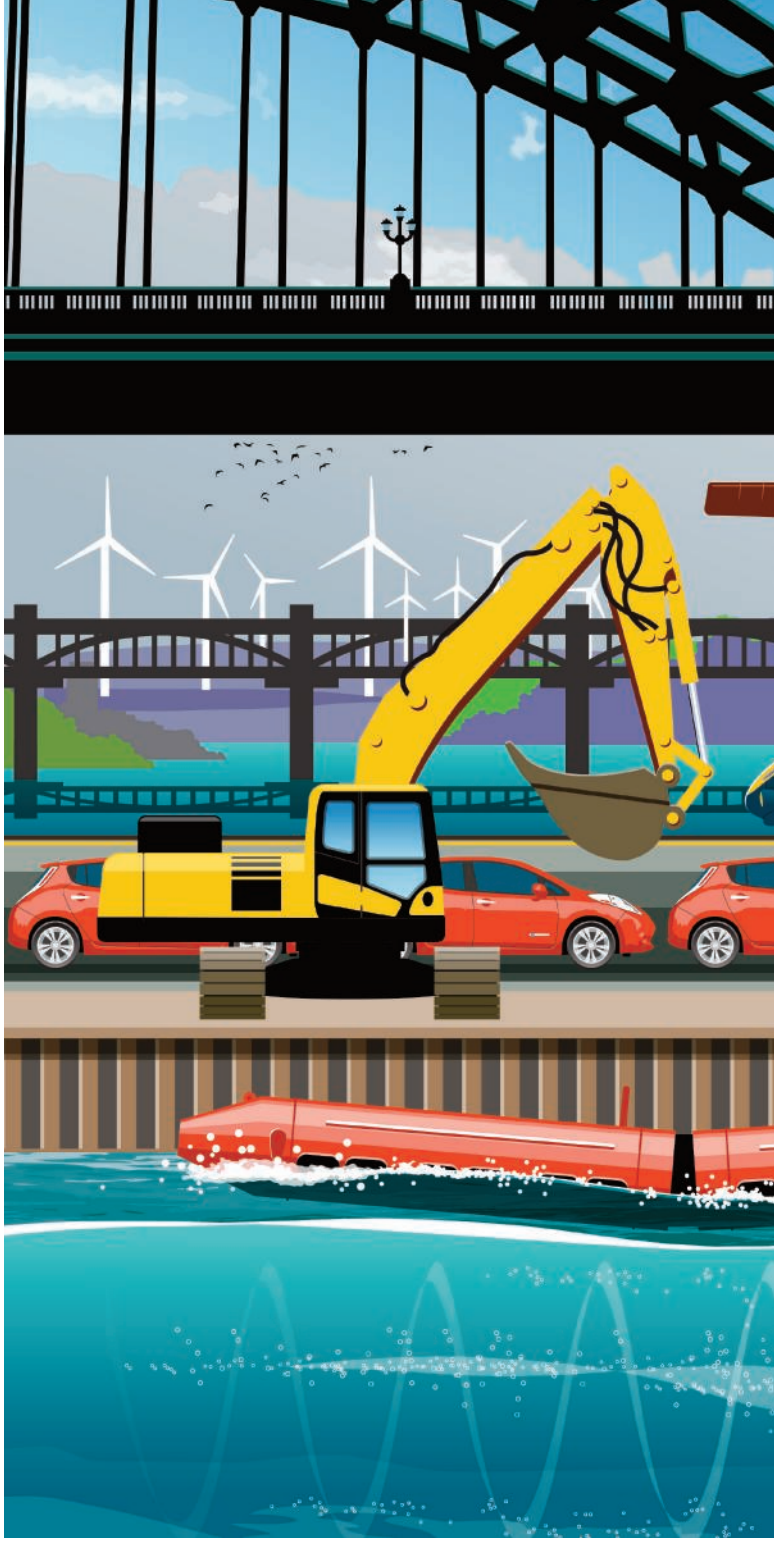
Today's industries are also very much geared to export. A region based on three relatively short river estuaries with easy access to the sea and not much hinterland to the north, south and west perhaps had no choice but to look outwards. But what started with exports of raw materials such as coal and iron is now universal: Nissan has been the UK's biggest automotive exporter for many years.

A third thread that unites past and present is innovation. The North East in the 19th century was the innovation incubator for empire and beyond. Wylam, a Tyne valley mining village, had at the start of the century an extraordinary collection of engineering talent: George Stephenson, Hedley, Hackworth and others worked in its mines. Their collective genius was less in terms of specific inventions – arguably, Stephenson's only true invention was the miner's safety lamp, and for that he was accused of having pinched the idea from the better connected Humphry Davy.

Rather, Wylam engineers were innovators in three crucial aspects. First, led by Stephenson, they brought together ideas from different inventions to do new things: steam-hauled railways, for example, combined ideas from 18th century inventors such as James Watt with age-old mining practice. Second, they were very much in the business of improving and reworking existing devices: it was Rocket's reliability and superior performance that won the Rainhill trials between Liverpool and Manchester in 1830, aided by five years' experience of running services on the Stockton & Darlington Railway.

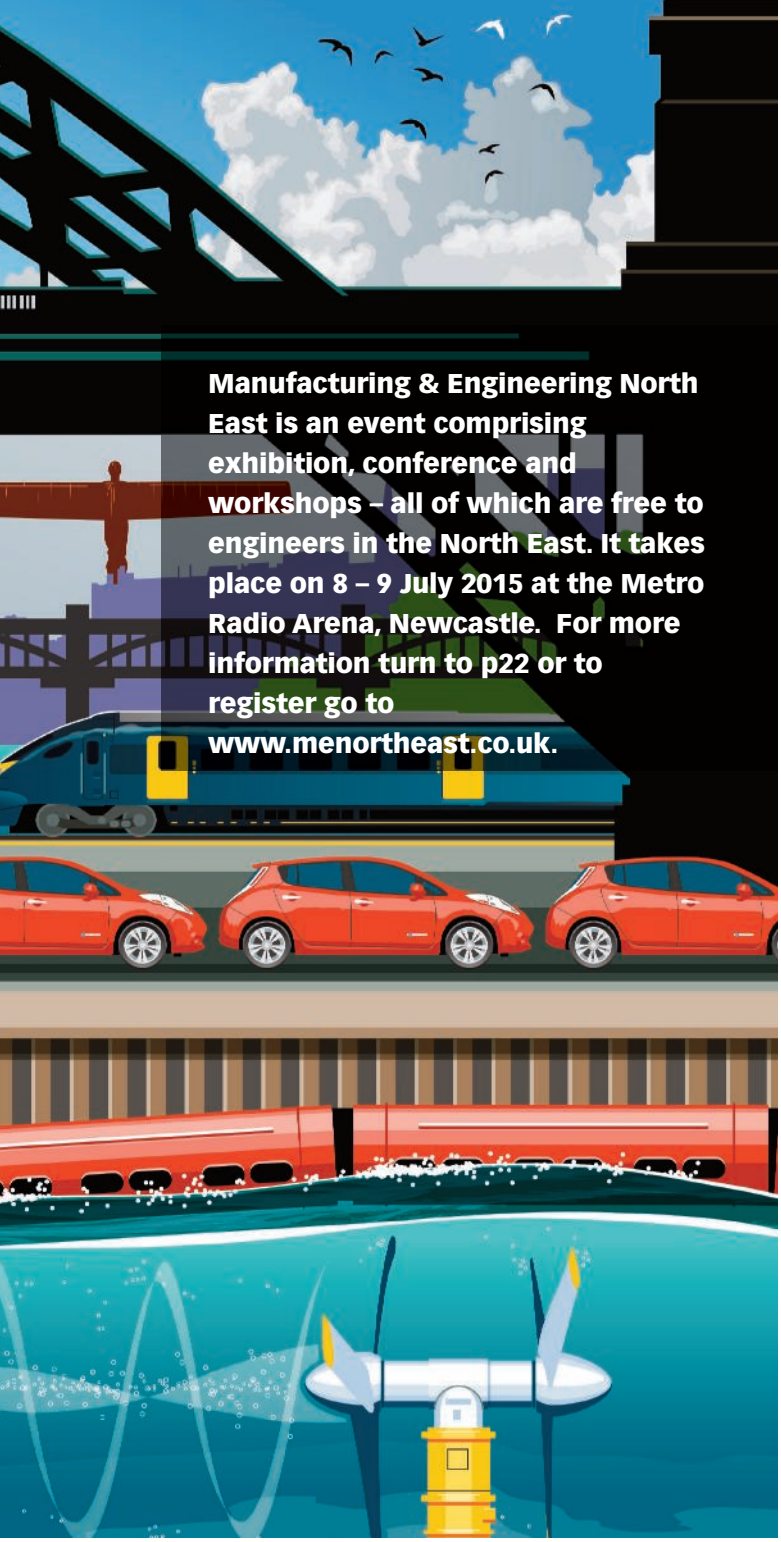
The third aspect which these North East engineers pioneered in heavy engineering and machine building was the concept of standardisation and repeatability. The railway track gauge that has gone around the world, 4 ft 8½ in, is Stephenson's; the locomotive works he established with his son in Newcastle was perhaps the first outside the textile industry to apply the "factory system" of precision, tolerances and common componentry. Hitachi's trains from its new North East plant will be very different, but they're not such a distant relation.

The North East's reputation for engineering innovation does not just rest on this one group of engineers of the distant past. Other industries and industrial empires were built by later 19th century engineers. Armstrong was an inventor and innovator in his own right with the development of hydraulic power and a serial entrepreneur in partnership with others in businesses that ran the full range of heavy engineering, from ships and their engines through to armaments. On the way, he was also the backer of Joseph Wilson Swan, inventor of the incandescent light bulb, and Armstrong's Tudorbethan mansion Cragside, at Rothbury in Northumberland, was the first to use hydroelectric power for lighting, with Swan's lamps.



Direct lines of continuity to today's engineering business can be found too in the work of Charles Parsons, the Irish aristocrat who invented the steam turbine. Like Armstrong, Parsons worked through a network of partnership companies, and he was influential in wider infrastructure terms, in that the first power generation application for his turbo generator technology was at the Newcastle and District Electric Lighting Co, which he had set up himself to demonstrate his own ideas for wide-scale power generation.

Parsons' original works in Newcastle celebrated its 125th anniversary last year and is still in the same general line of business, manufacturing and servicing gas turbines for power industry customers. The name,



though, is now Siemens and that global group also includes some of Parsons' North East partner companies of more than a century ago: the Hebburn switchgear and instrumentation plant of Reyrolle is still a Siemens operation, and Parsons' original Tyneside employer, Clarke Chapman, has merged into the same group along the way.

But if that suggests continuity, then there is also significant innovation in the business profile of the region too. Much of Siemens' work in the North East these days is to do with the renewable energy business and the region as a whole has reacted to the reduction of coal industry with a series of diversifications into other energy businesses.

For a period in the 1970s and 1980s, former shipyard and heavy engineering skills seemed likely to be tidily redeployed in the growing industry supplying structures into the then-new North Sea oil and gas industry. In the event, other places became the UK's oil capital and changing rig technology was more suited to other sites rather than the North East's riverside yards. But there remains a significant equipment supply and maintenance business in the region for the industry.

Renewable energies are now proving a potentially rich sector, and not just for big businesses such as Siemens. Blyth, a former coal port serving the mining area to the north of Newcastle, has become the UK's centre for testing the giant hardware required for the offshore wind turbines due to be installed far out to sea in the current round of licences, and for wave and tidal power devices too.

The development at Blyth, the National Renewable Energy Centre, is now part of the UK's new industrial/academic research landscape and is overseen by the Offshore Renewable Energy Catapult. It's a subtle change, but an important one in terms of North East industry: the vast 'sheds' in which the structures are tested look like modern equivalents of the old shipyards and heavy engineering plants. But their role is research; thinking as much as doing; brain, not brawn.

And that's true in other places in the North East. On Teesside, for example, an offshoot of petrochemicals and fertilisers businesses is the Centre for Process Innovation, which heads the biotechnology, industrial biology and flexible electronics segments in the national High Value Manufacturing Catapult.

North East universities are in on the act too: Northumbria continues the renewables theme and is known for expertise in solar energy, with the ironic twist that if it can make solar power work in Newcastle, then there's more potential for it than some people credit. Newcastle University is taking over the site of the former Scottish & Newcastle Brewery, original home to Newcastle Brown Ale, for a £50 million development it is calling "Science City" that aims to conduct a wide range of 'real-life testing' of the way technology-based systems work in practice: integrating human experience into intelligent vehicles, for instance, and making them fit into working cities.

The industrial heritage of the North East is of a region that gets things done: giants of engineering innovation, huge industries and enormous factories, a reach that extends out across the globe. The current industries of the region build on that heritage where they can, but increasingly there is a new dimension to them as well. They are about thinking, researching, designing and developing as well as doing.

If one plant can be said to embody both the heritage and the modern future of North East industry, it would probably, perversely, be the plant that operates in the industry that the old North East missed out on entirely, the automotive sector.

Nissan's carmaking plant has many of the attributes of the factories of the Stephensons, Armstrongs and Parsons of yesteryear: it's big – much bigger than Nissan probably ever thought it would be – it has national and international significance, it uses the region's helpful geography and infrastructure and it has partner companies surrounding it. But Nissan's success in the North East has also been based on the newer virtues of productivity, flexibility, research, design and technology. Maybe these things don't get pubs named after them. But the world has changed and so has the region.

Meet the maker

Changing the way people perceive engineering and getting more out of engineers is all in a day's work if you're a leading light of the maker movement. Justin Cunningham finds out what all the fuss is about and the hype behind its growing cult following.

One of the things with engineering, and engineers generally, is that we can have a tendency to approach all problems as technical. Whether it is getting the next generation involved in STEM or adding value in the supply chain, a logical approach usually sees us through.

But this can be intimidating and even off putting to those people outside technical industries. So, when a charismatic and enthusiastic individual stands up to get the message out that, actually, engineering is a creative industry, it is perhaps not surprising how quickly people change their mind.

"Educational institutions are designed such that failure is not an option," said Mark Hatch, CEO and Co-Founder of TechShop, a chain of member-based workshops that lets people of all skill levels use industrial tools and equipment. "You only get an 'A' on a test for getting the answer correct, not for great insight in to the problem, or for trying different solutions. But when you are creating something, you know the first and second renditions probably won't work. You know you have to spend time developing, and getting it wrong. But that isn't how you get trained at school."

Hatch is at the forefront of what has become known as the 'Maker Movement', and has managed to commercialise the cult trend throughout the USA. He now hopes to spread the concept further afield with possible sites being mentioned in Birmingham and London.

There are many facets to Techshop that should interest the engineer. While the US Techshops are filled with artists and academics, tinkerers and entrepreneurs, they are helping inspire young people to 'do engineering' as Hatch describes it.

And it is not surprising that this practical hands-on approach is at the centre of what is on offer. Interestingly though, it is also laced with the need to understand physics and maths, and their practical application. This goes down a lot better with the younger audience who can suddenly see a point to all those equations. And if that wasn't enough to get young people interested in STEM, failure at Techshop is encouraged!

"What's fascinating is that the cost of failure has come down, in fact it's so low I no longer talk about it as failure, I call it cheap learning," he said. "And that is inspiring people to be more creative and that's so important."

But aside from inspiring many more to take up engineering – from all ages and backgrounds – Techshop has proved hugely successful with professional engineers. When Techshop partnered with the Ford Motor Company in Detroit the results amazed everyone.

"We built a location in Detroit to try and help spur a cultural change inside of Ford," explained Hatch. "It was part of a process to help drive innovation and increase the number of patents coming out of their employee base. The results blew our minds. We've seen a 100% increase in high quality patents as a direct result.

"Those creative people can now produce the answers and ideas they have in their heads and rapidly assemble them. They have access to all the tools they need to prototype much more effectively. It is so much better than a PowerPoint presentation that they used to have to give for some development money. They're now able to get moving much more quickly."

As you would expect of a high class US facility, the Techshop's themselves are big, modern and very well run. They are in the region of 20,000 sq ft and as Hatch enthusiastically put it: "It has every tool you need to make anything on the planet, from machine tools to wood working tools to plastic tools to electronics to textiles."

"We built a location to spur a cultural change inside of Ford... We've seen a 100% increase in patents as a result."

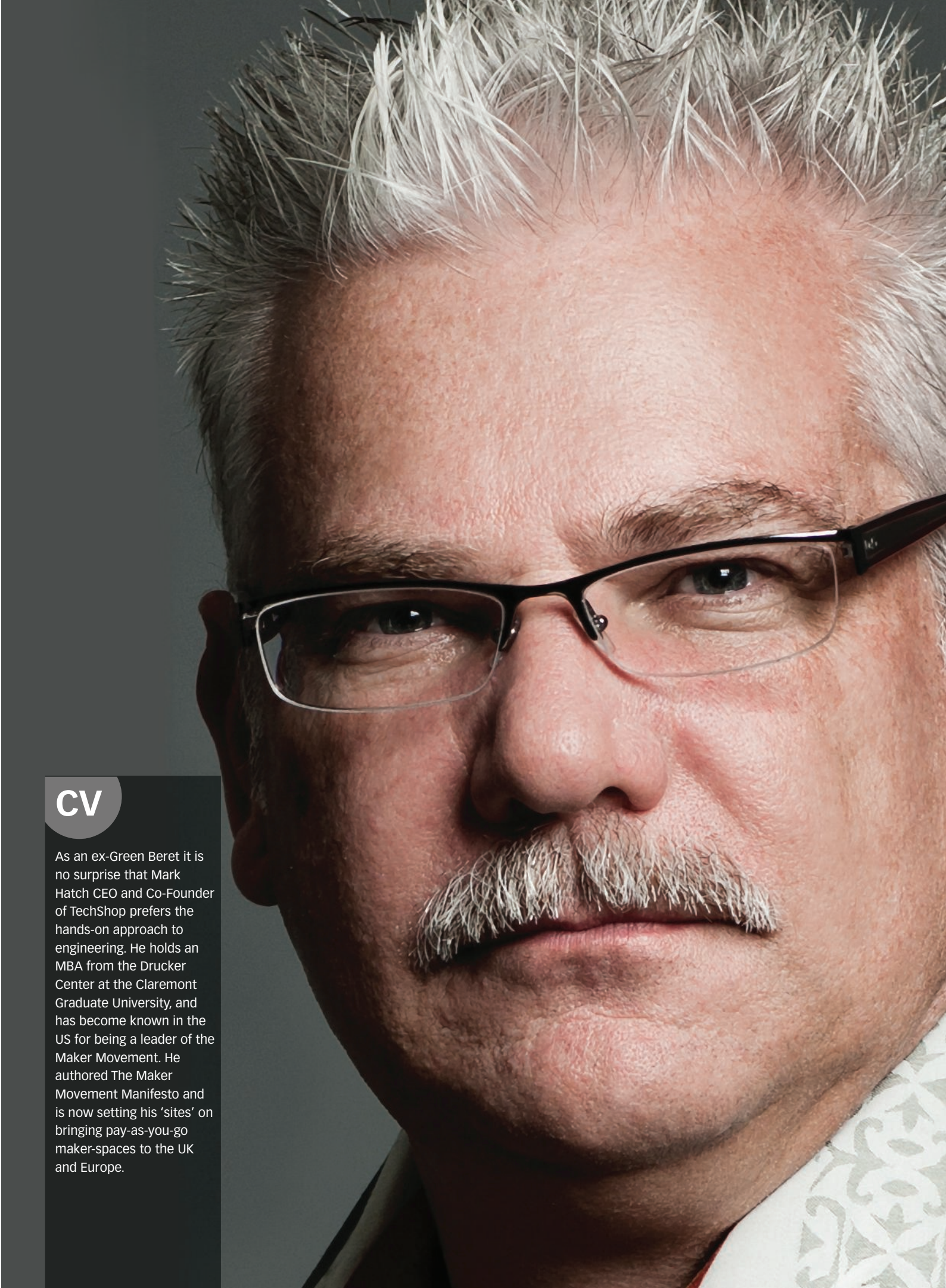
Members are charged a monthly fee of $125 a month, the same as 'a really bad coffee addiction'. And while many just like to play with the tools and make things, there have been countless successful Kickstarter campaigns that have been spun out, some of which have multi-million dollar turnovers. The maker movement is grassroots innovation.

"We are targeting the creating class," he said. "Our objective is to shift just a little bit of their disposable income to pursue creative activities in our facilities. And if we can get a small percentage of that and move it into creative pursuits then all that innovation pays for itself, because it is adding value to the economy with all these little businesses.

"People come in and take classes on electronics or laser cutters, and they start making things that you've never even thought of. In 90 days people are producing beautifully crafted products. It's amazing!"

One of the most prized aspects of Techshop, and the maker movement generally, is the variety of people and backgrounds that get involved. This has created a community and that is where Hatch really places value in what he does. It has become a place for engineers to get fresh perspectives as they talk to artists, tinkerers and entrepreneurs.

"It is not about the tools, it is about the people who show up to use them," he said. "We've had people build everything from downhill soapbox racers to a Lunar Lander! And they all share knowledge, ideas, inspiration and creativity in a way that really works."



CV

As an ex-Green Beret it is no surprise that Mark Hatch CEO and Co-Founder of TechShop prefers the hands-on approach to engineering. He holds an MBA from the Drucker Center at the Claremont Graduate University, and has become known in the US for being a leader of the Maker Movement. He authored The Maker Movement Manifesto and is now setting his 'sites' on bringing pay-as-you-go maker-spaces to the UK and Europe.

MANUFACTURING & ENGINEERING NORTH EAST

8 – 9 July 2015
Metro Radio Arena
Newcastle

Engineered for the

A fantastic new event – the *Manufacturing & Engineering North East* exhibition and conference – has been put together especially to meet the needs of the North East region.

CONFERENCE **HIGHLIGHTS**

Each keynote session provides case studies and insights from leading industry experts.

Programme highlights include:

- **Innovate UK** – hear how your company can gain funding and support as part of Innovate UK's remit to champion the development of British industrial innovation
- **IP Protection** – Newcastle IP company McDaniel & Co will provide engineers clear advice on how to protect their designs
- **Renewable Energy** – learn how to get your business designing and supplying to the renewable sector with the Offshore Renewable Energy Catapult
- **Creative Design** – IHC describes the key principles it uses to deliver award winning engineering designs
- **AMRC and the Boeing Training Centre** – the Advanced Manufacturing Research Catapult will outline the development of the employer-led training programme and explain the benefits it presents to other manufacturers
- **Ebac** – this Durham-based white goods manufacturer will provide insight into the design process
- **Pepsico** – an inspiring case study in manufacturing excellence from the Peterlee factory
- **EEF** – the manufacturer's association – will provide a master class on how to attract and retain world class employees
- **Automotive** – Nissan has reinvigorated the North East automotive sector and has enjoyed huge success. The North East Automotive Alliance explains the opportunities and growth potential for the region's manufacturers
- **Rail Alliance** – discover how your business can become part of the emerging supply chain and take advantage of the billions being invested in the North East rail sector

It's free to attend, but conference spaces are limited, so don't miss out!
Visit www.menortheast.co.uk to reserve your place.

More than 10,000 SME manufacturing and design sites operate within 100 miles of Newcastle and, with inward investment from larger manufacturers such as Nissan in Sunderland and now Hitachi in County Durham, the region's heartbeat is stronger than ever.

Manufacturing and Engineering North East will showcase the North East's strengths and provide a platform for local and national manufacturers, engineers and their suppliers to meet, learn, solve problems and do business.

All such companies have the same pressures as manufacturers and engineers across the nation – too much to do in too little time. At the same time, there is always the reality of having to keep ahead of the game. Keeping abreast with technology, business practices, new opportunities – this all takes time.

The event will comprise four key elements covering the full range of design, production and manufacturing all targeted to the needs of its visitors:

- Keynote conferences from market leading engineering and manufacturing businesses.
- Practical, hands-on workshops sessions.
- An exhibition providing access to market-leading suppliers.
- And, most importantly, it will be entirely FREE to attend for manufacturers and engineers within the region.

Manufacturing & Engineering North East conference and exhibition is an event fashioned on a national blueprint and tailored to the region's needs. Accepting that engineers do not have hours to spare travelling from North to South, MENE is an event on the doorstep of those involved in design, engineering and manufacturing in the North East.

And far from being a scaled down version of a national event, more than 100 market leading suppliers will fill MENE's sold out exhibition hall (at the largest venue in the region) with conferences and workshops of direct – and in many cases unique – relevance to the region.

Ed Tranter, Exhibition Director, commented: "We are tremendously excited about this event. Since we first started talking to agencies and organisations in the region, it has been clear that engineering is a way of life here – people take massive pride in being part of the sector. That pride has translated itself to enthusiasm for this event from all its participants – exhibitors, visitors, conference presenters and the organising team. We can't wait to open our doors to this thriving community in July."

Visit www.menortheast.co.uk and register now.

North East

Five reasons **you need to be there**

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2. Improve your knowledge at the 20 practical workshops
3. Get hands on with the latest technology from 100+ market leading suppliers
4. Live demonstrations – powered up equipment in action
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Date: 8 – 9 July
Opening Hours:
8th July: 10.00 – 17.00 (conference starts at 09.15)
9th July : 10.00 – 16.00 (conference starts at 09.15)
Venue: Metro Radio Arena, Newcastle
Getting there: As well as being in the centre of Newcastle, and therefore well served by public transport, the Metro Radio Arena is just three minutes drive from the A1.

Practical hands-on **workshops**

Across the two days of the event there will be 20 workshop sessions, each designed to drill deeper into certain technologies so that the engineer can get practical advice or information about new services, functions or technologies.

Workshop topics (with presenting companies) include:

- Industrial automation solutions (**Fanuc**)
- Engineering thermoplastic polymers (**KD Feddersen**)
- Bearings for automotive, aerospace and industrial uses (**Schaeffler**)
- 3D Printing software and services (**Materialise**)
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- Funding solutions to help businesses secure assets (**Lombard**)
- Improve machining processes with CNC Machine Tool Simulation (**CG Tech**)

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With more than 100 market leading suppliers filling the hall to capacity, the exhibition provides a 'must attend' platform for engineers or manufacturers looking to improve and grow their businesses.

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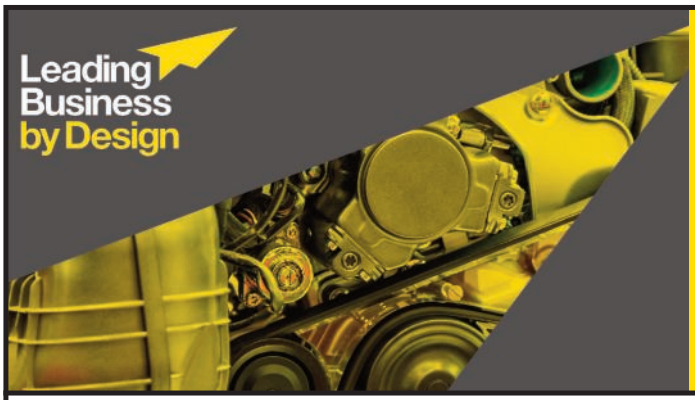

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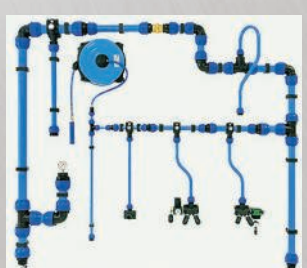

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Working on **the idea**

Possibly the standout announcement at this year's SolidWorks World, was the introduction of Industrial Design. Tim Fryer outlines what it does.

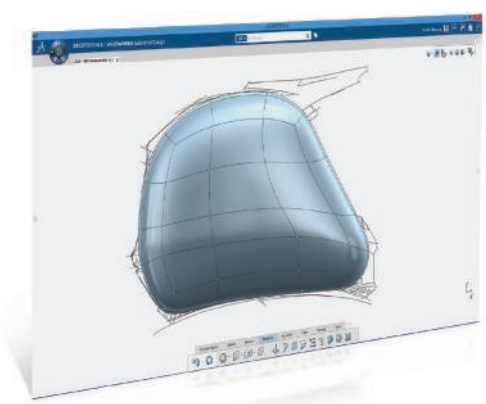
SolidWorks Industrial Design is the second package to be launched in the company's 3DExperience platform, following the introduction last year of Conceptual Design, which was called Mechanical Conceptual at its time of launch.

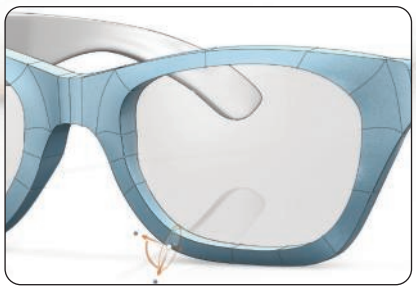
The intention behind these tools is to be able to take a design idea and then be able to immediately make a running start on the design. Currently the quickest and easiest way to make someone else understand an idea is to use pen and paper. But designs can evolve rapidly and in different directions, particularly when more resource, both in terms of time and people, is added. So how do you manage that, quickly and efficiently, based on an initial scribble?

Neil Cooke, SolidWorks' director of Portfolio Introduction, described the priorities of the industrial engineer: "The thing to focus on is to sell or promote an idea, whether that is internally inside your own company or externally to a customer. Is the idea going to work? Can we win the business? And how do we rapidly create the best idea? So we need tools that allow you to capture those ideas, create new designs in a very quick and easy way that you can then iterate as much as you want."

In the industrial design environment there is never enough time and being able to respond to a customer within days, or even hours, can make the difference between winning or losing some business. "You want to make sure that you can react and create these new designs as quickly as possible," said Cooke. "Tools that are out there today can be disconnected. There's lots of individual, different tools for different parts of the industrial design process, and some of those tools make you work by different rules. Rules imposed by the CAD software. So you may find it's going to take a long time to create something because of those rules, which is why we want to remove them."

Industrial Design is intended to remove these constraints and provide a connected collaborative working environment and as such is complementary to other SolidWorks design tools. There are four main areas that encompass the capabilities of the new software: Concept sketching in order to capture an idea as quickly as possible; Freeform design to create quite complex forms; Parametric modelling as that leads into the mechanical design; and Rendering to help present the design idea in its best light.





"All of this is working within a single collaboration, what we call 'single modelling' environment, where it doesn't matter what toolset you want to use to get that product created, just use it, and design in a way that you want," said Cooke.

The software provides social design capabilities and transparent data management that allows engineers and designers to quickly solve industrial design challenges and easily make the transition to mechanical design. Secure and intelligent data storage on the cloud can be accessed anytime from anywhere to share designs, collaborate on ideas, save and evaluate multiple concepts.

The interactive element extends to having an optional on-screen panel to display communications about the design – comments, ideas or endorsements – that could be used for real-time feedback about an emerging design idea.

It is of course intended to be quick and intuitive, using simple features like the ALT key to produce curves and SHIFT for straight lines. Cooke said: "You can do things like change the colour of the sketch from a set of custom colours that I want to work with. This is basically a nice sketching environment we've tried to create. We've even added familiar shortcuts for people. PhotoShop users, for example, will be able to use brackets to thicken or reduce the brush size. We're trying to look at what people are doing today and how we can incorporate that into a 3D environment."

Cooke believes the tools within Industrial Design allow a different way of thinking. He added: "A customer told us 'when I come to do a design I have to think about how I can design it in the product. I have to think about the structure of that assembly, and if I need several components, how many parts do I need to work with? And where do I start? Do I start on the assembly or do I start on the single path?' However, with this, the customer said 'It was great, I don't have to think about that, I just can start designing stuff and I can think about that other stuff later when I've got to a design that I care about', because the last thing you want to do is waste all the time on a product that you don't care about, one you don't want to go forward with."

One early adopter was Parrot, a developer of advanced wireless products, who used the Industrial Design application to successfully design complex 3D shapes for a future line of drones. Henri Seydoux, founder and CEO of Parrot, said: "SolidWorks Industrial Design enabled us to develop an innovative idea in record time without being derailed by challenges inherent to traditional design software."

Enhanced surfacing features allowed Parrot's engineers and designers to create complex 3D shapes that were not possible before, and the transition to mechanical design. The application's social collaboration capabilities also enabled Parrot's teams in France and China to seamlessly work together throughout the process to generate organic shapes in reduced time.

www.solidworks.com

TECH BRIEF

Building simulation

Comsol's latest version of its simulation software Multiphysics 5.0, includes the 'Application Builder'. This, claims the company, is 'a revolutionary product within the industry that will open up the power of Multiphysics simulation to a much larger audience'.

Application Builder expands the use of simulation to a much wider audience. It allows simulation experts to create an application from their Comsol model and using the Comsol Server, share this App with their colleagues or customers. The App can contain only the relevant inputs and outputs needed for a specific study allowing someone with little to no simulation experience to easily modify the information and still get the full benefits of the simulation.

The process for building an application starts with a simple command: 'Save Model as Application'. From here, the Application Builder goes through the different steps for building an application, from choosing the parameters that are to be made available for manipulation in the application's user interface to the post-processing and presentation of results most relevant to the application user. Modelling power that has traditionally been geared towards the engineering analyst or expert can now be employed by all members of the organisation.

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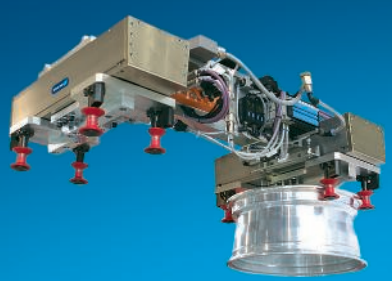

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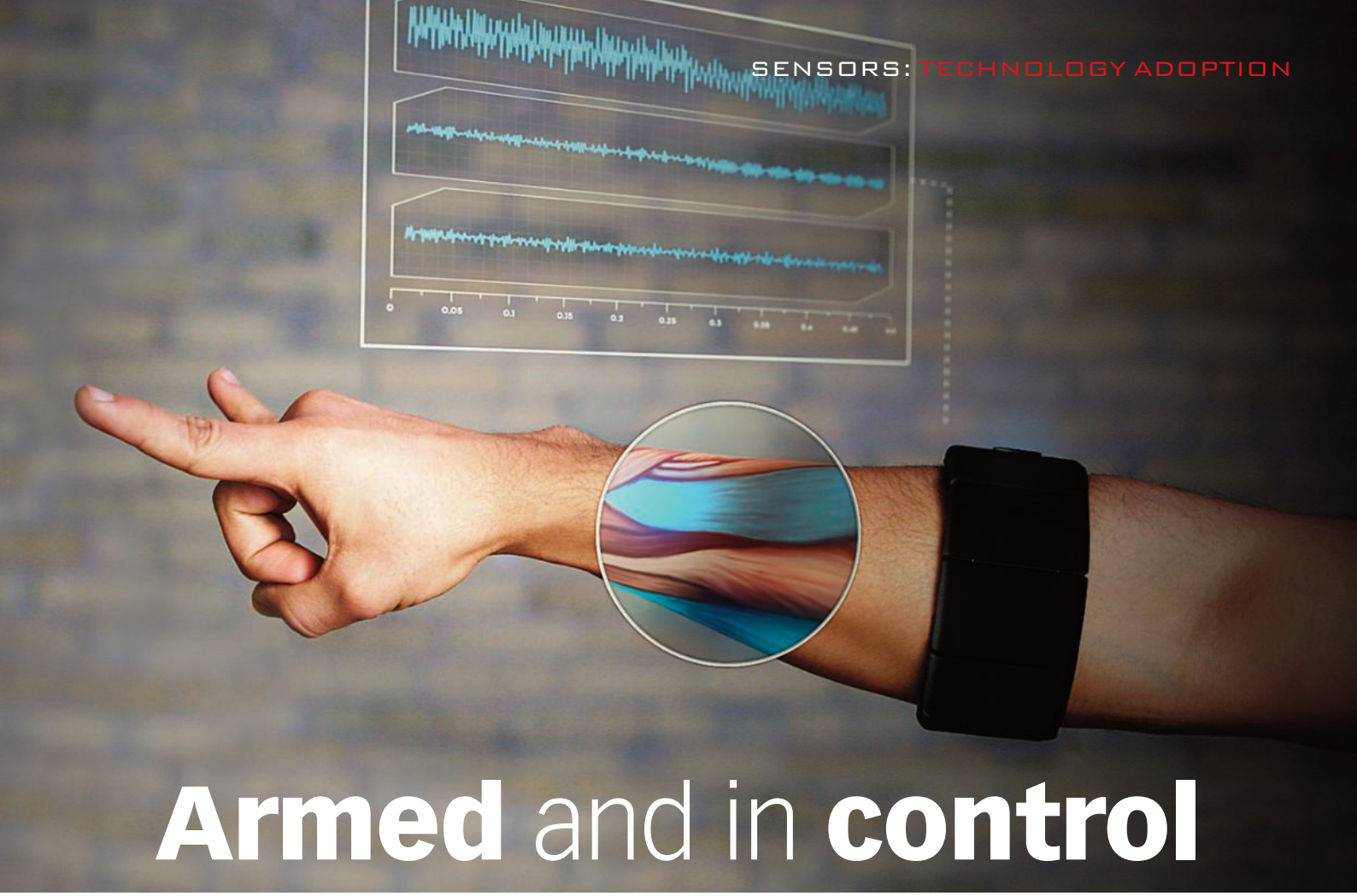


Armed and in control

The technology is there, the question is how you use it? Tim Fryer takes a look at some interesting new sensor technology that could point the way forward.

Thalmic Labs states its mission is to merge people with technology. Its core product, the Myo armband, provides the necessary link and, at the time of its launch last year Stephen Lake, CEO and Co-founder of Thalmic Labs said: "This final design is rugged, while also being lightweight, making it easy for the Myo armband to become a part of our everyday lives."

And the product is pretty unobtrusive. At 93g the armband weighs less than a typical watch and is essentially an elasticated band that is worn round the forearm. With a maximum width of 1.1cm it fits comfortably under most clothing, and as it has no cameras in its sensing armoury then it is no problem if it is covered.

Since development began in 2012 the look of the product has evolved from early 3D printed prototypes to the production design that was released at the end of 2014. The technology has advanced at a rapid rate as well. With a team of engineers brought together from across the world, Thalmic Labs developed a new type of muscle activity sensor from the ground up, made countless advances in gesture recognition algorithms, and developed a one-size-fits-all industrial design that will accommodate ages twelve and above.

"This is an emerging technology. It is a completely open technology and we built it up knowing that it's really our developers that are going to take it to the next level."

"The band itself is worn on the forearm, the thickest part of your arm because that's where you get the most muscle mass," explained Chris Goodine, who handles developer relations for the company. "This is where we get the strongest signal and the best performance."

The device includes a nine-axis motion sensor to detect all the movements and rotations of the arm. "This is strictly the accelerometer gyroscope and magnetometer together in one package called an IMU - an Inertial Measurement Unit," said Goodine. "The way it works is it understands the orientation of the device, so if the device is oriented upwards it knows that it's going upwards, when oriented down it knows that it's going downwards" The same is true of left and right and rotation (roll).

"This is all the motion sensor at work," continued Goodine. "Probably the most interesting thing is that you can combine that with gestural data. Gestural data comes from the muscle sensors at work."

The sensors that do this pick up the electrical activity in the forearm muscles. There are eight of these EMG (electromyography) sensors in the band. When a hand is flexed the forearm muscles are contracted, producing most electrical activity. By comparing the signals from each of the sensors it can be calculated what hand movements are taking place. Goodine said: "You start to recognise these sensor patterns. You can extrapolate those patterns, make them work with everyone, and that's basically how our gesture classification works."

There are five gestures that can be captured currently: a clenched fist, finger spread, wave in, wave out and 'double tap' pressing middle finger and thumb together twice. However, combine this with the motion information and the possibilities are vast. The device samples at 50 frames per second for the gesture recognition, and in terms of positional accuracy it is a fraction of a degree on all axes.

The device can be put on in any orientation

and can be calibrated by simply performing a couple of hand manoeuvres. The device will buzz when synchronised and equally will buzz if for any reason the device becomes dislodged and needs resynchronisation.

The Myo armband has a rechargeable lithium-ion battery and is designed to last a day of continued use. When not connected to a device and in standby mode, the battery lasts more than a week. The Myo armband works with Windows, Mac OS X, iOS, and Android devices that support Bluetooth 4.0 LE. Developers can build applications with C++, Objective-C, Java, Lua scripting as well as a number of community supported language bindings.

Through the Bluetooth connection the Myo can be used to interact with any other digital device, but while some applications – video gaming being the obvious one – seem made for this technology, Thalmic Labs is looking to the developer community to realise its potential.

Making MYO mine

Thalmic Labs presented the technology at SolidWorks 2015, not because the product was developed in SolidWorks, but because the event attracts upwards of 5000 design engineers, and that is the sort of developer community that Thalmic Labs' needs.

It could even be used directly in the CAD environment. By recognising the pattern in the sensor channels that were the result of the user making a fist, for example, that motion can then be translated into an action, like holding down a button. So the user could clench a fist to effectively grab control of an object on a screen which can then be moved around and rotated by movement of the hand.

This type of application is very much for demonstration rather than daily design, as Goodine clarified: "This isn't really a keyboard or mouse replacement. If you were a design engineer working with SolidWorks it's unlikely that you're going to be in front of your computer manipulating your models on a regular basis. What this is really meant for is in front of a larger audience – when I have a model and I want to walk you through it.

"This is an emerging technology. It's a completely open technology and we built it up knowing that it's really our developers that are going to take this to the next level. So in addition to building up this hardware, we put a lot of effort, basically half of our engineering efforts, into building up a software developer kit that enables developers to work with whatever data that we have."

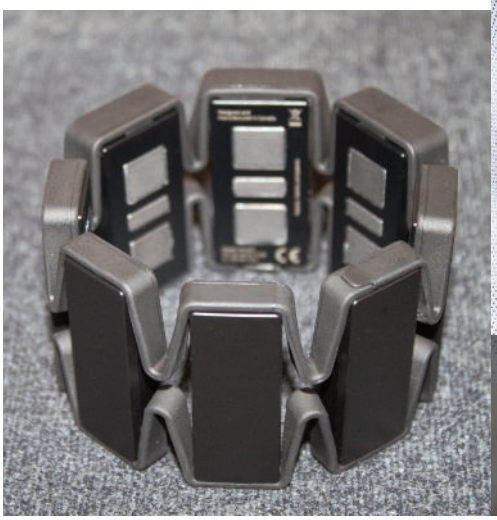
Moreover, Thalmic claims to have bought the technology into an affordable arena. Other EMG systems with dedicated controller and electrodes not only would cost 'thousands of dollars', they also require the user to shave the skin, apply a conductive gel and adhere the sensor onto the area somehow. By comparison the Myo armband costs around $200 and, claimed Goodine: "It can do essentially the same thing. It may not have the same frequency, but it has the same capabilities."

There are some applications that appear ready made for the Myo. When watching a movie online, the viewer can play, pause, fast forward, rewind, turn the volume up and down by using the keyboard or mouse. The Myo armband could very easily be used for this level of control – it is an application that already exists.

"Another really interesting consumer application is music control," said Goodine. "If you're a jogger or a biker, snowboarder or skier, and you want to control your music without having to stop or take out your phone from your pocket and taking off your gloves in the cold, you can just flip your wrist to change tracks.

"So these are consumer focused applications that do exist today and we do encourage developers to build up these use cases. There is a consumer focus for certain use cases like presentation control - if you go up on stage and you're constantly presenting. The great thing with this is that the average consumer can do it without having any sort of technical background. So we do encourage that, but we also encourage this sort of maker community where people are taking it to the next level through interesting innovations."

www.thalmic.com



The Myo armband, which can currently be fashioned in either black or white, expands to fit any arm larger than a typical 12 year old.

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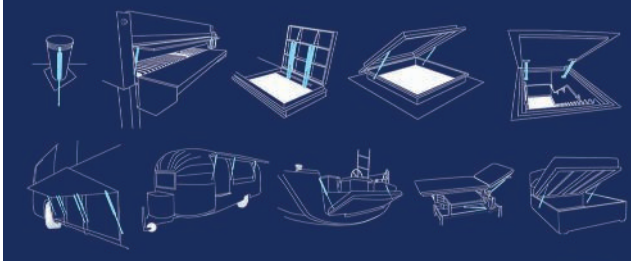

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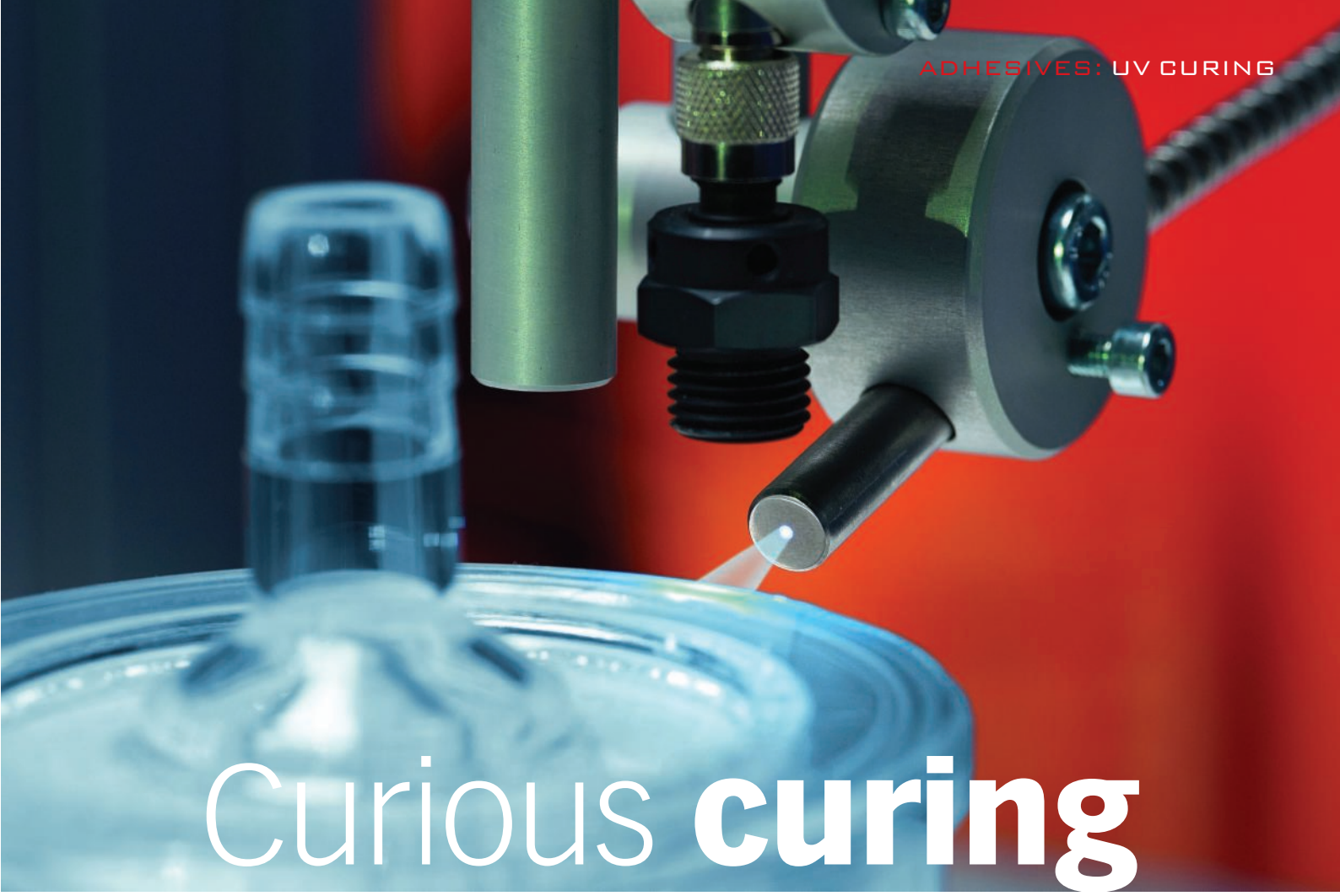


Curious **curing**

Curing adhesives with ultraviolet light was invented back in the 1960s, but it has taken 50 years for manufacturers to realise its full potential. Paul Gay considers the development of light curing technology.

Light curing materials, including those triggered by ultraviolet (UV) light, have become very popular with the manufacturing sector due to their rapid curing time and strong bond strength. Light curing adhesives can cure in as little as a second and many formulations can bond substrates of dissimilar materials and withstand harsh temperatures. These qualities make UV curing adhesives essential to the manufacturing of items in many industrial markets. And unlike traditional materials, UV light curing adhesives not only bond materials together but they can also be used to seal and coat products.

UV curing is a speed curing process in which high intensity ultraviolet light is used to create a photochemical reaction that instantly cures inks, adhesives and coatings.

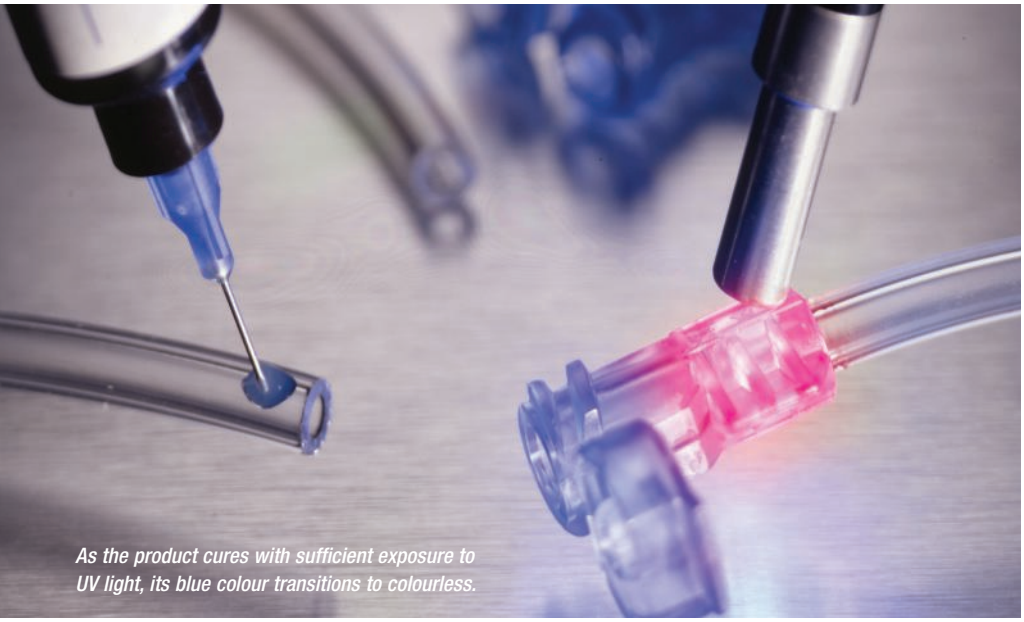
As a process, UV curing can be described as a low temperature, high speed and solventless process. The cure is effected by polymerisation rather than evaporation. Since its introduction, the technology has streamlined and increased automation in many industries.

The advantages of using adhesives over mechanical fasteners are well documented. They include distribution of load and stress over wider surface areas, elimination of joint fatigue, improved impact resistance, reduction in finishing and they can provide aesthetic enhancements.

Typically the LED systems designed for light curing are built into solid-state housings making them extremely durable and portable.

In addition to performance advantages, light curing adhesives can provide very significant process advantages. They are single part, which means that no mixing or mixing equipment is required, and there is less waste. They cure very quickly, typically in seconds, and on demand in that they only start curing when exposed to light of specific wavelength. This reduces the need for jigs and tools and minimises work in progress.

Light curing adhesives produce true structural bonds to glass, metal, ceramic and many plastics, including ABS, PC, PMMA, PA and PVC. They are used in assemblies with multiple substrate types and with the correctly chosen formulation, tensile shear and peel strengths are high, typically between 2500 to 4000psi at break. In general, they are resilient, tough and provide good impact strength. There are viscosity variations to suit wicking and thin bondlines, or to fill gaps, to be self-levelling or to be applied to a vertical surface. The operating



As the product cures with sufficient exposure to UV light, its blue colour transitions to colourless.

temperature window is typically -55ºC to 150ºC.

Historically, these materials were cured with UV light, reacting to light in the near-visible, long-wave UV-A range (315-400nm). Since many plastics have UV blocking ingredients in them to help prevent the embrittlement and yellowing caused by ambient UV light, plastic bonding adhesives use a synergistic combination of UV and visible light to generate fast and effective cures. UV curing equipment based on metal-halide lamps produce broad spectrum light suitable for curing most materials. The latest developments in curing technology include curing equipment based on LEDs, which produce a narrow spectrum light, centred around a specific wavelength (i.e. 385nm or 395nm).

Whilst not a drop-in replacement for broad spectrum lamps, UV LED curing lamps are becoming more popular, and adhesive formulations are emerging, which are optimised to cure with their output.

Due to the on demand cure, single component formulation and viscosity choice, light curing adhesives are very easy to employ in automated processes. They can be applied with a wide variety of dispensing technologies and with repeatable precision. As the cure is so fast, quality assessment procedures can be implemented immediately after assembly, or indeed sometimes in-line as part of the process. Yields are high, since the process is readily controlled and robust.

One such example has been developed to cure with visible light as well as radiation in the UV spectrum.

Originally formulated to be cured with UVA/UVC light and then UVV visible light, the latest generation of Loctite light cure adhesives rely solely on the visible light spectrum to provide a safer, more efficient and immediate cure for a broad range of assembly applications. In tandem with the technical advancement of the adhesives themselves, Henkel has also continuously developed its range of UV light curing equipment and has now introduced a series of LED-based systems that offer significant performance benefits.

The company believes it has developed its LED systems to be efficient and cost-effective. The life expectancy of an LED is up to 20,000 production hours where a traditional mercury vapour bulb lasts for around 1000 hours, including warm-up and cool-down time. Typically, LED systems are built into solid-state housings making them extremely durable and portable.

Long-life, durability and easy maintenance translates into immediate and on-going cost savings, especially as LED systems consume less energy. They also take up less space than traditional UV cure equipment and are easy to automate. Safety is another significant benefit as LED light systems require no heat protective equipment or costly ventilation systems to protect against infrared and ozone.

As the LED systems emit highly focused UV light wavelengths in a significantly tighter output range than visible lamp technology, unnecessary heat/infrared energy is not released. This can be an important benefit when bonding thermally sensitive plastics. They also produce higher outputs that cure the adhesives more effectively whilst having lower power consumption, therefore reducing operating costs.

The range of LED systems provided by Loctite spans a variety of application requirements and as Henkel is a single source supply of adhesives, dispensing and curing systems, the optimal choice and combination of each element can be assured. The 7700 hand-held LED light source is used for light-curing products that respond to UVV cold light. It is available in two versions: the first for continuous use that can either be hand-held or mounted in a fixed position and the second, a rechargeable battery powered unit for intermittent use.

For adhesives curing in the UVA range Henkel has the Loctite UV spot cure LED. In its basic configuration the system is equipped with one LED head and one condenser lens but it can be extended with three additional LED heads. The unit was designed with due consideration to the emission spectrum of the cure system, light intensity, transmission properties of the substrate and required cure characteristics. The equipment is intended for manual work stations and also for integration into production lines so can also be equipped with a sensor head for measuring UV intensity.

Dymax adhesives formulated with the latest Encompass technology incorporate the company's patented See-Cure colour-change and Ultra-Red fluorescing technologies into one light-curable product. As a result, manufacturers gain efficiencies from rapid, on-demand curing with easy cure confirmation and post-cure bond-line inspection.

While in an uncured state, an adhesive formulated with See-Cure technology is blue in colour for easy verification of placement. As the product cures with sufficient exposure to UV light, its blue colour transitions to colourless and provides obvious visual confirmation that the adhesive is fully cured and the bond site secure.

Products formulated with Ultra-Red technology fluoresce bright red under low-intensity black light (365nm), contrasting extremely well on plastics that naturally fluoresce blue in colour (like PVC). This allows

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TECH BRIEF

Software and an accompanying service from Granta Design supports a rigorous, auditable composite qualification process, particularly for where data traceability is required.

Software tools for capturing, processing, and reporting on composite data have been added to the existing Granta MI:Composites software package.

The software package was developed with input from leading aerospace companies, based on the Granta MImaterials information management platform. It manages all of the valuable, but complex, data associated with composite materials, i.e. lay-up, cure cycle, directional properties, and the properties and history of their constituent parts.

New qualification tools help with key tasks in the composite qualification process, such as defining a test program or importing data from test machines to a central database. These tools are available via a new service for Granta clients.

This Composites Qualification Service configures a Granta MI:Composites software package for an organisation's specific needs. For example, data import tools can be set up so that they automatically process data from a specific test machine. OEMs can use the service to build a system that makes it faster and easier to define test programs and to capture, analyse, and use their results. As well as a systematic, documented process, from test request to design allowable, they reduce errors and delays and protect vital corporate intellectual property.

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manufacturers to incorporate automated or manual quality inspection to verify complete and accurate placement of the adhesive after cure. Dymax is currently offering several medical-grade adhesives that are formulated with the new Encompass technology.

In addition to adhesives and coatings, Dymax also offers high-performance oligomers as well as a variety of dispensing and light-curing equipment.

The company's products are perfectly matched to work seamlessly with each other, providing design engineers with tools to dramatically improve manufacturing efficiency and reduce costs.

The machine is controlled pneumatically by foot pedal actuation, which is easy to use and ensures full and measured shot size control. Furthermore, its parallel fixed ratio drive mechanism ensures consistent processing of material from low to medium viscosity.

Ultraviolet curing has traditionally been carried out with mercury-vapour lamps. But with the advent of LEDs capable of producing UV radiation, curing devices using the technology have increasingly been incorporated in industrial and commercial applications. We can be sure that the generation of monochromatic ultraviolet radiation from LEDs is now very much a viable alternative to Mercury vapour lamps.

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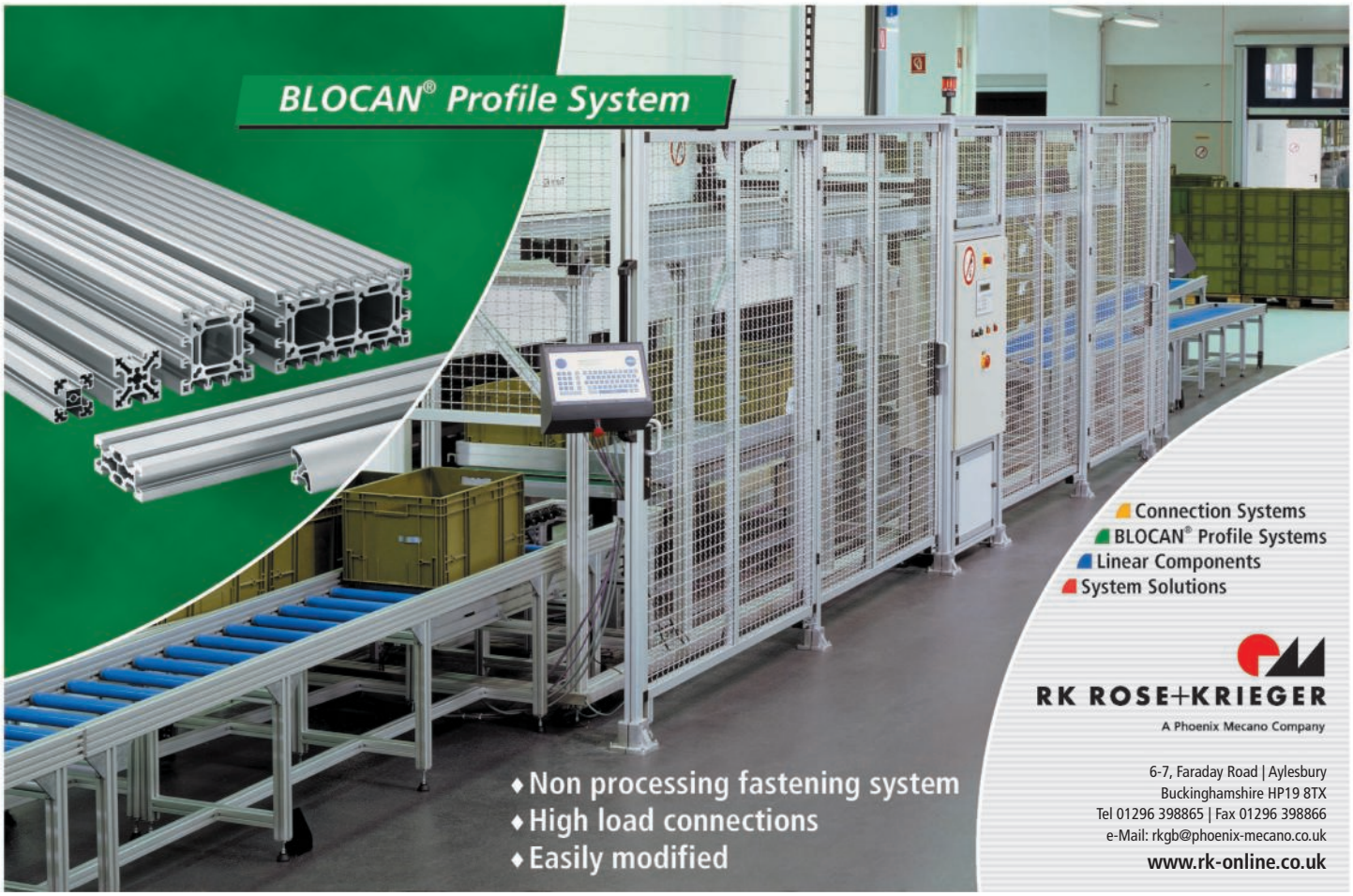
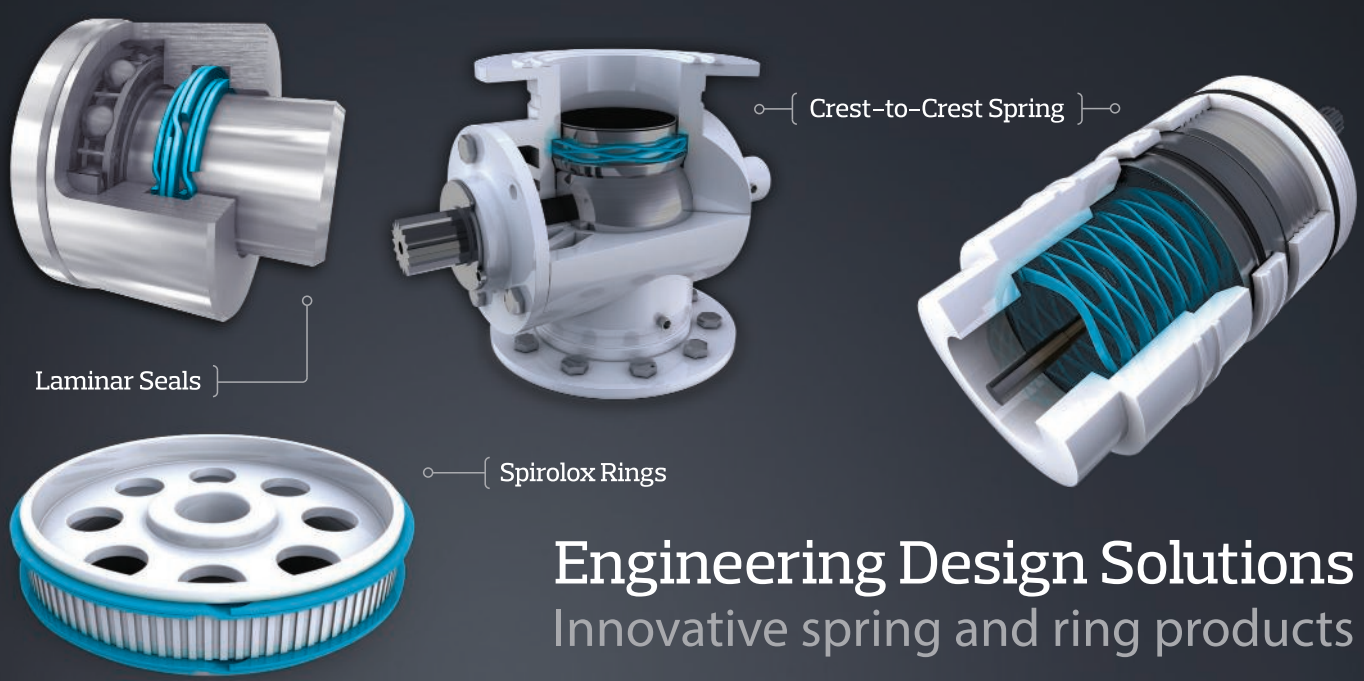
Paul Gay is editor of sister publication FAST





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Rubber – with no corrections

LSR is finding more and more uses. Proto Labs explains why and why knowledge of its properties can help make good LSR parts

For many of us, the easiest place to find liquid silicone rubber (LSR) is in a hardware shop. It comes in a tube and can be used to create flexible, formed-in-place gaskets that cure with the heat of an operating engine. In its extreme form, LSR can withstand constant temperatures of up to 316°C and intermittent temperatures of 371°C.

To those more familiar with ordinary thermoplastics, it may seem counter-intuitive that such a rubbery material can be used in high temperature applications, but LSR is actually made to take the heat. Unlike thermoplastics, which soften when heated, thermosets like LSR are created in high heat and, in their various forms, can easily withstand temperatures that would melt thermoplastics. This suits them well for a variety of high-heat automotive and industrial applications as well as for medical products that are sterilised with high heat.

In addition to high heat, LSR can typically handle low (sub-zero) temperatures, while maintaining its flexibility. The exact degree of flexibility varies with the compound, but can be very high; LR3003/50 for example, has an elongation at break of 480%. LSR compounds are available in varying durometer (hardness) and can be selected to match the requirements of the application.

While the material has excellent thermal, electrical and chemical resistance properties, it can be attacked by certain solvents such as gasoline or mineral spirits, which is why it can be used in high-temperature automotive applications but not for fuel lines. And it has low compression set - low permanent deformation when a force is applied and removed - making it ideal for elastomers. In comparing LSR to thermoplastic elastomers (TPEs) like Santoprene, LSR has been described as 'TPE on steroids'.

Thermoplastics vs. Thermosets

In some respects thermoplastics (polyethylene, polypropylene, polycarbonate and ABS, among others) and thermosets (like LSR) are opposites. Thermoplastics start out solid at room temperature, soften when heated, and re-solidify when cooled, which makes them excellent candidates for recycling. Thermosets, on the contrary, typically start out as gels and solidify permanently when heated with a platinum catalyst. That makes them poor candidates for recycling but accounts for their superior performance at high temperatures.

These differences in their response to heat define their respective moulding processes. Thermoplastic pellets are heated before injection to liquefy the resin and then allowed to cool in the mould before being ejected. Thermosetting resin, on the other hand, is chilled before injection and then heated in the mould for curing.

Shear Thinning

Before curing, liquid silicone rubber is a shear thinning fluid, also called a pseudoplastic. Shear thinning is the reduction of a fluid's viscosity when shear stress (like that caused by injection into a mould) is applied, and it significantly impacts the way LSR behaves in the mould. Consider ketchup, which, like LSR, is a shear thinning fluid. Upturn a bottle of ketchup and it may well stay inside the bottle, but shake it up, or squeeze a sqeezy bottle, and it flows quite easily. This change in viscosity is an example of shear thinning, and the same thing happens to LSR when it is injected into a mould.

Shear thinning has both positive and negative effects on the moulding of LSR. It actually improves flow through thin walled areas, reducing the need to maintain uniform wall thickness throughout a part as is recommended when moulding thermoplastics. On the other hand, because LSR flows so easily in a mould, it has an increased tendency to flash — to seep into spaces where mould halves meet — creating unwanted vestiges that must be removed by secondary operations.

Design Considerations for LSR Parts

From the part designer's standpoint, design guidelines for LSR are similar to those for thermoplastic though somewhat more relaxed in certain areas. The reason for the relaxation is that LSR, being flexible, is a more forgiving material than thermoplastics. Planes that are parallel to the direction of mould opening typically require some draft to allow milling of

the mould, though not to prevent scraping of the part against the mould wall during ejection. About one degree per 25.4mm of mould depth is usually sufficient.

Because shear-thinning LSR flows easily in the mould, it can traverse thin walls that would cause fill problems for thermoplastics. For the same reason, uniform wall thickness is not as critical. And because thermoset material is solidified by heat and is mostly cured before it cools, sink is not a problem, which means that part features can be made thicker than with typical thermoplastic material (although there are still good reasons not to make features thicker than they need to be). But the biggest difference between thermoplastic and thermoset LSR mould design may be in the handling of undercuts.

Rigid thermoplastics can be moulded with undercuts either by the use of side-actions that produce the undercut features and then withdrawn before the mould opens to allow the part to be ejected, or by complicated techniques like pickouts. But because LSR is so flexible, finished parts can often be 'peeled' out of the mould.

LSR moulding at Proto Labs

As it has for thermoplastics, ProtoQuote, Proto Labs' pricing and design analysis engine, now supports LSR. Simply upload the design, specify material and quantity, and get a quote with design analysis. LSR parts can be manufactured for prototyping, right up to production volumes.

Current turnaround time for LSR production is three weeks and for some designs, faster turnaround may be available. This is faster than

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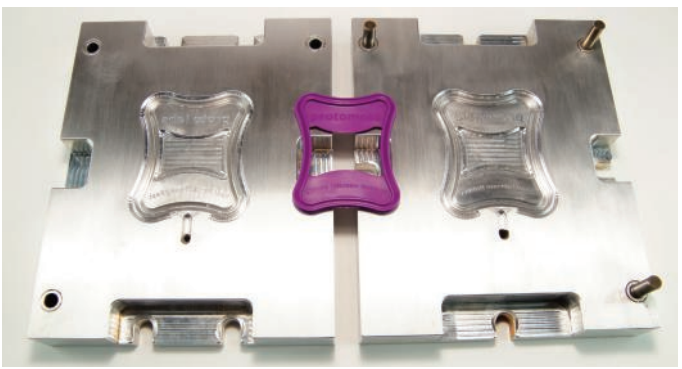
is possible using traditional methods because the Protomold process turns 3D CAD models directly into toolpaths for milling moulds. As with thermoplastics, the process for making LSR moulds at Proto Labs is managed using proprietary software running on a very large compute cluster. The toolpaths generated by the software run automatic milling machines that produce the mould halves, which are then placed into specialised liquid silicone moulding presses.

The process can cost-effectively produce LSR parts in quantities from 25 to 25,000+. In moderate production quantities, the process can turn out parts faster and less expensively than traditional LSR moulding processes, but even at very small production or prototyping volumes, Proto Labs still uses full-scale manufacturing processes.

Most producers of low-volume LSR prototypes hand mix the component gels in a blender, a process that cannot match the process control of Proto Labs' industrial process. In some cases, they don't use a milled mould or heat-cured LSR. Instead, the prototypes are made using a room temperature vulcanisation process that starts with a thermoplastic copy of the part made on a 3D printer. A mould is cast around the 3D-printed part and hand filled using a caulking gun. The resulting part may be suitable for testing form and fit, but since it does not duplicate the manufacturing process or use real LSR material, it cannot be relied on for functional testing or actual production of any volume.

To get real parts for prototyping, traditional producers have often had to wait until manufacturing moulds have been made, which can take weeks or months. At this late stage of development, problems that show up can cause serious setbacks in the development process and the scrapping of very expensive tools. Proto Labs' automated aluminium mould milling allows cost-effective prototyping using real materials and industrial processes earlier in development when redesign is easier, less time consuming and less costly.



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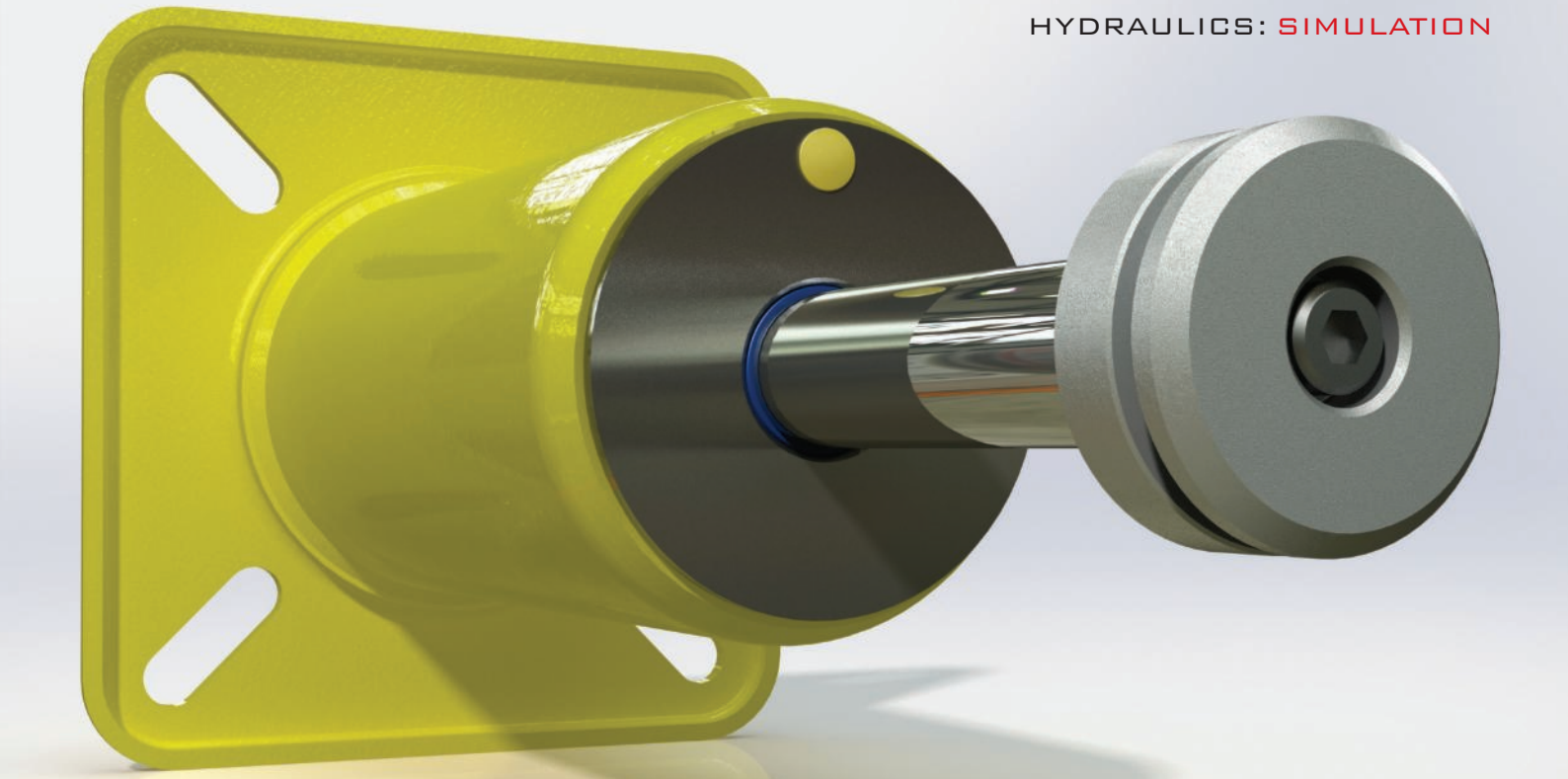


Adopting **crash** position

Big mobile machines often need more than just standard braking to stop them. Designing the appropriate buffer solution for such equipment is a skill set in its own right, as Tim Fryer reports.

Buffers are not regular components. Machines such as cranes for use in ports, railways, steelworks or other very heavy industrial environments, are rarely standard themselves, and so the buffers they incorporate need to meet individual specifications.

One manufacturer of buffer solutions is Oleo, who claims that its buffers have the ability to absorb and dissipate 95% of impact energy, which results in a controlled deceleration of the moving machine, irrespective of speed.

However, knowing the force (the maximum end force) and the stopping distance available (stroke) is only the starting point in finding the right solution, which is why Oleo has introduced its hydraulic buffer simulation software package.

Gregory Le Brasseur, general sales manager for Oleo International explained: "We work with the OEM's who buy our buffers to use on their products such as overhead cranes and in factories, steel mills and mines. This solution is aimed at people designing products that require crash energy management. They can look at the speed their application is travelling and the moving weight, and then use the simulation to work out what product performance is required for that application to protect the people within it and the physical product."

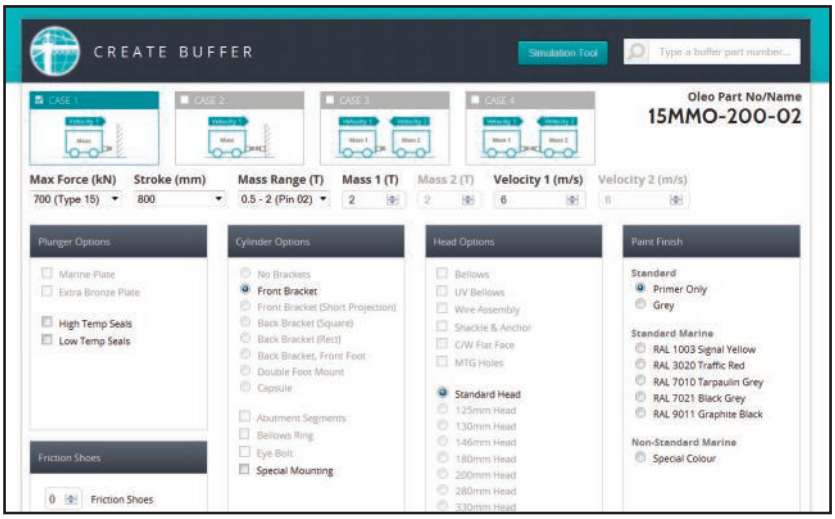
The technology is an advancement of Oleo's existing 1D Rail Simulation software, which evaluates options for various energy absorption methods used in bolt-on devices, including couplers, buffers, anti-climbers and other crush elements for the rail industry. But cranes vary much more than trains.

"Each application is different – some cranes will travel at faster speeds than others and carry heavier weights so the buffer specifications would vary depending on the type of application and what it is used for," said Le Brasseur. "Our buffers can be customised so that any performance characteristic that the customer simulates on the website for his application can be manufactured."

Hydraulic buffers have complex non-linear performance characteristics that vary with impact speed and time, but Le Brasseur claims that Oleo is the only organisation to have developed the mathematical algorithms that accurately simulate their performance.

The new Simulation Software, allows design engineers to investigate the controlled deceleration of moving equipment, whatever the speed of impact, to define the appropriate buffer solution for any given scenario. The software takes the mass and velocity for a moving object and analyses figures for stroke, mass, and velocity to calculate the final impact force and deceleration; pointing design engineers to an appropriate buffer to absorb the impact. For design engineers working on dockside equipment in marine environments, or crane builders, the new software will provide more information and control in specifying a buffer for an application and estimating the dynamic performance of the buffer when in service.

The software allows the user to optimise the hydraulic buffers performance characteristics for their specific application and allow them to download the simulation data, buffer characteristics, installation drawings and 3D CAD model, as STP or STEp files, so that it can be incorporated within another design in third party CAD software. It can also issue a request for the manufacturing of the customised buffer solution.



"The software analyses and simulates the damping performance also giving acceleration, velocity and stroke distance/time data," added Le Brasseur referring to the role of the buffer within the overall machine. "This data can be input into user's calculations of how their particular machine is affected by the buffer."

However, it does not go as far as predicting machine maintenance schedules or determining product life according to Le Brasseur. "It is not a predicture of how many impacts over how many years before preventative maintenance is required. In that situation the users OEM equipment is usually requiring earlier repair."

Redeveloped and tailored specifically for industrial sectors and design engineers, the software is the latest technology advancement at the company, and follows the recent launch of Oleo's solution for applications requiring low energy absorption capabilities - its Type 1 range of industrial buffer.

Le Brasseur, explained how the software was developed: "Similar to our 1D Rail software, we wanted technology that was intuitive and easy to use for design engineers, which would help them find safer buffer solutions in a more accurate and automated way. Our Industrial Simulation and Configuration software complements our existing software range perfectly and will become a vital resource for design engineers working in dockside and marine environments."

These simulations are standalone, but Oleo has developed plug in modules for use with Adams Multi Body Dynamics software as well as Radioss and LsDyna Finite Element packages.

And looking to the next phase Le Brasseur added: "Our industrial software will be translated into a variety of languages to make it accessible for the multiple global markets that we serve. The next step for us is to develop our range even further to accommodate the global elevator market, which is another growing sector for us."

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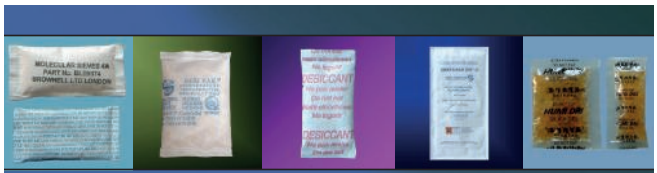

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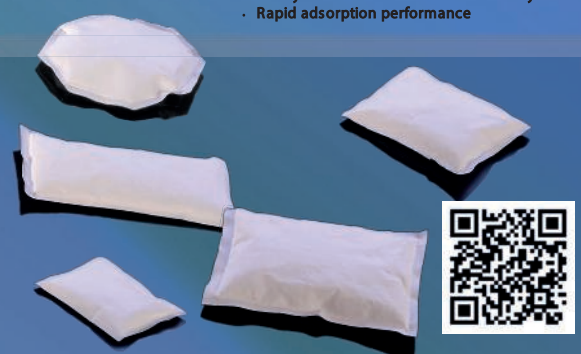

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Facing up to printing

The 3D printing of heads is improving outcomes in face transplant surgery, as Tim Fryer reports.

While not directly design engineering, this application demonstrates an innovative use of some tools more normally associated with the design and prototyping environment. And these techniques could bear relevance in the future, perhaps when technology, medicine and cosmetics have converged further.

This procedure was developed by physicians at Brigham and Women's Hospital in Boston. They performed the country's first full-face transplant in 2011 and have subsequently completed four additional face transplants. The procedure is performed on patients who have lost some or all of their face as a result of injury or disease.

"This is a complex surgery and its success is dependent on surgical planning," said Dr Frank Rybicki, one of the pioneers of this technology application. "Our study demonstrated that if you use this model and hold the skull in your hand, there is no better way to plan the procedure. The idea is to make a high-fidelity model of patients' skull before surgery so that surgeons have a better idea about the pathology."

The study was recently presented to the Radiological Society of North America (RSNA). The team was made up of radiologist and director of the Boston hospital's Applied Imaging Science Laboratory Dr Rybicki, Dr Bohdan Pomahac the lead face transplantation surgeon, and research fellow Dr Amir Imanzadeh. They assessed the clinical impact of using 3D printed models of the recipient's head in the planning of face transplantation surgery.

"Software translation and the 3D printers are the enabling technologies," Dr Frank Rybicki.

Each of the transplant recipients underwent preoperative CT with 3D visualisation. To build each life-size skull model, the CT images of the transplant recipient's head were segmented and processed using customised software, creating specialised files that were input into a 3D printer.

"You can spin, rotate and scroll through as many CT images as you want but there's no substitute for having the real thing in your hand," Dr Rybicki said. "The ability to work with the physical model gives you an unprecedented level of reassurance and confidence in the procedure."

"In some patients, we need to modify the recipient's facial bones prior to transplantation," Dr Imanzadeh said. "The 3D printed model helps us to prepare the facial structures so when the

The process typically starts with a CT scan although MRI and other data sets can also be used.

actual transplantation occurs, the surgery goes more smoothly."

The material can vary for each model, however the majority of models are made from photopolymers and resins.

Dr Rybicki commented: "Selection of material is dependent on a couple of factors including the technology of 3D printing. Some methods use metals, others use plastics, the cost, and the purpose of use i.e. implants vs surgical guides."

For means of medical 3D printing, three sets of software are required: software for determination of organs and structures from radiology images (segmentation software); software to refine the STL output from the first software package (CAD software); and software that can transfer final output from CAD software to a printer (printer driver/software). All of them are in common use and are designed and produced by commercial companies. The radiologists, who are behind this application, have nothing to do with that aspect.

The enabling technologies for this application are, according to Dr Rybicki: "Software translation and the printer - the scans have not changed. CT is used more because it is cheaper, more frequently used, and the segmentation of CT images are easier than MRI. However, if necessary MRI datasets can be utilised. Even ultrasound and 3D angiography images can be used as the source for means of 3D printing."

CT, or CAT, stands for computerised axial tomography. It uses x-ray technology but the images created, the tomograms, are more detailed than standard x-rays. Another advantage from the patient's perspective is that CT scans last five to ten minutes, while an MRI scan can take over an hour and involve being inside a tunnel, which some can find claustrophobic.

The quality of the models is of paramount importance and a couple of 3D printing systems have been used to attain this quality, the SLA 7000 by 3D systems and the Connex 5500 by Stratasys.

The SLA 7000 is the fastest printer in the 3D Systems range by a factor of two. It uses stereolithography technology to build up models with layers as thin as 0.025mm to provide a smooth finish and reduce the amount of post-processing required. The Connex printers use Stratasys' polyjet technology and the material is cured by UV light rather than by laser. These machines can achieve a resolution in terms of layer thickness of 0.016mm and can produce models made of more than one material.

Printing was not done internally, but as part of a U.S. Department of Defence contract and research collaboration with Walter Reed Medical Center, which was understandable given the low volumes involved and the high cost of the 3D printers. Each project therefore has its own price. "Generally speaking a model can cost from roughly $70 up to $2000, based on the material, size, etc.," said Dr Rybicki. "The average cost for our models was $500."

The entire transplant procedure lasts as long as 25 hours, and any time saved is precious for surgical, aesthetic and business reasons. This technique of printing the head has typically saved anywhere from ten minutes to more than an hour depending on the procedure. Dr Rybicki commented on the benefits: "Some of the studies demonstrated that surgeons who used models for pre-surgical planning, managed to decrease patients' blood loss during the operation significantly. Savings of even one minute of operating theatre time is very important, not only because it decreases the duration of anaesthesia, but also it saves considerable amount of money for the hospital."

And the use of models improves both medical and aesthetic outcomes, as Dr Rybicki explained: "For instance, using models in transplants (kidney, liver, etc.) reduces the total operation time as well as morbidity and mortality of the patients. And with the help of 3D printing, parts/prostheses, for example an ear that is very similar to patient's normal structures, can be fabricated, which improves the aesthetic outcome."

Despite the progress being initially made in face transplants, 3D models can be used in almost any type of surgeries for either pre-surgical planning or intra-operation navigation. For example, a spine surgeon can take 3D printed vertebrae models of a patient with scoliosis to the operating theatre and use them to find out the orientation of the vertebrae in the body.

Maybe this is a sphere where the skills of the design engineer in producing 3D printable designs will dovetail with the medical profession to develop this new discipline.

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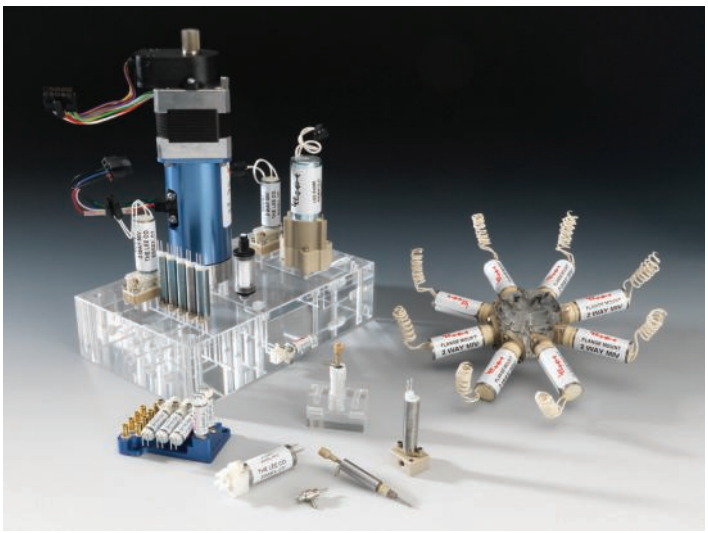

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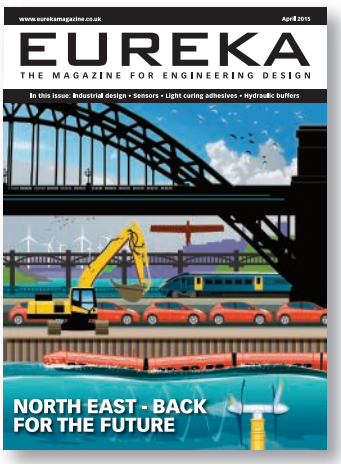

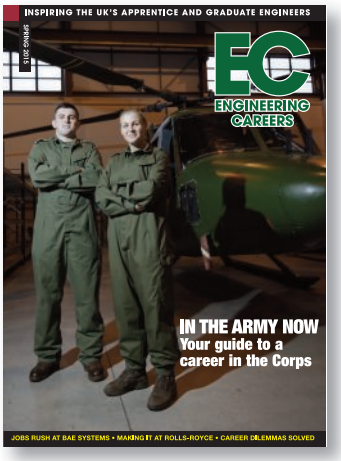

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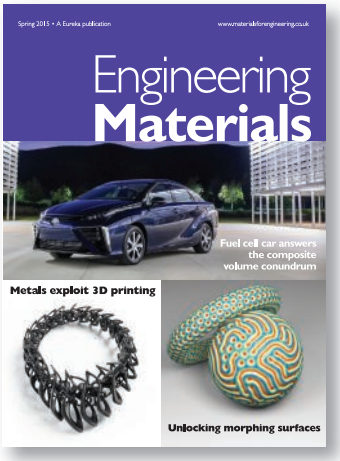


Passionate about engineering

Wagon to the moon

The moon continues to fascinate and the biggest 'lunar competition' is entering its business end. Tim Fryer reports on some of the design challenges one of the teams has faced.

The Google Lunar Xprize is offering a first prize of $20 million to the first team to land a robot safely on the moon, from where it must travel 500m and send good quality pictures back for us earthlings to enjoy.

One key stipulation is that these teams must be privately funded, no more than 10% coming from Government sources, and 18 teams from all around the world have registered and are still in the running to challenge for the prizes. Several of the teams are from Europe but sadly there is not one from the UK. There are several other prizes beyond the first prize to compete for, it is not winner takes all, and the total prize fund is $30m.

And the clock is ticking. To qualify for the award the successful expedition needs to be completed by 31st December 2016 – not far away in terms of space developments.

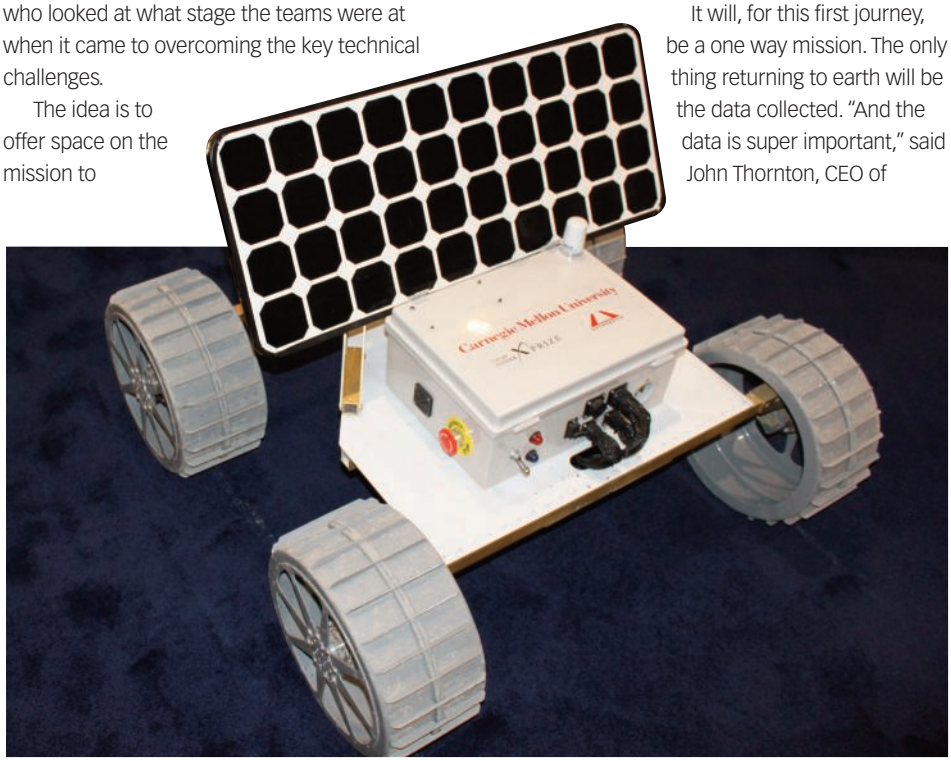
Putting a robot on the moon is no mean feat and comes at considerable expense, so the competition, rather than being a means to an end in its own right, is more a stimulus for companies' looking to capture their portion of what 'the eighth continent' has to offer.

One such contender is Astrobotic, a company that was spun out of the Carnegie Mellon University Robotics Institute in 2008 with the intention of competing for the Google Xprize. Beyond that it has the stated aim of 'Pioneering affordable planetary access that promises to spark a new era of exploration, science, tourism, resource utilisation, and mining.'

This company has already given a signal of its intent by winning a Google Milestone Award in all three categories – Landing, Mobility and Imaging – the only company to do so. These Milestone prizes, which were worth $1m, $0.5m and $0.25m respectively, were decided by a panel of judges who looked at what stage the teams were at when it came to overcoming the key technical challenges.

The idea is to offer space on the mission to payloads other than its own lander. The payload for these 'passengers' is set at 270kg out of a total payload of 800kg, a figure determined by the launch vehicle, a Falcon 9 rocket. This 200ft rocket has a million pound thrust force and will take off from Florida at the end of 2016, launching the Astrobotic lander towards the moon.

It will, for this first journey, be a one way mission. The only thing returning to earth will be the data collected. "And the data is super important," said John Thornton, CEO of



Astrobtics. "The way to think about this is the traditional space agencies, for example, like the US or the Soviet Union or the European Space Agency, if they wanted to do a surface mission exploration mission they will pull the science community, get the best science out of the entire community and then spend upwards of $300 million getting up there. With this capability you can send small payloads to the surface of the moon for single digit millions or even half a million dollars per pound.

"So what that allows you to do is every single science outfit in the world can have a small part of this mission. It's basically splitting up a large mission almost into timeshares."

Designing a landing platform and a robotic rover destined for the moon are clearly considerable challenges. Both of these are being designed in SolidWorks, but by different teams. The Rover is being designed principally by a team from Carnegie Mellon while the Lander is being designed by Astrobotics. The Rover is attached to the bottom of the lander by bolts that explode when heated up, this releases the Rover that drops to the ground before taking its 500m (minimum) journey.

Joan Yule is a mechanical engineer with the Lander team and her area of responsibility is propulsion, guidance and control. Being fired at the moon is not completely accurate, said Yule. "The reason that we have propulsion is so we can make corrections and burns to get captured by the lunar orbit and then do a powered descent down onto the surface.

"We are actually getting a lot of help from NASA through a Space Act Agreement," he added. "But we do a lot of the simulation work in-house

"Ultimately we want to turn the moon into the next continent of the world. We want it to be as accessible as getting on a plane and going up there."

on our own. We use software that's already been developed and also we have people who are developing simulations on their own – simulations for trajectory analysis, for environmental analysis, thermal analysis, structure analysis, all sorts of things."

But the biggest challenge, according to Yule, surrounds the physical testing. "Mimicking the environment that we're going to be seeing has been the hardest part. From a lower orbit all the way to the moon the environment changes quite a bit, so mimicking that on earth is very challenging, but we have found ways using thermal and vacuum chambers. Physical testing is crucial, it calibrates our simulations. We still do simulation on everything but the more tests you can run, the more calibration points you can get for your simulation, so you know that the simulation is accurate."

Another big issue is materials said Thornton: "Materials are very challenging in space. One of the biggest challenges is the vacuum environment, so there's a phenomenon called outgassing that happens very quickly in space because there's no atmosphere holding the molecules together. Rubbers and a lot of plastics don't work in space, and a lot of paints, so you have to fundamentally change your building

Astrobotic Technology has used SolidWorks to design the components for its lunar lander.

materials to go there. Mainly we use metals, a very small number of plastics and there's some resins that can work.

"Our goal is to increase access, make the moon more accessible," concluded Thornton. "We're the enabler; in the gold rush you could liken us to the people that are making the Conestoga wagons and the tools to go and explore. That's what we view our role of the lunar exploration development as."

lunar.xprize.org
www.solidworks.co.uk
www.astrobotic.com

Diverse team

One recurring topic at SolidWorks World, when the Astrobotic interviews took place, was the lack of women in engineering. Many companies (and national/international organisations and governments) seem to be waking up to the notion that we need twice as many engineers yet we only pitch it as a career to half the population – boys. Companies who are bringing women into the employee mix are benefitting, Astrobotic being a prime example. Joan Yule observed that nearly half of her colleagues at Astobotic were female and that she did pick up on things that others didn't, but is that because she is female or because she is a good engineer?

"I really can't say," she confessed. But her CEO John Thornton believes gender diversity does have an impact. He said: "It's important for women to be a part of it - it's a stronger team because of it and it's one that we will use to change the world. I think the best team is a diverse team that can see things from a lot of different angles. To have people from different backgrounds and different experiences can add a lot, so I think the more diverse the team is, the stronger it is."

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How to avoid 3D printing a legal landmine

3D printing is a fantastic technology, but it is open to abuse. Doug Ealey, Partner, D Young & Co takes a look at some of the potential pitfalls

3D printing enables the creation of highly complex objects without machining, and has the potential to disrupt key aspects of production, for example bypassing shipping to make items in-market, and changing obsolescence cycles through comprehensive access to spare parts.

As an industry, 3D printing needs three sectors; manufacturers of 3D printers, suppliers of printing services, and hosts to distribute digital files. However, these sectors in turn need a legal framework to protect them from abuse – it's easy to see that an individual adding a Nike logo to a generic 3D design is both inevitable and likely to cause serious headaches. This article briefly looks at the legal landscape for 3D printing.

Manufacturers of 3D printers clearly make a product that enables the legitimate copying and production of goods, but also enables illegal copying and the production of illegitimate goods such as the counterfeit Nike product described above. Will manufacturers be liable for the uses to which their machines are put? Fortunately, this question has already been answered in the UK: in CBS v Amstrad [1], CBS alleged that Amstrad's dual tape deck system clearly enabled the illegal duplication of music tapes, and so Amstrad had 'authorised' copyright infringement. The House of Lords, however, held that because the deck also had the legitimate use of copying a user's own recordings, Amstrad was not making such an authorisation and had no liability. So basically, as long as your operating manual doesn't include a link to The Pirate Bay, manufacturers of printers should be able to operate freely.

The hosts of 3D printing files should be aware of the Electronic Commerce (EC Directive) Regulations 2002 and in particular Regulation 19[2], which states that a service provider hosting content provided by a recipient of the service is not liable for sanctions as a result of that hosting, if they do not have actual knowledge of unlawful activity or information, and upon obtaining such knowledge or where it is apparent, they act expeditiously to remove or to disable access to the information, assuming that the recipient of the service themselves was not acting under the authority or the control of the service provider.

Doug Ealey

However this safeguard is conditional on the host not having an 'active role' that may give it apparent knowledge of what products are being hosted; examples of active roles given in L'Oreal v eBay[3][4] included providing assistance with the presentation of a product online, or promoting the product. Clearly therefore, a sensible approach for hosts is to provide terms of engagement for new users that prohibit unlawful IP acts, to provide a reporting and takedown service, and to carefully vet any promotion of hosted products.

Finally, suppliers of printing services actually make products according to designs sent to them by third parties, where the designs and indeed the parties may often be of obscure provenance. Given that 3D printing within a target market may be seen as a good way for counterfeiters to bypass border controls and customs checks, this makes suppliers uniquely vulnerable as they don't clearly fall into either of the above categories, whilst still taking an active role in the creation of the product. Consequently they may find themselves making products that have copyright, patent, trademark and/or design rights associated with them, resulting in a complex mix of potential liabilities.

The specific situation for each right goes beyond what can be covered here, but as a general principle, firstly don't act to induce or implicitly authorise infringement (for example, by advertising on The Pirate Bay) and secondly, like hosts, provide suitable terms of engagement and have an internal review process to check for apparent / obvious infringements.

As the 3D printing industry grows, we are sure to see some of these principles tested, so be prepared – and watch your step.

For more information contact Doug Ealey on
Tel: 020 7269 8550
Email: dre@dyoung.com
Web: www.dyoung.com

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[1] www.bailii.org/uk/cases/UKHL/1988/15.html
[2] www.legislation.gov.uk/uksi/2002/2013/regulation/19/made
[3] www.bailii.org/ew/cases/EWHC/Ch/2009/1094.html
[4] curia.europa.eu/juris/liste.jsf?num=C-324/09

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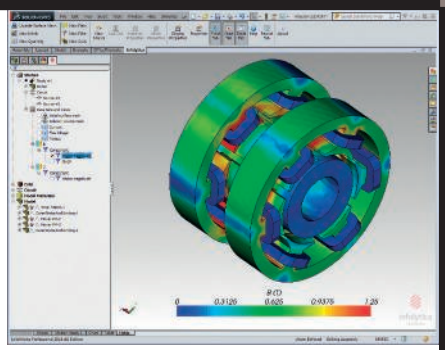
Infolytica - MagNet for SOLIDWORKS

MagNet for SOLIDWORKS is the foremost 3D electromagnetic field simulator embedded in the industry leading CAD software. A combination beyond compare: just one design environment for drawing the model and analyzing the performance of any EM device such as power transformers, sensors, MRI, actuators, solenoids and much more. This is not a live link or connection of two standalone software tools, but rather a fully integrated add-in to SOLIDWORKS which runs seamlessly inside the CAD environment.

Perform electromagnetic field simulations and quickly make geometric modifications to examine their impact on the design without worrying about exporting model data and dealing with compatibility issues. The property management pages and study setup use the same look and feel of SOLIDWORKS interface, making it intuitive to existing users.

MagNet for SOLIDWORKS' solution approach is based on the highly accurate finite element method for simulating static, frequency dependent or time varying electromagnetic fields. Read more about the complete feature set.

Useful features include:
Seamlessly add electromagnetic field simulations to the SOLIDWORKS CAD environment • Current flow in coils is automatically detected for easy setup • Detach and move components when post-processing results for easier understanding of the performance • Slice and peel through field results



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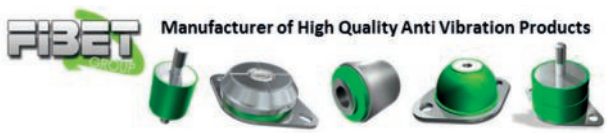

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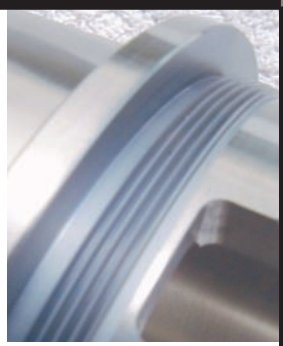

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Flowmeters

Ultrasonic Water Meter Technology Shows Promise

Titan Enterprises has built an ultrasonic water meter technology demonstrator using it's Atrato flowmeter as a platform. The new device easily satisfies all the required water industry performance standards and fits within the 110mm desirable mounting length.

The world domestic water meter market is estimated to reach over 30 million units this year. The majority of these will be "smart" meters requiring power to operate. The sub-meter and heat transfer markets are reported as being the fastest growth sector.

Titan has built and trialled a 110mm long, half inch bore, water meter and achieved an accuracy better than ±2% over a 250:1 flow range using an external power supply.

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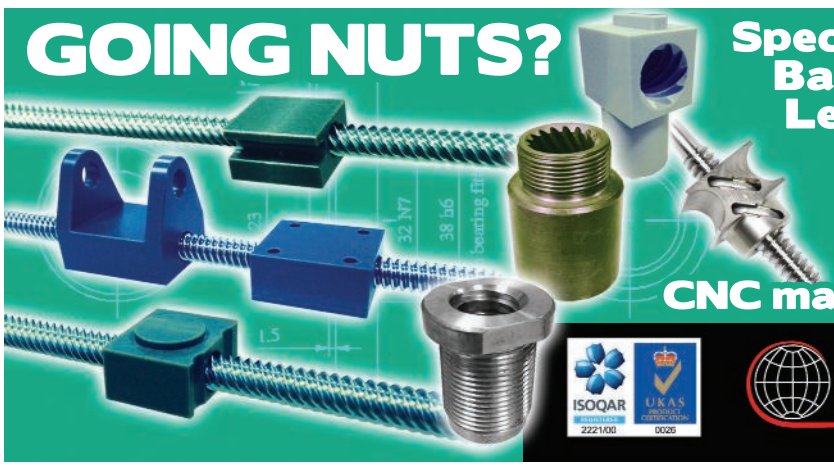

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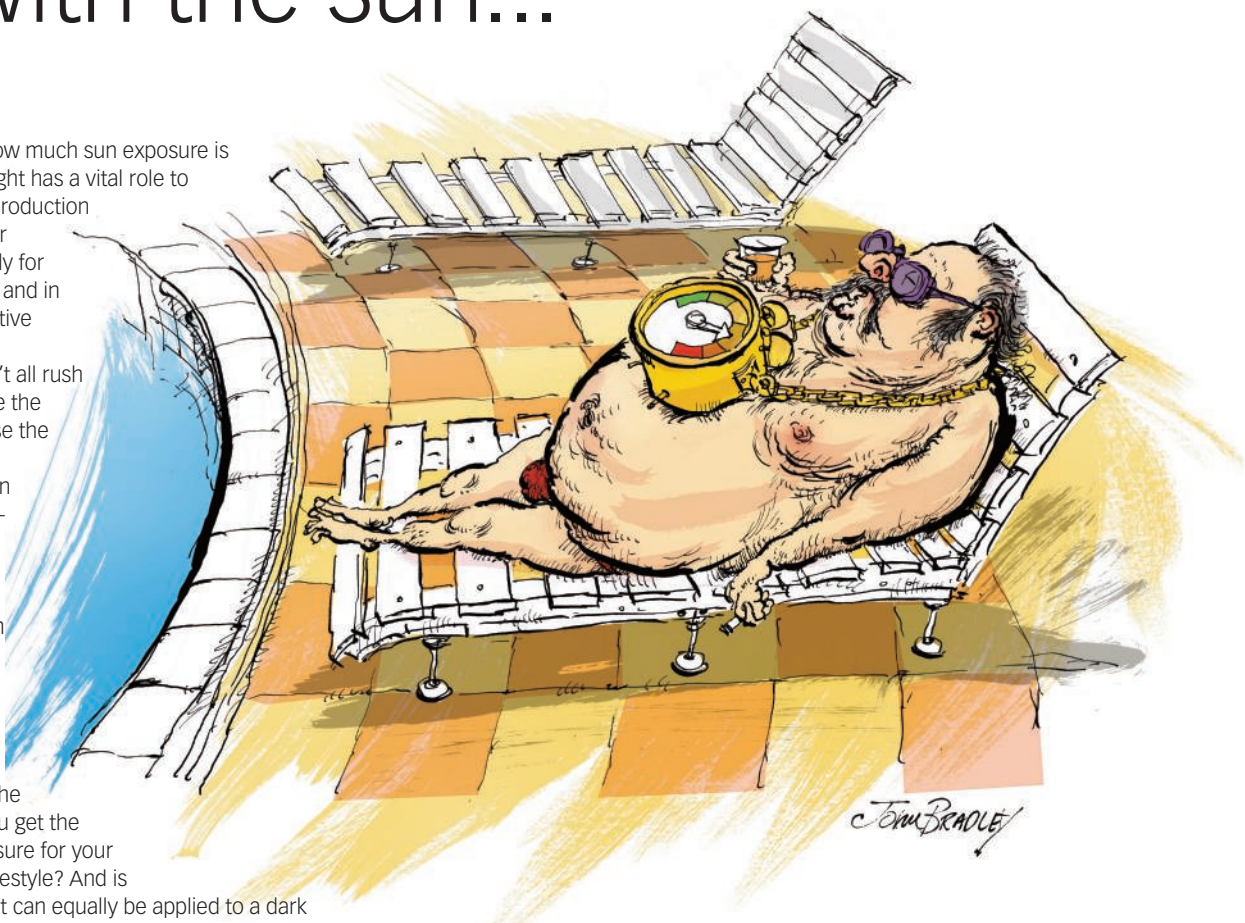
Fun with the sun...



How do you know how much sun exposure is right for you? Sunlight has a vital role to play in the body's production of vitamin D – essential for healthy bones and possibly for inhibiting some cancers – and in preventing seasonal affective disorder (SAD).

But, of course, we don't all rush into the garden every time the clouds blow away, because the sun has a dark side.

Its UV rays also have an ageing effect on the skin – and there is increasing concern about the rise in cases of skin cancer.

Moreover, a short-term overdose – sunburn – can cause headaches, blistered and sore skin, nausea, fever, and dehydration.

So how do you strike the right balance? How do you get the right amount of sun exposure for your particular skin type and lifestyle? And is there a magic formula that can equally be applied to a dark skinned woman in Scandinavia and a fair skinned man in the Sahara?

The challenge

We are looking for a device that will take care of the user. It must not be over-protective though and keep the user locked away, Dracula fashion, as soon as the sun comes out. But equally it must not put the user at risk from over-exposure.

Clearly the solution needs to be portable – but a perhaps a old-fashioned parasol would appeal only to ladies of a certain age and even then it only blocks out the sun, it does not allow the user to get safe doses of sunlight.

It also needs to be affordable. While this is a serious issue people do not want to feel that they are effectively paying to go outdoors.

It maybe there are solutions out there (or in people's imaginations) involving timed retraction of the brims of wide-brimmed hats, or an automated skin crawler distributing sunscreen, but we have a solution in mind that we will reveal next month.

In the meantime, if there are any ideas that you would like to share with us please go to the *Coffee Time Challenge* section of the website and leave a comment, or email your idea to tfryer@findlay.co.uk

The answer to last month's Coffee Time Challenge - to improve water management in buildings - can be found on p10 of this issue.

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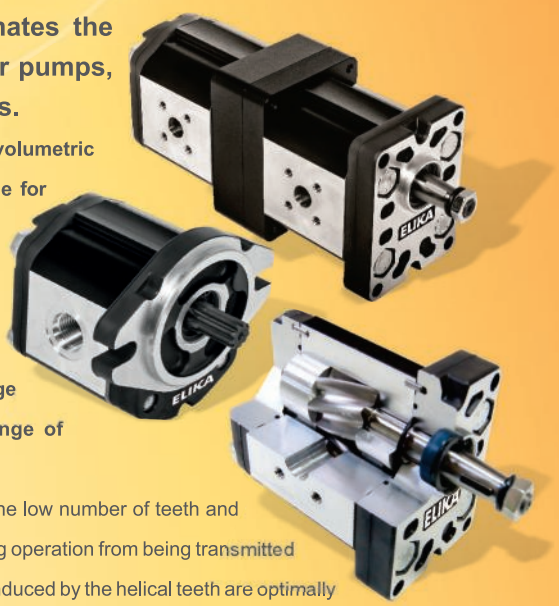
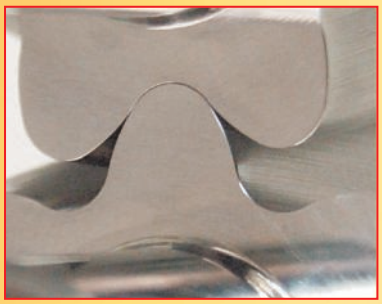
The helical shape of the patented Elika® profile eliminates the phenomenon of air encapsulation typical of normal gear pumps, curing the source of the main cause of noise and vibrations.



The structure of the pump minimizes the internal leakage, maximizing the volumetric efficiency under all conditions. This feature makes the Elika® pump suitable for work operations with low speed and high pressure. Internal leakage, laminating from outlet to inlet and overheating the pump components, is virtually eliminated in the Elika® pump range.

Comparing the characteristics of the Elika® pump range to other volumetric pumps, it can be seen that, due to the wide rotational speed range, large working pressure and viscosity bands, Elika® is suitable for a wide range of applications. The Elika® range includes group 2, 3 and multiple pumps.

The helical gear ensures continuity of motion despite the low number of teeth. The low number of teeth and shape of the profile significantly reduces pressure-oscillations and vibrations during operation from being transmitted to the other components, reducing the noise of the hydraulic system. Axial forces induced by the helical teeth are optimally balanced in all operating conditions by the axial compensation system integrated in the pump cover. Specific compensation areas in the flange and cover, insulated by special gaskets reinforced with anti-extrusion, allow for free axial and radial movement of the bushings, which is proportional to pump operating pressure. In this way, internal leakage is dramatically reduced, ensuring very good volumetric and mechanical pump performances, as well as proper lubrication of moving parts. **The ELIKA® gear pump reduces noise levels by an average of 15 dBA compared with a conventional external gear pump.**



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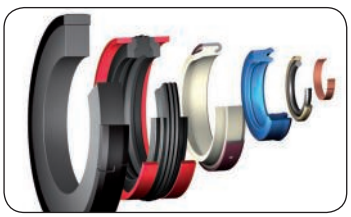

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