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10 COVER STORY
ROADMAP TO SUCCESS
The automotive sector is on the brink of unprecedented technological change that has the potential to revolutionise mobility. So, what’s being done to help UK companies capitalise on this and become world leaders?

16 ON THE TOPIC OF...
PREPARING FOR BREXIT
With the turmoil around Brexit continuing, Nicole Boehler, partner at law firm Squire Patton Boggs, says industry must forget politics and prepare for the worst-case scenario.

19 MOTORS
COOL RUNNING
In the race to have the most efficient electric motor for future vehicles, Equipmake says the unique cooling technology in its spoke motor marks it out as a world leader.

23 INNOVATION
AIR-FREE SPRAY’S A LIFESAVER
A device developed by a UK design consultancy can stop bleeds during surgery without risking deadly embolisms by removing air from the delivery system.

27 SENSORS, TEST AND MEASUREMENT
TAKING THE PAIN OUT OF GLUCOSE MONITORING
A painless glucose monitoring method is now ready for certification.

28 ROBOTICS
FATIGUE-CUTTING EXOSKELETON
A new wearable exoskeleton for industrial workers has been launched that could transform individuals’ output and efficiency.

31 FASTENING AND ADHESIVES
BOOSTING INNOVATION
Innovations in fastening technology broaden the options of design engineers and are in turn producing a number of new opportunities.

35 DESIGN SOFTWARE
GENERATIVE DESIGN BRINGS FUSION
London Autodesk University revealed some new approaches and design successes, including collaboration in the world’s fastest human powered bike.

41 DESIGN PLUS
CUTTING PLASTIC WASTE
With the current backlash against plastics raising serious issues, the BPF has outlined ways the UK plastics sector can be smarter and greener.

REGULARS

05 COMMENT
Why is it that design is so often a misunderstood and underappreciated concept?

06 NEWS
- Swansea Bay Tidal Lagoon rejected
- Rolls-Royce to develop flying taxi
- Discovery Live added to Creo
- Going against the flow
- Shortening design time

43 COFFEE TIME CHALLENGE
This month’s challenge is to design a thief-proof bike lock that is also easy to carry around.
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EDITOR’S COMMENT

IT WOULD BE NICE to think that the value of design to the UK’s economy would not need highlighting. However, the reality is that it is often a misunderstood concept and consequently underappreciated.

The Design Council has done its bit to remedy this by releasing its report entitled ‘Design Economy 2018’, in which the charity shows how design firms and designers are playing a more prominent role in the global economy and the fourth industrial revolution. It also highlights the impact of design on the UK economy, with the majority of its value (68%) generated by designers working in sectors including aviation and automotive.

According to the report, the design economy grew by 52% between 2009-16, generating £85.2bn in gross value added (GVA) to the UK in 2016, equivalent to 7% of total GVA in the UK. It added that 1.69 million people were employed in design in 2016, making the design economy the ninth largest employer in the UK.

Despite all this, design tends to be overlooked as a revenue-generating discipline in and of itself. It is often wrongly perceived as simply a preparatory stage to the ‘real’ business of manufacture, marketing and selling.

This attitude is all too commonly encountered. When one discusses Dyson as a UK success story, for instance, there is a tendency for nay-sayers to point out that the company does not manufacture in the UK and ‘only’ has its design, research and development based here, as though those things weren’t the beating heart of the business!

Design is what creates difference, breaks a product into markets and creates intellectual property. As a result (as these figures make abundantly clear), design is a very real source of revenue in and of itself. Underestimate it at your peril.

Paul Fanning, Editor

DESIGN MATTERS

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Swansea Bay tidal lagoon rejected

THE GOVERNMENT HAS decided not to back the world’s first tidal power lagoon as it does not offer value for money. The decision has been met mixed criticism from MPs and industry.

The lagoon’s owners, Tidal Lagoon Power (TLP) claims that, although the strike price would start off high (£123 per MWh), it would reduce over time to similar if not lower levels than that of the Hinkley Point C nuclear power plant (£92.50). Plus, the lagoon is expected to have a longer lifespan.

However, it has come to light that without an additional £200m investment from the Welsh government the strike price would be closer to £150 per MWh.

In 2017 a UK government-commissioned review by former energy minister Charles Hendry recommended that tidal lagoons could play “a cost-effective role in the UK’s energy mix.”

Hendry said: “They have taken 18 months when they could have said ‘no’ to it on day one.” But, he added: “They’re keen to look at other tidal technologies and that at least is positive.”

Ian Price, CBI Wales director, said that it is disappointing that the financially viable model for the project has not been possible but, “at the end of the day any project has to be affordable for consumers.”

“All major infrastructure projects require large amounts of time, energy and money, only for many to then fail to get the green light. There must be a smarter way of approaching such projects that does not discourage innovative entrepreneurial firms from entering the marketplace.”

ANSYS DISCOVERY LIVE ADDED TO PTC CREO

ANSYS AND PTC have partnered to incorporate ANSYS Discovery Live real-time simulation within PTC’s Creo 3D CAD software.

The combined solution will be sold by PTC as part of the Creo product suite. This solution will offer design engineers a unified modelling and simulation environment, removing the boundaries between CAD and simulation and enabling them to gain insight into each design decision they make throughout the product development process.

The companies say this insight will enable the creation of higher quality products, while reducing product and development costs.

“Partnering with ANSYS makes tremendous sense on every level,” said Jim Heppelman, president and CEO, PTC. “With the combined solution engineers will be able to see the real-time results of simulation during the modelling process, enabling them to understand design changes in their models.”

The first product planned to be delivered by the companies will integrate ANSYS Discovery Live into Creo to enable instantaneous static structural, thermal, and modal simulation.

Over time, the companies intend to integrate the full breadth of ANSYS Discovery simulation functionality into Creo.

Ajei Gopal, president and CEO, ANSYS, added: “The power of simulation will now readily be provided to engineers as they make thousands of decisions and model explorations, providing them with unprecedented insight into their design choices.”
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Algorithm skips steps to solve problems

COMPUTER SCIENTISTS AT the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) have developed an algorithm that exponentially speeds up computation by dramatically reducing the number of parallel steps required to reach a solution.

The algorithm, and variations of it, could be used for applications such as designing sensor arrays for medical imaging; more quickly assessing the accuracy of machine learning models; and designing clinical trials for drugs to treat Alzheimer’s, multiple sclerosis, obesity, diabetes, hepatitis C, HIV and more.

According to the scientists, so-called optimisation problems haven’t changed since the 1970s. They work by following a sequential step-by-step process where the number of steps is proportional to the size of the data. But this has led to a computational bottleneck, resulting in lines of questions and areas of research that are too computationally expensive to explore meaning the relative gain from each step becomes smaller.

The SEAS team asked: what if, instead of taking hundreds or thousands of small steps to reach a solution, an algorithm could take just a few leaps?

Their algorithm samples a variety of directions in parallel, discarding low-value directions from its search space and choosing the most valuable directions to progress towards a solution. This active learning is key to its ability to make the right decision at each step and solves the problem of diminishing returns.

“There is no algorithm to dramatically speed up computation for an enormously large class of problems across many different fields, including computer vision, information retrieval, network analysis, computational biology, auction design, and many others,” said Yaron Singer (pictured), assistant professor of computer science. “We can now perform computations in just a few seconds that would have previously taken weeks or months.”

The scientists are continuing to work on implementing the algorithm.

The scientists are continuing to work on implementing the algorithm.

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SOLUTION TO LAST MONTH'S COFFEE TIME CHALLENGE

The solution to July’s Coffee Time Challenge of how to provide an electric razor able to shave as well along the cheek, where skin is soft, as around and under the jaw bone where skin is tougher comes from one of the world’s leading makers of electrical goods, Philips.

To address this, Philips has been experimenting with smart materials, including one that can change its characteristics in response to environmental changes. For example, a smart material may increase or decrease in length when an electric potential is generated across it, or when it comes into contact with a particular chemical.

Until recently, shape changing smart materials have been regarded as experimental. They can also be costly to apply, which has prevented their widespread use in domestic products. However, recently granted patent EP 3197649 B1 shows how a smart material can be used in a personal grooming device to adjust how close the blades are to the skin.

This patent was brought to our attention by patent attorneys Withers & Rogers.

This approach allows us to dramatically speed up computation for an enormously large class of problems across many different fields, including computer vision, information retrieval, network analysis, computational biology, auction design, and many others,” said Yaron Singer (pictured), assistant professor of computer science. “We can now perform computations in just a few seconds that would have previously taken weeks or months.”

The scientists are continuing to work on implementing the algorithm.

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**Going against the flow**

**RESEARCHERS AT THE** University of Manchester’s National Graphene Institute (NGI) have successfully controlled water flow, and even stopped it, by sending an electrical current through graphene oxide membranes.

According to the researchers, this could be used to develop artificial biological systems and advanced nanofluidic devices for various applications including tissue engineering and filtration.

Dr Kai-Ge Zhou, lead researcher on the project said: “The technology can also be used as a smart sponge. Water adsorbed on the membrane can be preserved within it even in desert conditions if a current is applied. We could release this water on demand by switching the current off.”

**TRL INVESTS IN DRIVING SIMULATOR**

**TRL HAS MADE** a six-figure investment to enhance its driving simulator capabilities. The organisation claims this will help drive future transport policy, customer safety and road network performance.

To create a fully-immersive experience, the simulator combines full vehicle controls and hyper-realistic sensory inputs, including a wider field of view (300°) and road surface simulations, such as a rumble strip, speed bumps and a variety of weather conditions. Drivers’ physiological and biometric data is captured via a range of state-of-the-art measures and eye tracking capabilities.

“With the majority of vehicle manufacturers now investing in connected and autonomous technology, ‘DigiCar’ provides a safe and controlled environment for validation trials,” said Ryan Robbins, senior human factors researcher at TRL. “Using a simulator is a more cost-effective and time-efficient alternative to acquiring a fleet of vehicles and running labour-intensive trials.

“The continued evolution of the TRL DigiCar will enable us to gain a greater understanding of the impact innovative mobility technologies will have on our transport system, allowing for a safe and seamless introduction.”

**SHORTENING DESIGN TIME**

**ROCKWELL AUTOMATION HAS** released an updated version of the Allen-Bradley Motion Analyser software tool. Its optimised user experience, intuitive navigation and in-workflow product selection are said to help engineers more easily and efficiently develop complete motion control systems for their machines.

Using the Motion Analyser software, engineers can determine a system’s specifications, evaluate multiple products to find the best fit, finalise the design and create a bill of materials. The tool can also help reduce motion-system design time from a multiday process to a few hours.

“Sizing a motion system can be time consuming,” said Brett McNalley, product manager, motion solutions, Rockwell Automation. “We have simplified workflows to improve user experience and we have added features that make the process of designing a motion system as efficient as possible.”

Key improvements include faster axis definition and sizing, redesigned solution search and configure component features, additional application template profile support, and the ability to import from a legacy motion profile with support of more advanced motion segments.

**MOVING ENDLESS DESIGN TIMES**

**NEW VP OF TECH FOR FORCE-SENSING SPECIALIST**

Peratech has appointed Dr Tolis Voutsas as vice president of technology. He will focus on the development of solutions integrating Peratech’s quantum tunnelling composite (QTC) force-sensing technology with Displays and Thin-Film Transistor arrays.

**NEW ENGEL UK MD**

Graeme Herlihy of Engel UK has named Nigel Baker his successor for the role of managing director after he moves on to become regional president Europe West, effective September. Baker’s experience includes almost 25 years at the helm of injection moulding machine manufacturer Netstal UK and over five years as MD at BMB Plastics Machinery.

**NEW CEO AT STAR RAPID**

Star Rapid has announced the appointment of business transformation specialist, David Hunter, as CEO. Under Hunter’s leadership, Star Rapid will incorporate Industry 4.0 processes and systems that rely upon real-time data to increase operational efficiencies.

**RESHUFFLE AT MASS PORTAL**

Imants Treidis has been named CEO of thermoplastic extrusion 3D printer manufacturer Mass Portal. Treidis takes over the role from company co-founder Janis Grinhofs who has served in this position since early 2014.
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ROADMAP TO SUCCESS FOR THE UK

The automotive sector is on the brink of unprecedented technological change with the potential to revolutionise mobility. So what is being done to help UK companies capitalise on this and become world leaders? Tom Austin-Morgan investigates.

Though the UK has a long history of innovation and invention, it has not always been so good at commercialisation. This has left British startups, inventors and even large corporations struggling to stop their products or technologies from falling into the ‘valley of death’, between a viable working prototype and mass adoption.

To encourage and ‘de-risk’ invention and innovation in the UK’s automotive industry the Advanced Propulsion Centre (APC) was set up in 2013 and funded with £1bn, half by the government and half by the Automotive Council. Its brief is simple, but complex: support the UK industry’s move to low carbon solutions and create an ecosystem that supports R&D, eliminating the valley of death.

As part of this brief, and to provide a common understanding of opportunities and threats, as well as promote inventor confidence in the technologies they have invested in, the APC has published its latest ‘Roadmap Report – Towards 2040: a guide to automotive propulsion technologies’.

Drawing on the expertise of 139 organisations from vehicle manufacturers and technology suppliers to consultants and academics, the report contains eight separate roadmaps, with three in the vehicle sphere (passenger car, bus, commercial and off-highway) and five in technology (electrical energy storage, electric machines, power electronics, thermal propulsion systems, lightweight vehicle and powertrain structures).

“What we are seeing is a tremendous opportunity for British businesses,” says Ian Constance, APC’s CEO (pictured, right).

“This new analysis will help investors, innovators and government understand which technologies need to be developed as we drive at increasing speed to low carbon transport, helping them make the decisions that will ensure the UK remains a global player in 2030’s $1 trillion global market for low- and zero-tailpipe emissions vehicle technologies.”

In the 134-page report the APC has highlighted its key findings in its technology roadmaps as follows.

“After decades of evolution, vehicle technology is now at an inflexion point, changing faster than at any time in the last 100 years. That presents a tremendous opportunity for British businesses”
improvements are expected to be accompanied by a fall in price from $280kWh to $100kWh by 2035. However, to deliver these targets, battery chemistry will have to change with the development of new anode and cathode technologies.

Dave OudeNijeweme, the APC’s head of technology trends says: “Most future powertrain options require substantial battery capacity, but the environmental impact of these systems cannot be controlled through traditional vehicle-focused regulation.”

**SIEMENS AUTOMOTIVE SYMPOSIUM**

Consumers want high quality products when they need them and with as much customisation as possible. Typically, the automotive industry has moved at a slower pace than other consumer goods manufacturers when it comes to these factors, but now digitalisation is transforming this sector.

Siemens’ recent automotive symposium at The Manufacturing Technology Centre in Coventry showed how industry is reacting to future trends in design and manufacture in parallel to the APC laying out its Roadmap.

Perhaps the company furthest from the traditional automotive model was Uniti, a Swedish electric vehicle startup looking to disrupt the industry in a similar way to Tesla. The company’s founder and CEO, Lewis Horne said: “We barely have engineers within the company and no hardware even though we’re a hardware startup. We just have a digital backbone and a bunch of licences.”

According to Horne, this digital backbone, made up of Siemens’ PLM and NX CAD software, was Uniti’s ‘digital asset’, helping them to get the best designers and engineers in the world working for them across the value chain.

So far, Uniti has only produced a few prototypes but Siemens is helping build a state-of-the-art, fully automated factory in Sweden with a production capacity of 50,000 units per year. The first cars are expected to go on sale in 2019.

“Theoretically we won’t have to have humans. You could have the lights turned off in the building,” Horne says. “Previously there were billion-dollar factory set-ups, now, it’s a bunch of our engineers sitting with Siemens engineers working with software.”

Since December 2017 Uniti has received €50million in pre-order sales, 90% of which have been made online. The other 10% have been made through virtual reality viewings and ‘test-drives’ in Swedish electronics retail store MediaMarkt.

Uniti’s business model looks to be something the wider automotive industry could adopt. In fact, luxury marques like McLaren and Aston Martin are beginning to use VR technology in their showrooms to show customers what the various interior and exterior details and materials will look in real-life lighting conditions.

Indeed, Siemens’ automotive solutions manager, Steven Dom says: “Vehicles are getting more complex. BMW for example have built front-engine, rear-wheel-drive cars for around a century. Jaguar and Mercedes used to build two or three models, now they’re producing many more.”

Dom continues that hybridisation and electrification are the reason for this. Customers want, and governments and regulators demand, lower emission vehicles. As such, the architecture of these vehicles has had to change with the removal of the ICE from fully-electric models and the addition of batteries and electric motors to both electric and hybrid vehicles as well as the increase of electronics in the drivechain and the infotainment system.

Materials is another emissions-saving area and Steve Grant from Siemens PLM explained how the company has used its partnership with F1 teams like Renault to design lightweight fibre-reinforced composites in Fibersim that can also be fed back into road vehicles.
“This means a different approach to decision making is required, even before we consider trends in the availability of raw materials. The Roadmap will be of value to decision makers across many sectors, providing insights into areas of growing complexity and illuminating the impact of new business models such as mobility-as-a-service.”

**ELECTRIC MACHINES**

Likewise, costs are forecast to decline from $10 per kW to $4.5 per kW by 2035, while power density is expected to quadruple from the current 7kW/l to 30kW/l by 2035. Key to this, the APC says, is the introduction of alternative winding materials, while additive manufacturing has the potential to remove the need for dedicated winding processes.

**POWER ELECTRONICS**

Very high levels of integration are also predicted in electric drives, with the e-machine, transmission and power electronics coming together to create a single, light-weight, tightly-packaged and lower cost unit with greatly reduced complexity.

“These units operate in an exceptionally demanding environment that is a great example of ‘automotive grade’ to ensure durability,” explains OudeNijeweme. “Part of the role of the APC is to help innovators from outside our industry understand these requirements and to set-up programmes and partnerships that lead to the exceptionally robust yet light-weight and affordable technologies our industry excels at.”

**THERMAL PROPULSION SYSTEMS**

Growing electrification presents new approaches for internal combustion engine design. While some vehicle manufacturers will achieve ultra-low emissions by developing increasingly sophisticated internal combustion engines (ICEs), others may choose to simplify engine design by focusing on optimisation of a narrow operating region. This will enable greater levels of synergy between the ICE and powertrain electrification and permit further optimisation of the engine, such as the use of novel combustion cycles.”
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With increasing vehicle content and safety requirements, weight reduction continues to escalate as a priority for all vehicles regardless of propulsion type. The report identifies design, materials and processes as each having the potential to save vehicle weight through better optimisation and emphasises the need for new approaches to design and analysis that allow full advantage to be taken of developments in materials and joining technologies.

Underpinning many of these roadmaps is the huge electrification opportunity for UK companies. The APC calculates that the market will be worth €30bn by 2030 since the vast majority of lightweight vehicles will require some form of electrification. However, it says the window of opportunity is small as the automotive industry is only two full vehicle lifecycles away from this date.

The APC was originally conceived as a project with a 10-year shelf-life, however discussions have begun between government and industry to sustain the APC beyond 2023 as it has demonstrated its benefits in ‘de-risking’ innovation and helping the UK’s automotive R&D from avoiding the dreaded valley of death.

Constance concludes by calling for closer and wider collaboration between innovators, government and the transport sectors: “How can the UK’s chemical sector help accelerate automotive battery development? How can our steel industry help progress advanced traction motors? “In a period of unprecedented change in the automotive industry, we expect these roadmaps to facilitate activity between the key organisations operating in these fields as well as helping those businesses and researchers in adjacent sectors to understand and engage with the automotive industry changes.

“The true value of the roadmaps will only be realised if organisations work collaboratively to deliver the technologies the community has identified.”

ON THE ROADMAP

Accompanying the launch, several companies presented how they have benefited from collaborating with the APC to commercialise their projects and how the roadmaps have helped them identify opportunities.

Among these, the APC provided match funding for JLR’s High Volume E-Machine Supply (HVEMS) project. HVEMS was a three-year, £11.1m project that investigated what is required to manufacture electric machines in high volume in the UK.

With Prodrive, the APC provided funding of £4.7m for a project to convert a diesel-engine Ford Transit into a plug-in hybrid electric vehicle (PHEV). The PHEV’s CO2 output is rated at less than 50g per km, with a pure battery range of 50km and a total range of 500km. It is currently being trialled in London and Ford plans to put it into series production in 2019.

Williams Advanced Engineering is assisting with the engineering integration in Aston Martin’s first all-electric model, the RapidE, that will enter production in 2019. The two companies led a consortium in a successful bid for APC funding which will be used to build a high-performance, low volume, flexible battery manufacturing facility to produce the battery for the RapidE.

The UK Battery Industrialisation Centre (UKBIC) plans to operate a 20,000m2 battery prototyping plant in the UK by 2020. This giga factory will be able to manufacture lithium-ion anode and cathode materials as well as chemistries such as solid state, sodium iron and silicone-based electrodes.

LIGHTWEIGHT VEHICLE AND POWERTRAIN STRUCTURES

With increasing vehicle content and safety requirements, weight reduction continues to escalate as a priority for all vehicles regardless of propulsion type. The report identifies design, materials and processes as each having the potential to save vehicle weight through better optimisation and emphasises the need for new approaches to design and analysis that allow full advantage to be taken of developments in materials and joining technologies.

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ON THE TOPIC OF | BREXIT

KEEP CALM AND GET PREPARED

With the turmoil around Brexit continuing more than two years on from the result of the referendum, Nicole Boehler, a partner at law firm Squire Patton Boggs, says industry must forget the politics and prepare now for the worst-case scenario.

"One problem you have right now is that you can’t predict the future any better than I can, but what you can do is prepare for it."

This was the advice being given to UK industry by Nicole Boehler, partner at international law firm Squire Patton Boggs, at the Motorsport Industry Association’s Business Growth Conference in July.

Boehler encourages industry to engage with customers, suppliers and advisors to learn about business opportunities and plan to avoid the potential barriers.

“We all expect tariffs of some sort to come out of this,” Boehler continues. “It’s not going to be a magic solution where Britain gets everything it wants and the EU says ‘Oh, yes please!’ I don’t think that’s gonna happen.”

In fact, the previous day, Ralf Speth, CEO of Jaguar Land Rover, spelt out his feelings on the possibility of a ‘hard Brexit’ – one where the UK leaves the EU and the single market entirely and has a relationship with the continent based on World Trade Organization rules.

In a statement, Speth said that JLR would have to close plants in the UK (removing £80 billion of investment over the next five years) if a hard Brexit was actioned, as trade tariffs of £1.2bn per year would make it unprofitable for the company to remain in the UK.

This is because around 25% of JLR’s vehicles are exported to continental Europe, each of which will be slapped with an extra 10% tax to cross the border. In addition to this, 40% of JLR’s imports come from Europe and it is expected that, because of these tariffs, suppliers will have to raise their prices too.

Boehler is sceptical, however. “I think we all know that that’s not going to happen,” states Boehler. “Perhaps he’s just rattling the cage to get the attention of the lawmakers, who are set to meet this weekend [7th-8th July]?

“Interestingly for me, he indicated that he knew of no one who was looking for a hard Brexit and I thought that was unfortunate because all intents and purposes show that we are looking at a hard Brexit,” she adds.

However, Boehler says that the government is doing what it must do by making strides towards a final decision and is coming up with solutions. For example, on the right to remain in the UK for EU citizens.

“There is a solution in place and it does look fair,” she says. “But those are the steps that the government can take because it’s their job to regulate who can come in, who can leave and who can stay. But it’s our job as industry to do what we can do too.”

Boehler goes on to say that the
best plan is to prepare for a hard Brexit scenario and importantly not to see Brexit as a barrier to growth but an opportunity for growth.

“Reorganise, refocus. Take this rare opportunity where not only can you invest in your structures, but you must invest in your structures,” Boehler urges. “A lot of this is homework. You don’t need a bunch of outside advisors. What you need to do is take a look at your in-bound and out-bound supply chain and the cost that’s associated with them and optimise and leverage your global footprint.”

She continued by saying that British industry is in a unique position, in that it performs on a global stage (especially in automotive and aerospace), but that most of the economic activity happens locally. Proper planning and focusing on the product will help avoid poor performance.

“We’re not a bunch of hand-wringers,” Boehler says. “What I want you to do is think about what you can do to increase predictability and reduce risk by doing so. What happens if we have a belly-flop next Summer? I can’t tell you. That’s something you need to go home and do some homework on. Don’t forget the small, boring stuff. I mean, that’s generally what the lawyers are for but you’ve got to plan for it.”

Boehler says British companies need to: undertake a Brexit statement & risk report as well as a trade impact assessment; obtain systems advice and advice on immigration (although, this has already been simplified with the right to remain decision where the government’s ‘default’ position would be to grant rather than refuse settled status); look at issues around VAT; supply chain, contract renegotiation and new contracts; IP asessments (are your property rights going to carry over? Where will you have to register as a British company going forward?); and get advice about trading in new markets and countries outside the EU.

To help with all this, Squire Patton Boggs has drawn up a preparedness questionnaire and sends out regular updates to keep companies informed.

Since the MIA Business Growth Forum (and at the time of going to press), the Prime Minister has unveiled a whitepaper that sounds, on the face of it at least, to present a ‘soft’ Brexit for trade, with plans for frictionless trade at the border. However, this has already seen revisions in Parliament and, as with most things Brexit, whether these plans will be accepted by the EU, remains to be seen.

So, has Boehler’s message changed at all in the wake of these developments? No, she says being prepared for the worst scenario is still the best approach: “No matter what comes of the negotiation, be it smooth sailing or horrendous fall, I believe British industry is uniquely positioned to master this challenge.”
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In the race to have the most efficient, lightweight electric motor for future vehicles, Equipmake says the unique cooling technology in its spoke motor marks it out as a world leader. Tom Austin-Morgan reports.

Spoke motors are very much a known quantity in the world of electric motors. Essentially, they are compact permanent magnet motors where the magnets are arranged like spokes in a wheel for better torque generation. However, they have been prohibitively expensive to produce in volume – until now. Equipmake’s managing director, Ian Foley claims that the company has come up with a patented cooling design that makes its APM200 spoke motor more cost-effective.

“Two things really set the APM200 apart from other motors on the market,” Foley says. “The spoke motor itself has the highest torque density architecture for a permanent magnet motor and what we’ve done is worked out how to manufacture that cost-effectively and cool it very effectively. Our belief is that the main driver for the development of motors at the moment is the cooling systems.”

Foley has a career spanning 30 years, pioneering racing technology for the likes of Lotus and Williams in both World Endurance Championship and Formula One. More recently, when F1 cars began using KERS (kinetic energy recovery system) devices, Foley developed a high-speed flywheel for the Williams team which stored energy in a battery pack to be deployed in bursts to give the cars a boost when needed to overtake or defend.

“That was effectively a composite electric motor,” says Foley. “So, a huge amount of the learning from that went into this motor development and we’ve built on that. There is a huge amount of background knowledge and learning from the racing industry gone into it.”

The APM200 motor weighs 40kg in a 318 x 247mm package and produces 220kW, a maximum torque of 450Nm and a maximum speed of 10,000rpm. Equipmake says its liquid cooling system allows for longer continuous power output capability.

“With electric motors there’s always a large difference between the maximum power of the motor and its continuous power,” Foley explains. “The continuous power is always less because the motor will get too hot, we’ve put in a huge amount of effort into how to cool the motor better.

“We’ve got direct water cooling channels running up and around the rotor itself, close to the magnets, and back down again, keeping them cool, meaning we can run the motor harder for longer.”
A lot of development went into validating the system, Foley continues, because having high-flow water changing direction past the rotor can cause issues. A significant amount of CFD was carried out, but it was so complex that a specialist CFD company, TotalSim, was subcontracted to help solve the problem.

Another critical factor of the design was materials selection and the construction of the motor itself as it revolves at such high speeds. The rotor needed to be non-magnetic and very strong but also thermally conductive.

“We’ve ended up with an aluminium motor because we can keep it cool and therefore it retains its strength,” explains Foley. “We use neodymium iron boron magnets, again because we can keep them cool. Neodymium magnets get more expensive the higher temperature rating they are. So, the fact that we’ve got this cooling system, where we can get the water very close to the magnet, means we can use the cheapest grade of neodymium but get very high magnetic strength.”

As a result of its innovative cooling system, the APM200 rotor runs at around 100°C rather than typical electric motor rotors which tend to run at 150 to 200°C allowing cheaper materials to be used, driving down the cost of production.

According to Foley, both halves of the rotor are clamped together with standard bolts and the design of the motor means it holds itself together as the steel laminations slot into and interlock with the aluminium rotor and the magnets.

Foley says: “Compared to one motor that we have worked on and know quite a lot about, the APM200 is about half the volume and 80% of the weight while giving a very similar performance.”

Wishing to take advantage of a perceived two-year lead time over its rivals, Equipmake is now setting up a facility to produce the motors and powertrains for its current and more immediate projects. But the facility has the capacity to manufacture up to 10,000 units per year, a target it hopes to hit by 2020 thanks to interest from other automotive companies as well as aerospace and marine.

The APM200 was originally specified three years ago as part of the drivechain for niche automotive manufacturer, Ariel’s ultra-high performance, range extended, electric sports car project: Hipercar.

Due for release in 2020, Hipercar prototypes have been fitted with one motor on each wheel. This means the total power output for the car is 880kW, or 1000bhp, which allows the car to accelerate from 0-60mph in 2.4 seconds, 0-100mph in 3.8 second and on to a top speed of 160mph.

Another project Equipmake is involved in is the EBus drivechain for use in electric busses. It utilises two APM200 motors mated with Semikron SKAI inverters. The battery technology is provided by the latest generation batteries from AESC, which provides the batteries for the Nissan Leaf.

The £2.5m project is being supported with funding from Innovate UK, and will see the first prototype vehicles tested in Q2 of 2019, with in-service testing starting some time in 2020.

As for other areas of interest, Foley says: “We’ve focussed on automotive because of our current project and because that’s what our background is in, but we are interested in – and being approached by – industries such as aerospace and marine.”
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GRAND INNOVATION AWARD 2018

The back rest and seat shell of the new Opel Insignia GSI sports seat are made of Grivory GVL HP. This is a semi-crystalline, partially aromatic polyamide with special long glass-fibre reinforcement. During the injection-moulding process, the long glass fibres form a fibre ‘skeleton’ which significantly increases the performance capabilities of the seat components through a substantial increase in notched impact strength and accordingly higher energy absorption in the case of an impact. To emphasise the sporting design, lamella-like design panels, made of Grilamid TR 30 in matt and high-gloss optic, are attached near the head rest.

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A new device developed by a UK design consultancy can stop bleeds during surgery without risking deadly embolisms by removing air from the delivery system.

Says Dr Wicks: “We saw that the existing products for haemostat delivery could be safer and more convenient, so we challenged the team to come up with something better. They came back with various ideas, one of which used the Coanda principle, where air follows a curved surface.”

The principle was named after Romanian aerodynamics pioneer Henri Coanda, who was the first to recognise the practical application of the phenomenon in aircraft development. It is described as “the tendency of a jet of fluid emerging from an orifice to follow an adjacent flat or curved surface and to entrain fluid from the surroundings so that a region of lower pressure develops.”

On this basis, Team Consulting set about developing a powder sprayer which could never cause embolism. Called Convesaid, its ingenious airflow design uses the Coanda principle to ensure that only the haemostat powder exits the device. No air leaves the device and hence the sprayer is intrinsically safe.

The battery-powered pump inside Convesaid creates a stream of air, which picks up the haemostat powder particles and blows them out of the end of the device. The air, however, is funnelled round a smooth curve in the tip of the device. No air ever leaves the device.

Instead, the air follows the curve within the nozzle and is directed back into the device itself. Powder is ejected without any air leaving the opening, which means even if the nozzle were pushed into a vein, it can’t inject any air. This eliminates any potential for air embolism and is what makes Convesaid so intrinsically safe.

Simplicity, reliability, robustness and cost-effectiveness were key aspects in the design of Convesaid. Team Consulting estimates the device would cost around $15 to manufacture. These were always major factors in the design brief, as Dr Wicks makes clear. “As well as eliminating the risk of embolism, we also wanted to create a device that was easy to operate, reliable and cheap enough to be disposable,” he says.

Like any design process, however, it was not straightforward. Says Dr Wicks: “We created initial design concepts and used math modelling to simulate the device’s airflow and used this work to create the first prototype.”

According to the British Medical Council, 30% of specialist inpatient surgeries involved a bleed during the process which increased the length of hospital stay. Currently, such bleeds are managed using devices that dispense substances known as haemostat powders. These work by carrying the powder within a stream of air. However, the use of these devices carries with it the risk of squinting air into an open blood vessel and causing a lethal embolism.

The desire to create a device that eliminates this risk led UK-based medical device consultancy Team Consulting to embark on a development programme that this year emerged with a revolutionary new design.

Dr Ben Wicks, head of MedTech at Team Consulting says: “Haemostat powders are widely used to manage bleeding during surgery – the powder accelerates clotting and can easily be sprayed onto an area of bleeding using an air spray device. However, such devices generally rely on air to deliver the powder particles. The presence of air brings the risk of embolism if the device is placed too close to a vein, and we wanted to come up with a solution that could eliminate this entirely.”

Clearly, since air was the problem, the development had to centre around creating an an airless system for delivering powdered hemostats accurately, safely and cheaply.
Following successful demonstration of the first prototype, Team Consulting gathered user feedback to further refine the design. The original prototype was connected to an external pump and power source, but feedback suggested a handheld solution would better to meet stakeholder needs. It was also discovered that people pulled the trigger before switching on the device, so Team Consulting redesigned the device’s layout to feature a lock-out which prevents the trigger from activating until the device has been switched on.

Says Dr Wicks: “We ran some computer simulations, designed and built our first demonstrator – which worked brilliantly. The next challenge was to make it smaller – so more design work, prototyping and testing followed. The spray is almost like magic, it feels like air must be coming out, but it isn’t.”

According to the company: “User feedback was invaluable throughout the process, and this is typical of the way we develop products for our clients: we develop devices from understanding user needs, through design, lab testing and user studies – all the way to scale up and manufacture.”

The result is a product that is suitable for use in both laparoscopic and open surgery. Because the powder is delivered without air and as a fine, fully-controllable jet, surgical teams are able to focus on the procedure at hand and do not have to worry about embolism.

Ultimately, the device saves time, money and – most crucially – lives. Say Dr Wicks: “Convesaid gives surgeons the ability to stop a variety of bleeds in a rapid, accurate and safe way. It takes no time to set up and is unencumbered by any air lines.”

Convesaid will give haemostat manufacturers the ability to deliver haemostats more effectively, more conveniently and, above all, more safely than ever before. Of course, the development of Convesaid also has other advantages for Team. Says Dr Wicks: “We’ve developed countless medical devices over the years, but much of what we do is confidential. So Convesaid is like a concept car for us, a non-confidential way to illustrate how we work and what device development actually looks like up close.”

Dr Wicks concludes: “In a nutshell, Convesaid illustrates how we care about all aspects of development, from the clever new technology and engineering to the user experience and industrialisation. “It’s how we work and how we think.”

**TEAM CONSULTING**

Team Consulting was officially formed in 1986 by five colleagues who had worked together at PA Consulting (Andy Fry, Perran Newman, Alan Goodman, John Targell and Peter Sharpe).

In 1997 the company decided to specialise in medical device development. Prior to this we had worked in a number of different sectors, but this focus gave us the opportunity to explore its potential developing products that could make a real difference to people’s lives.

Today, the company specialises in drug delivery in the respiratory and parenteral drug delivery sectors and medical devices. Its clients come to it to develop pioneering devices for new treatments, interventions and tools that often require innovative new technologies or manufacturing systems.
Pushing the boundaries of plastic bearing capability with design and material innovation

The first of three Q&A sessions with Mark Goldsmith, Engineering Director of BNL, describes how design development and material testing in a Knowledge Transfer Partnership, increased the operational capabilities of BNL’s plastic bearings.

**Q What were the aims of the project?**
We wanted to expand the temperature, impact and load capability for a new generation of bearings, to satisfy requirements of our key markets, such as Automotive. The challenge was increasing the operational capabilities of our bearings in keeping with our signature offering of integration, cost-down and added-value.

**Q What were your key achievements?**
We met our objectives and advanced our moulding techniques, also identifying thirty new materials that were validated in application.

**Q How has it improved your product offering?**
Our research emphasised the importance of the load element in plastic bearing operation, guiding future development of advanced design and moulding processes, to produce bearings that have higher load capabilities than previously thought possible.

BNL bearings are moulded for quality and endurance. Building on testing and characterisation of materials, we can manipulate the substrate layering of the materials to improve wear rate and create added value for our customers. The advantages of this layering is lost in the machining processes used by other manufacturers of polymer bearings.

Our most commonly used material is POM. Our studies provided a deeper understanding of its performance characteristics in a moulded bearing. New performance boundaries of load, speeds and temperatures have excited our customers. We are using all these findings to develop new products.

These new products will be discussed in the next issue, followed by a focus on BNL’s new Adaptive DC bearing range in the third and final Q&A.

Further info: https://bnl-bearing.com/capabilities-expertise/innovation
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TAKING THE PAIN OUT OF GLUCOSE MONITORING

A painless method for glucose monitoring has been miniaturised and it is now ready for obtaining medical certifications.

GlucoScanner, a non-invasive sensor for blood glucose levels, has been miniaturised. The device has been developed at the Tokyo laboratory of Dynamic Brain Labs and is the only device in the world that does not require the penetration of tissues or disposable parts. An integrated system of sensors, mobile apps and data services will enable global research of diabetes, aiming to further understanding and to prevent health-related crises.

“As soon as the prototypes are ready, we will evaluate our product’s performance in a clinical trial and test if it complies with consumer product quality and safety standards. At the same time, we will also start the necessary procedures to evaluate if our product complies with different medical standards,” explains Stefano Valenzi, the inventor of GlucoScanner.

So far, the biggest challenge has been to find companies able to customise existing technology into sensors specialised for the GlucoScanner prototype. Sensors already available on the market were not able to fulfil the quality requirements needed for GlucoScanner’s measurements. Dynamic Brain Labs has finally found a partner in Japan able to develop sensors of satisfactory sensitivity, quality and in a form factor needed for fabrication of the GlucoScanner. The production of samples has begun and will be followed by any necessary safety tests and certifications in September.

“After reviewing and improving the hardware for the production of a photoplethysmogram and employing uncommon infrared wavelengths with other physiological data, we have also developed our personal approach and created an innovative method to collect and evaluate data. Thanks to our innovative technologies and experience with modern data analysis methods, GlucoScanner evaluation of blood glucose levels is extremely accurate. To the best of my knowledge, GlucoScanner shows higher accuracy than any other non-invasive optical device. Our prototypes were so far tested in the range of ~80mg up to 530mg/dL.

“Dynamic Brain Labs has already performed two experiments with the general public, inviting over 100 subjects in the Tokyo area. The first experiment took place in June 2017 with our third-generation prototype. The 3rd generation is the last prototype assembled manually in our labs, each with custom 3D printed finger cuff”, says Valenzi.

GlucoScanner will be a revolutionary product for the millions of people daily struggling with diabetes: the device is painless and cuts the cost of disposable products. Lowering the expenses of this procedure will mean that people, who until now could not afford the test strip method, could become able to monitor their blood glucose, and potentially live a better life.

Monitoring blood glucose is necessary to control body weight, to optimise work out activities, and finally to help people age in a healthier body and with a healthier mind. The device in fact, was intended not only for people with diabetes, but also for athletes, pregnant women, hospital patients and everyone who wants to live a healthier life.

The next step will be the launch to market, following further study in a Japanese hospital, aimed at evaluating the performance of the new GlucoScanner and obtaining medical certifications.
Industrial automation supplier Comau has unveiled MATE, its first innovative wearable exoskeleton. MATE has been designed to improve work quality in an efficient and highly ergonomic manner by providing consistent and advanced movement assistance during repetitive as well as daily tasks.

The MATE Fit for Workers exoskeleton uses an advanced spring-based passive structure and is claimed to deliver lightweight, breathable and highly effective postural support without the need for batteries, motors or other failure-prone devices. In other words, the mechanism poses no risk of battery or motor failure simply because the system does not use them.

It is also compact and ergonomically designed thanks to the partnership between Comau, ÖSSUR, a leading non-invasive orthopedics company, and IUVO, a spin-off from The BioRobotics Institute (Scuola Superiore Sant’Anna) that specialises in wearable technologies. MATE is fully able to replicate any movement of the shoulder while adhering to the body like a ‘second skin’.

MATE was designed in close collaboration with factory workers engaged in manual activities, which has aided greatly in the development of a naturally comfortable, breathable postural structure. The compact structure also fully follows the movements of the upper limb without resistance or misalignment.

Ultimately, the real benefit of these developments is that workers will enjoy a reduction of shoulder muscle activity for some muscles of up to 50%, meaning that they will be able to perform the same tasks with less fatigue. Consistent, ergonomically-assisted movement support also serves to increase the quality and precision of repetitive tasks, meaning users can improve their quality of work while reducing the risk of injury.

Tobias Daniel, vice president robotics and automation products global sales & marketing, commented: “For Comau, this is an extraordinary opportunity to reach a global market that, according to the IFR, grew more than 60% from 2015 to 2017 and is estimated to continue growing at a rate of 25% each year until 2020. We believe that the industrial sector will represent about one third of the exoskeleton’s applications.”

Reflecting Comau’s vision and commitment to innovative, open and easy-to-use technologies, MATE is an important part in the company’s HUMANufacturing Technology strategy, a concept in which people are protagonists within the smart factory together with cutting-edge, digital tools, enabling technologies and ‘intelligent’ industrial robotics within a networked production system.

MATE is the first of a series of wearable robotics that Comau is developing and commercialising in partnership with IUVO and Össur. A fundamental aspect of the collaboration is the joint desire to progress and evolve human-machine collaboration within diverse sectors, including biomedical, manufacturing and consumer. MATE was designed and developed at the Comau HUMANufacturing Innovation Center in Pontedera (Pisa), Italy.
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NEW FASTENERS
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Innovations in fastening technology broaden the options of design engineers and are in turn producing a number of new opportunities.

A number of recent mechanical fastening and joining developments are creating new design opportunities for a variety of applications.

For instance, a new earthing stud is allowing leading automotive OEMs to achieve the triple benefits of reduced installation time and cost, guaranteed electrical earthing and a substantial reduction in part count all at once.

Developed to keep pace with the materials mixes now prevalent in advanced vehicle manufacturing, the new KSB earthing stud from Profil has already allowed several automotive OEMs to reduce the number of earthing points on top-selling vehicles from thirty down to twenty-two. But this 25% saving on parts (and associated installation costs) is only part of the story.

Because the stud is self-piercing, manufacturers are also seeing significant cost savings by doing away with the need for the expensive additional processes involved in either welding studs into place or having to drill holes and then bolt them on. Also, with material thicknesses being continually reduced in the quest for weight saving, an added advantage cited by those now enjoying all the benefits of the Profil earthing stud is that the risk of deformation in the parent material – always high with welded studs – has also been eliminated through the use of a cleaner, better mounting and installation method.

Specified worldwide by some of the biggest brands, including Porsche, Mercedes-Benz, BMW and Jaguar Land Rover, Profil’s earthing stud has proven to be ideal for fitting at the body-in-white (BIW) stage, because it is installed complete. Its flanged construction also provides a total seal against paint or other material ingress or bleed through. When the vehicle then progresses from BIW to the electrical installation process, it is a quick and simple task to remove the integral nut on each Profil earthing stud, offer up the required cable shoes to the pair of completely clean faces and then torque it down for a guaranteed earth across the lifetime of the vehicle.

KSB earthing studs are available in two versions and can be used in both steel and aluminium construction, with material thicknesses ranging from just 0.7mm right up to 4mm. Profil recommends that OEMs embrace a galvanic coating on the studs where possible. All KSB earthing studs can be installed either manually for short-run or prototyping purposes, or by bespoke, fully automated installation equipment designed and installed by skilled Profil engineers direct into production lines.

POLYMERS
Moving away from metal, however, igus has expanded its range of leadscrew nuts with the material iglidur E7 for trapezoidal and high helix leadscrews. This is characterised by its smooth and low-vibration operation with low loads and high speed.

“In everyday life, linear drives can be found everywhere, from camera slides to train doors, wherever precise adjustment is required,” says Robert Dumayne, dry-tech director at igus. “Leadscrew units traditionally consist of two components: the leadscrew and the associated nut. At high adjustment speeds, leadscrew nuts made of standard plastics or metallic alternatives often reach their design limits. The consequences of which are unwelcome vibration and noise.”
For this reason, igus has added the material iglidur E7 to its range of leadscrew nuts for high helix and trapezoidal lead screws. The nuts are designed specifically for high-speed applications with low loads and small installation space. Typical application examples include fully automatic coffee machines, 3D printers or even in laboratory technology.

In comparison to other leadscrew nut materials, iglidur E7 is a high-performance polymer that is self-lubricating and therefore maintenance free. The softer material reduces noise while at the same time acts as a vibration-dampening device.

The in-house wear comparison test between iglidur E7 and the igus standard material revealed that this new material offers superior performance. The iglidur E7 leadscrew nut at 135 rpm and a load of 100 N has four times higher wear resistance on a high helix leadscrew and 19 times better wear resistance on a trapezoidal leadscrew. With matching materials and geometries, the new leadscrew nuts and the patented igus dryspin high helix thread technology provide the optimum linear drive.

Another non-metal fastening solution, Fitsco Industries’ recently unveiled LiteFit plastic inserts (see picture, right) have been attracting interest from a number of medical device manufacturers, according to the company. Launched just a few months ago, the LiteFit threaded insert is a patent-pending new product, made in the UK from a type of plastic originally developed for aerospace applications in the US. Among other attributes, the material is stated to be of “exceptional hardness”, says Fitsco CEO Philip Schofield, and offers design engineers the further advantages of lightness, durability and resistance to corrosion.

However, it isn’t these attributes that has attracted attention from the medical market. For example, recent enquiries concerned both the manufacture of MRI scanners and also the patients being studied within them. In the latter case, the fact that the scanner can ‘see through’ the new Fitsco plastic inserts attracted interest because of their potential for use ‘in or on body’ applications in a variety of medical devices. A concurrent benefit, this time for the manufacturers of the scanners themselves, is the non-magnetic properties of the LiteFit material. This is seen as a key advantage in an application environment, where the reduction of metal parts is of special value.

Magnetic Resonance Imaging (MRI) scanners provide medical staff with outstanding visual presentations of the chosen sections of the human body that is being examined, but the details provided can sometimes lack absolute clarity, due to a number of factors. In computed tomography (as in CT scanners), these variations are referred to as ‘artefacts’, a term applied to any systematic discrepancy between the CT numbers in the reconstructed image and the true attenuation coefficients of the object being studied. CT images are stated to be inherently more prone to these artefacts than conventional radiographs, because the image is reconstructed from somewhere in the region of a million independent measurements.

There are said to be a number of causal factors behind the presence of these artefacts in scans, two of which are patient-based. One of them results from patient movement during the scan itself and the other is due to the presence of metallic materials or objects in or on the body of the patient being scanned. The fact that these medical scanners and x-ray devices can ‘see through’ the plastic LiteFit threaded inserts is thus cited by Fitsco as a significant advantage to medical device designers and manufacturers. Additionally, for prosthetics or ‘in body’ devices, using LiteFit threaded inserts also obviates concerns about the potential material deterioration or degradation that may occur with metal inserts.
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“With the close collaboration between Autodesk and AWS, customers will be enabled to design and produce highly innovative products which outpace existing design.”

AIRBUS AND LIGHTNING MOTORCYCLES have already invested in generative design to develop products that are higher-performing, lighter, or require fewer parts than their predecessors.

“The power of the cloud is a key enabler to bring generative design technology to designers and engineers in a fast and cost-effective way,” says Josef Waltl, Global Industrial Software Segment Lead at AWS. “With the close collaboration between Autodesk and AWS, customers will be enabled to design and produce highly innovative products which outpace existing design in economic and environmental dimensions.”

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London Autodesk University revealed some new approaches and design successes.

Held in June, the London Autodesk University featured the announcement that the CAD giant was teaming up with Amazon Web Services (AWS) to offer 1,000 new Fusion 360 Ultimate subscribers additional cloud credits to get started with new design technology.

This move is designed to promote generative design, a new technology that uses cloud computing and artificial intelligence to accelerate design exploration beyond what is currently possible. By working with AWS, Autodesk hopes to offer even more compute power to the first 1,000 new subscribers who want to get started with generative design. The programme began on 1st July and is available to new annual subscribers of Fusion 360 Ultimate, ending on 30th September or as soon as 1,000 new subscriptions have been claimed.

With AWS, Autodesk has long been working toward providing solutions that leverage the broad connectivity and raw computing power of the cloud. Generative design is the latest technology to join its lineup of cloud-powered manufacturing tools. Designers and engineers can use it to quickly generate a set of high-performance design options based on their specific constraints (like materials, weight, or manufacturing methods). The cloud allows for rapid exploration of dozens or even hundreds of possible solutions in the design space. Engineers can then consider and judge between the different options that best meet their needs. Customers like GM, Airbus and Lightning Motorcycles have already invested in generative design to develop products that are higher-performing, lighter, or require fewer parts than their predecessors.

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cloud-based environment. To perform generative design studies, users can apply cloud credits (1 cloud credit=$1) to run the service in the cloud without disruption or delay. Every subscriber already receives 1,000 cloud credits with their Fusion 360 Ultimate subscription.

Fusion 360 Ultimate subscribers can use cloud credits to perform generative design studies (25 cloud credits), explore options, and download their chosen design (100 cloud credits). Customers who take part in this offer will be able to complete several design studies with their 1,500 credits.

One of the first customers to take advantage of this offer will be Aim93. The project, led by bike designer Mike Burrows and fellow engineers Barney Townsend and Glen Thompson from London South Bank University, Aim93 is on a mission to make the fastest human powered vehicle (HPV) – a recumbent bike designed to break the world’s land speed record by reaching 93mph over a 200m sprint. Numerous design challenges are involved—the frame must be lightweight yet stiff, while the drivetrain and components need to operate with minimal friction. “Fusion 360 has filled a gap that addresses all of our primary modeling needs, making our workflow massively easier, pleasurable and more efficient. The arrival of generative design elevates the potential for innovation in our outcomes to a whole new level,” says Townsend. “We’re really excited about the early results we’ve had so far with generative design and we’re confident that with some further refinement to the model and the inputs, we can achieve our goal of a super-lightweight, highly stiff frame that will enable us to break the world record.’’

To achieve this, they’re relying on decades of experience and the latest digital design and simulation tools from Autodesk, a team sponsor.

For context, how fast can a person typically go in a vehicle operated under their own power? Most people on a conventional bicycle can easily get to 10mph on flat terrain. Competitive cyclists can hit speeds of 25–30mph without too much trouble.

When most people think of cycling, whether that’s a trip to the park or the Tour de France, they think of what are called ‘upright’ frames, in which the rider is perched above the two wheels. This design has the advantage of enabling good visibility as well as allowing riders to use their own mass to drive the pedals, which is why most people stand to pedal uphill. But when it comes to achieving maximum speed, uprights have a big flaw: the rider produces a large profile, which causes significant drag.

Uprights are still used in competitive cycling because the sport is so highly regulated—innovation is purposely restricted to promote competition. They want to ensure that the riders are being tested in a race, not the equipment. In the world of HPVs, though, the rider is secondary to the vehicle, and innovation is not only tolerated, it’s expected—in many ways, innovation is the main event.

It’s rare to see an upright bike at an HPV competition. Instead you’ll see recumbent bikes because their aerodynamic profile is so much more streamlined. And the fastest vehicles are fully encased in farings that further reduce drag. You certainly won’t get any wind in your hair riding these machines, but it’s hard to argue with the results: velocities that exceed highway speed limits reached just by pedalling.

To make the Aim93 frame, Burrows used his normal approach: the design started on a large drafting board in the gantry office above his workshop; it then progressed through various lash-up prototypes to a track-ready frame design built by hand by wrapping carbon fiber around foam cores.

Thompson, meanwhile, got busy on the faring.
High performance Rings & Springs for automotive applications

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using a much more digital approach; he took the published data for the record holder at the time, Varna, and ran Computational Fluid Dynamics (CFD) simulations on it, then started making iterative changes to achieve aerodynamic improvements.

“Aerodynamics of HPVs is a unique field because they have the lowest extreme of drag forces for any human based vehicle (the fastest production cars at 93mph have 80 times more aerodynamic drag),” says Thompson. “Setting up a CFD model needs highly detailed settings to arrive at reliable data. The software tends to underestimate forces, and for many HPV teams in the past, the move from CFD to road test data has led to disappointing results. I have always tried to work to the most pessimistic interpretation of the digital simulation. Autodesk’s StephenHooper announces the collaboration with AWS on-stage at Autodesk University

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Fusion 360 does a great job of combining—fusing—elements of different software in one package. And the fact that it’s available free to all students means that my students can use it in their start-ups after they graduate.”

“I started out by defining the loads that the frame would be subjected to, and blocking out the areas that were off-limits, such as the space for the rider, wheels, and chain set, and the outer boundary limitation of the aerodynamic shell,” says Townsend. “Basically, once the software knows the spatial and load conditions it must work within, it fills this with material and then nibbles away at it, continuously analysing the internal stresses to remove as much mass as possible without going below the specified safety factor for the structure to do its job. It then presents the designer with a series of outcomes from which to make a decision. “Fusion 360 does a great job of combining – fusing – elements of different software in one package,” Townsend says. “And the fact that it’s available free to all students, as well as to companies with less than US$100,000 in revenue means that not only can I teach it in my university classes, my students can use it in their start-ups after they graduate.” He says that it has even changed the way he reviews student work, since students can share their models with him via web browser.

The big race comes at Battle Mountain, Nevada in September, sponsored by the International Human Powered Vehicle Association. There, the Aim93 team wants to set the new record for speed, period. On a uniquely flat and straight section of Nevada highway, they’ll have five miles to get the vehicle up to top speed, which will then be measured for 200m. So far, the 90mph mark has proved elusive for HPVs but the Aim93 team thinks they can beat that significantly: “All our simulations show that we should be able to hit 93,” says Townsend.
Q What has been the traditional area for the usage of ECO products?
Because PP has been the largest waste stream for recycled plastic and still remains so, then traditionally we have seen applications such as wheel archliners, engine shields and boot trim being the main focus for recycled plastics. All these are large components, so potentially the ones with the largest cost saving. These components are suited to the waste stream that has been available in recent years, which was predominantly co-polymer PP/PE higher impact type, this coupled with the added benefit that they can be produced in black and surface finish does not have to be class A.

Q What are the future material trends?
One of the current trends in the automotive industry at the moment is light weighting to help reduce CO₂ emissions and increase fuel efficiency. This can be achieved - reducing the density of the material used by replacing traditional fillers (glass fibre and minerals) with lower density fillers such as CF. Albis's acquisition of WIPAG, and the subsequent investment to increase the capacity of our rCF production, has enabled Albis to explore this light weighting trend by replacing traditional PA GF and PAGF/MF polymers with rCF PA and in some cases even rCF PP. To gain the biggest benefits, the components need to be large, such as front end modules, pillar supports and crash beams. We have found during some initial project work we can achieve weight saving of between 15% and 20% or around 0.5kg in a 3kg part.

Q Are Automotive OEMs serious about increasing the recycled plastics content in cars, or is their R&D focus more on EVs and autonomous vehicles?
Albis are seeing that certain automotive OEM’s and their engineers are working hard to develop products with more recycled plastics content into their vehicles, this is happening alongside the EVs and autonomous vehicle developments. Albis are seeing greater acceptance of ECO products from material engineering departments and they are being used as replacement of more traditional prime products in a wider range of applications, some of which would have been unheard of even 5 years ago.

Q How is the end-user perception of plastics/polymer changing the recycling climate?
At the moment there is limited pressure by the buying public on the Automotive OEM’s, their main focus is on the packaging sector and the perceived damage that plastic packaging is doing to the planet. In future people’s attention may be diverted to the manufacturers of investment goods and more pressure will be brought to bear for the use of ECO materials in their products, but we are not near that position yet.

Q Do you think compounds with recycled plastic content are being accepted?
ECO material suppliers still have some ground to make up with component engineers, but our experiences here at Albis are that once we convert one component into using an ECO based material, and it is seen to be acceptable, then project/component engineers are more amiable to the idea of using ECO materials.

Q What does the future hold for the use of ECO polymers in the automotive sector?
With new legislation being introduced, the improvements seen recently in the paint removal and separation of current ELV plastic waste and the new acceptance of ECO products by an ever increasing number of project and component Engineers for new designs, the future looks very bright for the use of ECO products in the Automotive industry.

Tony Evans
Business Manager
Plastics have been a mainstay of product design for so long that the idea of living without them – or even reducing their use – is almost unthinkable. The advantages of plastic are clear: almost infinite adaptability in terms of shape; lightweight; durability; and aesthetic finish. However, the problems are increasingly clear as well.

In January, the government launched its 25-year environment plan, which aims to eliminate all ‘avoidable plastic waste’ by the end of 2042. To help achieve this goal, carrier bag charges were extended to all retailers in England, and government is working with supermarkets to encourage plastic-free aisles in supermarkets.

The TV series Blue Planet II also served to highlight the fatal impact plastics can have on sea creatures and how degraded plastic has made its way into the human food chain. Needless to say, this has led to a wider backlash against plastics. The public is increasingly bombarded with the message that disposable plastics are at best undesirable and at worst actively unethical.

Clearly, this places design engineers in something of a bind. Pressure is already being exerted on companies to abandon non-recyclable plastics in their products, which means that briefs are reaching design engineers that reflect this.

To address this situation, the British Plastics Federation (BPF) has launched ‘Plastics: A Vision for a Circular Economy’ — a document outlining a range of key proposals intended to drive innovation in the plastics sector and improve UK recycling rates. The headline measures announced by the BPF are part of a new industry vision to ensure 100% of plastic packaging and single-use items are reused, recycled or recovered by 2030.

To help achieve these aims, the plastics industry has already proposed extending and revising the current Packaging Recovery Note (PRN) system. The BPF believes that the current PRN system should be extended to include plastic items that are not packaging products but are products used in conjunction with food and drink consumed ‘on the go’, such as cutlery or straws.

However, revisions to the current system need to support the development of the UK’s recycling infrastructure. Evidence suggests that collaborative work is also needed to deliver anti-littering, behaviour-change and educational campaigns to maximise recycling and stop plastic entering the marine environment.

The document also explains how the plastics industry wants to help deliver a streamlined recycling system, simplifying communication and eliminating confusion for the consumer. Evidence suggests that adopting consistent collection schemes by all councils throughout the UK (both kerbside and ‘on the go’) would be a major step forwards.

The BPF will also consult its members with the aim of agreeing a traffic light system and best practice design tools. It is hoped that this will encourage brands and retailers to make the best decisions when designing their products.

Philip Law, director-general of the BPF, said: “Plastic waste is an urgent issue and all of us have a shared responsibility to do something about it. As an industry, we want to play our part in reducing plastic waste so we leave the environment in a better place for generations to come.”

The current backlash against plastics is raising some serious ethical, commercial and technical issues for design engineers.
WS2 are both prone to galling and seizing. WS2 is a very low friction dry lubricant surface treatment, developed by NASA for use in deep space. It has been shown to provide a very cost effective solution, preventing both problems on threads and other sliding surfaces. WS2 works well from -273° to 450°C and down to 10-14 Torr. WS2 has been applied to bearings and gears to extend life. Design Out maintenance problems with WS2!

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Being a cyclist can be fraught with danger. Not only must you be ever vigilant of drivers who either ignore you at junctions or don’t give enough room when they pass by on the road, and pedestrians glued to their phones stepping off the pavement because they couldn’t hear you coming, there are also those that think that stealing your bike to make a quick buck is somehow acceptable.

We’ve all heard stories, seen videos or know someone who has had their bike stolen. Even if the bicycle in question has been – seemingly securely – locked to a purpose-built bike rack, stand or dock, thieves use bolt-cutters or specialist cutting equipment to make away with their quarry.

Also, from a cyclist’s point of view, bike locks themselves clearly aren’t cut out for the job. Too thin and feeble looking and they’re a target, too bulky and they’re a pain to carry around either in a bag or wrapped around the frame, getting in the way and ruining your aerodynamics (if you’re in shape enough to worry about such things).

THE CHALLENGE
This month’s challenge therefore is to design a thief-proof bike lock that is also easy to carry around. Perhaps your design will feature a super-strong materials innovation, maybe an upgrade to the general bicycle parking infrastructure is needed, or it could be some sort of fastening or adhesive challenge. Either way, it must be compact, lightweight and impossible to break.

The idea we have in mind will be revealed in the September 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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Join the UK’s leading design engineers and tomorrow’s rising stars as we unveil the winners of the 2018 British Engineering Excellence Awards

Where
e.c. venues County Hall, London

When
4th October 2018, 11.30am

What
Drinks reception followed by a 3-course lunch

Host
Dr Kevin Fong, writer, broadcaster and qualified doctor

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