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ISSUE**

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EXPERTISE**

**2016 BEEAS  
WINNERS**

**GREEN MOTOR  
FOR VENICE**

**WOMEN IN  
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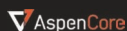
## TOP OF MIND...\*

#1 - SEMICONDUCTORS
#1 - INTERCONNECTS
#1 - PASSIVES
#1 - ELECTROMECHANICAL
#1 - AUTOMATION & CONTROL
#1 - POWER
#1 - TEST & MEASURE
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\*AspenCore's 11th Design Engineer and Supplier Interface Study gathered information from engineers regarding their need for product information and other services, as well as how and when they interface with suppliers and how they see the quality and value of that interface. 1,750 U.S. engineers participated in this year's web-based survey. The results represent those surveys completed by April 2016. Rankings reflect results among the industry's electronic component distributors.



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The return of Robot Wars to our screens this summer had completely re-engineered house robots – and to keep ahead of the pack they needed to be meaner than ever.

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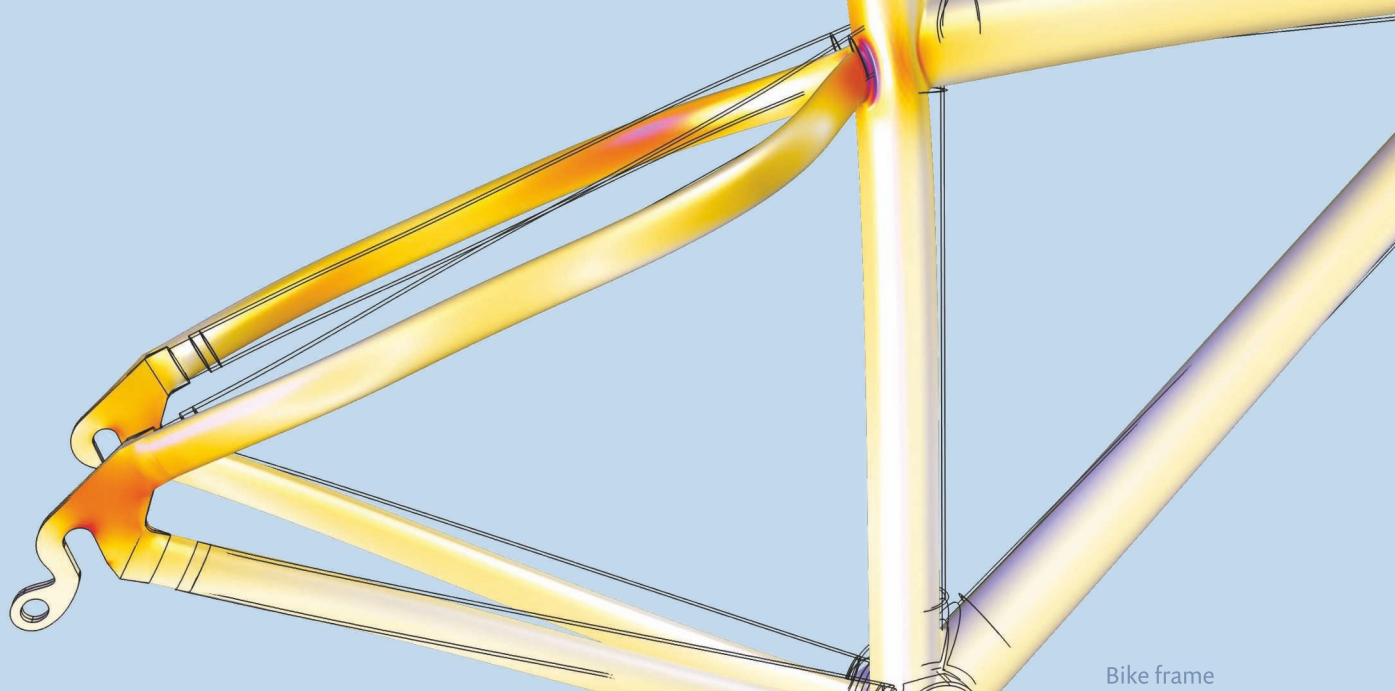
Measuring a fixed volume of water in a device that's no bigger than a golf ball meant engineering some tiny gears with a huge gear ratio.

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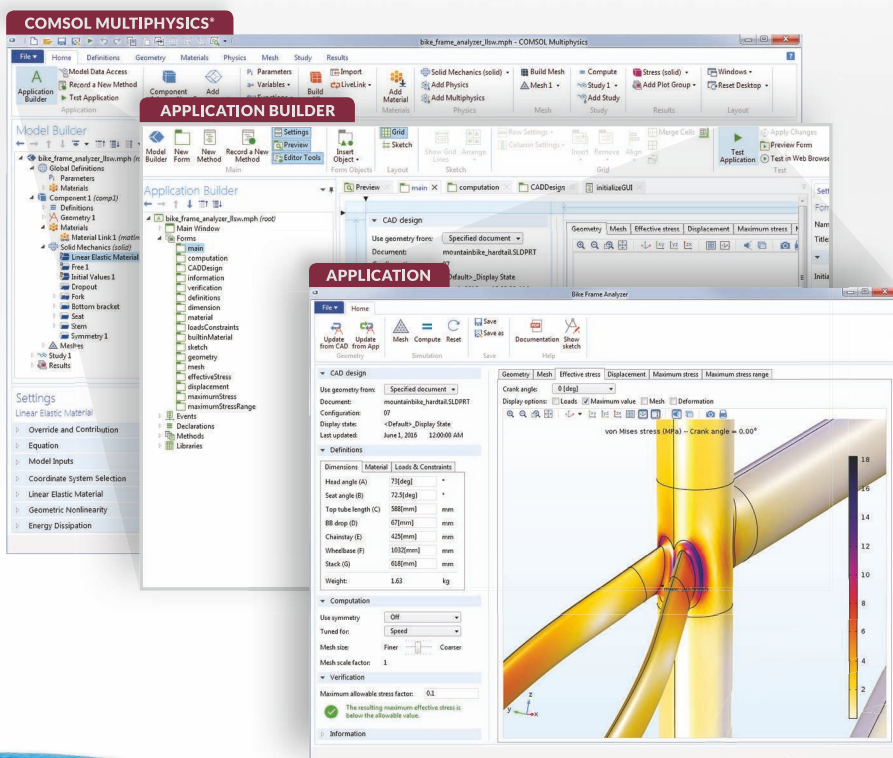
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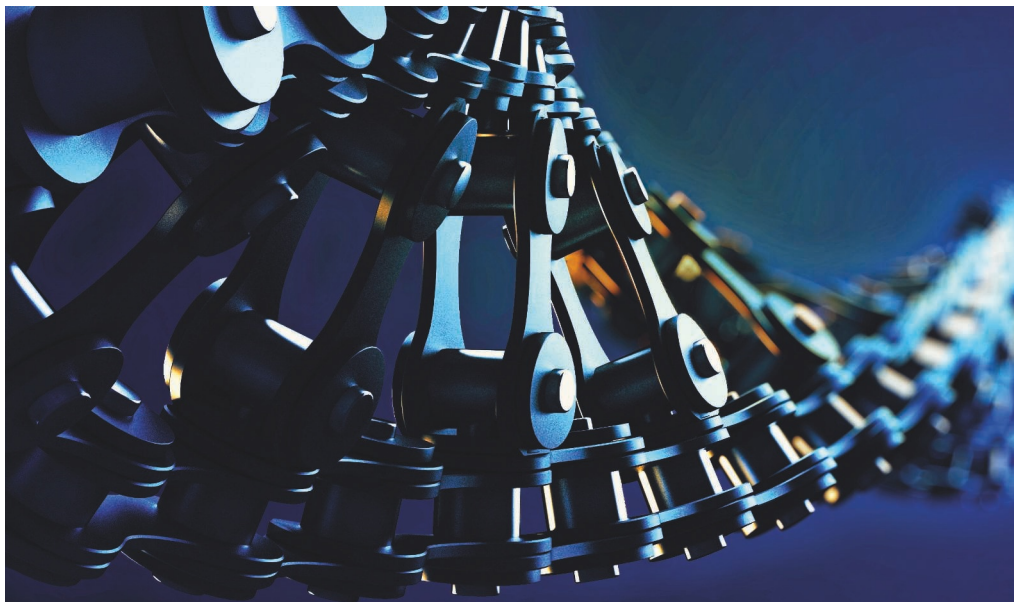
#### MOVING ON?

If you change jobs or your company moves to a new location, please contact circulation@markallengroup.com to continue receiving your free copy of Eureka!

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# WHEN CHEAPER BECAME BETTER



**AN INTERESTING OBSERVATION** from Roy Gandy in this month's interview (see p18) that the demanding requirements of the automotive industry could be behind general improvements in the capability of the supply chain. Unquestionably this is a factor, but I think the winds of change started blowing a good decade earlier, at the end of the last millennium.

Back in the 90s, I spent a good deal of time working in the electronics industry. It was a time when the UK was full of computer and large scale electronics manufacturing sites. Towards the end of the decade the Chinese option emerged and attracted the majority of the high volume work. Even some of the lower volumes moved East as 'made in China' seemed to add a certain kudos that appealed to certain corporate egos, as if 'made in China' provided a ticket into an exclusive club for international companies. The effect was that industry was decimated in the space of only a few years and those that were left were those who provided something different. The battle ground became not whether you could do something cheaper, it was whether you could do it better.

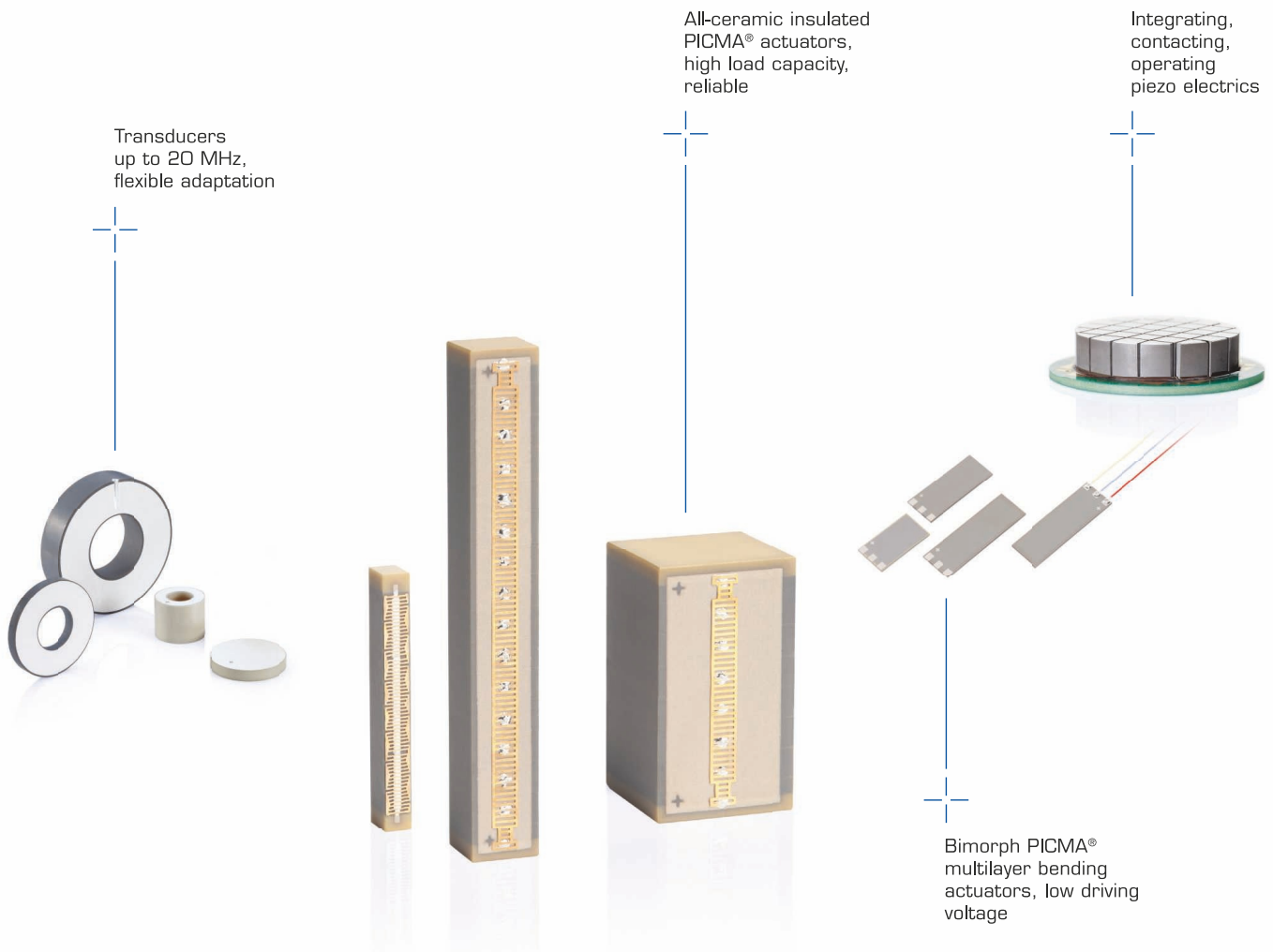
And this is where I think the broader engineering sector finds itself now. The 'can do' mentality was borne out of necessity. As engineering departments shrunk, dependency has been placed on suppliers to fill in the gaps – rather than an engineer being expected to be an expert in every kind of widget, now the widget expertise lies with the widget supplier. Expertise and the willingness to work with the customer's design team, are what differentiates between a good and an average supplier. And if suppliers are to survive they need to be able to provide engineering firms with those essential tools.

Our competent and compliant supply chain therefore is not a happy coincidence but the product of our times and, as we look forward to a post-Brexit Britain, this strong supply chain will prove invaluable.

**Tim Fryer, Editor**  
tim.fryer@markallengroup.com

## Piezo Technology from the Expert

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# NEW NATION IN SPACE

**BRITISH ENGINEERS WHO** were anticipating a thick slice of the global space industry are faced with competition from an unusual source – Asgardia, the first new ‘Space nation’.

Plans for Asgardia include a first satellite to be launched in autumn 2017. It will mark a new era in the Space Age as the satellite will be independent of any current nation state on Earth: the satellite will comprise the nation itself, creating its own legal framework, flag and other symbols of nationhood.

The project team is being led by Dr Igor Ashurbeyli, one of the Russian Federation’s most distinguished scientists and founder of the



Aerospace International Research Center (AIRC) in Vienna. He said: “The project’s concept comprises three parts – philosophical, legal and scientific/technological.

The scientific and technological component of the project can be explained in just three words – peace, access and protection.

“The scientific and technological envelope of Asgardia is a space arena for the scientific creativity of its

citizens and companies in developing a broad range of future space technologies, products and services for humanity on Earth and humanity in Space.”

One of the early developments planned by the Asgardia team will be the creation of a protective shield for all humankind from cosmic man-made and natural threats to life on earth such as space debris, coronal mass ejections and asteroid collisions.



## EVENTS

**07 - 11 NOVEMBER 2016**

**Tomorrow’s Engineers Week**

Nationwide

**29 NOVEMBER 2016**

**NIDays – Graphical System Design Conference**

QEII Conference Centre, London

**12 DECEMBER 2016**

**What next for British science?**

Central London

## All trains to self-sensor

**The University of Huddersfield Institute of Railway Research is working with Siemens to develop an inexpensive and easily-fitted sensor that could turn virtually every rail vehicle into a track monitor, detecting and transmitting vital information about the condition of rails and the rail bed throughout the network.**

Every train in the UK is fitted with a GSM-R cab radio system, meaning it’s possible to retrofit the Tracksure sensor card to the Siemens’ cab radios and, by picking up vibrations, transmit information about under-track voids.

These voids, in serious cases, can lead to an increased risk of rail breaks, along with poor vehicle ride performance.

### PRECISION ACOUSTICS HAS

collaborated with the National Physical Laboratory to improve the sensing and scanning used to detect the early signs of breast cancer. The work, based on ultrasonic technology, looked to overcome the problems of diagnosing breast cancer using conventional x-ray mammography and ultrasound scans.

The project called Phased Insensitive Ultrasound Computed Tomography has seen Precision Acoustics develop and manufacture a patented detection method that exploits pyrolytic sensor technology.

The detection method developed by the company converts the heat produced by the absorption of ultrasound

into voltage signals that are eventually combined to form an image of the acoustic properties of breast tissue. The new method of detecting ultrasound should produce images with fewer imaging artefacts.

Gary Livingstone, MD of Precision Acoustics commented further: “This new method of diagnosing breast cancer will be safer and lower cost than the screening techniques currently used and the results should be easier for clinicians to interpret.”

The work is supported by Innovate UK and other collaborators including Designworks and the University Hospital of Bristol.



### TECH BRIEF

## IoT developers kit available

**An IoT Learner Kit provides an end-to-end learning solution for makers, hardware and software developers and students looking to get started with IoT development and can be used in conjunction with IBM’s Coursera course: ‘A Developer’s Guide to Internet of Things (IoT)’.** It is available from Farnell element14 who developed the Kit in collaboration with IBM. The IoT learner kit has been built around the Raspberry Pi3 and Raspberry Pi sense hat. Using kit and course, developers will be able to learn the skills required for IoT development and bring innovative projects into commercial application.



View the video



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## Renishaw opens healthcare centre

**RENISHAW HAS OPENED** a new Healthcare Centre of Excellence at its Miskin site, located close to Cardiff. The Centre provides a facility for the manufacture of custom medical devices, as well as education and training for the life sciences community.

It contains a mock non-sterile operating theatre and facilities for education, training, workshops and lectures, plus a facility for the manufacture of class 3 custom medical devices produced on Renishaw's metal additive manufacturing machines.

The mock operating theatre suite, which is lead-lined to enable x-ray use, means surgeons can be trained to perform highly complex stereotactic neurosurgery procedures using the Renishaw range of neurological products.

Sir David McMurtry, Renishaw's chairman and chief executive, said: "When this site was formally opened in October 2012 I talked about our commitment to South Wales and the huge potential for the future. Four years on we have now invested over £40 million pounds at Miskin and The Healthcare Centre of Excellence is the latest example of that ongoing commitment."

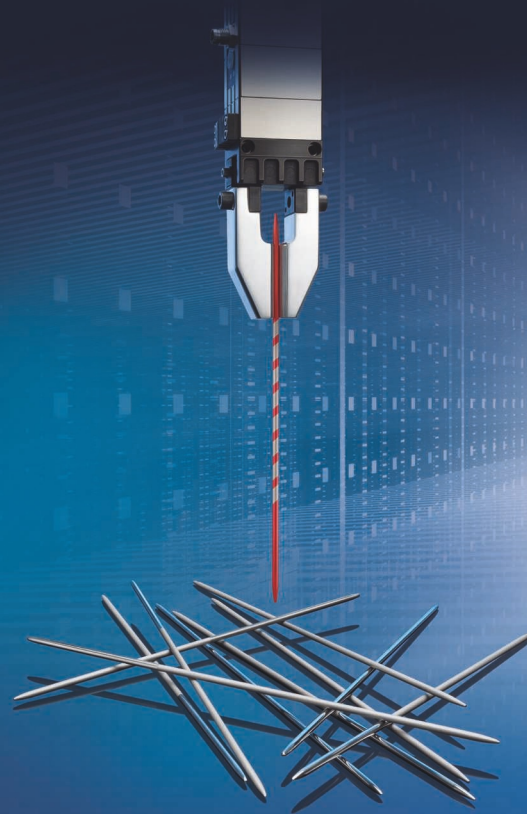
The close proximity of Renishaw's manufacturing operations to the Healthcare Centre of Excellence is seen as being beneficial for collaboration between engineers and healthcare professionals, as they work together on current and future healthcare challenges. A demonstration area within the Centre also showcases Renishaw's range of metrology and healthcare technologies.

## 'Zero-emission' coal plant

**Carbon Clean Solutions Limited (CCSL)** has launched a new project that will see more than 60,000 tonnes of CO<sub>2</sub> captured from a 10 megawatt coal-fired power station in India. Post-start up, the power station is set to become a 'zero-emission' plant.

The ground-breaking project, believed to be the first of its kind, is privately financed and will capture CO<sub>2</sub> at just \$30 per/tonne – much lower than the \$60-90 per tonne capture costs typically observed in the global power sector. The captured CO<sub>2</sub> will then be used by Indian firm, Tuticorin Alkali Chemicals & Fertilizers (TACFL), for soda ash production.

The announcement comes following the successful completion of CCSL's pilot testing programme at Technology Centre Mongstad, the world's largest and most advanced facility for testing and improving CO<sub>2</sub> capture. The pilot yielded results that showed the use of CCSL's solvent dramatically reduced emission levels and lowered corrosion, while improving system reliability.



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WE CREATE MOTION

# OPEN SOURCE HUMANOID

## AN AUTONOMOUS HUMANOID

robot has been developed in a joint project between academia and industry. The open platform robot was developed by The University of Bonn's Autonomous Intelligent Systems group with help from tribo-plastics specialist, igus.

The child-size robot was constructed using a number of 3D printed parts and is controlled by open source Robot Operating System software. The robot is capable of humanoid movement and interactive behaviour such as head movements and nods, handshakes, walking, balancing on one foot and standing from a laying position. Its variety of movement is largely thanks to the mechanical systems engineered and supplied by igus, which include its robolink D motor-driven slewing ring bearings in its articulated joints.

These self-lubricating and maintenance-free units are particularly suitable for robotic applications, where relatively slow-moving, but smooth movements of high loads are required.

The robot won the inaugural RoboCup Design Award at RoboCup 2015 in Hefei, China, before going on to win the Humanoid TeenSize Soccer category at RoboCup 2016 in Leipzig, Germany.



## New IET president

**Professor Jeremy Watson CBE**, who became the new president of the Institution of Engineering and Technology last month, has said he will use his year in office to showcase how different professional disciplines come together to create new opportunities and benefits for society – as well as to highlight the need for greater diversity and inclusivity in engineering.

## TECH BRIEF

### Carried away for Industry 4.0

**Festo has announced the Multi-Carrier-System (MCS), its Industry 4.0-ready linear motor track system, jointly developed with Siemens. MCS is an adaptable, modular transport solution for manufacturing and production, combining linear motors and mechanical guidance technology from Festo with Siemens' controls expertise.**

**Incorporating decentralised sensors and intelligence, MCS addresses Industry 4.0 applications. Its flexible electromechanical design enables adaptable, reconfigurable and economic production, even for mixed requirements and small batch sizes, while its OPC-UA interface enables integration into Industry 4.0 host environments.**

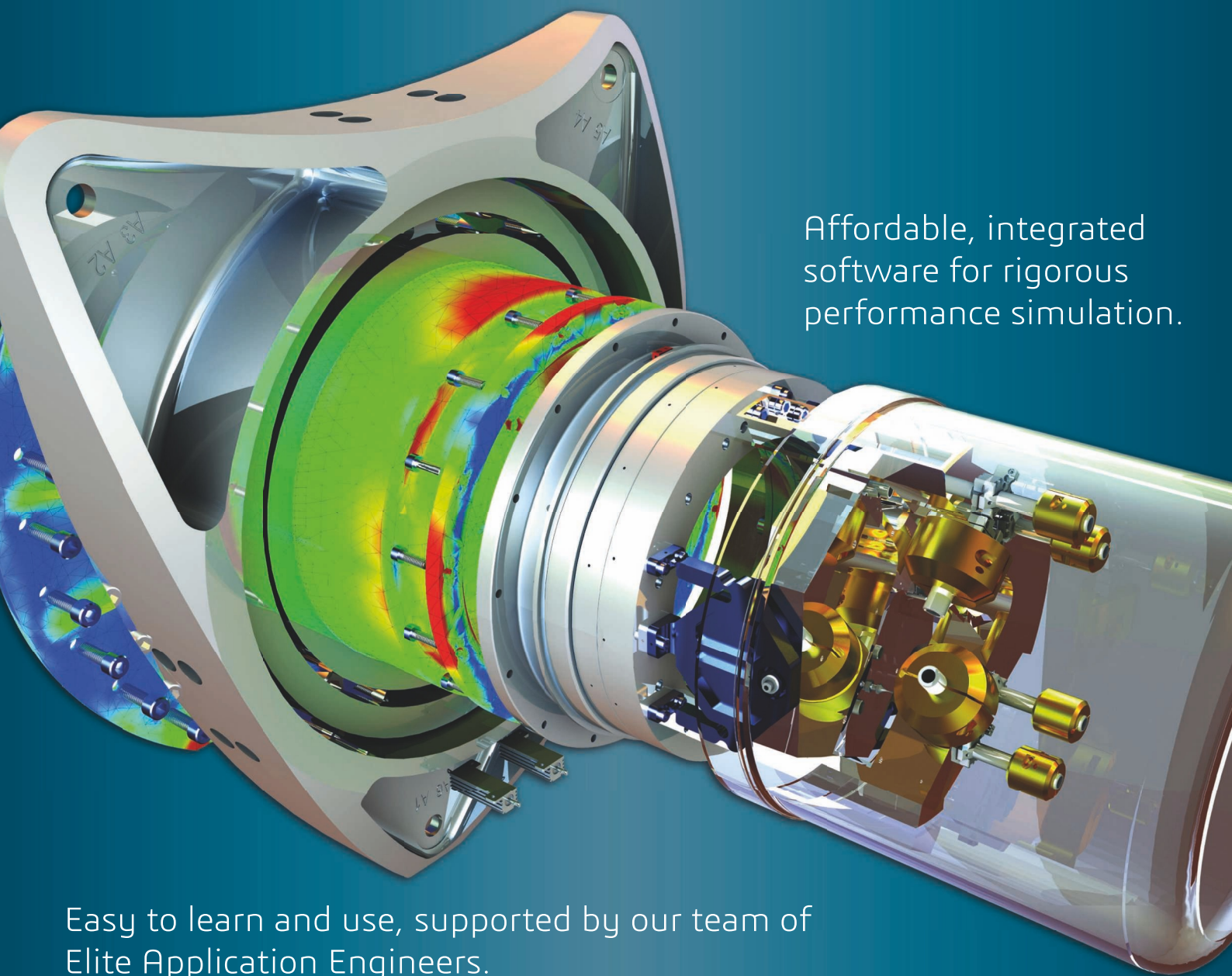


## 10k get 3D experience

**Dassault Systèmes has announced that its 3DEXPERIENCE platform has now reached its 10,000th production user at Groupe Renault for seamless, collaborative product development across all brands globally, including Renault, Dacia and Renault Samsung Motors.**



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## SOLUTION TO LAST MONTH'S

# Coffee Time Challenge

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Last month we asked you to come up with a device that could tell you how much electricity every appliance in a building was using. A number of readers said solutions to this problem are already out there, but our solution, admittedly still in the development phase, has been proposed by the inestimable MIT in Boston.

The MIT system involves placing postage stamp sized sensors over the incoming power line, requiring no special installation or wiring. With a very fast sampling rate, sensors can pick up enough detailed information about spikes and patterns in the voltage and current

that the system can, thanks to dedicated software, tell the difference between every different kind of light, motor, and other device in the home and show exactly which ones go on and off, at what times.

The system is designed so that all of the detailed information stays inside the user's own home, eliminating concerns about privacy.

The detailed analysis, including the potential for specialised analysis based on an individual user's specific needs or interests, can be provided by customised apps that can be developed using the MIT team's system.



## PRODUCTS

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

**146022**

Reamer offers modular flexibility

**146055**

Duraflow powered air respirator

**146057**

Ex-position switch for sub-zero applications

**146112**

Modular CSW command and signalling devices

**145107**

Digitally compensated pressure transmitter

**145162**

Data acquisition and test stand automation

**145243**

Heavy duty LVIT inductive linear position sensor

**145400**

Safety for compact stepper motors

**146017**

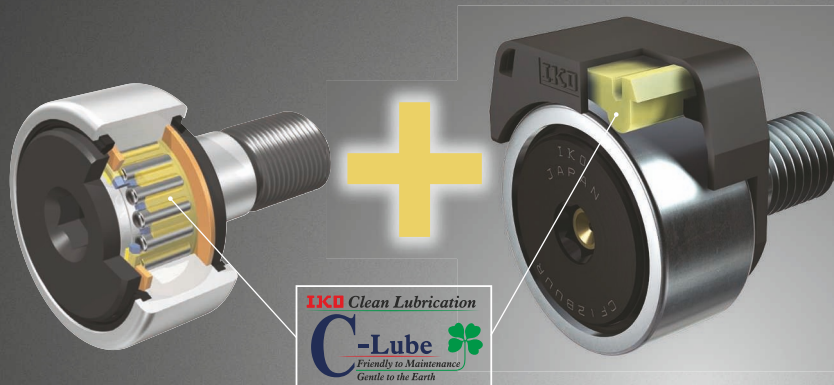
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# BUILT FOR BATTLE

**With completely re-engineered house robots, Robot Wars returned to our screens with a bang this summer. Justin Cunningham finds out how the technology has moved on, and why the arena's infamous bouncers were made meaner than ever.**



**T**hree. Two. One. Activate. As those immortal words rang out once again from our screens over the summer, it marked the fact that Robot Wars is at last back on our screens, with a host of competitors, new and old, willing to do battle. As the whirl of motors echoed around the arena, it didn't disappoint, with plenty of metal-on-metal clanging, banging, scraping and screeching, each escalating the roar of the enthusiastic crowd.

Contraptions came in all shapes, but mostly larger sizes, and were armed with all kinds of weapons.

The engineering behind the robots was a marked improvement since the show last aired in 2004. The quirky cult competition draws entrants from grassroots enthusiasts to professional engineers. There were few weaker robots this time around and all suffered considerable damage. Competition for the top spot was tighter than ever.

Besides the intrigue of just what the competitors will come up with

*Above: From right to left, Dead Metal, Sir Killalot, Matilda, Shunt.*

*Below right: The circular saw of Dead Metal.*

*Below far right: All of the house robots have been re-engineered.*

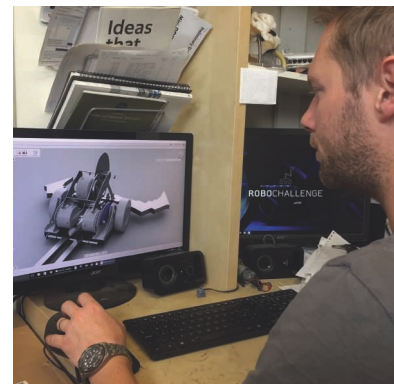
to do battle, are the other stars of the show, the antagonistic house robots. Bigger, meaner, heavier and incredibly well engineered, the house robots act as obstacles in the fight arena that must be able to engage any of the competitors and comfortably come out on top.

To make sure that the house robots were up to the new and improved class of 2016, the BBC got in touch with a Birmingham based technology specialist with a history of building all kinds of weird and

wonderful contraptions for television.

James Cooper, creative technologist at Robo Challenge, explained the design objectives: "We knew the house robots couldn't just start where they left off. We looked at the original house robots and knew they weren't anywhere near to being up to the job. The new competitors would destroy them. So, the brief was, 'make the original ones look like toys'."

Technology has moved on considerably since 2004, meaning







that while the new house robots might resemble the old ones, not a single bolt was re-used from the originals. Cue military grade armour, a 2.5 tonne-force hydraulic pincer, a liquid CO<sub>2</sub> high pressure pneumatic flipper to throw the 110kg competitors over the 5ft plus arena walls, and more.

## MOVING FORWARD

One of the biggest changes has been brought about by developments in battery technology, driven largely by the increasing electrification of the automotive industry. While competitors of old used to commonly opt for a car battery, modern lithium polymer batteries are lighter and offer significantly more power. That then has knock-on benefits when combined with more efficient motors and improved control systems. It means overall system efficiency is up, making for faster and more powerful combat on the arena floor.

Other improvements come in the shape of pneumatics, hydraulics and linear actuators – all put to use by

Robo Challenge depending on the application.

“Sir Killalot’s pincer arm is hydraulics,” said Cooper. “It’s a relatively slow but very high power pressure mechanism, which is nice and controlled. He has got about 2.5 tonnes of crush in his left arm and can lift 300kg.

“Matilda on the other hand uses a liquid CO<sub>2</sub> mechanism, so here high pressure pneumatics gives us an extremely high speed weapon. We have enough power to throw competitors out of the arena. And then we might use linear actuators to adjust ground clearance. So we assess what technology works best depending on the function.”

While technology progress certainly made the potential for improvement look good on paper, the big obstacle for Robo Challenge was the time frame to complete the redesign and build the four house robots: Sir Killalot, Matilda, Shunt and Dead Metal.

“It was an incredibly tight schedule,” said Cooper. “They only

## THE HOUSE ROBOTS

### SIR KILLALOT

Sir Killalot is Robot Wars royalty, first appearing in Series 2. With a weapon that weighs more than any of the competitors it can only mean trouble for anyone who enters the Corner Patrol Zones. If competitors enter this area or get pushed into it, then they face attack from the house robots. Sir Killalot’s only weakness is his slow speed, but if he does get a hold of competitors, expect them to be quickly damaged beyond repair.

---

WEIGHT || 741kg

---

PINCER FORCE || 22250N

---

SPEED || 10mph

---

### MATILDA

Perhaps the most famous house robot of all, Matilda has been around from the very beginning. Her organic features give her a dinosaur-like appearance, and over the years she has taken on a feisty persona. In her previous incarnation, she was virtually destroyed by competitors, but has since been redesigned with tougher armour, a 55 bar pneumatic flipper, and a rearward spinning circular saw made of Hardox steel.

---

WEIGHT || 350kg

---

CIRCULAR SAW || 1500rpm

---

SPEED || 14mph

---

### DEAD METAL

Also around from Series 1, Dead Metal uses an exterior metal framework for protection, with armour much closer to its internal structure. It is particularly dangerous to competitors as it clings on to them and then lowers its magnesium circular saw down to inflict damage. Due to its weight advantage, once you are in Dead Metal’s grips, it can be difficult to escape.

---

WEIGHT || 343kg

---

PINCER FORCE || 2950N

---

SAW SPEED || 4000rpm

---

### SHUNT

As the name suggests, Shunt uses more of a brute force approach. It’s weight advantage over competitors means it can comfortably push competitors around while inflicting damage from its titanium tipped axe.

---

WEIGHT || 327kg

---

AXE SPEED || 250ms

---

SPEED || 11mph

---





## ABOUT ROBO CHALLENGE

The company is a family business that started in 2007 to bring ideas to life for television shows or PR stunts. James Cooper, creative technologist at the company was a fan of the original Robot Wars, so to recreate, and improve the house robots, was a dream project to work on.

"We are a very hands-on small team that have got a really nice workshop here in Birmingham," he said. "Every couple of weeks we are working on something new."

"My brother and I were completely inspired by the original series of Robot Wars. We started with remote control cars and strapped bits and bobs on the front to do battle with our friends when we were at school."

"The BBC needed a partner that knew what they were doing, could produce what they needed, and our background in helping TV shows and inspiration from the original series, made this a perfect thing to come together so we jumped at the opportunity."

*Above: The Robo Challenge team standing in the arena.*

*Below right: New hosts Dara Ó Briain and Angela Scanlon.*

*Below far right: Robo Challenge creative technologist, James Cooper, completes final checks of Dead Metal.*

gave us 3.5 months from the green light to build them before filming started."

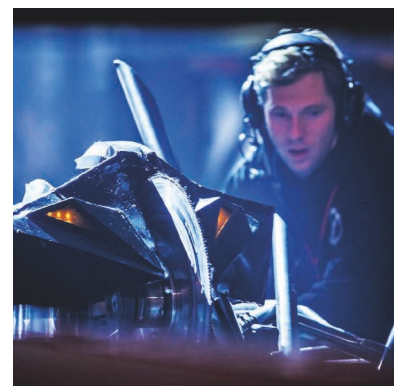
To overcome this fierce time pressure, the team used a number of other technology improvements, namely 3D CAD for the design and 3D printing to produce parts and moulds. The team worked with Autodesk, applying its Fusion 360 software to allow the design of the organic shapes and structures to give the robots facial features and personality, while at the same time strength, rigidity and often functionality.

Paul Sohi, a product designer at Autodesk worked with Robo

Challenge on the project. He said: "They gave me a call and said they'd won the project and wanted to use Fusion 360 to build the house robots. Robot Wars being what it is, I leapt at it!"

Fusion 360 allows designers to stipulate conditions, for example, what the loads are going to be, the material and then the connections. The software is then able to come up with the optimised outcome. It's very much along the lines of topology optimisation, and creates the organic structures that are increasingly being produced by 3D printers.

"I trained them in some of the





more advanced tools in Fusion 360," said Sohi. "For example, Sir Killalot's face and head are quite organic, so we use that as a training exercise."

"The benefit of doing it on the computer first is that you can also simulate everything. For a robot with so many moving parts, it's essential to make sure it all works. So when the weapon is operating, is there interference anywhere? Can the robot handle the power of its own weapon, so will the 600psi hammer that's coming down make the robot fall apart?"

Fusion has finite element analysis built in to it, enabling the team to do a variety of static stress, model stress and thermal stress analysis. In conjunction with a fair bit of 3D printing, it also allowed the design to evolve quickly, but with a great deal of confidence.

"We were able to 3D print the designs to show the BBC, to make sure they were happy and get our designs signed off very quickly," said Cooper. "It meant we were able to quickly crack on with building them and do all the necessary stress analysis."

"If you imagine what the old BBC team would have done, they'd model them in clay first and then get those signed off. That would take such a long time, time we didn't have."

An example is the design of Matilda's horns, which needed to look like they'd been grown rather than CNC turned or milled. So, the team designed the organic parts in CAD and then 3D printed the moulds.

"That is a very quick process," said Cooper. "I could design all of Matilda's horns in a couple of hours and have them on the 3D printer to have physical copies to show the BBC the following day. It is nice to set things on the printer and come back in the morning and it's made for you. It is quite a strange feeling when you first do that as we are very hands on engineers."

## NO CONSTRAINTS

Unlike the competitors, Robo Challenge had little constraint. It meant that the likes of Sir Killalot could utilise military grade specialist steel armour in the form of ultra-tough, ultra-hard, Armox, designed for high wear and extreme

impacts. However, this didn't come without a weight penalty, meaning the house robots weigh close to double that of the originals. That's no bad thing, however. Although almost every other moving vehicle is looking to shed weight, combat robots now have flippers that can comfortably lift 300kg or more. That extra weight helps keep the house robots grounded.


"They've all needed to be scaled and beefed up," said Cooper. "We need these specific grades of metals to secure the vitals on the house robots and make sure they are well protected."

"If you think of the old Sir Killalot, that weighs as much as the drive system of the new one. The new ones are all so much bigger and stronger than the originals."

The need to 'beef up' the robots was essential given that competitor robots are tremendously powerful and dangerous. So if, for example, a robot is damaged and becomes uncontrollable but still 'active', it would be far too dangerous to send a human in to the arena. It means, Sir Killalot needs to be able to take care of business without worrying about incurring damage itself.

"We can stop even the most powerful competitor," said Cooper. "Sir Killalot's left arm weighs more than any of the competitors, so he is monstrous compared to them and can lift them 6ft in the air, no problem."

"We can take on the meanest robots, not just what we have seen in Series 1, but going forward the competitors are going to step-up again."

Robo Challenge is sure it will be able to keep ahead of the competition for at least five years and will continue to be a match for any competitor. But the house robots will need to evolve to make them even more powerful, though Cooper remained tight lipped about exactly how. 

## WHAT HAPPENED TO THE OLD ONES?

The original house robots were made by the now defunct BBC Visual Effects Department. When the series went into hiatus, the robots were then put in to storage, reportedly temporarily lost, refund, and according to most reports, currently remain in storage.


















## FANCY YOUR CHANCES?

If you fancy your chances and have a design in mind, why not enter?

"In general, robotics has become so much more affordable than when it first aired," said Autodesk product designer, Paul Sohi. "It means the entry point is much more accessible. Parts are cheaper and the way to build has become much easier. There is a wealth of free knowledge out there."

One thing is for sure, there is no clear weapon of choice in the modern wars. While flippers were favoured early on, a variety of spinning, hammering and clamping weapons have all been used with great effect.

A full list of rules is available at [www.robotwars.tv](http://www.robotwars.tv) but here are some of the biggest constraints.

-  The maximum weight limit allowed is 110kg. However, for 'legged robots' known as walkers, there is an extra 25kg allowance.
-  Robots must be no longer than 2m, wider than 1.5m or higher than 1.2m.
-  Robots are not permitted to use exposed rotating aerofoil, rocket or jet propulsion methods.
-  Robots can have autonomous functions.
-  Voltage must not exceed 75V for direct current or 50V for alternating current.
-  Internal Combustion Engines can be used (but not turbines) but have a fuel capacity limit of 500ml (bouts last 3 minutes).
-  Pneumatic systems must use CO<sub>2</sub> or Air.
-  The maximum pressure at any point within a pneumatics system must not exceed 1000psi.
-  Hydraulic system pressure (In the actuator or cylinder) must be limited to 10,000psi by way of a maximum pressure relief valve.
-  Full body spinning robots with an eccentric mass, are excluded from this section unless they spin over 500rpm.
-  Weapons designed to cause invisible damage to the other robot are not allowed such as using electricity weapons like Tesla coils, Van-der-Graaf generators, stun guns, or cattle prods.
-  Radio Frequency jamming equipment or similar devices are not allowed.
-  Entanglement devices such as nets, fishing line, cables, string, glues or tapes and any similar devices are not allowed.
-  Commercially manufactured, hardened steel blades that may shatter are not allowed.
-  Projectiles must have a tether, no longer than 2.5m, capable of stopping the projectile at full speed.
-  Heat, fire, explosives and smoke are forbidden as weapons.
-  Interchangeable weapons are permitted – commonly used are different axes and saw blades.

# UK GETS IN THE GROOVE

**For Rega, the pursuit of perfection has revealed an interesting trend in its supply chain – it has become very, very good.**

**Founder Roy Gandy revealed all to Tim Fryer.**

Some people are hard to please and Roy Gandy admits to being one of those. His company, Rega, was formed over 50 years ago with the intention of providing music lovers with turntables that could do justice to the music played on them.

The interim years have seen major changes in the way music has been recorded and delivered to customers. However, the analogue world is making a comeback as some believe the sounds generated in the digital sphere is flat and fail to capture the fuller sound of the original recording.

Rega made its name producing high-end turntables and it is no surprise, therefore, that the resurgence in vinyl has resulted in huge growth at the company – music lovers who differentiate between an MP3 download and an original analogue recording are those who are more likely to invest in good quality audio equipment. And consequently Rega has tripled turnover in the last five years.

One issue with this is that the supply chain needs to remain supportive and committed and that's not a given when you are only producing 100 of your premium product a month. The more affordable range does account for another 4-5000 units a month, but it is still not the sort of numbers to excite the average component supplier – especially given Gandy's demands.

"All of our requirements are impossible," claimed Gandy. "We

need zero vibration from a motor, zero movement from a bearing, a plinth needs to have zero mass but with infinite stiffness. A bearing needs to have no friction and no vertical movement but be able to run freely. They are all impossible but the closer you get to those requirements the more likely you are to achieve your requirements for a turntable."

The relationship with suppliers would quite often be on a knife edge, according to Gandy. "They used to be really difficult to work with and deal with – tortured souls that we used to have to force to produce things. We haven't got anyone like that now but we used to have at least 10 for the first 30 years of our business."

The astonishing thing for Gandy, is that this has completely changed. "Now we've got wonderful, wonderful companies who are just always pushing the edge and are using us in a way that we just feel some sort of humility and gratitude for. It's not about us or our investment, it's just an interesting point about the UK.

"For me, that's just an amazing part of England now, we've got what England never had before, which was this manufacturing innovation. We had innovative ideas and then once they got out into the world, they disappeared. But now we have lots and lots of big and small companies that are interested.

"It has allowed us to make things

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Amy Winehouse
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Radiohead
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Fleetwood Mac
- 05 **GUARDIANS OF THE GALAXY - AWESOME MIX 1**  
Original Soundtrack
- 06 **LEGEND**  
Bob Marley & The Wailers
- 07 **THE STONE ROSES**  
Stone Roses
- 08 **PURPLE RAIN - OST**  
Prince & The Revolution
- 09 **25**  
Adele
- 10 **EVERYTHING YOU'VE COME TO EXPECT**  
Last Shadow Puppets

\*Data from Official UK Chart Company





## ROY GANDY

An ex-automotive engineer and lifelong music fan, Roy Gandy started out repairing, improving and building hi-fi equipment – particularly turntables – for himself and friends in his evenings. In 1975, he took voluntary redundancy from his full-time job as a technical editor at Ford and used the money to open the first Rega factory. The first product designed and produced there, the Planar 3, quickly established itself as one of the UK's finest budget turntables. Now with more than 90 employees, Rega assembles over 40 different products – primarily high quality turntables, cartridges and tonearms, but also loudspeakers, amplifiers and other hi-fi devices and peripherals – at its purpose-built 30,000 square foot manufacturing and warehouse facility in Essex.

we could have never made – things that were dreams. We knew what we wanted to do but we never even thought of trying because it seemed impossible.”

Gandy gave the example of Glass Products, a father and son operation who produce the glass platters for the premium turntables (others in the range use the phenolic resin platters that are an order of magnitude cheaper). But investment by Rega into equipment paid dividends.

“We used a modern CNC router pushed way beyond its intended capability, with jigs that the guy has made himself out of glass on the machine,” said Gandy. “He can make 12 [platters] in one go. We showed him how to make one and he took the idea on, and on, and on.

“Now they’ve got other people

knocking on their door – people from the MoD, companies making scientific glass. It’s amazing.”

So where has this ‘can do’ culture come from or is it just that Rega has stumbled on good suppliers?

Gandy claimed: “It’s nationwide because it’s not just one or two we’ve seen, it’s dozens, it’s hundreds. We think it’s probably because of the investment of the car industry in the UK. The EU says it gives Britain opportunities, but we’ve got Nissan, Honda, Toyota and Tata, all of which are non-EU investors. The UK has created this major industry. Although some of our contractors work with these major industries, most of them don’t. But the culture has been developed, in engineering terms, and that is what has really grown.”

This foundation of expertise is vital for companies like Rega who need suppliers’ expertise for the development of new products. It

demonstrates why manufacturing to the Far East now has limitations.

“The best quality ever in cabinets came from a Chinese company,” said Gandy, explaining why the majority of Rega’s suppliers are in the UK. “So I don’t know if quality is necessarily a problem. The biggest problem with working with China is the distance. To do anything excellent, you need to be there, have a partner who understands and you can discuss with.

“Asian thinking is you do the drawings and they make it. In the West we have this culture, we knock up a prototype, work on it for a few years then try to make it happen and that never existed out in Asia, although it’s starting to happen now.” **1**

One area that Rega explored was how to improve performance of the bearings on the arm. The story of how it worked with supplier igus to come up with a solution will be covered in a future issue of *Eureka!*



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bEEAS

# LIGHTPATH TO CANCER TREATMENT

**The rolling British Engineering Excellence Awards programme came to a climax in early October when the winners were announced at a gala luncheon in London. Tim Fryer and Graham Pitcher report.**

If ever there was doubt about the quality of innovation within the British engineering design sector it would have been quashed at the BEEAs. The 44 people, projects and teams that were shortlisted provided ample evidence of world-leading engineering and engineers within our ranks.

Even within the winners of the nine categories there was considerable diversity in terms of north and south, large and small, and a host of different industry sectors. If the BEEAs had been a banquet there would have been a distinctive flavour to each of the nine courses.

From the nine category winners the Judges selected the Grand Prix, the best of the best, and this year the Grand Prix winner demonstrated how important good engineering can be – potentially saving lives around the world through more effective cancer treatments.

Lightpoint Medical had already picked up the New Electronic Product of the Year Award for the Lightpath Imaging System on its way to winning the Grand Prix. Mike Irvine is VP Technology Alliances for the company and, after receiving the Award, he said: "It is a privilege to work in an organisation that is focussed on making a profound improvement to the care of cancer patients around the world. During the company's four-year history we have benefited from significant funding from various grant authorities who have recognised the impact that intraoperative imaging technologies will have on cancer



*Grand Prix winner Mike Irvine of Lightpoint Medical flanked by all of the 2016 BEEAs winners.*

patients, healthcare services and healthcare payers.

"It is a real boost to all at Lightpoint Medical and our engineering partners to have similar recognition from fellow scientists and engineers via the British Engineering Excellence Award."

Despite the improvement in techniques, cancer surgery carries with it some significant risks; one of which is the failure of the surgeon to remove all the cancerous tissue. So what better winner of the BEEAs Grand Prix than a system which holds in prospect a reduction in follow up operations, reduced healthcare costs and, most importantly, better peace of mind for the patient?

The Lightpath Imaging System integrates imaging technology into a mobile device that can be used in busy operating theatres. It provides surgeons with an effective tool that can be used during surgery and which promises to reduce the repeat operation rate.

Founded in 2012, Lightpoint has moved from initial concept to regulatory approval of the Lightpath Imaging System, which received a CE Mark in October 2015.

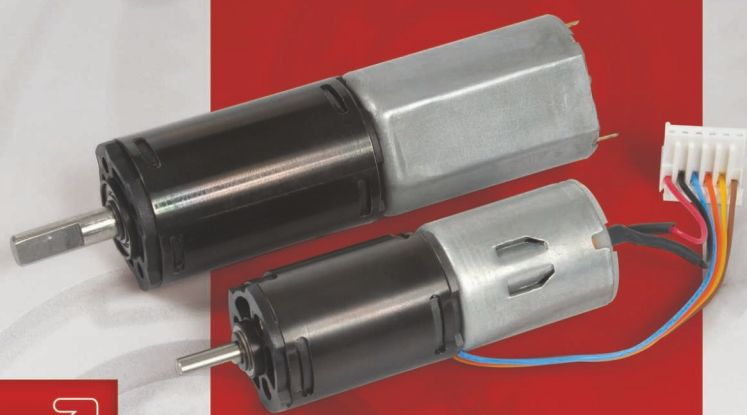
Designed, developed, verified and made in the UK, the Lightpath Imaging System lets the surgeon examine the tumour that has just been removed. If cancer is located at or near the surface, the surgeon may remove tissue adjacent to such locations for subsequent imaging to ensure the disease is cleared before the patient's surgery is completed.

Initial feasibility clinical studies undertaken in key UK hospitals have provided sufficient evidence and confidence in the technology for major grants to be awarded.

The Judges said: "Lightpath revolutionises cancer surgery, reduces the need for follow on surgery and brings peace of mind to patients. It is poised to make a big difference in people's lives."



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## CONSULTANCY OF THE YEAR

### WILLIAMS ADVANCED ENGINEERING

Although Williams has participated in a range of projects outside of Formula One since the 1980s, its diversification started in 2008 with the hybridisation of Formula One. As the only team in F1 to develop a hybrid system entirely in house, it realised the commercial potential and created Williams Hybrid Power.

The company has grown exponentially and now represents 17% of Williams Group revenues. Opening a new facility in 2014, the company has handled 40 projects and plans to expand to 200 employees by the end of 2016.

Williams was named as the sole supplier of batteries for Formula E, designing a battery that can propel a car at 225km/h, while remaining practical in terms of aerodynamics, range, recharging times and safety. Having built 40 batteries and a number of spares, the batteries have now completed two full seasons, with 760 race starts. So far, there have only been two battery failures during a race.

The Judges said: "Taking on the challenge of designing and making batteries for Formula E, which worked reliably was an impressive performance. It was hard to ignore the engineering excellence involved."



## DESIGN ENGINEER OF THE YEAR

### ALEXANDER MCDIARMID, PARKER BESTOBELL

Alex McDiarmid is a passionate, enthusiastic and innovative design engineer who has proved to be an outstanding member of Parker Bestobell's R&D and project design teams.

In the two years since joining the cryogenic valve manufacturer,



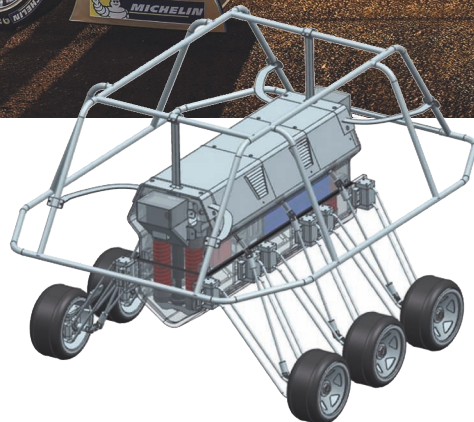
he has designed a number of innovative products which have helped to secure major new contracts in the marine industry. Thinking 'outside the box' and applying himself diligently, he has challenged accepted wisdom and demonstrated true ingenuity when it comes to problem solving.

One such challenge was to design a complete range of valves suitable for high pressure marine fuel applications – these needed to withstand temperatures of -196°C and pressures of 625bar. The result is said by Parker Bestobell to be beyond anything it has previously manufactured.

Alex has pioneered the use of standard calculations within the business to assist the design process, as well as introducing Best Practice Modelling.

He has taken part in a number of engineering projects with schools and the local community, including Get up to Speed with Engineering and Manufacturing – a showcase event dedicated to raising the profile of Engineering and Manufacturing which is visited by more than 2000 students from the Sheffield region.

The Judges said: "A driven young engineer who has moved his company's products forward. Alex is enthusiastic in his encouragement of the next generation of engineers."



**BAE SYSTEMS**  
INSPIRED WORK

## MATERIALS APPLICATION OF THE YEAR

### BAE SYSTEMS

In designing the Highly Robust Ground Platform (HRGP) – an unmanned ground vehicle capable of surviving a mine blast – BAE Systems turned to nature for inspiration.

Apparently, some insects resist predators because they have extremely hard bodies but flexible, lightweight legs. The HRGP has used this concept, with a protected hull and wheels on flexible legs. The key issue was to identify a material that could withstand a significant explosion and return to its original shape. Based on the super elastic properties of Shape Memory Alloys (SMA), these were selected for the final design.

Use of materials with high strain rates, such as SMAs, were seen to give a substantial advantage in withstanding significant blast levels.

The Judges said: "A novel application of materials in a challenging environment."



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**JCB****NEW PRODUCT OF THE YEAR (MECHANICAL)****HYDRADIG BY JCB**

Hydradig brings new levels of innovation and engineering to the market, looking to address a growing need for a compact wheeled machine that offers stability, mobility, manoeuvrability and visibility.

The team took the design back to first principles, in particular moving the engine, tanks and ancillaries from the upper structure to the lower structure – something previously not thought possible. This reduced the centre of gravity, improved stability and mobility and ensured there was a 'cone of visibility' – the operator can see all four wheels plus a 1m perimeter around the machine.

Even in confined urban sites, the choice of four wheel steer, two wheel steer and crab steer makes operating easy, allowing the machine to work in tighter confines than ever before. A tight turning circle makes the JCB Hydradig suited to urban sites.

Just 60 days after announcing the Hydradig's price, JCB achieved the full year sales target.

The Judges said: "A great assessment of market need, with a novel top down design targeted at a traditional industry. JCB has exceeded its yearly sales target, with every other target nailed."

**FORTH<sup>TM</sup>****SMALL COMPANY OF THE YEAR**  
**FORTH ENGINEERING**

Starting from the simple idea of manufacturing and supplying hoses to customer specifications, Forth Engineering has developed into a company providing specialist hydraulics and pneumatics services, both as a manufacturer and as an independent distributor.

Forth has developed a range of design capabilities, including mechanical, electrical, electronics and CE&I design services. Designs range from components and sub-assemblies to rigs, instruments and systems.

Forth is currently supplying ROVs, high definition cameras and bespoke tooling to the nuclear decommissioning industry and is diversifying into other areas, including designing and supplying equipment for decommissioning in the oil and gas and renewables sectors.

Also under development are a grapple crawler for wind turbine inspection, cleaning and repair; and an ROV platform inspired by a mechatronic spider.

The Judges said: "Building on earlier success, Forth has expanded its business by moving from traditional products to the supply and development of novel technology."

**BEEAS | 2016 WINNERS****ultrahaptics****START UP OF THE YEAR**  
**ULTRAHAPTICS**

One problem with touchless technology is the lack of feedback. Looking to solve this problem and to take advantage of a potentially massive market, Ultrahaptics has developed 'disruptive' haptic technology.

Ultrahaptics' technology uses ultrasound to enable 'feeling without touching'. Using a small array of ultrasound speakers, it can create the feeling of virtual objects, switches and dials which float in mid air, or track the user's fingertips to create a system that supports free space gesture recognition and control.

The Judges said: "Ultrahaptics has the potential to be a game changer in a number of markets. It has a sound business plan, significant backing, plus sales and orders in hand."





## DESIGN TEAM OF THE YEAR

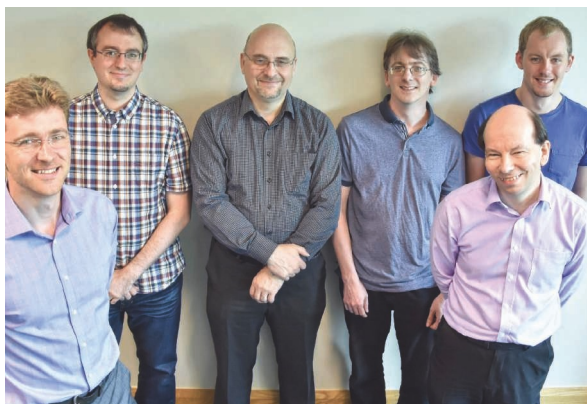
### BYTESNAP DESIGN

Cocoon, a technology company looking to transform the home security market, enlisted ByteSnap Design to provide electronics and software design expertise for its latest product. According to ByteSnap, the design presented particular challenges: it had to meet demanding video, Wi-Fi and audio performance targets at a commercial price point, whilst being tightly constrained mechanically.

These targets meant ByteSnap needed to bring together engineers with a range of experience and to work closely with Cocoon's mechanical and software teams. The size and shape of the end product was one critical area, requiring ECAD and MCAD collaboration. Several iterations of the PCB team were offered to Cocoon's mechanical team before component locations were finalised.

To address IoT security concerns, ByteSnap considered components with hardware level security features, allowing the customer to lock their device to prevent hacking.

The Judges said: "A tight, well scheduled design team with clearly outlined job descriptions and the expertise needed to deliver the design on time."



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## YOUNG DESIGN ENGINEER OF THE YEAR CHRISTOPHER BELLAMY, JAGUAR LAND ROVER

Throughout the graduate scheme and during his two years as a lead engineer at Jaguar Land Rover, Chris Bellamy has invented, designed and developed creative and novel solutions to customer problems, as well as being involved in advanced vehicle development and vehicle sustainability.

One of his main achievements has been the pioneering of a human-centric design process, a concept said to be 'very new' to JLR. Working closely with the company's consumer insight and human factors teams, Chris is said to have delivered 'outstanding results'.

Amongst Chris' innovative designs is a novel vehicle interior table system, which cuts weight by 50% and cost by 80%, while increasing fivefold the number of ways it can be used.

His charisma also ensures that colleagues 'buy into' his new ideas and concepts with confidence.

The Judges said: "He has achieved a lot in a short career; it's not easy to make a mark in companies such as JLR at such a young age."



## JUDGES SPECIAL AWARD MQA

According to start up MQA, since the MP3 format was adopted, sound quality has been sacrificed for convenience. Typically, it claims, 90% of the information is discarded during the MP3 compression process.

MQA founder Bob Stuart is passionate about preserving audio quality and was confident that labels, artists and music fans would appreciate an audio format that could not only deliver rich sound quality, but also do so using a convenient file size. That format is MQA.

Normally, when analogue sound is converted into a digital signal, temporal 'blurring' occurs, which makes recorded music sound 'flat' compared to 'live' music. According to MQA, using a process called 'Music Origami', it can clean up this distortion to create truly accurate 3D sound. At the Consumer Electronics

Show in January 2016, HTC showcased a 'proof of concept' by playing MQA music on its One A9 smartphone.

The Judges said: "Bob Stuart's development of the MQA audio codec – and its positive reception by leading consumer electronics brands – shows the UK is more than capable

of holding its own in this highly competitive market."

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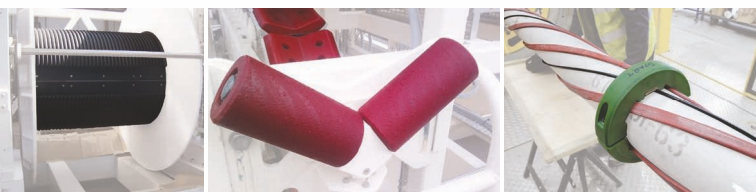
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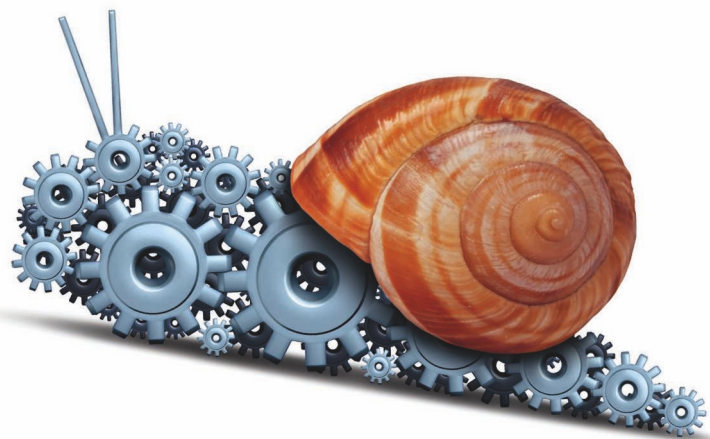
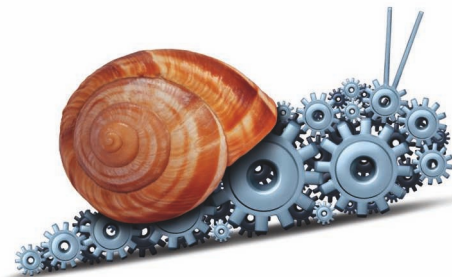
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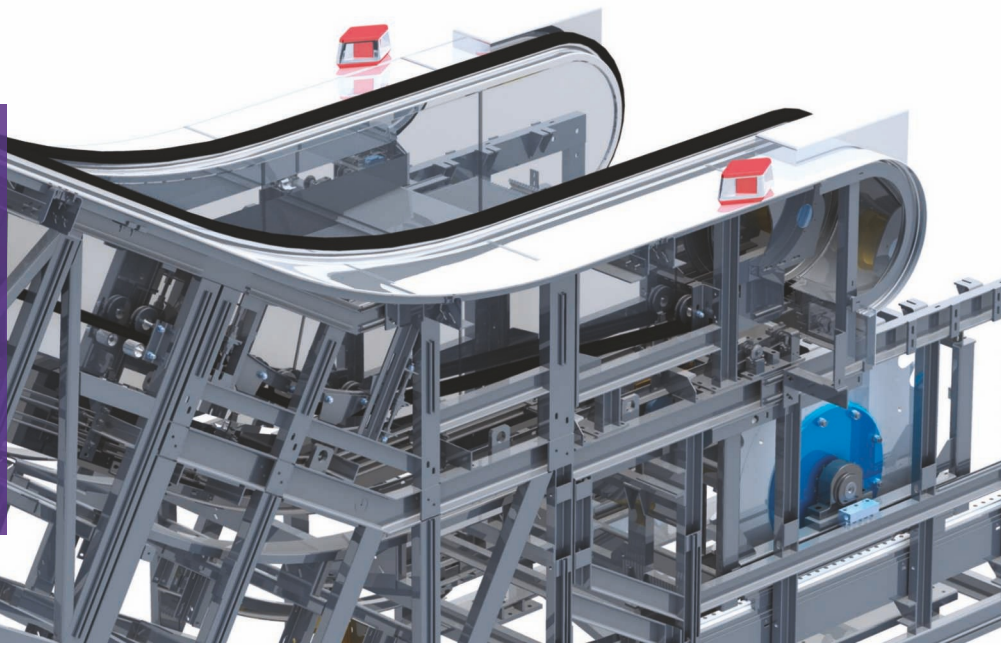
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# CUT CONTACT WITH MIRROR MEASUREMENTS

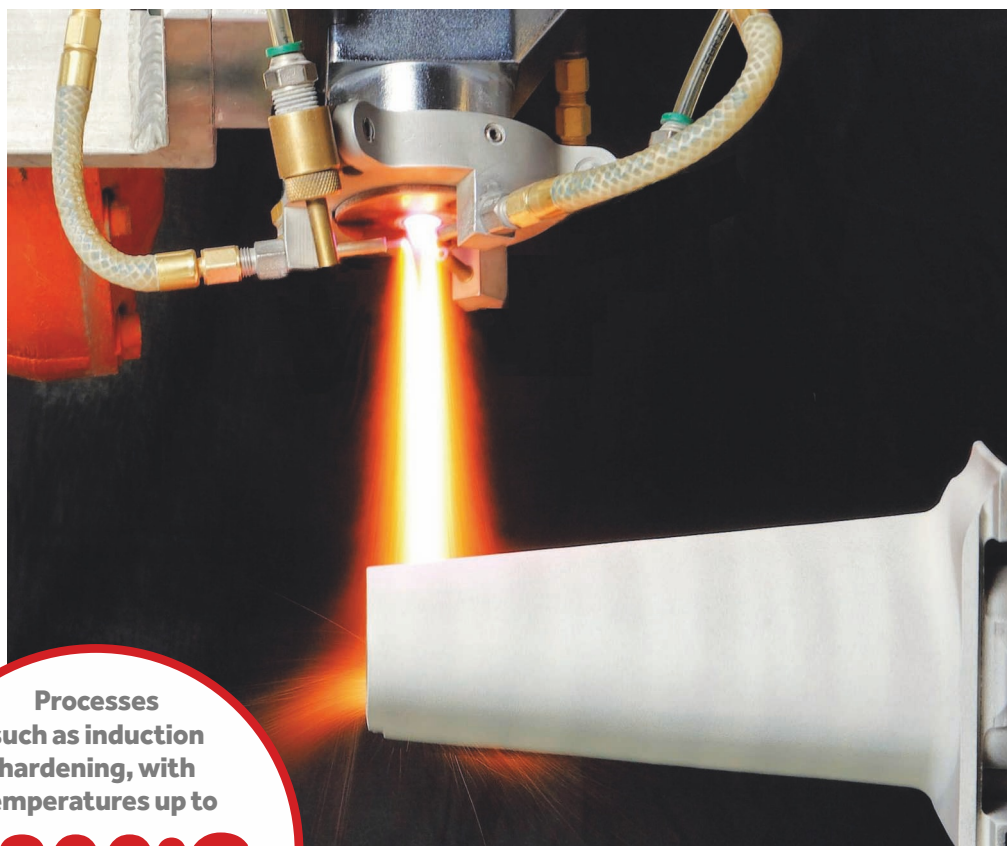
**In the heat treatment industry, depending on the application, there is a choice to be made between sensors that make contact with the material being tested and non-contact sensors. Which should you choose? Tom Austin-Morgan takes a look at the non-contact argument.**

**S**urface temperature is notoriously difficult to measure, as there is a discontinuity between the temperature of the object being measured and its environment, resulting in heat flows which can be significant. A sensor or probe attached to the surface, such as a thermocouple or resistance temperature detector (RTD), will likely be affected by the method of heating, or by the difference between the object and temperature variations of the atmosphere around it.

The problem is to get the sensor to contact the object without affecting the temperature being measured which, in principle, is impossible.

However, the requirement exists and surface probes have been specifically made for the purpose. A thermocouple wire laid along the surface for instance should make reasonable contact, but this is not always practical. A pointed probe like a skewer is more practical but unlikely to read correctly. Probes with some form of contact pad may also be effective, provided they do not mask the surface, changing the heat flow and temperature.

Non-contact pyrometers come into their own especially for applications in very high or low temperatures – from furnaces and steel production down to flash freezing. AMETEK Land claims to



**Processes  
such as induction  
hardening, with  
temperatures up to  
1800°C  
can be monitored  
with non-contact  
sensors**

have such a solution.

"We've been making non-contact measurement devices since around 1950," explained Richard Gagg, global IR product manager at AMETEK Land. "And only measure temperature by non-contact means, we don't do thermocouples or anything like that."

The company's latest generation of single point or spot pyrometers, known as 'SPOT', feature advanced optical systems so they can be locally or remotely focussed via their motorised focus mechanism. The units use mirror optics as opposed to the more traditional refractive optics meaning that all wavelengths reflect at the same angle as opposed to refracting light

**"If you get something stuck on it you can clean it off using a wood chisel, you can't scratch it."**

and infrared energy at different angles.

Gagg added: "With mirror optics you are precisely measuring what you are targeting rather than taking some of the energy from a slightly bigger area and some of the energy from a slightly smaller area. You're able to exactly define what's being measured."

The SPOT pyrometers use a green high-brightness LED to target the measurement instead of a red laser, which can have safety implications and is hard to see on a red, yellow or white hot surface. They also include a video camera mounted in the same optical axis as the detector allowing users to view exactly what the pyrometer is sensing. Gagg says this is specific to the SPOT sensors.

Another advantage that the non-contact sensors have over surface sensors is that, because of the very nature of not touching the surface, they have a longer lifetime and will avoid tip migration. This is where the tip of a thermocouple will begin to alloy over time, changing the millivoltage of the sensor's readings.

"I had a call a couple of years ago from a company in California who were complaining that the signals from their IR thermometers were drifting," Gagg said. "I was quite concerned with this and asked them for serial numbers of these thermometers and they were 28 years old! Changing them out every three months for this long had worn the gold plating off the electrical pins."

He added that, as well as watching out for the age of the sensors, maintaining the protective window on the pyrometers is also important. "The window on the SPOT pyrometers is made of sapphire, which is nearly as hard as diamond, but less expensive," said Gagg. "If you get something stuck on it you can clean it off using a wood chisel, you can't scratch it."

This is especially useful in



applications where a coating is being sprayed onto the surface of the object with a plasma as traditional temperature measurement devices cannot. Other processes like laser hardening, flame hardening and induction hardening have a heating method that directly affects the temperature of the sensor as well as the object it is measuring.

All the pyrometers in the SPOT range feature five selectable operating modes that enable the sensor to operate to its full capacity over specific wavelengths and temperature ranges. This makes them especially attractive to heat treaters of metals as these companies tend to do small batch jobs for customers in different fields. This flexibility means that, rather than have

multiple sensors for different processes, the SPOT pyrometers can be used on different materials and processes, eliminating downtime due to switch-out.

"I refer to it as like having a Swiss army knife," Gagg said.

Of course, all this presupposes that the surface temperature of the required application is significantly higher or lower from ambient. Gagg says that there are some applications where contact sensors are more suitable, for example: "If you have a close process that takes hours to come up to temperature and then soak and later ramp downwards slowly, these applications are ideal for a thermocouple."

Certain suppliers, such as Watlow and Isotech offer what they call 'true surface' temperature probes - TST and Model 944 respectively. These are said to include feed-back heating to compensate for heat losses along the probe, which then more closely show the 'true' surface temperature.

Non-contact sensors - low cost, long wavelength pyrometers, especially - can be prone to showing deviations in accuracy due to emissivity (a radiative property) of the surface, where a 10% change in emissivity may result in an 8% difference in temperature reading. Gagg said that higher quality, short wavelength pyrometers are insensitive, with just a 1% difference in temperature reading from a 10% change in emissivity.

"We have application specific pyrometers which are designed especially for very low and uncertain emissivity materials like aluminium," explained Gagg. "The multi-wavelength design with application specific signal processing algorithms means that these pyrometers actually compute the emissivity value, updated every 15 milliseconds. This makes them extremely accurate."

The choice of whether to use surface or non-contact sensors depends on the process being carried out. However, it seems that unless the process is one being carried out at room temperature, non-contact seems to have more advantages. **1**

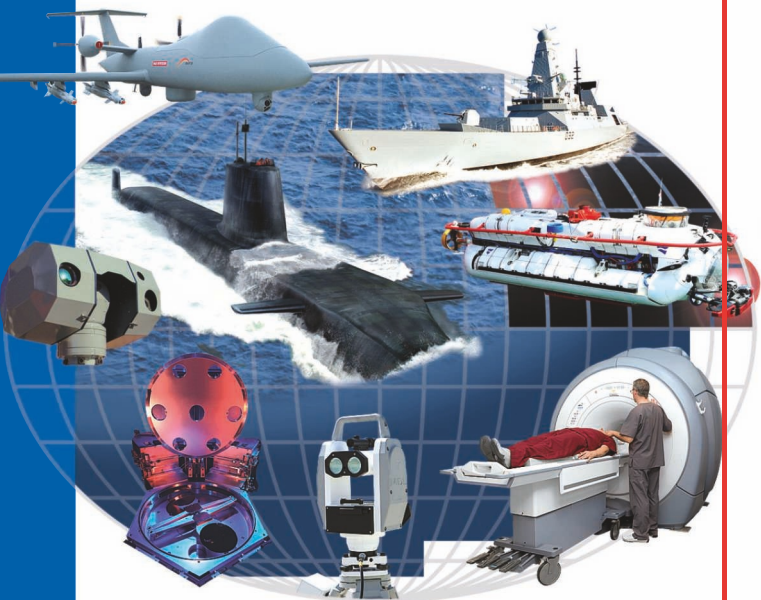
## DESIGNING IN SENSORS

Many industrial furnace makers include AMETEK Land non-contact pyrometers in the designs for their furnaces. They have also been designed in to the engines of the Tornado multi-role combat aircraft and the GE90 engines used on Boeing's 777 airliners to measure the temperature of the turbine blades and the engines' fuel economies.

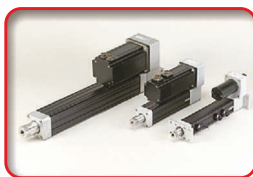




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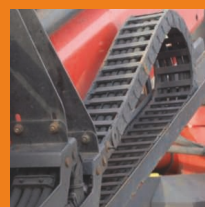
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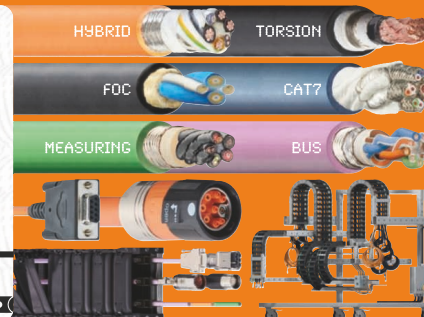


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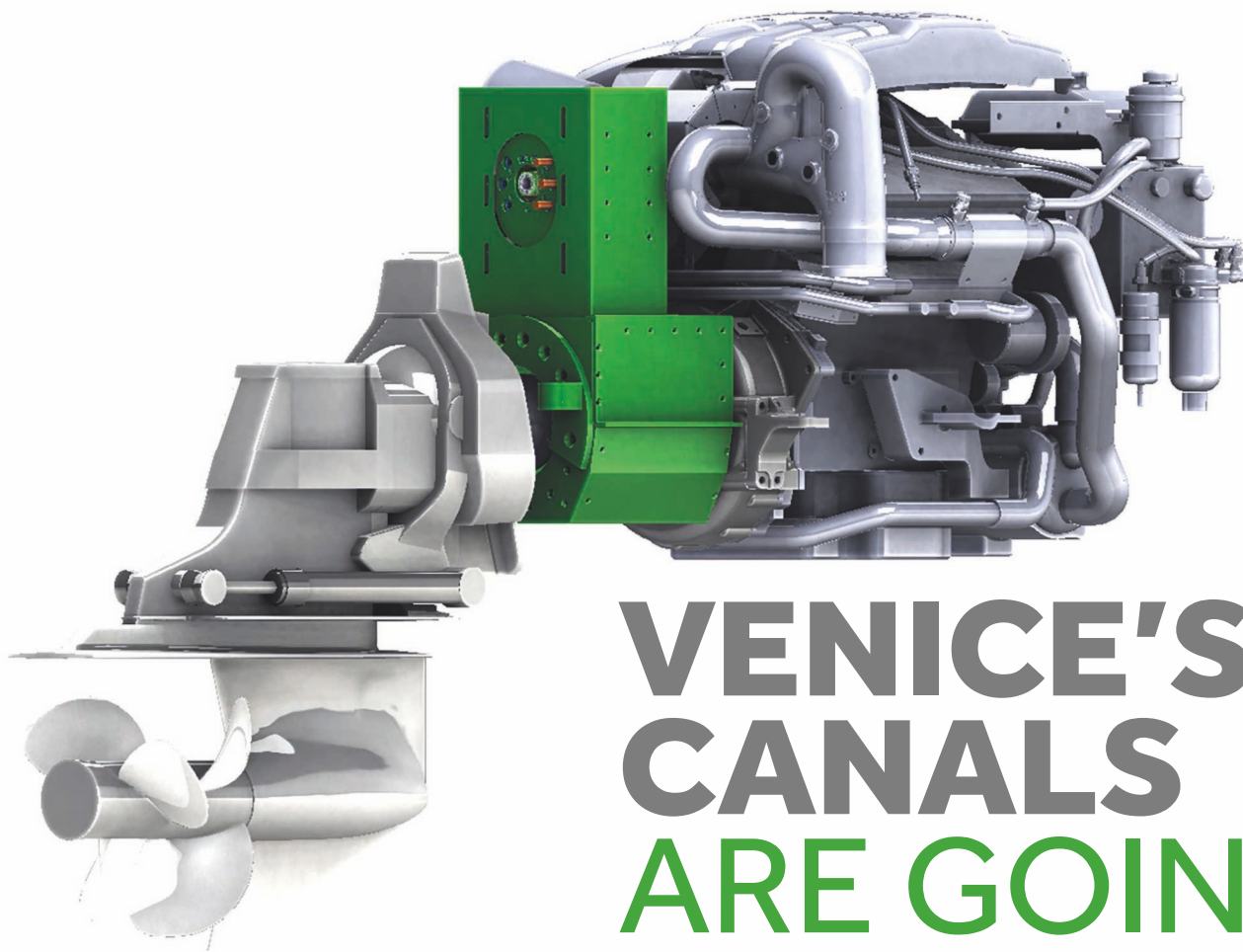
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# VENICE'S CANALS ARE GOING GREEN

In an environmental project that hopes to transform marine transportation, a British team is creating a clean drop-in hybrid diesel electric engine that can be installed by any boat builder and fitted into all existing boats. This first project to demonstrate the technology will start with the famous Venice water taxi.

The hybrid system has been developed by REAPsystems and uses the latest diesel engine technology paired with a high-power, compact and efficient electric motor and inverter, as well as a modern lithium-ion battery and advanced system control unit. The electric engine utilises a high performance Conti Synchrochain Carbon timing belt and specially manufactured pulleys from TransDev to drive the propeller. A Hybrid System Control Unit (HSCU) is connected to the clutch. The clutch is engaged when diesel operation is needed and disengaged when the electric motor is needed.

Apart from the environmental

## 18m

tourists visit  
Venice - on average  
around 50 thousand  
people per day

**Venice is suffering from the harmful effects of vibration and pollution from water transport. Could this be about to change? Eureka! reports.**

benefits REAPsystems estimate an average fuel saving of at least 50%, if compared with current diesel engine boats. The short-term aim is to develop a hybrid electric taxi-boat prototype that will be demonstrated and endurance tested in Venice next year, then to influence the new regulation on vehicle emissions to be imposed by the Venetian local authority.

### MARINE HYBRID ELECTRIC ENGINE

The hybrid system comprises two systems in one. Hence, the operator will benefit from high reliability and a

peace of mind backup/redundancy. In the city, the engine can be 'clutched out' to allow pure electric drive. Here, at low speed and where it matters most, users will benefit from all the advantages of the electric motor: no noise, no pollution, no vibrations and no fuel consumption. During fast transits with the diesel engine, the electric motor may also assist in order to reduce exhaust emissions. During medium to high speed, such as when transiting the lagoon, the diesel engine automatically kicks in and the electric motor smoothly transitions into a generator, recharging the batteries and pushing the engine into a more efficient engine loading. The choice

of a belt driven design for the hybrid engine was essential to provide the silent running required. It also lowered the design cost when compared to a custom gearbox.

## CREATING A COMPACT DRIVE

As a drop-in and compact solution the hybrid electric drivetrain can be installed into all existing diesel boats by any boat builder, either as a replacement or as an add-on to an existing diesel engine. There is virtually no compromise on passenger or cargo carrying capabilities.

The hybrid module design for the hybrid diesel-electric engine is very compact, light in weight, powerful and flexible. This enables it to suit a range of different engines, configurations and types of propulsion system. The hybrid module can work with the sterndrive, gearbox and shaft configuration.

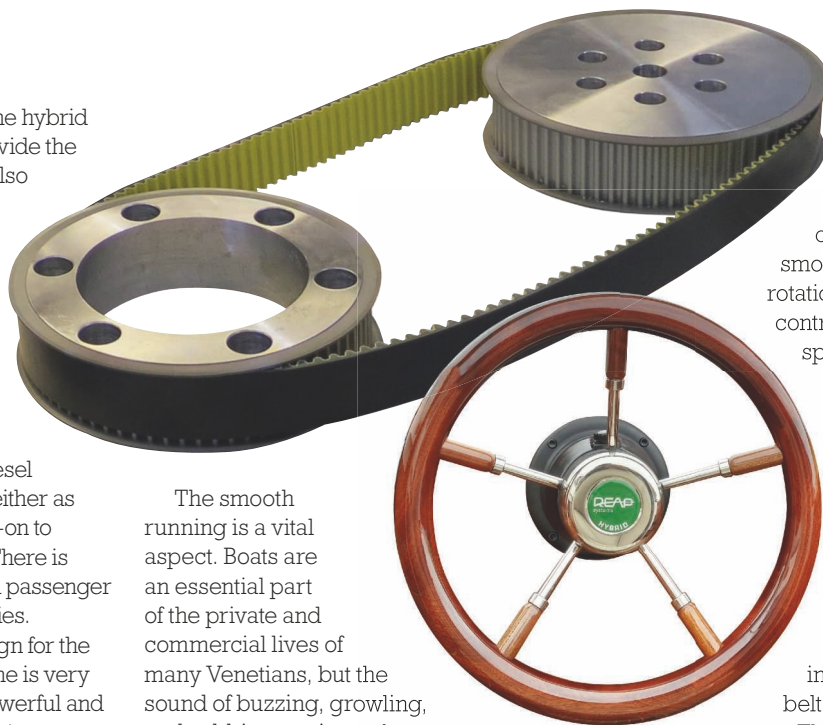
When it came to the drive belt and pulley solution REAPsystems turned to TransDev and ContiTech. The high tear resistance and high dynamic load carrying capacity of the Conti Synchrochain Carbon's high performance belt allows for synchronous drives even where boat engine compartment space is at a premium. A saving of up to 80% on overall belt width can be achieved, based on conventional timing belts when transmitting the same power requirement. This saving establishes ideal conditions for the design of economically compact, lightweight drives, such as the one in the REAPsystem hybrid engine.

This timing belt, with its CTD (Conti Torque Drive) profile, also makes extreme applications such as the hybrid engine possible. The newly developed CTD-profile features an arch-shaped pulley-entry geometry on the one hand, and a higher tooth on the other, providing harmonic tooth meshing and therefore ultra-smooth running. At the same time, it provides protection against belt slip at high torque. The belt's design and materials ensures the hybrid engine pulleys deliver reliable power transmission for high torques and high dynamic stressing plus longitudinally stable operation.

The smooth running is a vital aspect. Boats are an essential part of the private and commercial lives of many Venetians, but the sound of buzzing, growling, or throbbing engines often fills the air. Venice needs quiet, low vibration at low speed inside the canals of the city, which is one of the aims of this project. TransDev manufactured matching Synchrochain pulleys for the hybrid drive from unalloyed medium carbon steel. The optimised sectional match between timing belt and pulley and a belt construction with a multiply treated polyamide fabric, plus the dramatic reduction in the required timing belt width all make for considerably less noise, even at high belt speeds.

## THE VENICE WATER TAXI

Water taxis are the luxury means of transport in Venice, unless you want the romantic and more lingering experience of the gondola that is. They hold up to 12 people and feature comfortable leather seats. They are 8.8m long, 2.1m wide and despite the 150hp engine they must adhere to the 3mph speed limit in the city centre in order to protect the canals. The taxis have a fibreglass hull and mahogany finish in and around the cabin.



Above: The Reap belt and pulleys.

## A TOUGH ENVIRONMENT

The electric motor is very responsive; it can operate down to zero rpm and change smoothly from forward to reverse rotation. This gives the driver more controlled operation in the confined spaces of Venetian canals - all without gear changes.

Conti Synchrochain Carbon timing belts were designed for applications with extremely high acceleration forces as well as for the reliable transmission of high torque at low speeds. It is also well suited to transmission of lots of power involving a high dynamic load at belt speeds of up to 40 m/s.

The engine compartment of any boat is a challenge for belts and pulleys to operate in with its combination of cold, heat, oils, diesel, salt water and general contaminants. Venice is a salt water lagoon whilst the city canals can suffer from a wide range of man-made pollutants, both domestic and industrial. The Conti belt, consisting of polyurethane teeth and backing, carbon cord tension members and specially treated polyamide fabric, is highly resistant to oils, grease, fuel, UV and ozone, tropicalised and resistant to temperatures from -40 to +80°C.

One of the reasons for the slow uptake of clean hybrid technologies in the marine market is the high reliance on the reliability of the engine. A standard nine metre water taxi typically has a long, hard 20 hour day. However, TransDev claim that the Conti belt is essentially maintenance-free and the belt construction and the materials used help ensure a constant belt tension. No lubricating or re-tightening is required.

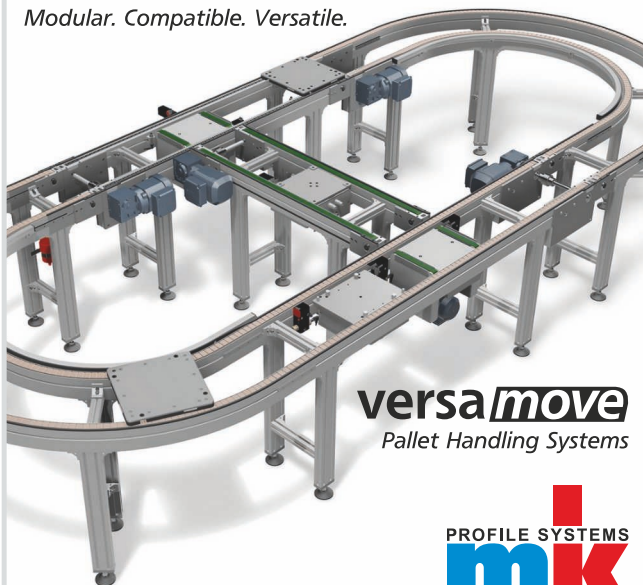
## NEXT STEPS

ContiTech and TransDev have continued to work closely with REAPsystems, performing on-site checks of the electric motor belt tension and alignment. They remain fully committed to the success of such an important project. Trials of the boat are expected to continue through the winter with a Venice debut in 2017. **E**



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# TURN DOWN THE VOLUME



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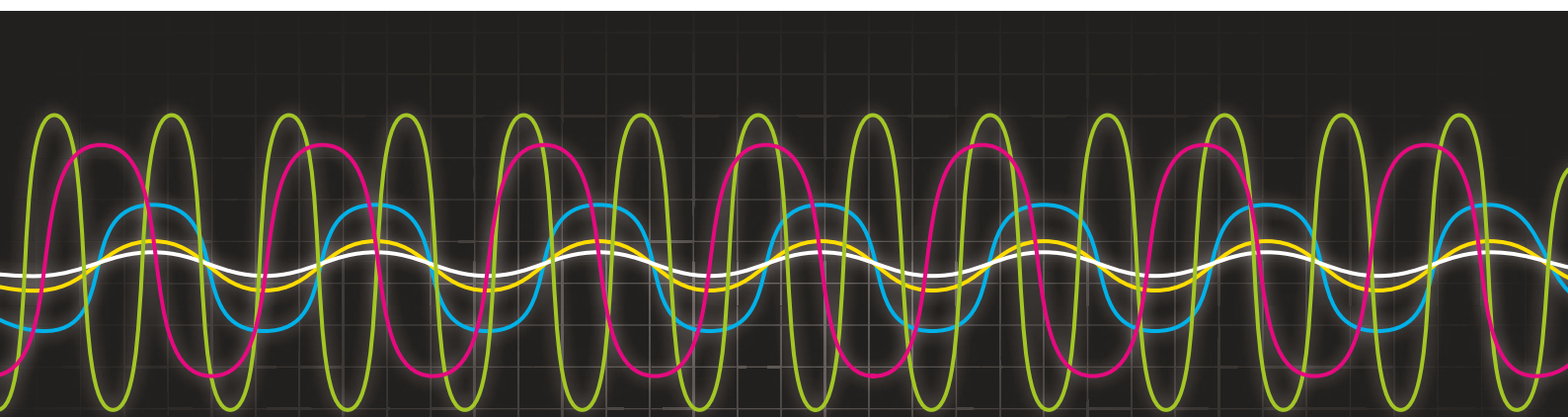
**Measuring a fixed volume of water in a device that's no bigger than a golf ball meant engineering some tiny gears with a huge gear ratio. Justin Cunningham finds out more.**

**W**ater is one natural resource that most people in the UK don't worry about. Yet globally, 'water stress' is becoming an increasing issue. The poster child that shows the extent of the problem is the massive decline of the Aral Sea in Central Asia. Formerly the fourth largest lake in the world, it has been in rapid decline since the 1960s, now just 10% of its original size.

Water saving, has therefore become a headline environmental mission and engineers are coming up with all kinds of ingenious solutions to help everyone do their

bit. This led to Hampshire-based consultancy 3form Design being approached to produce a low cost water limiting device for the consumer. And, it's not just for the environmentally conscious. With more homes being fitted with water meters and areas such as California experiencing regular drought, saving water has become a mainstream demand.

"We immediately thought, for this to be really effective in controlling and reducing water use, we need to measure the actual amount of water used," said Ally Le Sueur, operations manager at 3form Design. "The aim is to help people better understand just how much they are using."



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## FAST FACTS

- The average person in the UK uses 150L of water a day. This figure has risen on average by 1% a year since 1930.
- If you include the water used to produce food, known as embedded water, this figure rises to 3400L per person, per day.
- While 70% of the world is covered by water, only 2.5% is fresh.
- Of that, only 1% is easily accessible, with much of it trapped in glaciers and snowfields.
- There is the same amount of water on Earth now as there was millions of years ago.
- The length of the side of a cube which could hold the Earth's estimated total volume of water is 1150km.
- Approximately 3.5 Earths are needed to sustain the global population based on the current lifestyle of the average European or North American.



*The prototype FloSTEM installed on a shower inlet.*

The problem is that many water saving devices use time, rather than volume, to limit use. Of course, this omits things like water pressure and how much the user turns the tap on, so these largely fall in to the gimmick gadget category. Those that do measure flow are often smart devices, accompanied by an app, embedded electronics and of course a hefty price tag.

The team wanted to make it easy for people to know how much water they used in two main areas, the shower and the hose pipe. Long power showers, car washing and using a garden sprinkler use vast amounts of water, more than most of us realise. "We wanted to create a passive system – so no electronics and essentially a fit and forget mechanism that is low cost," added Le Sueur. "It enables the user to monitor their usage in 'packets', so they can make more informed decisions."

The principle is that the device can be easily attached between the shower head and shower or between an outside tap and hose, and it shuts off after 45L of water has passed through. Pushing a button on the side will reset the device and allow another 45L of water through.

The relatively small 45L capacity

was intentionally set on the conservative side, as fundamentally the device is about reducing water consumption. For comparison, an average shower will use 65L in 8 minutes and a typical bath, 80L.

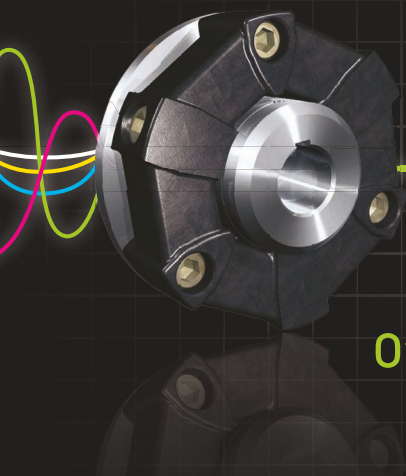
"You can still have a long shower but you know that you might use 90L," said Le Sueur. "Or you can turn the tap down, reduce the pressure and have a longer shower that way. Water is a commodity, so if you want to use it, use it. What this does is educate people so they know what they are using."

The device works by using an impeller that is driven by water flow. In turn, this drives a fixed ratio epicyclic gearbox. The gearbox steps down to trigger the 45L shut-off mechanism, which returns to its original position after reset. The team quickly realised that the step down in gearing would require an extraordinary gear ratio.

To gain inspiration the team began looking at epicyclic watch mechanisms as well as dissecting an egg timer. Though this gave them a useful insight, the team needed to take a leap and quickly evolve the design to get to the 262,000:1 gear ratio required, which also needed to be made in plastic. To add to the design challenge, the device also needed to fit through a letter box, meaning a space constraint of 44mm wide.


"We used an epicyclic gearing because you can make them really compact and you can get high ratios,"

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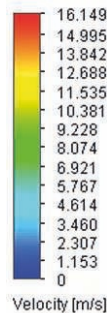
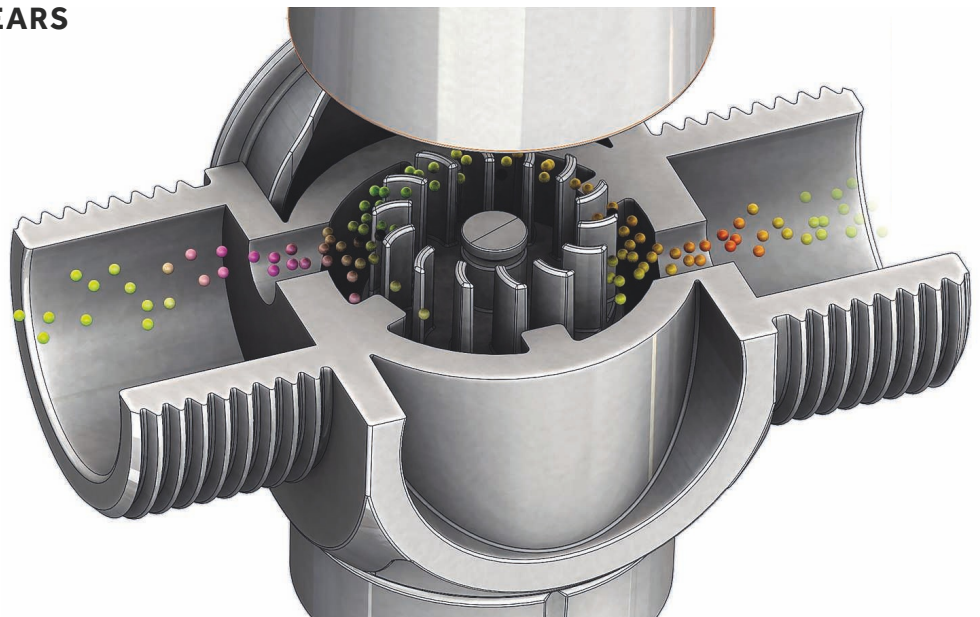
LEADING BY INNOVATION

said Simon Willis, product designer on the project. "At first glance, if you strip down the mechanism and have a look inside, it looks like a fairly standard gearbox. But, there are many nuances in the way it all comes together and I'm sure there aren't any as small as this."

Engineering the device so it could be made at a price point in the regions of £10 to £20 meant the gearing and housing would need to be made using plastic injection moulding. The challenge here was making sure the tiny gears work reliably, while making the surrounding housing strong enough to take the loads that it would be regularly subjected to.

"We decided we'd 3D print the gears and assemble the mechanism so we could test it," said Willis. "We marvelled at how small the gears were and how well the printer had produced them."

The team's in-house Stratasys Connex Fused Deposition Modelling (FDM) machine has become invaluable as a design and development tool, especially




on projects like this one that have involved many iterations to get right.

"FDM produces parts that are real ABS and really functional," said Willis. "That allowed us check our design data and prove the principles we've used to bring it together."

"We did do a lot of simulation and producing it in FDM and seeing it work, with what is a coarser and more fragile material, gives us a huge

amount of confidence going forward into mass production."

The product is known as FloSTEM and is due for release early next year, but it already claims pre-sales of around 1.5 million shower attachment units and 1.5 million hose attachments. And, while the current product is fixed at 45L, it is hoped future product variants could offer different capacities. 



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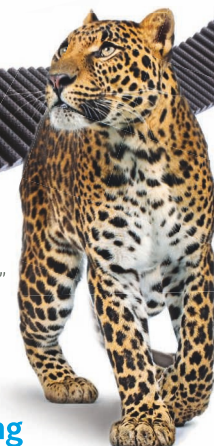
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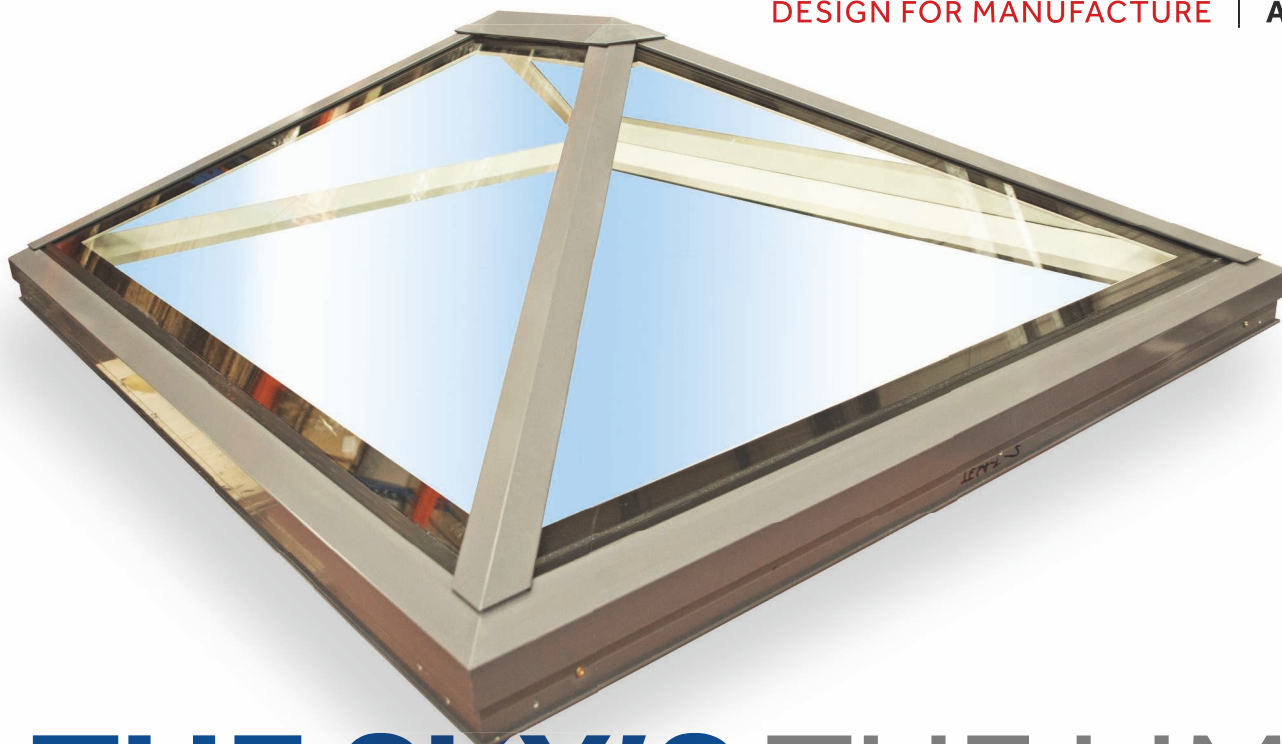
  
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# THE SKY'S THE LIMIT

**S**unsquare is the brainchild of technical director James Boughton, a design engineer who could see that roof and skylight design was stuck in a rut. In 2004 he sold his house and car for the funds to set-up Sunsquare in opposition to the then market leader of flat roof skylights.

Eight years ago, Justin Seldis bought into Sunsquare as managing director and today, under this partnership, Sunsquare has a turnover of around £5m, a workforce of nearly 50 and two factories.

Sunsquare was the first manufacturer to opt for heat soaked, toughened glass to exclude impurities for better performance. And this commitment to continuous improvement endures with traditional methods frequently making way for innovative processes.

"For example, just because the industry has always used neutral silicone to seal its glazed units, that's no reason to presume it's the only way or, more importantly, the best way to do it," Boughton explained. "The biggest problem with silicone is its life expectancy and this is one of the benefits we have gained by working with Henkel."

Indeed, when Sunsquare first opened discussions with Henkel at a trade exhibition this was one of several practices that proved ripe for

**Even relatively simple products can be engineered better by using elegant design solutions. Such was the case when Sunsquare looked to improve performance and processes by use of alternative adhesives.**

change. Since that first meeting, four applications for Henkel engineering adhesives have been proposed, extensively tested and proven.

Although there are standard Sunsquare designs, most of the company's products are manufactured to architects' specification. The framework, which comprises designed-for-purpose elements rather than off-the-shelf profiles, is constructed in the first of the company's two factories in Bury St Edmunds. To minimise airborne contamination, glazing and assembly are conducted in a separate factory. An important driving force behind

changing bonding and sealing methods was the need to equalise the output of both production units.

Around 35 frames can currently be produced per day, but glazing and assembly can only be completed on 25, a problem that could be largely attributed to the handling and curing times of the previously used bonding and sealing adhesives. Sunsquare has 48-hour turnaround in its sights so speed and efficiency, both in terms of the adhesive's characteristics and its method of application, are now more important than ever.

The first of the Henkel products employed to address this need is most commonly used to bond windscreens in trains, buses and other vehicles facing harsh environments. It is a single-part, polyurethane Teroson direct glazing adhesive with built-in UV stability which, when applied to a vehicle, gives a drive-away time of just one hour. The product's credentials for use in the safety-critical automotive industry together with its cure speed and ability to bond without the need

## SUNSQUARE ROOFLIGHTS

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for a primer, proved very attractive qualities for Sunsquare.

"By comparison with our previous glass bonding adhesive, the Teroson adhesive gives us longer open time but cures much quicker," Boughton confirmed. "The bondline is sufficiently hardened for us to clean off any excess within the hour and a good degree of cure in just four hours."

Further and significant production time savings have also been made by replacing the neutral silicone, traditionally used in this rooflight industry to weatherproof bond lines, with another Teroson product. Unlike silicone which is simply a sealant, the Teroson alternative is both a sealant and an adhesive that boosts the durability and performance of the end product.

The chemical basis of this product is a silane modified polymer which reacts with moisture in the air and cures to form a high performance polymer.

"The silicone we used before took over 2.5 hours to skin over and even longer when the ambient temperature was lower. Not only does Teroson outperform the silicone, it skins over in just 20 minutes and is

sufficiently hardened for us to move the glazed unit in an hour. This means it can be moved to a crate to cure fully, so we can increase our throughput," said Boughton.

### PROTECTING THE ENVIRONMENT

Another successful application for Henkel has been the use of one of its Teroson black windscreen primers to apply an opaque mask around the edge of the glazed frame to protect upstands from UV light. It also makes the unit more aesthetically pleasing as it effectively hides the mechanism.

After application, the previously-used primer dried to form a very uneven surface but, as the new primer can be roller-applied, it is both smooth and gives a clearly defined edge. Furthermore, it cures in just 20 minutes. The success of this application isn't judged purely in terms of its efficiency, however. Another big benefit is VOC reduction as it is free from chlorinated hydrocarbons and aromatic solvents.

### TIME SAVINGS

The final Henkel adhesive application is in the assembly of the framework.

Cleats made from Zamac and aluminium have, for some time, been bonded into the frame to provide additional strength at points of stress. Although the adhesive Sunsquare had been using was sufficiently strong for the purpose, it was described as being 'gloopy'. Consequently, it oozed from the joint after application, wasting product and involving additional clean-up time.

To address this issue, Henkel recommended a Loctite acrylic structural bonding adhesive whose thixotropic formulation would not run out of the joint. To ensure it would provide the necessary bond strength it was also subjected to extensive lab testing by Henkel.

Indeed, thanks to the strength of the bond, Sunsquare has subsequently been able to dispense with stainless steel straps that were previously needed to support the structure under stress.

For a company which has such sharp focus on innovation, optimising production processes is an essential element in funding further research and development of the next generation of rooflights. **1**

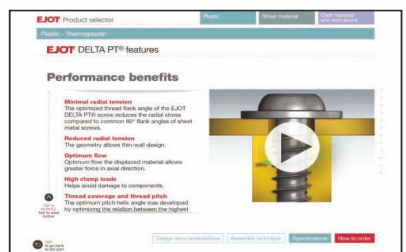
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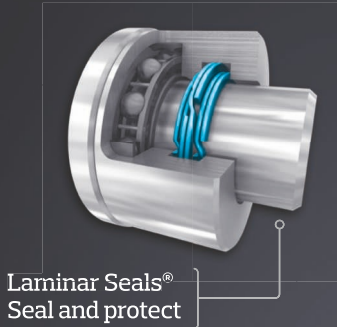


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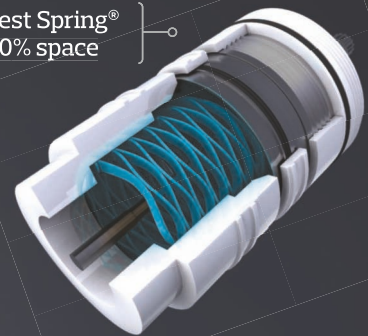




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# VARIETY PROVIDING SPICE FOR LIFE

**Keeping an engineer's mind fresh and challenged is not a problem if you work at a busy product design and development company.**

**H**aving graduated as an electronics engineer from Imperial College, and armed with a list of interests that was headed by being a contestant in Robot Wars, Gary Ewer entered full-time employment with the company he had spent a gap year with – Cambridge Consultants.

That was 12 years ago and Ewer is now technical lead on electromechanical and electronics projects with the company. "The project manager makes sure the budgets all work, and I make sure it works technically," he claimed.

Ewer is all too aware that engineering designers are in short supply and in demand. For those with knowledge and experience, there are plenty of options. However, they are options that are not turning his head. "This is one of those jobs where every six months to a year I'm working on a different project – I may as well have a completely different job," claimed Ewer. "It's for the same employer, but it's a different market, it's a different project, it's something completely different. I can't see any reason why I would ever change jobs, because I have the excitement of a new job every few months without having the faff of applying for any."

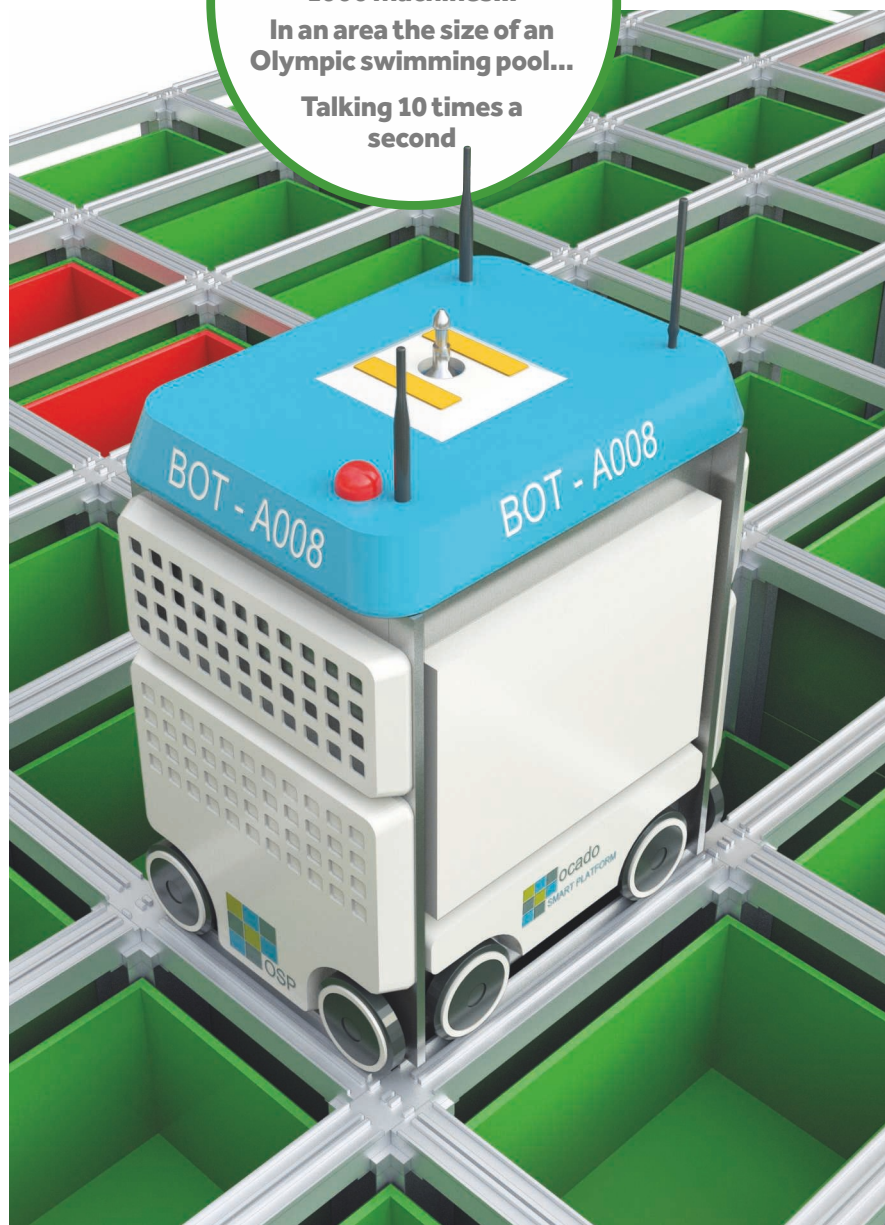
At the moment Ewer is concentrating on one large project to design a medical device, but at other times he could have four or five small

## Ocado warehouse automation

1000 machines...

In an area the size of an Olympic swimming pool...

Talking 10 times a second





projects on the go at the same time. "There's been quite a variation over the years," said Ewer, who then reeled off some examples – the electronics and software for a domestic icemaker; accounting software for a gas meter; electronics for a voice over IP Wi-Fi phone; electronics and software for a drinks machine that was designed to go behind the bar in the pub; and he was electronics lead on a personal emergency response device for the elderly.

But while the majority of projects are client led, Cambridge Consultants is not averse to throwing in a few development projects of its own – projects that the company sets up to prove a concept with potential to commercialise them further down the line. One such project which Ewer worked on was DropTag. This was originally perceived to be a very low-cost Bluetooth electronic logging device, that by a simple smartphone scan of a tag on a parcel would reveal how that parcel had been handled and therefore allow the recipient to decide whether or not they wanted to accept it.

It turned out that it could have applications in lots of other areas, some of which could be of interest to engineers designing industrial plant, such as operational monitoring and failure prediction. Another potential application is as an alternative for the black boxes in cars that are favoured by insurance companies, as the DropTags only cost pennies and can be installed for nothing.

This project simmers on in the background but having the freedom to design imaginatively, rather than design to specification, has very real benefits to the skill set Cambridge Consultants has to offer. Ewer explained: "I look back and think, wow, I was putting Wi-Fi in things before anyone was talking about the Internet of Things. I was talking about how my thermostat should be connected to the Internet; why is it not? So you often find you are a bit ahead of the curve. We've actually come into our own with the Internet of Things – we've already got all the skills under one roof."

One demonstration of this deployment of advanced wireless technology was a project with Ocado, which was looking to transform its warehouse automation. Cambridge

**"I have the excitement of a new job every few months without having the faff of applying for any."**



Consultants designed a wireless control system to control and co-ordinate the movements of hundreds of thousands of crates containing millions of grocery items, in real time and in parallel. It means that Ocado's next-generation warehouse is home to the most densely packed wireless network in the world.

The technology breakthrough is enabling Ocado to control 1,000 machines, communicating with them 10 times a second, all within an area the size of an Olympic swimming pool – maximising warehouse efficiency. The innovative solution is also scalable – so could potentially handle 20 times the number of movements.

## CUSTOM SOLUTIONS

"It was clear early on that no technology existed which would do what Ocado needed," said Ewer. "That meant they needed to create a completely custom solution to achieve the required performance – but do so in a way that had a manageable risk profile and in the minimum amount of time. They engaged us to help them achieve this."

Existing mobile communications technologies did not offer the real-time control or scalability that Ocado needed. The Cambridge Consultants team identified that a system based on 4G telecoms technology deployed in the unlicensed 5GHz Wi-Fi band gave the best chance of achieving Ocado's goal of co-ordinating thousands of fast-moving machines to within a fraction of a second.


"It's a massive system," said Ewer. "You need to take the orders from the website and process them into robot moves. We were responsible for getting the instructions from the big server that was working it all out, to the robots. Progress had to be

reported back as it happened so that the system could run highly efficiently in real time.

"The wireless design was particularly challenging – being able to make the densest wireless system in the world, with so many receivers in such a small area, all talking at high speed in real time. We developed a radio system that had never been done before."

There was a huge team of around 100 at Cambridge Consultants working on the project, and tens of thousands of man hours were attributed to it. Projects such as this have seen the company's workforce double to around 700 in the last four years, but even Cambridge Consultants cannot grow as fast as it would like without getting the right engineers through the door. And engineers, as everyone keeps saying, are in short supply.

"Electronics engineers are a particular pinch point at the moment," observed Ewer. "And we are always looking for software engineers and also in wireless. We are also really keen to get more project managers on board because that's becoming a bit of a bottleneck. We are constantly growing, so there are always new opportunities across the board."

"And it's not just about the projects. There is a good social side as well and we do a lot of work with students from the university and local schoolchildren. So the nice thing about working for Cambridge Consultants is being part of the community and having our own strong community as well." 

If you are interested in a career at Cambridge Consultants, have a look at the vacancies and application procedure at [www.cambridgeconsultants.com/careers](http://www.cambridgeconsultants.com/careers)



# simulation

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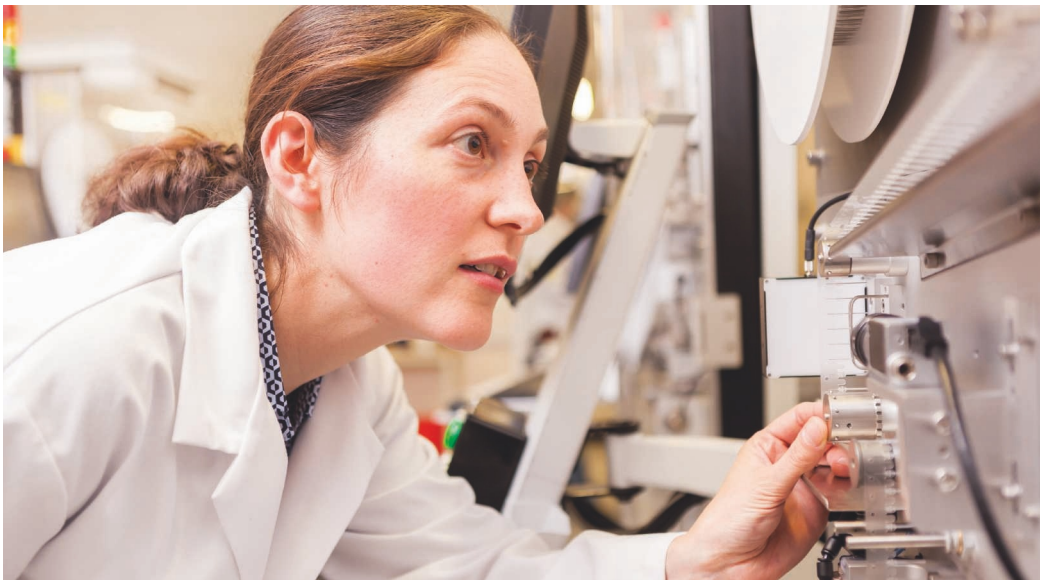






# ENGINEERS – YOUR INDUSTRY NEEDS YOU

**With the engineering industry facing a massive skills gap by 2020, and women only making up 8% of the total workforce, what can your company do to promote diversity and STEM careers in your local community? Tom Austin-Morgan finds out.**



## HELEN CAVILL

Helen always had an interest in maths, science and how things worked. While at school, she went on a week's work experience at Siemens Gas Turbines, seeing engineering up close convinced her that engineering was what she wanted to do.

During A-levels she took part in the Engineering Development Trust's (EDT) Head Start scheme, attending engineering lectures and practical sessions.

Helen then signed up for the EDT's year in industry scheme, making automotive body casings in an iron foundry.

In 2009 she graduated from Cambridge with a degree in Manufacturing Engineering.

Helen spent six years working at plastic bottle manufacturer, M&H Plastics, and has just started in a new role at TTP Labtech.

In 2015 she won the IET's Women's Engineering Society Prize which has given her more opportunities to spread the word through her STEM ambassador roles.

**A**ccording to a survey by the UK Commission for Employment and Skills, despite the engineering sector contributing around 27% of the UK's GDP in 2014, more than 55,000 engineering jobs go unfilled every year. This trend is projected to cost the economy £27 billion by 2020.

With UK companies reportedly faring better than expected after Brexit, how is it that the skills gap isn't being closed and what can be done about it? "It's no secret that one of the key issues we need to address in engineering is the low proportion of women entering the industry," explained Paul Jackson,

chief executive of EngineeringUK. "We need 1.82 million people with engineering skills by 2022 in order to keep up with demand."

The engineering community is working to create a more diverse workforce and to boost the numbers of girls joining engineering. There are many national programmes and events held across the country promoting STEM subjects and careers to young people, including Tomorrow's Engineers Week which will be well under way by the time you're reading this.

Jackson added: "Tomorrow's Engineers Week highlights the amazing work produced by female

engineers who play a pivotal role in our everyday lives. We want girls to understand they have the same opportunities as boys in this exciting and creative industry."

Tomorrow's Engineers Week is run by EngineeringUK and The Royal Academy of Engineering with support from many other organisations across the country. Schools, universities, companies and institutions come together to find creative ways to highlight the huge range of careers that engineering encompasses through hands-on events as well as online content. The ultimate aim of the initiative is to double the number of graduates and apprentices entering the industry.

"We need more work experience and summer placements," said Helen Cavill, manufacturing engineer at TTP Labtech. "It's really important for companies to put the time and effort in to have someone come in and see what the job's about. I've had several work for me and it's really rewarding when you hear that they have chosen to study engineering subjects at university because of the time they spent with you. It's getting that practical experience that really helps."

The Crossrail project in London set a target to recruit 400 apprentices over the lifetime of the project. This included the contractor companies

## MONYA ALKHALISI

Monya grew up in Morocco and enjoyed subjects like physics and chemistry. She was encouraged into pursuing a career in STEM by her parents.

She graduated with a degree in Mechanical Engineering from King's College London in 2006 and has worked at Bechtel since then, starting out on its graduate programme, in oil and gas, mining and infrastructure, working in Italy and Canada as well as the UK.

Monya became a chartered mechanical engineer in 2010 and moved into engineering and design management roles, including working on the Crossrail project. She is now a project manager at Gatwick Airport.



working on the project employing a certain number of apprentices depending on their budget. Andrew Dempsey, media relations manager at Crossrail, explained: "That was the first time that kind of model was used in industry and we've smashed out target, we're now at over 600 apprentices. 27% of those who joined in the last year were women, which is far higher than the industry average."

The government will apply this model to future projects including Tideway, HS2 and Hinkley and aims to reach gender parity in the construction industry by 2030.

Another barrier for attracting women into engineering is the stereotype of what an engineer is and does. Typing 'engineer' into a search engine brings up countless images of people, predominantly men, in hard hats.

Juliet Murray, track field engineer at Crossrail, said: "I have seen diversity improve massively, the first company I worked with was a very small consultancy, I was one female engineer in a team of 20. Now, within our Crossrail team, there's five female engineers in a team of around 20.

"Some of the health and safety boards on our sites show women in safety glasses and you just feel like you belong. I think it's important that Crossrail is promoting the women on the project, especially women in senior management positions."

Monya Alkhalisi was a design engineer with Bechtel, and has progressed over the last 10 years to become manager of a project at Gatwick Airport. She said: "I'm a member of the IMechE and some of their events have female engineers presenting. It's important for 15 and 16-year-old girls to see themselves represented and think that it could be them in 10 years doing well in their career and thinking engineering is a cool industry to be involved in."

Tomorrow's Engineers Week, as well as all the other national events and programmes, needs help to carry out its events across the country. From providing speakers in schools to manning a stall at an event or stewarding, all it takes is to send an email to get the ball rolling.

Alkhalisi, Cavill and Murray all work for companies that have some form of social engagement, either through apprenticeship schemes, arranging visits to schools or having children visit their places of work. These programmes not only raise the profile of their companies, but also help to close the skills gap.

"I just like being an engineer," said Cavill. "The fact that I'm female is kind of irrelevant to me but if that inspires more young girls into this exciting industry then I'm happy!"

## JULIET MURRAY

Juliet hadn't considered engineering while at school in Australia, but signed up to a summer course that offered subjects that enabled her to apply for a degree in civil engineering.

Her first job was with a small engineering consultancy where she felt she was giving something back to the community through the projects she worked on.

Juliet moved to the UK in 2013 and worked for Balfour Beatty in the London Underground.

For the last 18 months she has worked as a track field engineer on the Crossrail project where she splits her time between the office and being on-site.

Juliet is involved with the Young Crossrail programme, showing groups of school children around the sites where they can see what engineers do and promote the idea that engineering can be a job for women.

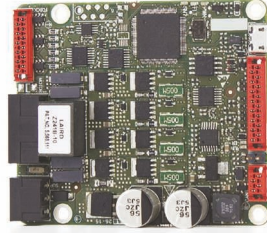




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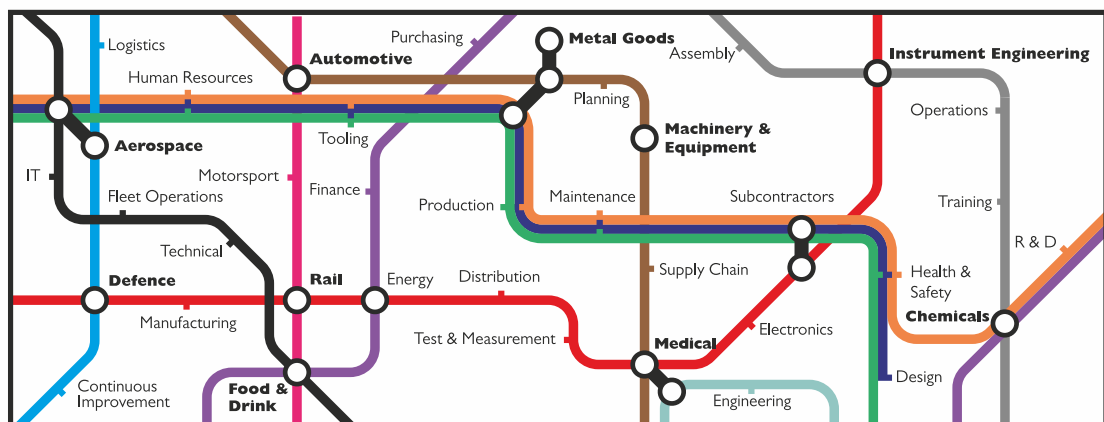
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# DESIGN FOR DESTRUCTION



**T**he *Eureka!* readership are a brainy bunch, and renowned for working on all kinds of projects and problems. So, this month we want to put you to the test, and ask for your innovative ideas and designs for your very own Robot Wars' entrant.

The standard of the 2016 competitor robots is no doubt the best yet. So, how would you do battle? What would your weapon be? And, how would you trade off weaponry and armoury?

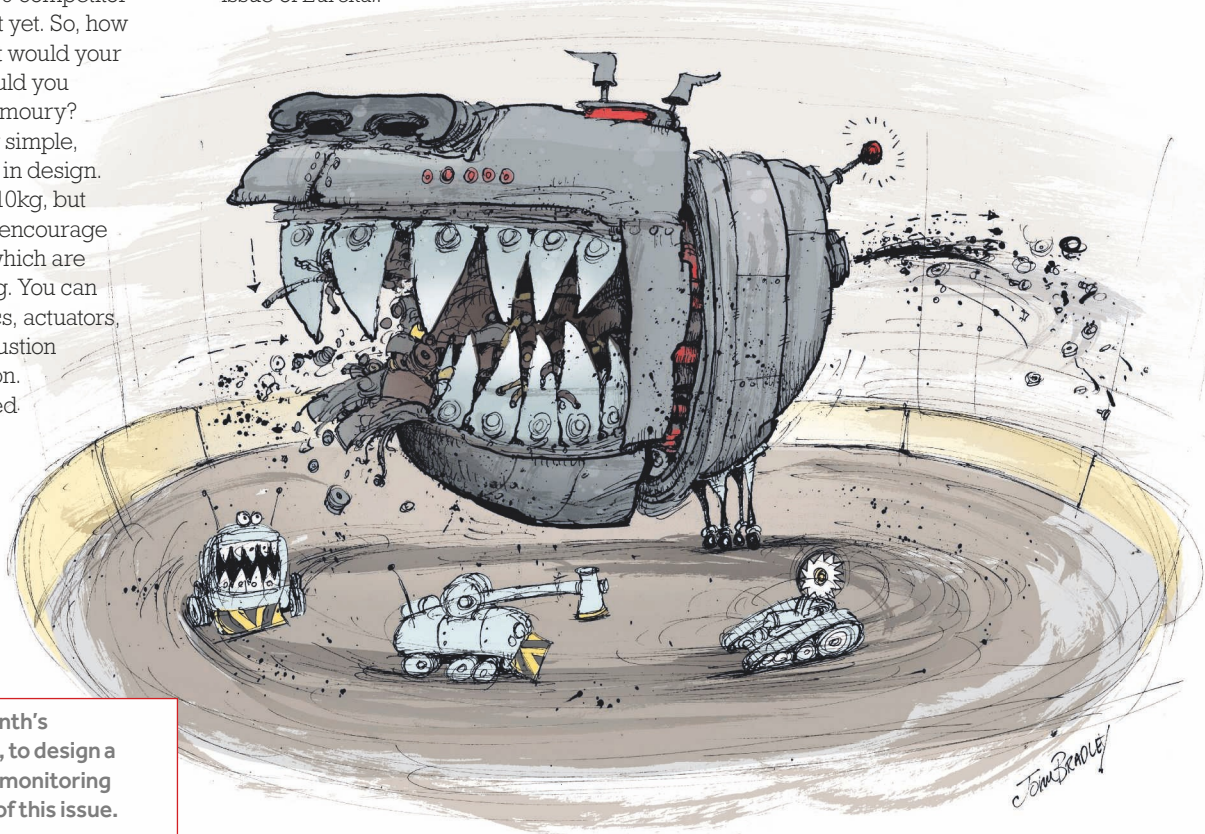
The rules are relatively simple, and allow a lot of variance in design. The maximum weight is 110kg, but the competition is keen to encourage 'walkers' in to the arena, which are allowed an additional 25kg. You can use hydraulics, pneumatics, actuators, motors and internal combustion engines in any combination.

Robots are not permitted to fly, 'invisible damage' weapons such as Tesla Coils are banned, and no radio jamming or nets either. Projectiles can be used but must be tethered, and your inner arsonist will also

not be pleased as flame throwers and explosives are also banned.

This is a brawn and brute force competition, but it needs a good engineering brain to produce a winning fighting machine. We'll show off the best designs, ideas and comments in the next issue of *Eureka!*

■ Any ideas, please share with the editor at [tim.fryer@markallengroup.com](mailto:tim.fryer@markallengroup.com) or go to the Coffee Time Challenge pages of the website and leave your ideas as a comment.



Our solution to last month's Coffee Time Challenge, to design an effective electricity monitoring method, is on page 12 of this issue.

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S19

CJ19

B28

S65 / CJ65

CJ15

B80

B48

S125 / CJ125

S28

CJ28

Larger size elements  
also available

S55 / CJ55

B24

## Coupling Element Size Comparison Chart

(up to Spidex S/CJ125 & Dentex B80)

Simply size your coupling, decide the shore hardness colour and contact us immediately. See the yellow (Pump Drive Component) catalogue found at: [www.jbj.co.uk/e-catalogues.html](http://www.jbj.co.uk/e-catalogues.html) for technical specifications, power, torque, speeds & other selection data.



# Half the seal friction, twice the limiting speed

## Small sealed SKF Explorer spherical roller bearings with improved performance

With up to 50% less seal friction, resulting in up to 20% less total bearing friction, the operating temperatures of small sealed SKF Explorer spherical roller bearings are as much as 20 °C lower. As a result, limiting speed ratings are now double those of previous sealed SKF spherical roller bearings.

This means that many more applications, from conveyors and cranes to elevators, fans and food and beverage equipment, can benefit from a long service life and reduced maintenance costs.

### Customer benefits:

- Significantly increased uptime
- Substantially reduced need for maintenance
- Reduced grease consumption and disposal cost
- Improved worker safety



Call: 01582 496662 or visit:  
[skf.co.uk/sealedsrb](http://skf.co.uk/sealedsrb)

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