


160 years of
innovation

theengineer.co.uk
May 2017 | £3.70

theENGINEER

F I R S T F O R T E C H N O L O G Y & I N N O V A T I O N



Building a
launchpad
for deep space
exploration

Next frontier

Making a splash

UK firm corners the market with an innovative waterproof coating for smartphones

»29

Race to market

Williams' Paul McNamara on why top-flight motorsport is more relevant than ever

»32

Design cycle

How 3D printing helped Chris Froome pedal his way to Tour de France victory

»54

Careers feature

The varied opportunities on offer in the UK's defence sector

»64

Your business water bill could be cheaper. Call in...



Now the water market in England is open, every business is free to shop around for better water prices and improved service from their supplier.

Savings of up to 25% are possible as well as up to £400 cashback* with a combined utilities deal from Utilitywise.

Join the thousands of businesses who have already taken the first steps towards lower water bills.

Contact the U-team today.

Call 0330 057 8627, text WATER to 62277 or visit utilitywise.com/water



Free water
mythbuster
guide for every
business

utilitywise 

www.utilitywise.com/water
Copyright © 2017 Utilitywise plc
*Terms and conditions apply

this issue

Volume 297
Issue No.7887
Established 1856

news

- 04 Automotive** Funding to help with low-carbon vehicle technologies
- 08 Nuclear** Cooling things down inside the reactor
- 10 Sensors** Video camera that mimics the mammalian brain

opinion

- 16 Viewpoint** Terry Scuoler
- 18 Mailbox** Your letters to the editor
- 20 Hayaatun Sillem** Setting out a firm industrial strategy
- 32 Interview** Paul McNamara
- 38 Scifi eye** World of tunnels

features

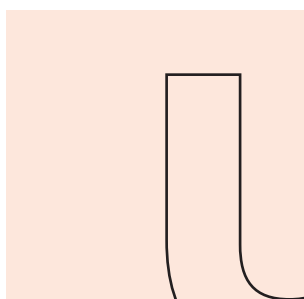
- 22 Cover story** Planning the Deep Space Gateway space station
- 29 Materials** Making smartphones water-repellent
- 34 Medical** Robots are being used to position electrodes in human brains
- 41 Car of the issue** Honda NSX
- 64 Careers** Defence
- 69 Archive**
- 70 Digest**

Your number-one website for engineering news, views, jobs and products **theengineer.co.uk**

our opinion



Joining forces



UK engineering has many strengths, but arguably one of its greatest assets is its strong and growing culture of collaboration: a willingness to share knowledge across organisations; an understanding that by tapping into external areas of expertise, engineering teams can achieve far more than they could ever do alone.

But while collaboration may be a UK strength, we shouldn't be complacent. Effective collaboration doesn't always just happen naturally and, as the government's industrial strategy green paper acknowledges, we can always get better at it.

This is why, last year, we launched Collaborate To Innovate (C2I): an awards competition aimed at celebrating the UK's most inspiring engineering collaborations and, critically, shedding some light on the factors at the heart of their success.

"We've come up with a list of categories to showcase the best cross-disciplinary collaborations"

The search is now on for the 2017 finalists.

This year – with the help of our project partner EPSRC – we've come up with a list of categories designed to showcase the very best cross-disciplinary collaborations. We want to hear from innovative collaborative projects across areas including transport, health, energy efficiency and sustainability, information and connectivity, safety and security, and the built environment. Two separate categories: Academic Innovator and Young Innovator, will respectively showcase excellence in the UK's academic research base, and great examples of STEM outreach to schools.

Entries will be judged by a panel of some of the UK's most respected engineers, and winners will be announced at a special party in London in September. In December, delegates at our dedicated C2I conference will then hear first hand from our winners about the secrets of their success.

The closing date for entries is 26 May, although, as in previous years, there will be an extension. We hope to welcome some of you to our winners' party later this summer.

To find out more visit: <http://conferences.theengineer.co.uk> ©

Jon Excell Editor
jon.excell@centaurmedia.com

UK subscriptions £75 pa UK/£117 pa overseas. Order online at www.theengineer.co.uk/subscribe or by telephone on +44 (0207) 292 3705. All rights reserved. No part of this publication may be reproduced in any form without prior permission from the publisher.

ISSN 0013-7758. Printed by Stones Ashford Ltd, Ashford TN24 8HH Visit www.theengineer.co.uk for constantly updated news, products and jobs and to sign up for our FREE weekly email newsletter and tailored job alerts

the ENGINEER

Centaur Media Plc, 79 Wells Street, London, W1T 3QN

Direct dial 020 7970 followed by extension listed Advertising fax 020 7970 4190 **Editor** Jon Excell (4437) jon.excell@centaurmedia.com **Features editor** Stuart Nathan (4125) stuart.nathan@centaurmedia.com **Senior reporter** Andrew Wade (4893) andrew.wade@centaurmedia.com **News editor** Jason Ford (4442) jason.ford@centaurmedia.com **Recruitment advertisement manager** Michael Whitehead (020 7970 4678) michael.whitehead@centaurmedia.com **Senior sales executive** Jason Padam (4677) **Commercial director** Sonal Dalglish (4487) sonal.dalglish@centaurmedia.com **Commercial manager** Peter York (4942) **Production** Lyndon White, Wendy Goodbun (4807) te.production@centaurmedia.com **Publisher** Simon Lodge (4849) simon.lodge@centaurmedia.com **Subscriptions & Customer Services** tecirc@centaurmedia.com

AUTOMOTIVE

Fund is vehicle for low-carbon future

Awards will help companies commercialise low-carbon vehicle technologies HELEN KNIGHT REPORTS

Technologies to advance autonomy and reduce the greenhouse gas emissions produced by cars and other vehicles are being

developed in the UK following a £62m funding announcement.

The Advanced Propulsion Centre (APC) has announced funding for seven projects, with the aim of helping companies develop and commercialise low-carbon vehicle technologies.

One of the projects being funded by the APC is a collaboration between BMW, Delta Motorsport and WMG at Warwick University. The project will design, develop and manufacture more power-dense batteries.

The project is aiming to increase the power density of lithium-ion batteries, and thereby reduce the weight of the devices in the medium term, according to Graham Biggs, a spokesperson for BMW.

Researchers at WMG will be providing the electrochemical know-how for the project, which will aim to develop the technology to the

stage at which it is ready to enter production, said Biggs.

"The project does not include the actual production [of the batteries], but the idea is that this technology could then appear in BMW Group production vehicles," he said.

The team is hoping to achieve a power density of 5kW per kilogram, or around three times that of existing lithium-ion batteries. It hopes to promote the uptake of battery electric and plug-in hybrid vehicles, in a bid to reduce pollution levels and improve air quality, and to increase the overall efficiency of the car fleet.

"The car industry sees electrification as a massively important initiative, and a fundamental part of that is the improvement of battery performance, in terms of energy density and recharge time," he said. "The challenge is to get a stable battery that can be charged and discharged quickly."

Another consortium receiving funding from the APC is aiming to develop more environmentally friendly tractors. This consortium, led by New Holland Agriculture, which is owned by Netherlands-based CNH Industrial, is

aiming to improve the performance, autonomy and efficiency of the company's existing concept natural gas tractor.

The project will attempt to overcome substantial technical challenges to develop the tractor to a level at which it can compete with conventional diesel-powered vehicles, the company said.

The project will also consider opportunities to further reduce the tractor's environmental footprint by linking it with anaerobic digestion plant technology. These plants break down biodegradable material to produce fuels such as renewable natural gas, which could then be used to power the tractor. The project could significantly reduce the carbon footprint of agricultural tractors used on farms, the company said.

Other projects receiving funding include a Jaguar Land Rover-led consortium to develop new lightweight vehicle technology, designed to allow carmakers to reduce emissions while maintaining performance, and a Penso Consulting project focused on complex composite structure manufacturing.

Williams Advanced Engineering will lead a project to develop high-performance, cost-competitive batteries, while Ford will be working on a project to develop combined system optimisation. Finally, Westfield Sportscars will be leading a consortium to produce a compact hybrid powertrain for use in niche vehicles such as driverless pods.

Altogether, the projects are expected to create or safeguard 2,370 jobs in the UK automotive industry. ©

A consortium led by New Holland Agriculture is aiming to develop more environmentally friendly tractors



Read more online

Aerospace

Uber plans on-demand flying taxi service

Automotive

Toyota unveils hydrogen-powered truck

Civil & Structural

Team develops system to 3D print buildings

Defence & Security

Roundtable report – innovation in defence

Electronics & Communications

New technique analyses battery failure

Energy & Environment

Radar-based technology aims for improved wind farm operations

Manufacturing

3D printing a Tour de France winner

Medical & Healthcare

Mending menisci with 3D-printed hydrogel

Policy & Business

Pharma industry urges healthcare investment

Process

Composite catalyst performs four sequential reactions

Rail & Marine

Rolls-Royce sets course for autonomous shipping

For
news
and jobs
theengineer.
co.uk

EtherCAT



Tool-free installation in 3 easy steps: the AX8000 multi-axis servo system.



www.beckhoff.co.uk/AX8000

With the highly compact AX8000 multi-axis servo system, Beckhoff enables quick installation and commissioning of high-performance drive equipment in just 3 easy steps:

1. Fast and tool-free module connection with the new AX-Bridge quick-connection
2. Safe and simple motor connection with plug connector on the AX8000 underside
3. Reduced number of cables and installation cost with One Cable Technology

At the same time, the AX8000 system brings high performance in a compact design into any control cabinet: with maximum control speed and 17 drive-integrated TwinSAFE functions.

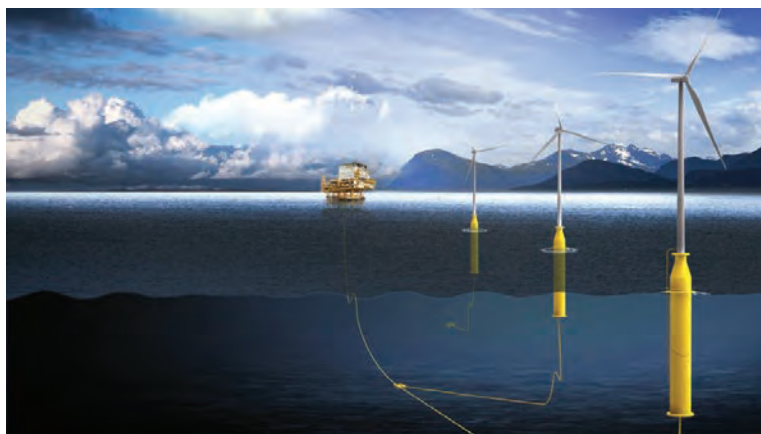


New Automation Technology **BECKHOFF**

RENEWABLES

Wind strikes blow for recovery of oil

Project investigates floating turbines powering water injection systems HELEN KNIGHT REPORTS



Floating turbines can aid enhanced oil recovery

Wind power could be used to help recover more oil from offshore fields, thanks to a project investigating floating turbines powering water injection systems.

In enhanced oil recovery, water is pumped into a reservoir to increase the pressure, stimulating production and helping to extract more oil from the well. In a project known as WIN WIN, or Wind-powered Water Injection,

researchers led by the classification society DNV-GL have used a floating wind turbine to generate the electricity needed to power the water injection system, according to project manager Johan Slätte.

"There is a big focus in the oil and gas industry at the moment on identifying means of reducing the environmental footprint," he said.

"There is also a drive to give oil and gas operators a means of establishing water injection facilities further from the host platform."

By using floating wind as the power source, operators could locate offshore

water injection systems where they are most needed, instead of being governed by their distance from the host platform, Slätte said.

The project team has spent the past year developing and evaluating the concept, which consists of a stand-alone system, including pumps and basic water treatment, and assessing its technical and commercial feasibility.

It has concluded that the concept is not only technically feasible, but capable of competing on costs with conventional water injection systems, he said.

As a result of this assessment the team, which in the first phase of the project also included ExxonMobil, Nexen Petroleum UK, Statoil and the UK's Offshore Renewable Energy Catapult, among others, concluded that wind power could be used to power offshore water injection.

In a second stage of the project, which will involve DNV-GL, ExxonMobil, ENI Norge and the Norwegian Research Council, and is expected to last for up to two years, the team will now move on to refine and test the electrical systems used in the concept.

This will include physical testing of the electrical systems at DNV-GL's laboratories at Arnhem, in the Netherlands, to monitor how they perform over time with a variable power input.

"Over the next two years we hope to validate some of the questions we have, and do physical testing of the electrical system, to ensure that it works as we anticipate," said Slätte.

If the tests are successful, the team hopes to move onto a pilot project with a full-scale prototype by 2020. ©

Newsinbrief

Train time

HS2 Ltd has opened the £2.75bn competition to design, build and maintain Britain's next generation of high-speed trains. The successful bidder will work with HS2 Ltd to develop around 60 trains to transport passengers across the country on the new high-speed rail network and onto the existing railway.

Global goal

Canada's SNC-Lavalin is to acquire Surrey-based WS Atkins for \$3.6bn, a move that creates a \$12bn global professional services and project management company. Active as a global consultancy in design, engineering and project management, Atkins currently has 18,000 employees and generated revenues of approximately £2bn in 2016.

Chinese drive

Production of GKN's electrified drivelines will be centred in China from 2018 when production of its eDrive technologies commences at its joint venture facility in Shanghai. GKN forecasts that its Chinese joint venture – Shanghai GKN HUAYU Driveline Systems (SDS) – will produce over one million eDrive units per year by 2025. SDS is scheduled to manufacture the GKN Driveline Multimode eTransmission for a domestic Chinese automaker from 2018.

Trump card

Britain's steelmakers have warned that UK steel exports to the US could be damaged by US protectionist measures to counter the dumping of cheap Chinese steel. The warning comes on the back of President Trump's initiation of a 'Section 232' investigation into the effects of steel imports on US national security. Total exports to the US in the last 12 months were 250,000 tonnes, worth £350m.

MATERIALS

Beads clean up for washing machines

Xeros offers retrofit for water saving

HELEN KNIGHT REPORTS

A British technology in which polymer beads are used to help remove soil from clothing, reducing the amount of water consumed, can be retrofitted onto conventional washing machines.

Xeros, the Leeds University spin-out that developed the polymer cleaning technology, has announced the launch of its Symphony Project, to provide washing machine manufacturers with 'open-source' access to its system.

In a Xeros washing machine, detergent and a small amount of water are used to lift dirt from clothing during the agitation phase. This dirt is then absorbed by the polymer beads.

Water is used to pump the beads into the wash, and the same water is then re-circulated through the system to repeat the process, according to Jonathan Benjamin, global president of cleaning technologies at Xeros.

"It looks like a normal washing

machine. All that is really different from a mechanical point of view is that the beads come into the wash drum, and are exited through the perforations in the drum and go back into a sump," he said. "They then get recycled."

In commercial use, the machines have shown they can reduce water consumption by at least 75 per cent per load. Now the company has developed a retrofit pedestal, which can integrate the cleaning system into conventional machines.

"All aspects of Xeros technology, in terms of the pump, the insertion into the drum and what comes out, are fixed in a very neat and tidy pedestal that can be attached to a number of different brands, said Benjamin. ©

For
news
and jobs
theengineer.
co.uk

Test Stand Solutions

- ✓ Testing equipment for e-mobility
- ✓ Rolling road and brake test stands
- ✓ Engine test stands
- ✓ Transmission/Gearbox test stands
- ✓ Generator test stands
- ✓ Pump test stands
- ✓ Component test stands

Our cutting edge drives and motors technology ensures:

- Performance & functionality for effective control solutions
- Highly accurate, realistic & reliable results
- Long term industrial expertise
- We offer design, installation, commissioning, and after sales support and training

Visit www.nidecautomation.com



Control Techniques™
Leroy-Somer™

NUCLEAR

Cool things down inside the reactor

Technology could deal with extremely hot plasma exhaust

HELEN KNIGHT REPORTS

Nuclear fusion has long held out the promise of clean, safe energy but dealing with the extremely high temperatures generated in the reactors is no easy task.

Now the UK's nuclear fusion experiment MAST Upgrade, at Culham in Oxfordshire, is to receive £21m to investigate new technology to cool the extremely hot plasma exhaust produced by the reaction.

Inside a fusion reactor, light atomic nuclei are fused together to form larger ones, releasing a huge amount of energy in the process.

This is achieved by confining the gas within a magnetic field and then heating it to temperatures of around 150 million celsius, according to Dr James Harrison, Tokamak science programme delivery manager at Culham Centre for Fusion Energy.

The hot fusion plasma exhaust is then passed through an area of the reactor known as a 'divertor' to allow it to dissipate some of this excess heat.

However, the extremely high temperatures involved mean the exhaust particles would damage the surfaces of a conventional divertor, meaning components would require

regular replacement, which adds to the cost of the electricity produced.

"As the super-heated gas is gradually transported away from the hot fusion-producing part of the machine into the area where it is exhausted, it comes into contact with solid surfaces of either tungsten or carbon, which are typically much closer to room temperature," said Harrison. "The super-heated plasma can heat the surfaces, leading to gradual melting or erosion of the material over time."

So the fusion researchers are investigating the use of a new 'Super X' divertor, which is designed to cool particles down by sending them on a longer exhaust path out of the plasma.

"The Super X divertor aims to take the exhaust plasma, which has a very high density, and expand that into a much larger volume," said Harrison.

This allows heat to be radiated away before it reaches solid material surfaces, he added.

The funding, from the European fusion research consortium EUROfusion and the EPSRC, will allow the researchers to improve their understanding of plasma exhaust physics, and to carry out better predictive modelling for the proposed prototype commercial fusion power plant, known as DEMO. ☐



The nuclear fusion experiment will receive £21m in funding

AUTOMOTIVE

London to Oxford

Consortium gets set for major autonomous vehicle trials

The world's first Level 4 autonomous vehicle trials are set to take place in the UK over the next 30 months.

Led by Oxbotica, the DRIVEN consortium will deploy a fleet of fully autonomous vehicles in urban areas and on motorways, culminating in an end-to-end journey from London to Oxford.

With Level 4 autonomy the vehicles will be capable of performing all safety-critical driving functions and monitoring of road conditions for an entire trip with no passenger occupancy.

Key challenges the consortium will address include: communication and data sharing between



Oxbotica is ready for the trials

connected vehicles; connected and autonomous vehicles insurance modelling; risk profiling and the new cybersecurity challenges that this amount of data sharing will bring.

Part of the consortium's work includes the use of a fleet of six inter-communicating vehicles equipped with Selenium, Oxbotica's vehicle manufacturer (OEM) agnostic software. **JF**

PROCESS

Keeping toxic elements out of the food chain

New scanner can spot carcinogenic substances

HELEN KNIGHT REPORTS

A laser scanner designed to detect cancer-causing compounds in products could help to prevent toxic substances entering the food chain.

A carcinogenic substance called acrylamide can be formed when starchy foods such as potatoes are cooked at high temperatures.

Now a new technique, developed by Lien Smeesters, a researcher in the B-PHOT Brussels Photonics Team at the University of Brussels, alongside Tomra Sorting Solutions, has been designed to spot potatoes that will

go on to form high levels of acrylamide before they are cooked.

Existing chemical analysis techniques are typically slow and destructive, meaning the product cannot be used once tested. What's more, carcinogenic substances can form in localised areas of the product. "This means that you could take a sample of bread, and the sample could be completely healthy, while in another part of the same loaf, there could be contamination present," she said.

The new scanner will be integrated into food-sorting machines built by Tomra, which has filed a patent on the technology. As the potatoes travel along the conveyor belt, they are sent into freefall, where they are illuminated by different lasers optimised to detect food stuffs and contaminants.

The infrared laser light passing through the food is scattered by the tissue inside, in a process known as spatially resolved spectroscopy.

Bad potatoes, with high levels of acrylamide precursors, will generate a different scattering signal to healthy potatoes. ☐



The technique could spot cancer-causing compounds in food



Helping our clients achieve success
through great product design

SENSORS

Focusing attention on the key objects

Video camera uses light-sensitive pixel to build up moving images

HELEN KNIGHT REPORTS

Researchers in Scotland have developed a video camera that mimics the mammalian brain by focusing visual attention on the most important object in a scene.

The sensor, developed at Glasgow University, uses one light-sensitive pixel to build up moving images of objects.

The device, unveiled in *Science Advances*, prioritises important objects in the scene, devoting less processing power to peripheral regions.

Single-pixel sensors are much cheaper than the megapixel devices in digital cameras, and can create images at wavelengths where cameras are expensive or do not exist, such as at infrared or terahertz frequencies.

The sensors consist of a conventional lens and a digital micromirror device (DMD), which is made up of a number of mirrors. Each mirror can be individually switched on, to transmit the light from that section of the scene to the sensor, or switched off, to block the light. Chessboard-like masks, in which half of the mirrors are turned on and half are turned off, are used to create the patterns that are displayed on the DMD, according to Dr David Phillips, who led the research.

But unlike previous single-pixel cameras, the new sensor can determine which parts of the scene should be higher resolution, and which should be lower, for each sequential frame, he said.

"I need to make the same number of mask pattern [light] measurements

as I want pixels in my final image," said Phillips.

So by using larger pixels at the edge of the scene, researchers can reduce the total number of pixels in the image, he added.

"This means we can make fewer measurements of the scene, so we can get a higher frame rate, by trading the resolution," said Phillips.

To allow the camera to operate autonomously, the researchers have pre-loaded it with a large number of DMD grid patterns. "The camera looks at its previous images to identify changes in the scene from one image to the next," he added.

It then selects the grid pattern that will put the high-resolution areas over those parts of the scene where something has changed, he said. ©



The sensors consist of a conventional lens and a digital micromirror device

MEDICAL

Detect tinnitus by putting on headphones

Technology designed for standard earpieces

ANDREW WADE REPORTS

Cambridge-based Plextek has developed a device that it says can detect the early signs of tinnitus and can be integrated into everyday consumer headphones.

According to the NHS, tinnitus affects around 10 per cent of the population in the UK, with around 600,000 (one per cent) affected severely. Characterised as the experience of sound when no external sound is present, it often manifests as ringing in the ears. Early intervention can be crucial to mitigating the worst of its effects, but the technology to test for the early signs of tinnitus is generally only available in hospitals.

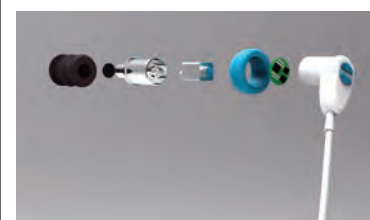
Plextek's technology is designed to work with standard headphones, enabling early detection outside of clinical settings. It measures changes to auditory evoked potentials (AEPs), signals sent by the brain in response to an auditory stimulus. Using a regular laptop and a USB audio card, Plextek was able to record AEP brain activity using in-ear and over-ear headphones.

The system enables people to test their hearing daily and gain a 'fingerprint' of their AEP response. This fingerprint flags very small changes in the hearing profile, enabling the user to limit any hearing damage.

In a statement, Collette Johnson, head of medical at Plextek, said: "The danger of hearing damage is not always immediately obvious.

"However, our modern lifestyle has meant loud music and noise pollution is commonplace. By placing detection technology within consumer products, everyone can constantly self-monitor and act quickly on a condition such as tinnitus, that often has life-changing effects on sufferers." ■

The system allows daily hearing tests



MILITARY

BAE Systems makes Astute move

Submarines will be armed with tomahawk missiles

BAE Systems has been awarded £1.4bn by the Ministry of Defence to deliver the next Astute-class submarine to the Royal Navy.

Agamemnon will be the sixth of seven nuclear-powered attack submarines designed and manufactured at BAE's site in Barrow-in-Furness, Cumbria.

Will Blamey, managing director of BAE Systems Submarines, said: "The Astute-class submarines are among the most highly capable and technologically advanced in the world and we're immensely proud to build them for the Royal Navy."

With a top speed of 30 knots and 7,400-tonne displacement, the 97m-long Astute-class submarines are the Royal Navy's next generation of attack subs. Armed



with spearfish torpedos and tomahawk cruise missiles, they are claimed to be the stealthiest of their type.

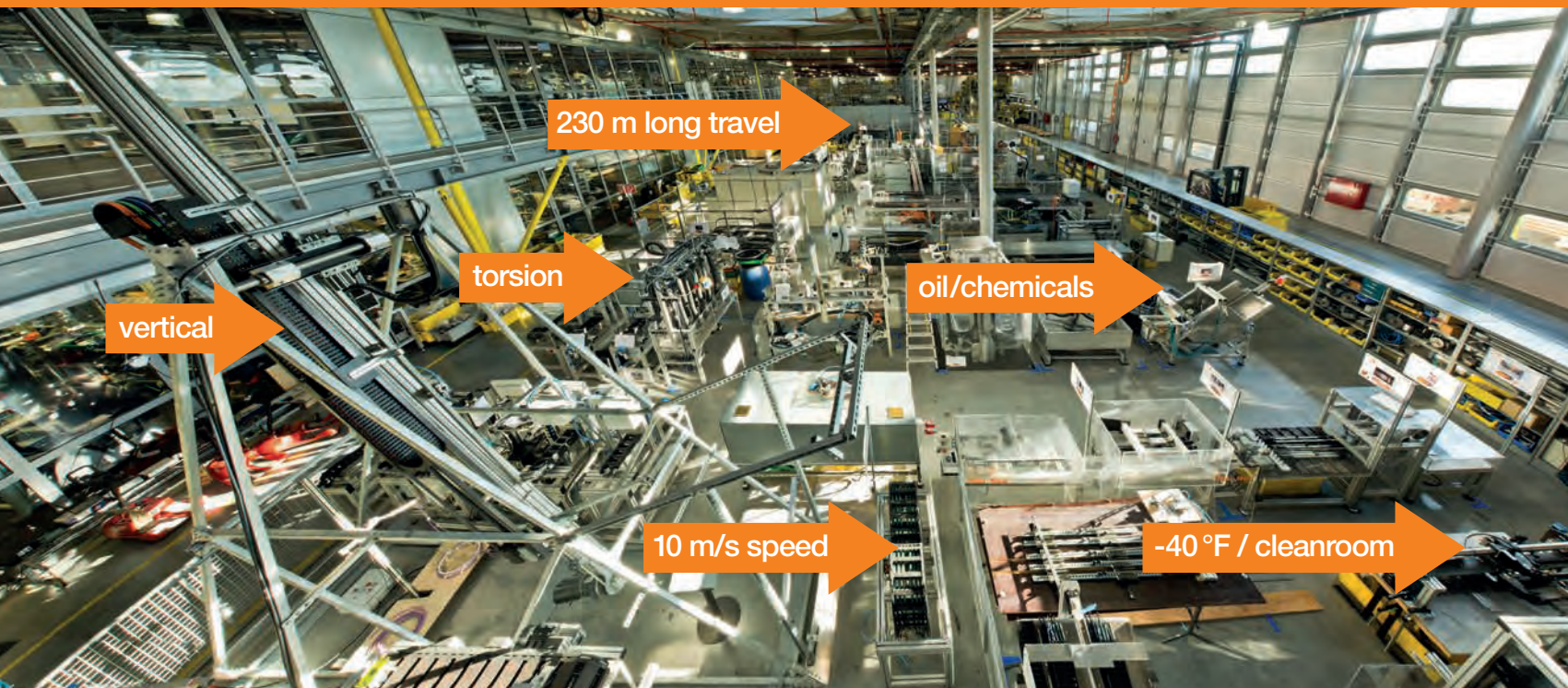
The first three Astute-class submarines HMS *Astute*, HMS *Ambush* and HMS *Artful* are in service with the Royal Navy.

BAE Systems is also industrial lead for the Dreadnought programme, the Royal Navy's next generation of submarines that will carry nuclear weapons. **JF**

Largest test lab for continuous-flex cables

#1

... number one
in moving cables



Widest selection. Unmatched Testing. 36 Month Guarantee.



Reduce downtime with chainflex®

- Developed & tested in the 2750 m² lab
- 600 tests run in parallel
- 1.4 million electrical measurements/year
- 2 billion test cycles/year



Shop now: www.igus.co.uk/chainflexshop
Free samples available: www.igus.co.uk/cf-sample

igus®
plastics for longer life®

sales@igus.co.uk
Tel 01604 677240

MEDICAL

Implants will show some resistance

Designs and 3D-printing techniques produce surfaces that resist bacteria

HELEN KNIGHT REPORTS

Prosthesis implants with enhanced resistance to bacterial infection could improve patient safety while reducing the use of antibiotics.

Most prosthetics carry a low risk of infection of below 1 per cent. But where implants are inserted following an accident, or must be produced at the hospital, the risk of infection can increase to 50 per cent.

Treating an infection involves removing the prosthetic and implanting a material that releases high levels of antibiotics to the site. This not only threatens the health of the patient, but risks adding to the rise of antibiotic-resistant bacteria.

Now, in an EPSRC-funded project, researchers at Birmingham

the prosthetics, according to Birmingham's Prof Liam Grover.

Using selective laser melting, they will use lasers to fuse powders together to create a porous structure onto which the bacterial-resistant silver can be added. Their first target for the technology will be to reduce infections following the implantation of metal plates into the skull.

These cranial implants must be refined to fit the patient. They are typically produced in hospital by

bending a titanium sheet over a 3D-printed model of the defect. They are then polished and dipped in acid, before being sterilised at over 100°C.

While this process typically kills most bacteria, the plates still carry a much higher risk of infection than other implants produced off-site.

"Obviously, if you have an infection near the brain, it can be really dangerous," said Grover. "We think we can have a significant impact into reducing infection in this particular class of patients."

The researchers also aim to alter implants to be imaged by MRI scanners. They will use topological optimisation to minimise the mass of titanium used while maintaining its mechanical properties.

The researchers will be working with clinicians at University Hospitals Birmingham and the Royal Orthopaedic Hospital NHS Foundation Trust, as well as Accentus Medical and Johnson Matthey. ©



Cranial implants must be refined to fit the patient

"We think we can have a significant impact in reducing infection among some patients"

Prof Liam Grover

University are developing implant designs and 3D-printing techniques to produce surfaces that are resistant to bacterial contamination.

The team will combine technology to embed silver into the material used to build implants, with additive manufacturing to produce

NUCLEAR

Looking after the nuclear 'orphans'

Waste could be trapped for geological disposal

HELEN KNIGHT REPORTS



Some waste is difficult to deal with

The same concept behind efforts to prevent greenhouse gases being emitted from fossil-fuel power plants could be used to trap radioactive waste for geological disposal.

In an EPSRC-funded project, researchers at Strathclyde University are developing a new approach to treating 'orphan' nuclear wastes.

Orphan wastes are radioactive wastes that cannot be dealt with in existing processing plants, and for which there is no accepted treatment option. The researchers, led by Dr Joanna Renshaw, are investigating the potential of a three-stage treatment process, in which the waste is first smouldered to burn the carbon.

This would produce a small volume of stable radioactive ash that can be encapsulated in cement, for example, and then placed in a steel or concrete container for future geological disposal.

The radioactive emissions released during the smouldering process – microscopic particles of radionuclides and carbon dioxide gas containing the radioactive element Carbon 14 – would then be trapped using a similar technology to that used in carbon capture and storage.

Bacteria would be used to stimulate the production of carbonate and phosphate minerals, removing the radioactivity from the gases and capturing it in stable rock form.

To reduce the amount of radioactive material requiring disposal, this mineral formation stage could be carried out as part of the encapsulation process, the researchers hope.

In this way the mineral would be used to encapsulate the radioactive ash, or other waste, before it is placed in a container. ©

RENEWABLES

Green light for tidal energy

Installation site is in Holyhead Deep

Natural Resources Wales has approved a marine licence application by Sweden's Minesto for the installation of a 0.5MW Deep Green tidal energy power plant.

The initial device will demonstrate the technology ahead of plans for installing a 10MW array at the site. The installation site is located in the southern corner of Holyhead Deep, 6.5km off the coast of Anglesey.

The first phase of the project will include a single Deep Green device unit, seabed foundation and a surfaced moored buoy, with installation planned this year.

Holyhead Deep marks the starting point of the industrialisation of Deep Green technology, which is the first low-velocity tidal energy project in the world.

Holyhead Deep matches all the site requirements by providing low-flow tidal velocities (1.5-2m/s mean peak flow) at a depth of 80-100m. Following successful deployment and testing of the first installed power plant, more Deep Green devices will be installed to form a tidal energy array. **JF**

Managing Safely helps us drive a better business.

Craig Barker CMIOSH
Head of Safety and Environment
National Express

We have 1,700 staff, cover millions of miles every year and have an enviable reputation to protect.

We take our responsibilities to our people, and to the public, extremely seriously.

We embarked on the IOSH *Managing Safely* course for our entire management team because we wanted to motivate, educate and train everyone in the business to recognise and manage hazards as well as challenge unsafe behaviours.

In practical terms that means fewer collisions, a reduction in passenger and employee injuries and less lost time as a result of injuries.

The *Managing Safely* course was precisely tailored to suit the needs and ambitions of our business. So every module, every practical exercise and every discussion was directly relevant to our day-to-day operation.

It's been hugely successful.

In 2015, the changes in our approach to safety led to a direct cost saving of £146,000. That's an annual figure and we intend to improve upon it year on year.

We won't leave safety to chance at National Express. That's why *Managing Safely* works perfectly for our business.

For more details about IOSH's *Managing Safely* and other training products call +44 (0)116 257 3192, email courses@iosh.co.uk or visit www.iosh.co.uk/training

AEROSPACE

A vertical air of experimentation

Aircraft designed to transition from vertical take-off to horizontal flight STUART NATHAN REPORTS

The Aurora Lightning Strike XV-24A, one of the most advanced experimental aircraft created by the US, has successfully concluded test flights

of a scaled-down model.

Designed to transition from vertical take-off and landing to horizontal flight using electrically powered vectored thrusts, the full-scale aircraft is currently in production and aiming for flight tests later next year.

The XV-24A is funded by the US Defense Advanced Research Projects Agency (DARPA) and has been developed by Aurora, a Virginia-based specialist in

with a single Rolls-Royce AE-1107C turbofan engine driving three Honeywell megawatt-scale generators, providing the power for 24 ducted fan thrusters housed between double-layer wings and forward canard.

These rotate to orient the fans vertically for take-off and landing, and horizontally for normal flight, in the same way as a tilt-rotor aircraft operates. However, the experimental aircraft is intended to be faster and to have a larger range than an Osprey.

The proposed mission type for the XV-24A has not yet been revealed. However, earlier in the project DARPA stated that the aircraft was to have a top sustained flight speed of 300 to 400 knots (345 to 460mph), twice as fast as a helicopter; hover efficiency of 75 per cent as opposed to 60 per cent for comparable aircraft; have a favourable cruise lift-to-drag ratio of 10, up from five to six for other VTOL aircraft; and the ability to carry at least 40 per cent of its own weight. It will be the first aircraft in history to use distributed hybrid electric propulsion with a synchronous drive system.

"We have pursued, developed and flown an extraordinary aircraft and matured key and innovative technologies in support of the future of vertical flight," said Aurora founder and CEO John Langford. "This is clearly an achievement like no other, and will be surpassed only by the flight of the full-scale aircraft." ©

The Aurora Lightning Strike



"We have pursued and developed an extraordinary aircraft"

John Langford,
Aurora

autonomous flight. The full-scale aircraft is envisaged as having an 18.5m wingspan.

The scale model is 20 per cent of the size of the full aircraft and weighs 147kg compared to the full aircraft's 5.5 tonnes. The model is powered by lithium-ion batteries, whereas the full-scale aircraft will be equipped

MARINE

Tunnelling will help navigate tricky waters

Full-scale ship tunnel will be in the Stadhavet Sea

JASON FORD REPORTS



Norway is to build the world's first full-scale ship tunnel in the Stadhavet Sea, a hazardous region of coastline that is difficult to navigate.

At an estimated cost of £245m, the 1,700m-long Stad Ship Tunnel will take approximately three-to-four years to build and will require the removal of three million cubic metres of rock.

The project will be delivered by the Norwegian Coastal Administration (NCA) with construction expected to begin in 2019. Once complete, the tunnel will have a ground-to-ceiling height of 49m, a cross-sectional area of 1,625m² and have a width of 36m between tunnel walls.

In use, the tunnel will prioritise commercial shipping, although leisure vessels will also be allowed.

"There are still many pieces of the puzzle that need to be put into place before construction can start, but we have previously stated that the actual construction could be at the earliest in 2019," said Terje Andreassen, project manager for Stad Ship Tunnel at NCA.

Located at the narrowest point of the Stad Peninsula, the tunnel is expected to lessen the risks associated with sailing in the region. According to NCA, the Kråkenes Lighthouse, just south of Stad, can experience between 45 and 106 days of stormy weather per year. The combination of wind, currents and waves around make it a challenging part of the Norwegian coast.

NCA added that the combination of sea currents and subsea topography creates complex navigation. Very high waves come from different directions simultaneously and can create critical situations. The conditions also cause heavy waves to continue for a number of days once the wind has subsided. ©

AUTOMOTIVE

China makes electric moves

China is the world's largest market for electrified cars and has targets to expand sales in this arena

Volvo Cars will build its first fully electric car in China, the company announced at Auto Shanghai in April 2017.

The company said the all-new model will be based on its Compact Modular Architecture (CMA) for smaller cars, and will be available for sale in 2019.

Håkan Samuelsson, chief executive of Volvo Cars,

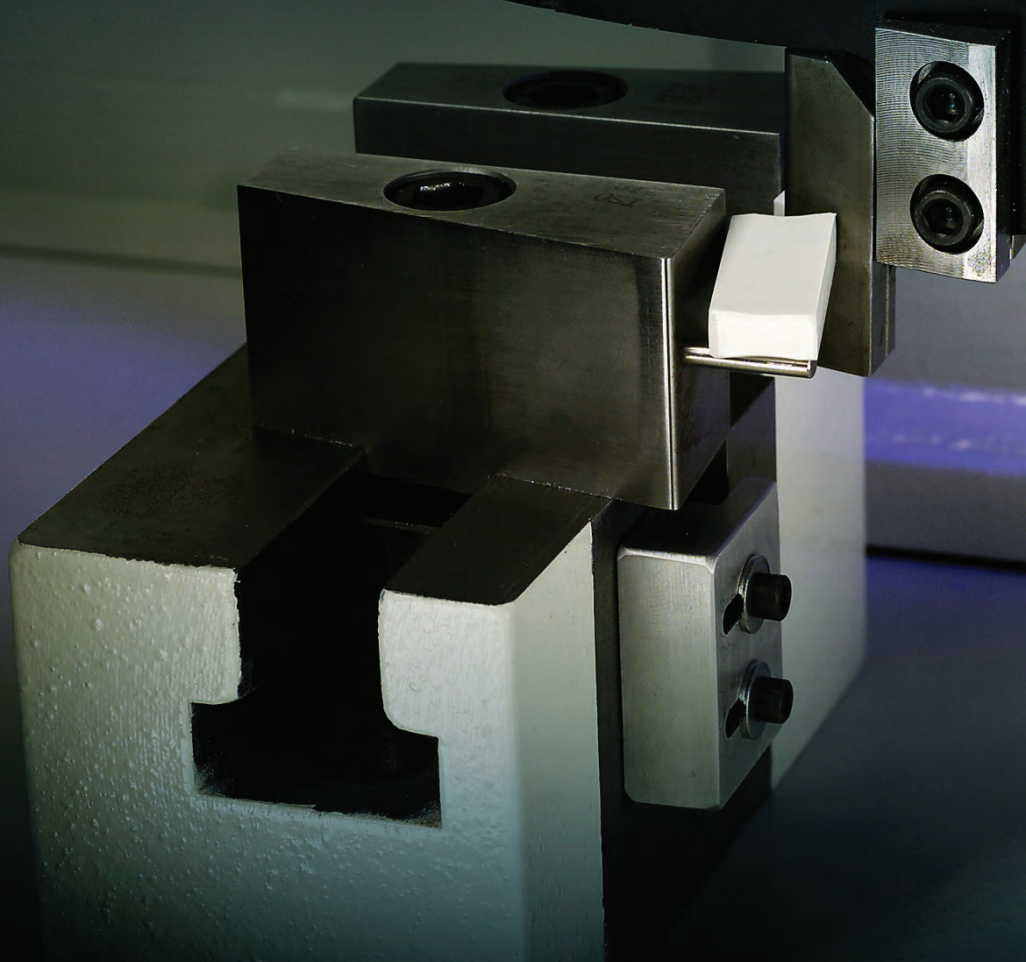
said: "Volvo Cars fully supports the Chinese government's call for cleaner air as outlined in the latest five-year plan.

"It is fully in line with our own core values of environmental care, quality and safety. We believe that electrification is the answer to sustainable mobility."

China is the world's largest market for electrified cars, and has targets to expand sales of fully electric and hybrid cars in order to address congestion and air-quality issues in its cities.

Volvo said it has a commitment to sell a total of one million electrified cars – including fully electric cars and hybrids – by 2025. **JF**

The first name in materials testing



- Tension
- Compression
- Flexure
- Shear
- Puncture
- Peel
- Tear
- COF
- Melt index
- Impact
- Vicat/HDT
- Hardness

All tests can be performed in accordance with
ISO, BS, ASTM and industry specific standards

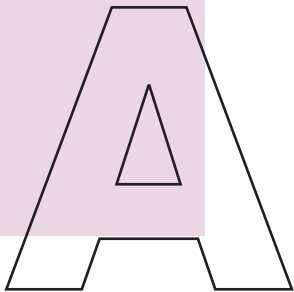
www.tiniusolsen.com

sales@tiniusolsen.co.uk

01737 765001

Another year, another election

Whichever party wins in June, the government's first priority should be a smooth Brexit strategy and a commitment to economic growth



another year, another election. Business is now familiar with the seemingly endless cycle of plebiscites and the uncertainty they inevitably create. With Brexit looming in less than two years' time, if we are to end this

uncertainty then what companies now need is a firm pledge from all political parties to commit to policies that support a deal with the EU, deliver economic growth, and a meaningful industrial strategy.

On 9 June, whichever party wins a mandate, the government's first priority should be to commit to a smooth Brexit strategy that leads to a positive deal for both the UK and the EU. This must ensure that businesses in Britain can continue to trade seamlessly with our EU partners. While we will no longer be members of the EU, we cannot afford to sacrifice our economy to satisfy a hard political ideology.

Such a deal must guarantee tariff-free access for UK goods into what remains the world's biggest market. There must also be a recognition of EU standards and, if necessary, potential ongoing payment of fees to the appropriate compliance bodies to ensure the UK's input in agreeing potential new regulation. Given that such a complex deal will take time to implement then a transition period of at least five years is imperative.

Business will also want to see a pragmatic and realistic approach to migration. Many manufacturing businesses employ EU staff across a wide range of skills. Any disruption to the flow of talent is damaging for industry. A new immigration system must therefore take into account employers' need for flexibility and the ability to recruit people with the right skills at the right time.

Many UK-based employees also need to be deployed across the EU for varying periods to manage contracts, win business and cement new partnerships. Red tape or political posturing must not be allowed to prevent this free flow of commercial activity and, if this means employers must accept a responsibility and burden of controlling a work-permit system then so be it. This demand-led approach would be far better than any heavy-handed government bureaucracy. The question of the



UK's border with the Republic of Ireland must also be addressed with urgency and a bilateral agreement put in place to manage cross-border traffic, goods and people.

In tandem with securing a positive deal with the EU, the new government must not forget that there is still a day job to do of driving growth and job creation across all regions of the UK. As a first step to demonstrate to business that it recognises this, it should commit to the principles of a wide-ranging and bold long-term industrial strategy. The 10 pillars recently published in the Green Paper remain valid and must become the foundation around which future economic policies and annual fiscal statements are created and implemented.

In particular, any government serious about industrial strategy must invest in clear horizontal policy levers of economic and industrial policy, an area where the UK has consistently lagged. This must deliver a world-class workforce, with technical and vocational training finally recognised as equal to academic qualifications, a secure and affordable energy supply and, more effective transport links

and infrastructure. A new administration must also commit to investing in research and development, both through fiscal incentives and direct funding for innovation programmes, as well as expanding the number of highly successful catapult centres that act as incubators of new technology. These are all basic and critical foundations for delivering growth and the holy grail of tackling the UK's productivity challenge.

Above all, the industrial strategy needs a clear vision, with specific and measurable outcomes, driven by Number 10 and accepted as a core cross-government commitment with recognition of the need for long termism, which competitor nations such as Germany have clearly benefitted from.

Successive governments have identified the UK's weak productivity performance and resolved to tackle it. This time it can and must be different. We now have a real opportunity to make a step change in the UK's economic performance. Let us grasp it.©

Terry Scuoler is chief executive officer of the EEF



Making cars, *faster*

Automotive manufacturers all over the world take advantage of REVO® 5-axis measurement systems to achieve up to 70% cycle time savings on their CMMs.

REVO® – a measurement revolution



High performance power supplies for rugged applications

Relec Electronics offers a wide range of solutions for ac-dc or dc-dc power conversion, whether for train-borne or trackside applications, our engineering team can provide you with the optimum solution from our extensive range of power supplies. Formats include PCB mounting, DIN rail mount, chassis mount & 19" rack mounting.

ac-dc power supplies

dc-dc power converters

Switching regulators

Up to 10:1 input dc-dc input conversion

High efficiency

Proven reliability in the harshest environments

Wide operating temperature range

Self-cooling rugged cases

Conformally-coated assemblies

Excellent MTBF

EN50155; EN50121-3-2; RIA12/13; IEC/EN60950-1



www.relec.co.uk

Tel: 01929 555800

e-mail: sales@relec.co.uk

POWER DISPLAYS EMC

Mailbox

Thehotopic

On politics and industry

News of the forthcoming election prompted a selection of critical commentaries



Successive governments of all colours have consistently ignored advice and warnings from all sides and pushed their political agendas to the detriment of the UK population. Closing down manufacturing and investing in banking and insurance – how well that worked. Banks went bust; we bailed them out; bankers made a

fortune; we sell the good bits for pence and keep the bad bits. Bankers make another fortune; nobody went to jail. As for the NHS, railways, defence and energy security – when politicians get involved you just know it will be over time, over budget and a complete dog's dinner.
1saveenergy

Unfortunately, with so few MPs having an industry background, and only a handful being engineers, we have a long history of none of the parties being good at strategy on manufacturing, energy policy and so on. But the current government appears to be making more effort than we have seen for some time.

Andrew Smith

Looking at the UK from the outside – and as a European I have a vested interest – the Liberal Democrats seem to be the only party that really appreciates the insanity (and collective irresponsibility) of Brexit. Pity that you don't have a proper electoral system. PR works a lot better than first past the post in that the wishes of the electorate have some chance of being equitably represented.

William Dick

Without seeing any manifestos I can't make any informed judgement. One thing I do like is the Labour Party's plans for an investment bank to invest in new UK business ventures. We lack the mass of innovative investors that fund the many start-ups in Silicon Valley; why shouldn't the government step in to help our own innovators?

Eric Christison

Every party in Germany is committed to the very best possible vocational training. Presently there are over 1.5 million apprentices in Germany and 60,000 unfilled ones.

Ron Simmonds

My vote goes to the Green Party. Hopefully they won't waste money on wars. We need that money to pay minimum wage and to pay stipends to apprentices and university students. We don't want them to waste their life in part-time work. Their job is to study and become ready for industry and society.

Nick Duddle

Inyour opinion

Parking problems

The VW Tiguan review in our April issue triggered a debate on self-parking technology

Great. Now the SUV drivers who think that they are driving a 2.5m-wide vehicle can reverse park it parallel and, more importantly, between the lines. I can still foresee a problem: as vehicle width has increased to accommodate the increasing width of us humans, the parking-bay width does not seem to have. How does this system overcome the problem of not being able to open the door(s) wide enough to get out of the vehicle? Does the reverse park mode allow for the driver and passengers (if any) to exit the vehicle before it parks itself? On return, will it

self-drive out of the bay to allow the occupants to enter the vehicle?

Keith Nuttall

I would have thought that a feature that allows you to get out of the car before it parks itself in a tight spot would be self-defeating. If the owners of the cars either side did not have the same function you would return to find a couple of irate shoppers waiting for you. Plus, you would be causing a traffic jam while putting your children, dogs or shopping back into the car on your return.

David Hogan

David, your comments are valid, and something I wondered about also. I have experienced coming back to my car only to find an oversized 'pavement hopper' parked so badly that I've had to lean in, release the hand brake, and roll my car out so I could get in; not a particularly safe operation. Any other thoughts anyone?

Keith Nuttall

Gentlemen, you both have great comments and recommendations. What if a car could slowly come out of its parked region and drive to where you are waiting for it, say on the side of the store you just shopped in? That would be similar to someone swinging by to pick you up.

Ranieri Nicola

The VW system will indeed drive itself back out of the space (again under supervision with the driver controlling the brake and accelerator). There are already some basic remote-parking systems out there – the BMW 7-Series can be driven forwards or backwards in a straight line using a mobile app. There's a legal question with regards to allowing a car to drive itself unaided, but, in engineering terms, I suspect we're very close to fully autonomous self-parking. It's been suggested that would work well with inductive charging for electric vehicles – the car could drop you off and then cruise round to locate a charging spot.

Chris Pickering



The **secret** engineer

Our anonymous blogger fails to be impressed by the burden of extra duties

The gloss of working at Sleepy Hollow Electronics, dear reader, is starting to wear a bit thin. It has taken its time but the honeymoon period is now well and truly over.

The problem is that I have a full-time job in design; I inherited another major chunk of work that owes nothing to my profession, knowledge or experience – and I am now having additional duties piled upon me in order to prevent impending doom.

The full-on aspect of the design role is, of course, absolutely fine. I have previously

affairs so a little longer isn't going to bring it all crashing down around our ears.

The upside is that I am now picking up new experiences and skill sets that will be transferable into other companies. Learning something new, and pushing ourselves is something that we should all try to do. I have never understood the 'I've never done that sort of stuff it's not my thing so I'm not even going to give it a go' mentality.

The problem then lies in the additional duties. From the above I hope you will realise that, even though I'm already spinning a number of

metaphorical plates, it is not the additional work in itself that's the problem. Especially as we are seeking to remove a risk to the company by pushing this project ahead. As a professional I am fully aware that a number of people's livelihoods depend on our success. No, the problem comes about because I and few others are having to really push on with this in order to cover other people's inadequacies.

We have had to commit to long and arduous hours because a sizeable percentage of those involved cannot, or will not, do their share of the work.

You may think that this has resulted in pressure being applied to them and

appreciation shown to us. Not a bit of it. As the weeks go by we have more and more pressure exerted on us without the merest acknowledgement of our commitment while they are effectively excused from their responsibilities.

Importantly, professionalism and loyalty keep us beavering away at our task. I wonder though if this is ultimately detrimental? Whether we rate ourselves highly or not we are undeniably of value to the company and if we allow ourselves to be treated as doormats it does nothing but lower our status in the eyes of others. A corrosive process that once underway is difficult to halt.

I'm not sure what the best response is but I am at a stage in my career where I am comfortable that this is an unsustainable state of affairs. Things will have to change.



worked extra hours when required; something that I am sure you are all familiar with. In my last position I did eight months straight where I never left work on time to cover the fact that the tyrannical MD had signed up to a contract that promised to ruin the company if a particularly difficult deadline wasn't met. To be honest, I could have done without it but I knuckled down and delivered.

A number of years ago, while at Dan Dare Aviation, I pulled a few all-nighters where must-not-miss targets meant working through until about 3 o'clock in the morning. By that time my wife was in bed and frankly it wasn't worth the petrol to go home, so I'd plough on for a few more hours and grab a short nap before putting in another day.

Inheriting another major role means I must ration my time and live with not being able to progress streamlining the design department. This is something needed to nullify the effect of poor working practices prevalent over a number of years. However, the company has survived so far with this parlous state of

**Join
the debate
theengineer.
co.uk**



FAULHABER Drive Systems

The flyweight that packs a heavyweight punch

Brushless DC-Servomotors
3274 ... BP4 series.

In the fight for high performance with minimum weight, FAULHABER with the development of its series 3274 BP4 has put a new champion in the ring. The brushless DC servomotor, measuring 32 mm in diameter and 74 mm in length, has a huge continuous torque of 165 mNm. Furthermore, it weighs in at just under 320 g, which is half that of conventional motors with comparable power.



Distributed exclusively in the UK by

EMS

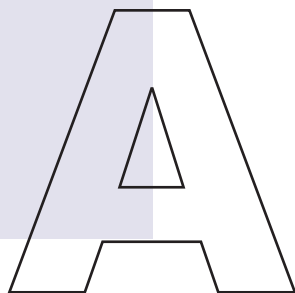
www.ems-limited.co.uk

WE CREATE MOTION



Setting out a firm industrial strategy

A successful industrial strategy is a vehicle for developing a shared vision for an ambitious and forward-looking UK



snap general election on the day we were due to publish.

There are good reasons to believe that an industrial strategy will ultimately be forthcoming. The Labour Party is committed to an industrial strategy, so for the first time in decades the government and the official opposition have been consulting on this policy.

So what are the features of a successful industrial strategy? At its heart, it is a vehicle for developing a shared vision for an ambitious and forward-looking UK, and for creating the policy framework and partnerships necessary to ensure that resources support this vision. An effective industrial strategy must provide a long-term horizon against which industry and other stakeholders can plan their activities with confidence. Cross-party support for the key tenets of the strategy is therefore highly desirable to ensure the main pillars of the strategy are not dismantled wholesale with each change of government. It is also essential that the strategy takes a systems approach in order to align the full gamut of policies – led by different departments and ministers – in favour of sustainable growth.

Perhaps the most consistent concern that has emerged from our consultation is the shortfall in engineering skills at all levels. The report argues that the industrial strategy should reach back into the schools system. It highlights the need for urgent action to address the shortage of STEM teachers in schools, as well as calling for a much greater focus on promoting STEM subjects and careers to under-represented groups to fully unlock the talent potential in the UK. Increasing the number of people with higher-level technical skills (levels 4 and 5) is critical and, while institutes of technology have a part to play, wider national provision and sustained investment in further education (FE) is needed.

The importance of ensuring that the UK is adequately prepared for an increasingly digital future is another strong theme. The report concludes that government must

continue to drive for world-class, secure and resilient digital connectivity and that digital strategies should be developed for all major infrastructure projects. Digital skills should be included in the future definition of basic skills and a comprehensive programme of upskilling developed in partnership with industry and training providers to ensure the UK workforce at all levels has the skills needed to shape and participate in the industries of tomorrow. I would welcome readers' views on the types of digital skills that industry will need over the next five to 10 years as we enter a period of increasing industrial digitalisation.

both UK and international companies, to extend the geographical reach of innovation activities beyond current centres of excellence.

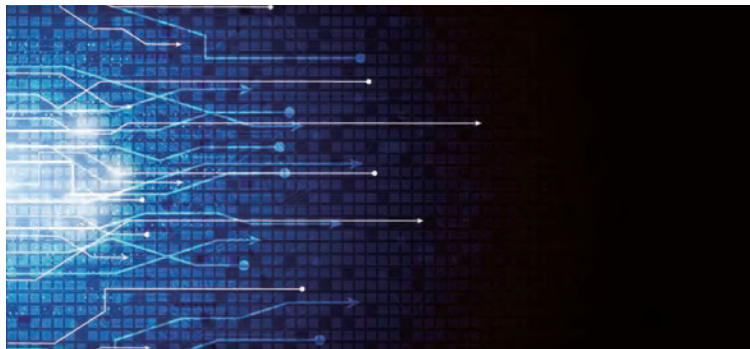
Strengthening innovation performance in SMEs remains a priority for the UK, and the report identifies public procurement as a key lever for promoting this. A radical reboot of the Small Business Research Initiative and greater transparency of procurement spend with SMEs could both help, but without clearer signposting to sources of support, low awareness among SMEs will continue to be a barrier to uptake. Greater exploitation of existing SME contact points such as banks, HMRC and regional networks would help.

Finally, improving energy efficiency and resource productivity are identified as priorities, particularly in buildings and energy networks. The report calls for a long-term, integrated, energy strategy to be developed, drawing on all available low-carbon generation technology, including CCS, nuclear power and heat networks.

Critics of industrial strategy argue that it encourages government intervention in activities best left to the market. However, a good strategy will not make intervention more likely; rather it makes it more predictable, and that builds confidence and supports investment. Our consultation demonstrates that many in the engineering community recognise this and are ready to support the next government in developing a modern industrial strategy that works for all. ©

Dr Hayaatun Sillem is deputy chief executive of the Royal Academy of Engineering

Engineering an economy that works for all is available at www.raeng.org.uk/policy/engineering-policy/industrial-strategy



The report concludes that digital strategies should be part of infrastructure projects

In order to boost investment in research and innovation, the report calls on government to set a target of 3 per cent of GDP for combined public and private research and development investment, and to work with industry to develop a roadmap to achieve that goal. It also suggests that government needs to demonstrate a greater willingness to accept the risk of failure, or perceptions of it, in its innovation support. A UK-wide register of 'national innovation assets', which can serve as test-beds, demonstrators and focal points for skills development, should be compiled and promoted to

HINGES

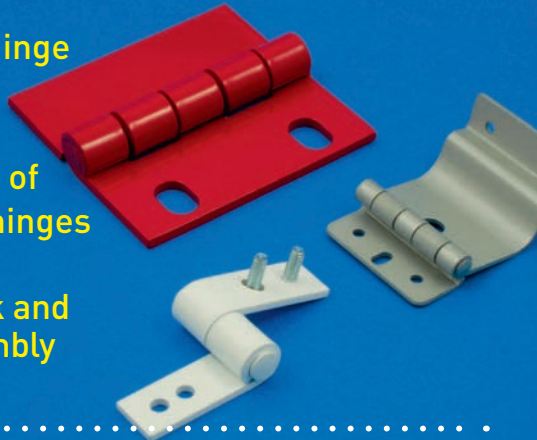
FOR EVERY APPLICATION

BESPOKE AND STOCK HINGES FROM THE
UK'S NO1 SPECIALIST MANUFACTURER

**Bespoke hinge
design**

**Full range of
standard hinges**

**Presswork and
sub-assembly
services**



01827 63391

www.goldwassallhinges.co.uk



Quality hinges for over 200 years

COMPLETE MEASUREMENT SOLUTIONS



Unit 16, Delta Lakes Enterprise Park
The Avenue, Delta Lakes, Llanelli
Carmarthenshire SA15 2DS

The company is run by two partners who have over 50 years experience within a quality environment. Both partners have extensive experience working in dimensional assessment, calibration, quality and supplier quality engineering making us your ideal solution to all your quality requirements.



We offer a fast efficient sub-contract measurement and inspection service including first offs and prototype components using the the latest measurement equipment and software including Faro Arm.



We offer a complete and comprehensive measuring service together with quality engineering support, tailored to meet your requirement within the UK and Europe.

We unite our technical know how with our experience and knowledge to provide our clients with the very best solutions to meet their measurement requirements.



For further information please call us on 01554 - 777733
or visit our website at www.completemeasurementsolutions.co.uk

SMALLEY
THE ENGINEER'S CHOICE®

WAVE SPRINGS

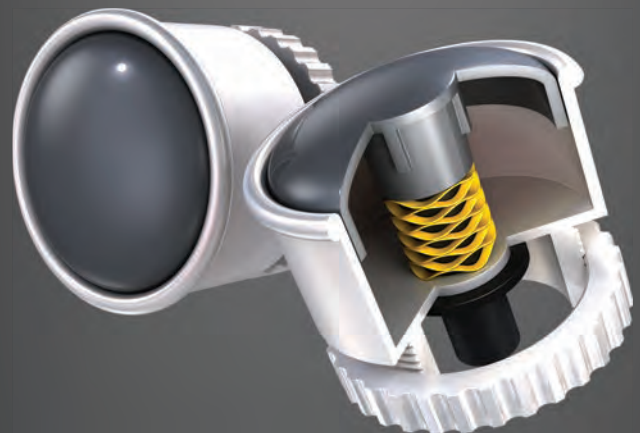
save up to 50% space



- ◆ Achieve more spring performance in the same assembly.
- ◆ Reduce housing material weight and costs.



- ◆ Standard sizes now as small as 5mm (0.197"). Ideal for compact applications.



- ◆ Challenge TFC's Engineers to see if we can design a wave spring to improve your application.

TFC
brings it together

+44 (0)1435 866011
sales@tfc.eu.com
www.tfc.eu.com

Next frontier

Private companies are building prototypes for a planned Deep Space Gateway space station to prepare crews and develop equipment for missions deeper into the solar system.

Stuart Nathan reports

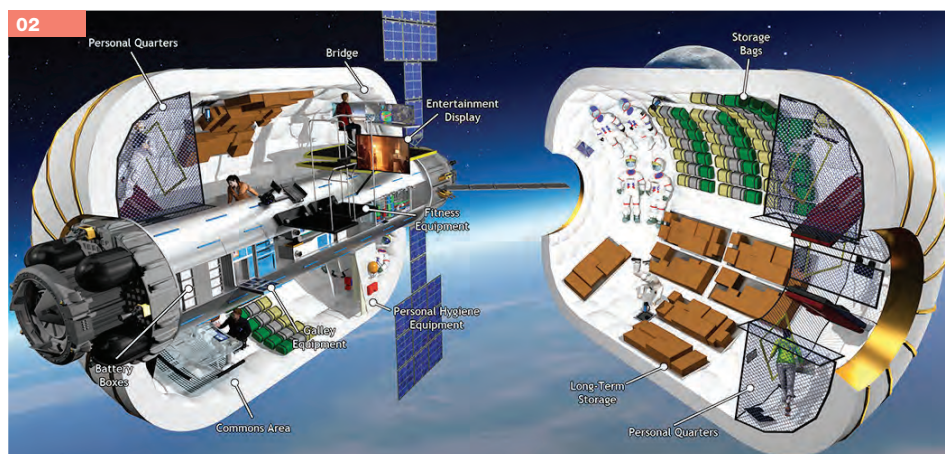
The time is now approaching for humanity to consider its next steps in space. For the past two decades, manned spaceflight has revolved around the International Space Station (ISS), which has been

continuously inhabited since 2000. But time is running out: after several life extensions, the ISS is currently scheduled to go out of service around 2024. It has been an outstanding success for international cooperation, composed of modules from the US, Japan, the former Soviet Union, Russia and Europe and hosting crew from 16 nations, but its position in low-Earth orbit limits the range of its operations and, to meet some of the more ambitious space exploration goals of coming decades, plans are now turning towards a rather different type of crewed outpost.

Although Russia reportedly plans to separate its modules from the ISS and establish them as a new low-orbit space station, NASA, ESA and other agencies are now discussing missions to take humans to Mars, and to investigate asteroids distant from Earth. The range of challenges such missions would present are very different from sending people into low-Earth orbit and are even more arduous than those posed by our previous forays into deeper space. The furthest we've been is the Moon and even that titanic effort involved supporting humans isolated from the Earth for a maximum of nine days.



02



01 Boeing rendering of DSG in lunar orbit with docked Orion capsule

02 Cutaway of possible internal layout of Bigelow inflatable module

By contrast, a journey to Mars will take six to eight months each way, depending on the relative positions of the planets. And while this is only slightly longer than the average trip to the ISS, there will be no chance to resupply the spacecraft during the journey and the conditions the crew have to endure are far more hostile than on the ISS, as they will not be able to rely on the protection of the Earth's magnetic field against radiation exposure from solar flares and galactic cosmic radiation, for example. What's more, operationally, with lunar orbit being so much further from Earth, communication delays will be introduced and resupply opportunities will be decreased.

To acclimatise crew for the long durations in space required for deep-space missions, and to develop and test systems for long-duration spaceflight and the conditions distant from Earth, the solution being considered by NASA is a Deep Space Gateway (DSG). This will be a space station positioned in lunar orbit (sometimes referred to as cis-lunar space), around a quarter of a million miles from Earth and well outside the protection of the magnetosphere.

Ian Crawford, professor of planetary science and astrobiology at University College London, told *The Engineer*: "A cis-lunar habitat [between the Earth and Moon] will enable development of techniques for long-duration stays outside the Earth's magnetosphere. It will also enable development of telerobotic operation of rovers on the lunar surface, and enable human-assisted sample return missions from the surface. Learning to operate for prolonged periods in deep space will certainly be required before it will be possible to send people to Mars."

The DSG project moved into a higher gear towards the end of March, when President Donald Trump signed a mandate for NASA to undertake a crewed Mars mission by 2033. In response, NASA's assistant administrator for human exploration and operations, William Gerstenmaier, made a presentation to the agency's steering committee detailing plans for the project and indicating that six companies had been invited to design parts of a prospective space station, initially as ground-based prototypes.

Gerstenmaier positioned the DSG as part of two larger projects: the series of missions to develop NASA's space launch system (SLS), the enormous rocket based on Space Shuttle technology intended to launch missions beyond Earth orbit; and the Mars project. The first SLS launch, designated Exploration Mission-1 (EM-1), is currently planned for September 2018, and will send an uncrewed Orion capsule into lunar orbit to test its systems. Gerstenmaier envisages a further series of launches between 2018 and 2025 to ferry components of the DSG into lunar orbit where they will be assembled. NASA's planned return to human Moon landings will use the DSG as a staging post.

Gerstenmaier conceives the DSG as being much smaller than the ISS, initially consisting of three module types: a power and propulsion bus (PPB), one or two habitation and

laboratory modules, and a logistics module to service research. A spokesman from Boeing, one of the contractors hoping to build the DSG, said that these modules will contain advanced, next-generation systems suitable for deep-space operations: "Significant advancements in space technology have occurred since ISS was built and this latest technology will be used, resulting in smaller, more efficient systems. One very visible change will be the use of docking ports compliant with the new International Docking System Standard."

NASA's long-term Mars plan also involves the delivery of a Deep Space Transport vehicle to the DSG in 2027. This will dock with the DSG to check its systems, then undertake a crewed cis-lunar checkout voyage lasting about a year in 2018-19, followed by the mandated crewed trip to Mars – orbiting, but not landing – in the early 2030s, which would last about three years.

One important difference between the ISS and the DSG is that the DSG would not be crewed permanently. Although crews will stay on the station for extended periods, much of the systems testing can take place with nobody on board using remote sensors. While the ISS requires around a thousand instructions from the ground to remain in operation, the DSG will be far more autonomous.

Gerstenmaier stressed that collaboration is vital to the project. "I envision different partners, both international and commercial, contributing to the gateway and using it in a variety of ways with a system that can move to different orbits to enable a variety of missions," he said in a NASA statement. "The gateway could move to support robotic or partner missions to the surface of the Moon, or to a high lunar orbit to support missions departing from the gateway to other destinations in the solar system."

Also, NASA envisages collaboration with the European Space Agency on the power and propulsion bus and the habitat modules.

ESA's director of human spaceflight and robotic exploration, David Parker, told *The Engineer* that initial talks about the agency's involvement in the project had already taken place. "The DSG is a concept that has emerged from discussions involving all the ISS partners, including ESA," he said. "ESA has been studying the possibilities for European contributions for over a year and the three main prime industries are involved. Nothing has been decided so far, but possible technologies include the habitation module itself, electric propulsion, docking systems and life-support systems. For example, ESA will shortly test a new system aboard the ISS. The Advanced Closed-Loop System [ACLS] is a regenerative life-support system for closed habitats."

Europe already has considerable experience in supplying habitats for space stations: the ISS's cupola viewing module, three multipurpose modules and a science laboratory module were all built by Thales Alenia Space; the Automated Transfer Vehicle, of which several flew resupply missions to the ISS, was also an ESA project.

"Time is running out: the ISS is scheduled to go out of service around 2024"



03



04



05

Parker pointed out that the project should not be underestimated. "As the crew module would be much smaller than the space station, conditions would more spartan — making the human challenges a lot greater than today," he said. "There are many technical challenges involved in sustained exploration, such as reducing the logistic supplies needed by increasing the efficiency recycling of consumables such as air and water; improving radiation protection; and maybe even using on-board manufacturing of spares using 3D printing."

However, Parker also added a note of caution. "Any proposal to build elements for the DSG will require a decision of our participating states. Therefore, we have started discussions with them, but it is too early to say what the outcome will be. But this looks like an exciting opportunity to put Europe at the heart of deep-space exploration."

The head of ESA's development and future projects division, Daniele Laurini, explained that providing the ACLS closed-loop life-support system is a considerable challenge. "ESA has provided some open-loop environmental control and life-support systems [ECLSS] for the ISS's Columbus module, but the ACLS is the first time we've launched a CO₂ recovery system to partially close the air loop," he said.

The ACLS will recover and purify water from the crew's urine and condensed sweat, some of which will be used for drinking, while it will use electrolysis to convert another portion of this into oxygen and hydrogen. The latter will then be used to convert exhaled CO₂, which will be scrubbed from the air using a regeneratable solid amine, into methane and water; the methane can be safely vented from the station. "So far, NASA and Russia have done more than ESA in terms of air

03 Hall-effect thruster under test at NASA

04 The Bigelow BEAM module

05 Inside the BEAM module on the ISS

and water loop closure; Russia on Mir and NASA on Skylab," Laurini said. "NASA currently recovers about 50 per cent of CO₂ and 80-85 per cent of the water on the ISS; we're hoping to improve on that."

ACLS will be launched next February aboard Japan's HTV-7 automated resupply mission and tested for about one continuous year in the US laboratory on the ISS, Laurini said. After that, it will be used as a back-up unit if there are more than four crew members on the non-Russian side of the station, or if the existing ECLSS is being maintained or fails.

Laurini also explained that while it would be possible for the DSG to use conventional chemical rocket thrusters for station-keeping and orbit adjustment, electrical propulsion units are lighter than chemical rockets and therefore offer an advantage in reducing launch mass.

The type of solar-electric propulsion proposed for the station — Hall-effect thrusters — use xenon gas as a propellant. It works by trapping electrons in a magnetic field; the electrons ionise the propellant gas, and the magnetic field accelerate the ions to eject them from the engine to generate thrust. This type of thruster produces constant acceleration and a higher impulse than the ion drives used for satellites and exploration vehicles in recent years, Laurini explained. "It is also a great opportunity to do long-duration testing for the thrusters that will support other exploration missions, including flights to Mars," he added. However, Laurini believed that a Mars transport will use a combination of electric and chemical thrust.

ESA is currently developing a high-power Hall effect thruster, while lower-power ones have been under development and long-term testing in the US for some time, Laurini said. "The technology is there; what is tricky is to make it long-lasting and avoid erosion."

Roscosmos presented its concept for the airlock at a NASA-run working group last Autumn. The airlock is planned as having two pressurised parts: a spherical compartment

"NASA currently recovers about 50 per cent of CO₂ and 80-85 per cent of the water on the ISS, we're hoping to improve on that"

Daniele Laurini, ESA

with two hatches and a docking port, attached to the end of a cylindrical chamber acting as a spacesuit storage and changing room, but capable of acting as an airlock if pressurisation on the other chamber fails.

Meanwhile, the six US companies designing ground-based prototypes for the station — Boeing, Lockheed Martin, Bigelow Aerospace, Sierra Nevada Corporation, Orbital ATK, and a consortium called Ixion — are to receive grants totalling \$65 million up to the end of this year as part of a programme NASA calls NextSTEP (Next Space Technologies for Exploration Partnership), with a decision taken on which designs will go on to become flight modules in 2018 or 2019.

Each of the six is developing different concepts for the station. Bigelow, whose 3m-diameter BEAM (Bigelow Expandable Activity Module) chamber is part-way through a two-year trial on the ISS, is developing another expandable structure, known as B330, as a habitat module for the DSG. Projected to be 13.7m long and 6.7m in diameter, the module is made of a multi-layer material capable of withstanding micrometeorite strikes, and, although designed to be inflated with compressed air, should be regarded as more similar to a steel radial tyre than a balloon.



FREE TO
ENTER!

Nothing's impossible

Are you an innovator? Then here's some
very good advice! Enter the IET Innovation
Awards 2017. After all, **every adventure**
requires a first step.

Are you the sort of person **who can believe as many as**
six impossible things before breakfast?

Put your innovation on the path to a profile-raising prize
and leave yourself smiling.

Our 15 cutting-edge categories are independently
peer-reviewed by an expert panel. Shortlisted entries benefit
from extensive media coverage and international exposure.

Curious?



The IET Innovation Awards. Don't be late!

Deadline for entries: 7 July 2017



@IETawards #IETia

www.theiet.org/innovation

Proudly sponsored by



altran



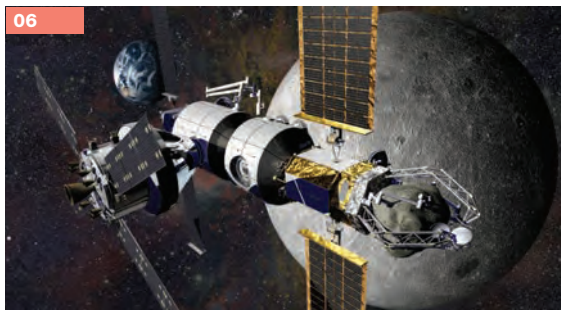
Makes a complex world yours



nationalgrid



06



Bigelow modules tend to be lighter than equivalent-sized ISS-type modules, with a density around 88kg per square metre of habitable space, compared with 137kg per square metre for conventional aluminium modules. They are launched uninflated, making good use of available space on the SLS, it claims.

Sierra Nevada is a space industry veteran, currently working with NASA to develop Dream Chaser, a lifting-body reusable spaceplane concept intended to ferry crew and supplies to the ISS. "This habitat will combine our experience in space technologies, satellite systems, propulsion and environmental control systems from our subsidiary Orbitec, as well as our work with Dream Chaser," said head of Sierra Nevada's space science business, Mark Sirangelo. "This programme is a perfect opportunity to showcase the heritage of our 25-plus years supporting space missions."

Like Sierra Nevada, Orbital ATK is basing its concept on features of an existing spacecraft, the Cygnus capsule. "This award allows us to mature plans to develop an Exploration Augmentation Module [EAM] based on the Cygnus product line and a new docking node concept," said Frank DeMauro, head of human spaceflight systems. "Cygnus modules can be added to increase pressurised volume for the crew and outfitted to increase the associated functionality of the EAM."

"We will also develop a concept of operations that describes how the EAM will develop over time and how it will be used to help long-duration human exploration of space and provide a recommended functional baseline for the system architecture," he added. "By studying the necessary functionality for the proposed reference missions, we believe that configurations, EAM layouts, and support equipment can be recommended for further review with an emphasis on providing hardware as early as possible."

Ixion includes satellite and space hardware specialist Nanoracks, which has worked extensively on ISS projects,

along with Space Systems/Loral, another satellite builder, and United Launch Alliance (ULA). Ixion is studying the feasibility of converting ULA Centaur rocket upper stages into habitat modules. NASA's first space station, Skylab, was originally proposed to be made from converted upper stages, and Nanoracks explains this is "more affordable and involves less risk than fabricating modules on the ground and subsequently launching them into orbit."

Lockheed Martin is developing a multipurpose habitat module that it is converting from an ISS logistics module, a container originally developed to be carried in the Space Shuttle's cargo bay, explained programme manager Bill Pratt. "These modules were made in Italy, and the one we're converting for our ground-based prototype never actually flew," he said.

The prototype module will include ECLSS and avionics systems, included for 'form-and-fit' testing, Pratt said. However, he added, Lockheed Martin anticipates that in use, the DSG will use an Orion module, which would always be docked to the station when it is crewed, as a 'flight deck' for the station. "It's rated for deep space, and it has all the necessary functionality, including avionics, communications, a toilet, galley and its own ECLSS that could augment any system on the DSG," he said.

Lockheed Martin is also keen to exploit its expertise in autonomous spacecraft design. "We have a lot of experience of that in the systems we've designed for long-duration exploration missions, as all those probes are autonomous," Pratt said.

The DSG will have to use a different internal architecture from the ISS, Pratt said. "We just won't have the space for the large racks that house equipment in the ISS; most things will have to be on pallets, and ideally reconfigurable." An example of this might be a shielded area for crew to shelter from the radiation of solar storms. "We don't want to have a permanent refuge, we'd just want to be able to put one up when it's needed." One possibility might be to use the docked Orion's shelter, he said.

Other radiation such as energetic cosmic rays could be more of a problem, Pratt added. "We really don't know much about them. We might use the DSG in autonomous mode, with no crew on board, to study them so we can come up with a protective system when crew go on board."

For the time being, however, the ISS remains the focus of research by NASA and its commercial partners into how humans can extend their time in space up to the duration of a Mars mission. "The ISS is going to be so important, especially for testing ECLSS," Pratt said. "These systems

"Commercial crew spacecraft will enable more research aboard the orbiting laboratory"

William Gerstenmaier,
NASA

have to be tested over a long period, so we'd have to fully check it out on the ISS before using it on the DSG."

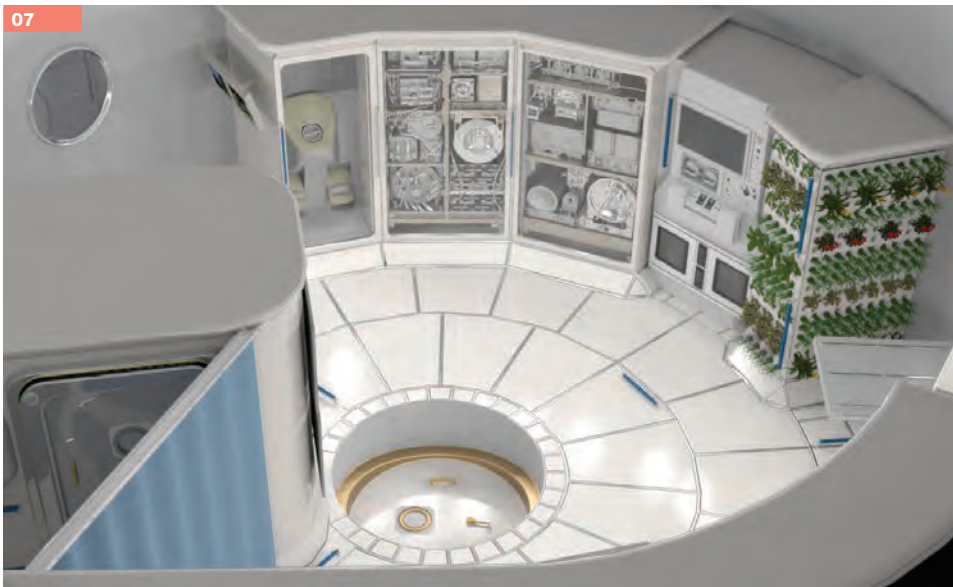
Boeing is using its experience as prime contractor for the US portions of the ISS and in designing SEP systems, and has unveiled concept designs both for the DSG and a SEP-equipped deep-space transit vehicle. Much of the hardware it is developing uses technology developed for the ion-driven Dawn spacecraft, which visited the asteroid belt last year, and the 702 series of high-power communication satellites.

Gerstenmaier stressed that NASA will be relying on commercial partners to help even on the ISS. "The commercial crew spacecraft will enable more research aboard the orbiting laboratory, which can lead to breakthroughs that benefit everyone on Earth and help future astronauts on long-distance missions," said Gerstenmaier. "Simultaneously, teams across the country are designing, developing and proving real hardware for the Orion spacecraft and SLS rocket for deep-space exploration." ©

06 Lockheed Martin's rendering of the DSG with captive asteroid

07 NASA rendering of possible DSG habitation module interior

07



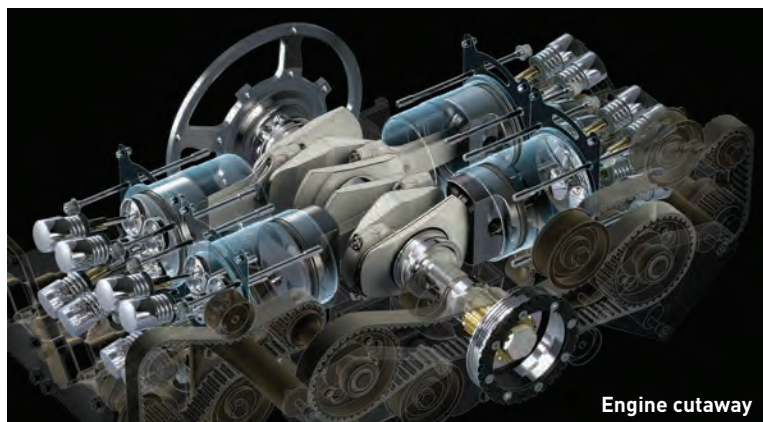
NVIDIA Quadro GP100 – The world's most powerful workstation graphics and compute card

The NVIDIA Quadro GP100, powered by NVIDIA's Pascal GPU architecture, is equipped with the most advanced visualization and simulation capabilities to meet the needs of the most demanding professional workflows. A single GP100 with 3584 FP32/1792 FP64 CUDA Cores has incredible horsepower to render photorealistic design concepts

interactively, create extremely detailed 3D models, run intensive CAE simulations to validate designs, and evaluate design prototypes in immersive VR. You can even connect two GP100's with NVIDIA NVLink technology to scale performance with an amazing 32GB of combined HBM2 ultra-high bandwidth memory.

Its compatibility enables the GP100 to build massive and sophisticated visualization, simulation and rendering environments. VR is changing all facets of entertainment, design, engineering, architecture and medicine. AI and deep learning are changing the way professionals are solving the most complex and challenging computing problems. Customers want to experience ideas, validate designs, test ideas, and simulate solutions and visualize the results as quickly as possible.

The GP100 is an excellent choice for developers who want to tap into the power of NVLink and Unified Memory to maximize their application performance. Additionally, its fast FP16 performance makes it an ideal desktop workstation solution for developers working on the latest Deep Learning/AI algorithms and frameworks.



Designs are becoming more complex. Media is becoming richer, higher fidelity, combining greater resolutions and complex visual effects. Scientific visualization and compute problems are larger than ever. NVIDIA Quadro Sync

NVIDIA® Quadro® is the world's largest most advanced visual computing platform for workstations.

The NVIDIA Quadro GP100, powered by Pascal GPU architecture, is equipped with the most advanced visualization and simulation capabilities to meet the needs of the most demanding professional workflows.

A single GP100 with 3580 FP32/1792 FP64 CUDA cores has incredible horsepower to render photorealistic concepts interactively, create extremely detailed 3D models, run intensive CAE simulations to validate designs, and evaluate design prototypes in immersive VR.

You can even connect two GP100's with NVIDIA NVLink™ technology to scale performance with an amazing 32GB of combined HBM2 ultra-high bandwidth memory.

Part Number - VCQGP100-PB

PNY®

NVIDIA

INTRODUCING
PNY NVIDIA QUADRO GP100



Elmtec is a trading division of manmachine



E: sales@elmtec.co.uk



T: 01844 263750



W: www.elmtec.co.uk



ELMTEC
DISTRIBUTION FOR DIGITAL DESIGN

Call for entries: Deadline 26th May 2017

the ENGINEER
collaborate to innovate

In association with



Celebrating the best engineering collaborations and innovations

MEDIA | AWARDS | CONFERENCE

Meet the Judges!



DANIELLE GEORGE,
PROFESSOR OF RADIO
FREQUENCY ENGINEERING,
UNIVERSITY OF MANCHESTER



PROFESSOR IAIN GRAY
CBE, DIRECTOR OF
AEROSPACE,
CRANFIELD UNIVERSITY



DR CHRIS GUYOTT,
ENGINEERING DIRECTOR,
FRAZER-NASH
CONSULTANCY LTD



JOHN HALTON,
DIRECTOR - BUSINESS
& INDUSTRY,
ENGINEERING UK



ALAN MUCKLOW,
DIRECTOR - UK AND
IRELAND SALES DIVISION,
YAMAZAKI MAZAK



ALAN NEWBY,
DIRECTOR AEROSPACE
TECHNOLOGY AND FUTURE
PROGRAMMES,
ROLLS-ROYCE PLC



TOM RODDEN,
DEPUTY CEO,
EPSRC



JENNI SIDEY,
LECTURER IN INTERNAL
COMBUSTION ENGINES,
CAMBRIDGE UNIVERSITY



PROFESSOR ANDY WRIGHT,
DIRECTOR STRATEGIC
TECHNOLOGY, BAE SYSTEMS
PROGRAMMES AND
SUPPORT

Whether you are a small business, large corporation or academic research department share your collaborative success stories, shout about your achievements and tell us why you are the best!

Enter collaborative projects in 8 categories!
Find out more and enter at: conferences.theengineer.co.uk

Brought to you by



In Association with:



Sponsor:



In Partnership with:



Invisible skin

A UK coating innovation is making a splash in one of the world's biggest consumer markets. Jason Ford reports



01

It won't have escaped your notice that smartphones are being marketed with features that have more to do with lifestyle than telephony.

Take the recent UK TV ad campaign for the Samsung Galaxy S7, which featured a young man anxious to receive a call from a young lady he'd exchanged telephone numbers with. The young lady eventually called him, but he fumbled with the phone and dropped it into the kitchen sink. Luckily, his Samsung Galaxy S7 continued ringing despite being immersed in a few inches of water.

Similarly, Samsung's 'Quality Assurance' advert depicts scientists at the company putting smartphones through a series of tests that include water being jetted horizontally at the screens of Samsung phones held at an angle.

It might not seem obvious but there are very good reasons for elevating waterproofing and water-repellent features up the USP rankings. According to IDC, the smartphone market has grown at an average rate of 33 per cent for a decade and the market is maturing. Consequently, handset manufacturers are looking more broadly at the features they offer in order to differentiate their products from those offered by competitors.



02

01 P2i's coating protects devices inside and out

02 Protection against water damage is becoming more marketable

A YouGov survey conducted in the US in 2016 found that water resistance was the third most desirable feature of a smartphone behind longer battery life and shatterproof screens.

IDC said that 900,000 smartphones are damaged by liquids alone on a daily basis and that this has an impact worth over \$97bn a year. Despite this, IDC found that only 27 out of 360 manufacturers offer any kind of resistance to liquids despite liquid damage being attributed to over 95

per cent of smartphone failures and 35 per cent of repairs.

The knock-on effects go beyond the consumer with OEMs, carriers, retailers, and insurers bearing the brunt of liquid-induced failures.

Enter Oxfordshire firm, p21, that has so far applied its hydrophobic nano-coating to over 175 million electronic devices worldwide and has won a 35 per cent of market share in water-protected smartphones.

The story began at Durham University where company chief technical officer Dr Stephen Coulson developed a

plasma-coating technique that maintains breathability in military uniforms but repels liquids.

"This was project Crusader 21, which was the ultimate combat ensemble for the 21st century soldier," said Coulson. "The idea was to build in as much functionality into a soldier's outfit without increasing the physiological load – the heat burden on the soldier. At the time, if you think back to the late 1990s you're looking at the end of the Cold War scenario and you're taking equipment out of urban... environment[s] and putting them into hot desert areas. We were addressing the issues associated with asymmetric warfare."

The coating process works like this: devices are loaded into the chamber of a machine where a vacuum is induced to hold the products at low pressure. A radio-frequency (RF) plasma then activates the device's surface, which creates free-radical sites.

The monomer (a molecule that can be bonded to other identical molecules to form a polymer) is introduced as a vapour and a pulsed RF plasma is used to polymerise it and bond it to the free-radical sites on the surfaces.

The low pressure in the chamber lets the monomer permeate into all areas of the device so that the polymer coats the internal and external surfaces and leaves an ultra-thin layer of polymer that is a few nanometres thick.

The chamber is then vented back to room pressure and the coated items – which do not require post-processing – are removed.

Coulson explained that conventional coating technologies attach weakly to substrates.

"We're growing it from the substrate, which gives it that chemical bond and because this is happening at the molecular level at low pressure, we're confident it gets into all the nooks and crannies," he said. The machines themselves are manufactured in the UK and are built to requirements of P2i's customers who use the technology under license.

P2i holds 65 patents for its technology that has so far been applied to filtration systems, performance and military clothing, electronic goods and life sciences applications. Its trademarks – Dunkable, ion-mask and Aridion – are applicable across these applications but the base technology is the same.

"The core patents take something that is very well known, which is liquid repellency and something that is very well known with regard to plasma deposition and combine the two to provide something very novel and inventive, which is the ability to retain [the] chemical structure at a surface using something that is known as a destructive technique, which is the plasmas. That was the inventive step," said Coulson.

The company was founded in 2004 and by 2010 it was providing coatings on 60 per cent of the world's hearing aids. A year later, the company introduced high-volume manufacturing, a move predicated by hearing aid manufacturers increasing production and mobile phone manufacturers looking to reduce what Coulson calls "field failure return rates". The company initially supplied four machines to the mobile phone manufacturing sector, which "quickly ramped onto 10 and then 14 machines and beyond".

P2i's international footprint includes an applications centre in China and further offices in Taiwan and the US. The company's clients include Huawei, Lenovo, BlackBerry, TCL, Nokia, Plantronics and Motorola, which was the first handset manufacturer to use the invisible coating, applying it to the Droid Razr.

Dubbed Splash-proof, the coating protects against splashes, sprays, humidity and sweat, which qualifies it for an ingress protection (IP) rating of IPX2. The IP rating relates to how well equipment within an enclosure is protected



03 Untreated devices are prone to water-induced corrosion

04 P2i's hydrophobic coatings bead and roll off surfaces

"In order to get the rest of the threats covered then you need a technology to protect against accidental dunking underwater"

Dr Stephen Coulson, P2i

against the ingress of solids such as dust and water, so a rating of IP67 would indicate that the device is totally dust tight (6) and protected against temporary immersion (7). According to Coulson, research carried out by IDC shows that Splash-proof technology protects against 42 per cent of liquid threats, but recent smartphone launches have seen an increase in standards that could work to P2i's advantage.

The Samsung Galaxy S7 and S7 Edge have an IP rating of IP68, which means they're water resistant to a maximum depth of 1.5m. Over at Apple, the iPhone 7 and iPhone 7 Plus have a rating of IP67.

"In order to get the rest of the threats covered as well then you need a technology to protect against accidental dunking underwater, hence the IPX7 criteria at the level that Sony, Apple and Samsung are now pitching the technology at," said Coulson. "Therefore, that becomes a must-have technology in the industry and the 'must-have' performance level."

The Galaxy S7 and S7 Edge are sealed mechanically, but P2i's IPX7 level Dunkable – which is scheduled to launch in smartphones in 2018 – would afford the same level of protection to phones and electronic devices without the extra gaskets, membranes, snubbers, jack plugs and watertight casings. "We have a coating technology [that we] can roll out across the entire portfolio of manufacturers devices because we're not limited to the huge costs and engineering constraints of a physical barrier," said Coulson. "We're identifying the partners we want to work with... and once we've collaborated with them and defined the timeline then we'll be able to... launch this technology." ©

Amplicon introduce new high power, small form factor embedded PC



By Gavin Chalkley - Product Specialist for Industrial Computing at Amplicon

UK electronic specialist, Amplicon, is once again first to market with the latest technology. With over 40 years of manufacturing experience based firmly in engineering delivering exceptional industrial computing solutions is second nature. Combine this with a wide range of Data Communications, Measurement & Control, and Security Automation products and Amplicon can provide the complete solution.

TODAY'S MARKET CHALLENGE

High computing power and small spaces are not generally considered a good match. The key is excellent thermal design, even more so when space limiting factors are introduced. Material used airflow and ambient air temperature play a large role in combining the most unlikely of partners. Not getting the balance exactly right will cause overheating and severely reduce any Mean-Time-Before-Failure (MTBF) and ultimately the life of the system. Traditional fan cooled systems require large amounts of lower temperature circuiting air in order to run within the limits of the components, they also require filters that will require regular servicing in order to maintain the air flow.

THE SOLUTION IS SMALL AND MIGHTY

Amplicon has introduced the new Impact-D 160, a powerful Embedded PC fully packed with exceptional features. The new system offers increased computing power thanks to its Skylake processor, is I/O rich and security availability is greater than in previous models.

End users can benefit from its surprisingly small form factor, which is perfectly suited to applications in markets such as transportation, security and automation.

Designed and built in the UK, the new Impact-D 160 from Amplicon

will offer two processor options: i5 and i3. Additionally, minimal design constraints enable the Impact-D 160 to be adapted and customised to suit a specific set of requirements for any application.

The unit offers both mSATA and a mechanical/solid-state drive capability for storage and OS requirements. Support of both cellular and Wi-Fi connectivity allows to "stay connected" even if you lose the Gigabit Ethernet connections ensuring maximum up time.

The Impact-D 160 comes with four DB9 serial communications ports: two supporting mixed protocol (RS232, 422, 485) and two static RS232, with options for an extra four ports of your choice. This gives the unit ease of operation in both new and legacy applications for serial control.

For more information send us an email at sales@amplicon.com



"The Impact-D 160 is an exceptionally compact and powerful unit designed and built by Amplicon to meet the most demanding applications where space is limited. We are confident our customers will find in these new units the perfect match to outperform in any application"

Gavin Chalkley
Product Specialist at Amplicon





Race to market

Motorsports' top flight is more relevant than ever says Williams' Paul McNamara. Jon Excell reports

The question of Formula One's (F1's) 'road relevance' never fails to divide opinion. For some, motorsport's biggest competition represents engineering at its purest: a pursuit of speed, energy efficiency and aerodynamic perfection that stirs the soul and pushes at the boundaries of what's possible.

For others it's an incongruous spectacle: a gas-guzzling parade that's got more to do with entertainment than engineering solutions to real problems.

According to Paul McNamara, technical director of Williams Advanced Engineering (WAE), the technology services arm of the world-famous racing team, top-flight motorsport and the engineering disciplines and technologies it helps to drive has rarely been more relevant to the wider world.

Based alongside the racing team, at its headquarters in Grove, Oxfordshire, WAE was established in 2010 to apply the expertise and technology developed by the racing business to technical challenges in other arenas.

Today, the division employs around 200 engineers and with its most recent results showing 74 per cent growth in revenue and a roster of around 48 separate projects spanning applications in motorsport, automotive, defence, sports science and healthcare, there's clearly a growing appetite for what McNamara terms a "motorsport mindset".

Joining the organisation in 2015, McNamara – formerly an executive director of Shanghai Automotive Industries and managing director of UK powertrain specialist Ricardo – was bought on board to identify some of the broader opportunities that those from a pure motorsport background might not pick up on. "The reason to have me with a non-motorsport background is to bring some perspective," he told *The Engineer*. "If you just had a load of motorsport guys sat here they'd find it hard to see what the connection is to the outside world."

In terms of what it offers the outside world, McNamara talks about three key areas of expertise.

The first of these is electrification, a specialism that emerged from the racing team's development of its own electric motor, battery and control system, and one that is becoming increasingly relevant to the world beyond the track.

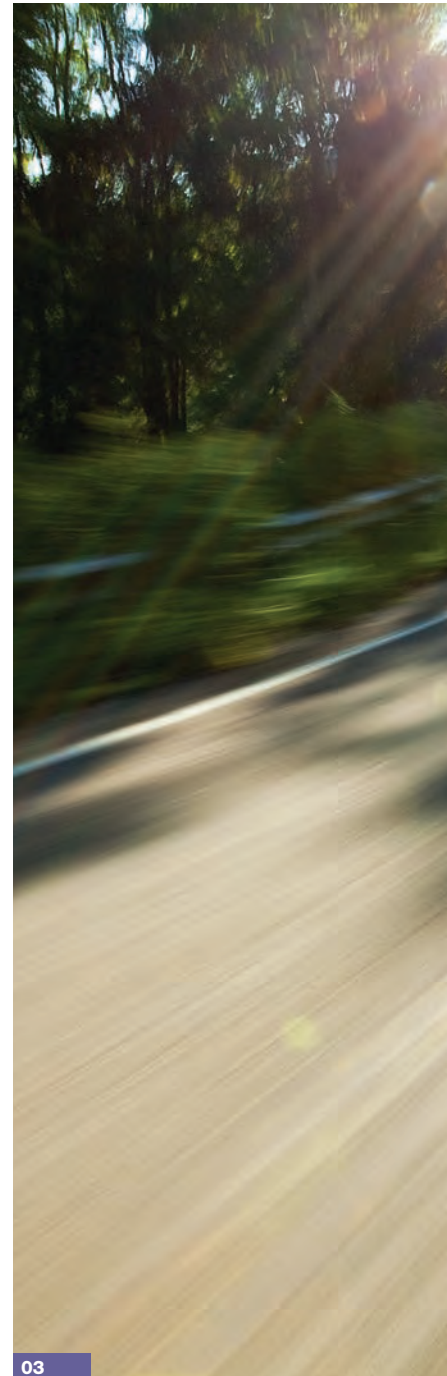
"If you look at the way automotive powertrains will be," he said, "there will be some internal combustion engines, but there will also be hybrids, pure electric vehicles and some sort of fuel cell. Three of those categories involve



01 WAE worked on an aerofoil for improving the efficiency of supermarket chillers

02 Inside one of Williams' two wind tunnels

02 Nissan's Blade Glider



03

some sort of battery and control system, and we're very much wanting to position ourselves as strong in batteries, control of batteries and lightweighting of batteries."

The group's most high-profile development in this area is the 28kW lithium-ion battery used to power the vehicles competing in the Formula E electric racing competition.

And while this application itself is a spin-off from the group's F1 activities, it's proven to be a valuable testbed for technology destined for the road. "Formula E is a great example of our battery technology," said McNamara, "we can design batteries, we know how they're going to get used, and we can develop and learn what works and get feedback after each race – and that has allowed us to take a lot of learning and know-how, and put that into automotive batteries."

WAE is now involved in a number of roadcar battery projects, including the development of Aston Martin's

Electric Rapide and a high-performance battery project for VW Audi. The group also recently won a bid to lead a consortium, including Coventry University, Unipart, WMG, and Productiv, in the development of a flexible battery manufacturing facility for UK industry.

The next key capability McNamara spotlights is aerodynamics and thermodynamics, another area of expertise refined on the racetrack that's becoming increasingly relevant to the wider world. "Energy... is a scarcer resource in a battery car," he said, "And if cars are more aerodynamic

that's going to help in the age of battery cars".

A key resource here is WAE's two state-of-the-art wind tunnels, which are increasingly being used to test concepts and refine designs for applications away from the racetrack. For instance, the facility was used to help develop the handling and improve the aerodynamic performance of Nissan's futuristic electric concept vehicle: the Blade Glider.

In a somewhat less predictable application, the group recently collaborated with UK start-up Aerofoil Energy to develop a new aerodynamic device that reduces the energy consumed by supermarket refrigerators. This retrofittable system, claimed to enable a 20-30 per cent energy saving, attaches onto each refrigerator shelf and controls the airflow, ensuring that more of the cool air stays inside the refrigerator cabinet. According to McNamara, the technology is currently undergoing trials with Sainsbury's, Waitrose and Asda.

The third key area of specialism is lightweighting, again,

an increasingly important area for the wider industry, and a discipline in which the UK, primarily through its motorsport heritage, is something of a world leader. But while WAE's track-inspired expertise in making stuff out of carbon fibre has obvious applications in the automotive sector, it's also leading to unexpected gains elsewhere. For instance, in one recent project, the

"Energy is a scarcer resource in a battery car. If cars are more aerodynamic that's going to help in the age of battery cars"

group used its knowledge in this area to develop the Baby Pod, a lightweight crash-proof carbon-fibre pod designed for transporting babies from one hospital to another.

The division currently has around 48 separate projects on the go and, according to McNamara, two-thirds of these are in the motorsport and automotive space.

But other sectors are becoming increasingly important, not least defence, which is a particular area of focus currently and an industry that Williams actively courts by sending engineers to defence exhibitions and trade shows.

So far, said McNamara, the group has been involved in three key projects that have progressed through to the deployment level: a power and connectivity project for military ground vehicles; an air-sampling system designed to work in a variety of wind conditions; and an initiative focused on driver ergonomics.

Looking to the future, McNamara hopes to help steer continued growth at WAE and is particularly keen to explore new applications of its expertise in the health and defence sectors. Interestingly, the group is also now beginning to look at whether some of the lessons that the company has learned outside of motorsport can actually be fed back into the racing business.

But ultimately, the main aim is to extract and export the expertise honed in the ultra-competitive and fast-paced world of F1 engineering and making the most of what McNamara terms the "motorsport mentality." "It's a particular way of doing engineering", he said. "For most industries there's something you can take from it but not everything. At the end of the day we're producing a relatively limited number of cars; there's a very controlled user experience; you know exactly what it's going to do; and you know exactly who the driver is, so it's different to when you move a product out into the field. But it does give us a great testbed." ©



The brains of the operation

A robot used to position electrodes in human brains is the star turn of a new medical centre of excellence in Wales. Jon Excell reports

The factory floor and the operating theatre may seem worlds apart but, in reality, these two outwardly different environments face many common challenges. Both are time-pressured, often high-volume environments that rely on exacting precision, tight tolerances, repeatability and high levels of technical expertise.

And as manufacturing technology becomes ever more sophisticated, the developments driven by the insatiable demands of industry are increasingly finding application in the medical arena.

One company at the forefront of this fascinating crossover is Gloucestershire engineering firm Renishaw, which has exploited the know-how developed by its core manufacturing technology business, to establish a growing and successful presence in the healthcare technology sector.

Renishaw first entered the world of healthcare in the late 1980s, when it began using its measurement and scanning expertise to design and develop custom dental implants – an area of business that's expanded over the following decades.

But while its dental work remains perhaps the best-known part of the firm's medical division, it now boasts a much wider medical offering: including world-leading expertise in the production of bespoke implants, and a robotic system for neurosurgeons that's helping to revolutionise the treatment and diagnosis of a range of conditions.

Last year, in a sign of the sector's growing prominence in the firm's plans, Renishaw opened a new Healthcare Centre of Excellence at its site in Miskin South Wales: which it acquired from Bosch in 2011.

Sharing the 461,000-square-foot site with a full production engineering facility and the UK's only dedicated production line for making additive manufacturing machines, the new centre was established as a manufacturing base for the company's medical products, as well as an education and training centre for the life sciences community.

Its striking centrepiece is a highly accurate mock-up operating theatre that it uses to help train surgeons in the use of some of its key technologies. And the star of the show is Neuromate, an image-guided robot based on technology acquired by the firm back in 2008 that's primarily used to precisely position implants and electrodes in the human brain.



Surgeons working with the Neuromate robot

The robot consists of an articulated arm tipped with a mount for a surgical instrument. Driven by sophisticated surgical planning software loaded with 3D images of the patient's brain, the system positions the surgical instrument above the skull, enabling the surgeon to precisely target the correct part of the brain and enter the organ at a carefully planned trajectory that ensures that no critical structures are damaged.

Now used in hospitals around the world, including seven in the UK, Neuromate is claimed to be both faster and more accurate than conventional manual techniques, which typically require a patient's head to be fixed to a frame and depend on continuous use of manual measurement devices.

A key area of application for the technology is in deep brain stimulation (DBS) a process that involves the implantation of small electrodes that are then used to stimulate a particular part of brain. The procedure is increasingly used to treat neurological disorders such as Parkinson's disease.

In the past, implantation of electrodes for DBS has typically required the patient to be awake so that surgeons can be sure they're not damaging any critical structures. But according to Anna Ritchie from

"The system positions the surgical instrument above the skull, enabling the surgeon to precisely target the correct part of the brain"

ROBOTICS

AND

AUTOMATION

11th & 12th October 2017 | Arena MK | Milton Keynes

Attend this **exciting new exhibition** to discover how the latest robotics and automation technology can help you **improve efficiency, reduce costs and gain competitive advantage** in a global market.

REGISTER FREE NOW AT www.roboticsandautomation.co.uk

Brought to you by:

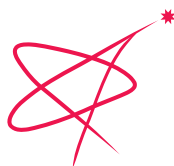


Media Partners:

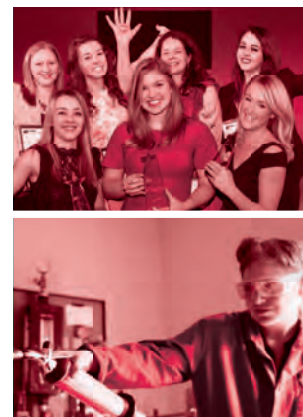


IET AWARDS
The Institution of
Engineering and Technology

**YOUNG WOMAN
ENGINEER**
40TH ANNIVERSARY



**SHE IS: OUTSTANDING
INSPIRING
AN ENGINEER**



ARE YOU? Apply now www.theiet.org/ywe

Sponsored by:



#9PercentIsNotEnough

#9PercentIsNotEnough

#9PercentIsNotEnough

#9PercentIsNotEnough

The Institution of Engineering and Technology is registered as a Charity in England and Wales (No. 211014) and Scotland (No. SC038698).

Renishaw's Neurological Products Division, the accuracy of Neuromate allows this procedure to be performed under general anaesthetic.

Another application for which the technology is proving useful is stereoelectroencephalography (SEEG), a diagnostic procedure used primarily in the treatment of epilepsy. Similar to DBS, this involves the precise positioning of multiple electrodes deep into the brain. These electrodes can then be used to record the signals from the brain during an epileptic fit, enabling surgeons to pinpoint and remove the area of the brain responsible for the epilepsy. It's a procedure that has a remarkable success rate – curing around 90 per cent of patients treated. And, according to Ritchie, the use of the robot both improves the accuracy of the process and radically reduces the amount of time it takes to place the electrodes in the patient's brain.

The robot was recently used to carry out the procedure for the first time in the UK by surgeons at the University Hospital of Wales in Cardiff. The patient, who had been suffering up to six fits every day for the past 20 years, has reportedly been fit-free since the procedure was carried out in March 2017.

A third application area for the system, and one

still at the clinical trials stage, is its use to implant a system for delivering medication directly to the brain.

Neurodegenerative diseases are particularly hard to treat with medication thanks to the protective role of the so-called 'blood brain barrier', but Renishaw has used Neuromate to develop an implantable system that can be used to inject drugs through an external port at the back of the head directly into different parts of the brain. Renishaw is currently working with pharmaceutical company Herantis on a clinical trial, using the system to deliver a drug called cerebral dopamine neurotrophic factor (CDNF) to patients with Parkinson's disease.

'Brain surgery' has long been associated with notions of extreme precision, so one might imagine that the challenges of developing a system such as Neuromate represents something of a step up technology-wise for a firm more used to dealing with the manufacturing industry. But, according to Ritchie, it's actually the opposite. "We're typically trying to target something like a square millimetre, which for Renishaw is a country mile compared to the low level micron demands of the aerospace sector – the key thing is repeatability of process, targeting and getting to that target in the brain – that's the challenge." ©

01 Mock-up operating theatre at Renishaw's new Healthcare Centre of Excellence

02 The robot takes its cue from sophisticated planning software



Exploiting the benefits of 3D printing

While Renishaw's heritage in industrial metrology has fed into its neurosurgical business, its expertise in additive manufacturing has helped drive advances in another area of its medical division – the design and additive manufacture of custom implants.

One particularly notable emerging area for the company is its use of 3D-printing technology to produce titanium maxillofacial implants.

Surgeons will typically provide Renishaw with CT data that will then be used to develop a design and produce parts that are sent back to the surgeon and fitted to the patient.

In one recent example, Renishaw collaborated with a surgeon involved in disaster relief in Nepal on the production of a 3D-printed orbital floor implant for a patient who had been injured in a road-traffic accident.

Orbital implants are particularly complex and sensitive structures, because of the proximity of the optic nerve. However, using CAD data supplied by the surgeons involved, Renishaw was able to produce a perfectly fitting implant in just one shot.

Ed Littlewood, marketing manager for Renishaw's Medical Dental Products Division, said that while it is currently a relatively low-volume business, Renishaw is actively working to educate hospitals about the potential of 3D printing. One of the key challenges, he said, is persuading surgeons to adopt new technology: "It varies from surgeon to surgeon. Some are open-minded and keen to try out new technologies, others are more conservative."

One notable way in which the company has helped to advance the uptake of the technology is through its ADEPT project – a winner at The Engineer's 2016 Collaborate to Innovate Awards. This has led to the development of new software that makes it easier for surgeons to exploit the benefits of 3D printing.



- PREDICTIVE MAINTENANCE
- MONITOR MACHINE HEALTH
- DETECT PROBLEMS EARLY
- REDUCE DOWNTIME
- AVOID FAILURES

BANNER[®]

Wireless Vibration & Temperature Monitoring

The QM42VT1 monitors the machine's health by detecting increases in vibration and temperature. Early detection of any increases allows for planned, preventative maintenance.

- Mount to motors, compressors, fans, pumps with a variety of options
- Connect one QM42VT1 to one wireless Node with 3 metre cable.
- Set vibration parameters according to ISO 10816 Vibration Severity Chart
- Set a temperature threshold up to 80°C
- Powered by Node
- Provides local indication, sends signal to a central location and collects data via the Gateway
- Rugged IP67 Zinc Alloy housing.

TURCK | **BANNER**

Turck Banner Ltd.

Blenheim House, Blenheim Court,
Wickford, Essex SS11 8YT
Tel: 01268 578888 wireless@turckbanner.co.uk

www.turckbanner.co.uk

vötschtechnik[®]
a schunk company

Quality Heat Technology Solutions

Industry leaders in the design, manufacture and servicing of high quality laboratory and industrial ovens and customised solutions for all applications.

▮ Heating & Drying ▮ Infrared ▮ ATEX ▮ Microwave ▮ Continuous Process Ovens

Test it. Heat it. Cool it.

Vötsch Industrietechnik ▮ 32 Rassau Industrial Estate ▮ Ebbw Vale
Gwent NP23 5SD ▮ South Wales UK ▮ Tel +44 1495 305555 ▮ info@weiss-uk.com

vötschtechnik[®]

weiss technik[®]

www.weiss-uk.com



Going underground

Novelist Jon Wallace considers the science fiction implications of engineering stories that have caught his eye. This month, the gloomy future worlds inspired by tunnels

To the 21st century citizen, the tunnel is one of those engineering accomplishments that's easily taken for granted, or barely noticed at all – unless it is as a source of disgruntlement: the British love to complain about their tunnels, either as frustrated commuters trapped in Dartford and Blackwall traffic, or as opponents to new projects. Excitement about new tunnels is equally limited: even the Channel Tunnel, an extraordinary achievement by any standard, is not cherished by the public as are our great bridges. Neither are the engines of tunnel construction: 'Victoria', the last machine used to excavate London's Crossrail, was picked to pieces underground and recycled, denied the museum space we so keenly reserve for other mechanical engineering heritage.

Despite the efforts of dreamers such as Elon Musk and his proposed network of underground highways, and astonishing achievements such as the Gotthard Base project, for many, the tunnel still lacks something in the aesthetic department. Rather than the horizon-straddling connection provided by a bridge, the tunnel is hidden away. Further, a bridge is almost uniquely a human innovation, where the tunnel 'merely' imitates the behaviour of our humbler animal kin: the worm, hag fish and gerbil. Or perhaps it's the tunnel's more unsavoury human connotations that detract from its appeal – as a means of intrusion: the favoured transportation of thief, smuggler, and sneak attacker. Well, when *The Engineer* reports on Norway's ambitious plans to build the world's first ship tunnel, the scifi eye, at least, likes what it sees. Tunnels make wonderful settings for story.

In much of science fiction, tunnels are the lairs of an alien menace, threatening the foundations of society: 1967's *Battle Beneath the Earth* sees Chinese invaders burrowing beneath the US laying atomic bombs; the bugs in Heinlein's *Starship Troopers* scurry beneath the surface of hostile planets; while the MUTO of 2014's *Godzilla* hatches below ground and burrows to the surface to wreak havoc. Often there's a nuclear element to these creatures' development, which is perhaps not an

entirely absurd notion: our tunnels do breed new species. (Post-war studies found a new strain of mosquito in London's tube.) Bearing in mind US plans to store its nuclear waste in Yucca Mountain tunnels; and North Korea's fondness for detonating nukes in deep excavations, the scifi imagination is naturally fired by the thought of some hideous super mutant emerging from centuries of radioactive incubation.

Where the inhabitants of science-fiction tunnels are human, they still tend toward the outlandish: mole men, Morlocks and the 'crawlers' of Neil Marshall's *The Descent* play on primeval fears of being dragged back to our prehistoric, cave-dwelling roots. Where normal people are found in tunnel settings they tend to be explorers and scientists, in fables such as Verne's *Journey to the Centre of the Earth* and the ludicrous film *The Core*. More effective are tales where humanity has adapted to endure a tunnel world, such as Roger Levy's novel *Icarus*.

What other gloomy worlds might tunnels explore? The Chunnel itself inspires: what other fractious near-neighbours could be bound by future tubes – Japan and China? Argentina and the Falklands? Such tunnels need not only serve paranoid invasion fantasies, but great escapes too. Imagine a future Russian police state, where a group of future engineers is excavating a grand Soviet-style subway in Yakutsk. Determined to escape the clutches of their megalomaniacal dictator, they secretly reprogramme their boring machines to

tunnel on, eastward, all the way to the Bering Strait and beyond to Alaska. Chased through the tunnel by a tipped-off secret police, they blow up the exit behind them: only to realise that their new home may not be quite what they imagined.

Boring machines might help colonise space. Self-assembling tunnelling robots might be the first to land on Mars, excavating underground habitats that avoid the perils of surface dwellings. One astronaut is sent to monitor their progress, but alone on Mars he goes mad, slowly dying from radiation sickness. Determined to find immortality, and inspired by the pharaohs, he reprogrammes his boring machines to excavate Olympus Mons, creating a huge pyramid in his honour: once complete they roam the passageways, ready to ambush any future Lord Carnarvon who comes raiding for treasure.

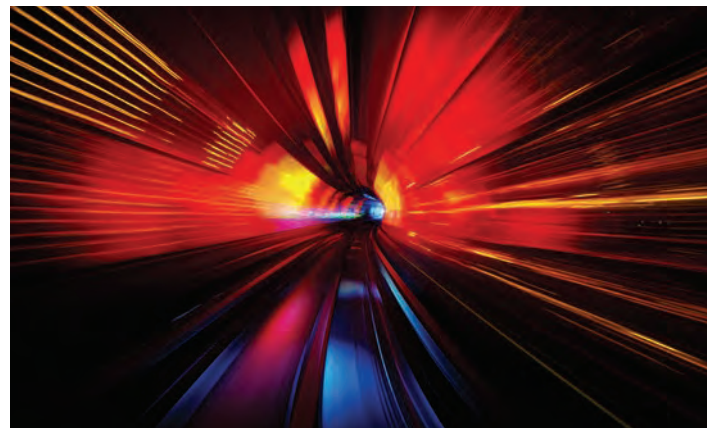
Or perhaps, finally, we should turn for inspiration to the seedier side of tunnelling: cartels use tunnels to smuggle product into the US. What of a future president who decrees drugs legal below the surface, literally driving the trade underground? A hugely expanded network of tunnels and caverns develops along the Mexican border, growing into a thriving shadow state. It is a dangerous territory, riven by petty theft and sporadic violence – but also the only place to go to hear good music.

Jon Wallace is a science fiction author living in England. He is the author of the Kenstibec trilogy published by Gollancz

"What other fractious neighbours could be bound by future tubes?"

Jon Wallace

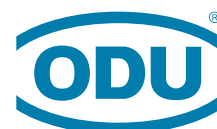
In much of science fiction, tunnels are the lairs of an alien menace



ODU-MAC[®]

THE ALL-ROUNDER FOR
MANUAL MATING AND
AUTOMATIC DOCKING

- + Application-specific hybrid interface
- + Maximum packing density
- + Flexible modular design
- + Wide variety of transmission modules
- + Various locking options
- + Mating cycles scalable as required:
from 10,000 to over
100,000 mating cycles



A PERFECT ALLIANCE.

ODU-UK Ltd.
Phone: +44 330 002 0640
sales@odu-uk.co.uk
www.odu-uk.co.uk

Silver-Line

White-Line

Blue-Line



Create Safe Access for Your Critical Energised Electrical Assets

www.iriss.com
info-emea@iriss.com
+44 (0)1245 399713

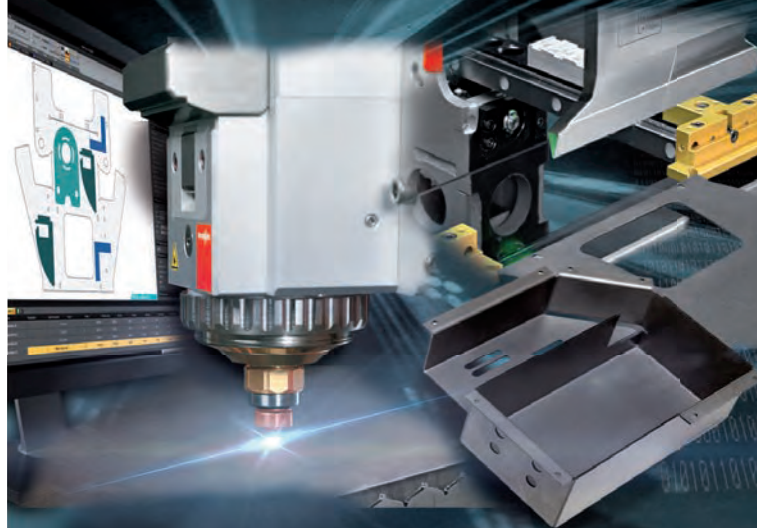
Use of Electrical Maintenance Safety Devices (EMSDs) such as inspection & IR windows, ultrasound ports, voltage detection ports and online monitoring all allow energised, electrical maintenance tasks to be completed while the electrical distribution equipment enclosure remains closed and provide a cost-effective way for companies to comply with all of the established IEE BS76 71 standards for maximum inspection.

Save Time, Save Money, Save Lives

Accurate

Laser Cutting

RAPID RESPONSE LASER CUTTING SERVICE



- SHEET METAL PROFILING EXPERTS • 4M X 2M CUTTING CAPACITY
- 4M 320 TONNE PRESSBRAKE CAPACITY • FREE UK DELIVERY

10KW FIBER LASER NOW IN FULL PRODUCTION

www.accurate-laser.co.uk

sales@accurate-laser.co.uk • Tel: 0121 520 2444

Technical Training Solutions

Providing Practical Engineering Skills
Training For Industry

Electronic Fault Finding
Soldering-to IPC standards
Pneumatics
Hydraulics
ATEX-DSEAR



Duty Holder
Instrumentation
Mechanical Maintenance
Electrical Maintenance
Welding
17 Edition Wiring Regs

City & Guilds
Approved Centre

Contact us for your copy of our latest brochure

T: 01634 731470

E: tech.training@zen.co.uk

www.technicaltrainingsolutions.co.uk

ELECTRICAL

INSTRUMENTATION

MECHANICAL

EURO-BEARINGS LTD

LINEAR BEARINGS



Corrosion
Resistant Slides

- No cutting charge
- Fast Service



See the full range on our website



Flanged Ball
Bushings, Linear
Bearings,
Housings and
Shafts

- Large range
- Variety of sizes

Not sure what to specify?
Contact our **Technical Sales** team for advice

Email: sales@euro-bearings.com

Tel: 01908 511733

www.euro-bearings.com/linear



Specialists in Design and Analysis Software for Electromagnetics

Infolytica has provided advanced Electromagnetic design and analysis tools since 1978 and provides both general purpose, and motor specific, electromagnetic design software.

Applications include: electromechanical devices; non-destructive testing (NDT); power electronics; induction heating; sensors; and industrial transformers.

Infolytica Europe

enquiries@infolytica.co.uk

+44 (0)1327 810383

www.infolytica.com



infolytica
europe

Inside Honda's hybrid supercar

The new Honda NSX is a technological tour de force, but can it still stir the soul? Chris Pickering reports

Sometimes, progress can be a mixed blessing. While cars have undoubtedly become quantifiably better in recent years, the same technology is often to blame for eroding the sense of connection that keen drivers crave.

The high-revving naturally aspirated V8s and V12s that once caused petrolheads to get all hot under the collar, for instance, are now an endangered species, while the manual gearbox is all but extinct on high-end performance cars. Likewise, the switch to electrically assisted steering may help to shave a few precious grams of CO₂ per kilometre, but it invariably robs a great deal more when it comes to tactility and feedback.

So, with this in mind, I approached the new Honda NSX with a degree of trepidation. On the face of it, a mid-engined supercar capable of 0-to-62mph in 'under three seconds' and the best part of 200mph can only be a good thing. There again, it's also a technological tour de force, packed with a multitude of clever features that stand to make or break the driving experience.

Where to start? Well, there's the obligatory downsized turbo engine – in this case a 3.5-litre V6 making 500bhp –

but here it's combined with a trio of electric motors. In between the engine and the nine-speed (yes, nine-speed) dual-clutch transmission lies a 47bhp motor, while each of the front wheels is powered by its own 36bhp motor.

Due to the differing speeds at which the four power units reach their peak, these figures can't simply be added up. Instead, Honda tells us the combined total is 573bhp. That's more than the similarly priced McLaren 570S or the Porsche 911 Turbo. What's more, the use of individual motors for the front wheels gives the NSX not only four-wheel drive, but also torque vectoring.

The bank of lithium-ion cells that supplies the electrical half of the powertrain is slung behind the

"There is a Quiet mode, which allows the car to run on electric propulsion whenever possible. It means you can glide serenely away from the traffic lights, but where's the fun in that?"

seats, while the power electronics sit in the central tunnel between the driver and passenger. Both are mounted low down, helping to give the NSX the lowest centre of gravity in its class, according to Honda. That's fortunate, because it weighs a not-inconsiderable 1,814kg.

Perhaps surprisingly, the NSX doesn't have a plug-in capability and there's no electric-only mode as such. There is, however, a Quiet mode, which allows the car to run on electric propulsion whenever possible, as well as closing a series of valves to channel the exhaust gases through additional silencers. It means you can glide serenely away from the traffic lights, but where's the fun in that?

In any of the NSX's other increasingly visceral driving modes (Sport, Sport+ and Track) things are rather >>

01 The Honda NSX is a mid-engined supercar that is capable of 200mph





02



03

>> different. The V6 begins with a deep, mechanical growl that builds into a proper supercar crescendo. It only revs to a comparatively mild 7,500rpm, but thanks to the wonders of hybrid assistance there's meaningful torque practically from tickover. That means when you reach the red line – exhausts bellowing and licence under threat – it feels like you've been flat out for a good 7,499 of those rpm.

Crucially, the electric motors also provide torque filling before the turbochargers wake up, which means the throttle response is both instant and unswervingly linear. It feels like a really well-sorted naturally aspirated engine – just one with disproportionate power and torque for its size.

You rarely hear anything to give away the presence of the electric motors, but more impressively you never really feel them either – even under braking. Often, hybrids have a rather wooden feel to the brake pedal as the electrical system harvests its energy, but not so in the NSX. It isn't just good for a hybrid, it's good full-stop.

The dual-clutch gearbox is also deeply impressive, even by the standards of what is now a very accomplished breed. Not only are the shifts smooth and lightning fast, but the unfeasibly large number of ratios actually feels totally natural once you're on the move. It's essentially a 7+2, with first only used for pullaway and ninth only for cruising.

And so we come to the steering. Not only is it electrically assisted, but it's also a variable rate rack. By rights, it should be horrible. In reality, it's rather good. There's not quite the same level of feedback as you'd get from the McLaren 570S's fixed-rate hydraulically assisted rack, but it feels pleasingly natural.

The only clue to the variable rate is the fact you can negotiate all but the tightest turns without taking your hands off the wheel.

Pitch it into a corner and the NSX feels spookily agile for a car that weighs as much as two Lotus Elises stacked on top of each other, yet it's also calm and composed at speed. That's an unusual combination, made possible by the ultra-low centre of gravity, plus the subtle effects of the variable-rate rack and the torque vectoring system. It's still not quite as light as the McLaren, but it would give an Audi R8 or a Porsche 911 Turbo a good run for their money.

And so, there you have it. A four-wheel-drive, hybrid supercar, built in the US by a Japanese company, which is capable of taking on the best of the European elite. But the real story here is that by combining lots of different technologies, Honda has produced a car that actually feels more analogue – more traditional, if you like – than we ever dared hope. Maybe the future isn't so bleak after all? ☐

“The dual-clutch gearbox is deeply impressive. The large number of ratios feels totally natural once you're on the move”

02/03/04 The NSX is packed with the kind of clever high-tech features that can make or break the driving experience



04




Remarkable people doing work that matters

Leading in technology means investing in talent. We recruit remarkable people who create innovative solutions for our customers.

www.baesystems.com

BAE SYSTEMS
INSPIRED WORK



Discover how we
helped a car parts
company stay on track

Agility is a flexible, dynamic asset and maintenance management platform that maximises uptime and minimises production disruption. Identifying the causes of repetitive maintenance and downtime is essential to reliable production.

Agility is delivered and fully supported by SoftSols, a global manufacturing solutions provider, so you have the reassurance of a technology you can trust and rely on.

The result is efficient working, increased productivity and a business working at full speed.

Take a look at our case studies to discover Agility in action at www.softsolsgroup.com or call us on 01924 200344 today.

agility

www.softsolsgroup.com

www.polysoude.com



POLYSOUDE

Orbital Welding
Automated Welding
Weld Overlay Cladding
Related Services

Drives are now coming up trunks

Kids' suitcases benefit from cut in energy costs. Supplier: ABB Drives

Magma Moulding, the manufacturer of the children's Trunki suitcase, has used an ABB drive to cut its energy costs by almost £8,000 per year.

Up to 23,000 Trunki suitcases are produced at the company's Plymouth facility each month, with around 1,000 manufactured over the course of every production day. The cases consist of two halves, each of which is made on a separate machine. One of the machines is 15 years old, while the other is only three years old. By attaching an ABB variable-speed drive (VSD) to the older machine, Magma Moulding was able to replicate the efficiency of the newer device.

"These machines were ideal to test the effect of a VSD as they are identical machines side by side making identical parts," said Tony Newbold, technical manager for Magma Moulding.

"The only difference is that the newer machine already has a speed-controlled hydraulic pump and we wanted to see if we could produce similar savings by retrofitting an electric variable-speed drive to the older machine."

The moulding machine has a 65-second cycle time. Around 30 per cent of the cycle time is spent off load, during which the hydraulic system is not in operation but the pump motor is still running at maximum speed. Magma Moulding wanted to save the energy that was wasted here while avoiding affecting the cycle time.

The variable-speed drive measures the torque in the motor to decide if

the machine is on or off load and reduces the speed of the motor when off load. Previously, the moulding drew 40kW, but, since fitting, the drive

has reduced this to 23.5kW. As it runs for 4,500 hours per year, the drive is saving 74,250kW/hrs annually. ☐



Painting a picture of better mixing

Paint manufacturer replaces variable-frequency drives in mixers. Supplier: Eaton

To minimise the risk of production downtime and guarantee a quick response in the event of a fault, paint manufacturer Dinova has replaced the

variable-frequency drives in its mixers with a compact PowerXL DG1 drive from Eaton featuring an integrated motor protection relay. Dinova has been able to minimise fault sources, prevent mechanical resonance from affecting the mixing element and reduce energy loss in the motor by dynamically maintaining the voltage/frequency curve at a minimum.

The DG1's electronic motor

potentiometer allows the motor speed to be controlled, making it easy to switch between the different speeds required for various process steps. The dissolver, for example, reaches a maximum speed of 22m/s. The DG1 can also deal with the wide range of viscosities of Dinova's different products. Depending on a material's viscosity, the operator selects a corresponding starting frequency at which the variable-frequency drive starts and begins to accelerate.

In addition, a 'skip frequency' function prevents mechanical resonance from affecting the mixing element when the vat is empty. This vibration would otherwise cause bearing damage on the motor and eventually cause the mixing element to break. To prevent this, the operator

can set the variable frequency drive's critical frequency range and, as a result, the drive will not operate at this range.

The five per cent DC choke within the DG1 prevents a voltage drop from affecting the drive. It also reduces harmonics more effectively and protects the drive from transients, like a mains choke, using input voltage surge protection. Additionally, the integrated motor protection relay calculates the motor's thermal load constantly. In the event of an overload, the DG1 goes into fault mode, protecting the motor from overloading.

To minimise energy loss, the DG1 has an 'Active Energy Control' function that increases motor efficiency by dynamically adapting the voltage/frequency curve. ☐





6-8 JUNE 2017 | BIRMINGHAM NEC

theENGINEER

design & innovation show

FIRST FOR TECHNOLOGY AND INNOVATION



A ONE-STOP SHOP FOR DESIGN ENGINEERS, SHOWCASING PRODUCTS AND SERVICES NEEDED AT THE PRODUCT DESIGN, PROTOTYPING AND DEVELOPMENT STAGES OF THE MANUFACTURING CYCLE.



NETWORK

Meet like-minded innovators, designers and product development professionals, share experiences and build business partnership.



SOURCE

Latest technology, components and design tools to help you bring innovative products to market and stay ahead of your competitors.



LEARN

Inspiring examples of engineering excellence, the latest developments in manufacturing technology and the latest thinking in engineering design.

3 SHOWS, 400 EXHIBITORS, OVER 30 FREE CONFERENCE SESSIONS

The Engineer and The Manufacturer come together to deliver a programme of unrivalled educational content.

NEW
FOR
2017

CO-LOCATED WITH

**Advanced
Manufacturing**

SUBCON

Show Partner



Association Partners



Conference Partners



Media Partners



REGISTER FOR FREE THEENGINEER-DESIGNINNOVATIONSHOW.CO.UK

6-8 JUNE 2017 BIRMINGHAM NEC

THREE CO-LOCATED EVENTS, THREE DAYS, ONE COMPLETE MANUFACTURING SOLUTION

Discover the suppliers, innovations and advice to
optimise your future manufacturing strategies



**AdVanced
Manufacturing**

THE GLOBAL PLATFORM
FOR MANUFACTURING
TECHNOLOGIES

#AMSHOW17



SUBCON

THE UK'S PREMIER
SUBCONTRACT
MANUFACTURING
SUPPLY CHAIN SHOW

#SUBCONSHOW



the ENGINEER
design & innovation show

FIRST FOR
TECHNOLOGY &
INNOVATION

#TEDISHOW

3 SHOWS, 400 EXHIBITORS, OVER 30 FREE CONFERENCE SESSIONS

The Engineer and The Manufacturer come together to
deliver a programme of unrivalled educational content.

Show Partner



Association Partners

CompositesUK



Conference Partners



Media Partners



REGISTER TO ATTEND FOR FREE

[HTTP://SHOWS.THEENGINEER.CO.UK](http://shows.theengineer.co.uk)

The benefits of downsizing

Downsized eDrive aids small-car hybridisation. Supplier: GKN Driveline

Driveline strategies are changing due to the requirement of future vehicles that will need to offer plug-in hybrids as an integral part of the range.

To meet this demand, GKN Driveline has delivered a downsized eDrive for small-car hybridisation.

Following a series of high-profile hybridisation programmes for Porsche, BMW, Volvo and Mitsubishi, GKN Driveline is continuing to make eDrive and eAWD more mainstream. The latest development is a new, more highly integrated system that will provide the electric drive to a global car platform when it starts production in 2019.

While competitor systems connect standard motors, inverter and reduction gearboxes, GKN's compact module integrates the three into a single unit.

The new module integrates a water-cooled electric motor and inverter with a single-speed eAxle reduction gearbox. The all-in-one eDrive system even replaces external wiring with a bus bar to eliminate unnecessary mechanical interfaces. The result is an eDrive system with higher power density that is simpler to install.

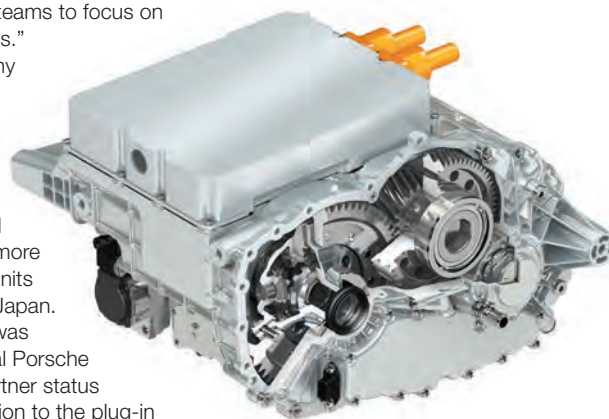
The system generates a maximum 65kW of power and can deliver up to 2,000Nm of torque to the rear wheels. The complete eDrive module measures just 300mm high and 325mm wide, and weighs 54kg, making it around 20mm narrower and 2.5kg lighter than comparable systems.

"Automakers increasingly want complete eDrive systems from suppliers, rather than sourcing the

different elements from different companies," said Peter Moelgg, chief executive of GKN Driveline's eDrive and AWD business. "Having experienced, specialist development partners support the programme frees in-house teams to focus on other challenges."

The company has been advancing the development of eAxle technology since 2002 and has produced more than 300,000 units in Europe and Japan. The company was awarded Official Porsche Technology Partner status for its contribution to the plug-in

hybrid Porsche 918 Spyder programme. GKN launched the world's first two-speed eAxle in the plug-in hybrid BMW i8. ©



Reclaiming the fine ore

Drive technology conveys fine ore at Austrian opencast mine. Supplier: WEG

At the Erzberg mine in Austria, mining operator VA Erzberg produces approximately 2.7 million tonnes of fine ore per year from an extraction volume of roughly 11 million tonnes.



A fully automated fine-ore storage facility has been operating at the opencast mine since 2014, and one of its key components is a reclaimer supplied by SBM Mineral Processing. WEG subsidiary Watt Drive provided the drive technology for the conveyors at this bridge bucket-wheel reclaimer.

SBM's Stationary Systems business designs and builds high-performance solutions for numerous industrial areas, including the sand and gravel sectors. Application areas include crushing and processing of ores.

SBM's new reclaimer has advantages over the previous storage method of tipping fine ore from heavy-duty trucks and further transport by wheel loaders.

The reclaimer, which is 65m wide and has a capacity of 1,100t/h, is designed to operate between temperatures of -30C° to +40C°. It has a storage capacity of 35,000m³ per pile, with two piles handled simultaneously.

The first pile contains processed material with a particle size of 0 to 8mm and is built up layer by layer using a reversible distribution belt.

The second pile is processed by the reclaimer using

a 9m-diameter bucket wheel, which removes material automatically or semi-automatically and transports it to the railcar loading station over conveyor belts.

Failure of one or more conveyor belts can lead to total production stoppage so low maintenance and reliable operation are key requirements for the geared motors of the drive systems.

Marcus Altenreiter, maintenance manager at VA Erzberg, said: "We already had good experience with gear units from Watt Drive in our processing plants. A significant success factor for the reclaimer project was that we could put this experience to good use in the layout and dimensioning of the new unit, and Watt Drive did a very good job of implementing our proposals." ©

Perfecting lamination for babies' nappies

Nappies present a number of significant engineering challenges. Supplier: Henkel



While possibly not at the forefront of many engineers' minds as a cutting-edge product, babies' nappies in fact present many challenges, as they have to both perform well in terms of their sanitary properties while not causing irritation to babies' sensitive skin. Italian manufacturer A Celli turned to adhesives manufacturer Henkel for help in one of the first stages of the manufacturing process, bonding a non-woven material to a plastic film to make a laminate. This involves laminating sheets up to 8m wide, running through machines at a rate of more than 100m/min, and requires a high level of bonding accuracy.

Henkel helped A Celli with know-how exchange on specific aspects of the lamination process such as corona treatment requirements (where an ionised gas is used to affect

the surface roughness and reactivity of polymer substrates to improve bond strength); web tensioning; coating head positioning; bonding optimisation to increase peel strength and minimise staining and bleed-through; and provided more understanding of the processes involved through hands-on demonstrations and expert help. The company also helped with the selection of the appropriate adhesive from its portfolio of products.

"We are extremely pleased at the customer feedback and successful outcome of this outstanding cooperation with Henkel, one of our preferred partners," said Francesco Vergentini, A Celli's sales director. ☐



Fastening on to a range of washing machines

Fasteners and fixings for the white goods industry. Supplier: TR Fastenings

TR Fastenings is partnering with EBAC to supply fasteners and fixings for the UK firm's new range of washing machines.

Durham-based EBAC is best known for designing and manufacturing dehumidifiers and water coolers, but is now also the only UK producer of washing machines. Building white goods requires specialised robotics and components, so EBAC looked for a fastenings supplier with experience in the industry and knowledge of the parts required.

TR has longstanding experience in the sector, primarily through its Italian sister firm, Viterie Italia Centrale (VIC), which specialises in supplying fastenings to the white goods industry. Following some initial meetings and

a period of consulting and testing, including bringing experts over from VIC to assist with the process, EBAC appointed TR Fastenings as its sole supplier of fastening parts for its new washing machines.

"This is a fantastic partnership for us, not only because we now have the privilege of supplying fastening parts to the only UK manufacturer of washing machines, but because it has also shown the strengths we have in consultancy and product knowledge," said Don Lamb, business development manager at TR Fastenings.

According to TR, the new EBAC washing machines are currently available in several independent UK retailers following a soft launch at the end of 2016, and will continue to be

rolled out across the UK in 2017.

"The washing machine market is technically challenging and it's vital that we source, test, and utilise only the best components and processes," said Andrew Jordan, logistics manager at EBAC. "Having TR and its Italian colleagues on board to advise us and supply the parts we needed and the expertise on how they should be used was invaluable." ☐



WAVED WASHER SPRINGS



In the world of waved washers for pre-loading applications Emmotts reign supreme, producing neat solutions in a wide variety of situations. We manufacture over 200 standard products as well as tailor-made specials in many materials right up to 400mm diameter.



Springs & Pressings

Geo. Emmott (Pawsons) Ltd.
Tel: 01535 643733 Fax: 01535 642108
email: mail@emmottsprings.co.uk
web: www.emmottsprings.co.uk

DESIGN • DEVELOPMENT
PROTOTYPING • MANUFACTURE



**Global engineering, manufacturer and distributor
of industrial fastenings and Cat C products.**



More **Features**



More **Products**



More **Data**

www.trfastenings.com

The go-to place for Engineers, Designers & Buyers

T: 08454 811 800 | E: sales@trfastenings.com

Keeping the cargo moving

Port of Rotterdam uses additive processes to repair damaged ships. Supplier: Autodesk

Engineers at Europe's largest port are exploring the use of additive manufacturing processes to carry out repairs to damaged ships.

The Netherlands' Port of Rotterdam is one of the most important intersections for the flow of cargo in the world.

Currently, if a vessel comes in to port needing a replacement part – a propeller, for example – it can take weeks or months to order and deliver, costing companies millions of dollars while they wait. It can also be quite costly for companies to keep large stockpiles of parts in warehouses around the globe.

To tackle this challenge, the Port opened the Rotterdam Additive Manufacturing Lab (RAMLAB) an onsite facility that includes a pair of six-axis robotic arms capable of

additively manufacturing large metal industrial parts.

The port is working alongside software firm Autodesk, which presented a scaled-down 3D-printed ships propeller at Hannover Messe in Germany this week.

As a main software partner in the project, Autodesk has played a key role in developing RAMLAB's innovative hybrid manufacturing approach, which entails combining additive and subtractive manufacturing.

This enables RAMLAB to pursue faster fabrication options: 3D printing large ship components in metal and then finishing the pieces using traditional CNC milling and grinding methods within a matter of days, saving time and money without sacrificing performance.

The next step for the Port of Rotterdam project will be production of a full-scale version that will be fitted to one of the partner's ships later this year.

"With the work being done at RAMLAB, the group hopes to accelerate the cross-industry adoption of hybrid manufacturing for making large-scale parts on-demand," said Vincent Wegener, managing director of the RAMLAB. "Our aim is to make the Port of Rotterdam not just an important gateway for Europe, but also a leader in the development of new manufacturing methods. Autodesk is a key partner for us due to its expertise in how to design and manufacture using both the latest additive manufacturing techniques and more traditional CNC and machining methods." ©



Racing into some weight reduction

Formula One team expands its use of 3D-printing technology. Supplier: Stratasys



Formula One team McLaren Honda has revealed it is expanding its use of Stratasys 3D-printing technology to accelerate design iterations and to reduce the weight of its racing car.

Some of the 3D-printed parts designed to improve performance have been applied to the 2017 race car, including a hydraulic line bracket; a flexible radio harness location boot; carbon-fibre composite brake-cooling ducts; and rear wing flap.

The bracket for the MCL32 race car was produced in four hours compared to an estimated two weeks using traditional manufacturing processes. McLaren Honda 3D printed the structural bracket to attach the hydraulic line using a Stratasys Fortus 450mc Production 3D Printer with carbon-fibre reinforced nylon material.

Similarly, a new two-way communication and data system was recently added to the MCL32 race car but the cable distracted the driver. To overcome this, McLaren used the Stratasys J750 3D printer's ability to print in flexible materials to produce a rubber-like boot to join the harness wires for the communication system. Three designs were iterated and 3D printed in one day. The final component was printed in two hours and was used on 26 March 2017 at the Australian Grand Prix.

At the back of the car a large rear wing flap extension designed to increase rear downforce was manufactured in carbon-fibre-reinforced composites using a 3D-printed lay-up tool produced on the FDM-based Fortus 900mc Production 3D Printer. The team 3D printed the 900mm-wide, high-temperature mould in ULTEM 1010 for the autoclave-cured composite structure in three days, which saved the team time in a critical limited testing period.

To further accelerate design and manufacturing cycles, McLaren Honda will be bringing a Stratasys uPrint SE Plus to track testing and races on site, enabling the team to produce parts and tooling on demand. ©



RAPID PROTOTYPES & PRODUCTION PARTS

Advanced prototyping and manufacturing solutions using traditional and additive manufacturing technologies, materials and finishing options. Provider of 3D printing and rapid prototyping services for industries including automotive, aerospace, medical and defense.

- **3D PRINTED PARTS & PROTOTYPES**
Largest selection of processes & materials
- **POLYURETHANE PARTS**
Short run products and clinical builds
- **INJECTION MOULD TOOLING & PARTS**
High quality, production-grade parts

Get a Quote at www.3dsystems.com/uk/quote

Wycombe Sands, Lane End Road, High Wycombe HP12 4HH UK
quickparts.uk@3dsystems.com | 08450 514 900

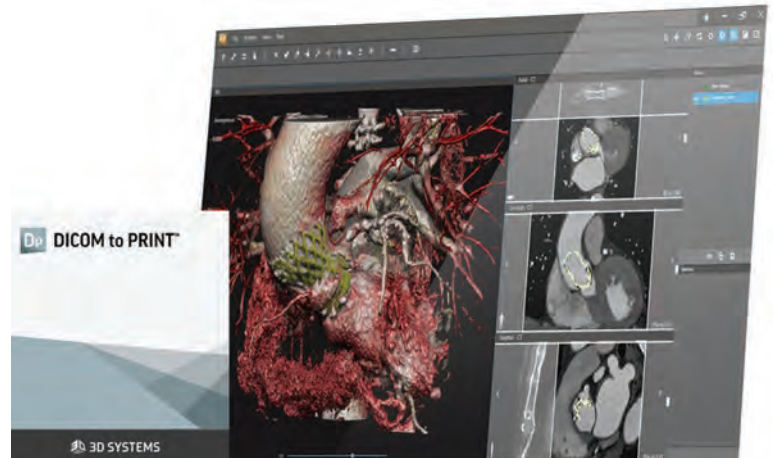
Scaffolds are in print for lungs

Collaboration will work on developing scaffold structures for solid organ transplants. Supplier: 3D Systems

United Therapeutics and 3D Systems are to collaborate on developing scaffold structures for solid organ transplants. Beginning with 3D-printed scaffolds for lungs, the agreement will see 3D Systems use collagen and other building-block proteins to make the scaffolds, which United Therapeutics will then seed with living cells, including re-differentiated stem cells from prospective transplant patients, with the goal of growing organs from the patients' own tissues that would not then be rejected.

"By cellularising scaffolds created with 3D Systems printers with a patient's own cells, there will no longer be a need for immunosuppression and a vastly greater number of patients can extend their enjoyment of life through organ transplantation," said Dr Martine Rothblatt, chairman and chief

executive officer of United Therapeutics. Vyomesh Joshi, chief executive of 3D Systems, said: "We believe bioprinting is a powerful opportunity and we are uniquely positioned with the broadest portfolio of technologies to partner with companies of the calibre of United Therapeutics to provide healthcare solutions of the future."



The project will be run from 3D Systems' new bioprinting lab in San Diego. "We expect one personalised

organ transplant will avoid years of healthcare spending on palliative medical therapies," Rothblatt said. ©

Closing the loop between design and 3D printers

New approach aims to combine design software and additive technology. Supplier: Materialise

Siemens and Materialise have come together to offer something that integrates the former's NX software with the latter's additive manufacturing technology.

This aims to streamline product design by linking Siemens' NX CAD software with Materialise's suite of 3D-printed offerings. According to the companies, the new approach will eliminate data translation and conversions, as well as ensure that changes to digital product design models are automatically and associatively reflected in the 3D-print jobs.

"Additive manufacturing is a reality now, even in highly regulated markets such as aerospace and healthcare," says Johan Pauwels, executive vice-president at Materialise. "By

bringing together products from Siemens and Materialise, we are optimising and simplifying the workflow for design, engineering and manufacturing of components. We're pleased to partner with Siemens, which truly understands

large-scale industrial manufacturing environments and shares our belief that designers and engineers can create better products if additive manufacturing is embedded into their mainstream business processes."

By closing the loop between

product design and 3D printers, the two partners say they can deliver greater model accuracy, higher quality and a much faster design-to-production process.

"Until now, the additive manufacturing process required manufacturers to work with two separate systems – one for product design, and another to prepare that design for 3D printing," said Zvi Feuer, senior vice-president of manufacturing engineering software for Siemens PLM Software.

"The data translation issues and lack of associativity between these two systems created a process that was time consuming and subject to errors. By eliminating these issues, we are helping to expand the adoption of additive manufacturing as a universally accepted production tool." ©



WE DON'T 3D, WE WINDFORM.



3D printed intake manifold functional prototype



WINDFORM, THE NEXT GENERATION OF 3D PRINTING. SINCE 1996, WINDFORM MATERIALS HAVE MADE IT POSSIBLE FOR LASER SINTERING TECHNOLOGY TO CREATE HIGH-PERFORMING PARTS. HIGHLY-FUNCTIONAL, BEAUTIFULLY FINISHED AND PROVEN RELIABLE. FREE-FORM DESIGN AND THE ABILITY TO BUILD SUPERIOR PROTOTYPES.

WINDFORM, IMPOSSIBLE APPLICATIONS ARE NOW POSSIBLE.

WINDFORM®
FOR ADVANCED 3D PRINTING
www.windform.com info@windform.com



www.crp-group.com

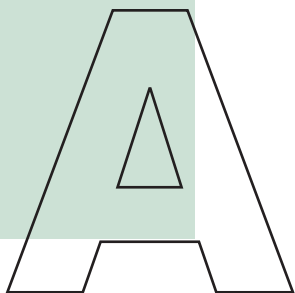


www.crp-usa.net



3D printing a Tour de France winner

Dimitris Katsanis, founder and CEO of Metron Advanced Equipment, discusses the advantages of 3D printing in competitive cycling



As a composites and design engineering expert, I have always been a dyed-in-the-wool carbon-fibre advocate. I've been designing and building competitive bicycles for some of the speediest

athletes on Earth since the 1990s and, until recently, have always relied on carbon fibre for its versatility, lightness and strength. Olympic and Tour de France champions will also attest to its benefits when it comes to producing medal-winning bicycles.

Previously, my team at Metron and I kept a close eye on additive manufacturing (AM) technology. We used it occasionally for printing prototypes for aerodynamics testing, but it was never central to our design process. The materials were fairly limited when it came to building bicycle frames and parts, and the cost and reliability couldn't compete with carbon fibre for what we needed.

That is, until more recently, when AM technology really upped its game with metals. Printing full, complex, robust end-use parts in titanium moved from the realms of fantasy and hype to reality. When it came to designing handlebars for Chris Froome's Tour de France-winning bicycle, we decided the time had come to choose AM over carbon fibre. And we haven't looked back. Here's some of the reasons why.

Although 3D printing isn't the instantaneous process some would lead you to believe, when it comes to design iterations, we found our timescales were compressed by 50-75 per cent over using carbon fibre.

This reduction from months to weeks – or even days in some cases – meant we were able to make adjustments and adapt designs more easily. Using AM, we no longer needed to make a new mould for each design iteration of Froome's handlebars, for example. Instead, we could test models and tweak the CAD design relatively easily, then 'print' a new version. This speedier processing in AM meant we were able to redesign the handlebars after initial tests, improving the aerodynamics and performance.

By cutting our timescales using AM, we were able to design the part to fit the rider, eliminating the need to create adjustable handlebars, and reducing

unnecessary weight. Faster turnaround times meant we were able to print two different handlebar designs in titanium for Froome's time trials: one for riding on the flats; and the other for hills.

Using AM allowed us to make changes to the designs on the computer screen and have a new set of handlebars within days, versus the weeks it would have required to make new moulds and produce the parts in carbon fibre.

Froome ended up using both sets, swapping them out based on the day's course, whereas most riders had to reposition theirs depending on the terrain. Custom handlebars not only have the advantage of optimum performance for the rider on for each section of the course, but they are a huge advantage when it comes to reducing weight. And when it comes to competing in the upper tiers of cycling, every milligram matters.

By designing and printing the handlebars out as one full part, we eliminated the need for nuts, bolts and adjusters. So, despite titanium being a heavier material than carbon fibre or aluminium, this process allowed us to manufacture a lighter overall part, saving up to 17 per cent of the weight and reducing the aerodynamic drag of the handlebar by eliminating clunky, heavy connectors and fasteners.

Even with all of its advantages and recent developments, AM is not a blanket solution for everything. Nor will it ever be. There is a reason that our business is basically split 50-50 into jobs using AM and those using carbon fibre.

AM metals can be expensive. No high-end

“Making use of additive manufacturing allowed us to have a new set of handlebars within days”

Dimitris Katsanis

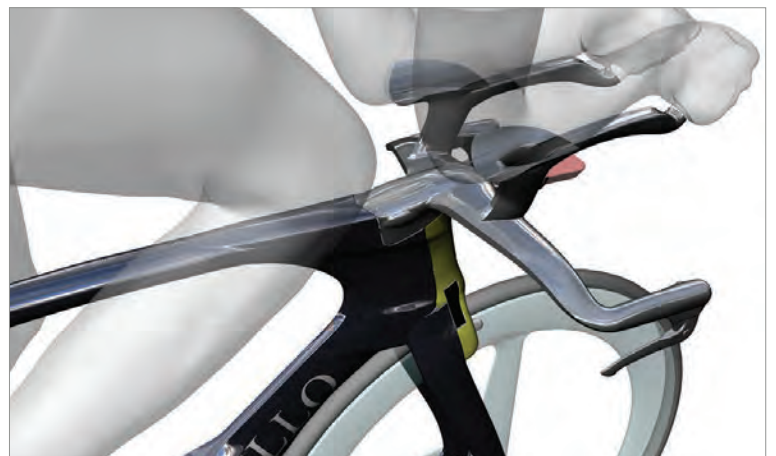
machine that prints metal is available on the market for less than £200,000. So while you can use AM to make a simple component, it will cost 10-50 times more than using more traditional machining methods.

When it comes to metal parts, AM really comes into its own with complex components; anything where complexity and weight mean a competitive advantage. In general, if a designer or engineer comes to the point that one says 'great idea but how can we make that?' then this is the moment that AM can be a solution. The relative speed of AM means you can make design changes in the weeks leading up to a competition to shave off a few precious seconds with a lighter-weight design. An approach that would cost much more with carbon fibre.

The adaptability and flexibility of AM can be worth its weight in gold – or at least titanium! ☺

Dimitris Katsanis will speak in more detail about additively manufactured titanium parts for high-performance bicycles at this year's Additive Manufacturing and 3D Printing International Conference, 11-13 July

AM means you can make changes in the weeks leading up to a race to shave off a few precious seconds with a lighter cycle design



Rencol

COMPONENTS

INDUSTRIAL MANUFACTURING
SINCE 1923

Rencol Components continues a tradition of quality manufacturing dating back to 1923. Our brand is synonymous with high quality plastic and metal components, and our team is unmatched in industry experience & product knowledge.

Take advantage of our near century of industry experience, diverse manufacturing capability and unbeatable value – **contact us to find out more & receive our updated catalogue.**

Tel: +44 (0) 117 916 0090

Email: sales@rencol.com

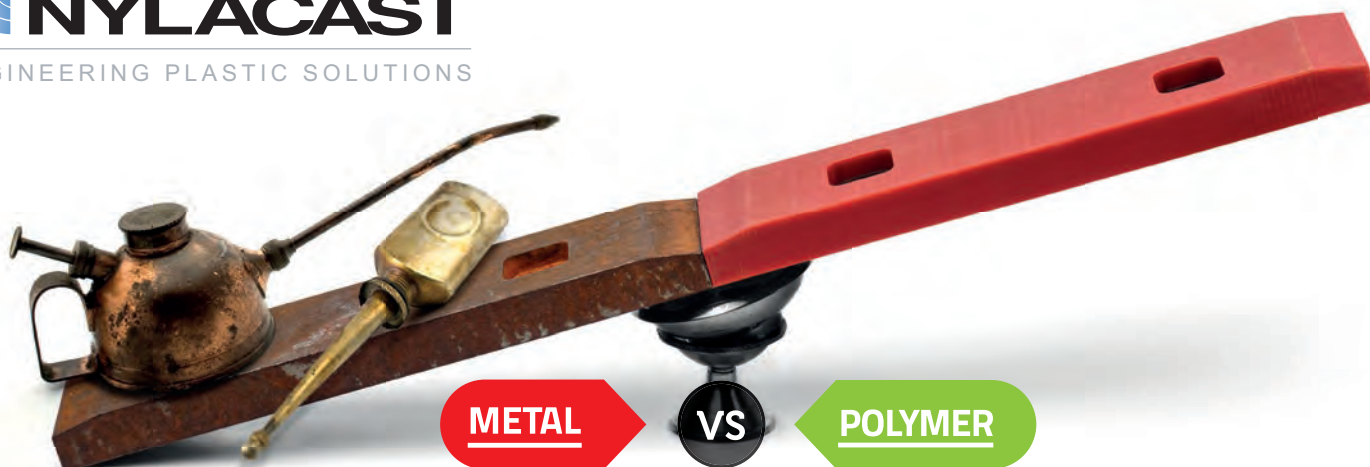
Website: www.rencol.com

Visit our stand G71 at TEDIS & SUBCON



NYLACAST

ENGINEERING PLASTIC SOLUTIONS



METAL

VS

POLYMER

Dimensional stability	✓	Rust/Corrosion	✗
Conducts heat	✓	Wear	✗
Convects heat	✓	Noise	✗
Conducts electricity	✓	Maintenance	✗
Strength	✓	Heavy weight	✗

Cost effective	✓	Impact resistance	✓
Low friction	✓	Insulation	✓
Noise reduction	✓	Lightweight	✓
Chemical resistance	✓	High temperatures (+180°C)	✗
Strength	✓	Heat	✗
Custom grades	✓	Extremely high loads	✗

Covering the whole cycle

Subcon, Advanced Manufacturing Show and The Engineer Design & Innovation Show reunite to create a key event for UK manufacturing

The three shows run from 6 to 8 June 2017 at the NEC Birmingham and are complemented by 36 free-to-attend presentations in two separate conference streams (see p58). Together, the three shows cover the complete manufacturing cycle from concept to component, bringing together design engineering, product development, in-house production and outsourced supply chains.

Around 500 exhibitors will come together with thousands of professional visitors who have current sourcing needs for equipment, software and manufacturing services.

Established over 40 years, Subcon is the UK's only event dedicated to outsourced manufacturing. It serves all sectors and all processes – from machining, sheet metalworking, casting and forging, to plastic moulding, composites and electronics.

This range of manufacturing technologies is reflected in some of the new services and investments being featured at the show.

In plastics, Hepworth Group has launched a new RIM Moulding Division, which adds an additional manufacturing

option to its extensive range of fabrications services.

In forming and fabrication, Kloeckner Metals UK, the multi-metal stockholder and distributor, has continued its investment in its processing portfolio with the installation of a new laser and press brake.

Materials coatings expert NikaWorks has partnered with Surgical Holdings to develop new functional coatings for surgical instruments.

The machining services sector is strongly represented with new services, including the launch of a subcontract CNC cylindrical grinding at Perfect Bore. Investment at Carlton Die Castings has seen the installation of a Mazak twin-pallet horizontal CNC machine that enables it to supply customers with fully machined castings ready for assembly. And specialist subcontract engineering company Mini Gears Group will be showcasing its complete new range of machined components.

Supporting the Subcon show, sourcing specialist Qimtek is sponsoring the Buyer's Programme and hosting a dedicated Qimtek UK Manufacturing Pavilion.

The Subcon Buyers Programme offers a package of networking opportunities, services and benefits to buyers who have been identified as having a high level of spend on contract manufacturing services.

Those invited to join the programme will benefit from access to the VIP Buyer Networking Lounge where they can

hold meetings, talk to colleagues and enjoy refreshments, including a complimentary lunch, as well as free parking.

Ahead of the show, buyers will also receive a shortlist of the suppliers that meet their specified requirements, allowing them to maximise their time at the event.

Buyers on the programme can also attend an invitation-only networking event, sponsored by Qimtek, with free drinks and canapés.

Last year, this attracted more than 100 buyers from companies including British Telecom, JCB, Jaguar Land Rover, Ishida and Oxford Instruments.

Launched in 2013, the Advanced Manufacturing Show covers every aspect of production technology, including machining and turning centres, lasers and press brakes, tooling and ancillaries.

As well as machine tool and accessory suppliers, including XYZ and 1st MTA, metrology is particularly strongly represented.

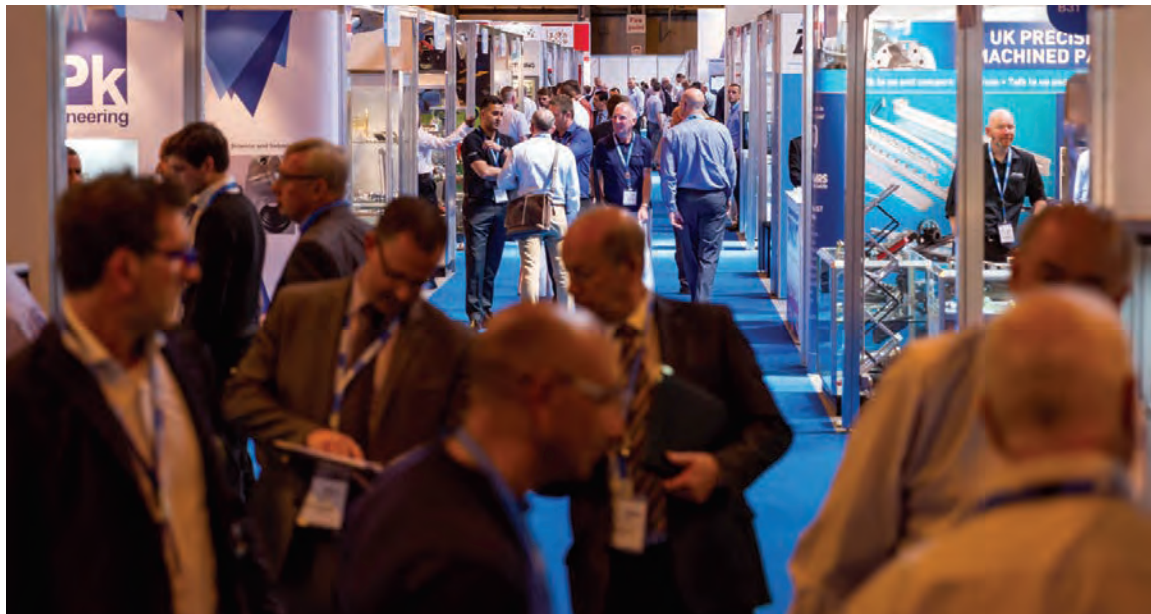
Global metrology brands, including Hexagon Manufacturing Intelligence, Zeiss, Olympus and Alicona, are joined by UK champions, including Renishaw and Aberlink, as well as specialists such as hire and contract scanning and measurement company Manchester Metrology; inspection, fixturing and calibration experts Verus; and representatives of world-leading equipment manufacturers such as Measurement Solutions.

Together they cover all aspects of scanning, measurement and quality systems from contact and optical CMMs, to laser scanners, 3D surface measurement, microscopy and automated systems.

The Engineer Design and Innovation Show offers everything a design engineer needs to create innovative new products – from CAD and simulation software to prototyping and components.

Highlights include the latest composite printing technology. CREAT3D, will be presenting the newest 3D-printer technology that uses a Nylon or carbon-fibre reinforced Nylon as base material and can incorporate Kevlar, fibre glass or carbon fibres to create a composite structure that can generate a higher strength-to-weight ratio than aluminium. ☐

You can find out more about visiting and exhibiting at the three shows at: www.subconshow.co.uk, www.advancedmanufacturingshow.co.uk and www.theengineer-designinnovationshow.co.uk



THE BIG
GREEN
BOOK

THE ENGINEER DESIGN & INNOVATION SHOW 6 - 8 June 2017
Birmingham NEC Hall 3 - booth G58

norelem

www.norelem.co.uk

Where are you on your Asset Management journey?

GETTING STARTED

Aware, Learning and Applying

- Introductory briefings, training and education (including online)
- Baseline and gap analysis, roadmap development
- Tools: criticality, risk and prioritization

INTEGRATING, EMBEDDING

Developing, Personalising and Consolidating

- ISO 55001 system design, implementation and certification
- Expert facilitation of business/culture change
- Structured competency development
- Tools: decision-support and business case justification

SEEKING EXCELLENCE

Optimizing Value, Continual Improvement

- Goals and roadmapping beyond ISO 55000
- Innovation, benchmarking and optimization processes
- Continual professional development and MSc qualifications
- Leading edge tools: decision and programme optimization

Contact us to discuss your Asset Management journey
+44 (0) 1635 298800 | enquiries@twpl.com | www.twpl.com



THE
WOODHOUSE PARTNERSHIP

Best practice and innovation

World-class speakers line up for free conference streams at Subcon, the Advanced Manufacturing Show and The Engineer Design & Innovation Show

Two free-to-attend conference streams addressing key issues, best practice and technological innovation will run alongside Subcon, the Advanced Manufacturing Show and The Engineer Design & Innovation Show.

World-class speakers come from global blue-chip organisations, including

Microsoft, Siemens, BAE Systems, Jaguar Land Rover, Bureau Veritas, Stratasys, Lloyds Bank and Renishaw.

The programme will also feature leading technological experts from top research and development bodies, and special presentations giving an exclusive behind-the-scenes look at companies showing the highest levels of engineering innovations and ingenuity in their products – including Ocado Technologies, BAC Mono and leading hi-fi turntable manufacturer Rega Research.

The sessions will be held in two separate streams hosted by *The Engineer* and *The Manufacturer* respectively.

Thirty-six sessions across the three days will cover topics ranging from virtual reality, additive manufacturing and Industry 4.0 to materials testing, updates to AS9100, magnesium components and big data.



02



03



01

01 The BAC Mono supercar was dubbed 'amazing' by Jeremy Clarkson

02 Roy Gandy is the founder and innovator behind hi-fi manufacturer Rega Research

03 Renishaw's additive expertise will be discussed by Marc Saunders

Microsoft's Lars Knoke will be examining the potential for virtual reality and augmented reality in manufacturing and supply chains, while some of the UK's foremost authorities on additive manufacturing (AM) will be looking at the latest developments in this technology.

Phil Reeves of Stratasys and Prof Richard Hague of Nottingham University will be giving keynote presentations, looking, respectively, at where to get the most valuable business benefits from AM and multifunctional 3D printing of complete components.

Complementing these talks, Marc Saunders of Renishaw will look at metal additive manufacturing as a viable series production process and Desi Bacheva of HiETA will look at its potential for lightweight automotive components.

Other keynote speakers include Sam Turner, chief technology officer at the High Value Manufacturing Catapult; Andy Wright director strategic technology

at BAE Systems Programmes and Support, who will be looking at disruptive technologies and the future of manufacturing; while Michael Ward, chief technology officer at the Advanced Forming Research Centre, will be looking at the way we will use conventional technologies in the future.

The fourth industrial revolution – also known as Industry 4.0 – will also be well covered, particularly from the perspective of SMEs and what they can do to engage with the demands these new technologies bring.

Alan Norbury of Siemens; Malcolm Harold of the Knowledge Transfer Network; and Chris Richards of the EEF are among the speakers; while Bin

Cai, Powertrain Metrology Manager at Jaguar Land Rover, will explore the vital role that metrology plays as the interface between the physical and digital worlds.

For many visitors, the high point of the conferences will be three presentations focusing on innovation and excellence in engineering.

The speakers here are Sid Shaikh, who will be talking about the automation systems that Ocado has developed to make sure that its retail operation delivers; Roy Gandy, founder and innovator behind the renowned top-end British hi-fi manufacturer Rega Research; and Neill Briggs of the Briggs Automotive Company on the story behind the BAC Mono, the single-seat, road-legal supercar that was dubbed 'amazing' by Jeremy Clarkson. ©

You can see the full conference programmes online at www.subconshow.co.uk/conference

Does your fabricator cut it?

LASER CUTTING WATERJET CUTTING FORMING FABRICATION DESIGN



info@emsea.com / +44 (0) 1684 299156 / www.emsea.com

emsea

SUBCON
stand D31



Follow Emsea on Twitter: @emsealtd

Emsea Ltd. Unit 5 / Green Lane / Tewkesbury / Gloucestershire / GL20 8HD

Induction hardening

Plasma nitriding

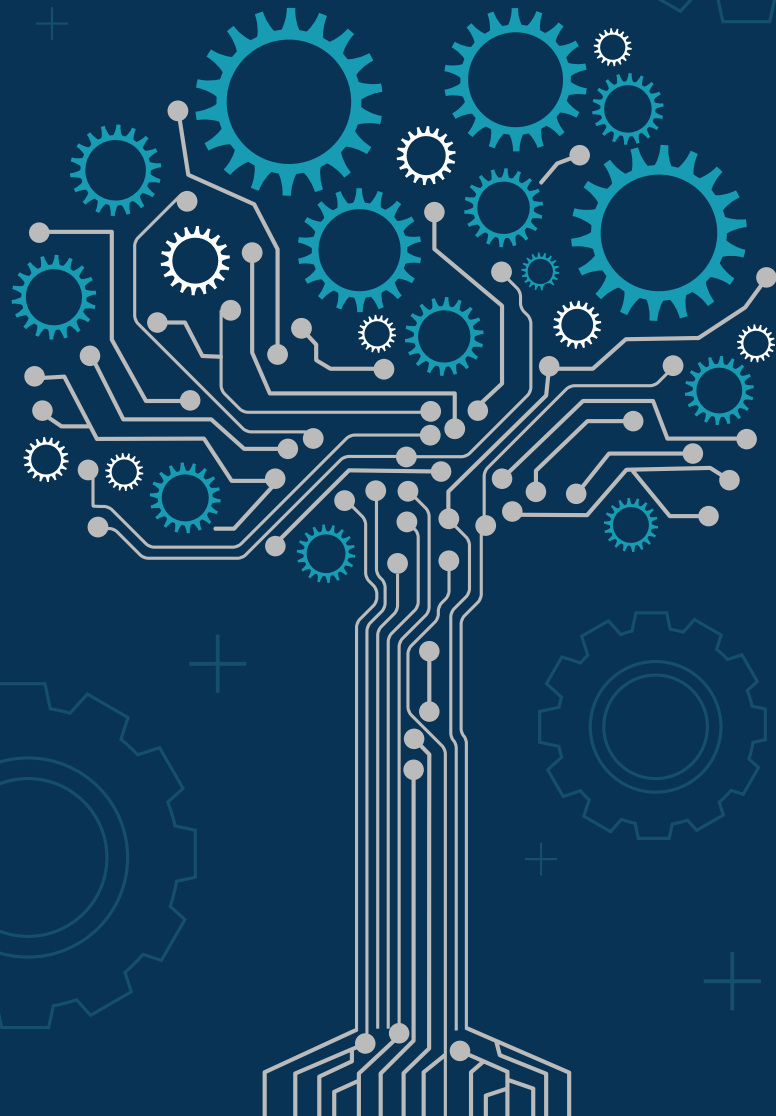
Stress relieving

PVD coating

JJ Heat Treatment
Simply the best

jjheattreatment.com +44 (029) 2088 7837

ECI M1™



THE ULTIMATE ERP SOLUTION FOR YOUR MANUFACTURING BUSINESS



SALES



ENGINEERING



INVENTORY



PURCHASING



PRODUCTION



QUALITY ASSURANCE



SHIPPING



ACCOUNTING

STOP BY **M1 STAND H28 AT SUBCON**
NEC BIRMINGHAM | HALL 3 | 6-8 JUNE

Don't forget to pre-book a demo: www2.ecisolutions.com/SUBCON17

ECI Software Solutions | **Inc. 5000**

UK +44 (0)333 123 0333 | eu-sales@ecisolutions.com | www.ECIM1.eu

© 2017 ECI Software Solutions Ltd. All rights reserved.
ECI, M1 and the ECI Red Box logo are trademarks or registered trademarks of ECI Software Solutions, Inc.

Packing it all in to three days

The PPMA Show will offer visitors the chance to see new machinery in action and to find new inspiration and ideas

The PPMA Show, the UK's free-to-attend, processing and packaging machinery exhibition, returns to the NEC from 26-28 September to provide manufacturers with insights into the latest machinery products, technologies and materials.

The PPMA Show is organised by the Processing and Packaging Machinery

Association (PPMA) which comprises the PPMA, British Automation & Robot Association (BARA) and the UK Industrial Vision Association (UKIVA). Serving manufacturers within the food and beverage, pharmaceutical, personal care and FMCG industries to contract packers and more, the show will offer visitors a chance to see new machinery in action, find inspiration and new ideas, gain access to potential new suppliers, evaluate and purchase the latest technology, as well as talk face to face with the industry's leading technical experts.

This year's PPMA Show will feature a new and improved Learning Hub, providing visitors and exhibitors with insights from a selection of leading industry experts, as well as some influential opinion leaders from the wider business world.

A full speaker programme will be announced in the coming months but early confirmations include TED speaker and chartered engineer Peter Anderton. Anderton, who previously worked as production manager for United Biscuits, will inform and inspire visitors in two sessions. The first session will introduce visitors to his two-rule approach to great leadership before revealing helpful insights into how to build a successful team.

Along with insights on leadership skills, the new Learning Hub will also shine a light on a wide range of issues and trends facing the manufacturing sectors. Topics currently under discussion include how businesses are evolving to meet changing market demands, embracing the future of Industry 4.0; the challenges of coding and labelling with details on need-to-know information; and the future of the retail landscape, with experts sharing their views on

expected changes and how this will impact the processing and packaging industries. By expanding the focus of the new Learning Hub beyond the traditional manufacturing industries, organisers hope to inspire visitors by providing a new perspective on relevant trends and issues, as well as skills applicable across all industries.

Speaking about the exhibition, Valerio Del Vecchio, head of marketing, PPMA Group of Associations, said: "Over the past 30 years, the PPMA Show has united buyers and suppliers at one of the UK's most visually dynamic exhibitions. It enables manufacturing professionals to come together, network, discuss future trends, find inspiration and gain invaluable insights from thought leaders.

"The PPMA Total Show 2016 saw over 1,000 leading packaging and processing machinery manufacturing represented, with more than 7,500 visitors descending on the NEC to find out more. Feedback from visitors attending the 2016 show revealed that the show is the destination to keep up to date with the industry, find inspiration and meet with new suppliers or business partners. We're looking forward to building on this success when we open the doors to the PPMA Show 2017 on 26 September." © For more information on the PPMA Show and its new features for this year, please visit www.ppmashow.co.uk



Idea. Prototype. Done.

(It's as simple as that.)



With our automated manufacturing process, we can make 1 to 10,000 parts in 15 days or less. You could call it a **game-changer.**

3D PRINTING | CNC MACHINING | INJECTION MOULDING

proto labs®

Real Parts. Really Fast.™

Order online anytime | Free design analysis



Fay Meadows
Senior Customer
Service Representative

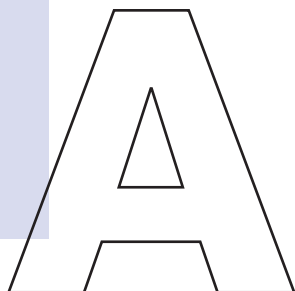
protolabs.co.uk

+44 (0) 1952 683047

customerservice@protolabs.co.uk

Looking beyond these borders

This year's Automechanika exhibition is set to feature an international line-up of exhibitors from the automotive aftermarket



Automechanika, the UK's leading exhibition for the automotive aftermarket and supply chain, returns to the NEC, Birmingham, on 6-8 June.

Expected to be over 70 per cent bigger than last year's event, the show will feature around 800 exhibitors from the

automotive aftermarket, who will be launching new products ranging from parts and components to garage equipment and tools, wheels rims and tyres, consumables, accessories, and raw materials for the supply chain.

Interestingly, after a successful outing for the 250 international suppliers attending last year's event, the 2017 show has even more of an international feel, with around half of the exhibitors coming from outside the UK.

As well as national pavilions from the Czech Republic, India, China and Taiwan, there is also significant



01/02 This year's Automechanika is expected to be over 70 per cent bigger than last year's event

representation from Italy, Spain, Germany, Poland and France.

Major international brands attending include Liqui Moly, Petronas, Arnott Europe, Nippon Pieces Services, Schmidt Metal Group and Sash Lubricants.

Simon Albert, event director, said: "This high number of international exhibitors for 2017's event proves the UK's motor industry is strong and truly open for business. We are delighted to see that major international automotive supply companies want to develop working relationships with the UK and we look forward to delivering a must-attend event for the automotive aftermarket and supply chain in June."

Meanwhile, away from the exhibition floor industry experts will deliver over 60 seminar sessions, technical talks and live demonstrations.

A dedicated stream of aftermarket content will cover key industry topics, including new technologies; business advice; and training opportunities. Insights into the future of the industry will also be explored.

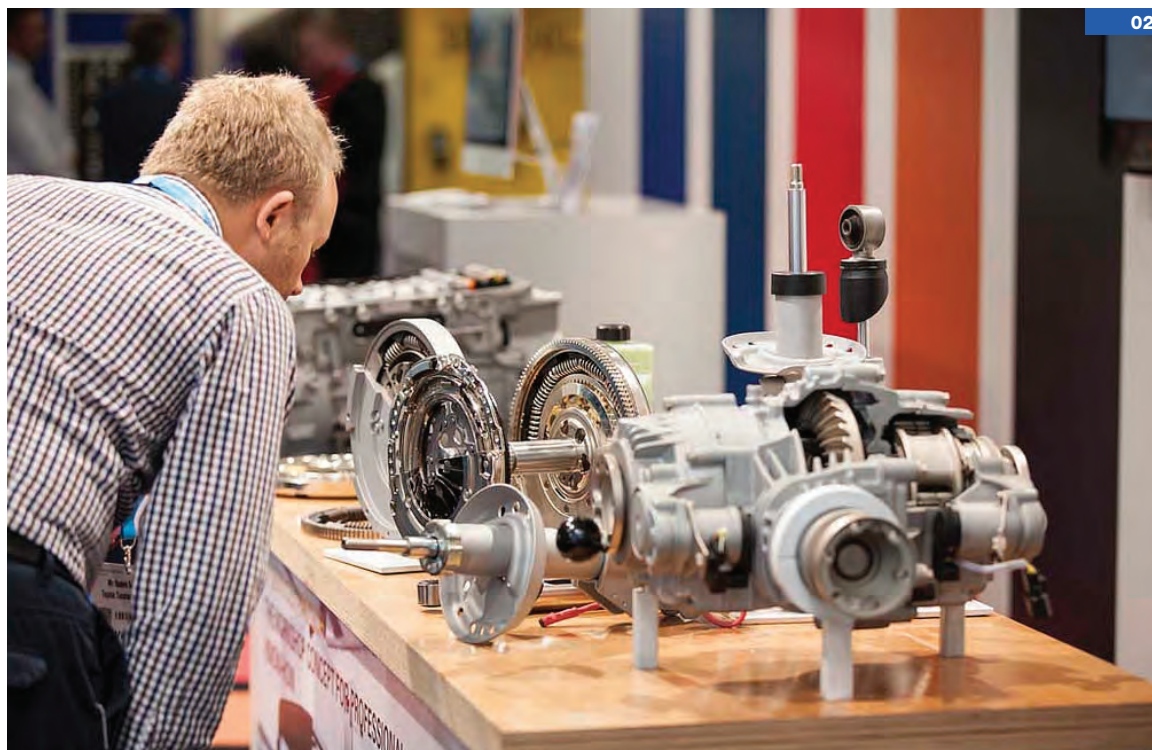
Key sessions will look at topics ranging from the digitalisation of automotive retail, through to the future of parts distribution in the UK.

In the dedicated Supply Chain Zone, the supply-chain seminars will host experts speakers from SMMT, Jaguar Land Rover and the National Composites Centre on topics ranging from connected and autonomous vehicles to industry 4.0. Meanwhile, a dedicated Connected and Digital Technology Zone will demonstrate the latest products coming to market as well as those that will enable the design, development and manufacture of the vehicles of tomorrow.

This year's show will also see industry trade body SMMT bring its two flagship networking events: Open Forum and Meet the Buyer.

Open Forum will deliver a morning of automotive supply-chain seminars on Tuesday 6 June, bringing together over 300 senior delegates from OEMs, tier-one, medium and small suppliers. Meet the Buyer on Wednesday 7 June will offer a day of one-to-one meetings and matches for suppliers with OEM and tier-one buyers. © www.automechanika-birmingham.com

"Key sessions will look at topics ranging from the digitalisation of automotive retail through to parts distribution"





Hydraulically Actuated (PTOs) Power Take-off Units

#DriveLineHarmony

Manufacturer & distributor of quality products for mechanical & fluid power transmission. Extensive knowledge, extensive ability, extensive products.

H ydraulic power take-off units available in side-load straddle-bearing clutched models, in-line clutched models and non-clutched models.

Applications for hydraulic clutches are similar to those for the mechanical PTOs. Hydraulic clutches can be used wherever a disconnect is required between the driven equipment and the prime mover.

Hydraulic Wet Clutches

- » **HP Series:** In-line or side-load applications to 783 kW (1,050 hp) @ 2,100 rpm.
- » **HPTO Series:** In-line or side-load applications to 1119 kW (1,500 hp) @ 2,750 rpm.
- » **PFI Series:** Pump mount or shaft output with integrated oil pump. Up to 380 kW (510 hp).

Hydraulic Dry Clutches

- » **RC Series:** Remotely actuated via hydraulic circuit.
- » **RO Series:** Remotely actuated via hydraulic/pneumatic circuit.

PTO line, up to 11389 Nm (8,400 ft-lb). Straddle bearing housing available.

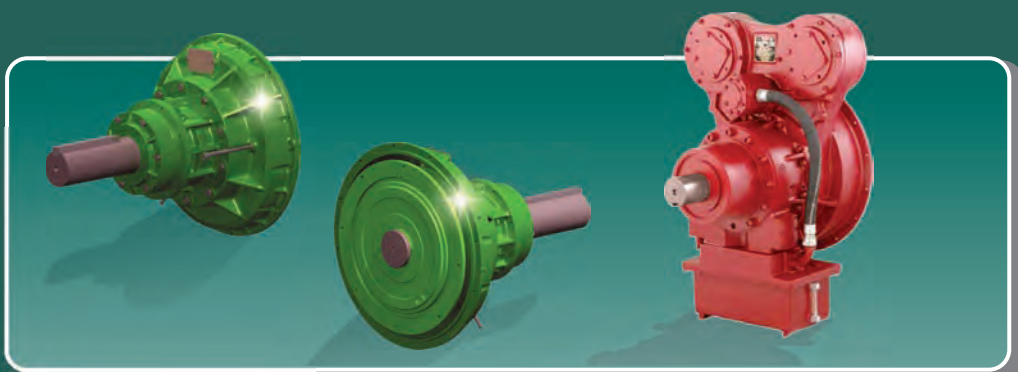
Typical applications include:

- » Centrifugal Pumps
- » Piston Pumps
- » Fans
- » Water jets
- » Bow Thrusters
- » Blowers
- » Propellers
- » Hammer Mills
- » Compressors
- » Generators
- » Winches
- » Conveyors
- » Hydraulic Pumps
- » Tub Grinders

- » Rock Crushers
- » Agitators
- » Horizontal Grinders
- » Mud Pumps

jbj Techniques integrate extensive product knowledge and specification ability with excellent machine shop services and comprehensive product stocks to provide the service needed to keep your machinery systems performing to the optimum.

For further details please visit: www.jbj.co.uk/mechanical-power-conversion.html#Hydraulic-power-take-off



#DriveLineHarmony stand 3E145 @



quality products for mechanical & fluid power



01737 767493



info@jbj.co.uk



www.jbj.co.uk



jbj Techniques Limited is ISO certified, committed to international coordination & unification of industrial standards.

- registered in England No: 1185469 -

A range of products ATEX certified to directive 94/9/E requirements



Military honours

Changing security threats and global instability has increased the need for skilled engineers in the defence industry. Evelyn Adams reports

Donald Trump vowed during his campaign that he would make the US military so big and powerful that “nobody – absolutely nobody – is going to mess with us”. The shares of global defence companies, including major players in the UK, rallied at his claim. But despite promises to increase military spending, Trump’s unique form of diplomacy has created a volatile landscape for defence companies around the world.

This instability, alongside rapidly changing security threats, has forced firms to innovate and respond to shifting demands faster than ever. British companies are leaders at doing this, and the figures prove it. The UK has the third-largest defence budget globally, which increased for the first time in six years last year to £35.1bn. Overall, the sector employs 142,000 people in the UK and supports a further 111,000 people indirectly. It has seen a 29 per cent growth in productivity, compared to the 2 per cent seen by the overall UK economy.

Major contract wins have increased opportunities across the country. In April 2017, weapons manufacturer MBDA was awarded three contracts worth more than £500m.

These contracts will create Meteor air-to-air missiles for Britain’s F-35 stealth fighters; provide maintenance of the Royal Navy’s the Sea Viper weapon; and produce more CAMM defence missiles, which are manufactured at MBDA’s sites in Bolton, Stevenage and Henlow. Together, the deals will sustain more than 130 jobs in the UK.

In the same month, a £330m defence contract was awarded to a General Dynamics in Oakdale, Caerphilly, to create a next-generation communications system for the Ministry of Defence. The platform will be used on a new fleet of Ajax armoured vehicles that are being assembled and tested in Merthyr Tydfil. In total, the contract is expected to create 125 new jobs. The firm is currently offering engineering technician apprenticeships in Oakdale and manufacturing and mechanical apprenticeships in Merthyr Tydfil.

01 Work has begun on new submarines (*credit: BAE Systems*)

02 Cyber security is creating new opportunities for engineers



01

“Away from combat, intelligence and data is a key commodity”

Tim Carling, Matchtech

To continue to win contracts in such a volatile landscape, the UK must invest in the right skills to deliver the technologies needed. According to industry group ADS, areas such as cyber security, research and development (R&D), and design and engineering, are all key employment priorities across the defence industry.

Cyber security is a particularly challenging area where engineers are highly sought after. A new wave of technologies and an increase in cyber-based attacks are forcing the defence industry to adapt. As a result, advancing technology in defence has become as much about improving communication and information protection as it has about enhancing traditional defence equipment. This demand has seen the development of new long-range surveillance systems, advanced targeting systems and smarter weapons technology.

“Away from combat theatre, intelligence and data is a key commodity both in defence and attack; intel interception and data protection are two examples of cyber technology, which is a large influence on the sector,” said Tim Carling, director of engineering technology at recruitment firm Matchtech. “We’re seeing an increasing demand for personnel in the converging skill space between traditional engineering and IT.

“The demand continues to be for electronics, software, systems and safety engineers. Increasingly, software is becoming less embedded and more application-based, presenting a challenge for the defence sector given the safety-critical nature of the environment. The advances aren’t creating new skills but instead evolving blends of experience... Those engineers with a blend of traditional software engineering skills and higher-level development experience will be particularly well placed to find opportunities in the defence sector.”

Over the next 10 years the equipment procurement plan commits the UK to spending £82bn on buying new ships, submarines, vehicles and complex weapon systems, with a further £92bn earmarked for the equipment support plan. Around £19bn of the equipment plan is being spent on surface warships, including Queen Elizabeth-class aircraft carriers, the Type 26 frigate, new Tide-class fleet tankers and offshore patrol vessels. This

will require more traditional skills that can be transferred from parallel industries such as civil aerospace, environment and the IT industry.

Opportunities are global. A large portion of customers in the UK defence industry are international, and that is set to continue post-Brexit given the falling pound. And it’s not just the larger firms where opportunities are ripe. The focus on innovative technology is providing a chance for smaller companies to provide a military edge to governments. This means engineers in SMEs may have more opportunity to innovate. In February, the Ministry of Defence announced the formation of a defence innovation advisory panel, which is backed by an £800m innovation fund.

Over half of all UK defence apprenticeships and trainees are currently within production and assembly functions, according to ADS. A large number of apprenticeships and trainees work within design and engineering and research and development, which reflects the sector’s focus on innovation. The industry also provides rewarding high-skill, high-value careers – the average salary in the UK defence industry is £39,000, which is 44 per cent more than the national average (approximately £27,000).

“The UK defence industry provides the skills, capabilities and innovation required to sustain our national security in the face of fast-evolving threats,” said Paul Everitt, chief executive of trade group ADS. “It will be involved in some of the most interesting, exciting and intellectually demanding programmes and projects. The defence industry provides long-term, high-value jobs where apprenticeships are encouraged and apprentices rewarded with real career progression. This is a great time to be joining the industry and the range of opportunities has never been greater.

“Whether it is designing and building nuclear submarines, supporting the development of new air capabilities or strengthening our cyber defences, there are rewarding careers available to all.” ©



Providing top engineering jobs in
the UK, Ireland and worldwide.

SEARCH AND APPLY TODAY:
theengineer.co.uk/jobs

theENGINEERJOBS



@TheEngineerJobs



The Engineer Jobs



USE YOUR ENGINEERING KNOWLEDGE IN A HIGH-REWARD TECHNICAL SALES CAREER

Are you a self-motivated, assertive engineer who may not have considered a role in technical sales?
Are you ready for a new challenge and change of direction?

Selling cutting-edge CAD technology requires individuals with the drive and determination to succeed. Our top technical sales people were engineers like you & are now seeing earnings in excess of £75,000.

We are the largest supplier of SOLIDWORKS CAD software.
Due to strong growth we are expanding our team -
positions are available across the UK & Ireland.

No previous sales experience is necessary as full
training, support and development will be given.



Call **01926 333 777** to arrange
an informal discussion with our
Sales Director, Steve Oxley.



Intersurgical is a leading global designer, manufacturer and supplier of a wide range of medical devices for respiratory support. We provide flexible patient solutions for airway management, anaesthesia, critical care, and oxygen and aerosol therapy, primarily for use within the hospital environment, but also in the home.

We are an integrated manufacturer with a global workforce of 3000 staff and are currently recruiting for:

DESIGN ENGINEER

To design and develop new products and products under change control due to continuous improvement, achieving clinical and commercial input requirements and meeting timescale targets.

JOB OVERVIEW

Working as an integral part of the Technical and Development team, this is a fantastic opportunity for an individual, with some experience of working in the medical device industry, to enhance their career as a Design Engineer.

The role involves developing new products and products under change control due to continuous improvement, achieving clinical and commercial input requirements and meeting timescale targets.

RESPONSIBILITIES

To design, develop and implement into production new and continuously improved products in accordance with the specified technical, quality and schedule requirements.

To be proactive in offering design solutions that will continuously improve the existing product range.

To support/assist senior designers in the timely and cost effective completion of design and development projects, through activities such as project documentation, project facilitation, risk analysis, CAD support and verification activities.

To carry out testing and evaluation work on various components, including prototype parts, and samples from pre-production trials.

To effectively utilise and support the Technical department's specialist personnel in the creation and effective implementation of new and continuous improvement projects.

Ensuring compliance to FDA/ISO 13485, and to ensure that design process and procedural requirements are maintained on assigned projects.

Provide stronger and more effective cross-functional links between Technical, Marketing/Sales, Tool Room, Quality, Manufacturing departments, and external customers/suppliers.

To support the production of Marketing and Sales promotional literature as required.

To ensure an efficient and effective transition from Development to User Field Trials for all respective projects.

ESSENTIAL EXPERIENCE / QUALIFICATIONS

Experience of leading and supporting teams in the timely and cost effective completion of design and development projects, through activities such as project facilitation, project documentation including design briefs and risk analysis, and verification activities.

Experience within the medical device industry, MDD 93/42/EEC, ISO 13485 and FDA Design Control. Experience in providing cross-functional links between Technical, Marketing/Sales, Tool Room, Quality, Manufacturing departments, and external customers/suppliers. Experience of UniGraphics or similar CAD software and creating 3D CAD models and 2D technical drawings.

DESIRABLE EXPERIENCE / QUALIFICATIONS

Knowledge of design for high volume injection moulding and design for manufacture and assembly.

KEY SKILLS

Methodical, organised with a structured approach to work.

Attention to detail.

Good communicator.

Good interpersonal skills.

If you feel you have the appropriate skills and experience please apply online at www.intersurgical.co.uk/careers



INTERSURGICAL
COMPLETE RESPIRATORY SYSTEMS

Molly Millars Lane, Wokingham, Berkshire, RG41 2RZ Tel: 0118 9656 300 Fax: 0118 9656356

Affordable maintenance software packed with new features

Pirana – computerised maintenance management system (CMMS). Sponsor: Shire Systems



Pirana Maintenance and FM software is easy to use and it is the complete CMMS solution, at a realistic price. Available on-premise or Cloud, it takes little time to setup. The modules are scalable and there are no hidden costs.

The price of Pirana CMMS shows that you don't have to look towards expensive and complex systems to meet maintenance goals.

- Asset, Meter & Task Registers.
- Checklists & Condition Monitoring (Servicing and Inspection).
- Preventative Maintenance, Work Scheduling & Requests.

- Stock, Inventory & Purchasing Control.
- Costs & Charges Management (ideal for Contractors).
- Sensible Key Performance Indicators (KPIs) and Reports.

Pirana Mobile solutions are a clever & powerful set of mobile applications for use on or off-line. Huge savings on travel, admin, printing and call charges are possible. Shire Systems can advise on or supply a range of devices including those that are ruggedised, drop tested, submersible, IP67, ATEX compliant, integral barcode or RFID scanner.

Conveniently, there is a choice of setup options:

1. On-premise (installed on your own network)
2. On-demand (cloud)
3. Stand-alone (laptop, PC)
4. Mobile

Shire Systems (UK No 1 maintenance & FM software producer) also delivers a range of 'hands-on' training courses and a schedule of regional FREE Roadshows.

See Pirana CMMS in action at The Facilities Show, NEC, 20-22 June, Stand R865.

High speed lasers for permanent markings

A range of galvo laser machines available for the industrial environment. Sponsor: Trotec Laser UK

Leading manufacturer of high specification laser cutting, marking and engraving machines, Trotec Laser, provide a range of galvo laser machines which are ideal for the industrial environment.

The SpeedMarker Series can be integrated into production lines to enable permanent and accurate marking of components, parts or finished goods. Within the industrial sectors, Trotec lasers are often used for creating permanent ID and quality standard markings.

Integration of the SpeedMarker laser with ERP systems enables serialised product information, QR codes and data matrices to be marked onto metals, plastics, foils and films

quickly and easily.

The accuracy of laser technology means that even the smallest of parts can be permanently marked with a company logo or part number and as it's a contactless process, there is no damage or accidental marking of the material, and no tooling costs.

The SpeedMarker laser marker is low maintenance with minimal running costs. Easy-to-use software makes changing graphics



straightforward, reducing production down-time and keeping productivity at its best.

Find out more about Trotec lasers at www.troteclaser.co.uk or call 0191 580 1182 to arrange a demonstration at one of our six showrooms across the UK and Ireland.

KD1: The first Windform SP 3D-printed driver clubhead

Additive and subtractive manufacturing combined to create golf driver. Sponsor: CRP Group

Krone, the world leader in custom engineered golf equipment, was determined to create the world's most advanced high-performance golf equipment.

Krone selected CRP Group for the project to provide guidance on how to combine the use of Additive Manufacturing and High-Precision CNC machining.

By partnering with the Italian-based group, Krone was tapped into a network of companies that provide a wide range of custom solution. Two specific divisions within CRP Group were placed on the project team: CRP Meccanica and CRP Technology.



The collaboration led to the creation of KD-1. It is a composite driver clubhead where the different materials have a specific function and structural competence.

The KD-1 body structure has been manufactured by CRP Technology's 3D Printing and Additive Manufacturing department utilizing Laser Sintering and the innovative Windform SP Additive Manufacturing material. Windform SP is a highly ductile material with top mechanical resistance. It is used where there is high stress fatigue even in time as type vibration or shock without the risk of breaking. The elasticity helps to absorb these mechanical stress.

The body has 4 Helicoil® M4 inserts at the end to fasten the weight.

The KD-1 face (the striking surface of the head of the club) is made in Ti6Al4V: it has been CNC machined from solid and sand blasted to clean external surfaces by CRP Meccanica; the hosel was also produced in Titanium as well.

The weight is also CNC machined in brass from solid and sand blasted by CRP Meccanica.

May 1960

Speed sensation

Donald Campbell's legendary Bluebird was designed with a target speed of 500mph in mind

D

onald Campbell's pursuit of speed records is the stuff of legend, and the vehicle that embodies his attempts on land is the Bluebird CN7. In the planning stages since 1956 – at which point Campbell was chasing records

exclusively on the water – the CN7 was almost ready for action by the time it featured in the May 1960 issue of *The Engineer*.

The land speed record (LSR) stood at 394mph, set by John Cobb in the Railton Mobil Special. Campbell, in collaboration with his engineering partners Norris Brothers, planned to obliterate that number, and Bluebird was designed with a target of 500mph in mind. To achieve this, the CN7 would incorporate a host of groundbreaking technology.

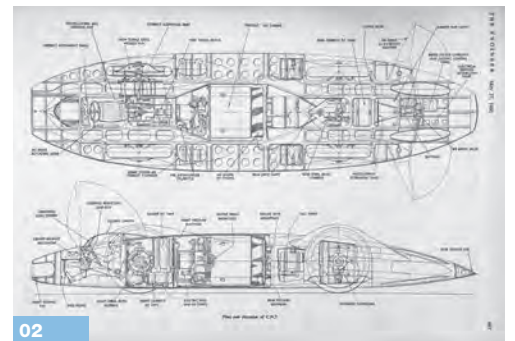
The four-wheel-drive monocoque Bluebird was the first LSR contender to be powered by a gas turbine engine, a Bristol-Siddeley 'Proteus' 705 with an output of 4,250bhp. According to this magazine, "the use of a 'Proteus' dictated other important characteristics of the design; since it has, in effect, a ring of air intakes around the centre section, a plenum chamber installation was virtually mandatory, so that the steel-tube-frame construction of the Norris-designed 'Bluebird' hydroplane was forsaken for an 'egg-box' design."

The 'egg-box' construction was apparently selected in order to sustain the pressure differential of around 3lb per square inch expected in the engine bay. To accommodate this, the team used an aluminium alloy, the stiffness of which "was obtained by using 'sandwich panels' with stabilising cores of 'Aeroweb' honeycomb".

Sandwiched honeycomb structures are common today in the aerospace industry, but their use for lightweighting in a motor vehicle was, at the time, revolutionary. According to our predecessors, the primary driver of the lightweighting was the split-rim design wheels and – more specifically – 52in diameter tyres, which were manufactured by Dunlop.



01



02

"The one component whose capability limited the performance and dictated alterations to the design was the tyre" *The Engineer*

"During the design of the car it proved that the one component whose capability limited the performance and dictated alterations to the design was the tyre. Weight saving and even drag reduction are prosecuted solely to lighten the duty of the tyres."

Tyre performance at speeds in excess of 420mph was so vital that Dunlop built an entirely new test rig on which to trial Bluebird's custom boots. They would see their first action at Goodwood in July 1960 at the vehicle's public launch, and would propel Campbell and the CN7 to a speed just shy of 400mph at Utah's Bonneville Salt Flat two months later.

Shortly after, on 16 September 1960, Campbell suffered a high-speed crash in Bluebird, fracturing his skull. It was 1963 before he was back at the wheel of the CN7 attempting to break the record, this time at the salt flats of Lake Eyre in South Australia. Having not seen rain in 20 years, the dried salt lake witnessed torrential downpours in May, and Campbell had to abandon his efforts. He returned a year later,

however, setting an official FIA LSR of 403.10mph on 17 July 1964. But rains that year also prevented Bluebird from reaching its full potential, and Campbell was disappointed not to have posted a speed in excess of 450mph.

His frustration was compounded by American Craig Breedlove having already exceeded Campbell's speed, although this was not officially recognised by the FIA, as Breedlove's Spirit of America was not wheel-driven by its jet engine. Bluebird was actually the last wheel-driven vehicle to hold the official record, as the FIA subsequently relaxed its technical rules.

Campbell's legendary status was cemented later in 1964 when he broke the water speed record (WSR) on the last day of the year, hitting a speed of 276.33mph in the Bluebird K7 hydroplane. He remains the only person to set land and water speed records in the same calendar year. Just over two years later, on 4 January 1967, Campbell was killed attempting to set an eighth WSR. On Coniston Water, in the Lake District, a heavily modified K7 broke up at speeds in excess of 300mph, killing its pilot instantly. Between them, Donald Campbell and his father, Sir Malcolm, set a total of 11 speed records on water and 10 on land. **AW** ®

01/02 The 'egg-box' construction was apparently selected to sustain a pressure differential

Word of the issue

Anthony Poulton-Smith explores the origins of the word 'lever'

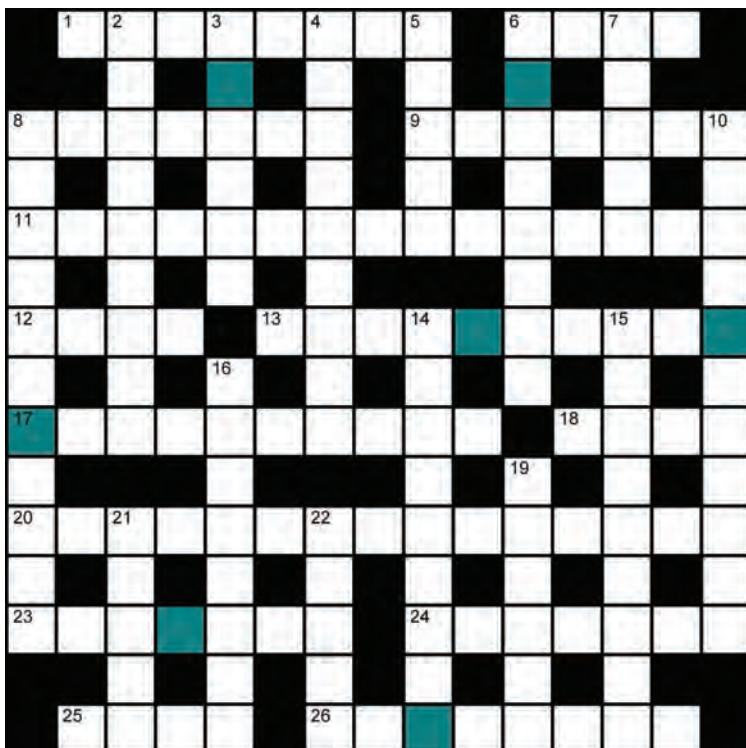
Such an ancient tool will once have had a more ancient name than we can hope to define. Yet this does not mean we are unable to trace the word back. This is a Latin word meaning 'to raise' and derived from *levare* and earlier *levis* 'light, not heavy' and in the sense of 'nimble, rapid, quick'. In turn this can be traced to Proto-Indo-European *leguh* also meaning 'not heavy' and 'agile, nimble'.

This dual meaning over a period of time is indicative of just how old the word is. Further evidence is seen in related words: Sanskrit *laghuh* 'quick, small'; Greek *elakhys* 'small' and *elaphros* 'light'; Lithuanian *lengvas* 'light'; and Old Irish *lu* 'light' and *laigiú* 'smaller'. While these meanings may not seem related, think again. Something which is easily raised is not heavy; a question of a lighter weight suggests smaller; and diminutive size is synonymous with speed.

Big picture



A Porsche Cayenne has successfully towed a 285-tonne Air France Airbus A380 over 42m at Paris Charles de Gaulle Airport. Driven by Porsche GB technician Richard Payne, the Cayenne has set a new Guinness World Records title for heaviest aircraft pull by a production car.



Prize crossword

When completed rearrange the highlighted squares to spell out a private chapel in a castle.. The first correct answer received will win a £20 Amazon voucher. Email your answer to jon.excell@centaur.co.uk

Across

- 1 The quality of being popular (3,5)
- 6 Social worker's patient (4)
- 8 Thin varnish used to finish wood (7)
- 9 Join together (7)
- 11 Belief accepted as authoritative by some group (6,2,7)
- 12 Equally (4)
- 13 Physicist who studies the heavens (10)
- 17 Extraordinarily large in size (10)
- 18 Not in favour of (4)
- 20 A province in western Canada (7,8)
- 23 Board a locomotive (7)
- 24 Having physical awareness (7)
- 25 Fundamental part (4)
- 26 At no particular point (8)

Down

- 2 Informal party of people with hospitality for all comers (4,5)
- 3 Unhealthy looking (6)
- 4 Spread out from a folded position (9)
- 5 Surface of cut gem (5)
- 6 A mixture of elements (8)
- 7 Support for broken arm (5)
- 8 Yielding readily (11)
- 10 Destroy completely (11)
- 14 In a rowdy manner (9)
- 15 The highest mountain in the Alps (4,5)
- 16 Easily broken or destroyed (8)
- 19 Cone-shaped tube (6)
- 21 Within, during
- 22 Reddish brown dye used especially on hair (5)

April's highlighted solution was Barbican. Winner: **Claire Anderton**

6-8 JUNE 2017 BIRMINGHAM NEC

Advanced Manufacturing

THE GLOBAL PLATFORM FOR MANUFACTURING TECHNOLOGIES



This eagerly anticipated event is an invaluable opportunity to gain insight from leading experts on current industry challenges and to stay up-to-date on the latest manufacturing developments, best practice and new trends at one venue over three days.



NETWORK

Meet with your peers from industry, build business relationships and partnerships to benefit your advanced manufacturing strategy



SOURCE

Meet exhibitors who can compete on price, quality and on-time delivery and discuss your specific requirements with leading suppliers



LEARN

Keep up to date and hear the latest thinking from leading minds at the forefront of advanced manufacturing

3 SHOWS, 400 EXHIBITORS, OVER 30 FREE CONFERENCE SESSIONS

The Engineer and The Manufacturer come together to deliver a programme of unrivalled educational content.

NEW
FOR
2017

Co-located with

SUBCON **THE ENGINEER**
design & innovation show

#AMSHOW17

Show Partner



Association Partners

Composites **UK**



Media Partners

Advanced Manufacturing

AEROSPACE
MANUFACTURING

GiM Composites in Manufacturing

PRODUCTION ENGINEERING SOLUTIONS

ENGINEERING capacity

Machinery Market

MACHINERY WORLD



REGISTER FOR FREE ADVANCEDMANUFACTURINGSHOW.CO.UK



Wireless Environmental Monitoring Systems

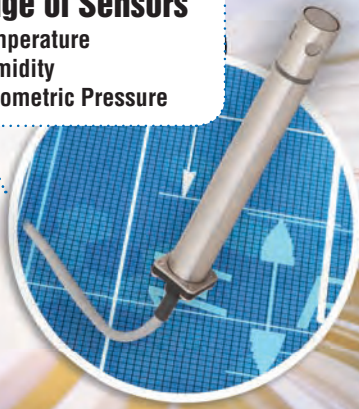
• Temperature • Humidity • Pressure

1. ZW-ED Transmitter



2. Range of Sensors

- Temperature
- Humidity
- Barometric Pressure



3. ZW-REC Receiver



4. Free OMEGA Dashboard Monitoring Software

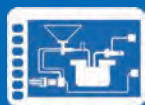


OMEGA® Wireless Environmental Monitoring Systems provide web-based monitoring of Temperature, Humidity, and Barometric Pressure, and are also available with a selection of sensors for your monitoring needs.

- 1,000 metre wireless range
- Connect up to 128 transmitters per receiver

Order online today for fast delivery and complete your monitoring needs

omega.co.uk/ZW-ED



0800 488 488
sales@omega.co.uk