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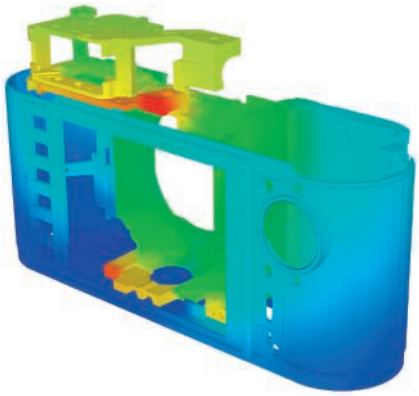

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WM
www.worksmanagement.co.uk

Editor
Tim Fryer
tfryer@findlay.co.uk

Technical Editor
Justin Cunningham
jcunningham@findlay.co.uk

Web Editor
Laura Hopperton
lhopperton@findlay.co.uk

Group Editor
Graham Pitcher
gpitcher@findlay.co.uk

Art Editor
Martin Cherry

Technical Illustrator
Phil Holmes

Advertising Sales
01322 221144

Sales Director
Luke Webster
lwebster@findlay.co.uk

Sales Manager
James Slade
jslade@findlay.co.uk

Deputy Sales Manager
Simon Bonell
sbonell@findlay.co.uk

Sales Executive
Matt Santer
msanter@findlay.co.uk

Production Manager
Heather Upton
hupton@findlay.co.uk

Circulation Manager
Chris Jones
cjones@findlay.co.uk

Publisher
Ed Tranter
etranter@findlay.co.uk

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One giant step for mankind....

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

It was nice to have a few days when the top news story in the national press was genuinely interesting. Space probe Rosetta's prompt arrival in August at comet G67, followed by months of inspection from its orbit, culminated in the landing of the Philae lander in mid November. A hop and a skip on landing meant that its resting place was not on the convenient flat spot intended – and will have consequences in terms of the information it transmits back – but it didn't seem to take the gloss off an incredible human achievement.

To land a human device on a spinning rock that measures no more that 6.5km in any direction, travelling at approximately 135,000 km/hour and at a distance (currently) from the Earth of 480 million kilometres, is a staggering achievement. It is hoped of course that Philae will be able to contribute further to the programme if it can summon up the power, but Rosetta will continue its observational duties for a further year. With the information gathered we will, say the scientists, have a better understanding of comets, the birth of the solar system and maybe even the start of life on earth (was life-giving water first delivered by comet?).

However, such endeavour comes at a cost – around €1.3bn – and along with the high profile the project has enjoyed recently there has come those who opine that this is a lot of money, and for what? Does such knowledge actually have any effect on modern life? Wouldn't that money be better spent on hospitals and schools?

The truth is that fundamental knowledge is invaluable. We may not know why yet, it may be decades or centuries before that information fits into a bigger, more important and more useful picture. But perhaps more immediately, the science, the maths and the engineering behind this feat are both astounding and inspiring.

Rosetta is the sort of project that will spawn another generation of engineers who may end up designing motors or toys or sports helmets [all in this issue!] rather than spacecraft, but they will be the lifeblood of our sector in the future. Maybe Rosetta is a giant step for mankind that prompts many other smaller steps for budding engineers.

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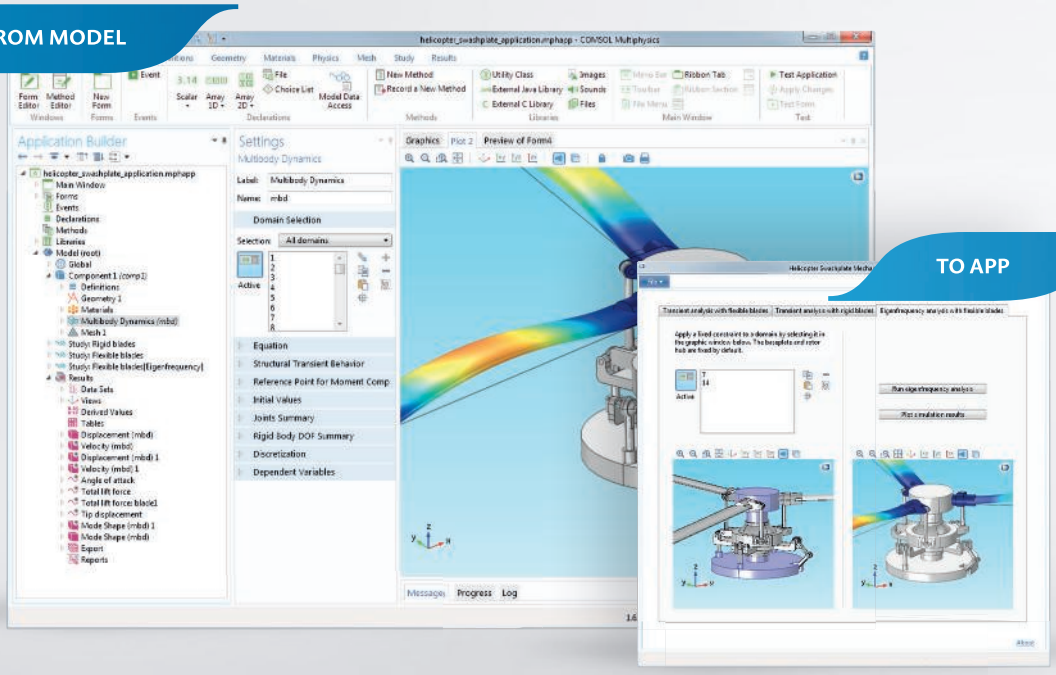

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UK inventors given funding platform

The Design Council has announced a £300,000 innovation fund to discover and propel UK talent in the field of new physical product innovation.

The Design Council Spark initiative seeks to energise UK product innovation and develop revolutionary products that solve everyday problems. The fund is open to submissions from anyone based in the UK.

Its investment panel will select a shortlist of 10 products from submissions with each set to receive an initial £15,000 investment. Those selected enter a 20-week programme of mentoring and support.

All teams will pitch at the end of the programme for the chance to receive one of three further £50,000 investments.

Emily Tulloh (pictured with wind-up radio inventor Trevor Baylis), a final-year Brunel University London product design student, 21, was chosen to help launch the initiative, representing young British product design after entering the Council's "Ones To Watch" competition.

Said Emily: "To speak alongside the cream of the country's designers and inventors was truly inspiring but my thoughts were with four-year-old Summer Stockley from Brighton.

"Summer has the rare disability Rett Syndrome which means she can't walk and can only get about on a custom-made tricycle. I got involved when she out-grew her first trike and designed a new one for her with charity Demand who produce one-off disability aids."

Manufacturing grows

UK manufacturing growth remains above average but sluggish export demand means the recovery has slowed compared to earlier in the year, according to the CBI's latest Industrial Trends Survey. Expectations for growth in output volumes over the next three months declined to a 13-month low, although it remains above the long-run average, according to the 421 manufacturers surveyed.

The majority of sectors (15 of 18) reported below-par export orders, with mechanical engineering at its lowest for two years, though this was offset by stronger performance in the aerospace sector.

GKN to lead £30m wing project

A national research programme – aimed at bringing the latest aircraft wing design, manufacture and assembly technologies to market – is being launched by GKN Aerospace. The £30million programme involves 13 partners, including Bombardier, Spirit, GE Aviation, the National Composites Centre, the Manufacturing Technology Centre and the Advanced Manufacturing Research Centre. Taking place over a 27-month period, it will produce test demonstrators to validate the maturity of key manufacturing technologies for aircraft wings.

Specifically, the VIEWS (Validation and Integration of Manufacturing Enablers for Future Wing Structures) programme will: Identify and define future manufacturing requirements to produce novel wing architectures; Assess tools that will improve product and process design and enhance the flow of production; Progress emerging composite and metallic manufacturing and assembly technologies and processes and; Study innovative inspection and repair tools.

Unite calls for engineered Britain

The UK economy is facing a dire engineering skills gap and needs 87,000 new engineers a year over the next decade, a report by the union Unite has warned. Launched in parliament, the 'Engineering excellence - a charter for UK engineering' report urges the government to do more to support engineering and calls for an 'engineered in Britain, bought in Britain' approach to public procurement.

The report goes on to call for companies to shorten supply chains and reshore jobs back to the UK to ensure they fulfil customer demands more quickly and flexibly, as well as for the creation of a government backed strategic investment bank to support engineering.

Linda McCulloch, national officer at Unite, said: "We need urgent action to close the engineering skills gap to ensure we rebalance the economy and have sustainable growth. As our report suggests, a lack of a joined up, robust industrial policy means the UK is still excessively reliant on service sector jobs and is contributing to the creation of a low wage, low skilled economy."

Shell invests in Tomorrow's Engineers

As part of its efforts to address the critical shortage of engineers facing the UK, Shell has announced an investment of over £1million in the Tomorrow's Engineers programme. The funding will be awarded over the next three years and will enable the programme to expand into over 500 new schools across the UK. Speaking at the launch of Tomorrow's Engineers Week, Erik Bonino, chairman of Shell UK, said: "When it comes to inspiring the next generation of great British scientists, engineers and innovators, we need to start in schools. Tomorrow's Engineers connects classroom learning to the exciting opportunities that a technical career can offer. Only by engaging young people and their teachers in this way, will we encourage more students to progress in STEM subjects and careers."

NEWS

£2bn potential for UK auto suppliers

The Automotive Council has highlighted a £2billion growth opportunity for UK component suppliers. Its latest report assesses the re-shoring potential for 'upstream' automotive suppliers.

The £2bn figure comes on top of £3bn identified last year for supply direct to vehicle manufacturers, on which progress is being made. Industry experts point to the accelerating growth potential in the automotive sector as well as local-sourcing benefits of lower logistics costs, greater flexibility and faster response times.

Mike Hawes, SMMT chief executive, said: "A strong domestic supply chain is vital to the success of the UK automotive sector. We want the UK supply chain to capitalise on the renaissance in UK vehicle manufacturing and this report sets out both the opportunity and the confidence that exists amongst companies.

"Continued government support through the Automotive Council is still required, however, particularly in facilitating access to finance and stimulating innovation – areas in which many companies are still encountering problems."

Currently around one third of the components in a UK-built vehicle are sourced in the UK. The report identifies a realistic aim to increase this local content to around 60% – similar to other European countries such as France, Germany, Italy and Spain. Business Minister Matthew Hancock noted: "The automotive sector is thriving and our supply chain firms are helping to create jobs and generate growth, but there is more to be done. That is why last month we announced £10million of government money to address skills shortages in the auto supply chain to help UK companies win more contracts."

Dave Allen, purchasing director at Jaguar Land Rover and chair of the Automotive Council Supply Chain Group, commented: "The current success of the UK automotive sector presents a renewed opportunity for automotive suppliers to invest in the UK and to increase local sourcing of the high value components that the UK's world-class vehicle makers require. With this report we now have good visibility of the depth and value of the opportunity throughout the supply chain, together with deliverable actions to turn this opportunity into reality."

TECH BRIEF

Tooth clutch specified for Arctic Conditions

A geophysical survey being carried out in Arctic Siberia has used a toothed clutch design on a winch drive for lowering a sensitive scanner carefully down boreholes up to 3000m deep.

The clutch must ensure a slow and careful descent with zero backlash, so that the delicate scanning equipment does not swing against the sides and cause damage to the instruments. It allows the scanner to be stopped at precise points in order to take readings.

Tooth clutches use two contacting plates – one driving, the other driven – with intermeshing teeth. The simple design is very robust making ideal for use in Arctic Siberia where replacement parts can take months.

The Warner Electric division of Altra Industrial Motion was able to supply the off the shelf E320 VAR-04 tooth clutch to meet the stringent requirements, and reliably operate despite temperature regularly falling below -20°C. The clutch system is positioned between a slow-moving gear motor and the winch drive.

www.warnerelectric-eu.com

NEWS

Advanced composites facility opened

Greg Clark, Minister of State for Universities, Science and Cities, has opened the University of Southampton's Advanced Composite Materials Facility.

The facility, the only one of its kind in the UK, will develop and manufacture new and advanced materials for semiconductor electronics, data storage, photonics and energy harvesting, conversion and storage.

One of the first projects will be the development and manufacture of a new form of solid state battery in collaboration with Ilika Technologies, a spin-out from the University. This involves the transfer back of experience gained at Ilika in the discovery, optimisation and synthesis of new materials.

Clark said: "The UK is already a world leader in advanced composite materials and today we took our capabilities to a new and exciting level. From consumer electronics to space, these facilities will play an important role in transforming British research into world beating products. Supported by a £3.3million government grant, the opening of this centre at the University of Southampton will ensure the UK continues to lead in this increasingly important industry."

Professor Brian Hayden, Director of the Advanced Composite Materials Laboratory, said: "This is a great example of a virtuous technology and intellectual property cycle between an academic institution and industry, resulting in an ongoing and mutually beneficial relationship. There are now huge opportunities to apply these synthetic and manufacturing methodologies in a wide variety of devices in the electronics and energy sectors."

Intelligent MCCs

Intelligent motor control centres (IMCCs) are gaining market share at the cost of traditional MCCs, new research shows. According to Frost & Sullivan, critical industries such as oil and gas, mining and water and wastewater are increasingly relying on IMCCs because of their remote diagnostic capabilities and features such as loss detection and predictive maintenance.
As such, the market is expected to reach sales of $5.12billion by 2018.

Compo-site

A new information service, dedicated to helping customers get to grips with composites, has been launched by Lucideon. The new online service allows companies to gather vital information specifically relating to composite materials, including processes, properties, applications and benefits.

To try out the service, visit **www.lucideon.com/composites**

Artificial muscle 'remembers' movements

Artificial muscles that can learn and recall specific movements have been developed by engineers from the University of Cambridge. The muscles are made from plastic and change size or shape when they receive an electrical signal. Movement can be stored, read, and restored independently. According to the researchers, this is the first time motion control and memory have been combined in a synthetic material.

The breakthrough is expected to benefit industries such as robotics, aerospace, exoskeletons and biomedical applications.

After chemically modifying thin strips of a bendable, commercially-available material used in batteries and fuel cells, the researchers programmed a variety of shapes at different temperatures and taught the artificial muscle to 'remember' the movement associated with each shape. The movements were later recovered one-by-one, on demand, by going back to the temperature which was used to programme it.

The restored states can be cycled thousands of times using low voltage inputs (1 - 2V). It is these low voltages, together with the potential biocompatibility of the muscles, which the researchers say could lead to bio-implantable devices.

TECH BRIEF

Multi-material joints find niche

Morgan Advanced Materials has used an active brazing alloy (ABA) process to join metals to ceramics in a variety of applications where conventional metallisation and brazing are either costly or impractical.

The ABA process is used in specialist applications in sectors from medical to aerospace, but Morgan believes its versatility means it could be even more widely employed in future. The company said it is seeing increased use of 'hybrid' components, where metals and ceramics are paired to bring benefit in performance.

Martin Davidson, a senior engineer at Morgan Advanced Materials, said: "The ABA process is a highly effective way to join metal and ceramic components together, forming a mechanically strong, hermetic joint. In many applications, it is considerably quicker and more cost-effective than standard metallisation, providing real alternatives for engineers, especially where multi-layered ceramics are being used.
www.morganadvancedmaterials.com

NEWS

Inflatable incubator wins Dyson Award

A low cost, inflatable incubator – designed for use in the developing world – has won the 2014 James Dyson Award. Created by design engineer James Roberts, pictured, MOM can be collapsed for transportation and runs off a battery which lasts 24 hours, in case of power outages.

The whole thing costs just £250 to make and is designed to provide the same performance as a £30,000 modern incubation system. MOM is blown up manually and is heated using ceramic heating elements.

Sir James Dyson said: "James' invention shows the impact design engineering can have on people's lives. The western world takes incubators for granted – we don't think about how their inefficient design makes them unusable in developing countries and disaster zones."

Roberts, 23, is a recent graduate from Loughborough University. He will now receive £30,000 for further prototyping and testing, with a view to seeing MOM mass produced. Loughborough University will also receive £10,000. "I was inspired to tackle this problem after watching a documentary on the high death rate among premature babies in refugee camps," Roberts commented. "It motivated me to use my design engineering skills to make a difference. Like many young inventors, there have been struggles along the way – I had to sell my car to fund my first prototype. The dream would be to meet a child that my incubator has saved – living proof that my design has made a difference."

Solution to last month's Coffee Time Challenge

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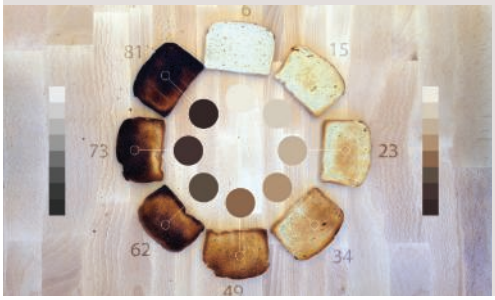
The solution to last month's challenge of how to toast the perfect slice of bread comes, perhaps unsurprisingly, from a student. While studying at the Georgia Institute of Technology in Atlanta, U.S, Basheer Tome came up with the idea after being tired of hovering around the toaster to ensure it came out just right.

He wanted to move away from toasters that use timers as these are essentially blind to their contents. So he incorporated an array of colour sensors inside the toaster that continuously assess the colour of the bread to determine the amount it is toasted.

By using the hue sensing system, frozen bread and darker breads can be added in exactly the same way so users just need to enter the desired colour and not worry about how long it is in the toaster. The sensors provide a constant feedback loop so toasting only stops once the sensors hit their mark. It is all controlled by a simple electronic 'hue' interface screen so users can simply enter the desired colour and be sure that there toast will emerge perfect every time.



TECH BRIEF

IE3 motors offer simple replacement

SEW Eurodrive has launched a range of IE3 motors that are the same frame size, making them simple and straight forward replacements for the older IE2 motors. Its DRN range has been launched in readiness for the impending IE3 legislation that requires that all 2, 4, and 6-pole asynchronous motors sold in the EU, Switzerland and Turkey with a power rating of between 7.5kW and 375kW to meet the specific energy efficiency requirements from January 2015.

The new drives have virtually the same dimensions as the older DRE range and are available at the same price.

www.sew-eurodrive.co.uk

Rolls-Royce lands Airbus deal

Rolls-Royce has secured a £3.2billion order from Delta Air Lines to supply engines for 50 new Airbus aircraft. The 25 XWB engines and 25 Trent 7000 engines will power the Airbus A350 and Airbus A330neo aeroplanes respectively.

The news comes just weeks after Rolls-Royce revealed plans to cut 2600 jobs as part of an efficiency drive. The company says it has ruled out growth this year due to the impact of defence spending cuts.

TECH BRIEF

Pressure sensor gives fast response

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As the frantic annual dash for presents gets into full swing, we look at the technical toys that are now dominating the market, and why they may play a vital role in stimulating the next generation of engineers. Justin Cunningham reports.

Hi-Tech TOY STORY

Gone are the days of plastic figurines or little die-cast cars that, with a little imagination, can drive or even fly around the room. Now, today many toys actually do fly, or perform other similarly impressive physical feats thanks to the inclusion of sensors and motion control technologies that increasingly come as standard.

Sam Loveday, editor of Toy News Magazine, said about the phenomenon: "The toy market is increasingly going hi-tech. With many things now vying for their time – multiple TV channels, iPads, apps, social media – it's often the case that children are also demanding more of their toys. Many now have a smartphone or tablet and they want to be able to connect toys to them and leverage that functionality. It might be to download apps that will change some aspect of it, or having live video steamed back to the controller from a quadcopter. But, overall, the expectation is now much higher that there will be some kind of tech element involved."

Some have adopted the phrase 'connected play' for the hi-tech toys that enable some additional functionality over the base product. A good example that has proved extremely popular in the last few years comes from Lego in its Lego Mindstorms range.

While still fundamentally the same Lego building blocks that we all know and love, the Mindstorm range integrates elements of hardware and software that allow the addition of motors, mechanical actuation, sensors, and electronic control of movement whether it's a cars, a robot, or whatever it is, made from Lego.

Rather innovatively, and in typical Lego style, both the programming software as well as all the hardware follow the same principle of using component building blocks – be it a motor and controller, for example – to allow users to easily integrate them together with the rest of the Lego model. However, it goes a step further and actually allows easy programming in the same modular fashion, block by block, step by step, so the whole thing can be assembled and built with relative ease.

The use of simple programming tools, known broadly as command box programming rather than code programming, allows the use of a number of sensors. These include touch, light, sound and distance sensors as well as cameras that can be used to create real embedded systems with computer controlled electromechanical parts. Many real-life embedded systems, from elevator controllers to industrial robots, may be – and have been – modelled using Mindstorms.

Though instructions can be followed – in much the same way as basic Lego models allow you to build a predefined model – once the principles are learnt, the modular approach allows a great deal of creativity. And let's not forget this is Lego's most successful product of all time, a hugely popular toy, aimed at children, many of which are under 12.

Smartphone control for Sphero (above right) and Ollie

'Fun' learning?

All this raises a further and more intriguing point around the rise of technical toys generally. Their influence in nurturing and inspiring the next generation in STEM and, indeed, engineering subjects, as well as actually preparing and teaching the practical skills that industry continually complains lack in the current set of graduates coming through.

Hi-tech toys, in many cases, can put in place fundamental problem solving skills and give confidence, and interest, toward taking on some of the more daunting STEM subjects at school, college and then university. Innovation is never a case of regurgitating facts, or manipulating formulae to give an output, it is about thinking laterally and being able to use and exploit technology for a given function.

Ray Almgren, Vice President of marketing at National Instruments – one of the technology partners behind Mindstorm – said: "We know

Ollie on the starting blocks

hands-on learning is the best way to inspire students and develop their skills in science, technology, engineering and math. With Lego Mindstorms, students learn valuable engineering concepts by programming Lego robots with software based on NI LabVIEW system design software.

Interactive learning with industry-grade tools not only keeps young people engaged in math and the sciences, but also prepares them for future careers in engineering and technology in a way that traditional toys cannot."

US based Go Sphero has much the same aim as the Lego Mindstorm in that it wants to encourage children using its robotic based toys to get interested in technology. It produces either a 2-tracked robot called Ollie, or the sphere robot Sphero. Both are Bluetooth connected to a smartphone and via an app are controlled to perform at the users will.

Go Sphero was founded by Ian Bernstein and Adam Wilson, both passionate robotics engineers. Part of what they want to achieve is getting children interested in both programming and engineering by using their products.

The robots are customisable and allow children to program the devices for their own playing experience. And it is not a case of simply changing a setting, but actually requires some problem solving and manipulation of software.

"We create connected toys - but that's not all," said Bernstein. "By fusing technology with robotics, our toys are teaching and inspiring tomorrow's innovators and inventors. Programming isn't easy, but you don't need to be a rocket scientist to give kids a strong foundation.

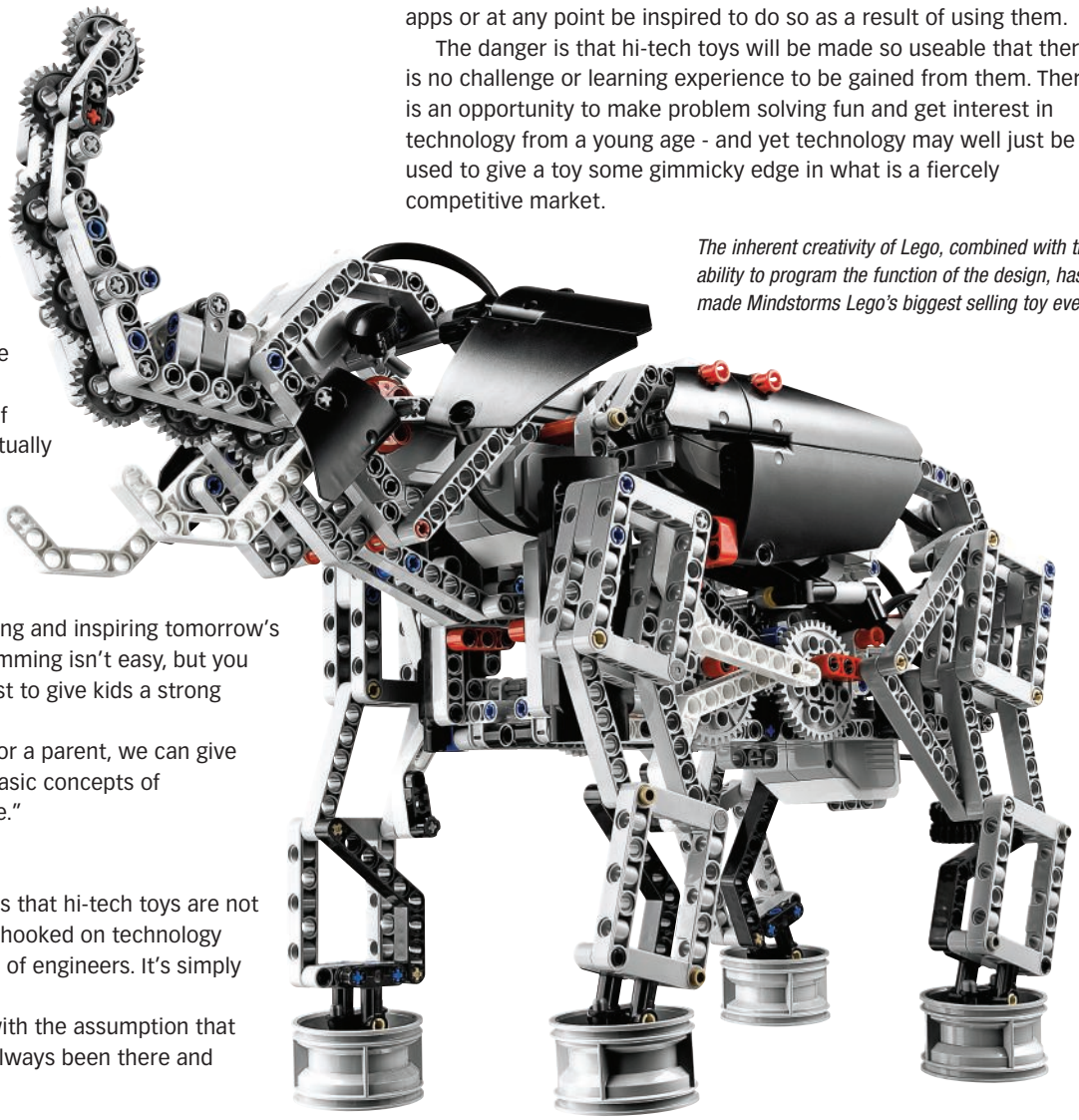
"Whether you're an educator or a parent, we can give lessons that will teach kids the basic concepts of programming, maths, and science."

Using vs utilising

The fact of the matter, however, is that hi-tech toys are not always about getting youngsters hooked on technology and inspiring the next generation of engineers. It's simply about entertainment.

Many children now grow up with the assumption that technology simply exists, it has always been there and always will be. And while they are able to use it, they are perhaps not able to learn from it in quite the same way that the Lego Mindstorm sets out and aims to do. Many are capable of using tablets and smartphones from a very young age, but will never go on to develop apps or at any point be inspired to do so as a result of using them.

The danger is that hi-tech toys will be made so useable that there is no challenge or learning experience to be gained from them. There is an opportunity to make problem solving fun and get interest in technology from a young age - and yet technology may well just be used to give a toy some gimmicky edge in what is a fiercely competitive market.



The inherent creativity of Lego, combined with the ability to program the function of the design, has made Mindstorms Lego's biggest selling toy ever

RS Components send Superman into space

RS Components has collaborated with toy maker Mattel to support its Extreme Toy Travel campaign that has successfully sent a Superman figurine to space and back.

The Toy Travel in Space project saw RS team up with Rlab, a peer run community 'hackspace', card modeller Jude Pullen, and high altitude balloonist Dave Akerman, with the aim of sending a Superman figurine to space and back in a custom-built capsule. Inspired by Felix Baumgartner's record-breaking freefall from the edge of space last year, the team collaborated to design and build a capsule that would attach to a hydrogen weather balloon.

The craft, packed full of electronics and 3D printed components, travelled to a height of around 39km, and at the edge of space Superman began his freefall back to Earth. The capsule included a Raspberry Pi to capture mission data as well as a specially designed tracking unit to locate and retrieve Superman.

"This project is a demonstration of our innovation in engineering design, using our industry-leading design resources, together with products such as the Raspberry Pi and 3D printing, made possible through collaboration with leading engineers and technology experts," said Pete Wood, DesignSpark community manager at RS Components. "It has been a unique experiment as it involved carefully identifying several challenges associated with High Altitude Ballooning (HAB) and developing a team of engineering experts who came up with the right plan for the capsule."

The launch took place on September 12, in Ross-on-Wye, Herefordshire, UK. During the flight, the mission data (altitude, temperature, weather) was collected along with HD videos and images. Both Superman and the capsule were monitored through a radio connection and GPS. The space capsule weighed about 2.5kg and slowly drifted down to Earth over the course of a few hours on a parachute that ended with a safe and low impact landing.

RS has now posted all the design files, bill of materials and design notes on the DesignShare section of the DesignSpark website under an open source licence so others can build their own space bound craft and figurines. The Toy Travel in Space project aims to enrich children's learning experience and inspire their competitive creativity by engaging them to build their own spaceship and posting the design on the La Scatola dei Giocattoli website.

www.rs-online.com/designspark
www.lascatoladeigiocattoli.it/viaggiodeigiocattoli/

Connected Play

The increase in smartphones and tablets means that apps, virtual entertainment and online play are increasingly coming together in the physical world. An example comes from a Kickstarter project launched to create the modern Teddy Ruxpin, dubbed SuperToy, which has been launched by UK based Supertoy Electronics.

The teddy bear is supposedly able to talk as naturally as a human and is able to engage with young children to help them learn language skills, hold conversations, and even help teach them to read. While on some level this is all slightly disturbing, it does no doubt hint at the fact that our interaction with machines – more widely – is likely to become the norm before long.

Speech recognition and the corresponding algorithms are now a mature technology, and though they have had some inclusion in the toy market to date, there is a niche for some bright spark – indeed perhaps the Supertoy – to fully exploit the technology so it will appeal to the next generation.

Where this young audience might have once used imagination to fill in any non-humanesque gaps, the Supertoy teddy bear begs the question of where this is all going? Will we soon be able to download different personalities to teddy bears and other toys as artificial intelligence continues to make leaps forward? While none of this is beyond the bounds of possibility, it is still likely to be a few years yet before you can have a full blown conversation with a present on Christmas morning.

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Engineering the pipeline

Everyone is bemoaning the lack of good engineers coming through the education system. But if we are to solve this problem rather than apportion blame, says Professor Anthony Finkelstein, we must all work together. Tim Fryer reports.

Unsurprisingly, as the Dean of the Faculty of Engineering Sciences at University College London (UCL), Professor Anthony Finkelstein has opinions and insights on many topics. Inevitably it is the supply of young trained engineers into the workplace that dominates – the so called 'pipeline issue'.

Clearly demand is currently outstripping supply. Engineering UK predicted the UK needs 87,000 new graduate engineers a year, for the next ten years, to get back on track – and we currently produce 46,000.

"This is a broad challenge for education and indeed for society as a whole," claimed Prof Finkelstein. "The problem is a complex multi factor problem and a whole range of things are tied together. Those things range from societal cultural attitudes towards engineering and technology, and the way that the sciences and mathematics are taught.

"I believe that all the elements of engineering – science, mathematics and design – need to be introduced to children in a more exciting and inspirational way. There are big efforts going into making that happen, and the situation is changing very rapidly, but there is a long way to go."

Prof Finkelstein believes the whole issue has been 'bedevilled' by people looking for simplistic solutions and magic bullets, while persistently underestimating the size of the challenge.

"It requires us to use all the array of tools at our disposal, and it will be necessary to do this over a long period of time," he stated. "It needs to be a 25 year project, not an 18 month project. It requires us to co-educate parents and children alongside each other. It requires us to address the media - there are a whole range of different things that we need to do. That means that industry, professional institutions, universities, further and vocational educators, school educators, cultural institutions: they all have to work in a unified way and as a partnership."

Currently, he believes, there are too many people in industry sniping at the universities, universities sniping at schools, while vocational education has been pushed to the side. "We have not been working in a coherent way," he said. However, change is possible and he cites the example of computer sciences.

"There was a problem with the way that information technology was being taught in schools," he said, "with an effect on the supply of computer scientists and ultimately with an effect on the economy."

A collaboration between professional institutions and the academies (the Royal Society and the Royal Academy of Engineering) along with universities and with industry formed to tackle the problem.

"The politicians were very responsive to it and the national curriculum was changed," he explained. "Now there is much stronger emphasis on computer science, with much more enriching and stimulating curricula, which will deliver a step change in the way that students engage with computing. So there is positive evidence that by working together we can change things for the better."

Prof Finkelstein believes one huge step towards solving the problem would be if young women were as interested in engineering as young men.

"It would make British engineering better through diversity," he said. "It would be a fantastic thing and would give us access to a greater number of talented young people."

'All the elements of engineering – science, maths and design – need to be introduced in a more exciting and inspirational way.'

Another beneficial component in the mix would be the return of the sandwich course, where students take a year out between year two and three of their course and do a placement in a relevant company. He said: "I think the demise of the sandwich courses was a sad moment, but we are moving back towards that situation with many more work placements and internships. I think that is going to be an almost inevitable end point."

Another notable difference has been in the nature of the school-leavers who arrive at universities. Prof Finkelstein said: "They come from schools, to us at universities, with better self organisation and self management skills. But they tend to have poorer technical problem solving skills. So the schools are preparing the students differently. It is not better or worse, it is just different. But that difference is a challenge, so we have to start students at a different point when it comes to solving certain sorts of problems."

He concluded: "There is still much design work in the UK and of course the balance between software and hardware in typical systems makes a difference to the shape of their education as well."

Professor Anthony Finkelstein

Professor Anthony Finkelstein is a Fellow of the Royal Academy of Engineering and a Fellow of the City & Guilds of London Institute. He is a graduate in systems engineering holding a BEng, MSc and PhD. Currently he is Professor of Software Systems Engineering at University College London (UCL) and serves as Dean of the Faculty of Engineering Sciences. Prof Finkelstein has published more than 240 scientific papers and is a Fellow of both the Institution of Engineering and Technology and the British Computer Society. He has provided consultancy advice to a large number of high profile companies and universities and has received the 'Entrepreneurial Spirit' award for his work on knowledge transfer to industry.

Morphing materials for industry

Materials that can react to external stimuli – dubbed smart materials – are a key area for UK exploitation. Justin Cunningham finds out how Innovate UK intends to capitalise on the potential.

It can all sound a bit sci-fi when the topic of smart materials comes up. The classic is liquid-like morphing metallic structures that have been used, in films at least, to make up the spaceship hull in Flight of the Navigator and, of course, the iconic T-1000 from the film Terminator 2.

Morphing metallics with this amount of functionality are still some way off. However, shape memory alloys do exist, though in real terms have had very little practical application. And this is the case for many smart materials that are broadly defined as having unusual and reactive properties.

There is a host of amazing and quite futuristic materials now available, some commercially, some in the maker space environment, but many stuck in the lab due to a lack of interest or uptake from industry. The possibilities and potential does exist, however, and many feel they could be, and should be, much more widely used.

This is a key area of interest for Innovate UK, the Government agency being charged with accelerating economic growth through high value – and hence innovative – manufacture.

"Historically, the UK has been exceptionally good at the research," said Andy Sellars, a lead technologist at Innovate UK. "And industry tends to be comfortable picking up technologies once they reach technology readiness levels 8 and 9. So, at Innovate UK, our job is actually to bridge the gap between what universities are producing and what industry can use."

"Smart materials offer some truly unusual properties that are no longer science fiction"

Innovate UK is targeting projects and applications that offer high growth potential in growing global markets. This has led to it launching a formal competition in March next year, and is keen to hear from designers and engineers about their ideas, and from companies willing to match fund the development of smart material systems.

"We want to fund areas where the UK has the technology and capacity to exploit," said Sellars. "So, for smart materials, we have high activity at the research base and SMEs working in this area, and we also have end customers that are ready to commercialise the technology."

The reaction of materials to some change in their environment is key to it being labelled as 'smart', so it must be a part of a structure or system. Classic examples may be the thermochromic paint used on small die-cast toy cars that change colour in the bath. However, smart materials now offer some truly

"Historically, the UK has been exceptionally good at the research"
Andy Sellars

unusual properties that are no longer science fiction. There is a vast array of materials available from magnetocaloric materials that change temperature when exposed to a magnetic field, to chemi-resisting materials that react to chemical vapours by changing their electrical conductivity, to photostrictive materials that generate strain upon exposure to light, to thixotropic materials exhibit a time-dependent decrease in viscosity when subjected to shear forces.

So why are so many designers and engineers not aware of their existence, or hesitant to use them? To help, Innovate UK has set up a website to outline the possibilities, which features an in-depth design guide on the smart materials now available. The aim is to give designers and engineers the information they need ahead of the competition launch.

Dr Steve Morris, technology manager at the Smart and Emerging Technologies Knowledge Transfer Network (KTN), said: "As a scientist it is hard to know what smart materials designers and engineers want as they tend to think more laterally than I would as a scientist."

The funding for smart, hybrid and multiple materials in March will be part of a £5 million investment specifically to fund the creation of smart products and systems. Smart systems and products are defined as being able to respond to the environment, for example a crash helmet that might respond to an impact (think non-Newtonian fluid).

The competition is centrally aimed at developing the ideas of individuals to see where these materials can be used to make products more useful, and at the same time attracting companies to match fund any developments.

Numerous examples already exist. In the US, a university project developed a liquid crystal technology where the crystals themselves respond to the light hitting them causing the liquid crystal display intensity to instantly change according to the external light intensity.

The technology was then used in the head up displays of fighter pilot helmets as they were having problems going from bright sunlight into cloud or from cloud into bright sunlight as they could not see the visual display due to the rapid change in light intensity. And this is the aim, to give UK industry the support it needs to use more smart material to solve problems.

Exploitation potential

"It can be any material," said Morris. "It can be metals, composites, powders, textiles, polymers... if it looks really interesting and could make a big impact then we want to make the community aware of it. And once they become aware of it then they can think about how to use it."

Following on from a workshop in September run by the Materials KTN, part of Innovate UK, key topics for exploitation were identified.

"It was a brainstorming exercise," said Sellars. "The workshop saw engineers and designers from a number of industries identify how they could use smart materials to make smarter products. And we then asked what is stopping them do that as there are a number of SMEs out there providing smart materials, so where are the challenges? Is it cost, the manufacturing processes, the development?"

Ultimately there are key areas of application that have since been identified as the most effective and likely to yield high value economic growth. These are the built environment, defence and security, energy, healthcare, transport and the catchall 'other'.

"Funding is competitively awarded and Innovate UK wants to see at least two companies, but welcomes more, to come together and bid for funding," said Sellars. "There are a lot of SMEs that have set up to establish a supply chain early from conductive inks, to materials that accurately change colour according to very specific temperature, to lenses that change refraction according to sunlight and so on. And this is about strengthening the position of these companies, so that's why Innovate UK wants to have partners with different individuals, universities and companies collaborating together."

connect.innovateuk.org
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"As a scientist it is hard to know what smart materials designers and engineers want as they tend to think more laterally than I would"
Dr Steve Morris

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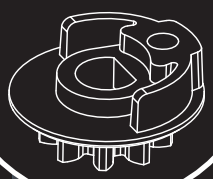

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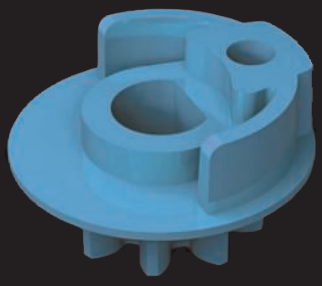

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Silent *running*

The Royal Navy's future anti-submarine vessel relies largely on a technology that has helped make factories around the world more efficient. So how do you navalise a variable speed drive for a modern warship? Justin Cunningham investigates.

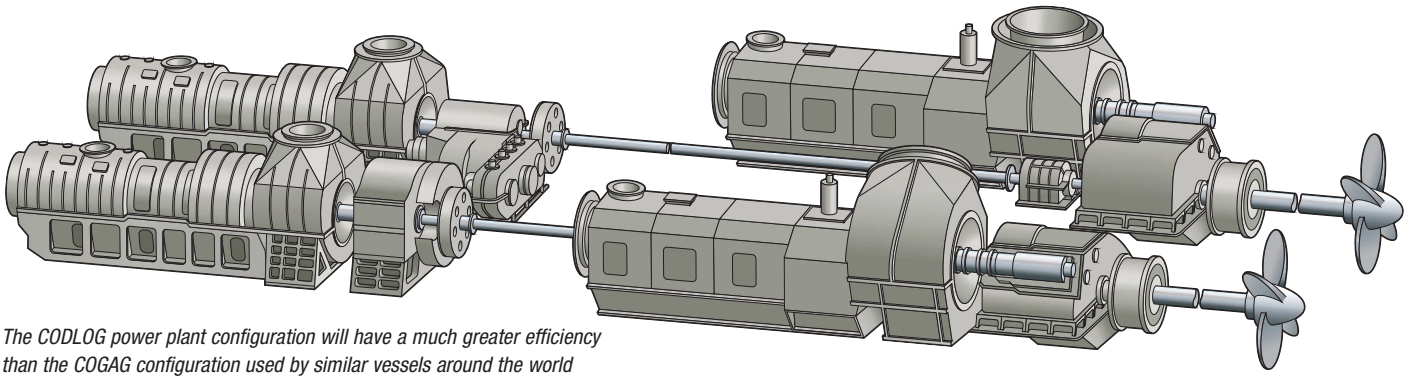
The Royal Navy's latest large procurement project, the Type 26 anti-submarine frigate, is proceeding well with many of the prime contractors being announced. One of the most fundamental is its propulsion system that has been awarded to General Electric's Power Conversion's naval business.

There are many challenges in providing propulsion on modern marine vessels, not least is one that fundamentally comes under the ambit of being a warship. The Type 26's primary role is searching for submarines, as well as a secondary role as a general support and humanitarian vessel. It means any propulsion system has to offer speed and efficiency, as well as near total silence – though not all at the same time.

The Type 26 is slightly larger than the Type 23 Frigate it is replacing, with a basic displacement of around 6500 tonnes. It is also slightly longer at 150m, and due to its varied multi-mission role the range of the Type 26 was one of the key drivers during its design, some 7000 nautical miles.

For this reason the ship uses a fairly well known 'hybrid' configuration in the marine industry known as combined diesel electric or gas (CODLOG). The reality for the Type 26 is that it will use a single large gas turbine that will directly drive both the ship's shaft lines via a splitting gearbox, in combination with four diesel generators. These will produce electricity and in turn power General Electric motors to drive the ships propellers at lower speeds and for near silent operation.

"When we are running in stealth mode the propellers do not run on batteries," said Paul English, marine business leader for GE Power Conversion. "The diesel generators keep running and produce the power to the propellers and the rest of the ship. So the noise of these engines is isolated by putting them on acoustic mounts and in an acoustic enclosure to reduce the airborne noise."



The CODLOG power plant configuration will have a much greater efficiency than the COGAG configuration used by similar vessels around the world

The gas turbines and the diesel generators will both use the same single onboard fuel – the NATO designated Dieso. While still broadly considered a distillate light fuel, it is slightly heavier than the diesel most of us are used to at service station pumps. However, it also has a much higher flash point, an obvious advantage for a ship likely to see combat during its service life.

For higher speeds, the ship uses the gas turbine. "In this mode the gas turbine drives through a splitting gearbox, and then into a second reduction gearbox, which then drives the shafts and propeller."

However, a gas turbine whirring away might well be an efficient and effective way of producing power and shifting the Type 26 to its top speed in excess of 28knots (32mph / 52kph), but when it needs to remain quiet and locate enemy submarines, its diesel generators kick in to enable near silent running. One of the key technologies enabling this propulsion system is its use of Variable Speed Drive (VSD) technology.

"When the ship is operating quietly the gas turbine and subsequent gearboxes shut down so to eliminate all the mechanical noise from those pieces of equipment," said English. "The propellers are then turned by the ultra-quiet GE propulsion motors, using electricity produced by up to four diesel generators. The motors receive their electricity from a combination of VSDs. A VSD is basically a frequency converter that controls the frequency it sends to the propulsion motor. We need to do this since the diesel generators run at a constant 'mains' frequency (60Hz), which is fine for the normal equipment on the ship - like the pumps, as their electric motors only need to work at one speed.

But, to control the speed of the ship through the water we need to be able to vary the shaft speed, so we obviously need to be able to change the frequency we give to the propulsion motor.

"There are all sorts of ways of doing that, the Type 23 that this is replacing does it by using direct DC voltage to give us variable speed control, but the modern way of doing it is to modify the fixed AC supply waveform to one of a different frequency for the motor, via an initial conversion to a direct current. This is done by a technique called Pulse Width Modulation (PWM). We're already well in to the design phase for the motors and converters, with the motors being designed at the moment and the VSD technology being based on commercial equipment."

The VSDs are controlled by computer to create variable frequencies that enable the speed control of the propeller.

"The greater the frequency out, the faster the motor will go," said English. "Conversely the lower the frequency the slower the motor will go.

"It is based on our standard MV3000 range of marinised drives. We produce

hundreds of these for use in commercial shipping and the core electronics are the same, but we have to navalise it."

Given the nature of the Type 26's primary role as an anti-submarine vessel, the drives have to ensure that the electrical waveform produced has very little noise and distortion, as any distorted waves going in to the motor will cause vibration and radiate noise in to the water.

This is achieved using a variety of technologies, including filtering techniques and the use of special PWM strategies to smooth the input to the motor ultimately turning the ships' propellers.

"The idea is it has to be very quiet as it is an anti-submarine frigate," said English. "So we put in a huge effort to reduce radiated noise from the ship to enable it to operate very effectively in that environment.

"And like much of the ship's components, generally, the VSDs need to be made more robust and shock hardened. If a ship suffers an explosion, for example, the VSDs need to be designed to survive. We do that by optimising their design using advanced dynamic computer modelling as well as simple techniques like putting it on specific mounts and surrounding it in a strong frame."

Fundamental to a low noise signature is the design of the motor. The motors, currently under design and development, must be carefully engineered to ensure that they generate a minimum of harmonics and to ensure the maximum of attenuation in the noise conduction paths. This work requires a great deal of computer modelling and the application of many years of data gathered from a large number of different noise quiet motor designs. There are very few companies in the world that have this capability and no other company has supplied more noise quiet, shock proof motors to the surface fleets of western Navies than GE.

Technology Transfer

By integrating gas turbines with an enhanced electric propulsion system, the Type 26 will be more efficient and have reduced fuel consumption compared to its predecessor as it is able to configure its electric propulsion system for a wider range of operational demands and over a wider speed range. The integration engineering to deliver a package that works, rather than just a collection of equipment, is key to this and integration is an area where GE Power Conversion has strength in depth; not just in the Naval arena but also in the wide range of commercial electric propulsion packages it produces.

And this sits well with General Electric's larger marine business. As the International Maritime Organization increasingly look to introduce guidelines around ship efficiency and in particular with CO_2 legislation becoming an increasing possibility in many regions, the integration of both gas turbine and electric propulsion technology, in a hybrid arrangement is likely to become much more prevalent in the civil marine industry.
www.gepowerconversion.com

Impact engineering

Whilst wearing a helmet offers some safeguards, is it really optimised for the job? Here, a leading expert believes that all head protection is in need of a redesign. Justin Cunningham finds out more.

The humble helmet dates back nearly 3000 years and though it has been used prolifically in warfare, it is now most commonly used to provide head protection outside the combat arena. However, although applications might have diversified, it is still fundamentally designed and used to provide the same thing.

So when this most traditional of objects is combined with modern sensor technologies, greater test data resolution and analysis, there is bound to be fresh insight.

And this is the case for many conventional designs where sensors, test and measurement technologies are changing conventional thinking into how something has been designed, to how it should be designed.

It sets the scene and means helmet design is on a collision course for further impact protection, specifically in preventing serious brain injury by giving helmet designers greater clarity in to the mechanical forces at play in any particular scenario.

It was this, along with a lifetime of comprehensive knowledge, which enabled biomechanist Dr John Lloyd, research director of BRAINS, to start up a company dedicated to improving current helmet technology and ultimately improve protection for wearers. He aims to shed new light on helmet design, and improve protection against the fundamental causes of concussion and brain injury.

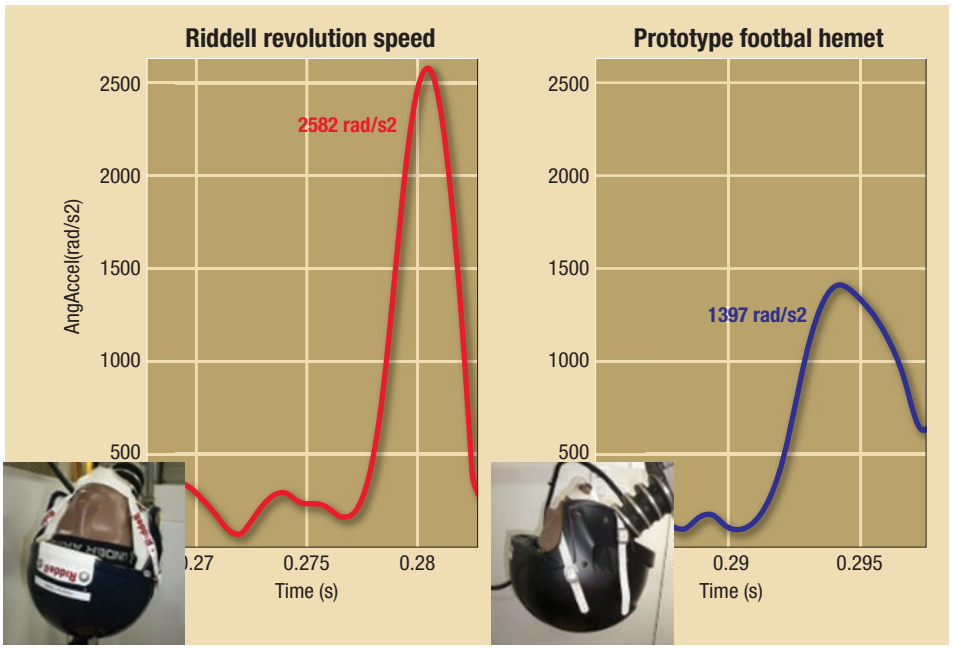
"There are two key forces at play during a head impact," said Dr Lloyd, speaking at this year's National Instruments Week in Austin, Texas. "Firstly there are linear forces, these are the ones that cause visible injuries such as bruising and skull fractures. However, the second is the rotational forces. These are the ones that cause invisible injuries such as concussion and brain injury.

"Current helmet testing technologies measure the linear forces. However, at this time, they do not measure the rotational forces, so consequently we have helmets for many sports that do not test against their ability to provide protection against concussions and brain injury."

Whether it is for riding a bike, horse riding, skiing or indeed for the soldier in the field, the effect of rotational movement is the same. Yet, it is rarely tested for, and even less frequently measured, to see how effective any helmet is in rotation force protection.

Dr Lloyd modified the standard apparatus used for testing helmets (see the rig on page 28), where a head section is raised 2m on a rig and dropped under gravity before it hits a striking plate with an impact force in the region of 4500N. However, instead of using a standard head form, Dr Lloyd replaced it with a standard automotive crash test dummy head and neck section. This way, when the head impacts the striking plate at the bottom of the test rig it will rotate, and the movement measured.

"We had multiple sensors embedded in the centre of mass of this head form," explained Lloyd. "So, during the impact we were able to measure the linear acceleration as well as the angular motion of the head.



Building a rig and conducting the test

A modification to the US National Operating Committee on Standards for Athletic Equipment (NOCSAE) standard test apparatus was used by Dr John Lloyd, research director of US helmet research start-up, BRAINS.

He developed and validated a new helmet test rig to measure the impact of protective headwear to include measurements of both linear and angular kinematics. This apparatus consists of a twin wire fall test system equipped with a drop arm that incorporates a 50th percentile Hybrid III head and neck assembly from HumaneticsATD crash test dummy, as used in the automotive industry.

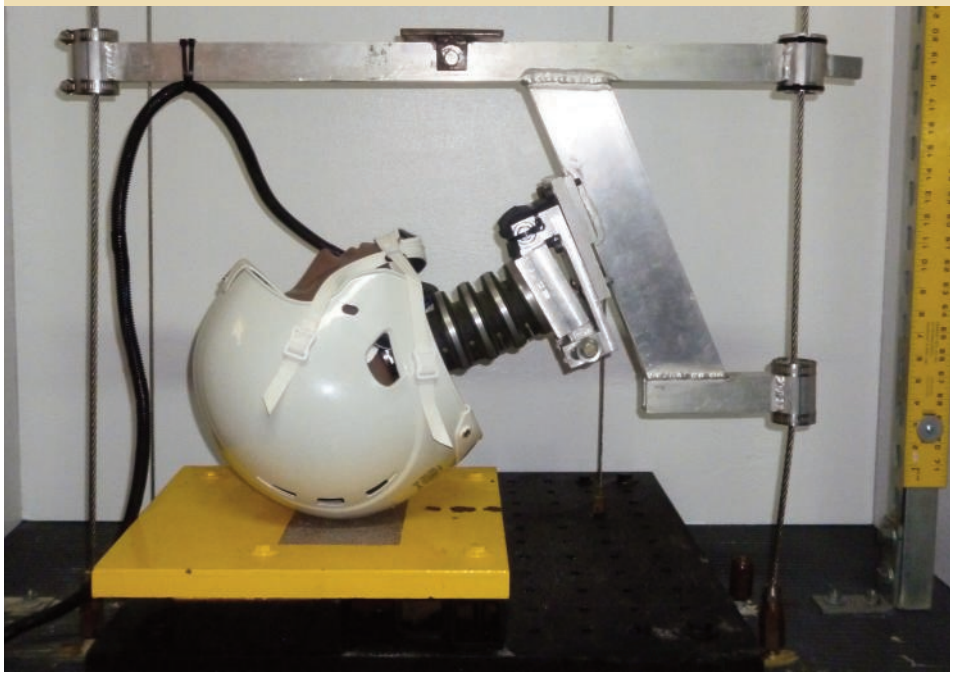
The aluminium fly arm runs on Teflon sleeves through parallel braided stainless steel wires, which are attached to mounting points in the building structure and anchored into the concrete foundation. The anvil, onto which the head drop systems impacts, consists of a 350mm x 350mm steel based plate.

Both the standard Riddell Revolution Speed US university football helmet, and the prototype BRAINS helmet that incorporates a non-Newtonian matrix, were dropped from a height of 2m onto a flat steel anvil, in accordance with American Society for Testing and Materials (ASTM) standards. This generated an impact velocity of 6.2 m/s (13.9 mph).

Instrumentation:
A triaxial accelerometer from PCB Piezotronics and three DTS-ARS Pro 18k angular rate sensors (Diversified Technical Systems) were affixed to a tri-axial block installed at the centre of mass in the Hybrid III head form. Data from the accelerometer and angular rate sensors were acquired using National Instruments compactDAQ hardware.

Analysis:
Data from the analogue sensors were acquired at 10,000Hz, per channel, using LabView and then filtered in Matlab using a phaseless 4th order Butterworth filter with a cut off frequency of 1650Hz. Angular acceleration values were derived from the angular velocity data based on a 5-point least squares quartic equation.

Result:
The result of the new helmet design shows significant improvement in rotational acceleration exerted on the head and neck, cutting the overall force by nearly 50%.



"My measuring apparatus includes sensors from several manufacturers.. The angular rate sensor, for example, that is used to measure the rotational forces is a highly specialised sensor. And, as a result, has its own data acquisition hardware and software."

Simplifying synchronisation

Trying to integrate all this data from different sensors was a challenge at best. And to make matters more complicated, the peak linear acceleration and peak angular acceleration actually happen at different points in time.

"So while you can just line up the data," he said, "there is a lag between them. So we need to measure that lag, which is a critical measurement in the research."

To resolve the problem, Dr Lloyd uses both the National Instruments LabView graphical software and a CompactDAQ to interface with the sensors and provide the necessary synchronisation between the various sensors.

Dr Lloyd modified his apparatus for testing helmets used by American footballers in the National Football League (NFL), to develop understanding of the how spinal and head injuries are caused and improve the design of the standard helmet.

"The results are pretty alarming in terms of how little protection they provide against concussions and traumatic brain injuries," he said.

"Based on lessons learned from that study, I have developed a new 'football' helmet prototype. This uses a patent pending matrix of non-Newtonian materials and when we tested the prototype helmet, on the same apparatus, the result blew me away. Not only did these materials reduce the linear forces but compared to the standard football helmet they actually reduced the rotational forces that cause concussion and brain injury by an amazing 50%."

The non-Newtonian materials Lloyd has in mind are inexpensive and produce a helmet that is considerably lighter and even said to be more comfortable for those wearing them.

Dr Lloyd is now expanding the concept of reducing rotation forces in helmets in every application and said it can be applied to almost any helmet design to help reduce concussion and brain injuries from sports to leisure and even back to warfare.

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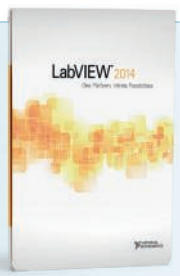

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VIEW FROM THE TOP

In this year's View From The Top, *Eureka* talks to two of the industry's leading companies to assess what lies ahead in 2015

"The 'rapid concept and prototyping' approach can bring many advantages."
***Glenn Jarrett**, RS Components*

"Computer simulation has only relatively recently matured as a 'must have' tool."
***Cris Emson**, Infolytica*

"The evolution of the new 'rapid concept and prototyping' approach can bring many advantages for companies."
***Glenn Jarrett**, RS Components*

Glenn Jarrett, Global Head of Product Marketing at RS Components talks about the industry trends and technologies that are enabling a new approach to the creation of product concepts.

The entrance fee is now lower than ever to gain the knowledge, tools and technologies that in many cases were previously out of reach for the majority of engineers. More than this, the same also applies for electronics and mechanical engineering enthusiasts or students at universities and schools. For example, increasingly rich engineering content is becoming readily available online and made even more accessible with the proliferation of personal and affordable smartphones and tablets in conjunction with ever higher levels of bandwidth for mobile data. In addition to which, engineers and developers are becoming more and more involved in online communities and forums to seek advice and share ideas in more collaborative processes for design.

New approach

Enabled by this increasing access to new technologies, the industry is undergoing a transformation in the product design flow. We are now seeing an acceleration of the development phase within the early stages of product conception. The evolution of this new 'rapid concept and prototyping' approach can bring many advantages for companies: it delivers the ability to rapidly react to market demands, reducing time-to-market; it encourages innovation at all levels with the empowerment of engineers across entire departments; and it allows the building of a base of experience, even if a potential product concept does not actually come to fruition.

However, it will only work if engineers are empowered to be a part of the concept development process. And certainly this has been difficult to realise in the past. But there are three key trends or enablers that are making it possible, while also changing the profile of the industry.

Open source

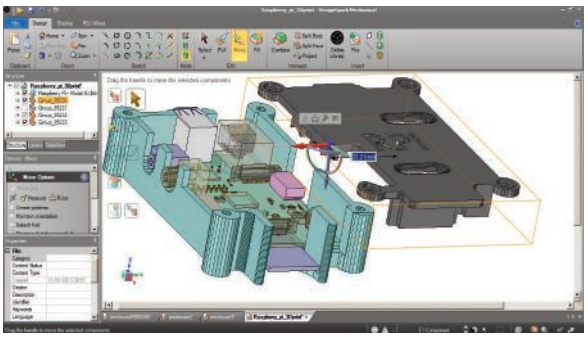
The first of these trends is the open source movement. The free and open source software movement is now well established with major OEMs at all levels across our industry. They are not just accommodating it, but building solutions based upon it and moving it forwards. The drive for open source hardware is also growing fast, and while it is still the early days in this endeavour, it is being accelerated with the availability of hardware-proven reference designs and software stacks from semiconductor vendors and others as one example among many. These template technologies are enabling engineers to quickly try out designs and concepts, which is a rather more advanced position to be in than having nothing beyond that idea sketched out on the back of the napkin. The Arduino platform and ecosystem is perhaps the leading enabling force in the open source hardware movement: hardware design files are freely available, enabling developers to extend these to meet their own objectives. And it is not only

Technology democratisation brings new approach to design

Arduino. For example, new industrial computing solutions and many new applications for the Internet-of-Things are being created on relatively low-cost building blocks such as the Raspberry Pi platform.

Design tools

A second key trend is the growing availability of free design software; and here RS is a leader. In 2010, the company launched DesignSpark PCB, an entirely free, powerful and easy-to-use PCB design tool that has no restrictions and no annual licence fee. Removing the bottleneck of having to use specialist PCB layout engineers (who typically might have used premium PCB software), the DesignSpark PCB software allows all engineers to rapidly design new electronics based concepts. In fact, many manufacturers are now choosing to employ the tool as the software to promote their reference designs to the widest possible audience. In addition to which, just over 12 months ago, RS moved in the 3D mechanical design arena with DesignSpark Mechanical. Based on direct modelling techniques, this downloadable free tool has allowed more engineers to use a powerful 3D design tool that has enabled them to quickly create mechanical concepts and designs.



These DesignSpark software tools are central to our pledge to engineers to provide them with the tools they need to rapidly develop concepts and prototypes and get their products out within a short time-to-market. And this promise is being manifested in the sustained commitment to these tools. For example, DesignSpark PCB is now in its 7th version and, this month, we are launching the second version of DesignSpark Mechanical, largely based on requests from its now sizeable user base. The new version of DesignSpark Mechanical offers a new and simplified user interface with built-in help text and Quick Guide tutorials, example designs, as well as making the tool's BOM-quote functionality even easier to use. Importantly, the tool also significantly extends the capabilities of the first version with the optional integration of new premium modules that provide engineers with the ability to build a seamless concept-to-production workflow. Accepting of course that this level of functionality offered by the premium modules may be beyond what is required, as the fundamental capabilities of version 2.0 will be more than enough for many, if not most, engineers. In addition, the tool provides access to a 3D library comprising tens of thousands of 3D models from leading component manufacturers, as well as the integration of all the necessary RS purchasing data for fast BOM creation. Crucially, DesignSpark Mechanical's STL-output format also enables the direct export of designs to 3D printers, which leads nicely into the third trend.

Printing and prototyping

3D printers are greatly facilitating increasingly cost-effective access to rapid prototyping and the physical realisation of mechanical design concepts. These 3D prototyping machines are becoming more and more affordable with plastic-material-based printers now available at similar prices to higher-end '2D' laser printers, such as the Ormerod 2, the latest 3D printer from RepRapPro, as one example among many. As well as 3D printing, an additional prototyping resource is the growing range of PCB board manufacturers that can deliver prototype boards in a matter of days and at relatively low cost. Overall, the 'Rapid Concept and Prototyping' approach can mean that up-front requirements and even an end goal can be significantly less strict. 'Must-have' functionality can be identified at a high level, while allowing entire engineering departments to be involved in brainstorming to create many concepts, which can be quickly and easily created digitally and developed in parallel with the strongest concepts progressed and the weakest quickly abandoned in an evolutionary and iterative process. Physical prototypes can be produced, quickly followed by customer and market testing with a small number of prototypes taken on through the full design process.

Democratisation

In summary, increased design resources from hardware suppliers, open-source platforms and IP, the availability of free-to-download PCB-design and 3D-modelling tools, extensive libraries of 3D models, and finally easy access to rapid prototyping capabilities such as the use of 3D printers, have all combined to enable a new agile and flexible approach to product development. RS is committed to furthering this democratisation of technology with the delivery of advanced products, tools and design resources, and thereby enabling more and more innovation in industrial companies of all shapes and sizes and empowering engineers to realise concept-to-creation of products in a substantially faster time.

DesignSpark PCB and DesignSpark Mechanical are available for free download and support via the DesignSpark community at: www.rs-online.com/designspark/electronics.

Infolytica Europe

More reliance on virtual prototypes

According to Dr Cris Emson, CEO, Infolytica Europe, computer simulation has only relatively recently matured as a 'must have' tool for designers. Tim Fryer reports

While the speed of modern computers has allowed much more sophisticated virtual design tools to be created, the real maturity point was when full 3D simulation became common place on an inexpensive desktop PC. But can it ever fully replace physical prototyping?

"In most cases I would say not," said Dr Emson. "There are some exceptions such as large magnets. For example the magnets for the CERN particle accelerators, you would not expect them to be building and testing a series of prototypes in that case. For more everyday applications it would be quite usual to use virtual prototyping tools to refine the design to what is hoped is the end product, but then build a physical prototype for final testing and confirmation.

What we do find however is that much more reliance is made of virtual prototyping tools than before. Engineers are willing to accept that modern simulation software really is very accurate indeed, or at least as accurate as the data being put in. What I mean by this is that both the physical size and shape as well as the material properties are always variable in nature (due to manufacturing tolerances)."

Where simulation tools become very effective is to establish how sensitive a design is to the various geometric parameters and material properties. Ideally a design is generated such that any variations in size and material properties do not cause the device to fail performance checks. These kinds of simulations are easy using the virtual design tools, basically a 'what-if' type analysis, and would be practically impossible to do in a consistent way using physical prototypes.

But progress continues and part of that is down to the hardware available. Dr Emson said: "Now that the speed of PCs has tended to stabilise, the biggest change in the hardware is the increase in number of Processors available.

Dr Cris Emson

Software is adapting to utilise this new type of hardware, but it is probably fair to say that rather than make the software run a lot faster, the use of multiple processors instead can be better used by allowing multiple simulations to run in parallel. This is ideal if trying out multiple solutions with varying parameters as mentioned earlier."

And the software tools themselves are changing in some cases by including a lot more 'knowledge'. Dr Emson takes the example of the motor design software tool MotorSolve. "It can perform initial 'sizing' by taking the basic specifications (supply voltage, required torque, size constraints) and having chosen a suitable template for the rotor and stator the software then adjusts the various dimensions to give a first iteration of the motor design. The designer can then apply their expertise to further refine the motor to obtain the optimal performance satisfying the initial specifications. This has completely changed the way design software works – rather than build a model and then run a simulation to extract the motor performance, we are instead starting with the desired performance and allowing the design tool to come up with an initial design.

"Added to that the software also includes the effect of various cooling strategies, all within a single, simple to use package – so you can see the nature of design software is definitely changing, making it accessible to design engineers who need to get the job done quickly, without wanting to learn the intricacies of complex software."

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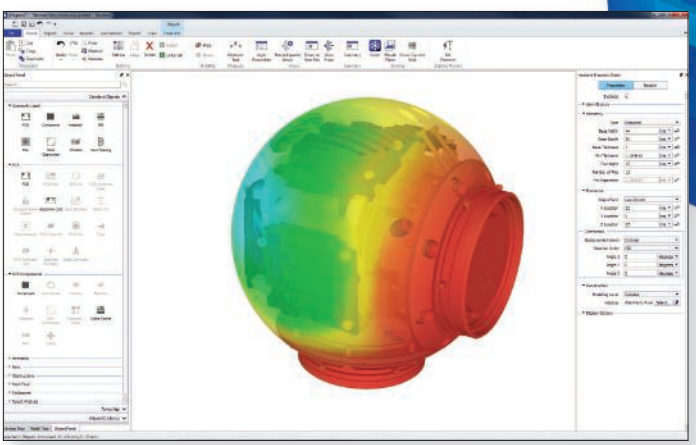
Early learning **of thermals**

A mechanical engineer has more to contend with than ever before. For example, what happens when the company's thermal engineer doesn't exist anymore? Tim Fryer reports.

Thermal engineering used to be a job for thermal engineers. In large companies, or companies where thermal design is absolutely crucial, they may still have an important role. They may deploy their talents during every stage in the design process, right from analysis of the concept in order to draw up initial design specifications. However, smaller design teams may have to accept that such expertise may not be readily available.

Even big companies get it wrong. The highest profile case is probably the overheating Xbox 360 that cost Microsoft somewhere upwards of $1bn when initial models had to be recalled in 2007.

Tom Gregory is the 6SigmaET product specialist at Future Facilities, and he commented: "They didn't release the exact reasons for the problem but I wonder if they didn't really consider how people might place the Xbox. It can be quite useful, for example, if there are things stacked on top of it or if there are vents that are blocked. It was certainly an embarrassing failure."



Over-heating consequences

There are three consequences to consider when looking at the thermal management. Firstly if a component exceeds its specified operating temperature then its operation may be compromised. Secondly, most specifically with respect to consumer items, it can cause the product to be uncomfortably hot to handle. And lastly it can actually be a safety risk if it is in danger of catching fire. So who is responsible for making sure this doesn't happen?

Gregory commented: "Some big companies will still have dedicated thermal engineers but many companies cannot afford that. Some work can be done at board level by the electronic engineer but at system level the mechanical engineer, the person responsible for the enclosure, will often be responsible for the making sure the electronic equipment inside the box doesn't overheat."

Clearly thermal engineering is a discipline in its own right and while such issues as experienced by Microsoft are an anomaly in the world of consumer electronics, Gregory believes that practice in other sectors is not always up to scratch.

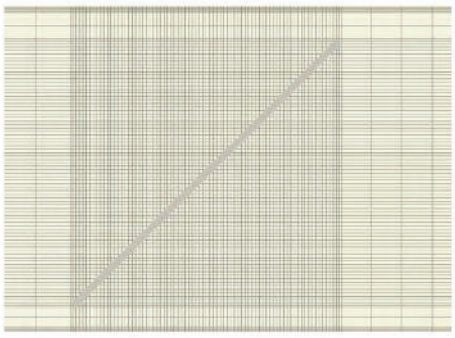
"I would say in some companies it is lower priority than other design aspects," he said. "There is a lack of understanding and over-reliance on rules of thumb – like if we put a big enough heat sink on it or use a large enough fan it should just about work. And perhaps an over-reliance on measurement after the case."

Measurement after the case is a familiar practice - that recurring loop of taking a design to prototype, taking measurements, fixing problems and then re-prototyping.

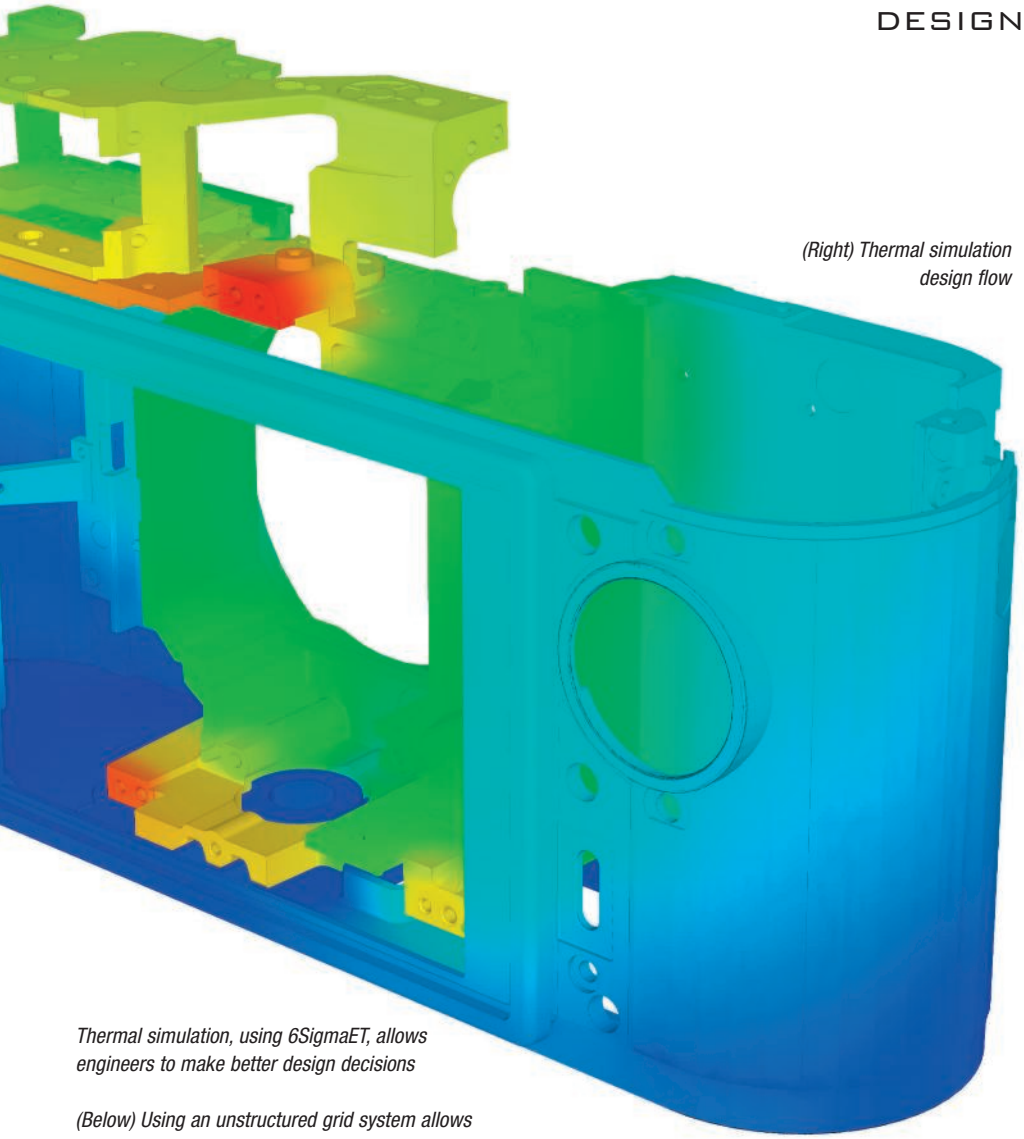
"Respinning a PCB or having to change the tooling for the enclosure can be incredibly expensive," claimed Gregory, "so you need to find mistakes before the prototype stage. The cost of fixing problems goes up the further down the design process you go."

What Future Facilities promotes is the use of thermal simulation right from the outset, starting with creating a thermal simulation at the design concept stage. By creating a simulation based just on a conceptual board, with certain components already on it, it is possible to get a good idea if the mechanical enclosure will be able to dissipate the right amount of heat in certain environmental conditions. This simulation can be done even before a mechanical or electronic engineer has got anywhere near their CAD packages and can help form some of the initial specifications for the project before they do.

As soon as CAD data has been developed for either the electronic or mechanical design, it can be fed into the model. This model can undergo continuous – daily if necessary – simulations to make sure that as it evolves its thermal performance is not being compromised by design iterations. At the end of this cycle a prototype can be made that when tested, theoretically, validates what was predicted by the simulation. This 'right first time' prototype can add speed to the time to market and reduce the



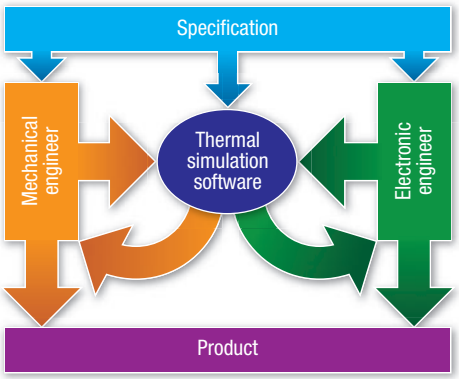
Structured



Thermal simulation, using 6SigmaET, allows engineers to make better design decisions

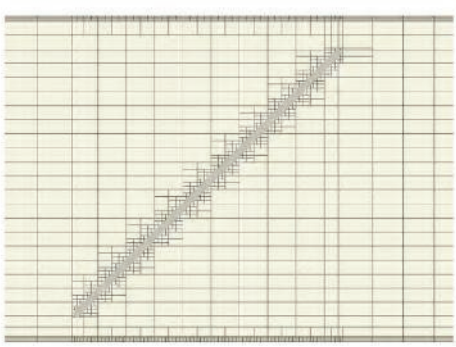
(Below) Using an unstructured grid system allows detail in the critical parts of the model

(Right) Thermal simulation design flow



cost of getting there.

Thermal simulations are not new. It is a process that has been around for around 25 years, but has predictably moved on a lot in that time. Chris Aldham, product manager at Future Facilities, commented: "25 years ago doing a thermal simulation required making a lot of assumptions. You were obliged to simplify the models, but there was always a danger in simplifying these models you would throw out something that is important. What has happened over the past few years is that the combination of more powerful computers and better software has meant that you can put more detail into the model."



Unstructured

That issue of detail forms the basis of one of the two major developments in the latest revision, R9, of 6SigmaET. Most thermal modelling systems are built up using a structured cell grid. Having uniform sized cells in this structured grid makes for a system that is relatively simple to run calculations on. However, it means that cells exist at non-critical parts of the model and equally the critical parts lack the necessary detail. And, said Gregory, it was limiting the potential of the system.

"So we went for the unstructured approach," he said, "which people have done before, and means only placing grid cells where required. It can be computationally quite an inefficient way of doing it and people who have done it in the past have had performance issues. So we spent a number of years developing 'the solver' that can solve an unstructured grid in a really fast and efficient way with none of the inefficiencies or limitations of previous attempts."

It means that fewer cells can better represent the important parts of a thermal simulation so it gives the option of either increasing model complexity without making extra demands on the computing environment, or simply running the simulation faster.

The other main improvement is in the user interface, which has become critical in making thermal engineers' software accessible to mechanical engineers. Aldham observed: "Sometimes people would only use the software once a week, or month or even three months. So if it is a complicated tool they will forget all the details that are needed, but if it is intuitive then they can leave it for three months and get straight back into it."

A simulated future?

So could simulation ever completely replace prototyping? "That is where people are going," claimed Gregory. "Already people, like Volvo, are trying to do as much virtual prototyping as possible."

But we are not there yet warned Aldham: "In order to do a very accurate thermal simulation you need a lot of data and that data has to be correct. This includes what the power dissipation of the components is and that sometimes is difficult to get a handle on in the theoretical stages – electronic engineers don't really know what power that component is going to be putting out until they have built and measured it, particularly with things like processors whose output depends on what software it is running. Until you can tie it all together there will always be a need for a bit of verification."

www.6sigmaet.info

Build it and *they will*

The EDS suite of exhibitions, conferences and workshops attracted 4026 engineers, cementing its place in the calendar as a focal point for the sector. Tim Fryer reports

Engineering design show

In 'Field of Dreams', the film in which, for those who don't know, the 'build it and they will come' reference is taken, Kevin Costner builds a baseball park in his maize field and thereby attracts a legendary baseball team. While the Engineering Design Show might not be quite as emotive, it does have similarities.

While we are all aware of the legendary stars of engineering from the UK's past – a disproportionately strong team in global terms – we often ignore the fact that we have a healthy crop of world-leading design engineers operating very successfully now, often for globally respected companies. Perhaps one reason they (or should that be 'you') do go under the radar is that it has proved notoriously difficult to get engineers away from their place of work. Is that down to a shortage of time, work pressures, lack of interest in going out, too much information already on the internet……or has industry lacked the kind of event that engineers really want?

The organiser, Findlay Media, surveyed engineers and found all of the above to be true, but it was the last one that held sway. So, armed with the wish list from readers of Eureka, the first Engineering Design Show was launched. It was built – and you came. 1500 of you. The attraction of industry leading suppliers to form an exhibitor base, supplemented by a stellar cast list presenting at the conferences and some meaty technical workshops, proved to be the right formula to get engineers to converge on Coventry's Rocoh Arena for the inaugural event.

The winning formula was expanded in 2013 with the addition of the Electronics Design Show, and 3100 engineers came. A further addition of the Embedded Design

come

Show saw attendance figures exceed 4000 – an increase of 28% - as doors closed on the 2014 event on October 23rd.

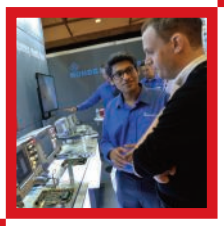
Ed Tranter, executive director of Findlay Media, said of the event: "When we launched the Show three years ago it was with the aim of providing a dedicated exhibition for the design engineering sector. The support we have received from the industry has been fantastic and enabled us to build a hugely successful event that we can all be very proud of. This year's Show has proved to be an absolute triumph and I want thank everyone involved for making it such a success."

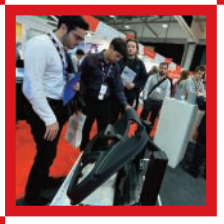
Although the event formula appears to be right, it still requires the quality of the content to be maintained – perhaps momentum in this respect, as well as in numbers of visitors, is gradually building from one year to the next.

So, possibly in part as a result of an excellent conference programme last year as well as the content of this year's schedule, over 1700 conference sessions were booked in advance.

The Eureka conferences represent the glamour end of engineering design. The most popular session in terms of pre-registrations was the excellent presentation 'Bringing a Formula One car to life' given by Al Peasland, Head of Technical Partnerships, Infiniti Red Bull Racing. With 186 pre-registrants and others joining on the day, this was one of several sessions that became standing room only.

The Eureka conferences represent the glamour end of engineering design.....





.....while the workshop sessions can provide the information

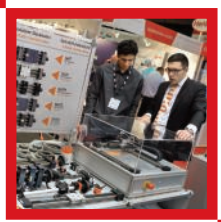
Peasland described how his multi-disciplinary team develops and identifies new technologies and integrates them into a Formula 1 car. As this year has proved in F1, every team is constantly moving forward, and Peasand described how innovation was an ongoing process at Red Bull.

Other presentations covered some of the most demanding and exciting environments in the UK today. Other automotive contributions came from Bob Bell, technical director of Mercedes AMG Petronas, who talked about 'Design integration in modern Formula 1', and Elliot Hawkins and John Roberts of Potenza Technology who described 'EV-Blue' – an electric car with an iPad driven control system. In this vehicle most of the wiring is replaced by wireless systems.

Meanwhile Millbrook's Peter Stoker and John Notman-Watt talked about vehicle design using a platform-based methodology.

Those who like their engines bigger were treated to the Rolls Royce view of why quality needs to be designed in from the start by Mick Carlisle, while those who prefer no engines at all (why do so many engineers like cycling?) were enthralled by Demitris Katsanis' presentation about designing Team GB's winning Olympic bikes. Describing the impact of a single 'weight-reduced' component as possibly only accounting for the difference of 2/100ths of a second over the course of an entire race, he put it into perspective by saying that the difference between gold and silver may only be 1/100th of a second.

Another burgeoning sector in the UK is medical and engineers interested in this market were not disappointed. Simon Calvert of Siemens Magnet Technology discussed the design of the 3 Tesla MRI magnet and how



Engineering design show

The formula for EDS will be taken to Newcastle for 'Manufacturing and Engineering North East' on 8 – 9 July 2015, while EDS will return to the Ricoh Arena on 21 – 22 October 2015.

cutting edge moleculat imaging is improving medical diagnostics.

Philip Canner from Team Consulting talked about the life-saving OrganOx project – a liver perfusion system – that won the 2013 Grand Prix a the British Engineering Excellence Awards.

Protecting rather than fixing the human body was the focus of Chris Davies of Morgan Advanced Materials, as he described some of the new material solutions used to protect provide body armour for soldiers – the balance between weight and protection being the vital thing here. Advanced materials have become part of the engineering battleground and composites are at the forefront. Marcus Royle of Gurit talked through some of the advances being made.

Rich Walker of Shadow Robot described how robotics is progressing giving the example of the 'dexterous hand', and Dr Joseph Darlington of the manufacturing Technology Centre took a look at virtual reality. Far from just being concerned with manufacturing, the MTC believes that using virtual reality in product design can give a competitive advantage.

And what conference programme in the technology sector would be complete without a look at the Internet of Things? Lynn Baranowski of Cambridge Consultants gave some practical advice on how to turn 'smart machines into brilliant machines' in an industrial environment.

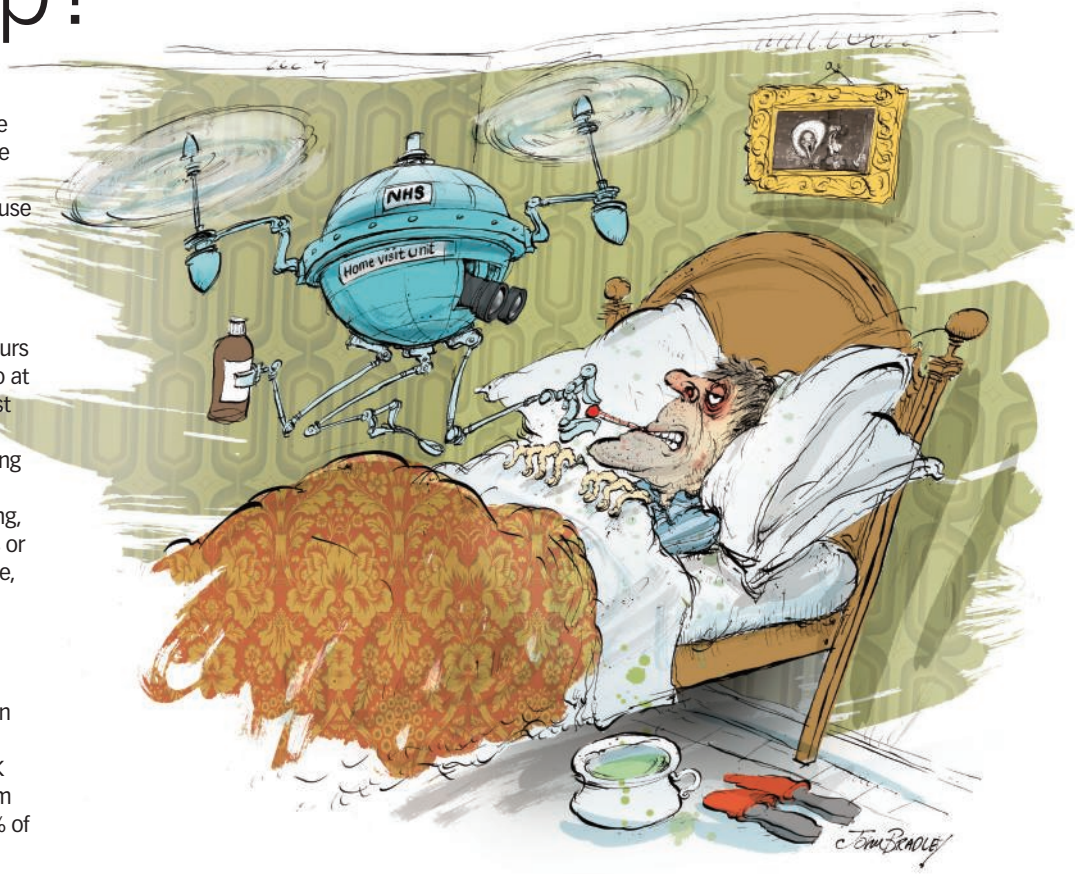
So while the conference sessions may provide the inspiration, it can be the EDS workshops that provide the information and 1500 delegates registered for their places in advance. In recognition of the value of these sessions, the Institute of Engineering Designers had CPD Certified these sessions, so delegates were issued with certificates in order that they can be be used for CPD assessment.

Most popular of the workshops was the presentation from Materialise titled: 'Break free from design limitations 3D printing'. While there were only 70 seats in the workshop theatres, they did at least have the advantage of being open on two sides to the exhibition, so creating extra capacity.

The other vital ingredient of course was the 200 or so exhibitors used up all of the 6000sqm of floorspace available at the Ricoh Arena. Judging by the badge scanning data, having the complementary electronics sister shows did provide a useful resource for design engineers looking for a greater understanding of electronics. Indeed electronics itself has so many specialisms that suppliers are used to 'filling in the gaps' where advice on a new subject is needed, and this added to the sense of this being a technical event for engineers, rather than simply a marketplace for suppliers.

Tranter concluded: "It really was a packed two days. We wanted to fire the imagination of design engineers and at the same time provide solid information that will help them on whatever projects they are working on right now. From all the feedback we have got, EDS has delivered that experience."

Home help?



The health service is at breaking point we are often told and, especially at this time of year as we enter the cold winter months, the most virulent of viruses could cause catastrophic melt down. Doctors, say the hospitals, must shoulder more of the burden. More patients should be treated at GP level rather than scurrying to A&E.

Doctors meanwhile have only so many hours in the day and their limited resources are also at breaking point. Patients, say the Doctors, must shoulder more of the burden.

So we end up with the health service seeing potential savings by having certain treatment and diagnosis, but most particularly monitoring, farmed out to the patient in their own homes or workplaces. Wearable electronics, for example, could play an important role as could cheap, portable and easy to use instruments.

Of the many potential ailments that could benefit from home monitoring, one is the ear infection. Ear infections are the most common reason for children to see a doctor. They account for six million consultations in the UK every year, with 90% of children suffering from an ear infection before the age of six and 50% of these recurring. Visits to the doctor are often inconvenient for parents, especially those who work, and cause children to miss school.

The Challenge

We are looking for a device that can be easily used by parents to provide the necessary information to Doctors to allow them to offer advice remotely. There needs to be a reliable quantity and quality of information if the Doctor is to be able give appropriate advice that both Doctor and patient (or patient's parents) are satisfied with. A low res and distant picture of a sore ear, for example, is not likely to give the Doctor much help.

The device needs to be medically safe to use so that any ailments are not worsened if it is used carelessly and it must be able to be reused. The doctor may advise continued vigilance or maybe able to offer a course of antibiotics – either way continued monitoring and communication of those results will be imperative, hence the need for reuse.

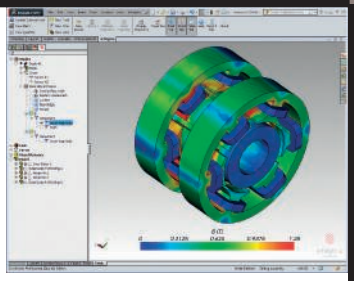
Even better would be if the device was not restricted to monitoring ear infections and could be used for domestic monitoring of all sorts of parameters in a sufficiently reliable way. Again the key is going to be providing information of the right quality. In our litigious society, if Doctors had any doubt they would ask all patients to come into the surgery as only good quality information will keep patients away and make this device have true value.

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 create the perfect slice of toast - can be found on page 12.

3D Electromagnetic Field Solver

Infolytica - MagNet for SolidWorks



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Sapa Profiles extrudes and supplies Load-Lok Manufacturing with high tensile aluminium, integral to the success of its most popular cargo restraint systems.

Thanks to this success, along with funding from the Welsh Assembly, Load-Lok is set to expand its Merthyr site. This will undoubtedly be a positive boost for the industry as well as the local economy. Since it was established in 1984, Load-Lok has been producing secure cargo fastenings for heavy-duty transports. By using Load-Lok's decking beams and making the most of potential load capacity, hauliers can greatly improve their transport efficiency.

The Wales Economic Growth Fund is supporting with £210,000 towards the £624,000 development. The funding will safeguard 12 jobs and create a further 10 for the site.

Sapa Profiles is a key supplier for Load-Lok and as a result the two companies have developed a strong working relationship, which allows continual improvement of the cargo restraint systems. Because Load-Lok is in such close contact with Sapa, Sapa design engineers understand the intricacies of the product and how aluminium can be used to improve the company's offering.

Load-Lok systems serve transport companies, trailer builders, distributors and retailers. One of Load-Lok's most popular products is the second-decking system which can be tailor-made for road, rail or aviation customers and enables the transport unit to reach maximum efficiency. By installing a strong and stable second deck, the second decking system ensures cost-efficiency by effectively doubling capacity. For example, the second decking system can be used in a closed lorry to easily improve flexibility and capacity. By utilising the system, the quality and safety of transportation is much improved, resulting in fewer interruptions and damages to goods in transit. The variations of the system can be applied to closed boxes, one side open or fully open curtain-sided vehicles.

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Joystick Controllers

Curtiss-Wright's Industrial division has launched the nVR2, a new addition consisting of a drive-only joystick module and 50A or 60A power modules

It is ideal for small- to mid-range drive-only powerchairs and is perfect for indoor use. Easy-to-access user controls also make it an ideal candidate for first-time wheelchair users and those with limited hand movement or children.

The power module motor and battery connectors are also recessed to reduce overall footprint, making it ideal for applications where space is at a premium. In addition, the range comprises multiple alternative modules and configurations, including actuator, dual-attendant and lighting controllers.

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