TUNNEL VISION
INSIDE UK CYCLING’S FIRST EVER DEDICATED WIND TUNNEL FACILITY

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CHALLENGE
This month’s challenge is to design a way to help professionals in high-pressure environments where an extra set of hands would help.
Q How is the PA 6.6 supply situation best characterised at present?

The European market for polyamide 6.6 (PA 6.6) is currently in a very tight supply situation. Persistently high demand and numerous incidents in the production process chain have led to a sharp rise in the European market price. As a result, we are currently receiving many enquiries from customers looking for alternatives for their applications.

Q How did the PA 6.6 bottleneck occur?

The production of PA 6.6 is dependent on essential pre-products. In particular, adiponitrile (ADN) and its resultant product hexamethylenediamine (HMD) are critical components of the PA 6.6 production chain. Of the four producers worldwide, the only European production site for ADN is in Butachimie, France (the other three are in the USA). The production of HMD is also limited to just a few producers. Since August 2017 the production of ADN and HMD have been plagued by numerous force majeure incidents.

Q How long will the situation last?

Although the existing ADN capacities at Butachimie are to be expanded in 2019, ALBIS expects a further shortage of PA 6.6 at least until the third quarter of 2019. The probability that the market will remain tight for the next two years is very high. In addition, the European PA 6.6 market will continue to be difficult to respond to any unplanned outages in upstream production stages and structural vulnerability will remain.

Q Can PA 6.6 be replaced?

Yes, alternatives to PA 6.6 which could be considered for drop-in solutions or indeed, for new projects are available. However, understanding the detailed requirements of each application is key when thinking about which material to choose.

Q Which alternatives play a role?

The nearest alternative to PA 6.6 is its “twin”, PA 6. Whilst there are some important differences between the two polymers, there are many similarities which make PA 6 the first option to consider. Renowned for its excellent electrical properties, PBT could be considered in E&E and under the hood applications – also in applications where flame retardancy is a main requirement. Reinforced grades of PBT with about 10% less glass fibre would have a similar modulus to their PA 6.6 equivalents, although long term contact with hot water is a limitation.

Polyphtalimamide (PPA) is a candidate where high and / or long term temperature resistance, low moisture absorption and high dimensional stability are the drivers. Available in glass fibre and mineral filled grades, as well as flame retardant and increased hydrolysis resistant types, PPA could be used in E&E and under the hood applications.

With its outstanding chemical resistance, extremely low moisture uptake, inherent flame retardancy, coupled with its high stiffness and extremely high temperature resistance, PPS is highly suitable in under the hood, hydrolysis resistant and E&E applications.

Q Could recycled grades be considered?

Indeed! Based on high quality post industrial recycled PA6.6 feedstocks, these products come with a full technical specification at near to prime quality. Also, recycled Carbon Fibre Reinforced PP and PA 6 are increasingly suitable alternatives. These products offer the same mechanical performance as traditional engineering compounds, whilst delivering an overall lower part cost and up to 30% lower density than their glass fibre counterparts, resulting in a huge reduction in weight.
A FADING DREAM?

THE NEWS THAT Bloodhound Programme Ltd has entered administration will have saddened – but perhaps not surprised – many of us who have followed the project over the years.

The company, which is behind the project to smash the land speed record by driving a car at over 1000mph, has said that the Bloodhound supersonic vehicle is all but built, but needs a £25m investment.

The administrators, FRP Advisory LLP, have already begun to talk to potential suitors and want to hear from others. But without the funds the project faces being wound up in the coming weeks.

Although all the R&D and low-speed trials are done, the project simply cannot move forward into its end phase unless the necessary funding is in place.

Bloodhound is a private undertaking. It is funded through donation, sponsorship and partnership and has leveraged all three over the last 10 years, but ultimately this funding model has not delivered sufficient cash to fully sustain such a complex venture.

The last two to three years have been an especially tough environment in which to raise financial support. The investment landscape is difficult because many large brands that might once have put their name on the side of a car to build awareness are now using other marketing tools, such as social media.

Bloodhound was launched exactly a decade before this announcement was made, which added further poignancy. However, the number of postponements and delays that the project has seen over the years has suggested that the technological and financial obstacles to its successful completion might one day prove insurmountable.

Should this prove the case, it would be a great shame. Bloodhound represented the sort of technological challenge that inspires engineers everywhere and drives industry. It can only be hoped that its plight will not put others off setting similar goals in future.

Paul Fanning, Editor
World’s first electric race airplane

THE UNIVERSITY OF Nottingham is developing the first electric race airplane which will help shape the model and rules for Air Race E, the world’s first all-electric airplane racing series, set to launch in 2020.

With transport on the verge of a green revolution the partners will drive the discovery and translation of new materials, components and technologies to change the game within electrified propulsion.

An integrated ‘plug and play’ electric motor, battery and power electronics system will be designed and retrofitted into an existing petrol-powered Air Race 1 plane at the University.

Richard Glasscock, research fellow in hybrid propulsion systems for aircraft, said: “Future transport platforms will require electrical machines and power conversion and transmission solutions which can deliver a step-change in power density, efficiency and reliability. Through strategic investment in facilities, talent and research programmes, and collaboration with academic and industrial partners, the University of Nottingham is at the forefront of this exciting revolution in aerospace, marine and automotive transport.”

SOLIDWORKS 2019

DASSAULT SYSTÈMES HAS launched SOLIDWORKS 2019, the latest release of its portfolio of 3D design and engineering applications. It is said to deliver enhancements and functionalities to help improve product development, getting products into production faster.

SOLIDWORKS 2019 is claimed to let product development teams better manage large amounts of data and capture a more complete digital representation of a design. It also offers improved collaboration and immersive, interactive experiences during design and engineering.

Gian Paolo Bassi, CEO, SOLIDWORKS, Dassault Systèmes, said: “This latest SOLIDWORKS release is packed with enhancements and innovations built based on insights and feedback from the SOLIDWORKS community.”

Among its new features, SOLIDWORKS 2019 includes an enhanced Large Design Review capability that allows teams to communicate outside the design community by adding markups to parts and assemblies directly, storing them with the model and exporting them as a PDF.

SOLIDWORKS Extended Reality (XR) is an application for publishing CAD data created in SOLIDWORKS and experiencing it in VR and AR. Designers and engineers can use SOLIDWORKS XR to improve collaborative internal and external design reviews, sell designs more effectively, train users to assemble and interact with their products throughout the product development process.

More information on page 33.
Encouraging young engineers

SHEFFIELD SCHOOLS ARE taking part in nationally recognised Primary Engineer programmes supported by the University of Sheffield Advanced Manufacturing Research Centre (AMRC) to inspire the engineering talent of tomorrow.

The programme develops engineering skills for teachers, brings engineers into the classroom and offers schools the chance to participate in the ‘Leaders Award’, the largest engineering design competition for children.

Following this first cohort, more schools will be invited to participate in subsequent years ensuring that the opportunity to impart engineering knowledge to teachers and children is increased annually.

Nikki Jones, director of the AMRC Training Centre, said: “Working in partnership with schools from across the Sheffield City Region not only helps raise the aspirations of our children by putting engineering at the heart of their learning, it shows them the possibilities of what they can achieve. It also cements our commitment to developing and nurturing the ambitions of future engineers needed to grow our economy.”

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SLIDING MICROROBOTS INTO MOTION

ELECTRIC MOTORS ARE powerful and efficient, but these qualities change for the worse when they are shrunk down to sizes smaller than 1cm3. Now, MIT is developing microhydraulic actuators, thinner than one-third the width of human hair, that are proving to be powerful and efficient at the microscale.

“At very small scales, you get a heater instead of a motor,” said Jakub Kedzierski, from MIT Lincoln Laboratory’s Chemical, Microsystem, and Nanoscale Technologies Group. “Today, no motor exists that is both highly efficient and powerful at microsized. That’s a problem, because motors on that scale are needed to put miniaturised systems into motion.”

To help power systems like microgimbals, to point lasers to a fraction of a degree over thousands of miles, tiny drones that can squeeze into wreckage to find survivors, or robots that can crawl through the human digestive tract, Kedzierski and his team are developing a new type of motor called a microhydraulic actuator. These use a technique called electrowetting to move with a level of precision, efficiency, and power that has not yet been possible at the microscale.

Electrowetting applies an electrical voltage to water droplets on a solid surface to distort the surface tension of the liquid. The actuators take advantage of this distortion to force water droplets inside the actuator to move.

The technology could be applied to exoskeletons, with the actuators working as lifelike muscle, configured into flexible joints instead of gears. Or aircraft wings that could shapeshift on an electrical command, with thousands of actuators sliding past each other to change the wing’s aerodynamic form.
More women in engineering will boost businesses

SOFTWARE ENGINEERING PIONEER
Dame Stephanie Shirley dispelled what she termed the ‘gender myth’ of engineering at the Royal Academy of Engineering in November, when she became the first woman to give the Academy’s annual Hinton Lecture.

Reflecting on her own career, from mathematical clerk at the Post Office to CEO of a successful software house, she described engineering as a profession at the heart of society and how it had opened the door to so many opportunities for her.

Dame Shirley described some of the challenges she faced as a woman when she started her business. For example, she needed her husband’s permission to open the company’s bank account, and she found that she was not taken seriously at first in securing work for her company, until she started signing her letters ‘Steve’ instead of ‘Stephanie’.

Dame Shirley said: “I refuse to accept that some disciplines are less or more feminine than others. Dispelling that myth is absolutely critical. Tackling gender diversity is the easiest way to improve an organisation’s economic and cultural wellbeing. But it is multi-faceted. All women also have an ethnicity, sexual orientation, socio-economic background, ability or disability, and may be younger or older. We shouldn’t be treated as an amorphous mass.”

THE FIRST AIRCRAFT

THE FIRST AIRCRAFT with no moving parts in its propulsion system, has successfully flown for a distance of 60 metres, proving that heavier-than-air flight is possible without jets or propellers.

The flight represents a breakthrough in ‘ionic wind’ technology, which uses an electric field to generate charged nitrogen ions, which are then expelled from the back of the aircraft, generating thrust.

Steven Barrett, an aeronautics professor at MIT, said: “This has potentially opened new and unexplored possibilities for aircraft which are quieter, mechanically simpler, and do not emit combustion emissions.”

The drone, which weighs just 2.45kg – including battery pack and power converter, has wires at the leading edge of its 3m wings have 600W of electrical power pumped through them at 40,000V. This is enough to induce “electron cascades”, charging air molecules near the wire which then flow along the electrical field towards a second wire at the back of the wing, bumping into neutral air molecules on the way, and imparting energy to them.

Those neutral air molecules then stream out of the back of the drone, providing a thrust-to-power ratio comparable to that achieved by conventional systems such as jet engines.
Jigs & Fixtures on the Factory Floor

BOOM Supersonic

BOOM’s mission is concise: to make the world dramatically more accessible by creating an aircraft that’s twice as fast as today’s commercial air fleet. But in an industry where innovation fuels success, the importance of tooling to support rapidly evolving designs can’t be underestimated. “This is where the 3D printer shines,” says Ryan Bocook, manufacturing engineer.

With additive manufacturing, “we can design and build a custom tool in a matter of hours.”

Cost savings are significant with additively manufactured jigs and fixtures. “I recently had a small part for an assembly fixture quoted from two machine shops. Both came in over $1K higher per part than what I could 3D print them for,” said Bocook. “Not to mention lead time and shipping.”

3D Printed Tools for Better Ergonomics, Speed and Design Complexity

Advice from BOOM’s Ryan Bocook:

1. Many shop floors limit the use of their 3D printers to a select few. “This is counterproductive. Let your team explore the possibilities. Give access to the full shop. Give them a material budget and time on the machine. I bet they will be printing things that will revolutionize your approach.”

2. Choose the right 3D printer. All the benefits of 3D printing, including speed, cost and iterations are lost if the 3D printer is difficult to use or is constantly requiring maintenance. “Our Stratasys machines are basically hands off/lights out manufacturing and require very little input to keep running. I can train anyone in the shop to set up and run the machines and they are off to the races the same day with zero issues.”

“If the 3D printed idea works – great! If not, make a quick iteration and print again. Continuous improvements are fast and simple with little cost, time or risk.”

Ryan Bocook, Manufacturing Engineer, BOOM Supersonic
World’s first drone standards drawn up

THE FIRST EVER worldwide Standards for the drone industry have been released by the International Standards Organisation (ISO).

Developed over three years between standards institutions across the world, the Standards are expected to trigger rapid growth within the drone industry. They will play an essential role in guiding how drones are used safely and effectively in a framework of regulatory compliance in all environments – Surface, Underwater, Air and Space.

The Standards are particularly significant for the general public and Government, in that they address Operational Requirements of the more recognised and prevalent aerial drones, including protocols on Safety, Security and overall ‘Etiquette’ for the use of drones, which will shape regulation and legislation going forward. They are the first in a four-part series for aerial drones, with the next three addressing General Specifications, Manufacturing Quality and Unmanned Traffic Management (UTM).

Robert Garbett, convenor of the ISO Working Group responsible for global drone operational standards, said: “Drones represent an unprecedented economic opportunity for any country which embraces the technology. The forthcoming UK Drone Bill, due in early 2019, will create a regulatory framework that allows the industry to flourish in an environment that is both safe and responsible.”

Drone professionals, academics, businesses and the public have been invited to submit comments on the ‘ISO Draft International Standards for Drone Operations’ by 21 January 2019.

SOLUTION TO LAST MONTH’S COFFEE TIME CHALLENGE

Last month we asked you to design a high-tech upgrade to the scarecrow to more efficiently reduce the losses arable farmers sustain each year through glutinous flocks of birds gobbling up their crops.

Our solution, Autonomic, comes from the Bird Control Group in the US in collaboration with Delft University of Technology in the Netherlands. Autonomic is a fully automated, environmentally friendly and silent bird repelling system that is said to provide continuous bird repelling capability. The company claims that birds perceive the system’s laser beam as a physical danger and in contrast to conventional methods they will not become accustomed to the laser. They will consider the area unsafe and will not return.

Autonomic has been tested on farms in South America where one field on each farm was protected by the system and another, containing the same crop, was left unprotected. Across the tests, crop losses in the fields protected by Autonomic decreased between 70% and 90%.

This solution works in daylight as well as at night and can also be used in sectors including aviation, oil and gas, real estate and many more.

BUSINESS NEWS

STRATASYS LAUNCHES UK TRAINING CENTRE

The Stratasys Academy, in Stoke, offers training and consultancy to users and businesses on how to optimise the use of its solutions and additive manufacturing in general within their development and manufacturing processes.

EMERSON BUYS GE’S INTELLIGENT PLATFORM BUSINESS

Emerson has acquired Intelligent Platforms, a division of General Electric. Intelligent Platforms’ programmable logic controller technologies will enable Emerson to provide its customers broader control and management of their operations. Terms of the deal were not disclosed.

£1.5M CONTRACTS BOOST

Birmingham automation and smart factory specialist, Mechatronic Solutions, has secured £1.5m of contracts across aerospace, automotive, food and drink and healthcare.

£20M FOR NEW UK MOBILITY DATA INSTITUTE

The Government has announced that the West Midlands Combined Authority will receive up to £20m to enable WMG, at the University of Warwick to create the UK Mobility Data Institute, to collect, process and analyse transport data generated by new mobility technologies such as autonomous vehicles and smart charging of electrified vehicles.
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TUNNEL VISION

Despite the incredible success of British Cycling over the last decade, the UK has never had a dedicated wind tunnel facility. Imagine what could lie ahead now there is one. Tom Austin-Morgan reports.

Sports Aero Solutions, a joint venture between high-performance design and engineering company, KW Special Projects (KWSP), CFD consultancy, TotalSim and bicycle manufacturer, Boardman Bikes has seen its goal of designing and opening the UK’s first cycling-specific wind tunnel come to fruition.

The 18,000ft² Boardman Performance Centre in Evesham, Worcestershire, was opened to the public in April 2018 and aims to service both professional athletes as well as ‘enthusiastic amateurs’. Alongside the wind tunnel, the facility also incorporates a retail store, a biomechanics suite and a physiology suite. With prices ranging from £150 to £695, depending on how in-depth you want to go with your session, it offers cyclists of any ability the chance to benefit from access to processes previously only available to elite-level athletes.

“Legend has it,” explains Keiron Salter, managing director, KWSP. “Chris [Boardman] said ‘what we need is a wind tunnel that you could use for the price of a curry to do some testing’. He must be eating expensive curries, but that’s how it was formed back in 2012.”

Shortly after this, TotalSim was bought in to help with air flow and aerodynamics. KWSP was later called in to provide engineering support, control systems, electrical integration and software development.

It took a further five years to find a customer that wanted to build a world-class, easily accessible wind tunnel facility specifically for cyclists. Boardman used his contacts at Boardman Bikes, which has been a fully-owned subsidiary of Halfords since 2014, to make the investment in a brand-new facility in Evesham.

“We started the design and installation of the Evesham tunnel in November 2017,” says Salter. “The main structure and the air line was built and shown to the public in April, so the actual construction period was relatively short.”

Until the tunnel was completed it couldn’t be tested, so for the last six months Sports Aero Solutions has been testing all the tunnel’s components – load cells, data
acquisition systems, control systems and electrical systems. With the validation complete, the paying public have been able to use the facility since the beginning of October 2018.

There are many different reasons for building a cycling-specific wind tunnel, but the biggest one is the cost. “There are really only a few wind tunnels you can use, the Formula One tunnels like Williams, Mercedes or McLaren, there’s Southampton University’s wind tunnel and that’s really about it,” says Salter. “The amount of time available is so limited and is expensive. It’s thousands of pounds an hour as opposed to with our tunnel where it could be hundreds of pounds an hour.”

The costs and time allowed for testing in these motorsport wind tunnels are even more prohibitive – even for professional cycling teams – since they must be decommissioned as a motorsport wind tunnel and recommissioned for use for cycling. Additionally, they are built with a rolling road, which needs an attached platform to which the bicycle is fixed. This platform affects the airflow around the cyclist, which is also exacerbated by the fact that motorsport wind tunnels are designed to run at 150mph, rather than the more sedate speeds of 40–50mph at which cyclists travel. So, in effect, one is paying a lot of money for not a lot of testing time in a wind tunnel that is not working in its optimum operating window.

Another way in which costs can be cut is, instead of having a closed loop configuration where the air is circulated and turned, to build an ‘open jet’ tunnel. The footprint of a closed loop wind tunnel would be almost three times larger than an open jet tunnel. And, because of the lower speeds the air needs to travel through the Boardman open jet wind tunnel, it sits in a room measuring just 27 x 14 metres.

The fan is located at the rear of the cyclist and pulls air through a bell mouth section at the front, which is five times larger than the opening in front of which the cyclist sits. This helps speed the air to 22–25mph across the athlete. Before it reaches the athlete, the chaotic air from the room is channelled through three screens, two honeycombed ones and a final fine mesh, at each stage the airflow is straightened out and by the time it hits the athlete it is completely laminar and concentrated into a
2m x 2m area. Even while the fan is on there is no turbulence around the outside of the tunnel. “Things have changed since motorsport tunnels were built, particularly around software and data acquisition systems,” explains Salter. “We’ve been able to strip it right back to being cost-effective. These wind tunnels don’t cost £20 million to build. They cost a million and a bit. A lot of that is because we haven’t got a rolling road, we don’t have very expensive proprietary software and data acquisition systems. We built our own (because you can now) relatively cost-effectively.”

Currently, Sports Aero Solutions is building a second wind tunnel at Silverstone Park, based on the one in Evesham, but with a more scientific focus. Though some development has been done in the last six months of validation at Evesham by professional sports teams and athletes, it is now a consumer-based operation. The Silverstone tunnel will comprise two tunnels, one for cycling, and other sports such as speed-skating, skeleton, running and wheelchair athletes; and the second for testing fabrics.

TotalSim’s managing director Dr Rob Lewis says: “Tapping into the world class, high-tech skills pool around Silverstone enables us to create a unique innovation incubator for companies in sports engineering and services which we predict will have global appeal. If we can pool the right things together then we believe that organisations will come from around the world to take advantage of the facility.”

The Silverstone facility is due to open in January or February 2019. It is hoped that the hub could be the start of a whole series of ventures around Silverstone to do with sports science, engineering and education.

The software and control systems that both facilities use will be the same, however. The tunnel is designed to be operated with a Beckhoff control system. Instead of using a PLC system, the Beckhoff IPC system allows the tunnel’s operators to do all the data collection, including the basic wind tunnel operational parameters, wind speed and load cell numbers. That’s then fed into a bespoke LabVIEW based data acquisition and analysis tool developed by KWSP which includes a bespoke front-end interface.

This data is brought together with data from the vision control system, which is made up of three GigE cameras. Of these, one looks at the frontal area; one looks from the plan view, down onto the cyclist; and one is side-on. Those images are all aligned with the data so at any point in the data stream the cyclist and the Boardman analyst can look at the drag from any one of those views.

An outline can be extrapolated from the data and overlaid on the live video feed to show the optimal position the cyclist should adopt in terms of optimum drag. This is then projected on to the floor of the wind tunnel in front of the athlete, so they can see the target position they’re trying to achieve as well as the graphs and metrics that back this up.

The bicycle itself is fitted to a circular platform in the centre of the test room right in front of the opening from the bell mouth section of the wind tunnel. The platform can accommodate any size of bicycle with an adjustable clamp for the front axle. Both axles are clamped to the platform, ensuring the wheels are in contact with rollers that are connected with a belt, so the front wheel turns at the same rate that the rear one is being driven. The whole platform can yaw up to 30° left and right to simulate the effect of side-winds.

This platform is sat on top of a series of four load cells which measure, calibrate and cancel out the vertical force and moments caused by the athlete as they pedal. Salter adds: “At the back is a load cell that measures drag, there are also two side force ones because the air flow is never regular around the athlete and as we yaw it we’re able to take out the impact of side force.”

For athletes using the wind tunnel, accuracy is all-important. They want to know that the data they’re
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producing is applicable to real-life marginal gains on the track or road. What is important to Sports Aero Solutions to prove is that the results in the tunnel are repeatable.

Despite the fact that from day-to-day an athlete’s performance can be affected by many different factors, the data being collected must be as accurate as possible. So, how do you make sure of that repeatability?

“It’s a really high-tech solution,” Salter jokes. “We’ve got a roof box from Halfords that’s mounted in the wind tunnel and that’s our validation object. It’s always the same, and a really good, aerodynamic shape.

“We’ve validated that in the wind tunnel to get the correlation and we can put that same roof box back in and see if it’s still measuring the same number as it was last week or last year.

“Repeatability is very important; it doesn’t matter whether the number’s 8 or 9, what you don’t want to do is measure 8 and next day, with exactly the same kit, measure 9. If you’re looking for a trend of improvement you need to have that repeatability. The roof box test gives us a neutral test body that no one can argue with.”

Looking forward, the Silverstone facility is due to open in the first few weeks of 2019 and there are also plans for other facilities where wind tunnels could be used.

“Going smaller might be of interest in terms of portability and where you can install them,” Salter says. “We are looking at how you could scale it down to fit into gymnasiums and fitness clubs where you could get a benefit of some much, much lower level aerodynamic knowledge. Lots of places have turbo-trainers and rowing machines, why not introduce some sort of aerodynamic testing facility too as a training tool.”

There’s also some interest from consumer areas such as gaming and collaborative training. Connecting through apps, users could compete with others on their own machines. This would also feed back into the R&D facilities such as the one at Silverstone, where entire road stages could be simulated via smart glasses, and adding servo drives to add resistance to the rollers in the wind tunnel would simulate gradients. This could be used to train professional riders to optimise their efforts across an entire race, like the Tour de France.

British Cycling has been at the top of its game for the last decade. Now the Evesham and Silverstone tunnels are coming online, British domination could well increase and continue for years ahead.

For more than a decade, Rob Lewis of TotalSim and Olympic gold medallist Chris Boardman, worked with some of the best athletes in the world to explore the effect of aerodynamics on their performance. Although hugely expensive, the advances in aerodynamics they achieved were enormous. Because of this, Boardman and TotalSim wanted to make aerodynamics exploration available to the wider sporting world. In 2015 they teamed up with Kieron Salter of KWSP to form Sports Aero Solutions Limited to design and manufacture accessible, highly accurate, sport-specific wind tunnels, with a goal of providing cutting-edge knowledge for everyone, from sports enthusiasts, to elite athletes and coaches.
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THE HUMAN FACTOR

For Industry 4.0 to succeed humans must be able to work side-by-side with automation equipment. Tom Austin-Morgan finds out how ergonomics will enable the future of industrial automation.

The scientific knowledge and methods used in ergonomics and human factors provides the ability to understand users, consumers and systems; to design new manufacturing technology, develop innovative and marketable products and services; improve operational efficiency; manage the ageing workforce; and improve health and safety.

Ergonomics and human factors have always been important to manufacturing. Ever since the industrial revolution forced people and machinery together in large-scale mass-production factory environments, sociotechnical problems began to emerge and have had to be dealt with. A similar need is arising in industry today with the uptake of Industry 4.0 technologies like collaborative robots (cobots) and reconfigurable production lines.

Although manufacturing engineers and managers have traditionally focused on developing technical systems to replace people, there is now an increasing recognition that even in highly advanced and automated production processes, people are still essential for various roles and therefore an equivalent understanding of human/social systems must be developed.

Recently, the rhetoric around automation has cooled. Rather than the ‘robots are going to take all our jobs’ hysteria, there now appears to be an acceptance that automation will be good for the workplace. What’s the reason for this?

“Think we’re getting closer to the reality of what robots and automation are going to do,” explains David Golightly from the Human Factors Research Group at the University of Nottingham. “I think there’s two elements to that. Some of it is we’re getting a better perception of the benefits and the limits of automation.”

He adds that certain factors aren’t going to be replaced very easily. For example, resilient, flexible problem-solving behaviours. “You’re always going to need to work with your automation, whether that’s an automated control system or robots, there’s always going to have to be that human, creative, more responsive element in collaboration with the automation to make it work,” Golightly adds.

He also believes that there is a realisation that many jobs will be created in their own right. Products, robotics and automation all generate data about how they’re performing and the various systems that they interact with. All that data can be analysed to improve the performance of the robot or product, the automation itself, or the system as a whole.

“A lot of it is in a very raw form, so from a user-centred design perspective it needs to be improved to present it to people,” Golightly says. “Nonetheless, there’s a huge opportunity coming along in terms of jobs and roles associated with the effective use of automation.”

Are these new jobs going to be higher skilled and higher paying? Golightly assumes so, but he adds: “We’re not going to have very skilled data analysts replacing everyone. I think people on the shopfloor are going to be upskilled in order to manage, on a local supervisory level, what’s going on with the automation. There’s talk about ergonomics and human factors and the increasing relevance of supervisory roles. I don’t mean a dull monitoring role, I mean an active, problem-solving, supervisory role and the designing of systems that actually support supervision in a constructive way.”

Automation has been introduced piecemeal over decades. This has proven problematic because, usually, only the simple or mundane parts of certain processes have been automated, leaving the more complex bits to the human operators. This means that there are certain
parts of the process at which humans are out of practice as they haven’t performed them in a long time. Programming robots to perform the more complex parts of the processes is also incredibly difficult. Introducing cobots into this environment is a real challenge, especially if the robot needs to communicate its movements to a human working nearby as well as understanding the human’s movements in real time, so as not to slow production.

Golightly suggests: “Think about co-operation and collaboration and start from what are the human and robot trying to achieve together? What is the aim of the system? And from that think about how the human and the robot are going to work together, to collaborate, that’s not just an afterthought.”

Industry 4.0 is allowing manufacturing spaces to change from fixed production lines to reconfigurable and adaptive as mass-customisation becomes more prevalent. If one component in the production line breaks, the production line can be reconfigured to continue. The challenge here is that automation equipment will have to physically move to keep things running, again requiring precise communication between cobot and human.

“If you’re going to realise the opportunity that Industry 4.0 and flexible manufacturing offers, you have to design systems that are going to cooperate with humans. You have to make that a core aspect to the design, whether that’s physical design to support cooperation, or whether it’s more of the cognitive and the software design to support cooperation and collaboration.”

Human factors and ergonomics is all about making processes and products user-centred, putting the user – their needs, capabilities and safety – at the heart of the process.

“One thing that’s interesting, in my experience of working in product design with design engineers,” says Golightly. “Is a lot of them do that intuitively anyway, that’s why they’re drawn to it as a discipline – they are already thinking about people and how they’re going to use their products.”

Going forward, Golightly sees human factors teams become an increasingly important part of an organisation’s makeup, not just in the manufacturing industry but also in transport, healthcare, education, the creative industries, natural environments and urban settlements. He also envisages it becoming a core part of engineering and product design courses.

David Golightly, Human Factors Research Group, University of Nottingham
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ACCESSIBLE AUTOMATION

The latest designs of industrial robots are making these technologies more affordable and accessible for smaller companies.

The wider adoption of industrial automation is broadly acknowledged to be a desirable thing. However, the gap between its desirability and its achievability can be considerable and usually boils down to one thing: affordability.

The race to fill this gap is therefore on. An ability to provide affordable robotics that allow smaller manufacturing companies entry to the world of automation is increasingly seen as a significant opportunity.

This is certainly the intention for igus, which recently launched a new robot with a unit cost far below that expected in discussions of automation.

Cost-effective and quick and easy to implement, the new Delta robot from igus is available directly from stock as a kit or delivered pre-assembled ready to install. Its maintenance-free belt drive units, lubrication-free link rods, encoders and stepper motors combine to create a lightweight, low-cost automation solution for automated tasks such as pick and place. The typical ROI period for the Delta robot is estimated at just six months, this compares favourably to the industry’s rule-of-thumb target of two years.

The Delta robot is based on three maintenance-free drylin ZLW toothed belt axes, lubrication-free igubal link rods and matching adapter plates. NEMA stepper motors and encoders ensure fast handling of up to 1kg with a precision of ±0.5mm. The complete system has an installation space of up to 420mm in diameter and can carry up to 5kg at lower speeds. The lightweight design, consisting of aluminium and plastic, makes the Delta robot extremely cost-effective at a price from as little as £5,000 and ensures high speeds with a pick rate of at least 60 per minute.

“The open design of the Delta robot enables manufacturers to use their own controller,” says Matthew Aldridge, managing director of igus. “We estimate that with the usual integration costs, each Delta robot installation will be around £10,000 to £15,000, which means that it will pay for itself after a few months.”

There are many other benefits inherent with Delta robot deployment; the higher the production rate the lower the cost per unit will be. If a company can make twice as many widgets as its competitor in the same amount of time, the advantage is obvious. There are also opportunities to reduce scrap and rework, increase quality and consistency, and improve overall safety.

**KIT IN A BOX**

Depending on requirements, the Delta robot can be delivered as a kit in a box within 24 hours of receipt of order. Alternatively, the delta robot can be delivered pre-assembled on a transport frame ready for installation. The machine builder is free to use their preferred software and controller or, as an alternative, they can opt for the intuitive and easy-to-use dryve D1 controller.

Also in this vein is igus’ robolink Aprio, a modular motion system which enables design engineers...
to develop low-cost automation systems. Consisting of three lubrication-free worm gears for standard movement, inverted movement and linear movement, the system can be configured to perform simple linear motion to complex humanoid and animatronic robotic tasks.

“The name says it all. Aprio is derived from the Greek word for “unlimited”, explains Robert Dumayne, dry-tech director at igus. “When the new series was being developed, the focus was on decoupling the motor and gearbox, as well as a new type of worm gear.”

**ROTATION**

With this system, Dumayne adds, even complicated movements can be implemented. For example, cost-effective and individual SCARA robots and linear robots as well as sprue pickers for the removal of products from injection-moulding machines. Transport and handling systems, as well as humanoid and animatronic robots which can perform movements like those of a spider, for instance. The new robolink series is also suitable for training, development and research as different kinematics can be set up easily and quickly.

In the worm gears of the new Aprio series, high-quality tribo-polymers with solid lubricants are used. The corrosion-free and chemical-resistant high-performance plastics ensure a high degree of stability, low weight, a long service life and freedom from the need for maintenance. The joints are joined together by a multi-functional profile made of aluminium. This makes it possible to insert drive shafts through a hollow space in the middle, a possibility that the inverted worm gear makes use of. The gearbox rotates the aluminium profile, making it suitable for use in robotics and rotating applications.

For linear motion, the aluminium profile travels linearly through the worm gear or the worm gear travels on the linear profile. The multi-functional profile also enables the engineer to connect the different gearboxes of the robolink Aprio series. Placing several Aprio joints side by side makes parallel joint connections possible as well. This results in endless possibilities of combinations in order to automate very different applications.

The aim is to be able to offer robolink Aprio as a series-produced solution for a wide market after the test phases. In addition, a configurator is being planned that is to simulate the modular system’s different possibilities of movement.

ABB’s YuMi robot, which was launched in 2015 is, by comparison with these, relatively expensive, originally being priced at approximately $40,000. However, it too was designed with the intention of breaking into the SME market.

Here, rather than price point, the attraction with YuMi lies in its collaborative nature. ABB developed a collaborative, dual-arm, small parts assembly robot solution that includes flexible hands, parts feeding systems, camera-based part location and state-of-the-art robot control.

YuMi can collaborate, side-by-side, with humans in a normal manufacturing environment enabling companies to get the best out of both humans and robots, together. One of YuMi’s unique features is its “inherently safe” design, allowing it to work alongside humans while reducing risks to acceptable safety levels.

ABB Robotics’ business development manager Mike Wilson makes clear why this is important in the adoption of robotics, saying: “Normally industrial robots are behind barriers, in cages or within cut-off zones. That has meant they are removed from the workforce and seen as separate. Because it is able to work closely and safely alongside humans, this particular model could be the bridge needed to bring shop floors across the country up to par with the world’s top industrial nations.”
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In cooperation with Pilz-Safe Automation, Stober has designed a new SE6 safety module for its SD6 drive controller. The SE6 safety module from Stober in cooperation with Pilz-Safe Automation is a new module that allows for safe drive monitoring in safety-related applications up to SIL 3, PL e (category 4) in accordance with EN 61800-5-2 and EN ISO 13849-1. The worst case response time of less than ten milliseconds enables fast stopping, allowing the design engineer to keep safety distances to a minimum.

One of its highlights is ‘safe brake management’, which consists of Safe Brake Control (SBC) and Safe Brake Test (SBT) with test cycle monitoring. “This enables the drive controller to fulfill the requirements of the soon to be released EN 16090-1 and is based on a publication of the German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung, or DGUV)”, explains Stober’s drive controller accessories product manager, Markus Frei. “The DGUV trade publication forms the basis for the draft standard DIN EN ISO 16090-1:2016-02, where the topic of protecting vertical axes is described in a standard for the first time.”

In addition to the Safe Torque Off (STO), Safe Stop 1 (SS1) and Safe Stop 2 (SS2) stop functions, SE6 also enables functions for safe movement and safe motion monitoring. The Safely Limited Speed (SLS) and Safe Speed Range (SSR) functions ensure that the drive does not exceed the configured velocity limit values.

Safe Direction (SDI) monitors the configured direction of motion, and Safely Limited Increment (SLI) limits the increment reliably. Safe Operating Stop (SOS) monitors an active stop.

The issue of real-world suitability took priority during development together with Pilz-Safe Automation and as a result, all safety functions can be used up to SIL 3, PL e (category 4).

Meanwhile, Control Techniques has revived the Commander name and green colour for a new family of general-purpose variable-speed drives (VSDs).

The Commander C200 version is aimed at general applications, and includes functions designed to make setup and installation as easy as possible. Commander C300 adds a dual Safe Torque Off (STO) input for applications requiring safety. It complies with SIL 3/PL e.

Both models have on-board Codesys-based PLCs which comply with IEC 61131-3, avoiding the need for an external controller and saving on cost and space when installing the drives in a system or cabinet. They are compatible with CT’s plug-in option modules, which include support for Profinet, Profinet, Ethernet/IP, EtherCat, DeviceNet and CANopen communications.

There are two built-in autotune procedures to simplify set-ups, and all of the parameters needed to set up around 80% of general-purpose applications are shown on the front of the drive, avoiding the need to refer to a manual.
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To accelerate the design and test of Sonopill, a revolutionary ultrasound endoscopy capsule, the team behind it required a single, unified instrumentation platform to take it from component and system integration testing, to lab-based in vitro testing, to in vivo pre-clinical trials.

The solution came from National Instruments and combined LabVIEW software with a broad range of NI Hardware, including PXIe, CompactRIO, myRIO and Diagnostic Sonar’s FlexRIO-based FIToolbox, to implement a full-featured system taking the Sonopill prototypes from initial characterisation through encapsulation to final deployment for pre-clinical validation.

Sonopill encompasses microelectronic sensors, including ultrasonic technology, to perform advanced health diagnostics as it travels through a patient’s gastrointestinal tract. It is the outcome of a five-year, $10m programme, established to develop a multimodal capsule endoscopy device, including ultrasound and other capabilities. It involves four university partners in the UK, Glasgow, Dundee, Heriot-Watt and Leeds, and features a multidisciplinary team of researchers ranging from electrical and mechanical engineers to life scientists and clinical fellows – all of whom have used NI hardware and software.

In 2010, there were almost 50 million visits to doctors in the US for gut related disorders. In the UK, 20-40% of the population report gastric conditions. Clearly, there is an urgent need for practical and accurate diagnosis and treatment options.

Current clinical endoscopy uses conventional devices, which are inserted into an orifice and manually controlled via external manipulation, with limited reach. These devices rely mainly on high definition optical sensors, with some also supporting low to mid-frequency ultrasound sensors. The last three decades have also seen the development of capsule endoscopy devices capable of passing through the entire gastrointestinal system. However, these systems are limited to lower definition optical imaging and do not exploit ultrasound imaging at all.

MINIATURISED SENSORS
To integrate ultrasound imaging into a capsule-sized device requires the highly miniaturised sensors and electronics, capable of operating in a power-limited, hermetically-sealed enclosure measuring 20-30mm (length) and 10mm (diameter). There are currently no commercial components that can meet these demanding system specifications – so sub-components of the Sonopill capsule had be developed from scratch and tested on the bench.

Once developed, these sub-components must then be functionally tested in isolation, then retested during system integration into the final capsule. These tests include measuring of basic device parameters, such as signal integrity and power usage, as well as the replication of imaging modalities for benchmarking image quality and sensing capabilities.

Finally, all capsules must be tested pre-clinically in vivo to establish safe operating conditions. These tests are done in a specialised facility with a variety of prototype devices, requiring a robust instrumentation solution, with a wide range of data logging and control options. »
One of the primary goals was to identify a single-vendor instrumentation solution that allowed replication of tests and results across all sites without significant equipment transport.

NI emerged as providing the best combination of equipment capability, flexibility, customisation and customer service. LabVIEW provides an intuitive means of building complex systems and allows the seamless integration of NI hardware along with specialised equipment, such as ultrasonic pulser/receivers and high-resolution motor controllers, using third-party LabVIEW drivers. These capabilities made NI products the winning solution.

To maximise the usability of the systems during and after development, NI provided instructor-led training for team members, as well as on-going support through its field sales engineers, who helped with developing the specifications of the required equipment for all phases. The online support, from both NI staff and the wider LabVIEW community, was also pivotal in the development and debugging of our various test software applications.

The NI platform provided a unifying system development experience, allowing us to transfer code assets seamlessly between sections of the project and efficiently handover entire systems when our engineers moved on to other tasks.

When establishing the testing requirements, the team identified several discrete phases in the device development, with the corresponding instrumentation solutions detailed below.

Ultrasound capsules use the natural motion of the human gastrointestinal tract to allow linear scanning of the full length of tissue. As this motion was not present during preliminary tests, a motorised scanning and integrated ultrasound generation and data capture system was developed. The team acquired a FlexRIO PXIe-1071 chassis, housing a PXIe-8360, NI-5772, PXIe-7966 and PXIe-5451, and connected it to a pair of linear motors and an ultrasonic pulser/receiver.

A PXIe-7966 FlexRIO module, coupled with a NI-5772 digitiser adapter module, to acquire data sets at very high repetition rates and to synchronise the pulser/receiver.

To ensure intuitive control of the motors, the team acquired a myRIO2374. The motor controller/data logger solution that would adapt well to any site in the UK.

The MultiPill grant will focus on the challenges of integration necessary for first-in-human trials and multimodal functionality. The level of inter-site coordination and communication that will be required to achieve this will demand standardisation of the existing solutions across all relevant work sites, with a particular focus on developing a portable instrumentation, based on a current myRIO-based in vivo test rig, which can be deployed on short notice to any site in the UK.

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MEASURING AND MANAGING ROBOTS

An innovative laser tracker-based robot calibration solution is increasing robot accuracy 12-fold.

Laser measurement technology company API has launched a laser tracker-based industrial robot performance and calibration solution. The API Robot Measurement Solution (RMS) provides a toolkit to verify robot accuracy to the ISO 9283 standard, allowing on-site, in-situ, robot performance verification and enhanced robot calibration to be performed.

In terms of results, industrial robots calibrated with the API’s RMS system during extensive development testing have exhibited an improvement in positioning accuracy of up to 12 times.

Robot performance measurement is quantified by examination of an installed robot performance in accordance with the ISO 9283 Standard. Robot performance verification is the process of identifying the real geometric parameters present in the kinematic structure of a robot, such as relative positions of robot joint links. A total of 14 static and dynamic tests are used to quantify a robot’s absolute performance. This performance check determines actual robot performance against the original OEM specifications, quickly determining robot accuracy, repeatability and identifying inherent robot joint wear.

Robots are historically repeatable but not accurate. Today many automation tasks require improved process control and a higher order of accuracy than that delivered by robot manufacturers. For instance, aerospace machining, drilling and assembly operations are increasingly performed by robots integrated into sophisticated and process critical manufacturing cells.

Typical applications for enhanced robot positional accuracy include machining, drilling, grinding, welding, cutting, inspection, deburring and 3D printing. Activities such as robot cell ‘cloning’, ‘cell mirroring’ or ‘robot swapping’ also benefit from enhanced robot accuracy by reducing manual programming time and allowing for seamless and precise off-line robot programming. Accurate robots improve process capability as a robot positions more accurately to its commanded position – also negating the physical ‘touch-up’ of robot programs.

The delivered solution includes API’s 6 DoF (Degrees of Freedom) RADIUS Laser Tracker complemented by the API Smart Track Sensor, which mounts directly to the robot’s end effector, allowing the laser tracker to dynamically collect x, y, z, and i, j, k data for each robot position in space accurately and automatically.

The robot is automatically driven to discrete positions using API’s Robot Performance Measurement (RPM) Software providing fully automated measurements and data acquisition and allows customisation of the actual workspace under calibration. Up to 30 robot parameters can be calibrated in a completely automated run-time.

API president Joe Bioty comments: “We expect our RMS robot accuracy verification and calibration solution to be of significant interest to robot system integrators, robot end users and robot OEMs, particularly since robot uptake is increasing dramatically, while at the same time manufacturing operations are looking to more tightly control production processes.”

API’s RMS provides a single seamless solution for robot process performance enhancement and optimisation. RMS can be supplied as a Robot Performance Measurement module or combined Robot Calibration (RoboCal) and Robot Path Plan Enhancement (PPE) module. Robocal offers both DH kinematic model and a volumetric error compensation (VEC) model to update robot accuracy using collected data. Once a robot has been calibrated, existing robot path programs can be automatically updated driving the robot to its corrected calibrated positions.

RMS provides access to an extensive library of industrial robots from over 30 manufacturers.
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Launched in October, Solidworks 2019 offers a number of new features to enhance design performance and efficiency.

Dassault Systèmes’ Solidworks 2019 is the latest release of its portfolio of 3D design and engineering applications. It delivers enhancements and new functionalities that help millions of innovators improve the product development process to get products into production faster, and create new categories of experiences for new categories of customers in today’s Industry Renaissance.

Powered by Dassault Systèmes’ 3DExperience platform, Solidworks 2019 supports the design to manufacturing process with digital capabilities to solve complex design challenges and facilitate detail work in engineering. New features let product development teams better manage large amounts of data and capture a more complete digital representation of a design. Solidworks 2019 also offers new technologies and workflows that improve collaboration and enable immersive, interactive experiences during design and engineering.

“We are using Solidworks to support implementation of the Maunakea Spectroscopic Explorer 10m-class telescope that will open new possibilities for scientific discovery,” said Greg Green, mechanical designer/instrument maker, Canada France Hawaii telescope facility. “Our design processes generate a large and growing dataset. The final production version of the telescope will contain over 100,000 parts. We needed technology that can tackle large design projects, and Solidworks delivers.”

Among its new features, Solidworks 2019 provides greater design flexibility to quickly interrogate or rapidly make changes to a model thanks to an enhanced Large Design Review capability. It also dramatically improves high performance view manipulation to scale with higher-end graphics hardware. In addition, Solidworks 2019 allows teams to communicate outside of the design community by adding markups to parts and assemblies directly using a touch device, storing them with the model, and exporting them as a PDF.

Another key feature of Solidworks 2019 is Solidworks Extended Reality (XR), a new application for publishing CAD scene data created in Solidworks — including lights, cameras, materials, decals, and motion study animations — and experiencing it in VR, AR and web viewers. As increasingly affordable immersive devices contribute to the growing ecosystem of technology and interactive experiences, designers and engineers can use Solidworks XR to improve collaborative internal and external design reviews, sell designs more effectively, train users how to assemble and interact.”
with their products and boost confidence in designs throughout the product development process.

“This latest Solidworks release is packed with enhancements and innovations built based on insights and feedback from the Solidworks community.

“We continue to drive our products forward in terms of usability, quality, and productivity, and Solidworks 2019 delivers a complete design ecosystem,” said Gian Paolo Bassi, CEO Solidworks, Dassault Systèmes. “Designers and engineers who prioritise design performance, attention to detail and innovation, as well as seek the powerful storytelling capabilities of VR and AR, can experience the prototyping shop of the future — one where digital design data makes it easier to visualize parts in 3D and improve how designs are translated from virtual to real.”

Solidworks 2019 introduces a number of new tools for working mesh geometry and to speed productivity of assemblies. For example, a common workflow for reverse engineering is to import mesh data and generate a solid model for production over the top of it. In Solidworks 2019, a new Slicing Tool is available to generate 2D sections at the intersection of the selected geometry and a series of planes. Just define the number of slicing planes and the offset and watch as Solidworks create the planes and intersection sketches, conveniently placing them in a folder. These sketches can be dynamically edited at any time for exact positioning, and can be used like any other sketch to create geometry or referenced to define the lofts and surfaces required to build a solid model.

Solidworks 2019 introduces a new 3D Texture Tool that leverages an image to define a pattern of bumps. This is particularly important because some designs, require textures or bumps, which can be functional or just for aesthetic purposes. Often time consuming to model; textures require many features such as ribs. The new 3D Texture command can be used to turn appearances into 3D geometry. The lighter the color in the appearance, the farther the offset from the base face and there are controls for mesh size and offset. Solidworks then creates a mesh body that is ready for downstream processing or 3D Printing.

**BODY MODELLING**

Multi-Body Part modelling is a standard method to create designs like weldments, and now the Interference Detection Tool is available in Part Mode. This brings great insight into a multi-body part, which is especially useful for weldments to verify that all members have been properly trimmed.

Solidworks 2019 adds support for sheet metal annotations. Bend notes can now be automatically inserted directly onto a components flat pattern view, displaying each bend direction, angle and radius. For components that contain many bends, a tabular display of the bend details is often the preferred method of capturing and viewing the information. Now in Solidworks 2019 you can capture all of your manufacturing information in a bend table. When a bend table is inserted, each bend on the component’s flat pattern view is tagged in relation to the table. This, combined with the tabulated bend information, enables designers to now detail sheet metal designs in the same manner as a traditional drawing. When finished all of the information can be captured in a 3D view, ready to be shared with other members of the design team and organisation.

Protection of intellectual property is often the number-one priority when sharing designs with other parties. When creating a 3D PDF file in Solidworks 2019, designers now have much greater control over the access of information contained within the document. New security settings provide further flexibility, enabling users to set the access to printing, editing, and copying.

Once a secure PDF document has been created, the password must be entered in order for it to be opened. Viewing the security information in Adobe Reader will confirm the limitations on printing, editing, and copying that were set back in Solidworks. 3D PDFs of Solidworks designs can be shared safely, in the knowledge that all intellectual property is secure.

When sharing parts for use in downstream manufacturing processes, derived parts provide an associative and controlled method of referencing the original design. Enhancing the workflow further, in Solidworks 2019 it is now possible to copy the pre-existing Dimension and Tolerance Schemes to a derived part, eliminating the need to recreate any PMI. 😊
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With the ultra-compact C6015 Industrial PC, Beckhoff is again expanding the application possibilities of PC-based control. Wherever space or cost limitations previously prevented the use of a PC-based control solution, this new IPC generation offers an excellent price-performance ratio in an extremely compact housing. With up to 4 CPU cores, low weight and unprecedented installation flexibility, the C6015 is universally applicable in automation, visualisation and communication tasks. It also makes an ideal IoT gateway.

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- Interfaces: 2 Ethernet, 1 DisplayPort, 2 USB
- Main memory: up to 4 GB DDR3L RAM
- Housing: Die-cast aluminium-zinc alloy
- Dimensions (W x H x D): 82 x 82 x 40 mm

Flexible installation with rear or side panel mounting.
In the AU General Session, Autodesk president and CEO Andrew Anagnost shared his perspective on how automation, the convergence of design and make technologies, and the changing nature of work can unlock opportunities to do more, better, with less negative impact on the world.

“With an increasing population and urbanisation and the continued rise of the global middle class, the demand for more is inevitable,” said Anagnost. “To meet the rising demand with the world’s finite resources, we must combine automation and human imagination to design and make in new ways.”

He was joined by several guests, including Autodesk CTO Scott Borduin, Autodesk director of robotics Erin Bradner, and author of ‘Imagine It Forward’ and former GE vice chair, Beth Comstock.

Bradner was part of a team that helped NASA’s Jet Propulsion Lab reduce the weight of a lander, proposed for a mission to Europa—a moon of Jupiter—to probe the ice on the surface of the moon in a search for life. Generative design was used to create optimised geometry of all the lander’s structural parts including the main body, that will house the instruments, and its legs, reducing overall weight by over a third.

She said that the main problem this project is solving is one for all designers: “The challenge of how they can better explore all possible design solutions. For most companies it’s a random walk through a field of solutions one design meeting at a time. Generative design produces a variety of potential design solutions each optimised to help determine manufacturability.”

Design consultancy Atkins was represented by Annette Chapman – regional commercial manager, Middle East – and Marc Durand – director, digital disruption – who explained how the company’s Caterpillar app was taking what it learned when preparing the sites for the 2012 Olympics in London and allowing them to more efficiently and effectively plan the sites for the 2028 Games to be held in Los Angeles. Essentially, the Caterpillar app, which is based on Autodesk’s Forge cloud-based development platform, uses big data and simulation to virtually place the footprint of the various stadia, athlete’s village, spectator zones and even food vendors to find the most optimum position of each in terms of the price of the land to be built on and congestion that would be created around them.

Two additional industry keynotes for the architecture, engineering and construction (AEC) and manufacturing industries, along with TED-style sessions in the AU Theater, brought together Autodesk and industry experts to take a deeper look at how the convergence of design and make, the blurring of industries, and new automation technologies are creating new opportunities.

Real-world examples of customers who have already taken advantage of these opportunities include a robot-equipped shipping container that can be brought on-site to additively manufacture custom construction components on-demand; a materially efficient flooring system that makes construction with concrete more sustainable; and a Formula One car reimagined with generative design and visualised in virtual reality.

Over the course of the event, Autodesk shared new product advances, partnerships and initiatives that it says will help its customers prepare for the future of making.
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Innovation in Miniature
Taking place from October 17-18 at the Ricoh Arena, Coventry, the 2018 Engineering Design Show once again provided more than 4,000 visitors with unrivalled access to more than 220 exhibitors showcasing their products and services; expert speakers exploring best practice, new design techniques and industry issues.

Speakers at the Eureka! Conference included Ben Hodgkinson, head of mechanical design for Mercedes AMG; Miguel Fernandez-Vicente, advanced research engineer, The Manufacturing Technology Centre; and Michael Huxham, head of technology and engineering, Smiths Detection.

The event saw the return of the Innovation Zone, a feature area focused on introducing visitors to ground-breaking technology, plus new additions including EDS TV – all designed to offer visitors a fully immersive experience of innovation, inspiration, interaction and insight.

With more than 25 conference speakers, a wide-range of free-to-attend workshops and exciting feature zones, the Engineering Design Show is the only event that caters for all aspects of engineering design under one roof in an efficient and dynamic environment. These pages offer a taste of the occasion.

The Engineering Design Show 2019 will take place at the same venue on October 16-17.
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Senior business decision makers have told the Royal Academy of Engineering that they need more support to take the final step in translating ideas into business success and economic growth. Research published by the Academy found that a lack of support in the final development and demonstration stage of innovation is holding back the potential of an otherwise strong innovation system in the UK, compared to other countries such as the US and Germany.

Late-stage development and demonstration is technically challenging and risky but crucial for bringing new products and services to market. At this stage companies demonstrate their technology to potential customers, and test them in purpose-built facilities or real-world situations increasing the probability of successful transition to the marketplace. The Royal Academy of Engineering’s research found that more support for this stage of development in the UK would encourage further investment in R&D in this country, develop local markets for new technologies and help the UK to become a leader in emerging technologies and sectors.

The government’s Industrial Strategy sets the UK a target of investing 2.4% of GDP in R&D by 2027, with a longer-term goal of 3%, to increase innovation and productivity in the UK. This target cannot be reached without stimulating more business investment in R&D, through this research the Academy has identified the factors that are influencing decision making on R&D investment into the UK in today’s boardrooms.

Professor Dame Ann Dowling, president of the Royal Academy of Engineering, said: “The UK undoubtedly has many attributes that already attract engineering businesses to locate their high quality early-stage R&D activities here, not least our world class academic research base and its excellent collaboration with industry. Unfortunately, this is undermined by gaps in the R&D and innovation system at a highly risky and expensive time in the development cycle. Plugging these gaps would help innovative engineering businesses, boost productivity, and create better jobs and social outcomes in the UK.”

Chief technology officers, chief executives and chief engineers from some of the UK’s leading large and small companies took part in the research, which highlights many advantages of locating R&D in the UK, including the UK’s highly-skilled engineering workforce, support mechanisms for early-stage R&D, and a healthy culture of collaboration with universities and between businesses. It also identified other areas for improvement including:

- Driving R&D and innovation in engineering services
- Transforming the unrealised potential of the UK’s public procurement spend to drive innovation
- Breaking sectoral boundaries to accelerate game changing innovation across sectors
- A more joined-up, coherent approach to R&D and innovation support across all government bodies

This report is available on the Academy website as a series of short explainers on the strengths and weaknesses identified through the research. It builds on ‘Engineering an economy that works for all’, a 2017 report from the engineering community in response to the government’s Industrial Strategy green paper.
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WS2 stops galling and seizing of stainless steel and titanium.
The human need for extra hands is long-established. For example, astronauts carrying out delicate repair work to the outside of the International Space Station, or even lunar or Mars bases in the future. These are high-pressure instances where the smallest lapse in concentration or mistake could be life-threatening, not just for the astronaut carrying out the maintenance, but also for the rest of the crew.

Alternatively, and with similar life or death stakes, a paramedic on the scene of a potentially fatal incident may be unfamiliar with particular medical procedures and would benefit from the experience of a consultant paramedic.

THE CHALLENGE
There are potentially thousands of other professionals who find themselves in scenarios where an objective set of eyes and an extra set of hands would be a huge help. So, this month’s challenge is to design a solution to this. It can be as high- or low-tech as you wish, but must be portable and as unobtrusive as possible.

The idea we have in mind will be revealed in the January 2019 issue of Eureka! Until then see what you can come up with. Submit your ideas by leaving a comment on the Coffee Time Challenge section of the Eureka! website or by emailing the editor: paul.fanning@markallengroup.com

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