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In this issue: Simulation software • Structural adhesives • Motors for space • Automotive development

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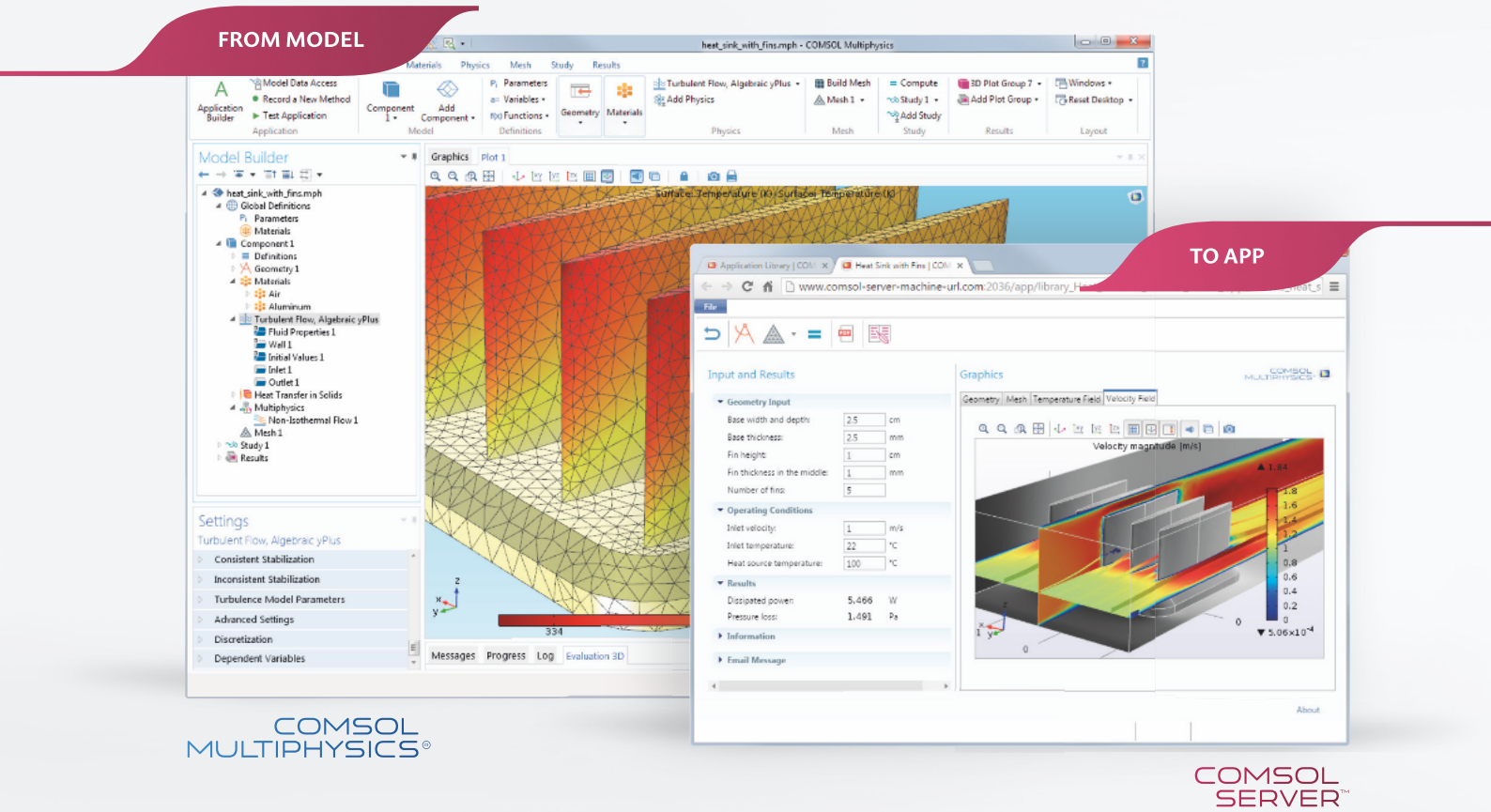

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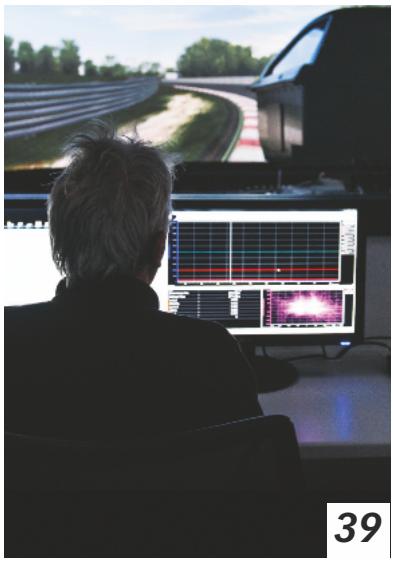

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Does your rotary application design demand unusual shaft attachments or perhaps the design requires a higher degree of angular offset than the standard flexible shaft coupling can deliver?

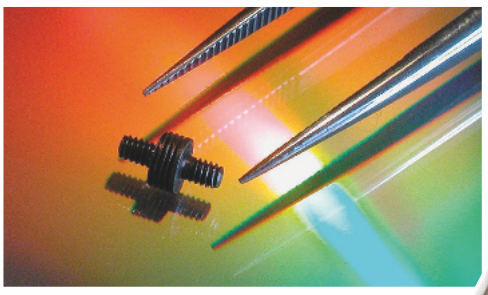
Perhaps your application needs to transmit more torque, but you cannot change the physical envelope size of the existing shaft coupling?

These questions are nothing new to Abssac, who have been solving such problems for over 30 years with its unique specialist Heli-Cal beam product. As the originators of the product, the ability to adapt into applications where simply others can not follow provides the end user with a means to help solve rotational challenges, without the cost burden normally associated with special or bespoke made products.

By utilising flawless production techniques, the single piece construction totally eliminates any form of friction wear within its design, whilst also ensuring a zero-backlash and no torque loss operation.

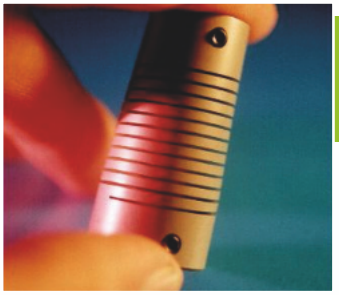
The Heli-Cal product, is determined by six major characteristics:

1. The shaft coupling outside diameter
2. The shaft coupling inside diameter
3. The coil thickness
4. The material used
5. The number of coils in the flexure area. i.e. more coils more flexibility
6. The number of coil starts i.e. single, double or triple start



Endless Possibilities

Did you know that Abssac has just supplied a fully functional 3mm diameter shaft coupling for a medical application. Using a left and right handed thread shaft for attachment the coupling could accept up to 1 degree of angular offset rotating up to 10,000 rpm. The same customer is now looking at a double start flexure with a 1.5mm outside diameter produced in titanium.



By altering these characteristics; torque capacity, angular and parallel misalignment capabilities, can be modified to suit specific specifications and or requirements.

Chris Cattle at Abssac says, "When you consider the Heli-Cal couplings capability as a shaft coupling and then add this ability to integrate the design engineers own end attachment ideas, you have a formidable product combination that other coupling manufacturers cannot supply"

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War games

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

I do not yet own a drone although I suspect it is only a matter of time. Their controllability even in basic models far outstrips that of toy/model helicopters and the addition of reasonable resolution cameras on a stable platform further adds to their appeal. They are the ultimate geek toy.

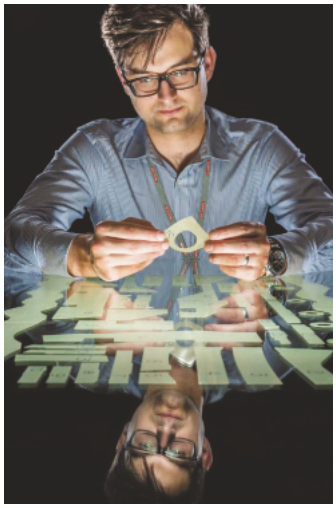
Progress at the top end of the market has also evolved, in this magazine we covered the development of the 'Flying Wing' in the February issue and we will have one of the latest products on the market on show at the Engineering Design Show in October. Such products will probably revolutionise surveillance and remote monitoring applications in the near future. Will they also be delivering Amazon packages to your doorstep? I doubt it. But the fact that it is being considered for such applications highlights that heavy duty drones can carry a considerable payload. Indeed there is no difference, except in name, between drones and the original name of Unmanned Aerial Vehicles (UAVs) – devices that the military use in some cases to carry missiles.

Recently an Airbus A320 coming into Heathrow flew under a drone, missing it by just 3m. Presumably this particular case was no more than the same level of stupidity that drives teenage boys to shine laser pointers at aircraft pilots, but it is no less dangerous for all that. And this level of access to potentially dangerous technology is a concern.

There are rules, rather than legislation, that guide the use of drones and you only need a CAA 'permission' if you are using them commercially. There are no initial obstacles to purchase or even to make such devices though - there are websites dedicated to DIY drone building. So in a society that feels at risk from an unknown enemy from within, should the sale of such devices be regulated? The mentality of a suicide bomber is not going to be too concerned with following a code of practice that doesn't allow drones to be flown above 400ft, above crowds or on a flightpath coming into an airport. Indeed, 9/11 turned the commercial aircraft into a weapon – we wouldn't want that to happen with a toy.

NEWS

Masking tape to save BAE Systems £45m



Engineers at BAE Systems have designed a masking tape that doesn't leave behind a messy residue. It could significantly reduce the need for metal cleaning activities in production environments, helping the company save up to an estimated £45million over the next 20 years.

The tape solution should address the common problem of adhesive residue being left on aircraft parts when traditional heavy aluminium tape is peeled away, which can be time-consuming, damaging and costly to remove during production and post production processes.

The tape was developed by a team that included structures engineer Sam Ashworth, a recent graduate, who said: "It is really exciting to work on an advanced project like this so early in my career. There is real satisfaction in developing a practical solution to a real problem, knowing that the finished product will result in significant time and cost savings for the F-35 Lightning II programme, and potentially other platforms across the sector in the future."

The tape saves around £15,000 per aircraft on the F-35 Lightning II, and the company is implementing it into the Hawk and Typhoon aircraft production processes.

Smart metal used in needlescopic surgery

A team of engineers and doctors at Vanderbilt University's Medical Engineering and Discovery Laboratory have developed a surgical robot with steerable needles equipped with 'wrists' just 2mm across.

Needlescopic surgery is a minimally invasive technique that has been used since the 1990s. It uses tiny surgical instruments with incisions to insert instruments in to the body that are so small (5 to 10mm), they can be sealed with surgical tape rather than stitches.

The Vanderbilt team's robotic arm is made of nitinol, a 'memory metal' that retains its shape after being bent. As nitinol is a rigid material, ridges were cut into one side of it to allow a bend of up to 90°, operated by a wire-and-pulley system threaded through the inside of the tube.

The new device is designed to provide needlescopic tools with a degree of dexterity, a function they have previously lacked. Not only will this allow surgeon-operators to perform a number of procedures such as precise resections and suturing that hasn't been possible before, but also the use of needles in places that have been beyond their reach, such as the nose, throat, ears and brain.

Events

For more event details go to www.eurekamagazine.co.uk

9 September 2015
FAST (For preview see P33)
Oxfordshire

FAST FASTENING & ASSEMBLY SOLUTIONS AND TECHNOLOGY EXHIBITION

Exhibition for designers who use adhesives and fasteners.

29 September - 1 October 2015
PPMA Show 2015
NEC, Birmingham
Exhibition from the Processing & Packaging Machinery Association.

30 September - 1 October 2015
Sensors & Instrumentation Exhibition co-located with TCT Show + Personalize
NEC, Birmingham
Exhibition for sensor technology located with an event dedicated to 3D printing and product development

21 – 22 October 2015
Engineering Design Show 2015 (For preview see P20) co-located with the Electronics Design Show
Coventry
The must-attend event for design engineers.

29 October 2015
British Engineering Excellence Awards (BEEAs)
London
The seventh British Engineering Excellence Awards (BEEAs) will be held at The Hurlingham Club.

3 November 2015
NIDays - London
QEII Conference Centre, London
The annual graphical system design technical conference and exhibition.

NEWS

Here is a selection of the latest products featured on the Eureka website. Just enter the reference code in the search box for the full story

Hall effect sensor suits extreme environments
87903

Unrivalled choice with extended valve system
87894

Share CAD data with 3D PDFs
87806

Visualise 3D provides support for CATIA V5
87760

Benefits of metal belts and drive tapes
87668

High performance drive in a small package
87620

On-the-go HMI access
87619

Two-in-one bearing lubricator
87518

UK leads autonomous vehicles

The RDM Group has welcomed the Government's commitment to driverless vehicles. The advanced engineering company is helping to bring the 'LUTZ Pathfinder' and 'UK Autodrive' projects to reality.

David Keene, chief executive of RDM Group, believes the £20m dedicated fund and 'Code of Practice' published by the Department for Transport will give the UK the opportunity to lead the world in the successful roll-out of intelligent mobility and autonomous vehicles.

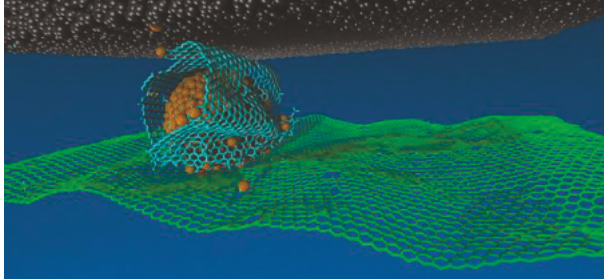
"This latest announcement proves that, as a country, we are serious about doing more than just talking about this technology," Keene said. "We welcome the clear direction that will come from a 'Code of Practice' and a new policy unit that will be committed to understanding the technology and removing potential obstacles in its development."

Keene continued: "We also need to make sure that autonomous vehicle development involves the entire UK supply chain and small manufacturing specialists.

"There is so much design and technical innovation present in the UK that can accelerate this journey and, if we get this right, the benefits for industry and the economy as a whole are huge."

TECH BRIEF

Near-frictionless material simulated



While reviewing the simulation results of a promising lubricant material, Argonne Leadership Computing Facility (ALCF) researcher Sanket Deshmukh stumbled upon a phenomenon that had never been observed before.

When the lubricant materials - graphene and diamond-like carbon (DLC) - slid against each other, the graphene began rolling up to form hollow cylindrical 'scrolls' that helped to practically eliminate friction. These so-called nanoscrolls represented a completely new mechanism for superlubricity, a state in which friction essentially disappears.

"The nanoscrolls combat friction in very much the same way that ball bearings do by creating separation between surfaces," said Deshmukh.

Co-researcher Subramanian Sankaranarayanan added: "The beauty of this particular discovery is that we were able to see sustained superlubricity at the macroscale for the first time, proving this mechanism can be used at engineering scales for real-world applications."

Scissor bridge for emergencies

A portable bridge inspired by Origami was presented at a symposium of the Japan Society of Civil Engineers by Dr Ichiro Ario, assistant professor at the Institute of Engineering, Hiroshima University. The Mobile Bridge Version 4.0 (MB4.0) has been designed to aid rescue teams in the aftermath of natural disasters such as floods, earthquakes and landslides.

The MB4.0 was deployed over the Hongo River in Fukuyama City to demonstrate its viability for practical use. During the test, the bridge was set up without any foundation work, and a vehicle travelled across it.

The bridge features a scissor-like structure that is connected to the main structural members to form an 'X' shape; this enables expansion and contraction while retaining strength. The idea for this bridge comes from academic studies on buckling based on Origami, which has attracted researchers involved with developments in other fields, such as space (see article on p35 of this issue - Space boom out on a limb).

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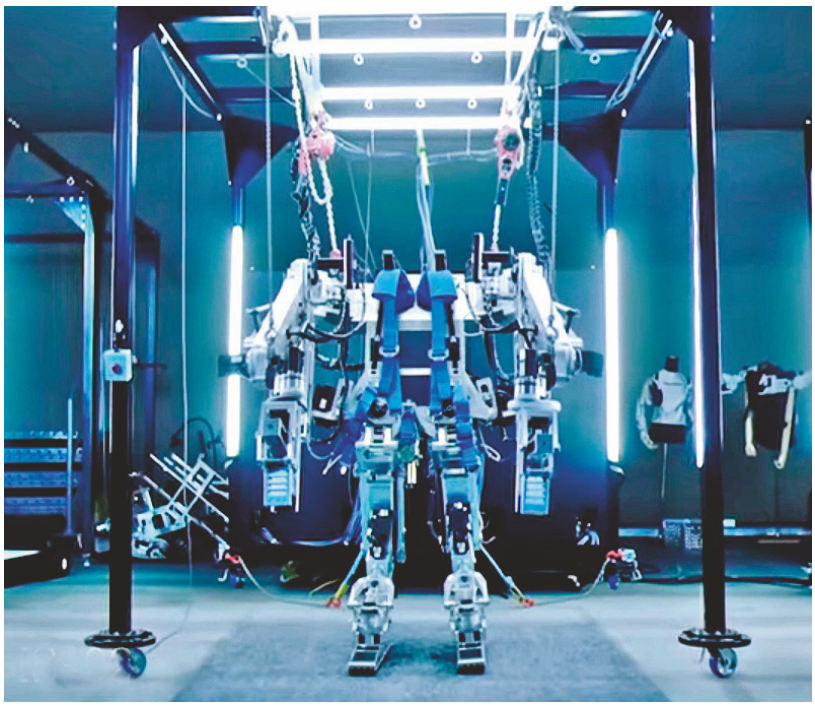


Exoskeleton to ease the load

ActiveLink, a subsidiary of global electronics giant Panasonic, is to release one of the world's first mechanical exoskeletons in September 2015 for industrial uses within warehouses, ship yards and anywhere that requires heavy lifting of equipment.

The suit weighs just 6kg – excluding the battery – and is attached to the wearer's shoulders, waist and legs. The suit is full of embedded sensors that respond to the movement of users and send signals to motors, allowing relatively free and normal movements. The aim is to dramatically increase the wearer's ability to lift heavy objects and replace forklift trucks and other lifting equipment where it is advantageous to do so.

There is little doubt that the designers were inspired by a similar suit worn by Sigourney Weaver in the 1979 film, Alien. The suit will retail at just over £5000.

Solution to last month's Coffee Time Challenge

SPONSORED BY MICRO EPSILON

The solution to last month's Coffee Time Challenge – to come up with a better, more accurate, way of counting steps – comes from South Korean firm 3L Labs. Engineers there have developed the FootLogger insoles that are clad with various sensors including 3-axis accelerometers and eight pressure sensors at key points on the foot.

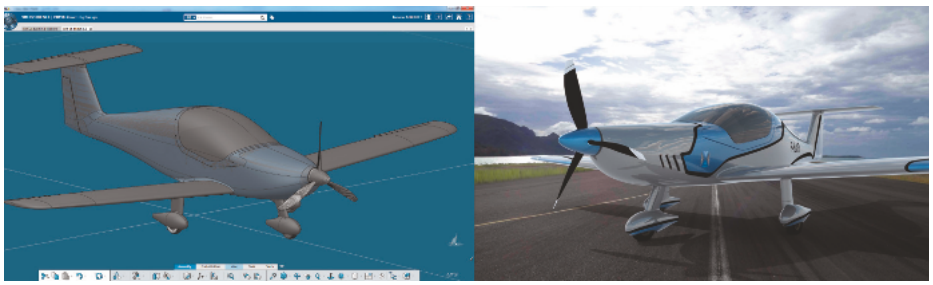
These light and unobtrusive insoles can log up to 50,000 footprints over the course of a day on its built in flash memory and can run 24 hours per charge on the integrated battery.

These then dock to a 'Shoe Station' that is able to download the data via Bluetooth and analyse it. The results are then sent via wifi to an app on the user's phone for easy and quick assessment of the day's activities. The Shoe Station also wirelessly charges the insoles.

Critically, however, the multiple pressure sensors allow the user to see how they distribute weight across their feet during various activities. This allows athletes to monitor weight distribution during something like a golf swing, as well as aid progress during rehabilitation.

TECH BRIEF

Aircraft designed in the cloud



The first aircraft designed using cloud-based applications is being developed by French aviation startup, Elixir Aircraft

Elixir Aircraft will rely on Dassault Systèmes' 'Engineered to Fly' industry solution experience for the cloud-based design and engineering of a two-seater airplane. The aircraft's first flight is expected to take place in mid-2016.

"Small companies face administrative and infrastructure challenges that require significant time and costs, and these can ultimately detract from achieving the primary business goal," said Arthur Leopold-Leger, CEO, Elixir Aircraft. "To create our first aircraft, we've chosen the Dassault Systèmes 'Engineered to Fly' cloud solution because it allows young businesses like ours to benefit from immediate deployment, ease of use, data security and full technical support. As a result, we can dedicate our resources to design and engineering."

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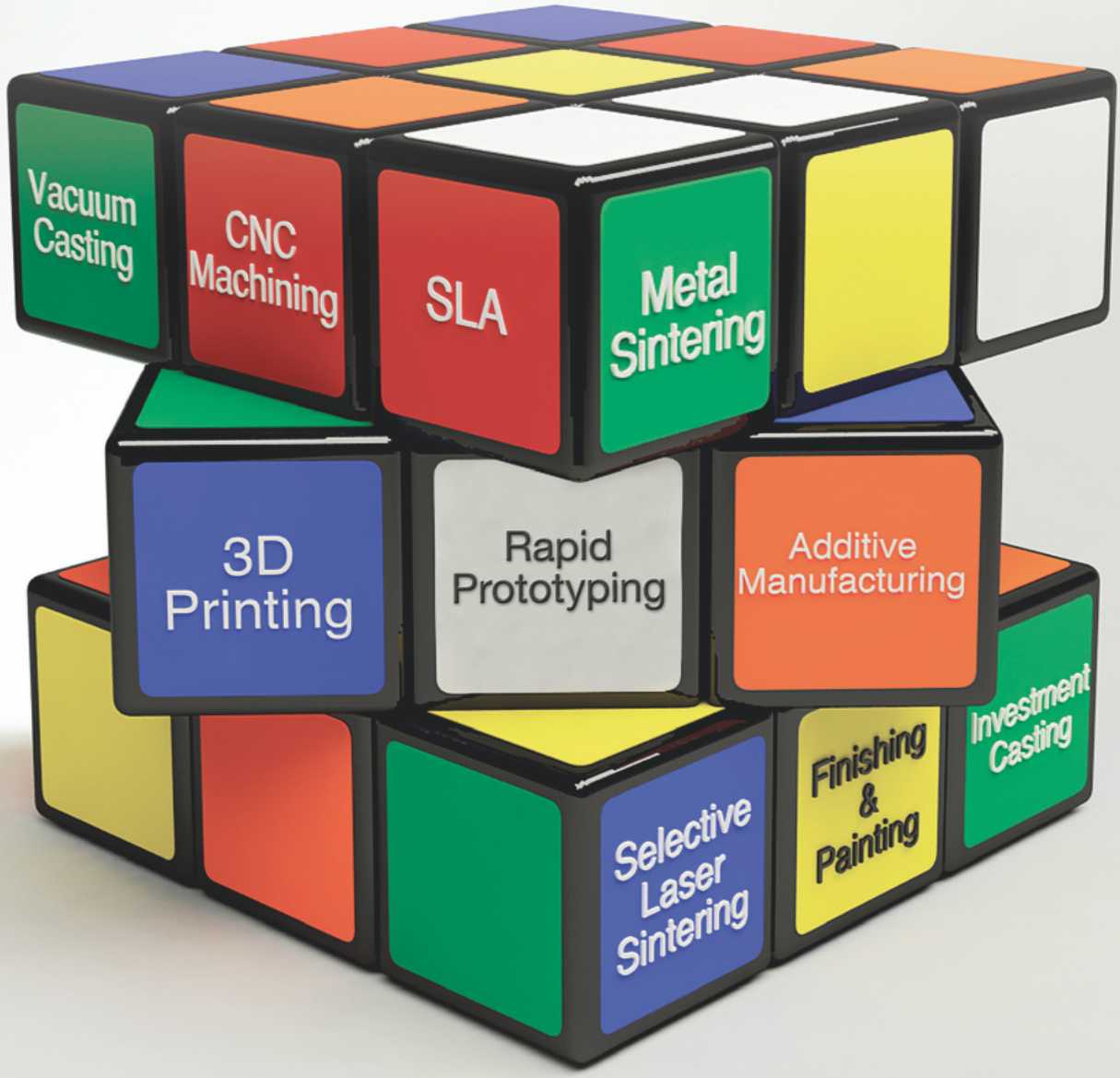

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NEWS

MENE makes its mark

Debut event reflects strength of North East's engineering sector. By Tim Fryer.

By the end of the Manufacturing & Engineering North East (MENE) show, held in July, over 1300 visitors from the manufacturing and engineering community had assembled at the Metro Radio Arena in Newcastle, exceeding target visitor numbers by 30%.

Ed Tranter, executive director for organiser Findlay Media, commented: "We have taken our proven events format to a region that can be slightly geographically isolated from mainstream exhibitions and conferences, yet it is one of our country's engineering heartlands."

The format Tranter referred to is the now well established Engineering Design Show (EDS) – an national annual event held in Coventry.

"Putting on an exhibition in isolation is no longer enough to encourage engineers to leave their workplaces," explained Tranter. "What we have done with EDS, and successfully replicated at MENE, is to combine a packed exhibition hall with a conference and workshop programme that will interest, educate and entertain the audience."

The conference programme at MENE did just that. It highlighted the national, and sometimes global, significance of the current generation of engineering, which has replaced the heavy industries of old. Prime examples of this were Lucy Prior of the Rail Alliance, talking about, 'Britain's second railway boom', with the backdrop of the new Hitachi train manufacturing plant in nearby Newton Aycliffe; and Paul Butler of the North East Automotive Alliance, describing how having the UK's largest car plant (Nissan in Sunderland) in the region is stimulating the whole automotive supply chain.

In another fascinating session, Pamela Petty, MD of Ebac, described how her company was at the point of introducing a range of washing machines that have been designed and manufactured in the North East. With perceived wisdom that household appliances can no longer be successfully manufactured on these shores, the Ebac story will offer encouragement to any design engineer looking for proof that even consumer goods can be successfully made in the UK.

There was plenty more in the conference programme that covered the renewable energy sector (another of the North East's success stories), additive manufacturing, design protection, Government investment through Innovate UK and the 'Catapults', and a look at sectors as diverse as food and pharmaceuticals.

The crucial subject of encouraging the next generation of engineers was also covered through sessions about apprenticeships given by Alan Metcalfe of the Advanced Manufacturing Forum and also an innovative scheme to get children interested in engineering at a very early age. The Primary Engineer scheme introduced by founder Susan Scurlock highlighted the role engineering companies need to play in the process.

"The conferences were a huge success, but we were equally as delighted with the workshops, which were designed to provide content of a more practical, technical nature," explained Tranter.

Rather than look at industry sectors, these were more focussed on particular technologies including robotics, lightweighting, linear motion, 3D printing, vibration monitoring and EMC regulations. Like the conference, the workshop theatres proved popular with lively Q&A sessions after each one.

Tranter concluded: "The North East is a hotbed of creativity, it has manufacturing and engineering in its genes. We worked with local companies and professional bodies to bring the industry together – to provide the platform that this region has been crying out for. It is only because so many turned this event into a partnership that it worked so successfully. By the time the doors had closed, 70% of exhibitors had already committed to the event next year, a true measure that this collaborative approach has worked."

Manufacturing & Engineering North East will return on 6 – 7 July 2016, again at the Metro Radio Arena, Newcastle. More information will be posted on the website as it becomes available. **www.menortheast.co.uk.**

Speed date for

Every concept, design and iteration has to start somewhere. So often it comes back to that basic question: what is it you're fundamentally trying to achieve? Defining that, clearly, sets the tone for the entire project, as it becomes an integral philosophy overseeing the design process that follows.

For automotive engineers, this philosophy has arguably been the same since the time of Henry Ford: produce a vehicle for transportation. Yes, carmakers go off and focus their efforts on different things from being off road capable to being an economic commuter car. But, at the heart of it, the fundamental aim of a road car is to transport people, and that is never comprised. So, when someone comes out and says they want to design a car, but start from somewhere completely different, is it madness or genius?

"We set out to produce a piece of sports equipment and had a really clear goal: make the best driving car possible," said Ian Briggs, design director at BAC. "The moment you start from there, you realise you'd never dream of creating anything else but a single seater. You don't see a snowboard with space for mate. Yet, because cars are a method of transport, they have never been looked at in this way.

"We were never tempted to think about passengers or space for golf clubs. Everything that improved the car was in, everything that didn't was out."

The BAC Mono was designed by Ian Briggs and engineered by his brother Neill, and both followed the same fundamental design philosophy: produce a road legal track day car that promises to deliver the purist driving experience.

The Mono shot to fame when it literally sent ripples across the

face of Jeremy Clarkson on Top Gear during a test drive. It also set the second fastest lap time ever for a road legal car on the show's circuit. So did they expect such a rapid lap?

"It was our secret hope," said Briggs. "But it is only from the point of view of you're paying a high price for performance. We had to be that fast to confirm that if you do away with aircon, a roof, doors and place for your mate, what you get in return is a lot of dynamics in the vehicle, how it feels to drive, and ultimately a very quick car."

The Mono has something unique about it, perhaps a certain Britishness and Northern spirit that has been able to challenge convention and bring together both engineering prowess and sublime design aesthetic. The whole concept of making a hybrid road/racing car is a brave and novel one, but in the Mono it really works.

The Briggs brothers are unsurprisingly no novices. Both have comprehensive industry experience as design and engineering consultants working for names including Porsche, Mercedes and Audi,

singles

It's one of the fastest cars on the market, and is full of elegance and style. But the single minded design and engineering effort has no place for passengers. Justin Cunningham finds out why.

along with Lufthansa and even luxury yacht makers. And despite selling a single product, and to date producing just over 30 of them, the Mono is on magazine covers around the world. For those that can afford the price tag (thought to start at around £110,000), it delivers on the promise of that pure driving experience.

The car uses a pushrod suspension system with damping elements that can be adjusted for the road or track, for dry and wet conditions, and it leaves a lot of scope for setting up the car for a particular need.

As you would expect it is incredibly light and uses a carbon fibre composite construction over the top of a seamless tube laser cut steel chassis and roll bar structure. While it isn't designed to produce all that much down force, it has mechanical grip in abundance, which makes it the driver's car it sets out to be.

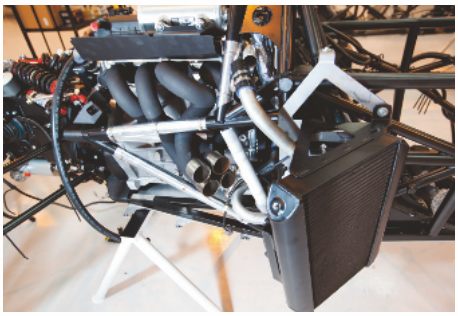
"We wanted to design a car that didn't exist," said Briggs. "No one has ever done a pure single seater for the road and it means the only thing not symmetrical is the intake and exhaust, and the wiring which runs down one side. The steering rack is right in the middle, where it should be."

Although climbing into the Mono is reminiscent of getting in to single seater racing car, the cockpit is covered in fabric and is far more elegant than the rough and ready inside thoroughbred track car. This was critical for Briggs, to include subtle features that make it comfortable and elegant, and not just fast.

An example is making sure the helmet will not bang against a hard surface, instead it only touches soft fabric. And nonslip fabric is above the steering wheel, so it doesn't slide off when its removed getting in and out. All practical, but insightful touches, that blend ergonomic design with the more brutish world of motorsport.

In turn, the engineering mind of Neill Briggs has delivered a car that is just as technically sound, as it is aesthetically pleasing. The two have perhaps been able to push the relationship between engineer and designer further than is normally possible. However, it was not without some sibling rivalry.

PHOTOGRAPHS: DEAN SMITH



"There were heated moments, of course," said Briggs, smiling. "But, it was good as there was a line. For example, I wanted rose joints all round. Neill told me that it has to work as a road car. We didn't want a jarring ride or things needing replacing, or even breaking after six months because of bumps in the road. And he was absolutely right."

Lots to learn

While many might view being a small car manufacturer in the north west of England as a hard place to be truly successful, Briggs' outlook is full of optimism. He actually sees the position of the business as an opportunity to improve the product and be competitive.

"The pedal box is our own design and is milled from a billet of aluminium," he explained. "There is nothing here that is brought, except the master cylinder. There is seven hours machining in the shear plate alone.

"A big OEM might buy a press tool, produce 100's or 1000's of that part, and pay a few pounds for it. But the advantage we have is that we can afford to put an expensive part there, which even sports car manufacturers can't. We might pay £300 for the part, but we only produce 50 cars a year."

All this means the car looks well engineered and can command its premium price tag. And for Briggs, it means that any changes to the design are immediate with no lock in because of existing tooling.

"We turn disadvantage into advantage," he explained. "We do that all over the car, and have a business and product that doesn't fight head to head with the bigger manufacturers on their terms."

And this philosophy goes way beyond the design and engineering of the Mono itself, and runs through the heart of the business. The fact that BAC don't have dealers to service cars all over the world has also become a point to leverage. Instead, BAC sends an engineer in person to wherever they are needed.

Similarities to Formula One

There are many aspects of the design of the BAC Mono that take inspiration from the world of F1, and wider motorsport sector. The process of having to climb in to the car with the steering wheel off gives that immediate sensation that you're getting into a racing car. And then a custom moulded seat and steering wheel further adds to the feeling that this is a car built around you.

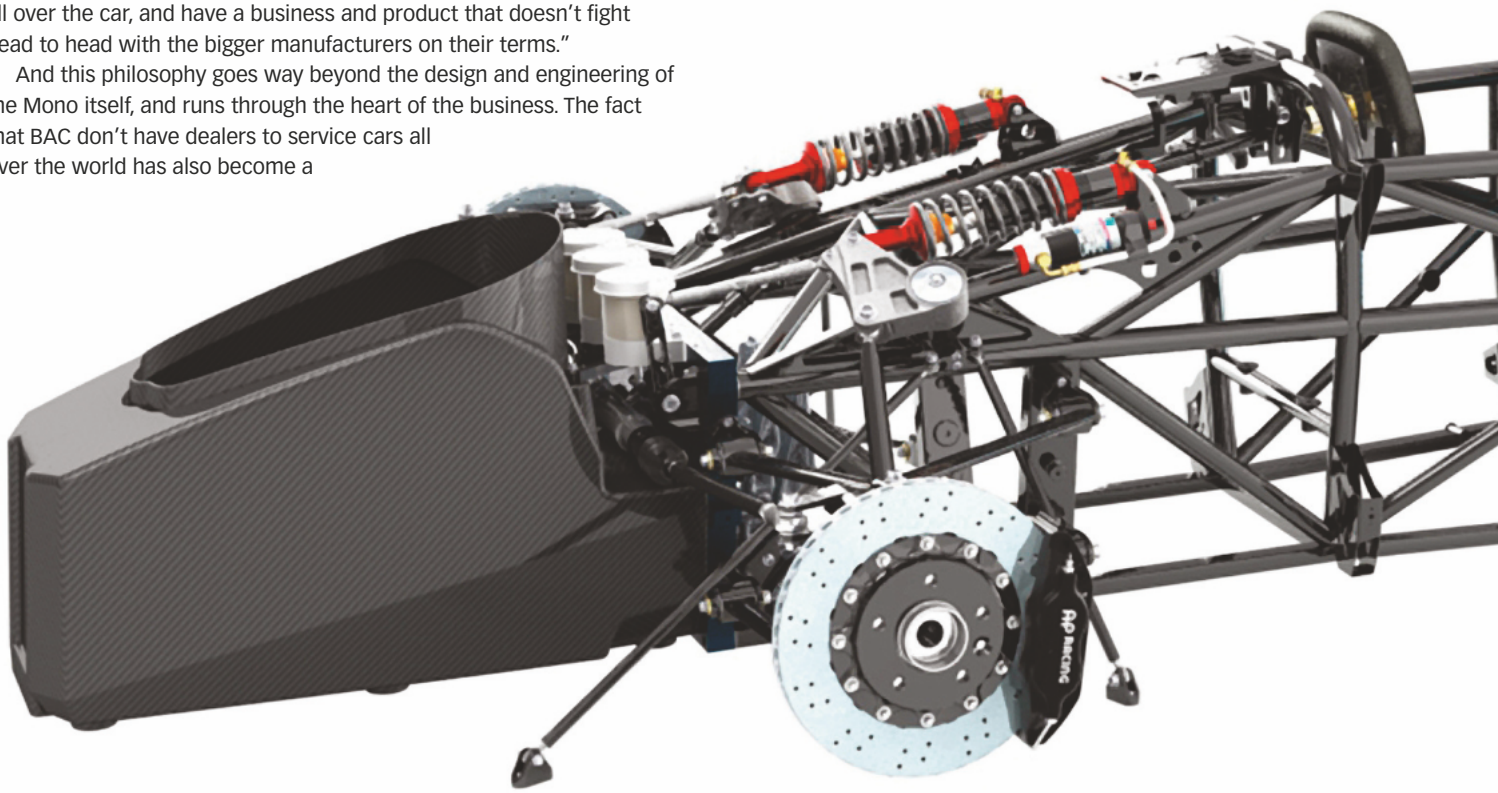
The steering wheel is moulded to the driver's hands using clay, which is then scanned and digitised before being 3D printed in rubber. This is then wrapped in leather, and integrated with various buttons and a display.

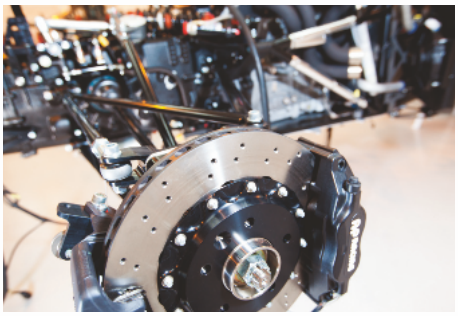
It is one of the most striking aspects of the car: the view you get sat inside. But despite its fanciful appearance, upon closer inspection it is simple to figure out and use.

"People have seen F1 steering wheels and when they sit in the car, they get that feeling," said Ian Briggs, design director at BAC.

The seat is moulded to the driver's body and buyers have to attend a 'sitting' – quite literally – to have the seat custom made for their body.

In addition, the website has a configurator that allows potential buyers to go through a raft of personalised options from colour of bodywork to other F1 inspired functionality such as brake bias adjustment from inside the cockpit.





"We send the guy that built the car to the owner's house," said Briggs. "So again, we turn the fact we don't have dealerships all over the world into an advantage as the customer gets great service. And that is what you need to do as a small business."

The short term success of the Mono has seen the team move in the last 18 months to a factory in Speke, Liverpool. BAC is now in the process of ramping up production to meet demand and by the end of the year hope to be producing one Mono a week. It is still ambitious for a company that has produced just over 30 to date.

"It is a hell of challenge building a Mono," said Briggs. "There's something like 1500 components from 100 suppliers. We are just going step by step."

And, to add to its complications, the company has recently increased the engine capacity, where customers desire, from 2.3L to 2.5L. This will increase horse power from 280hp to 305hp. But a turbo engine, much like the world of current F1 cars, is inevitable.

"At the moment all the engines are made by Cosworth and are normally aspirated," said Briggs. "We've not gone down the turbo route yet, but we will have to at some point I'm sure to get emissions down. While the 2020 emissions regulations do not affect us as we don't produce enough cars, if you want road registration in much of mainland Europe you need to meet Euro 6 emissions standards."

Beyond this the Briggs brothers have big plans, possibly a Mono race series, or possibly something completely different again. While it is certain that for at least the next few years they'll be kept busy, expect more.

For the time being, however, with current national figures showing the growing success of the UK car industry, the Briggs brothers are pleased to be part of the in-crowd, and continue their reputation as industry innovators.

www.bac-mono.com

Removing the composite bodywork shows the full extent of the Mono's motorsport credentials

Specification

Powertrain: Cosworth 2.3L or 2.5L 4-cylinder, normally aspirated, to give 285hp or 305hp.
Transmission: 6 speed sequential semi-automatic
Kerb weight: 540kg
0-62mph: 2.8second
Top speed: 175mph
Seats: 1

Link for the future

Children need to be introduced to engineering if they are to be excited by it, and this introductory role – a bridge between engineers and schools - is being filled by STEMNET. Tim Fryer asked chief executive Kirsten Bodley how the organisation is progressing.

The cover story of *Eureka's* June issue addressed the lack of school children taking an interest in STEM subjects, therefore turning their backs on careers in science and engineering at an early age. One organisation that hopes to remedy this on a national scale is STEMNET, which not only offers free advice to schools on how to embed STEM learning and create STEM clubs, but also runs its flagship STEM Ambassadors programme.

There are now over 30,000 STEM Ambassadors – volunteers from industry who provide context to the school curriculum, showing for example how maths and physics can be turned into a career.

STEMNET's remit is to work in every secondary school, co-ordinating these volunteers as STEM Ambassadors to provide a broad and positive image of technology based careers, and provide school teachers with a resource they can knit into curriculum-based studies.

Kirsten Bodley is chief executive of STEMNET and believes children need to get past the common belief that taking science subjects can only lead to being a doctor or science teacher.

"What we are doing is about the whole issue of STEM literacy," she explained. "It is more about life skills on one level, but also allows a look at a lot of different careers and will clearly help the skills shortage. But that isn't something that can happen overnight and it means working in a coordinated way."

Part of the problem is that we don't start early enough. "What we need is to start working in a less patchy manner with primary schools because then the difference we make is amplified in secondary schools," claimed Bodley. "If primary schools want STEM Ambassadors then we provide them, but we don't proactively form relationships like we do with secondary schools because there are just too many." There are 4000 secondary schools compared with 21,000 primaries in the UK.

STEMNET agrees targets with its principal funders of which BIS is the largest and also includes DFE, the Gatsby Foundation and the Scottish Government. These targets cover relationships with schools and engagement with the Ambassador programme, rather than looking for specific increases in students taking STEM subjects.

Bodley said: "We don't exist in isolation, so we can't say we are responsible for a certain number of extra students taking Physics A level, but our last evaluation report was incredibly positive. We have had a real impact on young people, the teachers and the employers we work with."

These employers are crucial, as they're responsible for providing STEM Ambassadors. However, diversity within engineering companies in terms of size, location, technology and many other factors means that every STEM Ambassador comes with a different message and each contributing company is looking to get something different out of it.

"The model is very flexible," said Bodley. "A lot of the large employers have a very national approach, like Rolls Royce for example. But a lot of schools and young people don't fully understand how many local SME's there are. There could be a smaller employer around the corner from the school that they are unaware of."

Companies like Rolls Royce have their own education departments but, according to Bodley, "smaller ones don't have that capacity, so they like to use us as their infrastructure. It makes them easy to engage with in their local area, and that is where their future workforce will come from."

By providing this path between engineering community and schools, some of the traditional stereotypes, which often prevent children from considering engineering careers, can be broken down.

"There is this wide perception that an engineer is the guy who comes round to look at your boiler - that is the public face of engineering and it's a difficult one to break," observed Bodley. "To me the best way to break it is to get role models in front of young people who can actually demonstrate what an engineer, scientist or technologist is. Many years ago there was a girl that commented to me, 'goodness I didn't know scientists could be married with kids!'

"40% of our STEM Ambassadors are female and that's not to just benefit the girls. I firmly believe that we need to put female role models in front of boys as well. If boys don't understand it is okay for girls to do science, maths and physics, then the girls won't choose to do them as there is too much peer pressure. We deliberately have a much higher proportion of females in our STEM Ambassadors programme than there is in the STEM workforce."

Equally, the profile of STEM Ambassadors is kept as young as possible – 60% are under 35 – in order to improve the connection with children. And there is still a need for more people to come forward from within the engineering community as every individual has had a different career path and perspective on engineering careers.

And the best way to utilise this resource and share this experience is to go through STEMNET concluded Bodley. "There is an awful lot of stuff that is sent into schools and they don't know how to sort it out. Because we are seen by schools as a trusted advisor in terms of STEM, we are actually the best route to get something into a school or to raise the schools awareness of something that is available."

www.stemnet.org.uk

"A lot of schools and young people don't fully understand how many local SME's there are, and there could be a smaller employer around the corner from the school that they are unaware of."

CV

Kirsten Bodley is the chief executive of STEMNET, a UK-wide charitable organisation that works with thousands of businesses and schools to inspire young people, and promote all aspects of Science, Technology, Engineering and Mathematics.

Kirsten began her career in industry as a development chemist for Courtaulds working in the coatings division. She then moved on to become a consultant for the chemical and pharmaceutical industries, in R&D, at KPMG Consulting.

She subsequently changed her career path and became a Year 6 teacher at Claygate Primary School. Continuing with her deep interest in education, she embarked on a career as STEMNET regional director for London. She then became director of networks in August 2008.

Kirsten has completed degrees in science, education and business, and is a member of the Society of Chemical Industry.

Over the past three years The Engineering Design Show has earned a reputation for being the 'must attend' event for those engineers looking for solutions, innovation and inspiration. Here is what to expect at this year's show.

Engineering design show Building

Since its launch in 2012, the Engineering Design Show (EDS) has tripled in size and continued to exceed expectations; not only in terms of visitor numbers, but also in the quality of the conference and workshop sessions.

"We have built our reputation on providing engineers with the information and inspiration to be able to do their jobs better when they return to their workplaces." That is the view of Ed Tranter, executive director of Findlay Media, who has been the driving force behind the event since its inception.

"Our goal was always to provide a comprehensive event so that engineers could guarantee that time with us at the Ricoh Arena was far more valuable than the time lost being away from their offices and factories," said Tranter. "If engineers want to talk to the leading suppliers in industry then we have 200 of them each looking to discuss innovative solutions. If engineers want practical, technical information, we have a full schedule in our four workshop theatres. Or if the focus is on broader issues and bigger projects, we have a conference programme that will intrigue and entertain."

Co-location with the Electronics and Embedded Design Shows adds that further lure for those exploring the integration of electronics within designs and projects.

It is a formula that has worked well: 1500 visitors in the inaugural year became 3000 in 2013. Last year that number had risen to 4200 as the reputation for 'time well spent' grew. However, while more visitors are expected, the focus for the organisers is fine tuning the event to maximise its impact.

Certainly the Ricoh Arena will, like the year before, be filled to capacity in terms of exhibitor space. However, Tranter emphasised that this demand would not compromise the focus for the event.

"We could have taken out the workshop theatres to make more room for paying exhibitors," he said, "but right from the beginning, our core philosophy has been to provide the content. And that means getting the right balance between exhibitors, conference and workshops."

In fact, in recognition of the value of the workshops, the Institute of Engineering Designers has CPD Certified these sessions, so delegates can be issued with certificates that can be used for CPD assessment.

Innovation Zone

Of course there also needs to be progress and this year will see further development of the Innovation Zone. This Zone, introduced in 2013, was a display of innovative products that often utilised components, tools and techniques being discussed in the exhibition workshops and stands.

Last year these included flexible electronic displays, the bebionic prosthetic hand, a 3D printed bicycle and the Williams Advanced Technology battery that powered this year's inaugural Formula E cars.

This year's collection will be equally eclectic – airships, robotic arms, unusual ceramic coatings and even a sub-sea cabling laying machine (a scaled down version of an awe-inspiring giant). Moreover the Innovation Zone is evolving into an

Fact file

When: 21 – 22 October 2015
Where: Ricoh Arena, Coventry (*2 minutes off the M6 JCT3*)
Parking: Free
No of conference sessions: 13 (Eureka conference) 13 (New Electronics conference)
No of workshop sessions: 40
No of exhibitors: 210
Pre-registration: NOW!

on a **reputation**

Innovation Trail, linking interesting exhibits around the whole event. Details of this will be announced nearer the time.

Conference

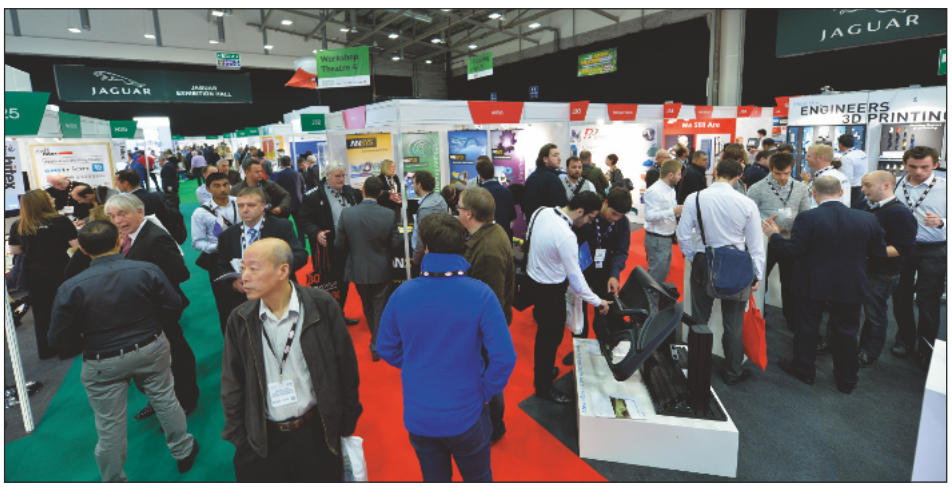
Once more the conference will take centre stage. At the time of writing the full conference programme is being finalised, with full details announced in the September issue of *Eureka*. However, to whet the appetite, one fascinating presentation will look at Britain's bid to win the America's Cup for the first time. Andy Claughton, technical director of the Ben Ainslie Racing team will lead the session and describe how his design team are creating the boat and also validate his claim that the America's Cup is as much an engineering competition as a sailing one.

Another intriguing session will reveal how a British company is completing the renaissance of the airship. Hybrid Air Vehicles has developed a vessel that is no novelty, it is a genuine workhorse offering advantages over planes and helicopters.

And with the tantalising recent glimpse of the surface of Pluto, has there ever been a better time to look at the space industry - not so much boldly going where no man has gone before, but more the technical and practical challenges of near earth satellites and their applications.

"It will be a great two days once again," concluded Tranter. "Working with all of our industry partners and using visitor feedback, the Engineering Design Show has evolved into the best event for design engineers in the UK. We have moved on from the old argument of 'why should I be there?' and onto 'why would I not be there?' And there are not many answers left to the latter question."

www.engineeringdesignshow.co.uk



An engineering

Our incumbent technical editor takes to the screen to present a new engineering show due to air later this month. He tells the story of what to expect, and how it all came about.

Some of you may have noticed that at the beginning of the year there was a distinct lack of content across the pages of *Eureka* written by myself. No? Well there wasn't. The reason is, well, slightly surreal.

Around this time last year I was called at work and asked if I was interested in auditioning to present an engineering show for Discovery Channel. Thinking nothing would come of it, I gave it a go. Well, one thing led to another and the show was commissioned. So, here I am, writing to you, readers of *Eureka*, about my TV debut.

The show is called 'Incredible Engineering Blunders: Fixed', and investigates strange engineering phenomena, errors and faux pas that have happened for one reason or another, and the extraordinary efforts and solutions applied to put them right. I loved the concept immediately as it embodies, for me at least, what engineering is all about: problem solving. It's not an exposé or finger pointing exercise, but more of a journey investigating what has happened and how it can be fixed.

My time as an engineer started when I was working for Astrium Space back in the early 2000s. There I saw some incredible engineering achievements, and met some wonderful characters. Among them was the late Colin Pillinger, the driving force of the Beagle 2 Mars Lander. To this day I think of that project as a triumph, and despite its superficial failure, it continues in my mind to be a star of ingenuity. So, perhaps my career has been building up to this, to look in more detail at infamous blunders!?

While filming the series I travelled to eight countries to investigate what I regard as mostly civil and construction engineering challenges. Now, without giving too much away, there are a number of reasons why these things have occurred. Some were historical, others a touch on the political, some bad judgement, and others are a compromise of the best bad solution.

I salute all the stories in the series as they're on the whole trying to push the boundaries, do something different, challenge the status quo, or provide solutions to complex, difficult problems. And for me, that's what's exciting about engineering and the show.

I'm not alone in hosting the series. In every episode I'm joined by guest investigators, who go on their own personal mission to undercover what has gone wrong in all corners of the globe. In total we cover 15 countries, from Canada to Australia, Brazil to Malaysia, and of course one or two here in the UK.

So let me give you a flavour of what to expect: I see the the remnants of a collapsed ski jump complex; walk the craziest crossroads in the world where a dual carriageway and international airport runway collide; help maintain wind turbines in the North Sea; walk across a stadium roof that is in danger of collapse and held up only by air; drive the worst roads in the US; and inspect the bearing of the world's tallest fully rotating structure. It certainly has been an adventure, to say the least.

Every story that I investigated was different. There wasn't a theme behind the blunders, and rarely was it down to poor engineering. Often it was the only practical solution such as the elevated roadway through São Paulo, Brazil. Here, cars and trucks fill an eight lane highway that is just metres from high rise apartments. But, I'll admit, in other cases I'm still wondering how things went so badly wrong and got so out of hand. For example, I see a Chilean drawbridge that was built back to front. Work that out!?

It was often impossible to get all the details, speculation was rife with locals and experts alike full of opinion, rather than fact. So, when the producers said it was up to me to use my engineering knowledge to explain the science behind the problem and come up with a solution – I suddenly became rather nervous. Explaining, for example, the science of a landslide in very simplistic terms was not easy. And when I thought I'd got

THAT campervan

I'm a huge fan of VW campervans. I've owned a 1970 VW Baywindow for about 10 years, and despite not ever really working, needing continuous maintenance and never setting a 0-60mph time (top speed – 53mph), I love it.

It turns out, so did the producers of the show, which thought this would be the perfect vehicle to accompany me on my journey to investigate various engineering problems. The back of the campervan was also turned in to a lab/workshop with tablets and CAD programmes to explain to viewers what the problem was, and propose a solution.

Did it breakdown? Of course. Did the producers have to get out and push? Yes they did. Do I still love campervans, absolutely. Do they? Not one bit.

adventure

it, I was told that actually the explanation needs to be no more than 45s, not the 20mins I had taken on the previous run.

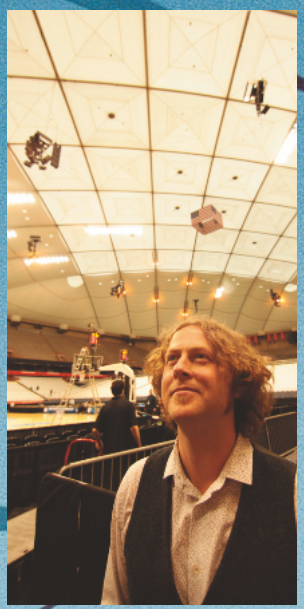
Coming up with a solution for each problem was an intimidating task. Often, I would talk to the specialists and expert engineers on the ground, who were actually in the process of fixing the blunders. But other times it was a case of brain storming. For example, how do you re-engineer the bearing system of a rotating tower, fix the worst roads in America built below sea level in New Orleans, or stop a building in Leeds generating hurricane force winds that are literally knocking people off their feet?

Part of the joy of filming the series was the access that we were able to get. One of the highlights was being able to get under the streets of London and walk alongside the tunnel boring machine working its way through the city, as part of the Crossrail project. I was able to come face to face with the business end of the tunnel boring machine, get a sense of its scale, and take viewers to places they would never normally get to go.

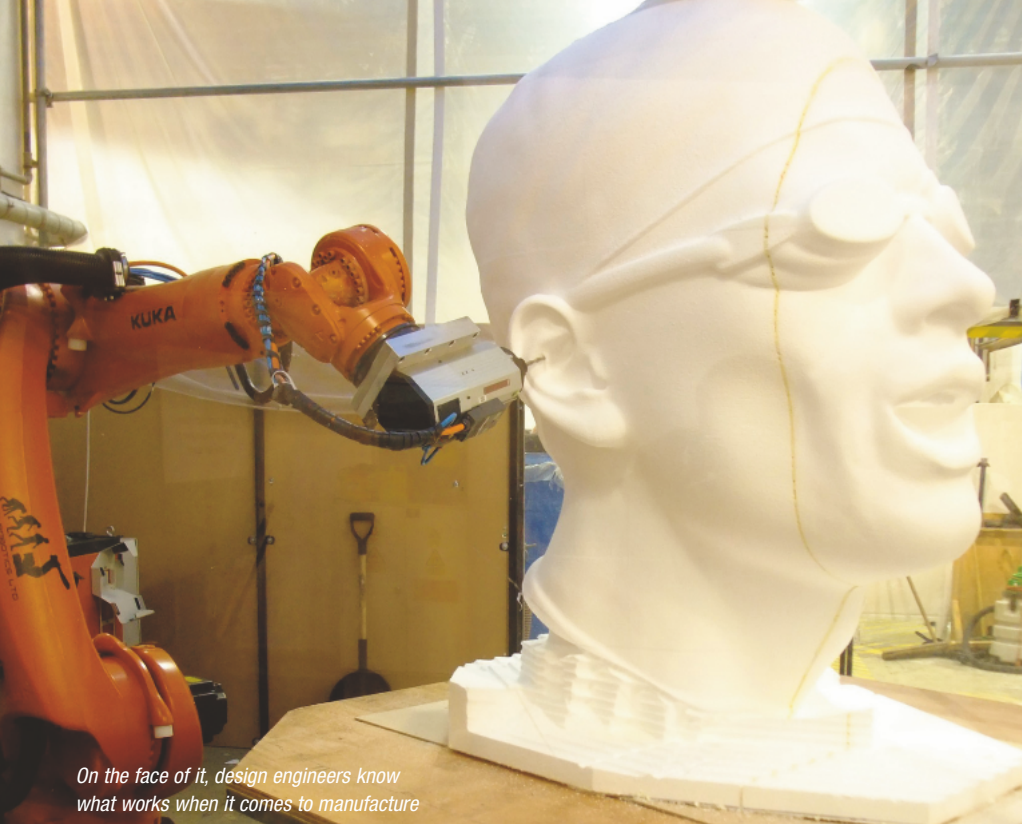
So, what was the blunder with Crossrail? Well, the actual problem is not in London, but in the USA, where a 4000 tonne behemoth of a tunnel boring machine got stuck under the city. Bertha, the world's largest boring machine, hit an 8-inch metal cable that fractured its main bearing about 20m under the streets of Seattle. The machine will not move... so how'd you go about fixing that one? We do indeed find out.

Above all else, filming and seeing these examples of engineering mishaps was a fun experience, and hopefully that comes across in the show. There is a cheeky element to it all, but at its heart, it is an opportunity to share some incredible engineering stories and talk to some brilliant engineers. I do hope you tune in.

Above: Onsite at a windfarm in the North Sea
Below: Looking up, nervously, at the stadium roof held up by air moments before walking on it
Below left: What do you do with a tunnel boring giant when it gets stuck?



Incredible Engineering Blunders: Fixed **will be broadcast in the UK from 20th August on the Discovery Channel and consists of six one hour episodes, and it will be hosted by none other than *Eureka's* Justin Cunningham.**



On the face of it, design engineers know what works when it comes to manufacture

Most engineers have some knowledge about the world of manufacture, but a broad brush approach might lead to inefficiency. And with reshoring set to rise, there is an opportunity for more to be done up front, as Justin Cunningham finds out.

Design *for* Manufacture 2.0

Engineers are comfortable with CAD. Many have grown up with it, using it in one form or another for years. Yet, when it comes to CAM, for many designers at least, it provokes a standoffish reaction.

Perhaps it's that designers have less interest when it comes to the nuts and bolts of assembly, or perhaps it's that many these days have less hands-on experience than they'd like. Indeed, it's one of the worrying trends of today, that many designers – experienced CAD professionals – are removed from manufacture. They may see a finished product, but not the work to get it there.

Many firms claim the days of designs being thrown back and forth between feuding engineers and manufacturers are gone, but this feels like only half the story. There can be a tendency to use certain manufacturing processes as a go-to option when coming up with designs – knowing that at some point someone will ask 'how are we going to make it?'

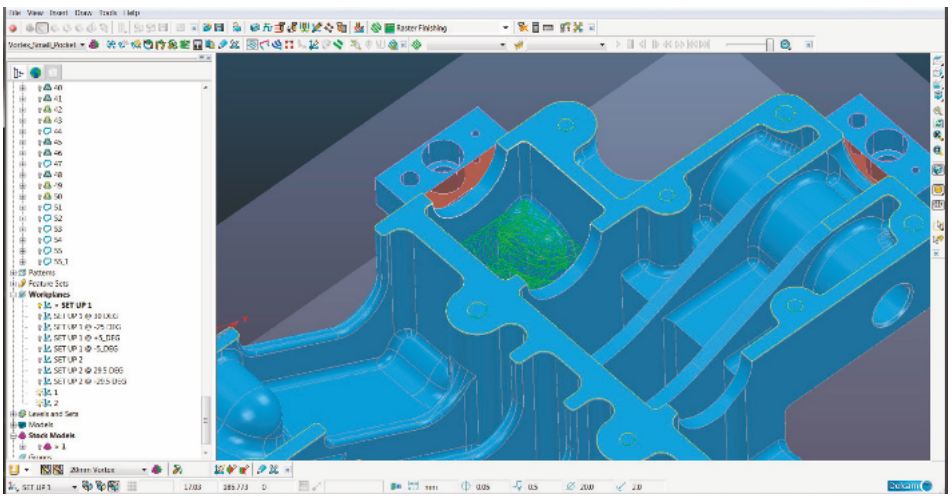
Yes, it is always possible to do it a certain way, but these assumptions are not being challenged as much as they should be. There are numerous flexible and hybrid manufacturing facilities being created, and while a well-trodden path is valid, it may be incurring significantly extra time and cost.

"People have the assumption that they can design almost anything, and then they'll figure out what machines will be able to make it later," said Bart Simpson, commercial director at Delcam. "Take 3D printers for example, they are not Star Trek replicators. Most additive machines are terrible at making holes, for example. Yes, you can produce holes with them but isn't it far quicker, cheaper and easier to make the holes by drilling them out, and combining the processes?"

Globalisation means that designers, engineers and manufacturers can be thousands of miles apart, speak different languages and have different skill sets. In many (most) cases, going across the road to chat to a production engineer face to face during the design process is not possible. It has led to fragmented product development, which would simply not be possible without the software support of CAD, CAM and PLM.

PLM has undergone many acronym changes over the years as it has come to incorporate more management functions and datasets from the engineering and production processes. But, essentially, engineers see it as the same thing as always: an admin tool.

CAM, however, is viewed much differently. For some reason it lost favour in the mid-90s onwards. While many CAD companies sprawled



CAM do attitude: Producing something as efficiently as possible is complex

well beyond engineering industries, and went on to become giants, CAM companies experienced no such boom. There was steady growth, certainly, but by no means on the same level.

Birmingham based Delcam to a large extent bucked the trend and has been one of the most successful CAM companies of recent years. It has built a reputation around technical consultancy and manufacturing knowledge, and has produced multiple specialist software packages to aid and support manufacturers.

The genesis of Delcam can be traced back to work done at Cambridge University in the 1970s. Now, the company boasts some 50,000 customers across the globe and has numerous impressive applications to its name. Its products are used to make 65% of all the worlds' coins, as well as the Olympic medals.

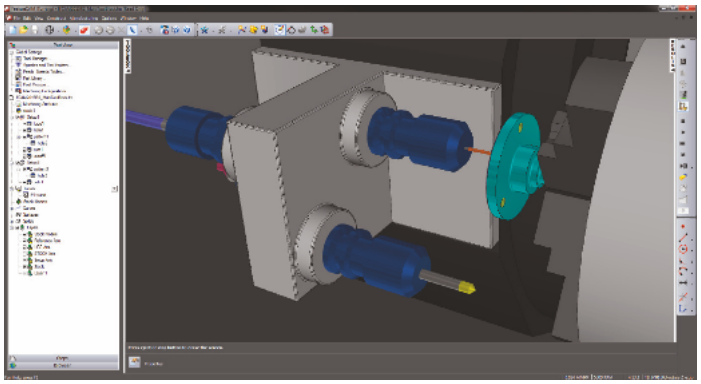
In February 2014 Delcam was acquired by Autodesk, which at the time was claimed to be, 'the biggest news in the history of the CAM industry'. So, why the renewed interest in CAM from the design community?

"What has changed is that there are many different manufacturing processes to be aware of and people have different assumptions about the capabilities," said Simpson. "All these technologies are having an impact on design."

Design for Manufacture 2.0

Design for manufacture was a term commonly used five or more years ago, but it has almost dropped out of the day to day vocabulary of engineers, or at least the one's I speak to. It is an advantageous habit to get in to if you are a designer, and stops the virtual throwing of ideas back and forth between design and manufacture.

Experienced design engineers are no doubt aware of the processes to make components and will design accordingly. However, manufacturing processes are changing with the introduction of additive technology, an increase in the number of different materials used and the then necessary joining techniques. Suddenly CAM becomes something of very real interest and importance to the designer, and not just something for machinists and manufacturers.



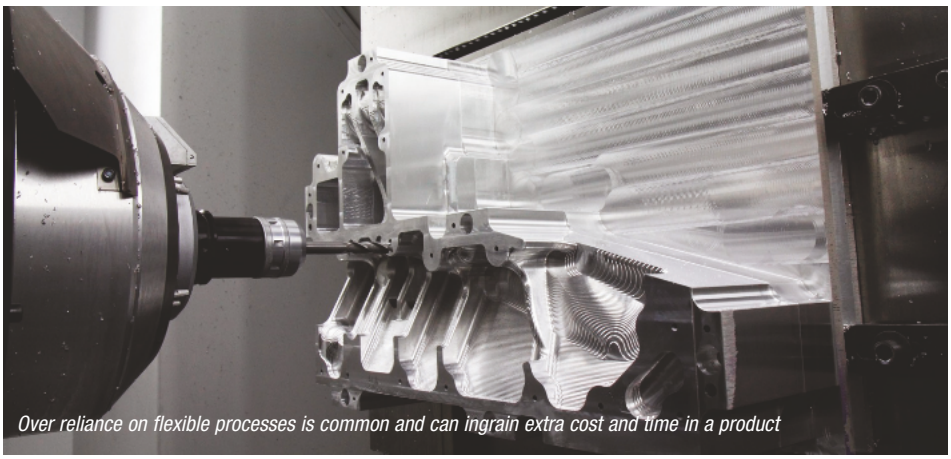
CAM is finding favour with engineers to better utilise available factory machinery

"There is a massive opportunity for design engineers, but there is a steep learning curve," said Simpson.

And here lies the potential pitfall. While modern CAD packages no doubt stimulate the creativity of designers, practical engineering (i.e. how something is going to be made efficiently), has become less of a priority. Rightly or wrongly, product innovation rather than productivity has in many places become the priority.

However, let's not forget where we have come from. The last decade saw a marked shift of production to the East, in particular China. Low labour costs meant that optimising an assembly was less important, as it didn't save much money. However, the tides are turning with manufacturing operations from consumer products to more industrial ones coming back to the UK.

Modern and efficient manufacturing facilities allow much greater product flexibility on single production lines. Automation is also now possible in areas that use to be reliant on people in the loop. However, over reliance on what certain process can do, means inefficiency can be rife, and getting it wrong is all too easy.



Over reliance on flexible processes is common and can ingrain extra cost and time in a product

And this is where Delcam is enlightening users. The fact is, there are now so many ways to make the same thing, and this needs considering at the design stage if it is to be leveraged later during production. Do you want it make in volume, with a high quality finish, with five variations or five hundred?

"If you are doing any kind of sophisticated design, it's best to take a holistic view early on," said Simpson. "You may even need to re-engineer the design process. Are you making the most of the hybrid manufacturing environment that now exists by using all the technologies effectively? Or are you being over reliant on one?"

This optimisation is giving rise to a new generation of factories, many of which have been previewed by the likes of Airbus and Rolls Royce. Here increased automation, product variability, additive and subtractive machinery, and multiple materials are being set up to work with the design process. Designers, with the help of CAD and CAM software, will be able to carry out complex trade-offs early on, that will act as a guide about how products should be made, assembled and eventually put into service. And this all feeds back to design, so products are optimised for a particular machine or set of processes.

"Doing very complex trade-offs during design, about the manufacturing process, is an important part of what we offer," said Simpson. "There is a huge opportunity, but you need to understand the processes involved if you really want to reduce time to market, allow more design iterations, and get the most out of modern manufacturing environment."

www.delcam.com

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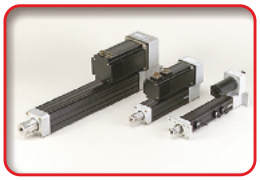

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Instant fix for structures conceals hidden costs

Liquid adhesives require curing, which takes time, but Tom Buckley argues that this doesn't mean it can't be a cost-effective alternative to 'instant fix' bonding in structural applications.

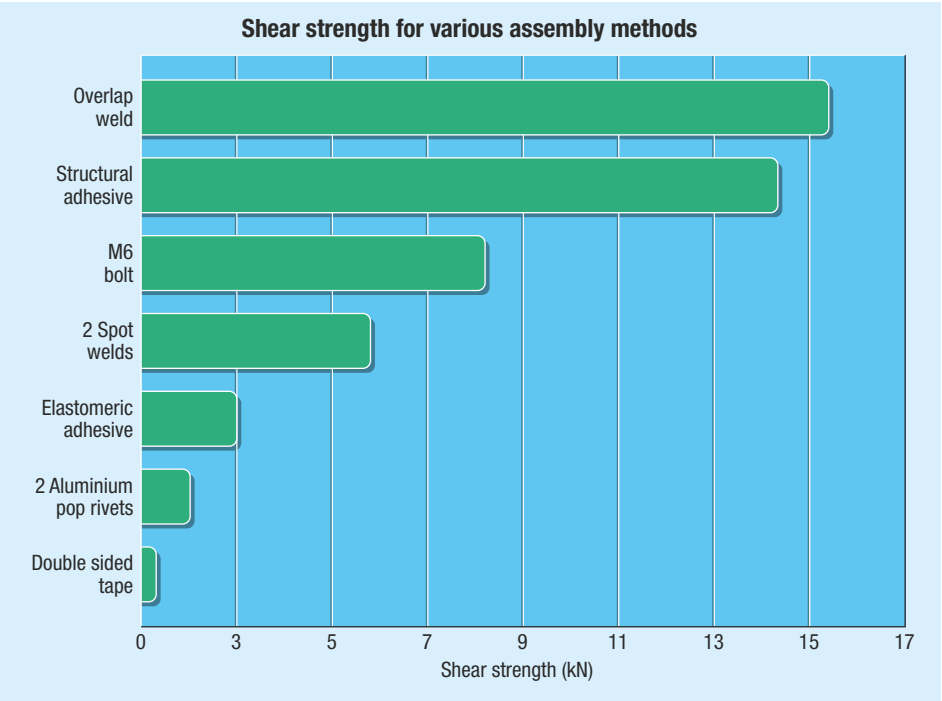
Four major assembly methods exist in today's manufacturing environment: thermal methods such as spot or overlap welding; mechanical fasteners such as bolts, screws, or rivets; double-sided tapes; and liquid adhesives. The first three assembly methods in the list are considered 'instant' assembly methods.

All four of these methods are used to varying degrees of effectiveness depending on the final application, end-use requirements, and environmental constraints such as weather, moisture, salt or chemicals.

As shown in the chart (right), overlap welds and structural adhesives are the strongest assembly methods available. Strength drops off dramatically using bolts, spot welds, flexible adhesives, pop rivets, and double-sided adhesive tape. For some applications, double-sided tape may provide adequate strength, but a blend of adequate strength and lowest overall cost is the target for most applications.

For many industries, structural adhesives are replacing or augmenting instant assembly methods because they can lower production costs, improve product performance and aesthetics, and reduce overall assembly-time.

Adhesives offer many benefits over mechanical and thermal methods of assembly, for a start they distribute stress load evenly over a broad area, reducing stress on a joint. Adhesives are also applied inside the joint and are nearly invisible within the assembly. They can resist flex and vibrational stresses, and form a seal as well as a bond to protect joints from corrosion. Some adhesives can fill large gaps and can join irregularly shaped surfaces more easily than mechanical or thermal fastening, minimally increase the weight of an assembly, create virtually no change in part dimensions or geometry, and quickly and easily bond dissimilar substrates and heat-sensitive materials.



An overview of the shear strength performance over a 645 mm² fastening area for different assembly methods.

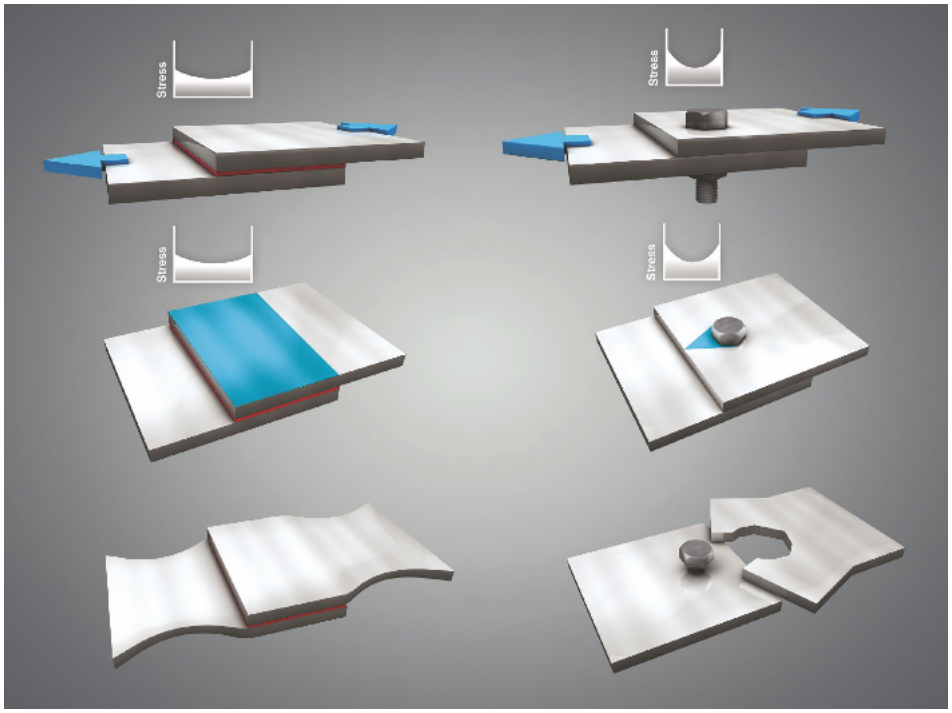
Since adhesives are liquids prior to curing, application and assembly can be easily automated. Bonding requires fewer skilled workers and can be up to twenty times faster than welding. Structural adhesives do not distort metals or require reworking of the metal after application, a significant advantage over the grinding and abrading required to generate a smooth welded finish.

However, adhesives also have several limitations. They must achieve handling strength prior to moving an assembly, a process that can take seconds to hours. Adhesives also cannot be easily disassembled for rework, repair or upgrades, and they add to the number of chemicals used within the plant environment.

The cost of thermal joining

Once a welding process is completed, the resulting assembly immediately has full strength. Thermal joining is widely acknowledged as an expensive assembly process that requires specialised, skilled labour and extensive time depending on the size of the weld area. In addition, manufacturers must also consider other costs involved, such as equipment, filler metals, gas, energy, and the time it takes to complete the process.

Welded joints are often non-uniform and lack the clean aesthetics desired for high-end applications. Once welding has been completed, most joints must be cleaned up, a time-consuming process where weld seams are ground and polished to meet aesthetic



requirements. To reduce the time involved with welding, manufacturers may choose stitch or spot weld, but this will sacrifice some strength and will still need time invested to clean it up. Welded parts are also very difficult to disassemble.

The cost of mechanical fastening

Assembly using mechanical fasteners such as bolts, rivets, and screws is also considered to be 'instant'. However, all mechanical methods of assembly are expensive, requiring labour to drill holes and insert fasteners. Manufacturers must keep an extensive inventory of fasteners on hand, and assembly with fasteners is time consuming.

Fasteners do not distribute loads over the full area of attachment; rather, they concentrate stress at the fastener site. This concentrated stress often results in substrate failure just above the fastener hole or failure of the fastener itself. The figure above illustrates the distribution of stress, often an overlooked concept in the fundamental design process.

The left-hand side shows the bonded joint. The blue arrows represent the shear force applied. The leading edge of the joint has a slightly elevated level of stress than the middle, but the overall force is distributed across the entire bond area, spreading out the load. In many cases, this can lead to 'necking' or stretching of the substrate as illustrated in the bottom left of the image above.

The bolted joint is shown on the right-hand side, with the shear stress represented by the red arrows. In this instance, the entire force applied to the joint is concentrated on the bolt. This concentration of stress leads to failure of the joint at approximately half the final strength of the bonded assembly. In addition, the holes drilled for fasteners can create leak paths, a starting point for corrosion.

Market report

According to a report from Research and Markets, the market for structural adhesives is estimated to reach around $24.20 billion by 2020, signifying an annual growth of 7.71% between 2015 and 2020. The report identifies and analyses important application sectors that include automotive, aerospace, building and construction, marine, rail, wind, truck and bus manufacture. It says wind, automotive, and aerospace applications are expected to show excellent growth in the future due to the urbanisation and growing government initatives.

www.researchandmarkets.com

The cost of double-sided tapes

While double-sided adhesive tapes are not considered a high-strength assembly method, they do deliver an instant bond. Application of double-sided adhesives tape is a multi-step process, requiring at least two additional processes and takes approximately 20% more time than liquid adhesive application.

Double-sided tapes require complete removal of surface contaminants if performance is not to suffer. While contamination does result in a drop in strength with structural adhesives, they drastically outperform double-sided tapes, even on clean surfaces. Double-sided tapes also display a complete performance failure when used on oily surfaces.

For filling large gaps, tapes are offered in a variety of thicknesses and can be an effective assembly option if gap width is consistent. As gap width increases, the shear strength of a double-sided tape can drop more than 50%. However, peel strength can increase by approximately 100%. In order to maximise shear and peel strength, the tape thickness should be approximately 0.8mm. Liquid structural adhesives have a similar relationship, but the drop in shear strength with widening gaps is not as drastic. Liquid adhesives offer an 80% increase in peel strength as the gap increases, and shear strength is almost 20 times greater.

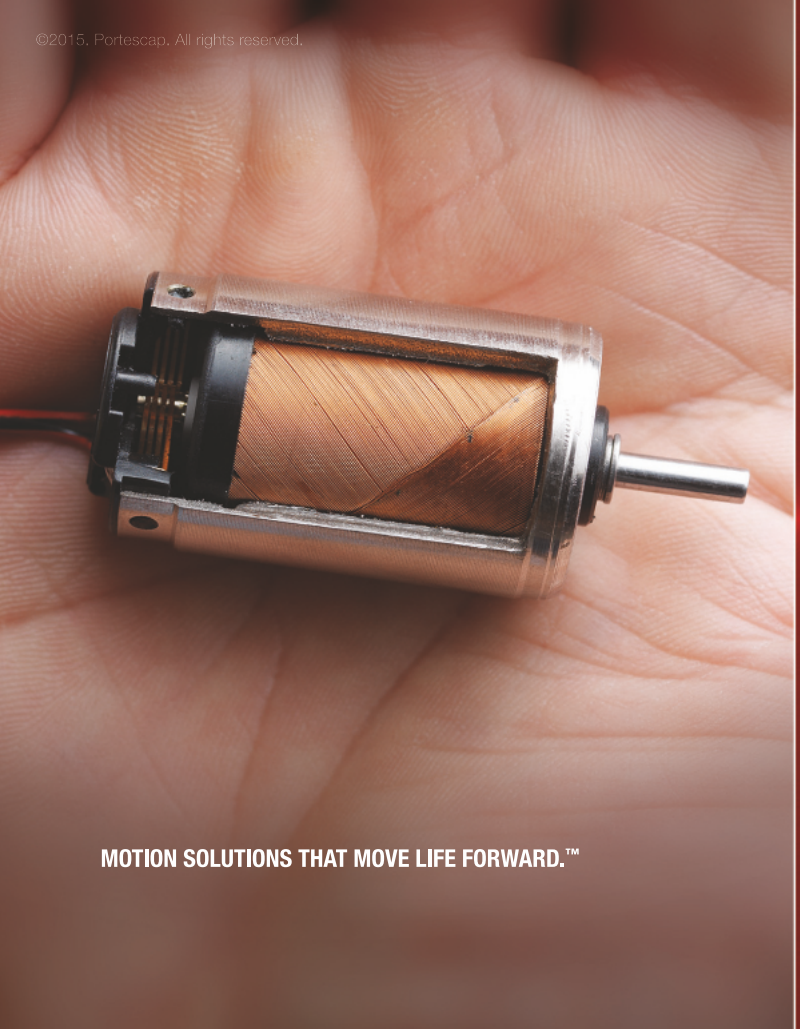
Since structural adhesives are so strong, the effect of gaps is not a major consideration when designing an assembly, but should be considered more carefully when using double-sided tapes.

Assembly with structural adhesives

Recent advances in structural adhesives have dramatically expanded the scope of potential bonding applications, and includes hard-to-bond substrates, such as galvanised steel and polyolefins, including polyethylene and polypropylene. On specialty vehicles such as trailers, truck bodies and buses, structural adhesives are used to assemble frames, panels and cabs made of different materials.

In moist end-use environments such as tubs and spas, these adhesives attach galvanised steel frames to fiberglass and ABS tubs. On assemblies exposed to environmental elements, adhesives attach metals, plastics, and composites, creating a unique appearance for the customer.

Tom Buckley is market application engineer, Henkel Corporation.



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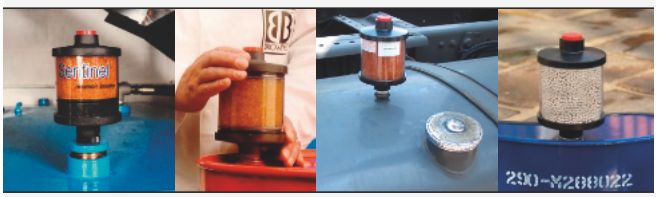

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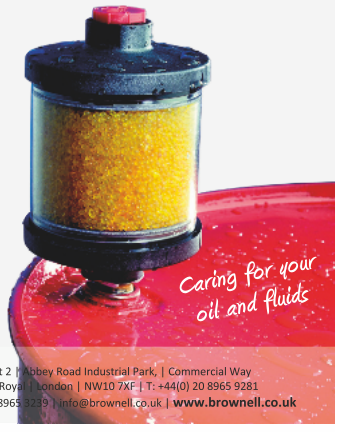

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FAST expo promises solutions

Engineers from all sectors are looking much more broadly at materials options these days. However, this new found openness throws up numerous questions about how to effectively join and assemble them all together. Justin Cunningham looks at the place where many get the answers.

Fact file

When: 9th September 2015

Where: The Williams Conference Centre, Grove, Oxfordshire, OX12 0DQ

Opening Times: 08:30 - 14:30

Entry is **FREE** but is by pre-registration ONLY
For more information and to register go to:
www.fastenerexhibition.co.uk

Looking for new and better solutions is a key part of an engineer's job. But, as is so often the case these days, finding out about all the options can be difficult. It's for this reason that the FAST exhibition brings them together under one roof, twice a year. Here, engineers congregate to talk to suppliers and find solutions, all in a single day.

The event is the UK's only dedicated fastening, bonding and assembly exhibition for design engineers, production professionals, senior manufacturing managers and fastener buyers. The specialist event is now in its 10th year, having proven to be an invaluable resource for engineering teams in just about every corner of UK industry. Last year, over 90% of attendees surveyed said they achieved their objectives for the visit.

All companies at the FAST Exhibition have a base here in the UK, so attendees can be sure of ongoing support as well as experienced application expertise being readily available. To make the exhibition as efficient as possible for visitors, the exhibition is configured in a 'roadshow' style to deliver maximum information in the minimum of time.

The focus is squarely on fastening, bonding and assembly in design and production engineering, and cost-reduction in assembly-related activities.

Seminar programme

09.30 A Practical Guide To Using Foamed Acrylic Tape. **Eurobond Adhesives**

10.30 Why Adhesives? **Henkel**

11.30 The Art & Science Of Choosing A Structural Adhesive. **Intertronics**

Last year, over 90% of attendees surveyed said they had achieved their objectives for the visit.

Organiser Mark Newby said: "This exhibition has a reputation for providing solutions for OEMs large and small, and for problem solving engineers that want to put things together better. Visitors appreciate the 'roadshow' style of event: turn up, get expert opinions and options from the engineering teams at leading suppliers, and get back to the office. Whether it's a design challenge, a production problem or a cost reduction requirement, all the answers in fastening and bonding will be found here, and found swiftly."

The FAST event takes place at the home of the Williams F1 team in Oxfordshire on 9th September and will attract a quality audience of OEM buyers, specifiers and users of fastening and bonding products and processes from almost every part of UK industry.

"With a free Seminar programme, free bacon roll and brew on arrival for VIP visitors, as well as the official Williams F1 simulator available throughout the day for visitors to drive – and free guided tours of the otherwise private Williams collection of iconic F1 cars – there is much to discover when The FAST Exhibition opens its doors," added Newby.

Seminar Programme announced

For those that have not explored the use of adhesives, or if you want to find out more, the event's seminar programme aims to introduce the possibilities.

The first seminar, starting at 9.30, aims to give a practical guide for selecting and choosing foamed acrylic tapes for assembly applications.

This is followed by a session entitled, 'Why Adhesives?' that will talk through the various options on offer, the cost variables, and why many have found improvements by making the switch.

The third session describes the black art of choosing the correct structural adhesive for an application and the development of a specification based on necessary priorities and allowable compromises.

Sessions last 30mins with 10mins for Q&A.

SPACE BOOM
out on a limb

Pardon the pun, but space really is taking off. One of the new entrants to this exciting market is Oxford Space Systems, which has developed some novel deployable technology. Tim Fryer went to visit.

Oxford Space Systems is not yet two years old but it is already looking forward to flying its technology for the first time in space next year. Mike Lawton, the company's CEO, believes this is something of a record: "If you ask the European Space Agency how long it takes to go from idea to first flight, they'll tell you 10 years, which is totally incompatible with the investment community. They'll find a better home for their money. But we are managing to go from concept to flight in round about two and a half years – that means we'll be setting a bit of a record in the space industry."

If people's lives were being put at risk or vast sums of money were at stake then such development speed might be viewed as reckless haste, but the platform here is the diminutive CubeSat, which is about the price of a family car and the size of a loaf of bread. This particular mission is as a technology demonstrator called AlSat Nano – a UK Space Agency joint venture with the Algerian Space Agency – and the technology that OSS will demonstrate is the Astro Tube boom.

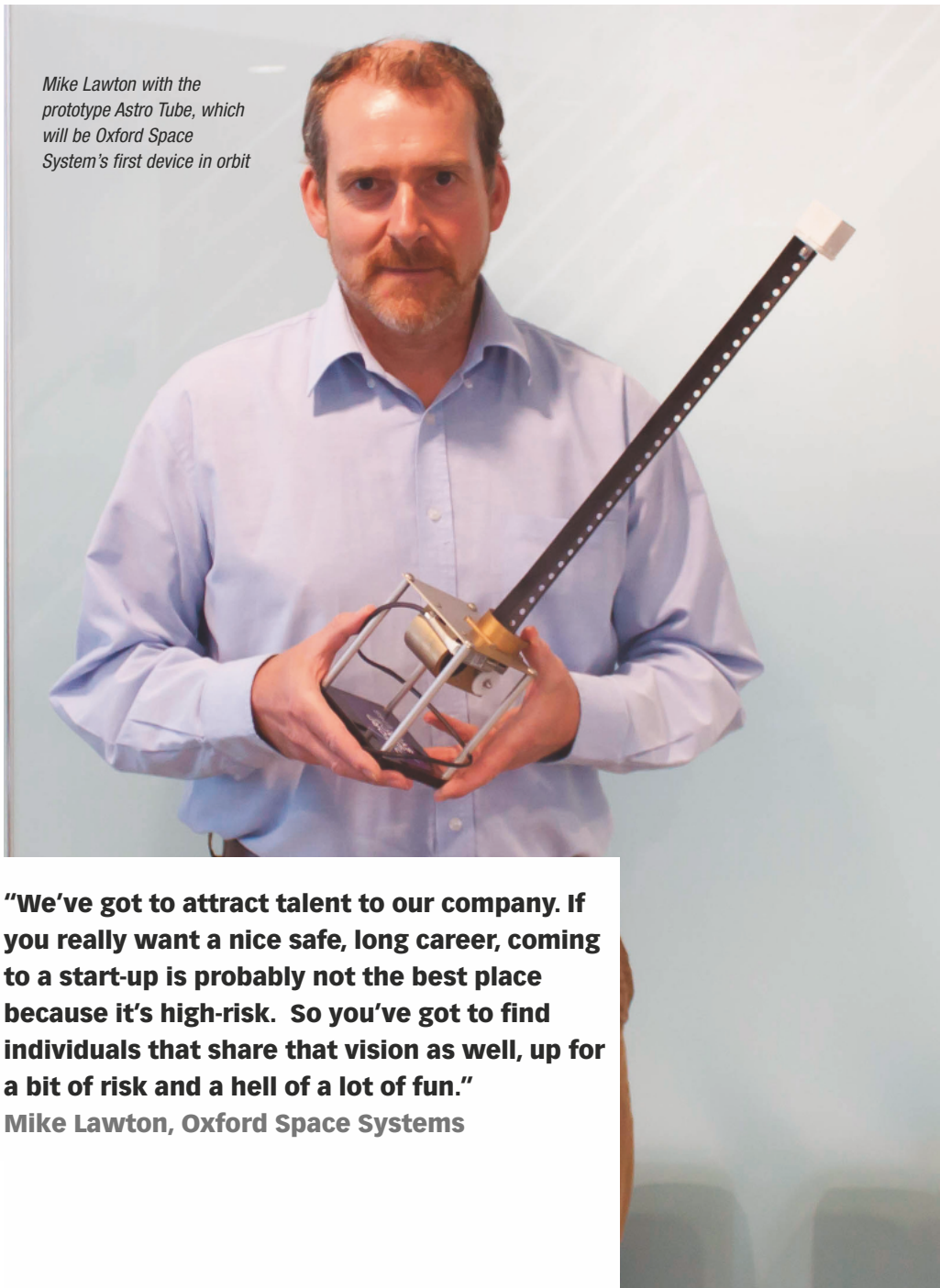
Deployable structures are critical when making an economic case for a satellite. Payload within a rocket is at a premium, but in space it is important to maximise whatever surface area is available for solar panels, antennae and instruments. The surface area can be increased by using deployable structures – equipment that unfurls from within or the side of the spacecraft. It is no surprise that one of the senior consultants to OSS is Professor Zhong You of Oxford University, who is an expert in deployable closed kinematic chain structures and origami folding.

"As well as using conventional materials we're using new and novel materials we're developing ourselves," said Lawton, "and putting this together with the art of origami."

Some of the really complex folding techniques are being developed for other further-down-the-line projects, like a deployable antennae that can expand from a size of a wastepaper bin to a dish 12m across. The Astro Tube is not a complex bit of folding, but is clever use of materials.

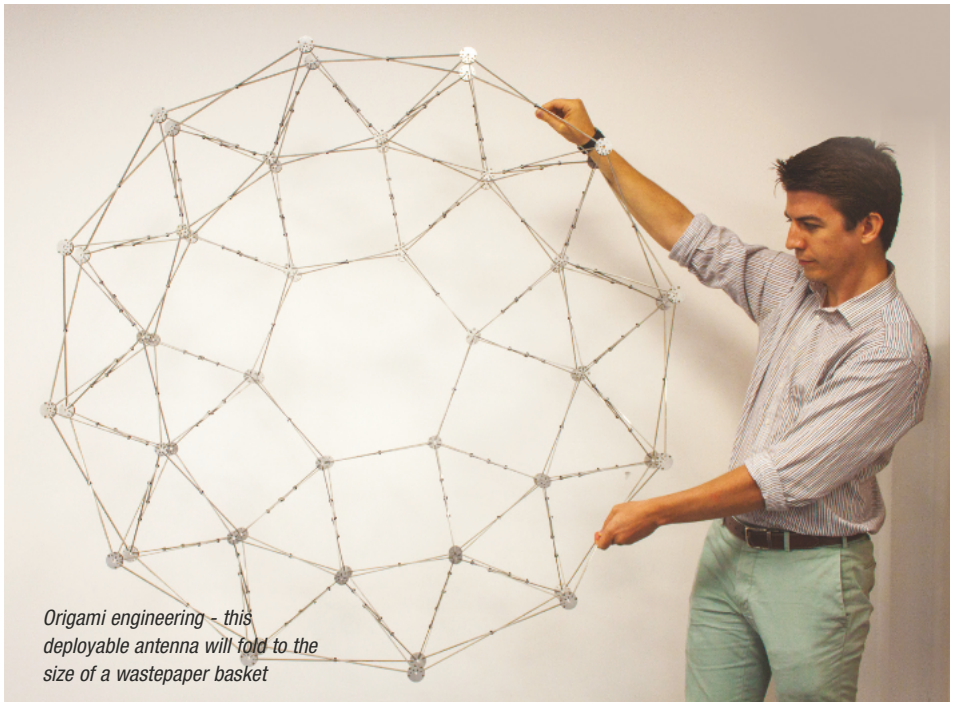
One example of why a deployable boom is an advantage will be demonstrated on Astro Tube's second flight, also next year. It will deploy a magnetometer to measure the Earth's magnetic field as part of an ongoing attempt to predict earthquakes.

Being an electrical device itself, the satellite



Mike Lawton with the prototype Astro Tube, which will be Oxford Space System's first device in orbit

"We've got to attract talent to our company. If you really want a nice safe, long career, coming to a start-up is probably not the best place because it's high-risk. So you've got to find individuals that share that vision as well, up for a bit of risk and a hell of a lot of fun."
Mike Lawton, Oxford Space Systems



Origami engineering - this deployable antenna will fold to the size of a wastepaper basket

creates its own magnetic field, so the further away from the craft the instrument is, a metre in this case, the better the integrity of the signals recorded.

One of the problems with deployable structures is that they can destabilise the platform if deployed too quickly, particularly when the platform is as small as a CubeSat.

Lawton said: "A long boom can act as a gravity gradient boom – that means it starts acting like a pendulum against the Earth's gravity, so you can be constantly just destabilising your satellite. The fact we can restow the boom means the satellite can be reoriented and stabilised a lot more easily. So there's some genuine firsts that we'll be achieving with our boom."

Astro Tube is probably the easiest of OSS's projects to visualise as it is a more sophisticated version of a builders tape measure. OSS has been working with companies that supply advanced composites to the F1 industry. The process started by looking at all the different carbon fibre materials and resin systems, and then discarding those that wouldn't survive the radiation, temperature or long term degradation due to atomic oxygen or storage.

"So when you whittle down the candidate materials you can use, you're left with a very, very small subset," claimed Lawton. "And getting those together in a favourable combination is really tough. And where we've pushed things even further, where there's really some quite exciting IP, is the ability to embed things."

Embedding the electronics can provide power, control and a data route to the instrument at the end of the boom, which also can itself act as an aerial. Movement is controlled through the motor gearbox with a tooth cogged wheel to interface to the holes in the material. This in itself causes a whole bunch of challenges.

Lawton said: "You can get micro delamination – micro cracks and fractures in the material. So the engineering, even to create the holes in a material that you want to flex, is non-trivial."

Choosing components for the device is, according to Lawton, essentially a compromise between cost, availability and reliability. He explained the choice of the two motors (as always in space projects, one is required for redundancy), that were sourced from maxon motors.

"I believe one of the Mars Rovers is using the same type of motor that we are using," he commented. "So it's space proven, it's available at a sensible price point, and the lead times are tolerable."

They were also off-the-shelf components that required only limited modification for space readiness. "Essentially it was the lubricant inside," continued Lawton. "Lubricants that you can use on Earth are unsuitable for space. When you subject them to a vacuum, terrestrial lubricants will essentially vaporise. So you've got to use a very specific type that is space-approved."

One possibility that OSS is exploring is using two such Astro Tube's in tandem with a 'rollable' photovoltaic panel in between. This could vastly increase the power of small satellites.

"No one is making a huge amount of money out of CubeSats at the moment, because of the power restrictions," concluded Lawton. "The first person that can solve the power problem, coupled with the ability to communicate at high bandwidth from CubeSat, will absolutely clean up because the cost of the platform is inherently low."

A team effort

Getting into the space industry, especially for a new company, is not easy. "It's a good market to be in, but it's a damned hard market to enter," Mike Lawton, chief executive of Oxford Space Systems observed. "Getting yourself designed onto a platform is a huge barrier to entry because the industry is so risk-averse, the last thing they actually want to do is then change. It's an uphill struggle but once you're there, you're pretty much in the club. And you'll struggle to find a better definition of low volume, high value engineering. So the margins and the cost of space hardware currently is very, very good."

Oxford Space Systems is unusual in that no other space technology start-up has attracted venture capital funding. "Most start-ups tend to go what we call the friends, family and fools route. We went straight to the VCs because we were convinced of the value proposition of the technology," said Lawton.

The company also got considerable funding and support from Innovate UK and the Satellite Applications Catapult, which has provided OSS with facilities and introductions.

These have been, "instrumental in our journey to get us this far," according to Lawton. The company also uses other Innovate UK organisations, like the National Composites Centre and the Advanced Manufacturing Centre.

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VIRTUAL ROAD AHEAD

A driving simulator makes a double facetted story as it is both an interesting design and an innovative design tool in its own right. Tim Fryer went to Ansible Motion to find out about the development of such a machine.

At the heart of Ansible Motion's new £2m R&D facility near Norwich is its Delta series simulator. This is not just a demonstrator, it is a working tool that uses simulation techniques to help automotive designers test and develop vehicles in the virtual environment, so they are ready for the road.

Delta is a 'Driver in the Loop' simulator that can be used to validate vehicle safety systems and dial in vehicle settings. In motorsport, the company has already supplied one F1 team that use it to define aerodynamic, gearbox and suspension settings. These can then be used to accurately predict a lap time, allowing various trade offs and optimisations to be made, before anything physical needs to be created.

By working in a virtual world, engineers can cut months from a vehicles' test programme, as roads and weather conditions from anywhere on the planet can be simulated, delivering significant cost savings.

The Delta series simulator offers a six degrees of freedom motion system, and is powered by 16 5GHz computers, with five projectors offering a frame rate that is five times faster than a cinema, projecting a 240 degree wrap-around view on an 8m screen.

The R&D Centre also features a full control room to monitor up to 300 channels of data, a separate viewing gallery and secure conference rooms.

"Simulators, such as the Delta series in our new R&D Centre, offer vehicle manufacturers a no-compromise method to reduce development costs and time," said Kia Cammaerts, founder of Ansible Motion. "For example, our simulator has cut the validation time from 10 days to just three for an Electronic Stability Control programme for one particular car maker. Apply those kinds of savings in cost and time across the whole car and it explains why we are now getting more and more enquiries from global OEMs to see what our simulator can do."

Designing and building such a simulator has not been easy. The first step was to define the operation of the machine and this was done by superimposing car racing data on simulator principles, which essentially involves fluid movements in the inner ear.

Bob Stevens, chief designer at Ansible Motion, explained: "You cannot sense sustained G-Force because it is a fluid in a semi-circular canal [in the ear] and it just adopts the position, so you have no sense of continued acceleration. What you have a sense of is change of acceleration, and so you don't need to carry on accelerating at 1G so long as you have given the initial feeling that you have started to do that. Then you let the vehicle position itself back to a neutral point without the driver perceiving the reversal."

Cammaerts created algorithms based on these movements and married them up to real data from motor racing teams, so a certain manoeuvre produced a certain effect in the ear. Translating this into a machine involved the talents of Stevens.

"So I was given forces or accelerations and a space envelope, principally for all six degrees of freedom – longitude, lateral, vertical, pitch, roll and yaw [spin]," he said. "My brief was then to make the machine as small as possible, as light as possible, and as cheap as possible."

The machine developed has X-travel, a wide travel table and a rotary table on top of which is a three degree of freedom machine to give pitch, roll and heave.

"All we have is basic machine elements configured in a unique way," Stevens observed.

What it means is that unlike other simulators, there is freedom of movement anywhere within the space envelope.

The traditional simulator, typically the flight simulator hexapod, is a parallel machine so all the actuators have to work simultaneously. However, this approach potentially creates 'conflicts' at the extremes.

"A hexapod can yaw when it is straight upright, but if it moves forwards it can't go sideway, so it can't yaw," explained Stevens. "So they buy a bigger machine and don't take the payload [the module the driver sits in] to its extremes. They end up with very large hexapods to do the same job as our relatively small machine."

The initial design phase, having set the basic parameters, was simply trawling the catalogues for some of the key components, like the linear drives and actuators with the right stroke force and speed. But when Stevens started it was not simply a case of downloading some files into his 3D CAD design.

"It was nearly all hand calculations," he said. "At the time it was all 2D CAD. I drew out all the links at all their angularities and worked out mechanical advantages and things at those positions and motor authority at those stroke and combinations of angles. It was all done the old fashioned way really.

"Since then we have got SolidWorks and it would have made it a lot easier in the early stages. It is greatly helping us now [building a second generation machine]; we are bolder with our decisions and things we make. Things we have made have always fitted together but in the early days we did have a few fingers crossed behind our backs. But now with SolidWorks we don't because we have seen it together as a virtual model."

Above: The bearing for the large rotary turntable was made internally. Stevens said: "Principally because we couldn't find one to do what we wanted it to do and the lead time on all that sort of componentry is huge."

Left: A close-up view of the Ansible Motion Hand Wheel Loading System (HWLS) that provides precision driver feedback and road feel.

This R&D Centre will enable automotive engineers to assess how our simulator performs."
Kia Cammaerts, founder of Ansible Motion

To drive the basic machine there are six motors and on top of that in the payload there is one on the steering wheel, two on the seat belts and potentially three more motors for various things. Different customers want different feedback, so it is important that the motors themselves are not causing any feedback through the steering wheel.

"We have got somebody touching what is basically an electric motor via a steering column and steering wheel, it is very sensitive," said Stevens. "As soon as you connect the electric motor for false feedback it hums and buzzes. But if the steering wheel buzzes, it's wrong, it has to feel like it is connected to wheels at the other end.

"We have done lots of work minimising that with screening and earthing, and repositioning the drives as close to the motor as possible to reduce cable runs. We also changed connectors and various other things to sort out these sorts of problems. We have been through so many different drives and motor configurations in the last five years - it is quite a can of worms."

The obvious mechanical engineering solution would be to put some damping to suppress unwanted feedback, but the whole purpose of the simulator is to maintain precision and response.

This philosophy extends throughout the whole system – it works better if there is no compliance or flex as this loses motor control.

"We are actually a bit upset when people want to put in road car seats because it isolates the person, and the person doesn't move where we are trying to move them," concluded Stevens. "So, from an engineer's point of view, I would rather have them in a moulded-in race seat because they move as one with the payload. The best way is to be as rigid as possible, and the best way to do that, as with most mechanical structures, is to make them small."

The result has been a simulator that has already attracted interest from the automotive engineers as it is the first to be designed especially to meet their needs.

www.ansiblemotion.com

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Sports car in reverse

Majenta PLM has partnered with Physical Digital, a 3D scanning and reverse engineering company, to transform the design and manufacturing processes of DAX Sports Cars.

DAX Sports Cars has been producing DAX 427 replicas for over 30 years and has sold over 4000 kits to date. Now, using Siemens PLM Software's CAD solutions – Solid Edge and NX – combined with the assistance of Physical Digital for non-contact 3D scanning and measurement, DAX Sports Cars is able to scan and reverse engineer a DAX 427 like never before.

Mark Parry, managing director of UK reseller Majenta PLM said: "This is a really exciting partnership for Majenta PLM and one that I believe will truly inspire kit car manufacturers and fanatics alike. We have provided DAX Sports Cars with a new lease of life through the use of CAD software and are reinventing the company's design and manufacturing processes. The DAX replicas are known to be the best in the industry, but need to adapt to keep ahead of the competition through innovation and the continuous introduction of upgrades."

Reverse engineering enables the capture of previous designs in a CAD environment. Parry continued: "It is then possible to quickly design and test virtually, reducing the need for expensive and time-consuming models. CAE is used to test for mechanical stress, air flow, and heat dissipation for optimal design.

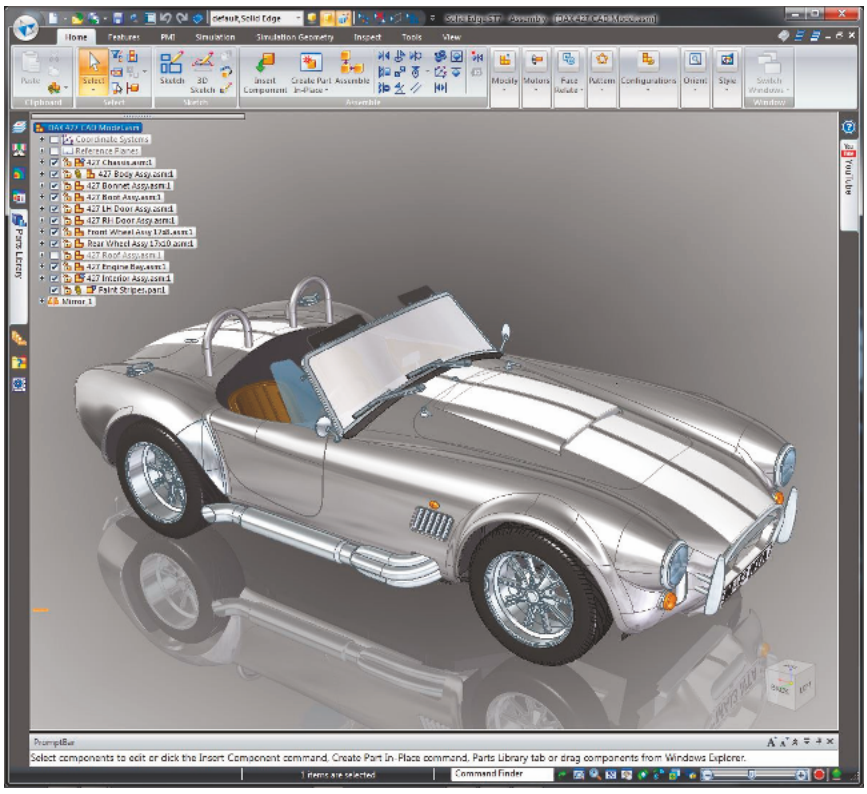
"Although reverse engineering is a design manufacturing process, the relationship with reverse engineering truly pulls the real 'physical' world and 'virtual' designs together."

Majenta PLM initially visited the DAX workshop to collect a full car Bill Of Materials (BOM) and all existing 2D drawings of manufactured parts. The original 2D drawings were then redesigned in Siemens Solid Edge to turn them into 3D models.

Physical Digital then scanned the major body parts, where the body, doors, bonnet, boot and coupe roof were reverse engineered by into the CAD system. This allowed the team to make use of A-class surfacing technology to produce a complete and accurate solid 3D model of the car. Attention then turned to the inner workings. Again the team used the scanned data of all the parts beneath the bodywork to complete the mechanical workings.

The reverse engineered data and 2D model drawings were then assembled together to create a complete 3D model of the DAX 427 replica whilst other parts were modelled straight into the CAD software.

Simon Johns, director of DAX Sports Cars, commented: "We're the first kit car manufacturer to adopt CAD/CAM/CAE software to assist with the design and manufacturing of our cars. We wanted to change all of the past concepts of the kit car industry and innovate, not just ourselves, but hopefully the whole industry as well. As a result, our cars will benefit from increased quality through build and fit. The software and support provided by Majenta PLM enables design, manufacturing and analysis to take place together, which in turn enables us to carry out a full analysis, create custom designs and provides our customers with the option to see their car in a virtual 3D environment prior to purchasing it – giving us a unique selling proposition in today's kit car market."



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IP on show

Trade shows can be a great way of shouting about what you do, but make sure you don't shout too loudly if your IP is not protected. Jonathan Jackson, Partner and European Patent Attorney, D Young & Co LLP, discusses the issues.

A trade show is a highly effective platform to raise awareness of your new product, discuss collaborative work within your technology or sector, as well as an ideal opportunity to gain inspiration, secure funding and seek out advice. Be cautious however that lack of IP planning doesn't mean losing more than you stand to gain in a competitive marketplace.

IP rights are all about enabling business opportunities and mitigating risk. With the right IP strategy in place, which need not be complex, you can sign up for the show confident that your product is protected, before you give away all your secrets. Without such a strategy in place, you can end up shooting yourself in the foot by telling your competitors your new idea and, at the same time, stopping yourself from protecting your new idea. This allows your competitor to steal your idea.

Once your IP is secured by having an application filed, a trade show may well offer a practical and cost-effective opportunity to identify potential infringers, or counterfeit products, potentially well before their market presence is established and when the threats are still manageable.

Innovators should consider the intellectual property available to protect their products prior to attendance at any trade show.

So what is your pre-show IP checklist?

Registered designs

Registered designs protect the appearance of a particular product or promotional material, or important aspects of them. In electronics, the distinctive appearance of a particular product is sometimes crucial to the success of that product. In the rapidly growing area of wearable technology, for example, the appearance of a product is a critical aspect of product differentiation. In order to protect this distinctive appearance, manufacturers need to consider protecting the appearance using registered designs. In Europe, designs can be registered on a national or EU bases. Especially useful is a Community registered design since this can offer low cost but effective protection for up to 25 years, not just in the UK but in all 28 member states of the EU. The speed of obtaining protection for designs is without doubt one of its most attractive features. Most applications are accepted within a week or two and more often than not, within just a day or two.

Jonathan Jackson

Patents

Patents protect the way in which a product operates. Specifically, a patent protects the way in which the product solves a technical problem. Critical here is the message that you should not publicly disclose your invention or use or sell it before a patent application has been filed, as this will almost certainly invalidate any patent.

To be granted a patent an invention must be new, inventive (not obvious) and have practical (industrial) application. It can take several weeks to prepare an application, and two to five years for a patent to be granted, depending on complexity, technology and industry sector. However, all that you need to do before a trade show is file the application – you need not wait for the patent to be granted before exhibiting your new product. Getting professional advice is invariably worthwhile as there are many pitfalls for the uninitiated.

Trade marks

A particular brand name or logo used to market your product can be protected as a trade mark. Registered trade marks ensure that the goodwill and business reputation built up under that brand name or logo is protected in relation to specified goods or services. Back to our example of a wearable technology product, this would contain features that relate to both fashion and function, so it will be important to ensure that trade mark protection is obtained for both aspects. For example, Smart Glasses would require protection both for the glasses themselves and the display device technology.

Conclusion

Before you broadcast your new product at an exhibition or trade show it is important to protect every aspect of your innovation; from the appearance of the product, the way in which it operates, to any associated branding. This synergistic approach to IP will offer protection should competitors get too close or should any copy-cat products appear. It is well worth obtaining legal advice before demonstrating a new product at a trade show.

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Web: www.dyoung.com

Let there be light

One in five people in the world has no access to electricity, a proportion that is predicted to remain the same for the next 20 years due to the pressures of population growth. In such electricity deprived areas the source of light is often the Kerosene lamp.

The World Bank estimates 780million women and children breathe Kerosene fumes equivalent to 40 cigarettes a day.

In India 1.5 million people suffer severe burns caused by such lamps being knocked over. And they are expensive – in the poorest countries. Kerosene can represent 30% of household income. In other words – kerosene lamps are not ideal.

The challenge

So this month's challenge is to come up with an alternative. The key requirements are that it is cheap, reliable and safe.

Batteries are expensive and raise their own environmental issues, so we don't want them. It needs to be a source of energy that is constantly available, day and night, so a solar panel based solution is unlikely to satisfy demands.

And while a wind up torch might offer short relief in a power cut, anyone who has used one will know it is never going to provide a constant light source unless you have a team of super fit 'winders' on the case.

In addition, although there is no reason why this should not have applications everywhere and in every environment, the target audience is primarily those places where poverty prevails. So bear this in mind: any solution needs to keep the upfront and running costs as low as possible.

Any ideas?

We will publish the solution we have in mind in the next issue of *Eureka* magazine. However, if in the meantime you have any entertaining or interesting solutions then feel free to leave a comment on the Coffee Time Challenge section of the website or email the editor at tfryer@findlay.co.uk.

The answer to last month's challenge – how to accurately count steps – can be found on p10 of this issue.

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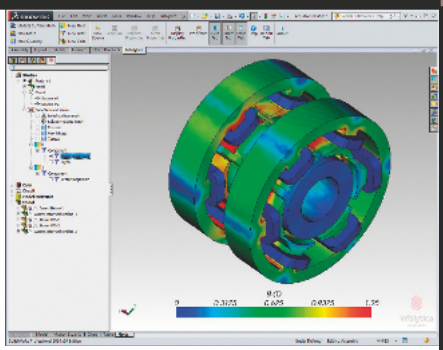

MagNet for SOLIDWORKS is the foremost 3D electromagnetic field simulator embedded in the industry leading CAD software. A combination beyond compare: just one design environment for drawing the model and analyzing the performance of any EM device such as power transformers, sensors, MRI, actuators, solenoids 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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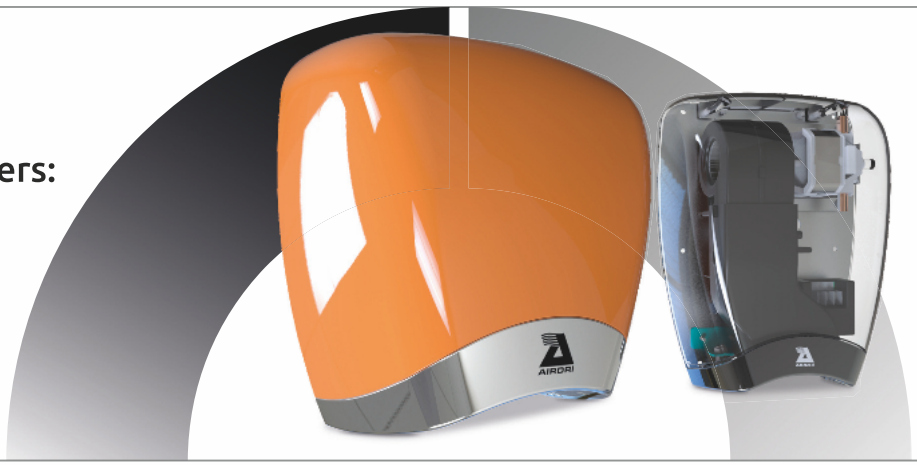
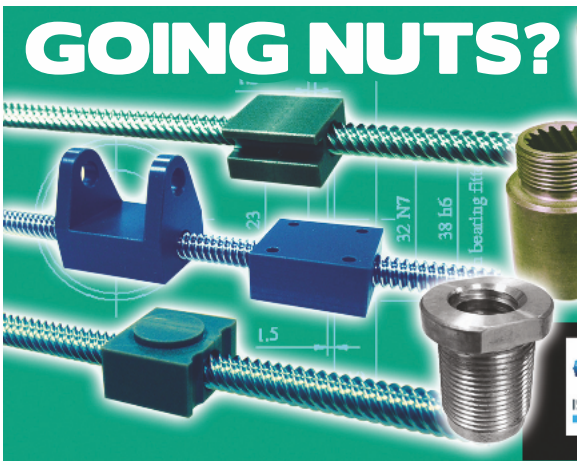


GOING NUTS?



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