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THE MAGAZINE FOR ENGINEERING DESIGN

In this issue: Conflict minerals • Design software • Aerospace • Motor control

Airships are no longer a flight of fancy

Adam Hartles
Elite Applications Engineer

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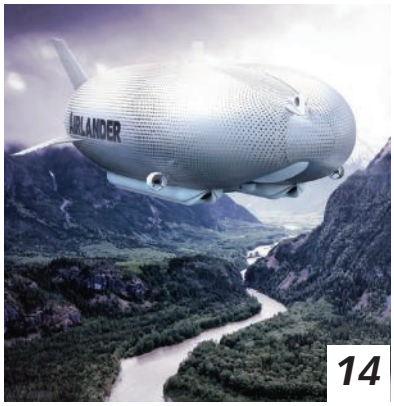

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Wrestling with conflict minerals

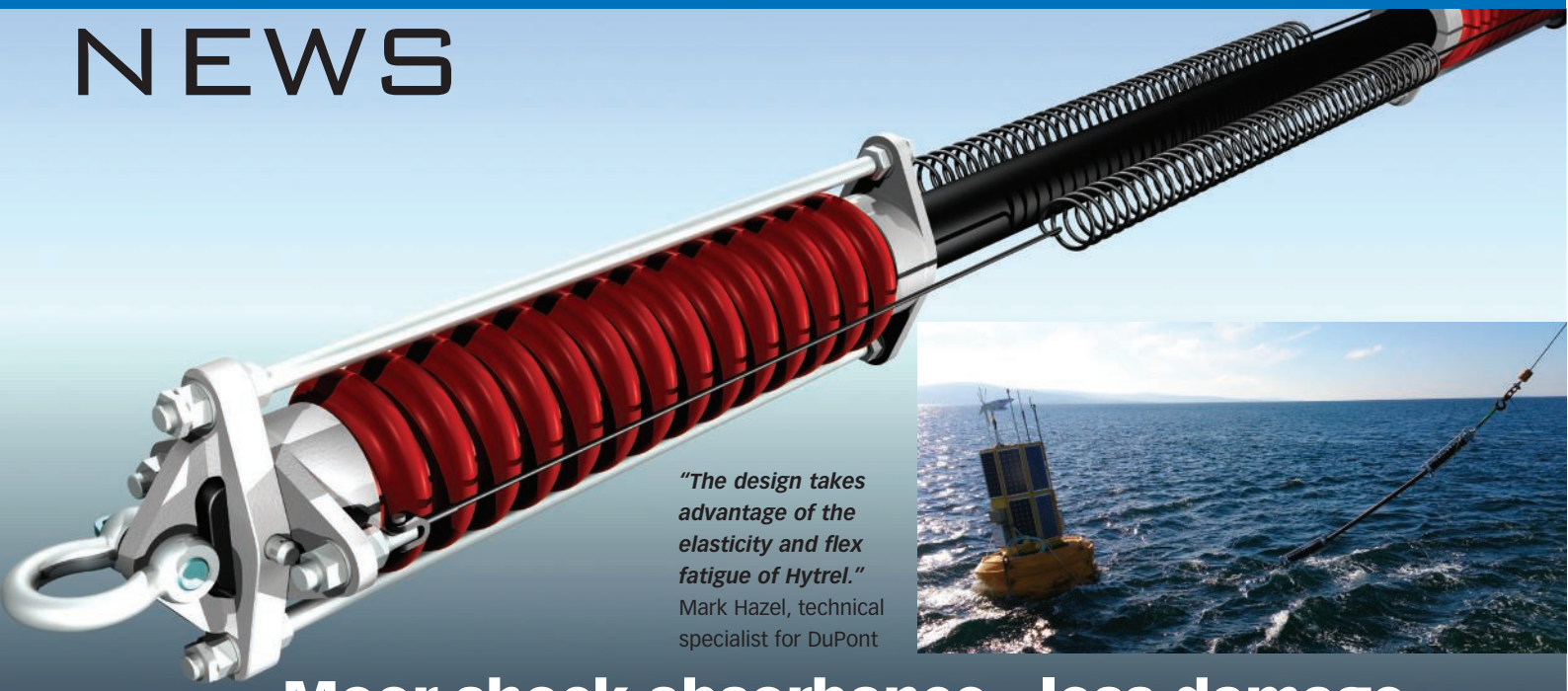
Tim Fryer, Editor (tfryer@findlay.co.uk)

Although you might not think so, it is more than likely that the issue of conflict minerals is relevant to you. If the product you design contains tin or tungsten, or any alloys containing them, then you are using conflict minerals. Cassiterite and wolframite, their respective ores, are the conflict minerals in this case. Equally, if your products include any electronic gadgetry, then it is virtually certain that you will be using tin, and a good chance that you will also be using gold and tantalum (in capacitors). These four are deemed conflict minerals, irrespective of where they come from. If you live in Cornwall and dig up a lump of cassiterite in your garden it is still a conflict mineral – it is just a conflict mineral from a legitimate source.

Conflict minerals play a large part in funding violence, typified by the rebel armies in the eastern provinces of the Democratic Republic of Congo. According to an International Rescue Committee report, the death toll in the DRC war since 1998 is over five million. Two American senators, Dodd and Frank, formed some legislation that bears their names to try and force American companies, and anyone in their supply chain, to take a responsible attitude towards buying these conflict minerals. This legislation is still rolling out, as is a softer approach in the EU. However, as our report on page 21 shows, a large chunk of people who are potentially affected by the legislation remains ill-informed.

More important is the effectiveness of the legislative programme, unquestionably well intentioned as it is. The problem comes from the perceived complexity of knowing from where certain elements of every component have been extracted. Theoretically the Smelter Programme, which means that the mine to smelter part of the process is verified by the smelter, should ease this problem. But some companies have taken more radical steps. One is to not use any mineral that comes from DRC, legitimate or otherwise; another is to design out the four conflict minerals altogether. The problem with this of course is that in a country with not much going for it, DRC depends on its legitimate mineral wealth. The value of tin in DRC is now nearly half of what it was before the legislation was introduced, despite increases in the global price. The consequences are poverty, unrest and, potentially, more support for rebel forces.

So I am not saying that the legislation is bad, but that companies need to understand properly why it is there before they decide how to tackle the issue.



"The design takes advantage of the elasticity and flex fatigue of Hytrel." Mark Hazel, technical specialist for DuPont

Moor shock absorbance - less damage

A mooring device that acts as a shock absorber against powerful waves has been developed in a joint project by DuPont and Ireland-based Technology From Ideas (TFI). The pair collaborated to develop a novel way to stop moored devices being damaged from waves jarring the attaching lines.

The Dynamic Tether Wave Protection System was developed to provide a level of shock absorption against the peak loads generated from harsh seas. The energy-damping bellow is extruded using a DuPont Hytrel TPC-ET polyester thermoplastic elastomer, with a tensile elastomer element made of a soft material with lower stiffness to deliver a low force response to the system. This enables elongations up to 250% of the original length while withstanding repeated low force events in excess of 3.5 million cycles per year.

DuPont used its design knowledge from automotive shock-absorbing bellows to create precise corrugations so it would compress at different rates to give increasing stiffness.

Mark Hazel, technical specialist for DuPont, explained the design philosophy: "The design takes advantage of the elasticity and flex fatigue of Hytrel. We adapted our technology for constant velocity joint boots, which are a mainstay in the automotive industry, and developed a highly functional bellow to handle the extreme load conditions and meet the demanding overall performance requirements of the marine industry."

Wheels grind artificial eyes

Industrial abrasive wheels are being used by Moorfields Eye Hospital to help produce its prosthetic eyes. A wax mould is used is used to cast the acrylic plastic that is trimmed back using the Scotch-Brite EXL Unitised Wheel XL-UW, made by 3M, normally used to deburr metal parts in industry. Moorfields makes 1400 customised eyes every year, each of which are hand-made from medical grade acrylic plastic and finished with the abrasive. The Scotch-Brite grinding wheel used is made of a compressed, non-woven fibre.

Printing in Comfort

Unilever has cut lead times for prototype parts by 40% since introducing Stratasys' PolyJet 3D printing technology into its manufacturing process. Utilising 3D printed injection moulding tools, the company is now able to produce prototype parts in the final material for functional and consumer tests significantly faster than traditional tooling methods.

Unilever, which owns brands such as Surf, Comfort, Hellmanns and Domestos, is using its Objet500 Connex multi-material 3D production system to produce injection mould tools for its household care and laundry goods divisions, with a run of around 50 units for a wide variety of prototype parts such as bottle caps and closures and toilet rim blocks.

"With Stratasys 3D printing technology, we can design and print a variety of injection moulds for different parts that can undergo functional and consumer testing, all on the same day," said Stefano Cademartiri, R&D, CAD and prototyping specialist at Unilever. "Before, we would have to wait several weeks to receive prototype parts using our traditional tooling process; not only would this lengthen lead times, it would also increase costs if iterations were required. With 3D printing we're now able to apply design iterations to the mould within a matter of hours, enabling us to produce prototype parts in final materials such as polypropylene, 40% faster than before."

NEWS

Amphibious vehicle benefits from large composite moulding

Morgan Advanced Materials has helped in the design and development of a highly innovative amphibious vehicle.

Gibbs Technologies has developed the Humdinga, a 6.7m long utility vehicle for potential use in a number of sectors. With any vehicle intended for use in water, minimising the number of panels used in its construction reduces the number of potential leak points and so helps to protect critical internal components.

Gibbs turned to Morgan Advanced Materials' Composites and Defence Systems division. Morgan's large autoclaves meant it could construct and manufacture the 2.5m composite component in a single piece.

Steve Baker from Morgan Advanced Materials said: "We recognise the importance to manufacture large mouldings, which in different applications can contribute structural integrity, aerodynamic qualities and in this case water resistance. We are able to draw on experience in applications from defence to medical, ensuring we deliver the best design and performance."

Composite wrap

A composite wrap is being used to repair metal pipework on site without the need of hot curing.

The SuperWrap II, by Belzona, has been optimised for use on a variety of difficult geometries including bends, straights and tees, tank walls and can also be used as a patch repair on larger diameter pipes. The resulting repair is expected to last in excess of 15 years.

The material used is a bespoke hybrid fabric combining glass and carbon fibres. Glass fibres give the sheet flexibility and act as a wet out indicator, while carbon fibres provide the strength needed to withstand the high pressures and mechanical loading.

Innovation funding

Innovate UK has launched a number of new funding competitions and schemes recently. £2m has been set aside for technology-inspired feasibility studies. It is only open to SMEs and is aimed at the following sectors: advanced materials, biosciences, electronics and sensors, and ICT.

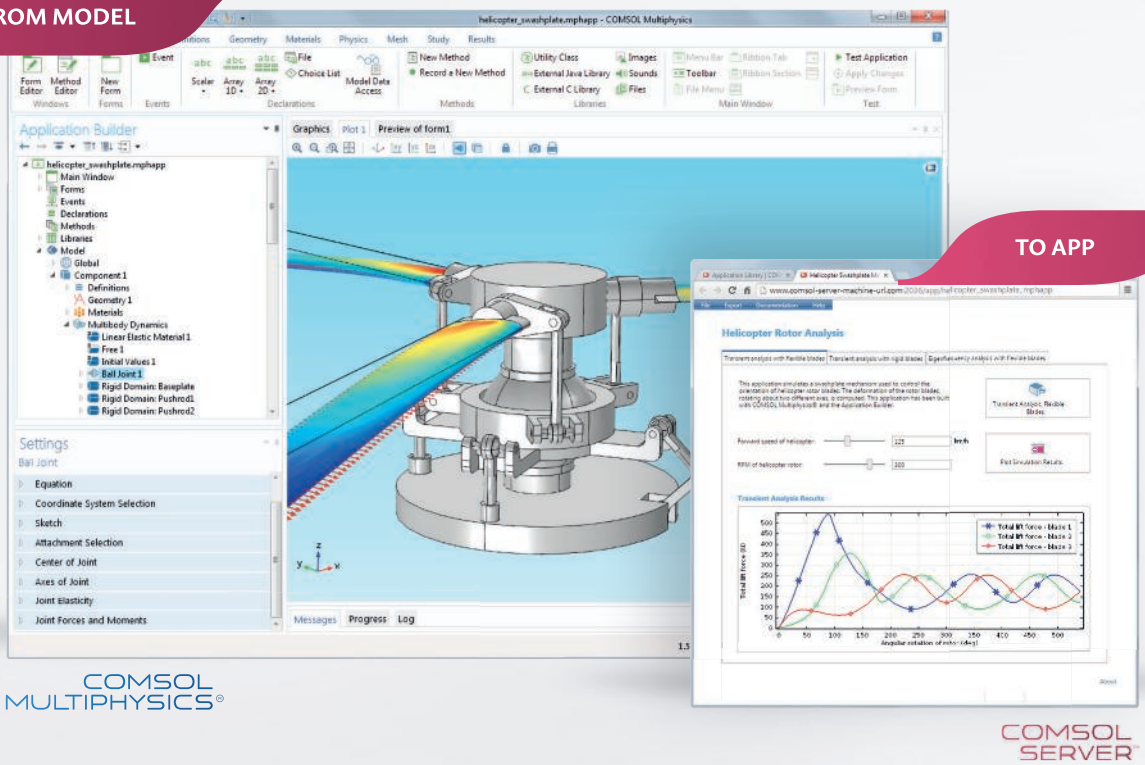
A funding competition with up to £9.5m available has also been launched to address the need for a diverse mix of energy sources and systems. The aim of this competition is to encourage cross-sector supply chains that can deliver integrated energy solutions to meet the energy systems challenges, ultimately with the goal of achieving a low-carbon economy by 2050.

Another £7.5m is available in a competition, run in partnership with Defence Science and Technology Laboratory for collaborative R&D projects to improve the ways in which energy is managed on ships and other marine and maritime vessels.

Finally, £9m is available for funding collaborative R&D projects concerning connecting people and/or goods to transport products and services.

All of these competitions are open for registration. For more information email: support@innovateuk.gov.uk.

FROM MODEL



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NEWS

Composite replaces titanium shuttle successor

TenCate Advanced Composites developed a heat resistant composite material that is being used to provide a heat shield and backshell structure of the Lockheed Martin Orion multi-purpose manned spacecraft, currently being tested and developed by Nasa.

The composite material has replaced what was initially earmarked to be a fully titanium structure, used to provide shielding to the space capsule during re-entry. Lockheed Martin Space Systems thermal protection group worked closely with TenCate Advanced Composites to develop the special heat resistant composite resin for the 5m diameter heat shield that will protect crew during the capsules re-entry.

The successful launch and subsequent re-entry in December 2014 of Orion multi-purpose development vehicle saw the material validated.

Steve Mead, Vice President of marketing and sales at TenCate Advanced Composites said: "The flight represents the culmination of a five year development and qualification effort for a suite of materials used in this extreme application. Further, as a result of the heat shield's large size and thickness, the advanced composites used had to achieve high consolidation using only a low pressure vacuum bag only process."

The Orion spacecraft is a multi-stage to orbit rocket that will replace the now retired Shuttle. It is due for manned launch in 2018 and is hoped to allow a mission to Mars by 2025.

Added CAD

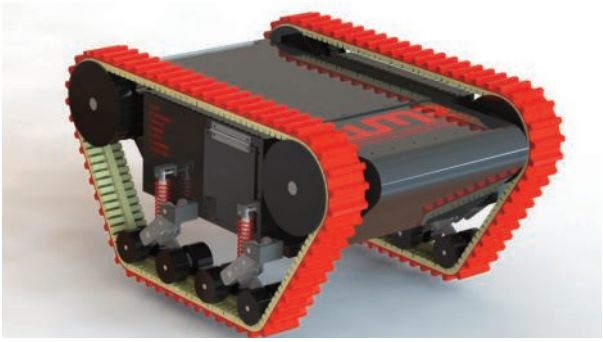
TraceParts has recently added six new CAD formats to its growing list of supported formats. The newest CAD additions to the TracePartsOnline.net platform include PLY, COLLADA, OFF, WAVEFRONT OBJ, VTK and THREE JS, opening up possibilities to a community of design professionals for rendering, gaming or 3D animation purposes.

Optical fibre creates pyrometer

Optical fibre is normally used to transmit information, but a group of researchers at the Universidad Carlos III de Madrid (UC3M) has developed a technique that makes it possible to use optic fibre as a thermometer in extreme industrial environments.

The system measures temperatures of mechanical or cutting processes in areas where conventional techniques – including thermographic cameras and thermocouples – do not have access.

The pyrometer measures radiation in two colours and calculates the temperature based on the quotient of the two signals. This system is calibrated, says the team, so that it can 'start to measure at 300°'.



Robots to the rescue

A miniaturised rescue robot is being developed by a team of eight final year engineering students at the University of Warwick. The Miniature Urban Search and Rescue (M-USAR) robot is designed to investigate areas that are too dangerous or inaccessible for rescue personnel.

The team is being sponsored by maxon motors, who supplies the two EC – 4 pole 22 90W brushless motors that drive the robots. Each motor is connected to a GP 32 C planetary gearhead offering a 123:1 reduction in motor output speed. This generates the required torque to allow the robot to negotiate difficult obstacles. The high motor efficiency (88%) makes maximum use of the available battery power.

The students each bring different backgrounds to the project, including students on degree streams from Electrical and Systems Engineering to Manufacturing and Mechanical Engineering.

Pressure sensitive growth in adhesives

The Global pressure-sensitive adhesives market is forecast to grow at a CAGR of 5.32% over the period 2013-2018 according to a report from analysts Research and Markets.

Pressure-sensitive adhesives are a category of adhesives that form a bond with the substrate on the application of slight pressure. They provide a strong and durable bond for lightly loaded applications. Pressure-sensitive adhesives are used in a wide range of applications, from automotive to medical and general industrial applications.

According to the report, the most important factor driving the market is the increase in demand from the automotive industry. The trend of manufacturing lightweight vehicles has led to an increase in the demand for pressure-sensitive adhesives that contribute to weight reduction in automobiles.

Further, the report states that one of the major challenges in the market is the volatile prices of raw materials. The prices of most raw materials used in the manufacture of pressure-sensitive adhesives are dependent on the price fluctuations of crude oil.

Solution to last month's Coffee Time Challenge

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The solution to last month's challenge to develop a personal electricity generator for mobile phones (and other electrical goods) that is able to harness all types of natural sources of energy comes from US start-up HydroBee.

The patent-pending HydroBee is no bigger than a bottle of water, and acts as a USB battery pack that can be charged using many types of free natural energy sources. It comes with a number of accessories that allow it to harvest energy, including from water (from a tap, stream, river, or tides), bicycles and carts, hand-cranks, belt drive pulleys, solar panels and thermal energy (eg heat from a fire).

The energy is converted internally and stored in a battery, so it can be left all day to charge in a river or in the sun, and just transferred to a mobile phone when it is needed. This avoids the problem of trickle charging, and having to leave a mobile phone plugged in all day waiting for it to charge. The device also has a build in LED light should the user want illumination, instead of a charged phone.

Other applications for the HydroBee include leisure and camping, a power source for festival goers, and anywhere that does not have a permanent source of electricity but is able to exploit some form of natural energy.

www.hydrobee.com

New connections

RS Components has signed a global trading agreement with industrial connectivity specialist Weidmuller. The Weidmuller range now available from RS satisfies interconnection needs across numerous industries such as manufacturing, process control, energy, and transportation.

Controlled development

A webinar titled 'Taking control of your product development information with PLM', is being run by Autodesk on February 24th at 10.00am. To register go to https://attendee.gotowebinar.com/register/3420400718205072642

TECH BRIEF

Chilly chains

William Hackett Chains working with McKinnon Chain have developed the HA range of master links and quad assemblies with a design temperature of -40 °C at a minimum toughness value of 42 Joule.

The need for improved material toughness at sub-zero temperatures has become an increasing requirement in the off shore oil and gas industries due to the exploration and development into some of the planet's most remote locations and extreme conditions.

Tim Burgess (below), managing director at William Hackett Chains, explained: "Material toughness at low temperatures has become recognised as an essential characteristic in lifting equipment used in the energy sector. McKinnon Chain has responded to our market feedback and developed an already proven tough product into an even a better one".

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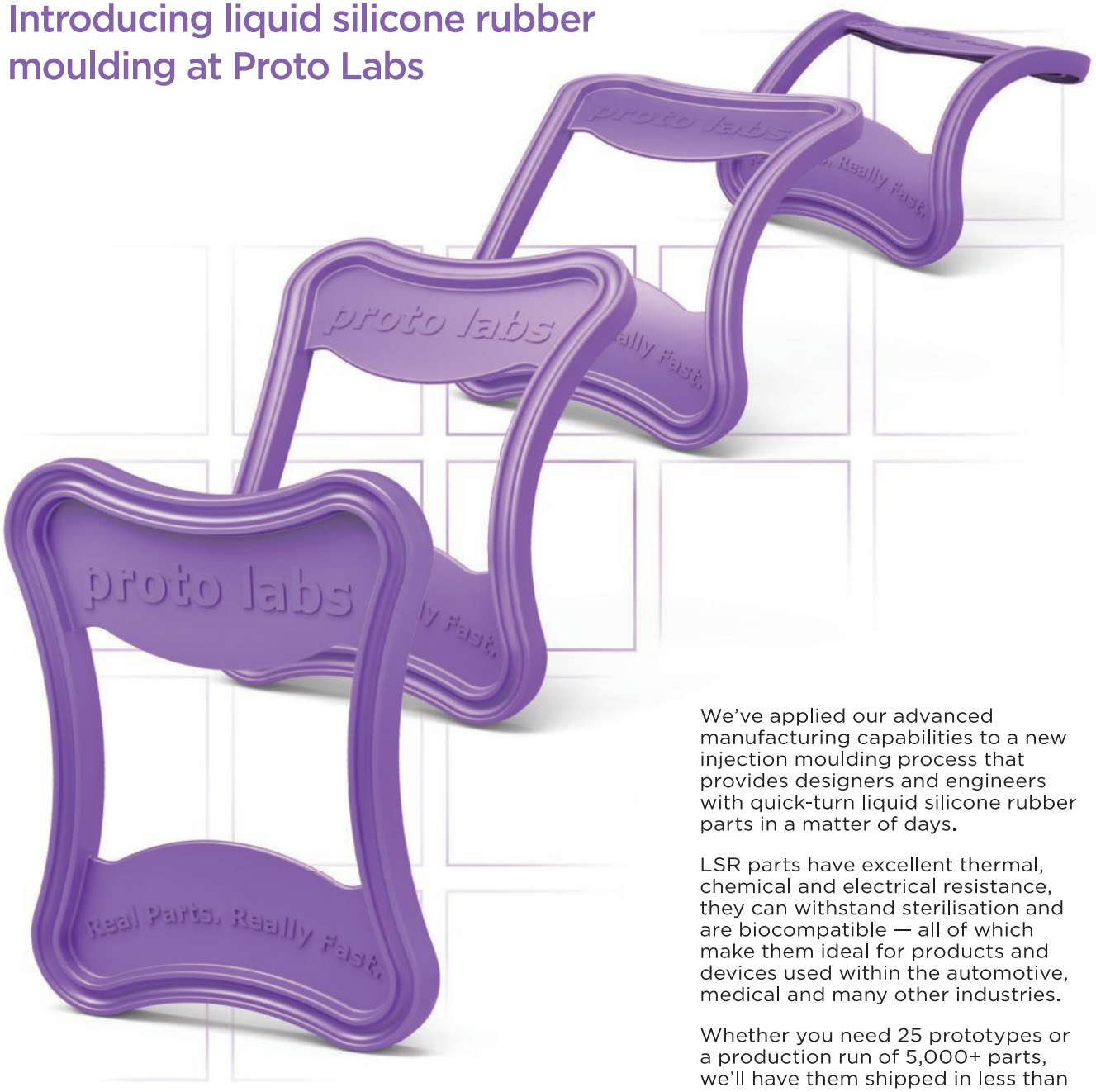

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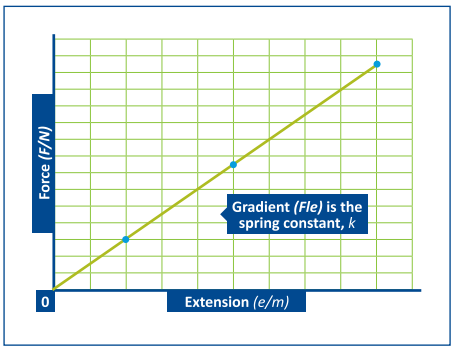
Compression spring machined from a solid piece of material.

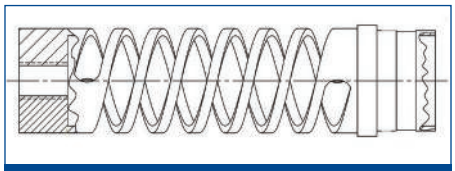
Integrate end attachments into the one piece machined spring

In classical physics, a spring is seen as a device that stores potential energy, specifically elastic potential energy. Back in the 17th century the British physicist Robert Hooke developed what was to become known as *Hooke's law of elasticity.* This states that the extension of an elastic rod (its distended length minus its relaxed length) is linearly proportional to its tension, the force used to stretch it. Similarly, the contraction (negative extension) is proportional to the compression (negative tension).



This accuracy of spring rate is more or less impossible to achieve with a wound spring but is readily available in the machined spring format.

All spring forms adhere to this law, however it is the linear accuracy of the relationship between the compression or extension to the force applied, that separates the traditional wire wound spring from the machined spring. As the name suggests, the product is machined from a single piece of bar stock material rather than coiling wire. Due to the geometry of the machined coil, the spring rate is extremely linear in compression and extension. In fact spring rate tolerance can be as good as +/- 1% if required.



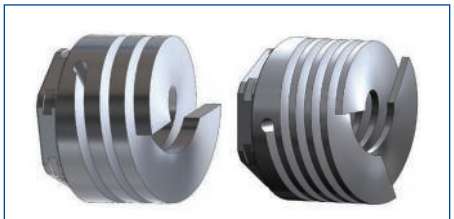
The spring is machined from bar stock material

So why use machined springs?

Two main advantages are immediately apparent. Machined springs can provide very precise, linear deflection rates because virtually all-residual stresses are eliminated. Secondly, the machined spring also enables the designer to incorporate the way in which the spring attaches into the single piece design, often incorporating parts of the spring assembly into the single part construction.

Why are machined springs so unique?

Quite simply, it is possible to have one, two, three of more spring coil elements in the single piece spring construction. Multi-start springs



Double and triple start springs are available

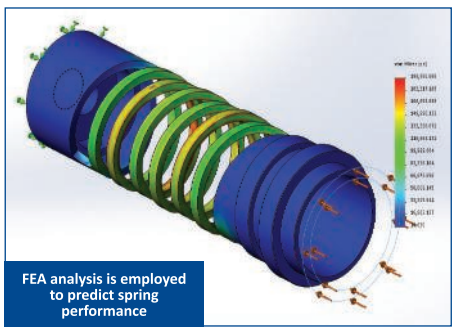
deliver outstanding performance advantages, since the independent helixes are in the same cylindrical plane, which provides totally enhanced spring performance. In fact, the machined multiple start spring coil configurations takes the performance and reliability to levels simply not achievable by the traditional wound spring format.

So why use machined Compression or Extension springs?

A single start spring provides a reaction force plus a moment. On multiple start springs, virtually all internal moments are resolved within the spring itself, which translates into excellent compression or extension parallelism.

The machined spring product has proven itself in medical, aerospace, semiconductor and motor-sport industries to name a few. Wherever a wound spring is not able to meet your performance criteria or a new spring design requires accuracy and repeatability, the machined spring is the ideal partner.

The next time you require a spring in a critical or high duty cycle environment, the machined spring from Abssac Limited may be the answer to your design problems.



FEA analysis is employed to predict spring performance

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NEWS

Sustainability ready-reckoner

The Global Environmental Management Initiative (GEMI) has rolled out the first categories of its Supply Chain Sustainability (SCS) Tool. Bill Gill, Chair of GEMI as well as GEMI's SCS Work Group, commented: "The SCS tool has been designed as a guide to help support and assist with strategic sourcing and procurement by providing visibility into CO_2 emissions and water impacts within a financial context. We believe it is the first tool to offer a portfolio view of the supply chain, enabling tradeoffs between impacts and across purchase categories."

The first three product categories for the tool are paperboard container manufacturing, plastic film and sheet manufacturing, and soap and cleaning compound manufacturing, which may not be directly relevant to many in the British design community. However a look at the drop down menu on the tool reveals that just about every industry sector and material are planned for the future, and so it could be an interesting project to monitor as it expands, especially for engineers with an environmental agenda.

TECH BRIEF

Complete vibro-acoustic simulation

Virtual prototyping company ESI Group has launched its latest version of VA One, which is claimed to offer a complete simulation environment for vibro-acoustic analysis and design. The software combines key vibro-acoustic modeling methods - Finite Elements, Boundary Elements (BEM), and Statistical Energy Analysis - in a single model. This latest release focuses on providing increased flexibility for daily use, seamless coupling with open source CFD software OpenFOAM and supporting advanced aeronautic materials.

The new Distributed Memory Processing BEM solver can reduce computational times by a factor of 10 for large cases on high performance computing architectures, which is especially beneficial when faced with challenges such as the assessment of vehicle pass-by noise.

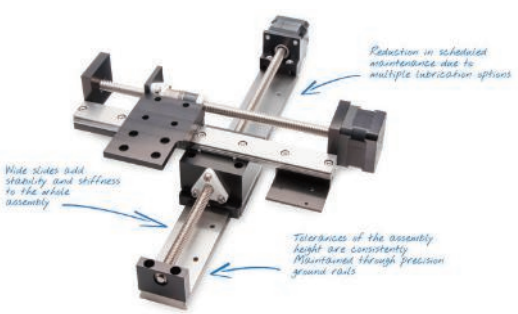
An important evolution in the new VA One has been made in the arena of Cloud Computing to satisfy the needs of small companies requiring high performance computing facilities on an ad-hoc basis, and larger ones requiring a temporary increase in their computing capacity.

TECH BRIEF

Stiff test for guides

Closer integration of products has led to a need for linear motion solutions that offer high speed without compromising rigidity, torsional resistance or life. Reliance Precision's range of linear guides are designed for high load, high moment applications and this is made possible due to a unique re-circulating ball design in the carriage which delivers smooth motion, low noise and high accuracy. The guides provide high levels of stiffness to enable the carriage to operate at higher speeds. Forty five degree contact angles and a gothic profile design incorporated into the carriage result in a multi-direction equalisation of force.

The linear guides consist of a stainless steel rail and built-in lubrication reservoirs to provide an effective, low maintenance solution. Design engineers can integrate linear guides within higher level assemblies and Reliance Precision has developed a motorised anti-backlash X-Y stage with a positional accuracy of 0.01mm, unloaded repeatability of 0.005mm and a load capacity of 50N.



HUNDRED YEARS TO TAKE OFF

A new design of airship is nearly ready for take-off, 100 years after the iconic Cardington hangars were built to house the UK airship industry. Tim Fryer went to visit

Airships are slow, difficult to manoeuvre, impractical and, more than anything else, very dangerous. That was certainly the view of the British Government, who effectively pulled the plug on the British Airship industry after the crash of the R101 in 1930. Most of the R101's leading designers were among the 48 who died on that disastrous maiden voyage.

The replacement of hydrogen with helium to fill the airships meant that the dangers of catastrophic fire which beset the R101 - and more famously the Hindenburg seven years later - were removed. But beyond the use of airships as tourist attractions, and even then not in the UK, it is a sector that has failed to take off again, all previous attempts having fallen victim to financial difficulties.

Despite the adoption of helium the other problems with airships remained and were identified by Sir Barnes Wallis. Although more famous for his later work on the bouncing bomb, Wallis had led the design team on the R100, the rather more successful branch of the twin track development plan for British airships. In fact the R100 had made a return trans Atlantic crossing, and it was suspected that this success hastened the R101s development, as both were effectively in a race to prove which had the better design. The consequent premature flight of the R101 and its tragic outcome therefore resulted in the loss of some more promising technology in the R100.

However Wallis remained interested in lighter-than-air travel and appreciated some of the fundamental problems that remained, particularly concerning the manoeuvrability of the airship on the ground – the traditional method of throwing out hundreds of ropes to a waiting team below was clearly not viable. Other concerns were the avionics systems and the materials used. Wallis shared these thoughts with a designer called Roger Munk, who continued to work on airship theory but, as long as the core product was to remain as an improved airship, those fundamental problems remained unresolved. The breakthrough came with the idea of developing a hybrid aircraft and in 2007 he launched a company, Hybrid Air Vehicles (HAV), aimed at making the theory a reality.

The basic premise of the hybrid was to combine the lighter-than-air properties of an airship with the aerodynamics of an aeroplane wing.

"The thought process behind the hybrid was something that Roger and myself were having in the early 90s," said Mike Durham, HAV's technical director. "We built our first sub-scale demonstrator, a 12m long remote controlled vehicle, in the late 90s and we have been developing it since then. The hybrid is what makes it possible to fix all of Barnes Wallis' problems."

"Mixing an aeroplane wing shape with an airship allows you to make an airship heavier than air," explained Chris Daniels, head of partnerships and communications at HAV, "and as soon as it is heavier than air it is controllable. You can land it easily and take off in a more controlled manner. It is less dependent on weather and in particular cross winds. So that is why we set up as a hybrid and all the evidence we have points to that being the future for lighter-than-air."

That evidence includes a study by one of the world's biggest aircraft manufacturers who independently suggested that there would be an initial demand for around 600 such airships and that the market would be worth £50bn within 10 years.

Daniels added: "Another independent report, from a well-known British billionaire, suggested that we were three years ahead of the competition. So we know there is a market, we know we are ahead of the game, but we are not complacent, we just want to do things

> "MIXING AN AEROPLANE WING SHAPE WITH AN AIRSHIP ALLOWS YOU TO MAKE AN AIRSHIP HEAVIER THAN AIR,"

right. It is about measured development and getting the right aircraft flying. The only thing that is slowing development is money. It is just the economics of a small business - the more engineers we have working on this the quicker we get it in the air."

The aircraft, the Airlander 10, has already flown. HAV initially won a contract in 2010 from the American military, beating offerings from the Lockheed Martin Skunk Works, with a very fast development schedule aimed at deployment in Afghanistan. Withdrawal of troops followed by defence cuts in 2013 meant the project was pulled just when trial flights were taking place. It was fit to fly back across the Atlantic but was not allowed to for regulatory reasons.

"What we have is a kit that has already flown but we now need to test every single item to prove that it is airworthy," said Daniels. "So for example we have a big engine test rig that we will be using in January and running them to make sure we have got the right amount of thrust and so on." The engines themselves are standard light aircraft engines from Technify, which, claims Daniels, is: "the only credible solution for 300hp+ diesel engines providing efficiency at a wide range of speeds. Xtrac, the gearbox provider for F1 cars, have provided gear boxes to us in F1 timescales too. They are reliable and flexible and therefore allows us to have a large electrical power generation."

Each of the four engines provides forward thrust but can be manoeuvred to provide low speed vehicle control. Each is also fitted with four vectoring vanes for control in normal flight conditions.

The hull is made of a specialist strong and lightweight material, supplied by Warwick Mills, which is based on carbon fibre, three layers of Mylar and a layer of Kevlar. The resulting material is no thicker than shoe leather. NASA spacesuit manufacturer ILC Dover built the hull, which has no internal structure but is instead what HAV engineers call a double-bubble hull. It is two separate gas volumes that are blended together to form a slightly corrupted figure eight. Durham commented: "The Airlander 10, although it looks like a big bubble, already produces five or six times the lift of an ordinary airship. In a cigar-shaped airship you might get 5 or 6% of your lift from aerodynamics, in a hybrid vehicle you can get up to 40%, which is why the hybrid shape is more efficient."

But how easy is it to prove something the size of an airship has

The versatily of the platform makes it a suitable workhorse in remote locations. (Far left) The Airlander 10 in the Cardington hangar. (Above left) one of the four engines awaiting test.

reached its most efficient design? Durham responded: "Through scale demonstrators, through wind tunnel testing you just get a better and better design. I am sure what we have is not the ultimate design, in 20 years time somebody will have come up with an even more efficient version. But what we have works, and it is good – maybe we have lucked out and got the optimal design but we can't be 100% sure of that at the moment.

"You can't build one of these just on CFD, and you can't build one of these based on just a few test flights of the demonstrator. It is the whole engineering development process that puts it together. We did a lot of wind tunnel modelling back in the late 90s and early 2000s on the concept of a hybrid vehicle. That testing gives you confidence to scale the data up to build a sub-scale demonstrator – the 12m model. With the information you get from that you can go back to the wind tunnel and to use CFD for a computer simulation – all the pieces fit together."

There are currently a dozen engineers and half as many technicians

"THE AIRLANDER 10, ALTHOUGH IT LOOKS LIKE A BIG BUBBLE, PRODUCES FIVE OR SIX TIMES THE LIFT OF AN ORDINARY AIRSHIP"

and Durham describes it as true hands-on engineering, with CAD terminal being swapped for screwdriver whenever necessary. However, the main design environment is Solidworks although Durham said: "We use everything from Solidworks to Catia. We have CFD and stress analysis tools and the basic shape was established in a Unigraphics package 15 years ago."

The range of engineering disciplines covers mechanical, electrical, avionics, structural, mechanical, fuel systems, propulsion..... "We have to have the complete spectrum of engineers because we are unique in the UK in that we design complete aircraft," said Durham. "We are designing a complete vehicle system, everything starts from this office. We may package up the design of a fuel tank for instance, our fuel systems engineer would set all the basic requirements push that spec out to a manufacturing and design company who will do the detailed design on that fuel tank. So we do tend to run a distributed design and manufacture process."

In particular Blue Bear Systems, Tensys and Cranfield University all helped with aspects of design for the hull structure, simulators and wind tunnel models and testing, respectively.

Other notable contributors have been Raytheon who has done the electrical wiring and Triumph who supply the high performance actuators. Beside the hull, most of the aircraft, like the payload modules, fins, engine housings etc are made of carbon composites. These materials have come from a variety of carbon composite manufacturers, Forward Composites being the most significant.

The vital statistics of the Airlander 10 are that it is 92m long, 44m wide and 26m high. In manned mode it can remain airborne for five days and 21 days unmanned. Its maximum payload is 10 tonnes and maximum speed is in the region of 80 knots.

If it was to be used for passenger transport then it would probably, for regulatory reasons, be limited to 48. Daniels commented: "For passengers it is a much more pleasant experience – you can have floor to ceiling windows, and you can open windows. But on short haul routes, like island hopping it can be quicker than having to go through airports, even if the flying speed is slower. It is a different market to a 747 going across the Atlantic, athough you can go around the world. Where that is useful is for tasks like communication or search and rescue where it can be available for weeks at a time."

One project that is planned for next year is shifting wind turbine blades and gear parts to the north of Sweden. The alternative way to transport the equipment would either be to use helicopters, although they can struggle with underslung loads, of start building roads through forests.

Airlander 10 will cost about £25m, which is cheaper than a large aircraft and roughly equivalent to a large helicopter. However it is far more efficient than a helicopter and HAV claim it has under 20% of the operating costs, so over a ten year period it will be a lot cheaper than any other aircraft. It is also the safest form of air travel – it can still fly even if all four engines fail.

Under development already is the triple-hulled Airlander 50 which will have more powerful turbofan propulsion and a payload of 50 tonnes, bringing it into direct competition with large cargo planes.

www.hybridairvehicles.com

The Cardington hangars

During the first World War, the British airship programme, already over a decade behind the German Zepplin development, was initiated across a handful of sites in the UK. This involved the construction of vast hangars of which only the two at Cardington still exist. The first of the two was built in 1915 by Short Brothers, who had been commissioned by the Admiralty to develop airships, the R31 and R32. A decade later the hangar was extended to 247m long to accommodate construction of the R101 airship. In 1928 the second hangar was disassembled at the Royal Airship Works in Pulham, Norfolk and re-assembled at Cardington.

After the collapse of the British airship industry in 1930 the site was used to build barrage balloons but after the Second World War the RAF no longer used the site. Since then the sheds have been used for filming, construction and fire research and an unsuccessful attempt by a company called Airship Industries to resurrect the airship industry in the 1980s.

Shed 2 (below) is now home of Hybrid Air Vehicles.

CV

Ric Parker is director of research and technology at Rolls Royce. He graduated from Imperial College London in Physics and has also received a distinction on completion of his MBA at Loughborough University. In 2013 he was awarded a CBE for services to engineering. Since he joined Rolls Royce in 1978 and has held various positions within the business including chief of composites and ceramics, followed by manager of compressor systems, and has been appointed director of research and technology for the whole group since 2001. He is now responsible for the direction and coordination of all Rolls Royce research and technology programs across the globe.

Innovation cultivation

There is more to innovation than putting bright people together. Here, we get an insight in to how Rolls Royce goes about the business of innovating and find out what the rest of us can learn from its example. Justin Cunningham reports.

When you are charged with cultivating innovation for one of the world's most prestigious engineering organisations, you need to be sure that you're able to match bright ideas with customer needs.

This is exactly the role Ric Parker, director of research and technology at Rolls-Royce, has been doing since 2001. So what can he tell the rest us about turning bright ideas in to business success?

"Innovation is not just about technology," he said. "Innovation is the entire process of taking an idea and turning it into a successful product. While it is great having a room full of bright people coming up with ideas, unless a company can turn those ideas into successful products, it is a waste of time."

Rolls Royce has become synonymous with good design and quality engineering and this is something Parker is keen to proliferate throughout UK industry. While the UK might well have lost much manufacturing overseas in the last few decades, the design and innovation has stayed largely onshore.

"I passionately believe innovation is vital for the UK if we are going to succeed as a nation," he said. "If you copy the rest of the world you can only ever be number two at best, but if you want to be number one then you must innovate to stay ahead of the competition."

So how does a firm with such a rich R&D heritage perpetuate commercially viable innovations?

"There are two important factors the whole company follow: innovation and the customer," he said. "If you get these two things right – satisfying customer needs using innovative ideas – then you will succeed. You'll find this DNA within everyone at Rolls Royce.

"Giving a customer an innovative idea that isn't reliable, doesn't work or doesn't arrive on time is not good business."

What is surprising, perhaps, are the sources that Parker, and Rolls Royce, use to find innovation. It uses close customer relationships to feedback information and to drive future technological development and direction. In addition, it invites innovation to happen in every aspect of its business. It is not the sole responsibility of engineers to innovate and should in fact happen within every department of its business to ultimately deliver better products and services.

But it also goes a step further and not just invites, but practically insists, that its supply chain is of the same mindset. Its suppliers must also continually innovate, and show incremental improvements that lead to customer benefit.

"The idea that you have single group of bright boffins, and those are the people that will innovate, is rather old fashioned," said Parker. "Innovation can come from anywhere – inside an organisation, in R&D centres, or in the supply chain. Increasingly being competitive is about making the whole supply chain competitive, and that means it needs to be innovative. Ensuring the supply chain is full of ideas and is able to bring them to the fore is vital.

"Customers too will also have ideas. Even if they might not know how to turn them in to products, they can tell you what they would like. It is wise for companies to tap in to these external sources to help bring about new ideas of where you can improve."

"Innovation is the entire chain of taking an idea, turning it in to a successful product and creating wealth."

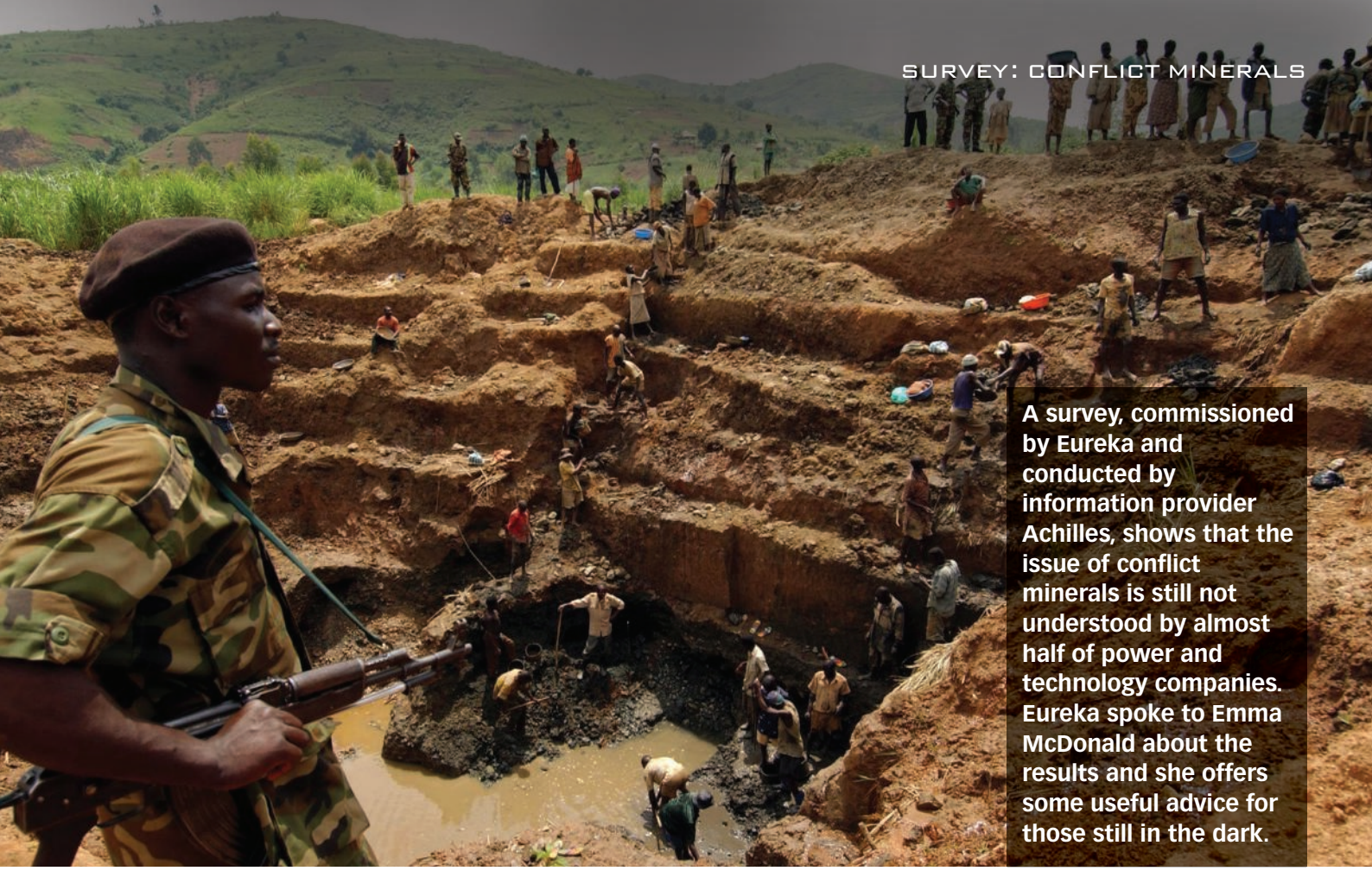
It is this philosophy that sees Rolls Royce integrate its 'ideas people' with more constrained engineers. It is a delicate and challenging balance of allowing those creative individuals the freedom to innovate while at the same time, given the highly regulated and safety imperative nature of its business, having engineers in place to deliver the quality and reliability needed.

"The Lockheed Martin Skunk Works is an example of where bright people are separated to do the clever stuff, and everyone else in the business gets on with the day to day products," said Parker. "We tend not to do that and we keep our innovators in amongst the people delivering to customers, so they understand the real problems and issues."

There is no doubt the world demands more innovation, faster. It doesn't seem to matter if it is Rolls Royce or a start up, product development cycles are being squeezed in almost every industry. So should companies feel the need to release new products more frequently?

"It is important to understand the difference between invention and innovation," explained Parker. "The big leaps forward often don't happen in one big innovative step. It's not one primary technology but instead usually takes lots of ancillary technologies. It is often these ancillary technologies that are vital and these have to keep pace.

"Invention is that flash of genius without which you don't get the new ideas, products and processes for the future. But innovation is the entire chain of taking an idea and turning it into a successful product and ultimately creating wealth. That is the vital difference."



A survey, commissioned by Eureka and conducted by information provider Achilles, shows that the issue of conflict minerals is still not understood by almost half of power and technology companies. Eureka spoke to Emma McDonald about the results and she offers some useful advice for those still in the dark.

Can collaboration **cut conflict?**

Almost half (43%) of power and tech companies have admitted they are 'not at all confident' about conflict minerals rules – just weeks before the launch of another raft of regulations. Just 7% of businesses said in a market survey they were 'very confident' they understand the existing US Dodd-Frank Act on conflict minerals.

And the issue looks set to get worse in early 2015, when the EU is due to unveil another raft of regulations on conflict minerals.

In total, more than half (52%) of power and tech companies were 'not at all confident' they understand these new rules, or the OECD guidelines which underpin them, the survey showed. In addition, two thirds (65%) of power and tech businesses also said in the survey that they do not have a policy on conflict minerals.

The market survey was carried out by Achilles – a global supplier information firm which provides reporting on conflict minerals and other supply chain risks to 850 buying organisations.

A total of 104 manufacturing organisations, which were not part of any Achilles conflict minerals programme, took part in the survey. Most were involved with:

- The manufacture or provision of engineering parts or mechanical components
- Electrical components and electronics
- Plant sub-systems and equipment
- Services and IS
- Raw materials and semi-finished products

Different results for different approaches

In the survey, half of power and tech companies said they did not understand conflict minerals rules. In contrast, 98% of Achilles conflict minerals customers said they were clear on regulations as well as their customers' code of conduct on conflict minerals – with half having undertaken bespoke training to ensure they are compliant with the legislation.

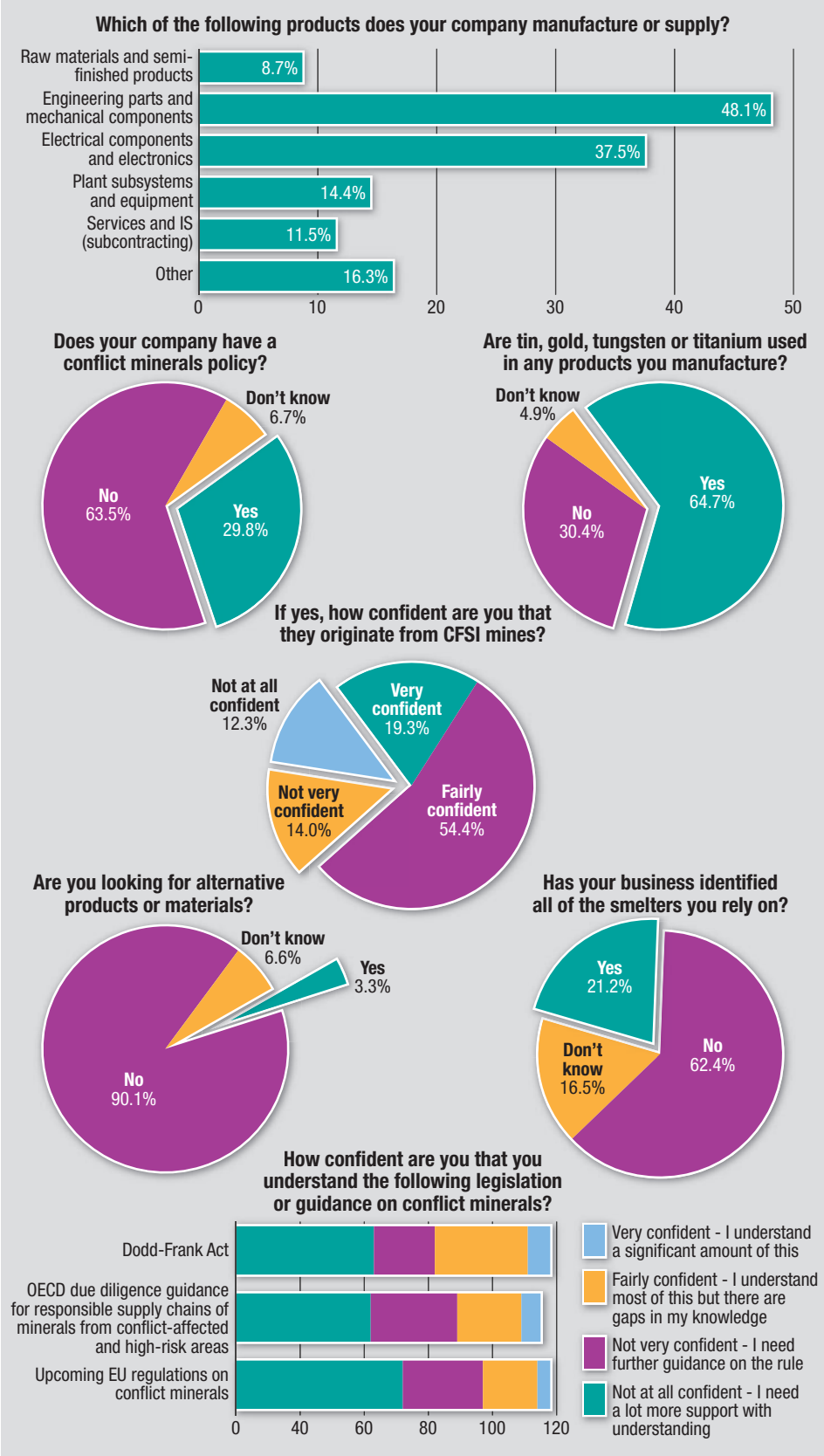
In the market survey, only one fifth of suppliers had identified the smelters they rely on. Emma McDonald, Global Programme Director at Achilles, said: "To the uninitiated, every aspect of conflict minerals seems complex – from understanding the rules, to identifying one's involvement with the specific elements, mines and smelters; to recording and reporting data in the correct way.

"What this survey shows is that suppliers are falling at the first stage – communicating loud and clear that they do not understand the rules.

"Buying organisations could lead by example and take steps to educate the supply chain about the Dodd- Frank Act and the new upcoming EU rules on conflict minerals."

McDonald said it was also crucial that large power and tech buyers agreed and communicated clear standards and requirements for suppliers, so everyone in the supply chain understands what they need to do to comply. Finally, buyers need to put in place a clear process for gathering and managing information provided by suppliers and carry out audits. "Without support, this is a significant undertaking, but in reality, conflict minerals could be a catalyst for power and tech companies to think even smarter," she said.

"Most global power and tech companies rely on the same suppliers. In our experience it is much easier to achieve compliance when corporations get around a table and agree a common 'pre-qualification' questionnaire, with clear standards for suppliers in business critical areas, including conflict minerals.



"This would enable them to share the burden in terms of time and resources, and prevent suppliers from providing the same information over and over again to their buyers. They'd complete one form and be eligible to work with any of the buying organisations. There is no 'competitive advantage' in having a compliant supply chain; it's the law."

Achilles first implemented conflict minerals services on behalf of Shell in 2012 – in preparation for the Dodd-Frank Act. The company launched conflict minerals services to the Automotive, and Power and Tech sectors in 2013.

"Achieving compliance with conflict minerals legislation is not an easy task but the more power and tech companies that collaborate to share the workload, the simpler it will be for everyone," said McDonald.

Five tips for managing conflict minerals

1. Educate the supply chain

It is estimated in the last 15 years, about five million people have died in wars funded by conflict minerals production in the Democratic Republic of Congo (DRC) alone. That's a record that no company – irrespective of size – would want to be associated with.

The reputational damage suffered by a company discovered using conflict minerals could be almost crippling which is why it is essential for buyers to ensure suppliers are aware of their obligations.

In addition, buyers that fail to comply face hefty fines. In the US, under the Dodd-Frank Act, manufacturers can be fined between $75,000 and $725,000 if they do not put in place systems to eradicate conflict minerals.

In order to avoid reputational damage and legislative ramifications, buying organisations must have support from suppliers in lower tiers to accurately report their source of their materials. If a buyer has to pay a financial cost – then ultimately, so will suppliers.

2. Understand the challenges

Companies should be prepared for a challenge. Identifying the provenance and primary source of precious metals can be a highly complex process.

Supply chains are becoming increasingly globalised, with many companies reliant on suppliers in all corners of the world.

A complex network of people is involved in

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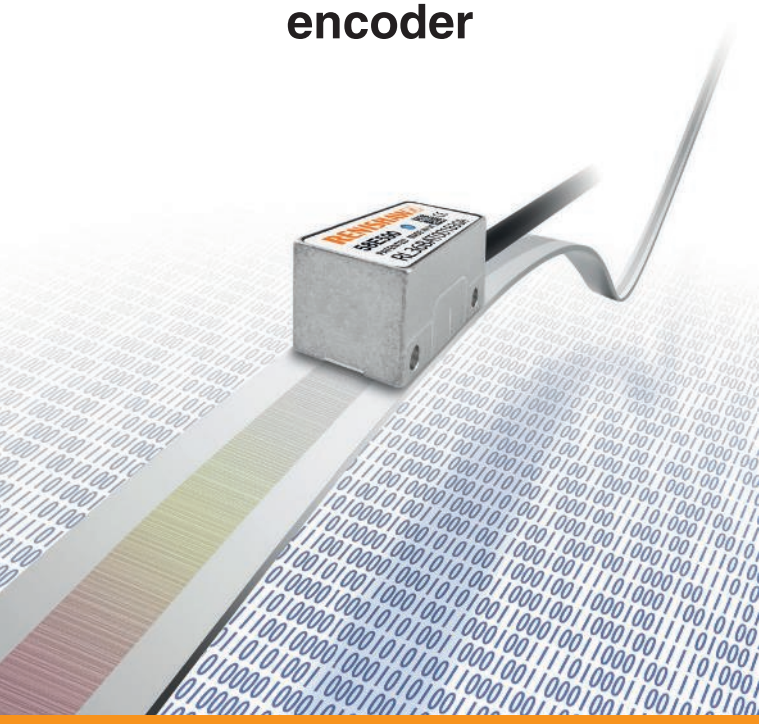

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mineral production – from labourers in the mine to exporters, traders, intermediaries and smelters – who extract the mineral from larger pieces of matter. By the end of this chain, it can be impossible to know how the material was sourced.

3. Know who your suppliers are

Many companies have difficulties identifying how many suppliers they have in their first tier, let alone how many make up their entire supply chain. This often makes it difficult for companies to gain visibility of their suppliers and how they do business.

Buying organisations must have in place databases comprising business critical details for their suppliers. This allows them to check and validate responses from suppliers, implement improvement plans and achieve accurate reporting. Only with a robust database of core information can buyers start to track down to identify all contractors in lower tiers and whether they have a connection with conflict minerals.

Emma McDonald, Programme Director for Achilles

www.achilles.com

4. Build a supply chain map

At this stage, buyers should consider mapping the supply chain to identify all suppliers, right down through the tiers of the supply chain.

Suppliers in each level ask their own suppliers to provide information about conflict minerals via cascading invitations. This information can then be put together in a 'map' or database making it easy for a business to see which companies each of their suppliers deal with. From that point, they can create a clearer picture about their supply chain's involvement with conflict minerals.

Implementing a supply chain map takes time and effort but is preferable to the possible consequences of discovering a company is risking your bottom line and reputation by purchasing products made using conflict minerals.

5. Work collaboratively

We believe that many power and tech companies rely on the same suppliers. It is not a competitive advantage to comply with the law so companies should work collaboratively to remove conflict minerals from the supply chain. Businesses that work together to shoulder the burden will see a significant reduction in the time, cost and resources needed to undertake the task.

Procurement professionals should focus their time on activities that add value – not chasing forms and checking submissions from suppliers.

Creating a conflict mineral free supply chain is a complex task, but the benefits companies receive will make the exercise beneficial for everyone in the supply chain.

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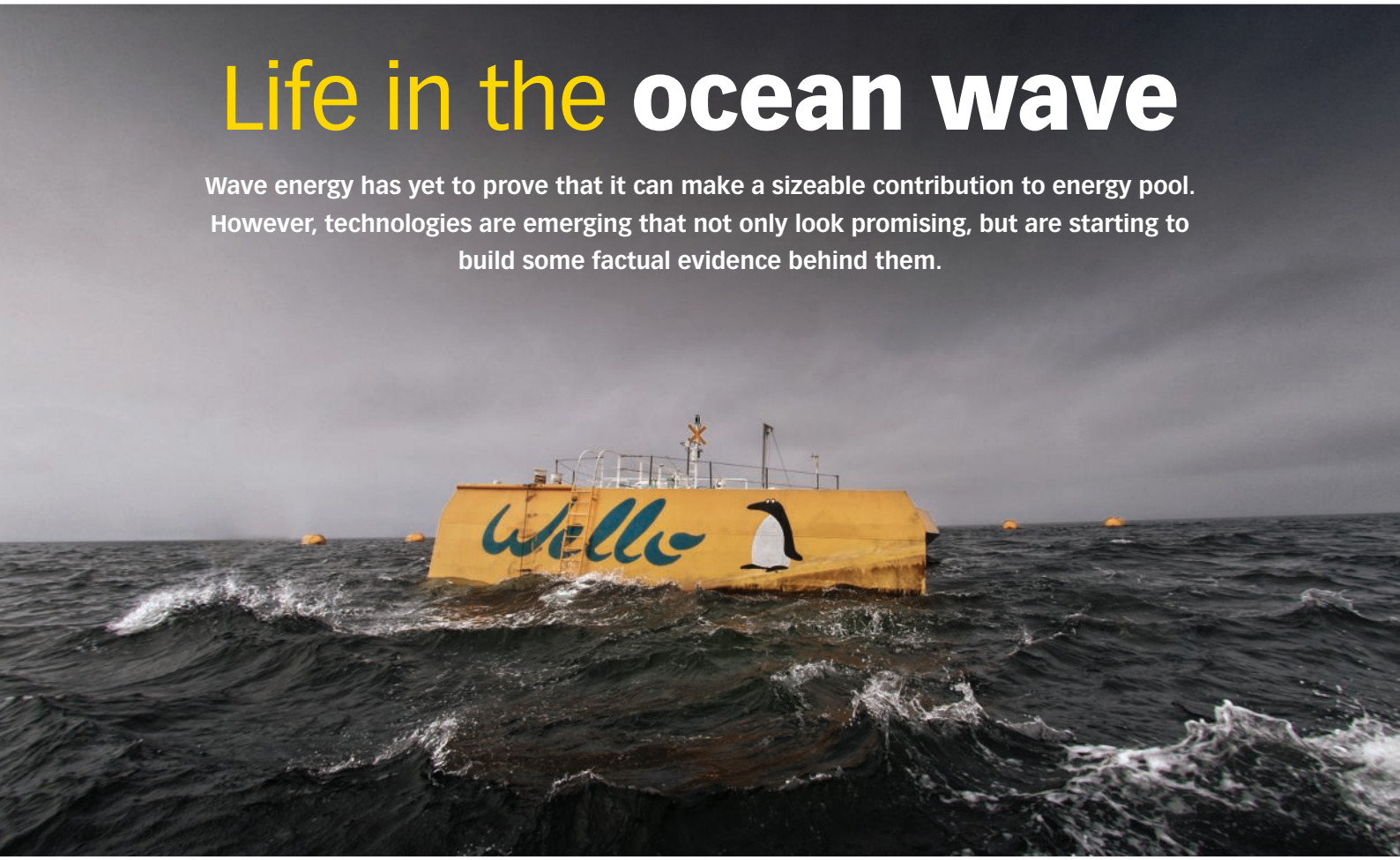
Life in the **ocean wave**

Wave energy has yet to prove that it can make a sizeable contribution to energy pool. However, technologies are emerging that not only look promising, but are starting to build some factual evidence behind them.



Oceans cover two-thirds of the Earth's surface, are integral to all life on the planet, impacting on climate and weather patterns, and are home to 230,000 known species. They are also one of our greatest assets and now stand to deliver far more to us through wave energy harvesting as we look to a future without fossil fuels.

Heikki Paakkinen was confident his idea of a wave energy converter would create a sustainable source of energy for future generations and founded Wello.

The pioneer programme, the Wello Penguin, is a patented wave energy solution, designed to work in harmony with the ocean to provide an ecological means of tapping into a source of pure, unlimited energy.

A 1:8 scale model survived testing in a 100 year storm in 2010, before a full scale unit was constructed in 2011. This was put under test in Orkney at the European Marine Energy Centre, during which time it was connected to the grid, successfully generating electricity, while surviving 12m waves.

The Penguin, which floats on the water, is designed to capture rotational energy generated by the movement of its asymmetrically shaped hull, which rolls, heaves and pitches with each passing wave. This motion is used to accelerate and maintain the revolutions of a spinning flywheel housed inside the hull, which in turn drives an electric generator to produce electricity that is then exported via a subsea cable. The vessels are static so they do not disrupt the water's natural rhythm or disturb marine life and are proving to be both reliable and extremely durable.

The devices produce no visual or noise pollution and they can be used on almost any coastal area, with the power to generate enough electricity to power 400 homes from one device. The current device is rated up to 500kW and the Orkney tests in 2013 showed that continuous current control ranges for the device were between 160 – 180 kWs with peak performance periods of up to 700kW in sea conditions of 3m and up.

It is an idea that Wello believes has the potential to make a dramatic impact on the way in which the world can harness the power of the sea.

Like many of the best ideas, Wello's technology relies on its philosophy of making a complex solution simple. The design team has developed a converter that contains only one moving part inside the actual hull of the device. This means the internal parts are not exposed to sea water and are therefore not subject to corrosion. The asymmetrical design of the device is also important to the conversion from continuous rotational movement to electricity, and this is an area in which Wello believes itself to be unique. All other wave energy harvesting devices convert the movement of the waves into a back and forth motion. This drives a piston

which feeds the generator. The problem with this is that the energy is not continuous. The Penguin, on the other hand, uses continuous rotational movement, directly converting the motion to electricity without the need for hydraulics, joints or gears.

The Penguin's design also uses off-the-shelf commercial components for the converter and the steel hull and, as the actual device is built like a ship, the manufacturing can be completed locally by ship yards using existing tools and manufacturing processes. In addition, the generator is the same as used in wind turbines. All of this ensures low manufacturing and installation costs, as well as minimal maintenance outlays.

Instead of complex fixed structures which can cause damage to the sea bed, the Penguin converter floats on the surface with only minimal anchoring attached to the bottom, making it also easier to install and disassemble. The 30m x 15m vessel is nine metres in height but since less than two metres are above the waterline, it is barely visible from the shore and floats in a discreet and non-disruptive manner without making any sound.

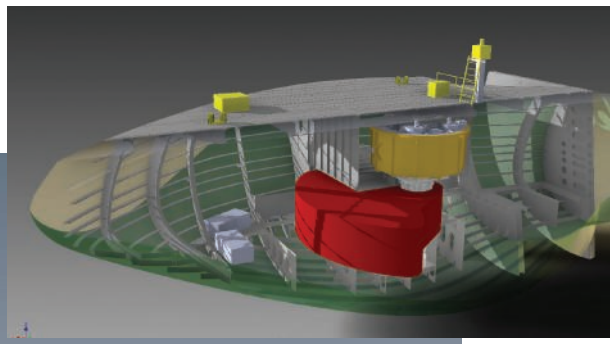
The actual energy is generated in one step only as there is a direct conversion from the movement of the vessel to electricity which is then fed directly into the onshore grid through a 2km long cable.

"The Penguin is a truly unique way to harness the waves with all of the components inside the device, ensuring that they are protected against the force of the sea. Wello has gone from simple conception to technological development and commercial piloting of clean technology and will soon be able to make a difference, not just in the field of clean energy, but in the lives of people who want to make a smart change," claimed Aki Luukkainen, CEO Wello.

Style and substance

Throughout the design process, the team wanted to maintain a balance between form and function, to ensure that any resulting device was beautifully designed and wouldn't take away from the grace of the sea, as well as delivering an innovative solution to future energy shortages. Working within the Autodesk Cleantech Partner Program, and using the free design software which it provided them with, the Wello team was able to achieve this balance, without compromising the success of the project. Working with Autodesk over the past four years, the team of ten engineers and designers used Autodesk Inventor from the Autodesk Product Design Suite to create the mechanical components and mechanisms. The key design challenge for the team was keeping the product simple, with simplicity one of the main elements of the company's philosophy.

Autodesk Alias was used for the form of the design, allowing the innovative three dimensional curved hull design to be sketched using the digital tool. "Autodesk helps with the design and visualisation of innovations, a critical part of the process, as well as creating a beneficial link from design to manufacturing of prototypes," said Luukkainen. "We had to create a new category of wave power converters and having the design tools free of charge thanks to Autodesk's Cleantech Partner Program enables us to use software we wouldn't otherwise have been able to provide to our designers and engineers. This in turn has significantly reduced our time to market."



The company's goal is to install ten Penguin wave converters around the world in the next three to five years. At the end of last year Wello received a financial and psychological boost when Scandinavian utility company Fortum bought a minority shareholding. Luukkainen viewed the collaboration with Fortum as a natural step as Wello moves from technology development to the commercial piloting phase. "This is an excellent example of a small company partnering with a big company, which can significantly speed up the development of new technology into a commercial product. Together Wello and Fortum can take a significant step in this evolving sector."

Looking ahead, the Wello team are planning to expand on the design tools which they use, particularly drawing on simulation tools to better understand how the Penguin can be refined and rolled out successfully across the globe.

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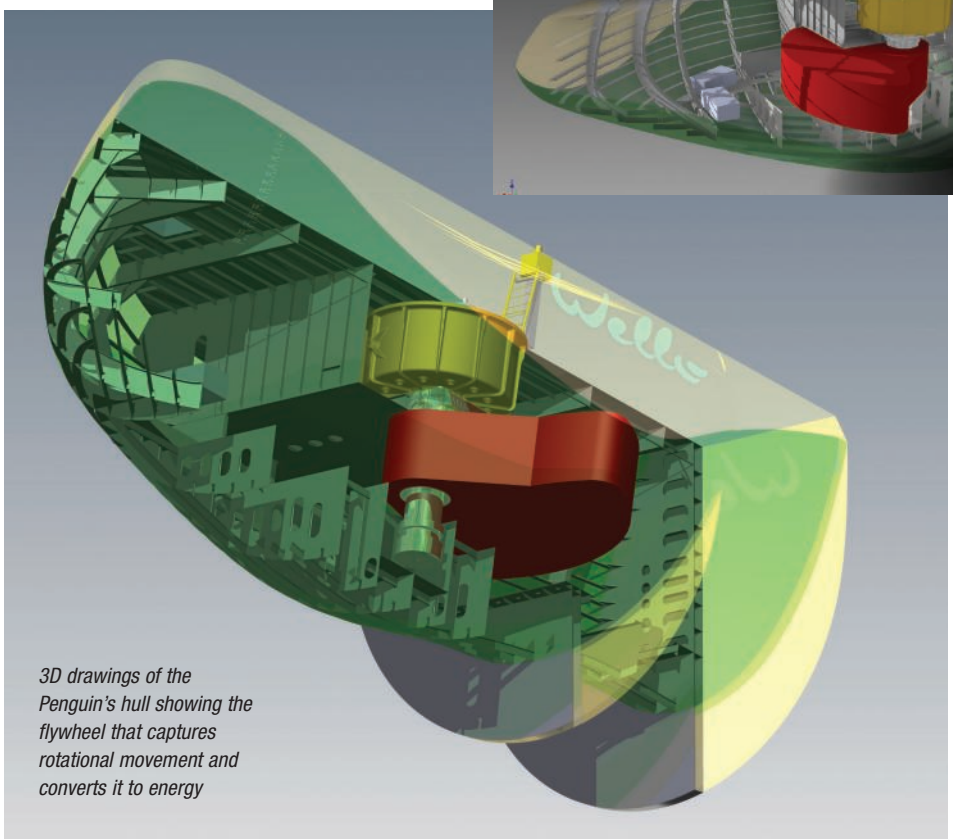

3D drawings of the Penguin's hull showing the flywheel that captures rotational movement and converts it to energy

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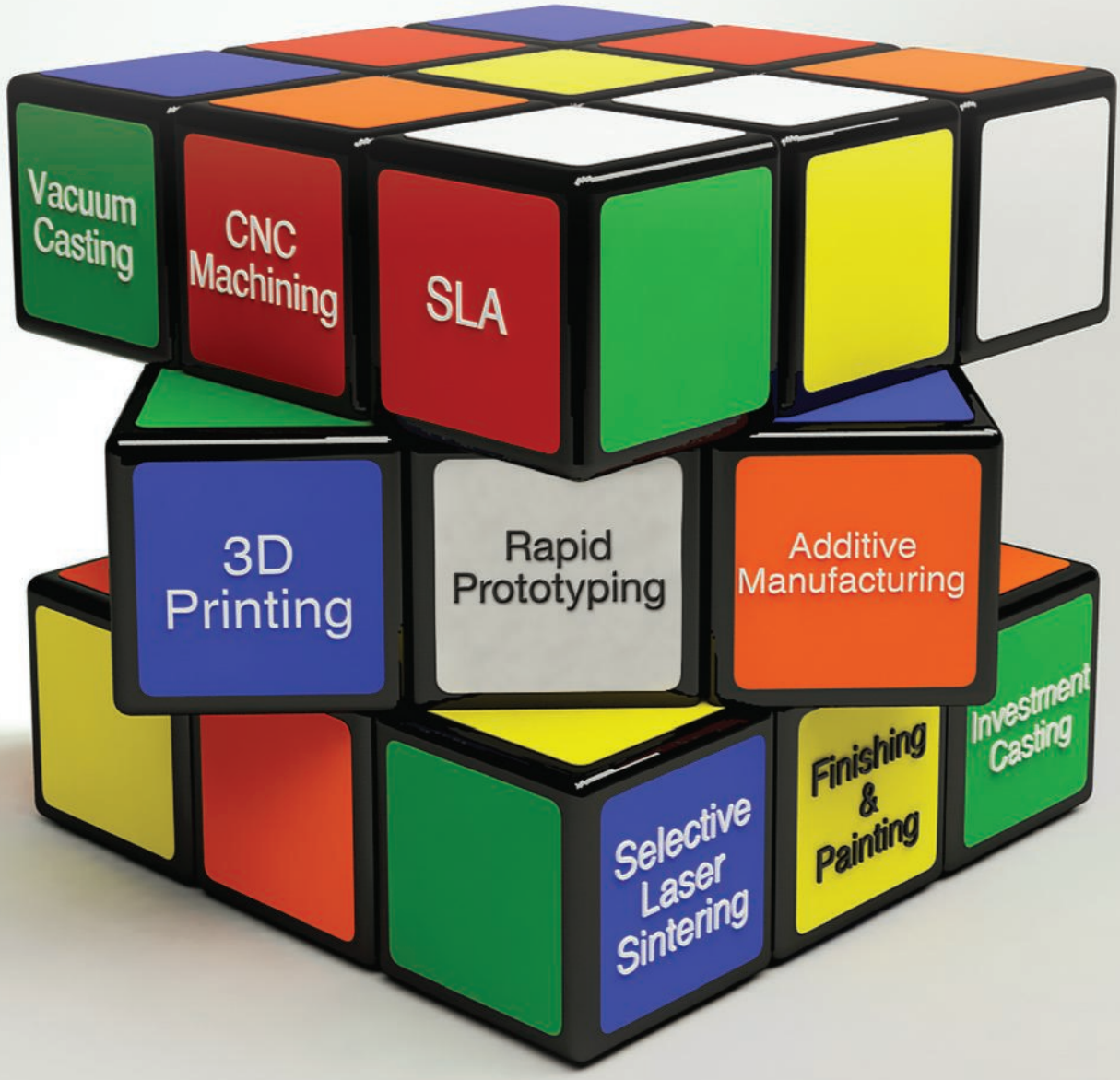

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Success on *the slide*

When not hurling himself down bob-sled tracks at 90 miles an hour on a small high-tech sled, Kristan Bromley designs and manufacturers sleds for 22 nations preparing for the next Winter Olympics. He described to Tim Fryer how he does it.

In 2008 he became the first man in history to win the World Championship, European Championship and World Cup in the same season. The British media nicknamed him Doctor Ice because he gained a PhD from Nottingham University with a thesis entitled "Factors affecting the performance of skeleton bobsleds".

His company, Bromley Sports, ships between 100 and 200 bespoke sleds to athletes around the world, but is currently moving into the recreational arena, having designed and developed a patented sled for an exciting new snow activity, Baseboarding.

"Over the next two to three years we're changing from purely providing a low volume, highly customisable Olympic-governed sled, to manufacturing up to 10,000 Baseboards for a mass market. Our mission is to become the most advanced sliding sport product manufacturer in the world."

Bromley has always had the ethos of optimising processes. This stems from his extremely competitive goal driven nature, tuned through four Olympics combined with his engineering background at BAE Systems. He is never happy with the status quo and he is naturally innovating and always looking to add value in every way possible.

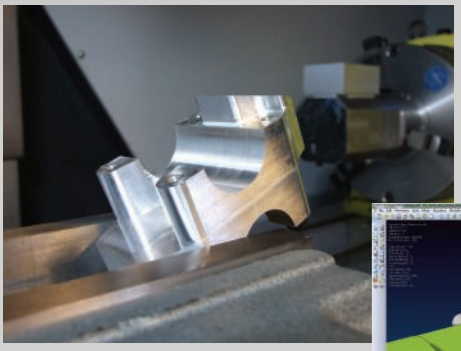
Key to this optimisation is VISI, from Vero Software, which is used for creating both high precision performance parts and carbon fibre lay-up tooling."

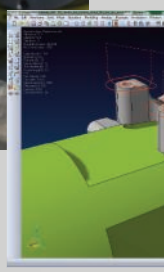
It has made the progression from design, which is done in PTC's Creo, through to machining virtually seamless – almost making the design engineer a production engineer as well.

Bromley said: "We have found that combining the two roles has opened up considerable opportunity for creating products that can be manufactured more cost effectively and efficiently."

Baseboarding has recently been introduced


Kristan Bromley with one of his Baseboards





at the Whistler Olympic Park in Canada, and Bromley describes it as 'bodyboarding on snow'.

"The Baseboard has a low friction curved base and parallel runners that create a highly agile board with easy-to-learn steering using feet and subtle upper body movements. It's a safe recreational way for families visiting snow resorts to experience the head-first ride position of skeleton racing – which is an amazing adrenalin rush."

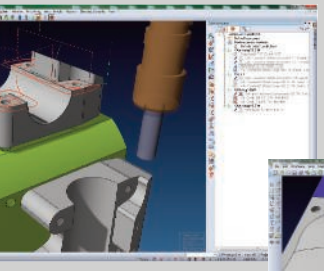
Although the Baseboard is extremely light, it is strong and stylised. The product is underpinned with thermoplastic composites, creating a super-tough 3D structure that can withstand temperatures of minus -30°C. Bromley also uses a CFD package FloEFD from Mentor Graphics, which embeds in to Creo.

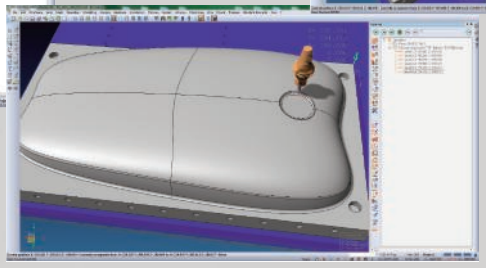
He said: "The product design capabilities of Creo coupled with the power and ease of FloEFD enables fast and very accurate analysis of designs with respect to aerodynamic and fluid dynamic performance without leaving the design environment."

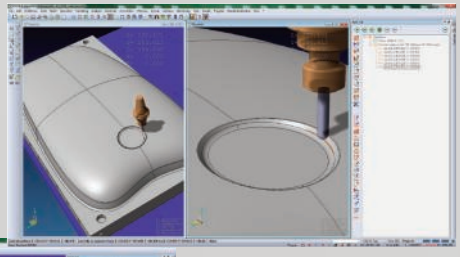
However the design and production requirements of the two markets – the competitive and the consumer – are very different. "At the elite end of the market we focus on developing products that improve the performance of the athlete," said Bromley. "This requires designs that are customised to give athletes tangible improvements, for example; improved aerodynamic drag, improved ride response and better fitting. Design focuses on small batch numbers, specialised materials and cost effective tooling for one off production runs.

"At the recreational end we focus on design and performance in a different way. Design is driven more by achieving set price points and delivering large volumes of a more standardised product offering. This requires considerable design expertise in tooling and materials for high volume manufacture."

But Bromley Sports made its name in the highly competitive world of skeleton racing. "We're giving athletes the tools to fight for Olympic medals, and VISI is absolutely pivotal in creating maximum-performing sleds by pushing boundaries to improve performance. Reducing aerodynamic drag by 5% can cut an athlete's time by one, two, or even three tenths of a second, and that's enough to take them from tenth place right through to Gold."







VISI Machining is used to manufacture both high precision performance parts and carbon fibre lay-up tooling

With more than 60 carbon fibre and stainless steel components in the skeleton sled, and the prospect of mass producing Baseboards, he says it was important to bring the whole operation in-house. Previously, most of the tooling work was sent to sub-contractors, but he realised that by bringing tool design and manufacturing in-house they could create new designs, develop products faster, and innovate more efficiently.

The company, which was established by Kristan and his brother Richard in 2000, now use VISI for every component in their skeleton sleds and Baseboards.

"And it's not just the components that go into making up the products. We develop everything that supports the manufacturing process in VISI as well – the tooling and jigs. Tools are designed in both Creo and VISI. If we are happy with the design at an early stage we design the tool in Creo and then drag and drop it into VISI for developing a machining strategy. If we need to redesign tooling at a later stage the direct modelling of VISI can achieve late changes faster. VISI is a very powerful surface modeller, which when it comes to machining tooling to give class A surface finishes is critical. We often find ourselves using the power of VISI to clean up surfaces imported from other CAD packages."

The development process includes ensuring that the sled is tailored to an individual athlete's body.

"We design it around the athlete's own ergonomics, reflecting the pressure points of their shoulders and knees," he added.

Bromley Sports use Hexagon Metrology's ROMER Absolute Arm with integrated laser scanner to reverse engineer the athlete's form.

"We scan an athlete's body shape and generate accurate mesh data for Computational Fluid Dynamics analysis in less than an hour."

Once the design is completed in Creo, he seamlessly drops the file into VISI and starts to work on machining strategies.

"Although VISI is extremely powerful and flexible, it's also simple to use. When we're machining new tooling for the carbon fibre composites, being able to approach that particular tool with different machining

strategies, and having the ability to manipulate those cuttings paths, is critical. To achieve the precision we need to help athletes win medals, we've found we can't hit a tool with a 'one toolpath suits all' approach. We need to tailor those toolpaths and the cutting strategy in order to reduce machining time and produce a part with a high level of surface finish that requires minimal hand polishing."

Bromley also points to the loop between design and production environments: "After running different machining strategies on the same component we often find ourselves going back to Creo and redesigning small features that at the time did not have real functional value but at the manufacturing stage have huge impacts on machining time. From a design standpoint we find the machining strategy capabilities in VISI of enormous benefit in the iterative design process."

It is a design to manufacture service that Bromley Sports offers to other companies looking to balance product performance and manufacturing efficiency.

Referring to the software tools employed by his company, Bromley concluded: "Gaining performance is all in the detail, and as an organisation trying to help athletes win Olympic medals we need the world's best, to help the world's best."

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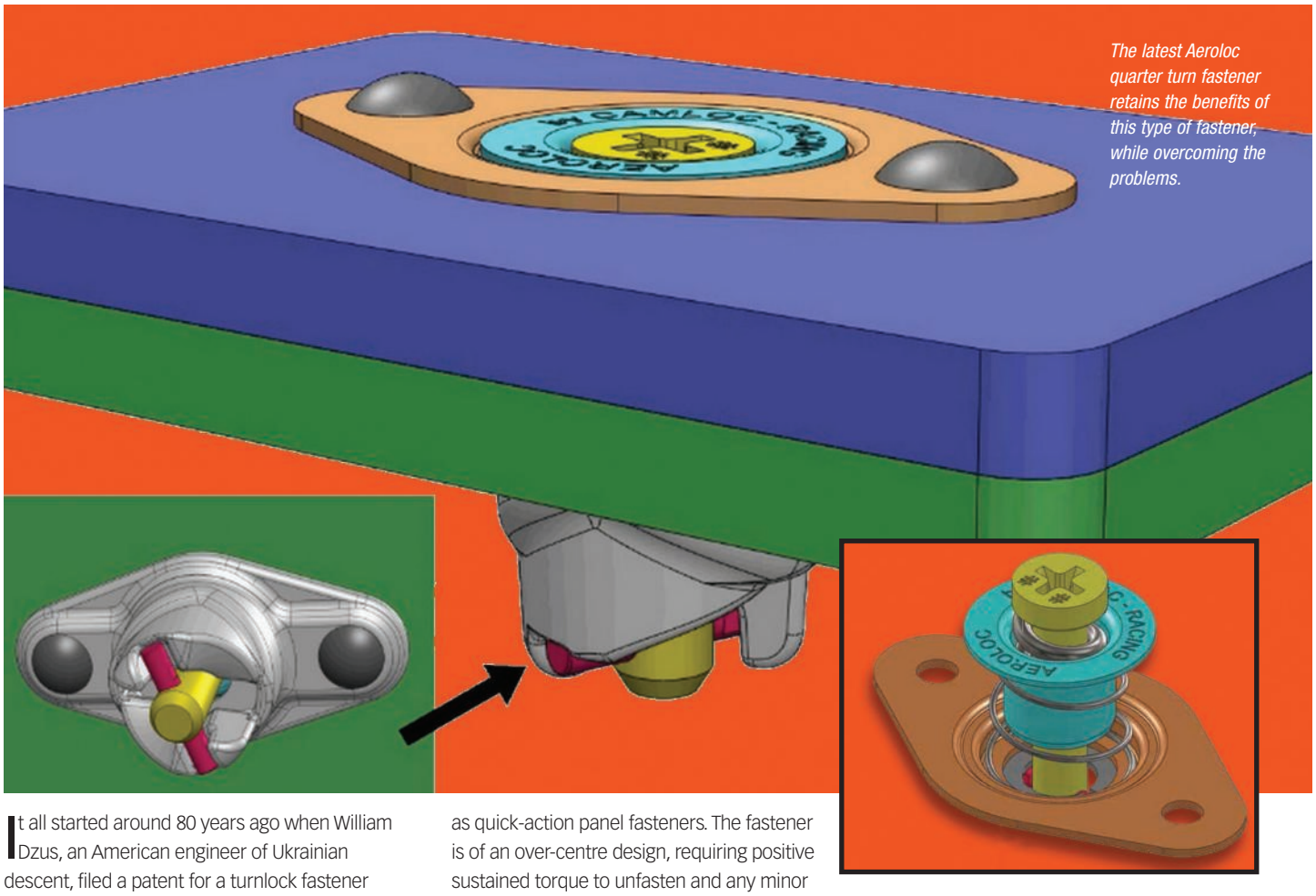
Quarter turn revolution

The quarter turn fastener has proved a mainstay in panel fastening over the years. Paul Gay, Editor of sister publication *FAST*, takes a look at the long term development of the humble quick access fastener.



The latest Aeroloc quarter turn fastener retains the benefits of this type of fastener, while overcoming the problems.

It all started around 80 years ago when William Dzus, an American engineer of Ukrainian descent, filed a patent for a turnlock fastener intended to be used to secure skin panels on aircraft and other high-performance vehicles.

In the late 1930s, the World was preparing for another war and development of fabrication techniques, especially in aircraft manufacture, was gathering pace. The 1936 patent would become the foundation of what has become an important fastener type.

Based on the 1936 patent, the Dzus fastener is particularly suitable for securing plates, doors, and panels that require frequent removal for inspection and servicing. It a type of proprietary quarter-turn lock fastener that is often referred to as quick-action panel fasteners. The fastener is of an over-centre design, requiring positive sustained torque to unfasten and any minor disturbance to the fastener will tend to correct itself rather than lead to further loosening as it would in threaded fasteners. The aerospace industry adopted the Dzus whole heartedly, the fastener finding its way into many warplane designs including the famous Spitfire.

Over the years, the design has developed and other turnlock fasteners have become available on the market. The Dzus fastener is now joined by other designs and are also referred to by their maker's trade name, such as Camloc and Airloc.

The current Camloc fastener, the 4002 series, consists of four principal parts: the receptacle, the grommet, the retaining ring, and the stud assembly. The receptacle is an aluminium alloy forging mounted in a stamped sheet metal base, compare this with the spring wire arrangement of the Dzus where the fastening pin has a slot that turns a quarter turn onto the spring to fasten.

Camloc's receptacle assembly can be riveted to the access door frame, which is attached to the structure of the aircraft. The grommet is a sheet metal ring held in the access panel with the retaining ring. Grommets are furnished in two types: the flush type and the protruding type. Besides serving as a grommet for the hole in the

access panel, it also holds the stud assembly. The stud assembly consists of a stud, a cross pin, a spring, and a spring cup. The assembly is designed so it can be quickly inserted into the grommet by compressing the spring. Once installed in the grommet, the stud assembly cannot be removed unless the spring is again compressed.

There is also a high- strength version of the Camloc, which is a quick-release rotary fastener that may be used on flat or curved panels. This fastener may be distinguished from screws by the deep No. 2 Phillips recess in the stud head and by the bushing in which the stud is installed.

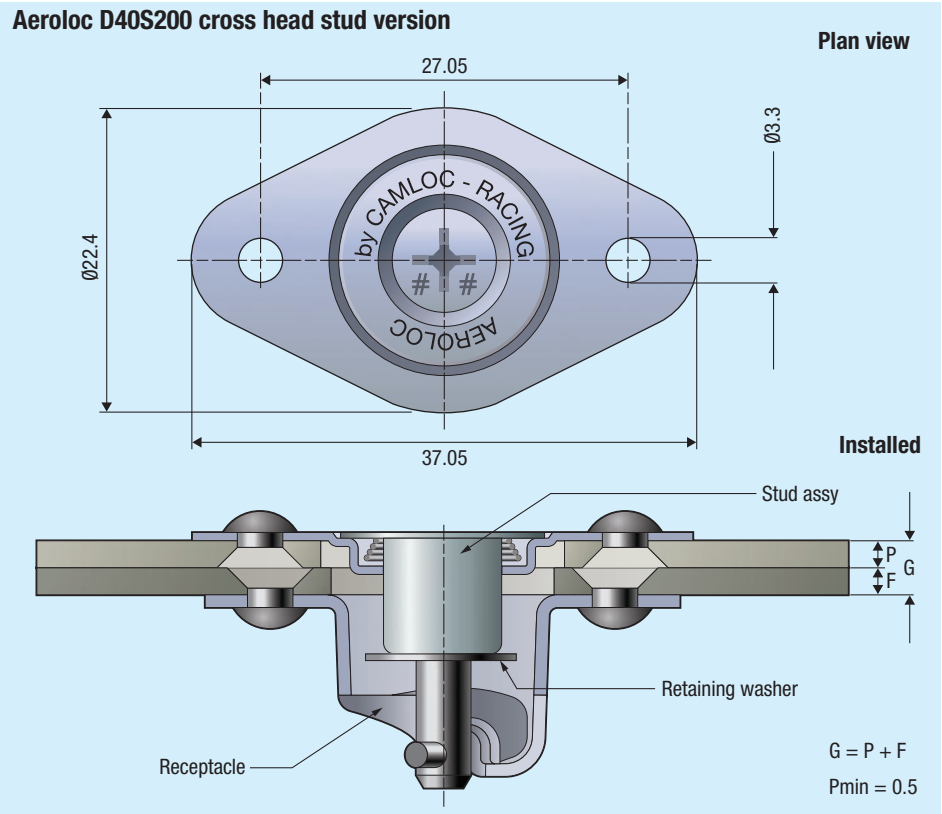
A threaded insert in the receptacle provides an adjustable locking device. As the stud is inserted and turned counter clockwise one-half turn or more, it screws out the insert to permit the stud key to engage the insert cam when turned clockwise. Rotating the stud clockwise one-quarter turn engages the insert. Continued rotation screws the insert in and tightens the fastener.

The Airloc fastener is similar to the Camloc but consists of a receptacle, stud, and cross pin. The stud is attached to the access panel and is held in place by the cross pin. The receptacle is riveted to the access panel frame. Two types of receptacles are available, either fixed or floating type. The floating type makes for easier alignment of the stud in the receptacle. Several types of studs are also available. In each instance the stud and cross pin come as separate units so that the stud may be easily installed in the access panel.

The Airloc receptacle is fastened to the inner surface of the access panel frame by two rivets. The rivet heads must be flush with the outer surface of the panel frame. When you are replacing receptacles, drill out the two old rivets and attach the new receptacle by flush riveting.

Dzus fasteners, today are available in two types. One is the light-duty type, used on box covers, access hole covers, and lightweight fairing. The second is the heavy-duty type, which is used on cowling and heavy fairing. The main difference between the two types is a grommet, which is only used on the heavy-duty fasteners. Otherwise, their construction features are about the same.

The light-duty Dzus includes a spring and a stud. The spring is made of cadmium-plated steel music wire and is usually riveted to an aircraft structural member. The stud comes in various designs and mounts in a dimpled hole in the cover assembly. When the panel is being positioned on an aircraft, the spring riveted to the structural



member enters the hollow centre of the stud. Then, when the stud is turned about a quarter turn, the curved jaws of the stud slip over the spring and compress it. The resulting tension locks the stud in place and secures the panel.

In the 1930s, vehicles were not as powerful as they are today and the higher vibration levels experienced these days, especially on the race track, are capable of much more disturbance that the traditional Dzus design is capable of handling. Development work on a new design began and fastener engineers at Specialty Fasteners & Components (SFC) came up with a new design, suited to motor sport but equally valuable as a premium product for access panel fastening.

SFC had listened to its motorsport customers who were experiencing problems during the frenetic atmosphere of qualifying and pit stops. It became obvious that a more reliable, easy-to-use and consistent self-ejecting fastener was something that was sorely needed.

Working with engineering partner Camloc, SFC came up with what it considers an ideal solution. The design includes some interesting features including a cross-head stud that operate the lock. This removes the risk of accidental tool damage to panels during operation.

A locking spring ensures consistent, positive lock performance and light weight construction is in keeping with motorsport requirements. The design offers the benefits of high strength without any weight penalty.

The mounting plate is fully interchangeable with any panel prepared for EHF series fastener and helps distribute the load over a greater area. A hold out spring lifts the stud for easier panel removal. And for installations, where use of a screwdriver is difficult, the bail handled version can be specified. The AeroLoc quarter turn fastener is now in production and has proved it is able to overcome the short comings of the 80 year old design.

There is no doubt that panels traditionally fixed with quick access quarter turn fasteners do occasionally vibrate loose and come undone. Motorsport spectators will see the ultimate machinery racing around a track with many of its quick release fasteners taped up with ubiquitous pit lane tape that all teams stock.

The Aeroloc - designed in the UK and made in Germany - overcomes these problems and will surely enjoy a long and effective future.

Complete control

Integrating electrical and pneumatic control has a number of benefits for machine designers, particularly for packaging equipment. Tim Fryer reports

Machine builders, particularly for designers of such equipment as packaging machines, have traditionally been faced with controlling both pneumatics and electrical equipment independently, working with at least two sets of suppliers to come up with the required solutions. An alternative is just coming on the market that firstly means dealing with only one supplier and secondly involves taking a radical step – removing the PLC.

The solution came about following a consolidation of technology within Emerson Industrial Automation, replacing the individual approach to its brands in the past. Most notably for this machine building application is the convergence of motor control from Control Techniques and fluid automation from ASCO Numatics.

Resulting from this shared expertise is the Unidrive M800 – the company's most powerful machine controller. It is essentially created by adding a MCi machine controller to its existing top of the range M700 drive.

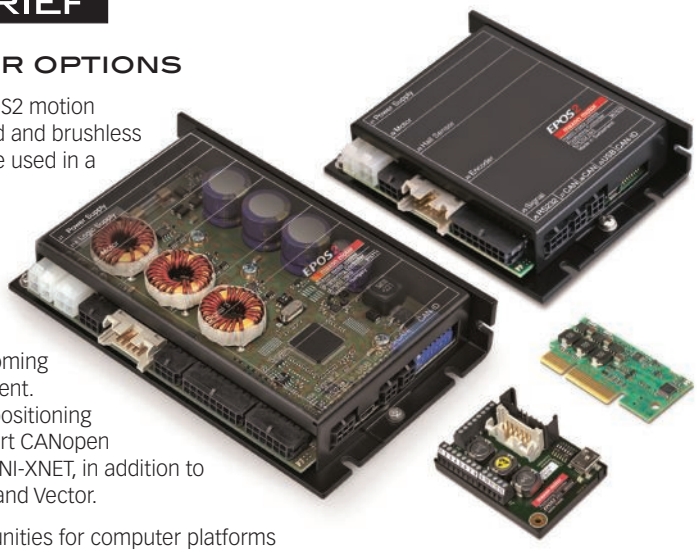
Stewart Dowsett, UK sales manager for the manufacturing team at Emerson Industrial Automation, commented: "Instead of having a separate PLC and a whole bunch of drives, what we have done is taken a lot of technology that is onboard a PLC and we have installed it on what we term a machine controller. The machine controller is effectively a drive and a PLC all in one box."

It takes a shift of mindset for the machine builder believes Dowsett. " I just don't think anybody has done it before. Traditionally people have a PLC that sends a signal to a valve island, which then does its stuff and sends a signal back

TECH BRIEF

More motor options

The maxon motor EPOS2 motion controllers for brushed and brushless DC motors can now be used in a broader range of applications.



Deployment of computer-based motor drives, rather than traditionally used PLC systems, are becoming more and more prevalent. Maxon motor EPOS2 positioning controllers now support CANopen interfaces Kvaser and NI-XNET, in addition to the existing NI, IXXAT and Vector.

There are also opportunities for computer platforms with serial communication, via USB or RS232, using Windows or Linux. The existing libraries for Intel/AMD (Windows 32/64-Bit, Linux 32-Bit) have been extended with a Linux 64-Bit version, with additional support of 32-Bit ARMv6/v7 solutions, allowing broad scale use within trend platforms, such as Raspberry Pi and BeagleBone.

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to the PLC. That same PLC would be controlling our drives." The starting, and central, point was the PLC.

While individual PLCs will have different levels of performance and attributes, they are in general, compared to an intelligent drive, less efficient to run, more expensive and use a proprietary programming environment. Being able to simply remove such a pivotal item of equipment clearly reduces the complexity of the whole system.

"In terms of energy, you do have the secondary processor on the drive but typically that is going to be a more efficient to operate than a PLC, which needs to be kept running. We can shut down the drives when they are not operating - put them in standby very quickly - and that is very efficient in terms of saving electrical costs."

Comparing the performance of the drive with that of a PLC is ignoring its key advantage. Dowsett said: "This is nothing new for Control Techniques. With the SP drive – our older technology – we have had this ability to manage IO, and so some customers stopped using a PLC. The obvious benefit of this is a reduced component count, reduced cost in manufacture and then reduced complexity in the actual assembly of a machine. A drive used to be simply a method of controlling a motor turning. It is now evolving with more intelligence and functionality to take on the role of the PLC."

Another key difference is that PLCs are programmed in the suppliers proprietary language, therefore requiring a very specific skill set. These new intelligent drives are programmed in Codesys, an open software that supports a number of other IEC 61131-3 programming languages, making program migration easy. Becoming the norm amongst the drive suppliers, Codesys brings with it an open-source community with numerous function blocks in addition to Emerson's own Machine Control Studio library, and a library that can be built up by the user.

Dowsett said: "If you look at a lot of our competitors now we are all starting to use Codesys as the primary programming language. Codesys is now being taught in schools and colleges, so what we are giving customers who choose our product is a huge talent bank - they can effectively call on people coming out of colleges."

"We can now link the electrical elements and the pneumatic elements together, and as far as we are aware no other manufacturer has been able to do that," summed up Dowsett. "Typically drive manufacturers are drive manufacturers and pneumatic manufacturers are pneumatic manufacturers. Because of the Emerson Industrial Automation brand we have the benefit of having both of those product ranges available, so we have linked them together to demonstrate how we could use the valve terminal as the IO for the drive or for the system and we could drive the mechanical element i.e. the pneumatics, without the need for a PLC."

The first application of the technology is being configured for a customer in Ipswich, but it is open to any system that requires a mixture of electrical and pneumatic control equipment. "The typical customer for this would be a machine builder in the packaging industry," added Dowsett. "The mixture in packaging [between pneumatic and electrical] is a good split for us."

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Droning on...**and on**

There is something authentic about the designer whose design came about following a 'Eureka moment'. That is what happened to Ashley Bryant who is now at the point of taking an innovative long-endurance drone to market, as he explained to Tim Fryer.

Bryant 's Eureka moment came nearly a decade after necessity had forced a hobby to become business, albeit a business that had the rug pulled from under it.

Building a Harrier jump jet was the hobby Bryant pursued while working at a commercial airline, a business that effectively collapsed after 9/11. This was the point when Bryant looked at the advantages of combining vertical-take-off-and-landing (VTOL), as found on the Harrier jet, with the emerging drone technology. He won a £1.5m contract with a defence prime to the American military to develop a maritime platform based on a 'Harrier drone'. Unfortunately, in 2008, the budget to the prime was cut and the programme was axed, although all the IP was retained by the military leaving Bryant high and dry.

This was when Bryant woke up in the night with his brainwave – springing out of bed to write it all down lest he forgot. The idea was to remove the fuselage, essentially have a flying wing, and put a rotor on each corner, each falling outside the boundaries of the airframe. "When I started to research flying wings, I realised it was the most stable aircraft architecture going," said Bryant.

An obvious comparison for someone who knows their aircraft is the Boeing V-22 Osprey, which has rotors that can be orientated in the vertical for take-off and rotated to the horizontal to provide forward thrust in flight. The equally obvious difference is one of scale – with a 14m wingspan the V-22 is an order of magnitude bigger than the Flying Wing that Bryant's company VTOL Technologies has subsequently developed. A more subtle difference is that the rotors on the flying wing, of which there are four rather than two, are outside of the airframe, whereas in the V-22 they are, in the vertical position, overlapping the wing. This means that downward thrust goes straight into the wing, causing disturbance and no lift, so proportionally more power is required to take-off.

The Flying Wing developed by VTOL will in some cases be used in the same environments as helicopters, although not cargo or passenger duties like the V-22, but more commonly it will compete with drones.

Main applications will be repeatable automated operations, principally inspection duties for the utility, network and infrastructure sectors. Bryant said: "We are developing brand-new techniques for inspection, so we're combining the capabilities of new camera technologies with the advanced technologies that this platform delivers and that is above and beyond what other platforms deliver."

These new technologies mean that sensors are shrinking in size and weight. Reduced weight means that technology that may have needed a helicopter to carry it previously can now be installed on a platform like this. Regulations allow lightweight unmanned aircraft to fly under 400ft, getting closer to the inspection target, so the sensors may not need to provide as high definition and can again be made smaller. It is a virtuous circle. Lighter payloads also result in reduced power consumption and therefore longer air time.

Comparisons will be made with the existing drone technologies - rotorcraft and fixed wing. A typical rotorcraft will require an operator to control the platform, possibly another to control the payload sensor, and will require line of sight operation. It also will be limited in terms of its

Ashley Bryant: "Designing an aircraft like this is a huge challenge. There is a huge number of technologies and we have had to develop some specialist design tools."

flight time (usually about half an hour) and speed – and therefore its range. Fixed wing aircraft can be in the air longer, three to four hours, but launching can be a problem as is load balancing with the fuselage, and also they have a minimum air speed – in other words they cannot hover.

Bryant, believing his aircraft could take the positives and remove the negatives for each drone type, took his idea to DLR, the German aerospace research centre. He commented: "The Germans are very, very clever at small wing design - high lift, low drag wing design. It is an advanced aerofoil shape that means we can create high lift at low speed. So if, for example, were flying at 10 knots we reduce the amount of power by 50%, if we fly 15 knots it is a 75% power reduction, just because the aerofoil is providing the lift." It also means the Flying Wing can hover into the wind while using very little energy

Bryant continued: "A key feature is that it is a fly-by-wire aircraft. Unlike many other small light unmanned aircraft we have completely decoupled the command input from the actual control of the aircraft. We have teamed up with National Instruments and are using its myRIO, which is a phenomenal bit of kit for us. We are fully exploiting all the FPGA capabilities on that platform."

Although initially aimed as a project tool for students, myRIO is a hardware device that has provided all the control functions needed on the Flying Wing. Bryant continued: "We are using all of the NI LabVIEW software development tools to develop the flight control system and other elements of the system, and use it for hardware in the loop testing."

However, the main design environment is Solidworks. "We also use their finite element product to do the stress analysis," said Bryant, "and we have used specialist CFD companies for other parts of the design."

The simulation capabilities VTOL has developed for product design has been extended into a virtual reality environment so that potential customers can compare different inspection technologies and determine if the Flying Wing is suitable for their application. The company already has a virtual overhead cable inspection simulation aimed at helping its first tranche of customers this year.

Bryant said that while expertise in house was building in order to deliver on such projects as the simulation tools, the company was still happy to look elsewhere. "As we have gained more experience we have been able to resolve more issues in house, but we have used and continue to use best in class subcontractors." Brick Kiln composites, an F1 subcontractor, make the airframe. "Wherever we can we leverage all the research effort that has gone into the Formula 1 industry to help us," commented Bryant. "We are using advanced foam cores inside certain elements of the design that are going to make the structures incredibly strong but also incredibly light."

Other contributors are Rutherford Appleton on the electronics side who has developed a specialist power board. For vision systems the company is working with Varioptic, who has developed some liquid lens technology that allows ultra-fast autofocus. Hydrogen fuel cells research is going on with Cella Energy for the next generation models – the first ones are powered by rechargeable (and replaceable) lithium polymer batteries. And E2E is working on satellite communications systems.

"Designing an aircraft like this is a huge challenge," concluded Bryant. "There is a huge number of technologies and we have had to develop some specialist design tools. But it is all part of the design process - it is a bit like we have to go round the spiral time and time again."

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Is embedded technology innovation outpacing IP law?

Advances in the wearable technology sector are making the path to IP protection less clear, as Rachel Bateman and Jonathan Jackson explain

For watches, fitness bands and other more traditional wearable technology, intellectual property is fairly predictable; if the innovation is in how a product operates, protect it with a patent, if it is how the product looks, protect it with a design. However, as companies innovate ever more disruptive technology such as 'invasive' or 'embedded' technology, will the IP system be quite as easy to navigate?

By the end of 2015 it is predicted that more than 13.1m users will have a wearable health and fitness device in the UK alone. In the future, however, medical applications for invasive technology will increase massively. Even now implants have been developed that sit inside the body to monitor a patient's well-being. 'Smart dust' is being developed, which is an array of tiny computers with antennas, each smaller than a grain of sand. These computers, controlled by a doctor, arrange themselves inside the body to power a range of complex internal processes.

Outside the medical arena implantable technology is also being developed to replace externally worn technology. A company called Dangerous Things has developed a Near Field Communication (NFC) chip that is embedded in a finger through a tattoo-like process, allowing devices to be unlocked and payment for goods being carried out by simply pointing.

Whilst sensors, nano-devices and chips should be capable of patent protection in their own right, in Europe there are exclusions in the field of medical diagnosis and surgery which may impact on a company's ability to maximise their IP protection for these new and useful products.

European patents will not be granted for: a method of treatment of the human or animal body by surgery; a method of treatment of the human or animal body by therapy; or diagnostic methods practised on the human or animal body.

Rachel Bateman *Jonathan Jackson*

Whether a method involves 'treatment by surgery' depends on the nature of the treatment, rather than its purpose. It must involve a substantial physical intervention which requires professional medical expertise and which entails a substantial health risk. Other criteria to consider are the degree of invasiveness or the complexity of the intervention performed. An example might be the injection of a contrast agent into the heart, catheterisation and endoscopy. Invasive techniques which are performed on uncritical body parts and which are generally carried out in a non-medical, commercial environment are not affected by this exclusion, for example tattooing and piercing.

A method of implanting or embedding a nano-device (eg, smart dust) into a subject is therefore likely to fall within this exclusion. In contrast, the method of implanting an NFC chip into a user's finger through a tattoo-like process should be protectable.

Whether a method involves ' treatment by therapy' depends on if a disease or malfunction of the human or animal body is cured or prevented.

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For the wearable technology discussed above, this exclusion is therefore most relevant to the use of nano-devices (e.g. smart dust) for treatment or prevention of a condition in a human or animal body. For instance a method of treating early-stage cancer or providing pain relief to an open wound using nano-devices is likely to fall within this exclusion.

Whether a method is an excluded 'diagnostic method', depends on the inclusion of the following four steps, all of which must be performed on the human or animal body:

1. Collection of data.
2. Comparison of data with standard values.
3. Finding any significant deviation.
4. Attribution of this deviation to a particular medical or veterinary medical condition.

The exclusion does not therefore apply to X-ray methods, MRI studies and blood pressure measurements. The latter means that the use of bionic sensors to monitor certain aspects of a patient's well-being should be protectable.

We note, however, that products for use in any of these methods are not excluded. As well as being protectable in their own right, the medical use of wearable technology such as implantable nano-devices should therefore be protectable.

By moving technology into the human body, companies face a possible challenge to the breadth of IP protection available to them by falling under exclusions intended to ensure that medical and veterinary practitioners can practice freely without worrying about patent infringement.

It may be possible to obtain protection for the use of the technology as well as the actual technology itself. This clearly is advantageous in maximising patent protection. This is a complex area where the technology may evolve faster than the law. Companies should seek professional advice on how best to protect their innovations.

Forward... from the past?

It's been 30 years since Back to the Future was first shown on the silver screen. One of the most intriguing aspects of the movie trilogy is during Part II, when Marty McFly (that's the protagonist for those unaware) travels to the year 2015.

It gives a fascinating insight into what people 30 years ago thought the future might, and could, one day look like. It was perhaps the hoverboard that captured the imagination of most youngsters at the time, but while that has not become a reality, 2015 is set to offer many new personal transportation options that even moviemakers of the time could not have imagined.

The challenge

The challenge this month is to therefore come up with a method of personalised transport. In the spirit of a clean future, it should not use any onboard combustion as a basis for power, but instead should rely on an alternative power source. And while some kind of improved bicycle could yield the answer, the inclusion of some form of onboard propulsion that doesn't come from muscle power is advantageous.

It should allow people to travel commutable distances in the region of five miles in a relatively quick fashion, but not so fast that it will be banned from pavements or parks. And while it can use muscle power, it should primarily allow anyone using it to arrive with minimum effort, so those using it do not have to start the day sweaty and in need of a shower.

In addition, any personalised transport system should offer one of the advantages of the hoverboard in that it is not too bulky and is easily stored or carried. It should also be relatively easy to use and while it might take a bit of a knack, it should not be akin to skiing but more like learning to ride a bike.

It should also be convenient, and while using a giant sail to pull a skateboard might make for a fun ride at the beach, for the inner city it is never going to be a solution for the mass market. And this is key, the solution we have in mind has the possibility to allow individual mass transport around cities and rural communities alike. And while it might require some skill to use, most are up and moving before long.

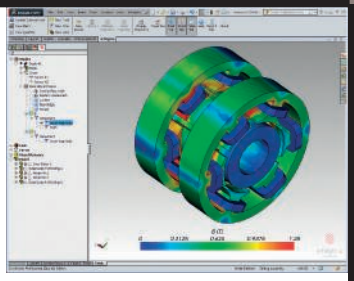
Any ideas that you would like to share with us? Feel free to send an email to the editor at **tfryer@findlay.co.uk**

The answer to last month's Coffee Time Challenge - how to develop a personal electricity generator - can be found on p10 of this issue.

3D Electromagnetic Field Solver

www.infolytica.com/en/products/mfs/

Infolytica - MagNet for SolidWorks



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