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March 2020

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FIRST TOUCH

THE LIFE-CHANGING EFFECT OF BIONIC PROSTHETICS

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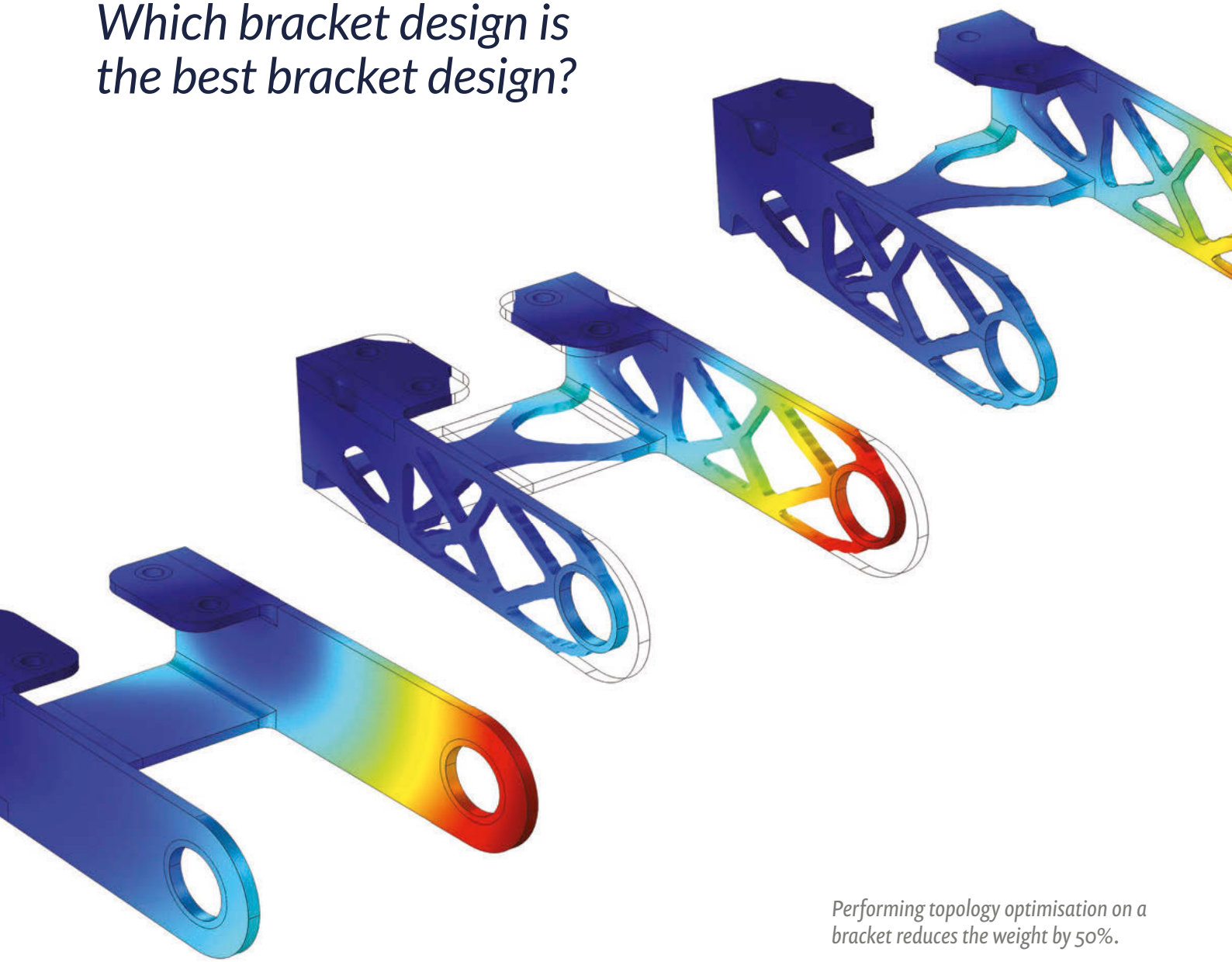

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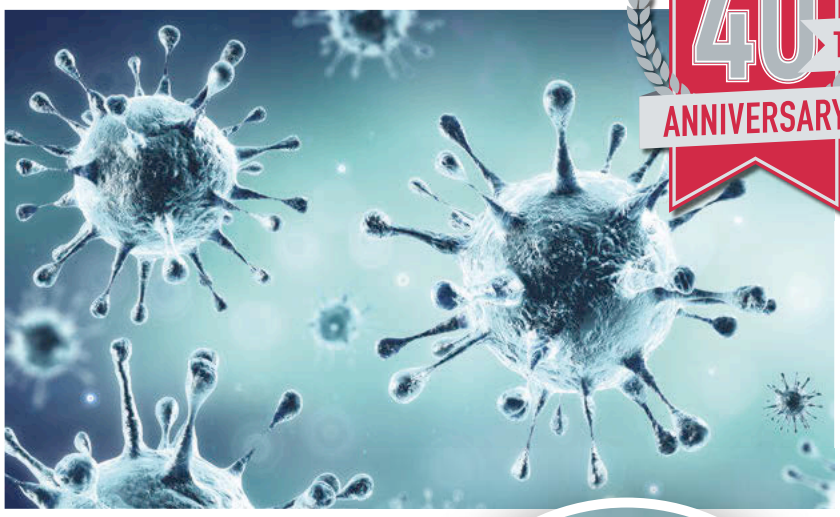

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CHINA CRISIS?

WHEN ASKED WHAT Prime Ministers most feared, Harold Wilson is apocryphally said to have answered "Events, dear boy. Events."

This sentiment does not just extend to Prime Ministers, of course. Events do have a nasty habit of ruining carefully-crafted plans or punishing unwarrented optimism.

2019 has thus far proved a case in point.No sooner has one uncertainty been removed than we are assailed by others. Undoubtedly the most serious of those so far has been the Coronavirus outbreak.

In the last few weeks, the effect of this virus has been felt not just in China, but across the globe. And while its health implications are clearly the most serious factor, its economic and industrial impacts cannot be ignored.

On February 13, for instance, JCB announced it was cutting production and working hoursin the UK due to a shortage of components from China due to the outbreak. This came about because 25% of JCB's suppliers in China are closed because of the disease.

Sadly, this is far from being an isoltated example. Nissan also warned that it might shut one of its factories as it can't get parts from China. T Fiat Chrysler said the impact of the coronavirus epidemic could halt production at one of its European car plants within four weeks.

Meanwhile, the world's largest mobile phone showcase, Mobile World Congress (MWC), has been cancelled over coronavirus concerns, organisers have confirmed.

These disruptions are a direct (some might say inevitable) consequence of extended global supply chains that it could be argued are over-reliant on China. This is a strategy that could be coming back to haunt global manufacturers.

In the short term, of course, there is little that can be done to mitigate these problems. What will be interesting, however, is to see whether in the longer term, this crisis affects thinking on component sourcing .

Paul Fanning, Editor

MISSION STATEMENT

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Eureka! connects design engineers with the UK's industrial heartbeat by providing in-depth coverage on the very latest technology developments and industry trends; keeping you inspired, informed and innovative.

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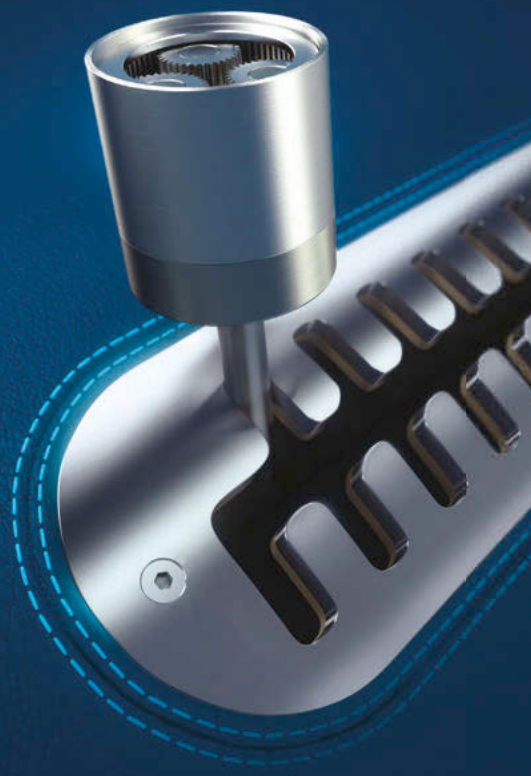

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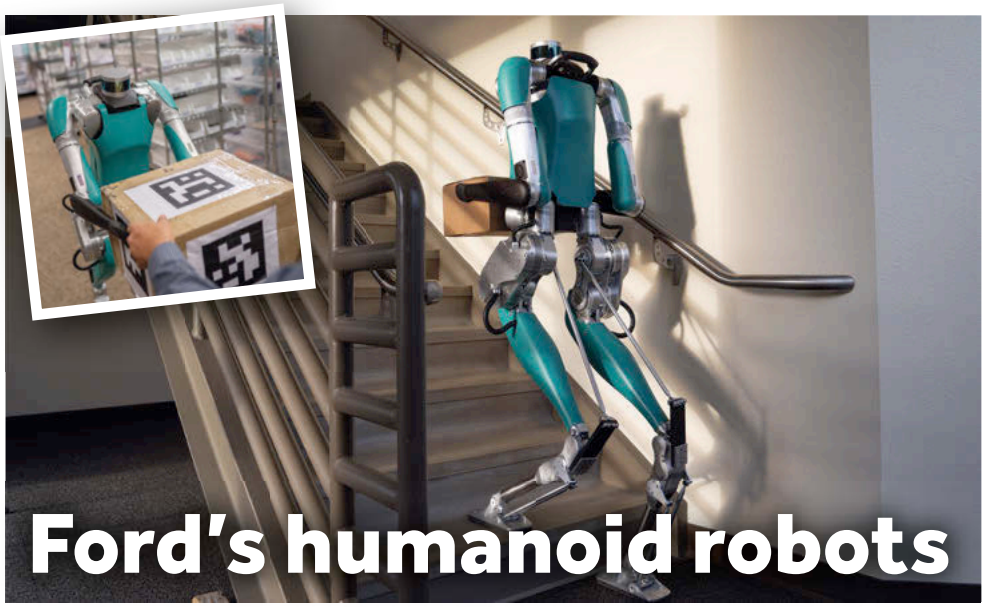

Ford's humanoid robots

AGILITY ROBOTICS HAS launched Digit, a robot with arms and legs that will work with humans. Ford Motor Company has become the first customer, receiving the first two robots off the line to explore ways to help businesses make warehousing and delivery more efficient and affordable for their customers.

The research will also focus on how Ford's commercial vehicles and Digit "talk" to each other and their surroundings through advanced connectivity technologies. For example, Ford's connected vehicles can continually update cloud-based maps that can be shared with Digit, so it doesn't have to recreate the same type of information.

Ken Washington, vice president and CTO, Ford Research and Advanced Engineering, said: "As online retailing continues growing, we believe robots will help our commercial customers build stronger businesses by making deliveries more efficient and affordable for all of us."

Since the first Digit prototype was shown in May 2019, Agility Robotics has tested it extensively, refined the design, and added features to be ready for production and sale to customers. Upgrades and improvements include more advanced feet that allow Digit to balance on one foot or carefully navigate obstacles, new sensors to perceive and map the world for robot navigation, and customer-ready, powerful onboard computer hardware.

POWERFUL MID-RANGE 3D PRINTER

STRATASYS HAS UNVEILED the J826 3D Printer. At about half the price of other J8-series PolyJet printers, the J826 combines part realism and productivity, including full PANTONE-Validated colour and multi-material 3D printing.

The J826 is particularly suited for enterprises with mid-volume modelling requirements in industries such as consumer goods and electronics, automotive, and educational institutions.

Shamir Shoham, vice president, PolyJet Business Unit at Stratasys, said: "We believe that exceptional resolution, full colour, multiple materials, and high productivity should not be the province of the few."

Built as a mid-range full-colour 3D printer for enterprise shops, the J826 supports the full design process with same day send-to-print and easy post-processing. It provides the same resolution and detail as other Stratasys J8-series 3D printers, with models matching the shape, material, colour and finish of final products.

The J826 3D printer leverages the same high-performance PolyJet materials as the J850, meeting the needs of both designers and design engineers. It includes the full range of textures, transparency with VeroUltraClear, and PANTONE Validated color1. Fully supported by GrabCAD Print software, it enables a smooth import of common CAD formats.

The J826 is expected to be available to order in May 2020.

SOLUTION TO LAST MONTH'S
COFFEE TIME CHALLENGE

Last month we challenged you to come up with a better, safer and easy to use quick release system for the lifejackets of sailors. Our solution is the Harness Release System (HRS) from British marine design and manufacturer, Spinlock.

Attached to the lifejacket itself, the HRS is a discreet but easy to locate two-stage release handle which with a short pull opens the soft loop harness connection.

As well as the focus on user simplicity the HRS is a surprisingly detailed piece of design engineering. It works by combining a rotating stainless-steel lock and release pin in a moulded locking system all within a small space envelope. This interacts with a lifejacket harness attachment loop made from Dyneema, which is 15 times stronger than steel, light enough to float on water and low in friction, that allows the HRS pin to release with an easy but positive action.

Few concepts get the chance to be put through a test bed of 3 million cumulative miles in the most gruelling ocean-going challenge in the world, but Spinlock was so convinced that integrating a HRS into a lifejacket would work, that it successfully presented the idea of including it in the design of the custom lifejackets for each of the 70 crew taking part in the elite Volvo Ocean Race, forming a focus group for discussion and quickly developing a brief for the Volvo Ocean Race Deckvest.

The lessons learned from this toughest of environments allowed Spinlock to create a production HRS for other lifejackets in its range and reduce its complexity, bulk and cost.

First multiplatform VR haptic glove

SMART FABRIC SENSOR technology company, BeBop Sensors has announced the Forte Data Glove, claimed to be the first VR haptic glove integrated and exclusively designed for Oculus Quest, Oculus Link, Oculus Rift S, Microsoft Windows Mixed Reality, HTC Vive Cosmos, HTC Vive Pro, HTC Focus Plus, and Varjo VR headset technology.

Targeted to enterprise, as well as Location Based Entertainment gaming markets, the one-size-fits-all Forte Data Glove provides true real-time haptic feedback that lets users 'feel' textures and surfaces and move digital objects around as if they existed in real life. Applications include VR enterprise training, VR medical trials/rehabilitation, robotics and drone control, VR CAD design and review, and gaming.

With an under 6 millisecond response time and all-day battery life, the gloves feature a comfortable design that fits almost everyone.

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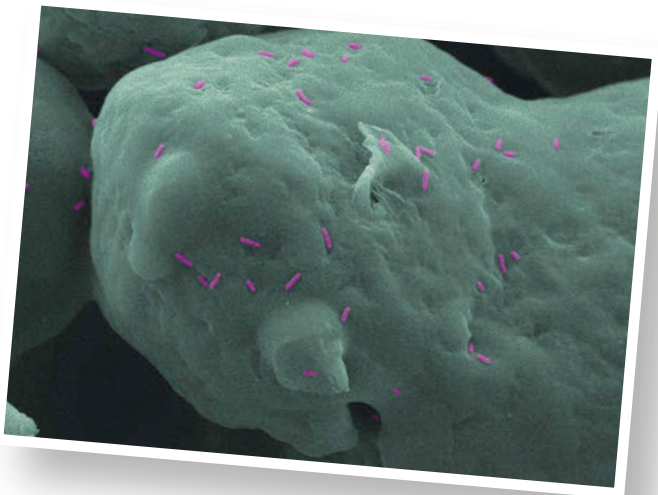


3D PRINTED PARTS KILL BACTERIA

RESEARCHERS FROM THE University of Sheffield have manufactured 3D printed parts that show resistance to common bacteria. This could stop the spread of infections such as MRSA in hospitals and care homes.

The research combined 3D printing with a silver-based antibacterial compound. Results have shown that the anti-bacterial compound can be successfully incorporated into existing 3D printing materials without any negative influence on processability or part strength, and that under the right conditions, the resultant parts demonstrate anti-bacterial properties without being toxic to human cells. Further work is ongoing to investigate the full extent of this capability.

The compound is suitable for applications including medical devices, general parts for hospitals which are subject to high levels of human contact, door handles or children's toys, oral health products (dentures) and consumer products, such as mobile phone cases. Further projects are planned in each of these areas, with an aim to work with leaders in industry and the potential to bring some of these products to market.

Dr Candice Majewski, lead academic on the project, said: "Managing the spread of harmful bacteria, infection and the increasing resistance to antibiotics is a global concern. Introducing antibacterial protection to products and devices at the point of manufacture could be an essential tool in this fight."

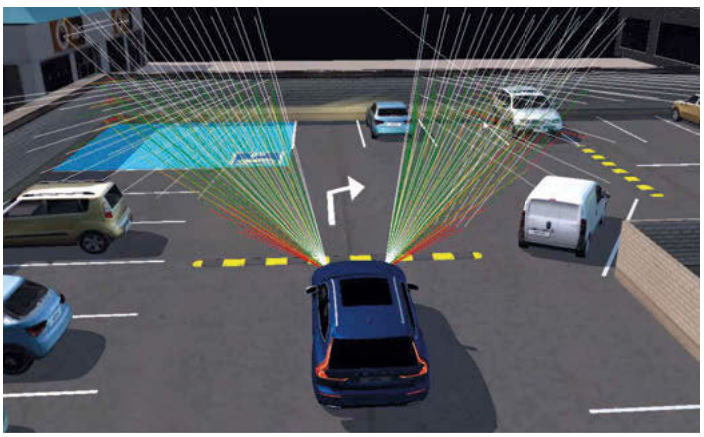
Enhancing autonomous vehicle safety

FLIR SYSTEMS AND ANSYS are collaborating to improve hazard detection capabilities for assisted driving and autonomous vehicles (AVs) — which could increase safety. FLIR Systems will integrate a fully physics-based thermal sensor into ANSYS' driving simulator to model, test, and validate thermal camera designs within an ultra-realistic virtual world.

Paul Clayton, general manager at FLIR Systems, said: "Enabling engineers, automakers and auto suppliers to rapidly simulate and test countless scenarios greatly reduces reliance on physical prototype testing while cutting development costs and the time required to test. This results in increasing the adoption of thermal technology in automotive safety to help save lives and livelihoods."

Current AV and advanced driver assistance systems (ADAS) sensors cannot dependably identify objects in darkness and through smog, inclement weather, shadows and sun glare. Thermal cameras, however, can effectively detect and classify objects in these conditions.

Eric Bantegnie, vice president and general manager at ANSYS, added: "FLIR Systems' automotive thermal cameras enhance the safety and reliability of ADAS, creating smarter AVs that improve decision making in challenging road environments."



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LIFE-CHANGING TECHNOLOGY

A new, 3D-printed bionic hand from a Bristol-based company is allowing an amputee to bond with his young son for the first time.

For 21 years, Danny Florence has lived with one hand. But when he became a father, he decided to apply for an Open Bionics Hero Arm. With the help of this state-of-the-art prosthesis he can now build a strong bond with his son.

At the age of five, Danny Florence lost both legs, a hand and most of his fingers. "I remember always being outside on my bike or my rollerblades and one day my ankle started hurting. I went to bed and during the night began to hallucinate and my body started spasming," Danny had contracted meningitis.

Danny was put into an induced coma and doesn't remember anything until he woke some eight weeks later. During that time doctors had to amputate his limbs to save his life. He had to learn how to talk and drink again and get used to the pain. When he became aware he had lost his legs his first thought was that he wouldn't be able to ride his bike again.

Danny explains, "Mum took me to the hospital every day for two years to have physiotherapy as part of my rehabilitation. The doctors gave me basic leg prosthetics after three months and, after a while, I learnt to walk with them. These days I use a powered wheelchair as I can't walk far. I didn't do anything about my lack of a hand until I reached eleven or twelve and became self-conscious about it."

Unfortunately, the hospital could only offer two options; a body-powered prosthetic with a gripper or a 'mannequin-like' hand with no functionality. After a couple of days wearing the heavy passive prosthesis, Danny decided to stop using it. "It looked worse than not having a hand," he said.

"I've always managed well with

only one hand but when my son Joshua came along ten months ago, I realised how much more I could do with two.'' Danny, and his partner Danielle, had anticipated having issues with dexterous tasks like nappy changing and getting the baby dressed, but Danny hadn't realised how much not doing these things would affect the bond with his son.

Danny had heard of a company called Open Bionics. The Bristol-based company is a multi-award-winning designer and manufacturer of affordable prosthetic limbs and is responsible for producing the world's first medically certified 3D-printed bionic arm.

Bristol-based Open Robotics was founded by 2014 British Engineering Excellence Awards winner Joel Gibbard and Samantha Payne. The company is committed to developing affordable robotic systems that enhance the human body. According to the company, the main areas where it has been able to innovate to achieve savings are cost; weight; size; style and control.

The Hero Arm represents the latest stage in this process. It is the world's first medically certified 3D-printed bionic arm, with multi-grip functionality and empowering aesthetics. Engineered and manufactured in Bristol, UK, the Hero Arm is a lightweight and affordable myoelectric prosthesis, available now in the USA, UK and France for below elbow amputee adults and children over eight.

Each Hero Arm is custom built using 3D printing and 3D scanning technologies. The prosthesis is robust, and the socket is comfortable, adjustable and breathable too, which means it's easy to take on and off while providing the user with the best possible fit.

Even though the Hero Arm is powered by space grade motors, advanced software and long-lasting batteries, it is lightweight and super sleek. The hand, which comes in three sizes, is the lightest on the market. They are also very strong, being able to lift up to 8 kg (17.64 lbs).

Special sensors within the Hero Arm detect muscle movements, meaning users can effortlessly control their bionic hand with intuitive life-like precision. Also, haptic vibrations, beepers, buttons and lights provide intuitive notifications.

Open Bionics has worked with global DC drive manufacturer maxon since its inception in 2015. maxon designed and produced the actuator for the digits in the Hero Arm – each finger uses a maxon DCX 12 L motor. The actuator consists of a DC motor driving a customised gearbox and lead screw and nut, developed for the speed of each user.

As muscles generate electrical signals when they contract, they create movement when connected to the electrodes in the prosthetic. Adult hands use four DC motors and, as they are so much smaller, a child's hand uses only three. As space is limited, Open Bionics chose maxon's DCX 12mm as it is the most compact DC motor with the highest power density on the market. The company was also able to get samples quickly delivered by using the maxon online Configurator.

Although Open Bionics offer Hero Arms in various designs, including ones from Disney, Danny has opted to go for the sleek black cover to match his legs. ''When I was younger, I was given skin-coloured tights and padding to make my legs look 'real', but they snagged a lot and it wasn't practical. I used to park in the disabled bays and get abuse from people not realising I didn't have any legs, now I »

» wear shorts all the time and don't get any abuse.

"These days prosthetic designs look much better and all my nieces and nephews think I'm bionic!" Danny admits being terrified at how Joshua is going to react to his new hand. "He loves my prosthetic legs. He gets all excited and laughs when I put them on and likes to touch them."

Danny has two hopes for his new hand; he wants to make the bond stronger between him and his son and, importantly, wants to increase the publicity for the hand itself.

"This technology should be offered to everyone. This is life-changing, not only for the obvious physical side but mentally as well. People who lose limbs can get very depressed, struggling with the ongoing pain and mourning the life they had before. They can even contemplate suicide. This hand has such huge benefits, it should be available on the National Health Service and I want to help the cause to make that happen."

Danny had a socket fitting in November. The suitability of myoelectric control is determined by the fit between the stump and the prosthetic. Danny was surprised when he tried the arm for the first time, as he was able to work it straight away, even though it was using muscles that he hadn't used for 21 years.

"I wanted to get a Hero Arm a few years ago, but I decided at the time that I managed ok. But then, when I had my little boy, I realised there was a lot I couldn't do, and that led me to actually do something about it"

Danny said "I've been very excited and it's better than I imagined. Seeing the arm, you get an overwhelming sense when you first see it. I then got to try it on and, like magic, I got it to work pretty much straight away. It's amazing. It's very smart. Previously I've had a very ugly static hand, and this is a very nice-looking hand."

As well as being nice-looking, the hand offers a range of features and functionality. These include a posable wrist that can be rotated through 180 degrees; a posable thumb capable of picking up tiny objects; multiple easy-to-select grips giving great user control that can be reconfigured to the user's preferences by their prosthetist; and a freeze mode that allows the hand to be held in a static position for no fuss, reliable grip such as when holding a glass.

Proportional control of the speed of the fingers allows for delicate tasks such as picking up an egg, while the arm's long battery life gives all-day usage without needing to plug in and charge.

Bionic arms such as the Hero Arm work by picking up myoelectric signals from a user's muscles. When a user puts on their bionic arm and flexes muscles in their residual limb just below their elbow; special sensors detect tiny naturally generated electric signals and convert these into intuitive and proportional bionic hand movement. The Arm has up to six different grips, and these are grouped in pairs to make switching between them quick and easy.

Danny explains "I wanted to get a Hero Arm a few years ago, but I decided at the time that I managed OK. But then, when I had my little boy, I realised there was a lot I couldn't do, and that led me to actually do something about it. I started a Go Fund Me page. Many, many companies raised money - and many individuals - and for that, I'm always going to be grateful. Eventually, maxon got in touch and advised that they were going to sponsor it. That call was surreal. I'll never forget it."

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AVOIDING PRODUCT DEVELOPMENT PITFALLS

Jeremy Carey, senior consultant and Alan Hart, head of business development at 42 Technology highlight the common traps that design engineers and entrepreneurs face when developing products.

It's a common refrain amongst successful entrepreneurs that had they known how difficult the journey would be, they might never have embarked upon it. And it's usually said to help embolden those starting out on their own journey. Although many of an entrepreneur's best life lessons are probably learned from making mistakes, that does not mean expensive errors should be embraced.

Spotting problems early and better understanding the challenges ahead are crucial in staying on track and limiting the cost and consequences when things don't turn out as planned. 42 Technology has helped many start-ups to develop their first products and has seen them frequently confronting similar challenges on the way. This article considers seven of the most common pitfalls with suggestions for avoiding them.

FAILING TO BALANCE MVP WITH THE LONGER TERM

Today's entrepreneurial best practice is focused on developing a Minimum Viable Product (MVP) that can be sold to a small group of price-insensitive early adopters, who are desperate for the product. MVP is an invaluable philosophy for de-risking a project as it forces a focus on a genuine 'pain point' and helps to create first generation products, delivering early revenues. But it does not provide a robust business case for the longer term.

Early adopters might have niche requirements, different from the mass-market, and can be a distraction for entrepreneurs, leading to product over-complication. MVP should therefore be coupled to an evolving view of how the market requirements will differ when sales are ten (or a thousand) times higher.

ABOUT THE AUTHORS

Jeremy Carey, senior consultant at 42 Technology

Alan Hart, head of business development at 42 Technology

FAILING TO UNDERSTAND HOW MARKET STRUCTURES AFFECT SALES

Apocryphal or not, the phrase 'Build a better mousetrap and the world will beat a path to your door' may be some of the worst possible advice to the budding product developer.

Even the most promising new products can fail to sell as expected if they are presented in a way that is impossible for customers to buy. For example: a paradigm-changing product in a standards-driven industry may need buy-in up and down the value chain before it will sell; larger corporations typically find it difficult to buy from SMEs; or some markets want service, while others want product. Entrepreneurs need to understand the structures of their target markets and how they can best fit into the existing value-net.

PLANNING AN UNBALANCED DEVELOPMENT

Many entrepreneurs focus on the aspects of entrepreneurship they are most familiar with, assuming other areas are somehow simpler or can be tackled later.

But bringing a product to commercial success almost always involves multiple risks and challenges. A laser-like focus on one area, for example on theoretical modelling, building first prototypes or branding, will solve problems and generate interesting results but, without balanced risk reduction, the overall threat to a profitable business is likely to be dominated by the issues being ignored.

THE BOOTSTRAP/EQUITY CHASM

Entrepreneurs walk a fine line between raising enough capital to progress a development, while retaining sufficient ownership to make the endeavour worthwhile. And squaring away these constraints can be particularly challenging in early funding rounds.

Securing a sufficiently high


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valuation when an entrepreneur might have little to show can be tough. Consequently, start-ups often have to compromise by over-promising the upside to investors or understating the total likely investment required. This ultimately harms the entrepreneur's reputation when the team is 'found out' and can lead to a dreaded 'down round' or even prevent follow-on investments.

As an alternative, founders frequently try to advance their developments before taking investment; but without proper resources, progress can be glacial. Or, they scale down their dreams to make the pre-money process of 'pulling themselves up by their own bootstraps' more viable.

For some projects there is no simple way to cross this chasm and it may be better to opt for an early investor that is not focused on immediate financial return: family, friends, philanthropists, university incubators, or government.

NOT IDENTIFYING/ MANAGING ALL THE UNCERTAINTIES

Most entrepreneurs who have raised public funding (for example through Innovate UK) will have prepared a 'risk register' but in an R&D context it is usually more helpful to consider 'uncertainties'. In other words, examining what it is that you just do not know yet.

A well-deployed uncertainty register equips the entrepreneur to pilot the optimum development route, to identify skills and experience gaps within the team, and to decide where best to focus scarce resources. The register should consider all uncertainties on the road to commercial success, including expectations on what stage of the development each uncertainty will be resolved, by whom, and how.

FAILING TO PLAN FOR CHANGE

Even if an entrepreneur has carefully determined their MVP and has a good idea of who will buy their product, why and how, a focus on the highest priorities can sometimes cause product features to be deferred to later product versions when, with hindsight, they would have saved time and money overall.

For example, the need for 'over the air' (OTA) software updates is often seen as functionality that can be deferred to help save short-term development cost. However, incorporating the flexibility of an OTA update capability can greatly increase the resilience of the R&D programme to solve some of the (almost) inevitable unexpected behavioural issues that can occur with a system's early firmware releases.

It is worth investing in some light-touch product roadmapping and 'platform thinking' to ensure the initial launch product/MVP can be evolved rather than binned for subsequent release generations.

Spotting problems early and better understanding the challenges ahead are crucial in staying on track and limiting the cost and consequences when things don't turn out as planned.

NOT THINKING THROUGH PRODUCTION RAMP-UP

Most developments follow a progressive scale-up in production volumes: from a handful of prototype units through to higher volume manufacturing.

The bill of materials cost is usually relatively unimportant when the mission is to build a single proof of concept unit, but it becomes critical when you want to sell a million units for $20 each. Most design for manufacture stages tend to focus on manufacturing larger volumes at the lowest possible marginal cost, with the tooling investment spread across high volume production. But the budgets required either for a fully tooled product or to scale up the processes used for prototype manufacturing are likely to be prohibitive at the intermediate volumes needed for field trials or year one production. If the business plan calls for a few hundred or thousand units at reasonable cost, then this needs to be carefully planned and budgeted for.

We hope the ideas discussed above will be useful and will help even the more experienced entrepreneur to navigate around the inevitable hurdles and roadblocks on their road to commercial success. Good luck!

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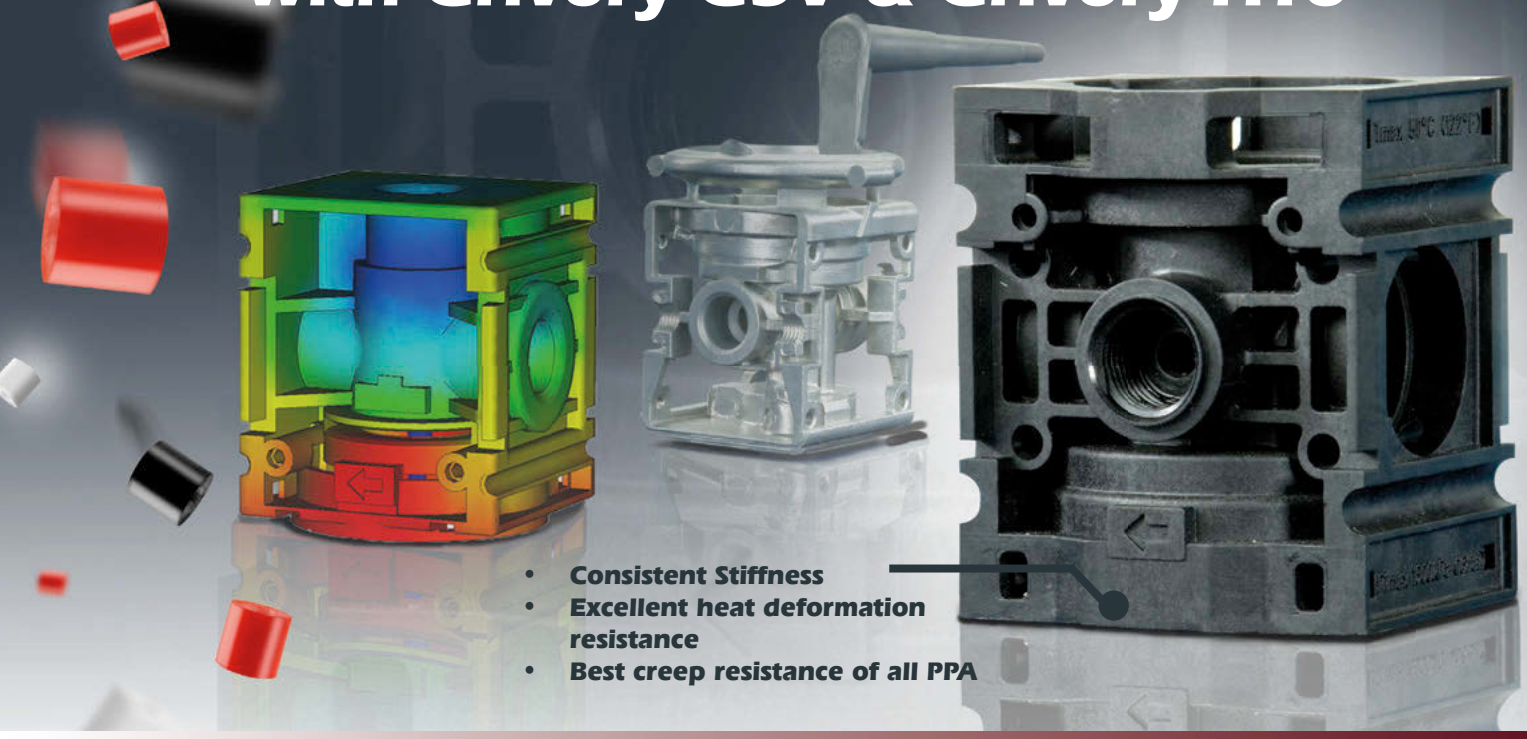

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3D PRINTING HITS NEW HEIGHTS

The importance of additive manufacturing is growing in the aerospace industry. Here, Scott Sevcik, VP Aerospace Business Segment at Stratasys looks at some of the current trends and developments.

The ability of AM to produce complex geometries not possible with conventional production methods using lightweight materials, while enabling high levels of customisation, work in symmetry with the needs of aerospace manufacturers, who continually strive to achieve faster speeds and utilise complex part designs to increase efficiency.

While AM is still viewed as a relatively young industry, both aerospace OEMs and aircraft interior OEMs have actually been leveraging the most common additive manufacturing technology, Fused Deposition Modelling (FDM), for the better part of 30 years for prototyping. Fast forward a few decades and today the portfolio of FDM materials is expanding to meet the stringent requirements necessary to make interior aircraft parts flightworthy, while the level of repeatability achievable by high-performance systems enables production of parts with consistent performance.

One of the greatest challenges faced by aerospace manufacturers looking to 3D print flight-ready parts is of course certification. While this and material performance have been barriers to wider adoption in the past, huge progress has been made in recent years in material development and specific solutions for aerospace.

There are now a number of aerospace-grade materials that comply with the traceability standards outlined by regulatory agencies. For example, Stratasys certification grade filament based on ULTEM 9085 resin is FST (flame, smoke and toxicity) compliant, which was key to achieving Airbus material certification. Another example is Antero 800NA material, which is based on the highly chemical resistant PEKK thermoplastic, making it appropriate for those parts of the aircraft exposed to fuel or hydraulic fluid.

Having materials that meet the required properties of in-flight applications is essential, but production technologies also need to be trusted. »

» Part of building this trust is demonstrating a level of repeatability that can provide the basis for industry standards. Repeatable performance simplifies qualification and enables the development of process specifications that can be certified as easily as a more traditionally produced part.

To further increase accessibility, we have identified the need for a product specification and qualification data available in the public domain that meets the expected standards of the aerospace industry. For aircraft interiors, we have worked closely with America Makes, the US Air Force, the National Institute of Aviation Research, and the FAA (Federation of Aviation Administration) to produce the Aircraft Interior Solution (AIS). This package provides customers with all the information necessary to manufacture parts with ULTEM 9085 resin that will perform with highly consistent results.

While certification is crucial, having the capacity to produce high performance thermoplastic parts that can be fully characterised and trusted to have consistent mechanical and geometric properties is also vital. If a lightweight 3D printed thermoplastic part can perform in the most demanding and rigorous applications like a traditionally manufactured counterpart would with its additive benefits of design freedom and supply chain flexibility, it's easy to see why aircraft manufacturers are increasing their use of FDM technology within the production process.

These are just some of the developments that underscore the exciting turning point that the industry is at right now – where the technical maturity of FDM machines and materials is enabling aerospace manufacturers to move beyond prototyping and tooling applications and into the production of certifiable production parts at a scale rapidly increasing year on year. Indeed, there are already tens of thousands of interior aircraft parts flying today that have been produced using FDM.

AM is already having a significant impact in use cases where retrofitting or reducing manufacturing lead times are a priority. When we look at the needs of the industry today, the benefits of AM are not just felt in prototyping or concept vehicles, but in changing the economics of part production.

Above: Some of the aerospace parts produced by additive manufacturing
Below:Scott Sevcik

Traditional inventory and part production can be time and cost intensive, and what we frequently see in the industry is stockpiling of 20 years' worth of spares when a part goes out of mass production in order to avoid the expenses of retrofitting. AM can lead to a much more efficient approach, with the digitisation of spare parts allowing much greater flexibility for operators.

This is because, rather than design decisions being based around complicated manufacturing processes or the limitations of tooling, AM parts can be designed optimally for their end use and result in a more efficient aftermarket at the same time.

For example, BOOM Supersonic uses a variety of Stratasys FDM equipment, including an F900 3D Printer with the Stratasys Aircraft Interiors Solution, for the design and production of its XB-1 test vehicle. The XB-1 is intended to lead the way to Overture, the world's first new commercial supersonic aircraft since Concorde. BOOM is utilising AM to produce dozens of prototypes, tools, simulator components, and parts for the XB-1, significantly accelerating the development process.

The flexibility of AM's high-performance, low-volume manufacturing also allows the creation of complex shapes without the geometric restrictions of tooling and moulds, opening up in-cabin applications that can really differentiate customer experiences. As lower-volume production becomes more economically viable, manufacturers can create customised parts that are intended for specific classes within aircraft.

For instance, customers can print their branding and logos on aircraft components or integrate unique decorative features, giving each airline or aircraft personality. Where previously we've seen this done in some VIP private vehicles, this can now be cost effectively applied to commercial aircraft. This personalisation can even benefit pilots: China Eastern Airlines printed a common mount for their electronic flight bags so pilots can mount their tablet the same way regardless of aircraft.

Some of these applications are quite complex. Diehl Aviation recently utilised FDM technology to produce a curtain header – an enclosure that sits above the curtain rail separating classes onboard. Traditionally the enclosure was constructed using several layers of laminated fibreglass and required specialised aluminium tooling, which was time-consuming and costly. Diehl was able to assemble this part from 12 3D-printed thermoplastic components, drastically reducing the tooling costs and saving hours of workforce time. This piece is actually the largest fully 3D-printed passenger aircraft part ever produced and is being line-fit into A350s.

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SENSORS OFFER NUCLEAR OPTIONS

A 2D laser profile sensor is being used by the Nuclear Advanced Manufacturing and Research Centre (Nuclear AMRC) in a project to develop a smart robotic grinding/deburring solution for welded components.

Coroma is a robotic system development and integration project to automate a variety of manufacturing tasks. Most of these tasks are secondary finishing operations (e.g. grinding, sanding, deburring, etc.) which are typically carried out manually on welded components such as nuclear fuel racks and tube structures.

As Ozan Gurdal, research engineer at Nuclear AMRC states: ''Manual finishing can take tens of hours of cycle time, as well as being a health and safety issue. The idea of the Coroma Project was to use robots to automate these processes with sensor and software assistance and to demonstrate the work on full-scale demonstrators provided by the use case owner companies.''

Nuclear AMRC's involvement in the project was to develop a smart robotic grinding/deburring solution for welded components. The use case owner was Equipos Nucleares SA, a nuclear fabricator from Spain. Gurdal adds: ''We developed an integrated end-effector for the robot with a Micro-Epsilon 2910-100 BL laser profile sensor on one end and a pneumatic spindle on the other – to eliminate the need to use a tool changing system, which would stand out as an expensive item.''

''It is not possible to use the part's design CAD model when it comes to programming robots for weld grinding or conditioning as there is a significant [sufficient to affect robot paths] difference between the design and actual [as-welded] part because distortion and/or warpage is inevitable after welding and so exact weld sizes are unknown. Therefore, the 3D CAD model of the as-welded part is required to programme paths accurately,'' explains Gurdal.

The scanCONTROL 2910-100_BL laser sensor held by the end effector is used to scan the areas of interest in the part, which are welded joints »

The sensor is equipped with a Gigabit Ethernet interface for transferring profile data, as well as a multi-purpose connector for RS422, encoder input triggering, Digital In (HTL/TTL), power supply and synchronisation

» and planar surfaces used for reference. The sensor provides the axial and lateral distance (2D) measurements between the scanned object and sensor frame, which is not sufficient for reconstruction. Therefore, the 2D data obtained from the laser sensor is combined with the position of the robot flange, which is read in real-time from the robot controller using a LabVIEW-based central controller. Combining these two, the central controller generates the 3D reconstruction of the as-welded part as a point-cloud and converts it into the desired CAD format.

"The 3D CAD model of the as-welded part is then used to generate grinding/deburring paths either offline [using CAM or robot path programming software] or online using in-house developed path generation algorithms. Once path generation has been completed, the grinding or deburring operation begins," states Gurdal. The robot used for this work was a six-axis Staubli TX200, as Staubli was one of the partners on the project.

The scanCONTROL 2910-100_BL is a compact, high performance laser profile sensor (laser line scanner) with integrated electronics that makes it ideally suited to robot mounting. It operates using blue (violet) laser technology rather than red, especially useful for measuring against shiny metallic structures or difficult-to-measure surfaces. The sensor projects a wide laser line from 58mm to 143mm over the object with a profile resolution of 1280 measuring points. The measuring range in the z-axis is from 100mm to 290mm, which gives useful flexibility for the robot positioning.

The sensor is equipped with a Gigabit Ethernet interface for transferring profile data, as well as a multi-purpose connector for RS422, encoder input triggering, Digital In (HTL/TTL), power supply and synchronisation. The sensors support Power-over-Ethernet (PoE), which means they can be operated with only one cable, thus simplifying installation even further. nsor and a PLC.

"The scanCONTROL laser sensor is a good piece of kit. We've successfully used the sensor in multiple projects, for example, weld monitoring and weld grinding. The integration was straightforward too. There are a variety of APIs/software tools provided by Micro-Epsilon for integration with different software platforms and programming languages such as LabVIEW and C++, so it was really a plug-and-play set up without much hassle which saved precious time for us. We've also been very happy with the technical support provided by Micro-Epsilon when we've needed this," concludes Gurdal.

NUCLEAR AMRC

The Nuclear Advanced Manufacturing Research Centre helps UK manufacturers win work across the nuclear sector – in new build, operations and decommissioning – and in other quality-critical industries. Its facilities and services are open to all.

It is led by its industrial members, but companies don't have to be members to take advantage of its capabilities and expertise. Its manufacturing innovation capabilities and supply chain development services are open to all UK manufacturers, from specialist SMEs to top-tier OEMs.

Its engineers and sector specialists work with companies to develop innovative techniques and optimised processes for large-scale high-precision manufacturing. Companies can use its state-of-the-art workshops to develop and test new processes on production-scale machines, without losing capacity in their own factories.

It also provides a range of supply chain development support to help manufacturers enter the nuclear market and compete worldwide. The Fit For Nuclear programme is a unique diagnostic tool which lets you measure your operations against industry requirements and take steps to close any gaps.

The Nuclear AMRC is backed by industry leaders and government and owned by the University of Sheffield. Its research factory at the Advanced Manufacturing Park in South Yorkshire forms part of a world-leading innovation cluster alongside the AMRC, Castings Technology International and AMRC Training Centre.

It also operates a modularisation R&D facility in Birkenhead, and the new Nuclear AMRC Midlands in Derby. Its applied manufacturing research is underpinned by the nuclear and materials technology expertise of The University of Manchester Dalton Nuclear Institute.

It is part of the High Value Manufacturing Catapult, an alliance of seven leading manufacturing research centres backed by Innovate UK. This allows it to tap into a national network of manufacturing research excellence – if a particular technology falls outside the Nuclear AMRC's areas of expertise, it can call on other Catapult partners for the support needed.


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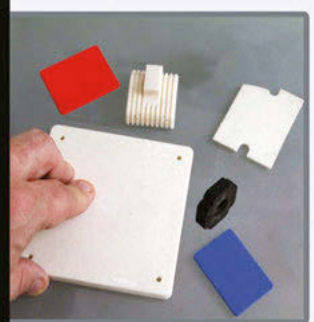

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5 WAYS TO IMPROVE ROI

Bosch Rexroth's industry sector manager, Paul Streatfield, gives his top five ways to improve ROI on industrial drive technology.

Industry 4.0, smart manufacturing, factory of the future - call it what you will, the evolution of manufacturing is underway, at least for some UK manufacturers. Across the country, businesses vary drastically in their adoption of these smart technologies. Some have been embracing digitalisation for years, with forward-thinking factories harnessing technology to automate processes or gather and analyse data to improve production, while others are watching from the side lines, yet to take the leap.

Yet if you read about smart manufacturing or factories of the future, promises of greater productivity, quality and efficiency are commonplace. So, why are manufacturers yet to fully embrace the new dawn of connected manufacturing? For many, the answer lies in the cost – or the perceived cost – of digitalisation. The initial investment in smart technology can be enough to put many manufacturers off making the move to a smarter way of working, but the benefits of real-time quality check, continuous improvement and equipment maintenance will undoubtedly lead to cost savings and productivity improvements.

Let's explore some of the benefits of investing in smart drive technology.

1 MANUFACTURING AGILITY: GET PRODUCTS TO MARKET, FAST

In the past, improvements to any manufacturing facility were carried out on the basis that they would improve the efficiency, quality and effectiveness of either the manufacturing process or the product itself. However, customer demands are changing, and the manufacturing industry and technology is being forced to adapt to keep up. More and more often, products need to be produced in small, highly customised batches, putting pressure on businesses to reduce their time-to-market and adapt to changes in demand. To do so, businesses need to invest in technology that gives them the flexibility to adapt quickly to fulfil demand.

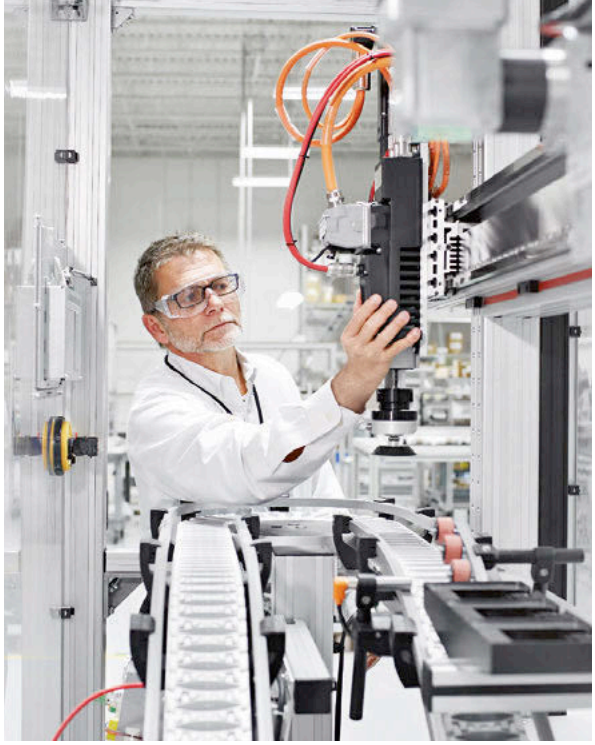
In older, less agile manufacturing environments, changes in production processes required an investment in new technology and resulted in significant downtime while a changeover was implemented. In today's world, critical drive and control technology can be configured at a digital level rather than a physical one, enabling manufacturing facilities to support customisation of products and meet customer demand in a far quicker and more cost-effective way without significant downtime.

An additional 'Smart Energy Mode' on the power supply evens out the surges in power demand reducing the peak loads of the machine. This added energy efficiency helps to realise energy savings of up to 50%

2 AN INVESTMENT IN ENERGY EFFICIENT TECHNOLOGY

Reducing carbon footprint, saving the world or making cost-savings by reducing energy bills? Whatever your motivation, investing in systems that reduce energy usage is a win-win situation.

By moving to cabinet-free drive technology, users can actively reduce energy consumption in several ways. Until recently drive technology has been designed in such a way that drives and »



» related wiring were enclosed within a cabinet. To avoid overheating, fans or AC units had to be used to cool the high temperatures within the enclosure. With cabinet-free drive technology, the cooling hardware – and the energy required to run it – becomes completely redundant.

The system also features energetic coupling via the hybrid cable – at a basic level, this means it can generate energy which can be put back into the system. If, for example, one drive brakes, the energy created by the brakes can now be used to power another drive within the machine. An additional 'Smart Energy Mode' on the power supply evens out the surges in power demand reducing the peak loads of the machine. This added energy efficiency helps to realise energy savings of up to 50%.

3 OPEN CORE: A NEW ERA IN AUTOMATION PROGRAMMING

As with all manufacturing processes, machine manufacturers often look for ways to speed up time-consuming tasks and shorten delivery times. Bosch Rexroth's IndraDrive technology features Sequential Motion Control (SMC) - a function which reduces users' programming and commissioning time by up to 90% compared to PLC programming.

Using open-core software engineering opens new opportunities – both by enhancing processes by creating bespoke software tools and by tapping into a whole new skillset. High level software languages, or even standard PC packages such as Excel, can be used to produce common data collection programs that are run at the IT level, and not at the machine PLC level.

As well as making it far simpler and faster to collate production data from several machines without the need for time-consuming PLC coding on each individual machine, open core helps to bridge the skills gap by opening systems up to a range of programming languages. The result is increased flexibility and a quicker time to market – saving time and money in the process.

Additional efficiencies can also be realised out-of-the-box. Using a series of pre-defined commands stored in a function library, users can easily achieve a range of common functions – from positioning axis, master and slave axes couplings, synchronous axis operation, cam profile applications and sequential movements. With no need for an external motion control system, hardware costs are reduced, and system integration is simplified. The result is a far faster turnaround and an increase in ROI.

4 REDUCE DOWNTIME USING MACHINE DIAGNOSTICS

Another hot topic – and one anyone in manufacturing is aware of – predictive maintenance. While there has been a definite shift in recent years, many facilities are still trying to reduce the impact of downtime by repairing equipment before strictly necessary. The cabinet free drive technology we provide at Bosch Rexroth can collect and record data such as vibration, temperature, torque, position and speed via the motor and the decentrally-wired sensors. This data is collected, stored and analysed in order to detect issues before they result in failure. In doing so, manufacturing facilities can avoid unplanned downtime, or even complete shutdown of equipment, all of which can have a catastrophic impact on the company's bottom line.

The benefits of real-time quality check, continuous improvement and equipment maintenance will undoubtedly lead to cost savings and productivity improvements.

5 REDUCE INITIAL OUTLAY WITH SIMPLE INSTALLATION

Intelligent system design can reduce both the cost of the initial components and the installation time itself. Rexroth's IndraDrive Mi technology allows machinery manufacturers to relocate their complete drive technology – including mains connectivity – from the control cabinet directly into the machine itself. As a result of this clever design, the system uses 90% less wiring – reducing hardware costs and installation time. By using cabinet free drive technology – which essentially combines drive electronics and motor technology into a single unit – the system uses less hardware and takes up less space on the shop floor.

IN CONCLUSION: OUTLAY VS ROI

While ROI can be a way of building a solid business case for investment in technology – including the cost savings associated with faster turnaround, easier programming and reduction in downtime – it focusses purely on what happens after an investment has taken place. What it fails to consider is the business impact of not making the investment at all. Changes in consumer demand, a requirement for a fast turnaround and increased personalisation have resulted in a huge shift in the way companies operate. Businesses that fail to invest are running the risk of being unable to meet demand and falling behind competitors. When it comes to ROI, there can't be a much stronger argument for investment.

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DEMOCRATISING SIMULATION WITH APPLICATIONS

Simulation applications (and the ability to distribute them) benefit organisations by making modelling accessible to a wider range of engineers, colleagues and customers.

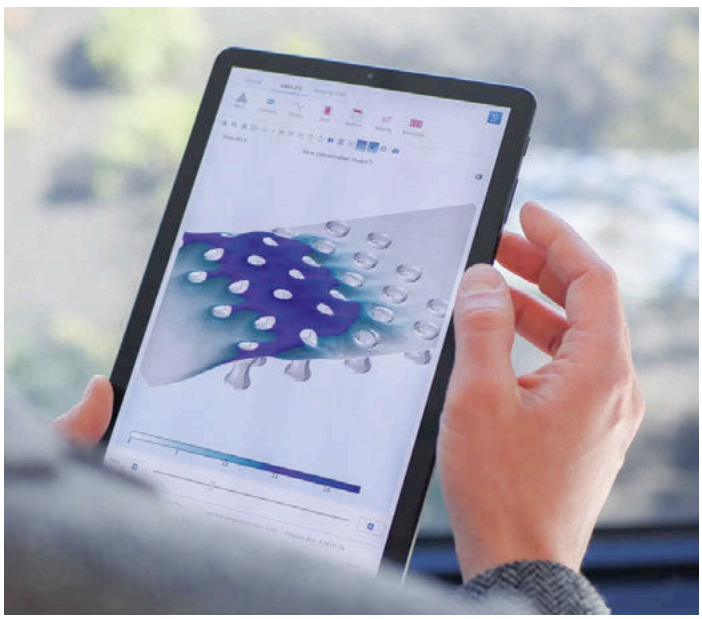
Simulation is a powerful tool that enables users to save time and money by studying physics phenomena within designs to predict operating conditions before prototyping. However, computational modelling is often left to the simulation specialist, which can limit resources and production within a company. While other team members may not be experts in simulation, their insights can be invaluable to research, design and manufacturing processes.

Extending the reach of multiphysics simulation enables companies to get higher-quality products to market faster and cheaper than by developing iteration after iteration of a prototype. By creating and distributing simulation applications, specialists can include nonexperts in simulation in the process, demystifying it and breaking down barriers within an organisation so that there is more room for collaboration, prediction of outcomes, innovation, and optimisation.

At Veryst Engineering, AltaSim Technologies and GLL Bio-Med Analytics, building and distributing applications helps make their customers' design workflows more efficient.

APPLICATION DEVELOPMENT AND DISTRIBUTION MADE EASY

Applications enable anyone to test parameters and run repeated analyses without a simulation specialist. This larger group of customers or colleagues without engineering backgrounds can make quick, informed decisions with confidence. This way, teams can work together more effectively.



Users can access applications via COMSOL Server™ and run them on a web browser or client.

To get an overview of the workflow from model to application, a simulation expert will start by creating a model in COMSOL Multiphysics®. Then, the expert can use the Application Builder in COMSOL Multiphysics to turn the model into an application. Applications can be created in minutes using drag-and-drop functionality. The result is a specialised interface with restricted inputs and outputs, so that the end user focuses only on the parameters pertinent to their work.

"The application development process itself is very easy and user friendly," says Nagi Elabbasi from Veryst Engineering, a consulting firm that offers simulation expertise to customers. He added that applications have a lot of functionality and for Veryst, they are also a good marketing tool. As Elabbasi explained, "In the applications, you have access to extensive Java® functionality," which means that Veryst can link applications to their material library, the PolyUMod® Library, allowing for even more advanced application development to share with their customers.

To give collaborators access to applications, there are two methods: compiling standalone executable files or distributing them via an application management tool. As the name implies, COMSOL Compiler™ is used for creating compiled applications that can be run without a COMSOL® software license on Windows®, Linux® or macOS. COMSOL Server™ is the choice for those who want to upload and manage applications for their organisation and let their application users run simulations via web browser or client (see image left).

PRESENTING SIMULATION APPLICATIONS AS CUSTOMER SOLUTIONS

The ways in which consultants use simulation applications with their customers varies. For instance, GLL has received positive feedback from their customers about how applications allow even those without a physics background to run analyses. "You can see a light going on in their head," says Gary Long of GLL, "when they realise they can produce their own simulations and results."

Sometimes, a customer realises the possibilities opened up by applications after working with a model developed for them. In Veryst's experience, customers will "realise how the model is useful to them, want to use it internally and then they see how an application can help them do that," says Elabbasi, adding that the more the awareness of applications spreads, the earlier

they will be able to introduce applications when working with customers.

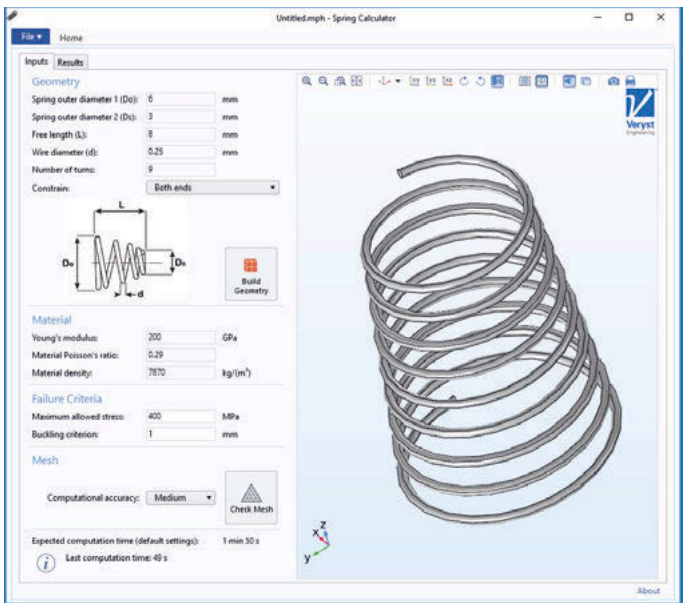
At AltaSim, applications come into play after learning more about what their customers need. "We go through a lot of discovery with our clients to understand what it is, exactly, that they're looking for," says Kyle Koppenhoefer of AltaSim, "and if we find some key parameters, then we typically suggest an application."

BUILDING SPECIALISED APPLICATIONS TO MEET A VARIETY OF CUSTOMER NEEDS

Even the most complex models can translate into easy-to-use interfaces (applications). Veryst's customers use applications to simulate design variations and perform parametric studies and sensitivity analyses, which "helps them focus on their core expertise of improving the product," says Elabbasi, "and not worry about the simulation settings." Some of Veryst's customers just use applications as interactive model viewers that enable them to visualise model results in 3D, including rotating the model, looking at results at different cross-sections or at different times and more (see above). That helps them better understand the model predictions.

Applications enable organisations' internal simulation experts to focus on more advanced modelling projects by distributing applications to other teams. Koppenhoefer says that applications give field engineers a better understanding of how their designs operate, so they are better able to make design decisions.

AltaSim assists with their customers' challenge of reducing rework. For example, variations in factors like temperature and flow rate make it difficult to accurately predict a device's real-world behaviour, leading to designs that have to be continuously reworked. This process can be greatly reduced with applications, because engineers from a range of specialties can run as many tests as they need, leading to increased productivity and revenue.



A spring calculator application. Image courtesy Veryst Engineering.

Many of GLL's customers are medical device startups that often perform their own experiments. GLL simulates these experiments to demonstrate the accuracy of modelling to their customers. "It's very powerful to see the [simulation] results and compare them to experimental results," says Long. They then build applications from the validated models to get simulation engineers, application users and other team members (often doctors) on the same page by visualising simulation results in real time.

GLL built a medical device application that simulates thermal and nonthermal tumor ablation. The application helps engineers design devices that ablate cancer cells, visualise ablation zones and even import MRI and CT scans for specific anatomies. The user interface for the application includes a menu so that users can easily choose a study. For instance, because the temperature and thermal necrotic zones are time dependent, users can specify a time at which they can see the damage due to the heat or temperature profile in the results. The application includes three inputs for parameters: thermal voltage, nonthermal voltage and electrode spacing. The current can be plotted via the experimental current so that users can easily validate the simulation.

COLLABORATION PROMOTES INNOVATION

As illustrated by these three simulation experts, the democratisation of applications is well underway. The Application Builder makes it simple to build a simulation application in as little as a few minutes, and COMSOL Server and COMSOL Compiler help bring the applications to the people. Through the democratisation of simulation, specialists, researchers, engineers and customers can develop and innovate by working together.

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WEN ZHANG
Managing Director
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COMSOL is a global provider of simulation software for product design, engineering and research in technical enterprises, labs and universities. COMSOL Multiphysics® is an integrated environment for creating physics-based models and simulation applications. Simulation experts use COMSOL Server™ and COMSOL Compiler™ to deploy applications to design teams and customers worldwide.

NEW FOR 2020

ENGINEERING SOLUTIONS LIVE

Taking place on 12th March at the British Motor Museum, Gaydon, Engineering Solutions Live is a new event that features some familiar names.

Engineering Solutions Live brings together four key engineering technology areas under one roof, in a one-day, easy-to attend-event. Those events are:

FAST LIVE
Featuring adhesives, joining technologies, bonding techniques and assembly solutions.

ENGINEERING MATERIALS LIVE
Showcasing lightweighting, materials selection, plastics, metals, alloys, 3D printing, prototyping.

PCB DESIGN & MANUFACTURING LIVE
The UK's only dedicated PCB design, manufacture and test event.

MAKE MEASUREMENT MATTER
Metrology, measurement and inspection technologies & services.

By bringing these events together under a single banner, Engineering Solutions Live builds on the power of established, successful exhibition brands, but also includes newer, complementary elements that offer time-poor engineers a broader and more valuable visiting experience.

Clearly, the range of exhibitors brought together by an event such as this is diverse and extensive, offering visitors a unique opportunity to meet suppliers and familiarise themselves with the latest products.

Some of the highlights of the exhibitors include FAST LIVE exhibitor Telsonic, which has been leading the way with light weight joining on the new Skoda Kamiq.

Rather than use mechanical fasteners, Skoda engineers reflected on the advantages offered by ultrasonic welding in a number of applications, and the result was that some key parts on the new model are joined using this process from Telsonic. Included amongst these are airflow components for the intake and thin-wall welding on

bumper reinforcement structures. The advantages of ultrasonic welding across all applications can be discussed on the Telsonic stand at FAST LIVE on March 12th.

New from Phoenix Mecano and available to discuss at the Engineering Materials Live event is a range of new, compact, monitor mounts from Rose+Krieger. Suitable for both monitors and other display devices, these new mounts have a length which has been shortened by 50mm compared to the standard mount, rendering them ideal for applications where space is at a premium.

The connection for the display devices is can be either via a universal plate or VESA mount, and users can choose between the VESA 50/75 (new) and VESA 75/100 option. Thanks to its design the new mount is said to provide a great degree of freedom, featuring variable fixing with half shells and reducing inserts (for round and square tubes) allowing installation on profiles and tubes with edge lengths or diameters of 20, 25 or 30mm.

Also exhibiting will be tesa, whose tesa 65605 is a multi-use residue-free removable double-sided foam adhesive tape that can be re-used up to five times. This newly developed product eliminates both adhesive and foam residue with a special PET reinforcement film which allows quick, easy and complete removal multiple times.

The arrival of this new multi-use tape follows the success of tesa 65610, launched in 2017 as a versatile, single-use double-sided adhesive foam tape providing high initial and ultimate bonding power even on critical substrates, together with excellent conformability that can even out surface imperfections when applied. The white tape, which has a thickness of 1.25mm, consists of five layers; a release liner (brown glassine paper), an initial layer of tackified acrylic adhesive, PET reinforcement film, PE foam backing and finally a second layer of tackified acrylic adhesive.

Engineering Materials Live exhibitor Goodfellow has introduced an ultra-pure 'green' graphene material, which is guaranteed metal-free and therefore uniquely suitable for use in metal-sensitive processes and applications.

The graphene is produced by means of a highly scalable process that involves breaking methane gas (CH_4), into hydrogen and elemental carbon atoms in a plasma reactor. The carbon atoms are then recombined into graphene sheets in the hydrogen atmosphere. Elapsed time from the methane gas entering the plasma reactor to the point when graphene is formed is quick - typically less than a second. The speed and cost effectiveness of this 'green' mass production method promises to make graphene readily available to a wide range of industries with a minimal impact on the environment.

Clearly, the range of exhibitors brought together by an event such as this is diverse and extensive, offering visitors a unique opportunity to meet suppliers and familiarise themselves with the latest products

The graphene nanoplatelets produced by this innovative process are very thin and slightly crumpled, and they do not stack (unlike exfoliated materials), thus ensuring optimal electrical, thermal and mechanical performance. These characteristics also make this easy-to-use product an extremely good nanofiller which is suitable for electronic inks, polymers, metal composites and coating.

Cambridge-based Goodfellow, has also recently introduced a new range of Perovskites, one of many advanced materials which can be discussed on the company's stand »

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Eureka! Engineering Materials newelectronics THE ENGINEER FAST MACHINERY

» at Engineering Materials Live on March 12th. Currently, Goodfellow researchers are focusing on the further development of these Perovskites, new-generation crystalline materials that are demonstrating great potential for optoelectronic and photonic applications.

Perovskites are a group of materials that have a unique, versatile lattice crystal structure. Due to this, they are characterised by special properties like superconductivity, magnetoresistance, piezoelectricity, dielectric and pyroelectric behaviours, and Goodfellow offers a wide range of Perovskites including $BaTiO_3$, $CaTiO_3$, $PbTiO_3$ in different forms such as powders or, alternatively, sputtering targets.

When Willenhall Rubber & Industrial Supplies identified a need to bond ply sheets of Fabreeka rubber together, it turned to a recently introduced new-generation high strength RTV silicone-based adhesive from FAST LIVE exhibitor Techsil.

RTV10533 is just one of Techsil's extensive portfolio of bonding products that have become popular across manufacturing industry, and this particular single-part adhesive is used in a wide range of applications, especially those involving textiles and rubbers.

Techsil states that RTV10533 has also become the product of choice for many users who seek to bond silicone coated fabrics. Although it can be used with a primer, many customers have found that this translucent, flowable adhesive will bond perfectly to bare surfaces that are well prepared and clean without a primer.

SEMINAR PROGRAMME

In addition to the show, Engineering Solutions Live offers a full programme of free-to-attend, CPD-accredited seminars. Here, industry experts will offer extensive insights into the latest technologies and applications for your market.

MATERIALS

9:00 AM - 9:40 AM

3D Printing in the electronics industry

Room 15/16

***James Short**, application engineer, Stratasys*

PCB

9:30 AM - 10:10 AM

Manage SI/PI, DFM, DFA and DFT in the Design Cycle to Prevent Costly Re-Spins

Lecture Room 1

***Andrew Windscheffel**, EMEA AE Director, Cadence Design Systems*

MATERIALS

9:30 AM - 10:10 AM

Plasma and Corona – What Will You Do with Plasma?

Lecture Room 2

***Chris Howey**, Managing Director, Tantec*

FASTENING & JOINING

9:30 AM - 10:10 AM

Achieve Your Productivity Potential with UV Light Curing Adhesives

Room: Lecture Room 3

***Peter Swanson**, Managing Director, INTERTRONICS*

MEASUREMENT

10:00 AM - 10:40 AM

Additive Manufacturing & Measurement

Room 15/16

***Peter Woolliams**, Higher Research Scientist, National Physical Laboratory*

PCB

10:30 AM - 11:10 AM

Why Thermal Simulation is a Must for Electronics Design?

Lecture Room 1

***Matt Evans**, Product Engineer, 6SigmaET by Future Facilities*

MATERIALS

10:30 AM - 11:10 AM

Solving the Challenges of Inline Automated Surface Defect Detection

Lecture Room 2

***Jason Biddulph**, Applications & Integration Engineer, Micro-Epsilon UK*

FASTENING & JOINING

10:30 AM - 11:10 AM

Achieving Ultimate Fastener Reliability Using LOCTITE Adhesives

Lecture Room 3

***Bob Orme**, senior technology specialist, Henkel*

PCB

11:30 AM - 12:10 PM

New age of communication for electronics design & development

Lecture Room 1

***Tony Folan**, senior field application engineer, Altium UK*

MATERIALS

11:30 AM - 12:10 PM

Aluminium with Form - Hot Form Quench Lightweighting for New Vehicle Architectures

Lecture Room 2

***Bruce Girvan**, Director IP and Licensing, Impression Technologies*

FASTENING & JOINING

11:30 AM - 12:10 PM

Spida Fixings and Fiba Spida: the ultimate fixing technology

Lecture Room 3

***Thomas Wood**, managing director, Adhesion Technologies*

PCB

12:30 PM - 1:10 PM

How to Maximise PCB Space with Connector Selection

Lecture Room 1

***Neil Moore**, Product Manager – EMC Boardware & Industrial Connectors, Harwin*

MATERIALS

12:30 PM - 1:10 PM

Aluminium Matrix Composites: Displacing Titanium Landing Gear Components

Lecture Room 2

***Richard Thompson**, Commercial Director, Alvant*

MATERIALS

12:30 PM - 1:10 PM

Lightweighting and metal replacement: 3D printing carbon fibre and engineering thermoplastics

Room: Room 15/16

***James Short**, application engineer, Stratasys*

FASTENING & JOINING

12:30 PM - 1:10 PM

Understanding and Implementing Torque Standards relating to Torque Tools

Lecture Room 3

***Ron Sangster**, managing director, Advanced Witness Systems*

PCB

1:30 PM - 2:10 PM

Speeding up your design time-to-market

Lecture Room 1

***Maurice Banting**, Head of Design Software and Tools at DesignSpark, RS Components*

MATERIALS

1:30 PM - 2:10 PM

Maximising the Potential of Lightweight Materials with Intelligent Design Technologies

Lecture Room 2

***Michal Stefuca**, technical support manager, Altair*

FASTENING & JOINING

1:30 PM - 2:10 PM

Savings through collaborative design: optimise product design through early fastening integration

Lecture Room 3

***Sven Brehler**, engineering project manager, TR Fastenings*

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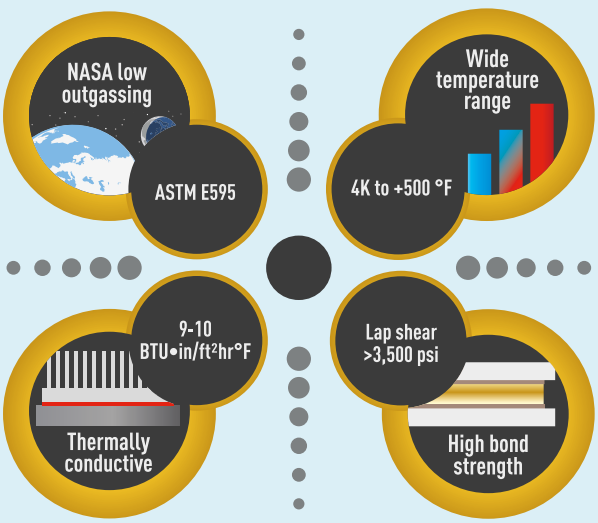

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CFRPS INCREASE MACHINE PERFORMANCE

Why is it that carbon fibre-reinforced plastics are less likely to be used for the manufacture of industrial machine tools and automation systems?

If you hear mention of carbon fibre-reinforced plastics (CFRPs), you – like many designers and engineers – will likely think immediately of Formula 1 cars, racing bikes and fighter jets.

"While CFRPs are being increasingly used in commercial aerospace and mainstream automotive applications, where the stiffness and light weight of these materials drive reductions in fuel consumption and carbon dioxide emissions, they are typically associated with the expensive, the exotic and the niche," says head of business development at CompoTech, Humphrey Carter. "With some creative thinking and the right technical knowledge, however, the unique properties of CFRPs can be exploited in a wide variety of more down-to-earth industries, too. And the results can be striking."

The manufacture of industrial machine tools and automation systems, for instance, is a highly competitive business, where end-users demand systems that deliver high levels of productivity and quality. As a consequence, companies operating in this sector are designing larger machines, with high-speed moving elements that can often be several meters in length.

These elements must be produced to extremely tight tolerances and must be stable enough to accelerate and decelerate rapidly in such a way as to maintain the accuracy of the machine. Much like structural parts for racing cars and aeroplanes, therefore, they must be lightweight, and demonstrate sufficient strength and stiffness to support both static and dynamic loads with minimal deflection. They also offer damping advantage for machine performance and prolong their lifetime.

Indeed, for load-bearing and structural components, or for precision movements, the use of CFRP can help to improve speed of movement and acceleration, especially over extended distances. The accuracy and repeatability with which, for example, a tool set can be returned to exactly the same location, operation after operation.

Recently, Poland-based manufacturer of fibre laser machines, Eagle, was trying to reduce the weight of, and the deflection exhibited by, a 3.1m-long steel y-axis transverse beam for one of its laser cutters. By adopting a thin-walled composite »

» design reinforced with foam cores, designed and manufactured by CompoTech, a composite manufacturing specialist based in Czech Republic, the company reduced the weight of the beam by 44% while increasing its stiffness.

These improvements enabled Eagle to double the peak acceleration of the beam from 3g to 6g, which, in turn, reduced the time required to cut a sheet of material in the machine by up to 30%. Furthermore, the extra stiffness and improved damping characteristics of the part resulted in accuracy improvements of up to 50%.

The development of composite transfer beams, meanwhile, was the aim of press manufacturer Schuler, which replaced a basic square section beam with a 3D hybrid composite version of a steel T-slot beam. The resulting beam weighed just a quarter of the original section while demonstrating an axial modulus of 400GPa, which increased its natural frequency of resonance while decreasing its dynamic response. This allowed the machine to run at a faster rate than was previously possible, from 20 strokes a minute to 32 – increasing its output by 40%, on average.

"It's not just in large parts that the properties of CFRPs can yield real benefits," adds Carter. "A steel/composite hybrid milling tool developed by CompoTech, for instance, can perform faster and machine more accurately than conventional alternatives. The tool also imparts improved surface roughness meaning that, in certain circumstances, it can do the job of two varieties of steel tool, for rough and final machining. This increases milling productivity, decreases machining time and reduces machining cost."

The reduction in weight – up to 40% – and the increased stiffness enabled by the use of carbon fibres also enhances the damping properties and increases natural frequency of the tool – reducing unwanted vibrations in the machining process, thus giving the tool more stability.

The low weight of the milling tool also means that less energy by the machine is used in non-loaded positioning, while its lower inertia slashes peek energy in acceleration. This can also reduce wear on parts of the machine, meaning that the lifetime of the machine and the durability of the tool tip can be increased. If you consider replacing the spindle motor and the bearings with composites, these parts can reduce the lifetime cost of a machine. In some cases, they can allow a machine to handle and machine with a larger tool where weight might be the restriction.

"Of course, CFRPs are significantly more expensive than steel or aluminium, which might be enough to stop some machine designers from considering the use of parts made from such composites," says Carter.

"To maximise the stiffness of the final parts, CompoTech employs Graphite Carbon fibres made from pitch, rather than the more common polyacrylonitrile (PAN) fibres. Differences in their microstructures mean that while they are not as strong, pitch-derived graphite carbon fibres possess a Young's modulus significantly higher than that of their PAN counterparts, making them ideal for such stiffness-driven applications."

The reduction in weight – up to 40% – and the increased stiffness enabled by the use of carbon fibres also enhances the damping properties and increases natural frequency of the tool...

Furthermore, Carter adds, modern manufacturing methods can be employed to significantly narrow the cost gap between CFRPs and metals. Automated axial fibre placement allows fibres to be aligned along the length of the tube or beam, suiting it for machine members and other components that must be highly resistant to bending loads. The vibration behaviour of the parts can also be tailored through this process.

The dimensions and wall thickness of the part can be adjusted to tune its natural frequencies, for example, and damping materials, such as rubber and cork fillers, can be incorporated into the structure. Additionally, internal foam reinforcements can be used to improve the vibration stability of the walls of large-section parts.

Finally, the performance benefits associated with the use CFRP parts and tools rather than conventional metallic alternatives can be significant – helping to offset any extra expense as well as improving some lifecycle costs.

"Designers and engineers in the manufacturing industry may be shy of specifying CFRPs, underestimating their benefits while overestimating the cost and complexity associated with their use," concludes Carter. "As we have seen though, the use of composite components can play significant role in boosting the performance of machines."

CompoTech's steel/composite hybrid milling tool (above) and spindle (below) can perform faster and machine more accurately than conventional alternatives.

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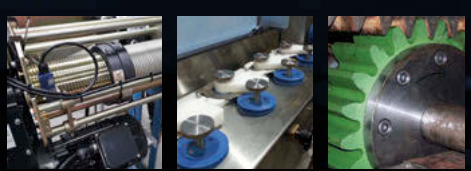

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COMPOSITES ARE THE NEW BLACK

It's not just 80s music and fashion that have seen a revival in recent times; it appears the renaissance has extended into the realms of engineering materials.

Aluminium Matrix Composites (AMCs) first appeared around 40 years ago, for use in automotive components and far from being a short-lived comeback trend, it looks as though they are here to stay, thanks to a raft of applications showcasing their capabilities across multiple sectors.

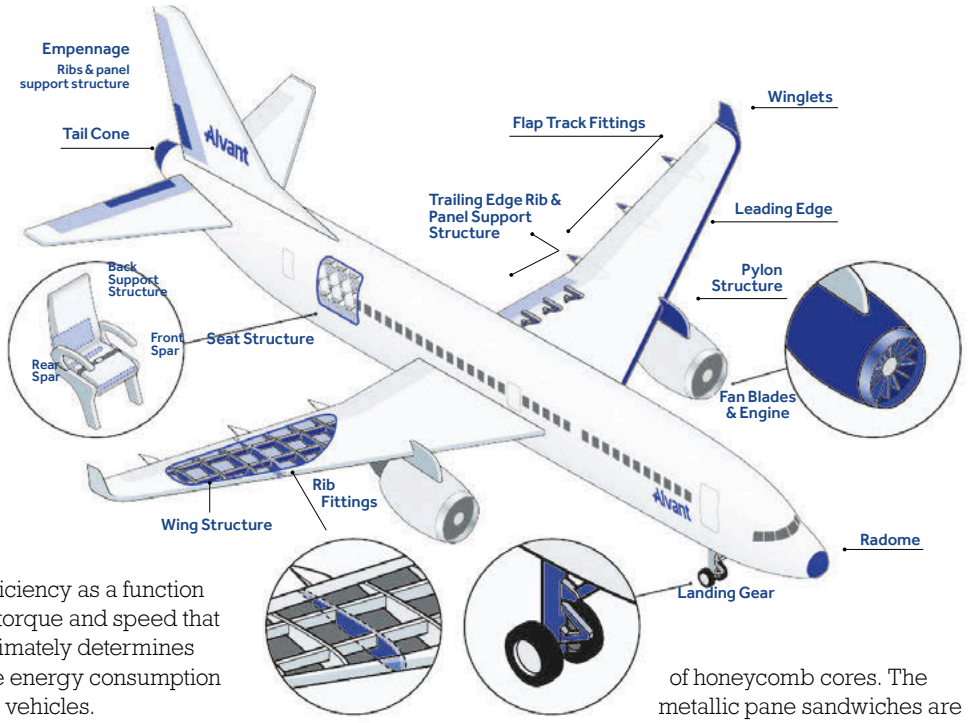
When AMCs were in their infancy during the 80s, often the advantages were over-sold and their properties were largely unproven, cutting short their potential and doing little for their reputation. As carbon composites became more widely adopted, AMCs were forgotten by engineers and designers, and fell off the radar. However, fast forward almost four decades, and subsequent R&D investment into the manufacturing of these composites has resulted in progress that has been deemed a "game-changer". Sectors such as aerospace are under sustained pressure to improve performance, and with weight reduction playing a key role, AMCs are now firmly back on centre stage.

Leading the way in the development of AMCs is UK firm Alvant. Originally formed in 2003 as CMT, Alvant has created a process known as Advanced Liquid Pressure Forming (ALPF), a method by which it brings together aluminium, which acts as the matrix, and a high strength reinforcement fibre to create a high-performance Aluminium Matrix Composite material. There are four Alvant AMC materials families, namely AlXal (pronounced Al-Zal) – a continuous fibre reinforced AMC; ParXal – a particle loaded AMC; AerXal – an aluminium syntactic foam; and CorXal – a unique high-performance multi-phase AMC similar in concept to a sandwich material but made in a single-shot process providing ultra-high stiffness and low density (~1.5g/cc).

AMCs can be used to engineer durable lightweight components for harsh environments.

Now the proprietary rights owner of the ALPF AMC manufacturing process, Alvant is creating a stir in aerospace, defence and automotive fields, with involvement in several key projects hailing the shift from R&D to commercial applications.

AMCs can be used to engineer durable lightweight components for harsh environments. Compared to unreinforced metals, AMCs are »



» said to have higher strength, greater stiffness, lower weight, superior wear resistance, as well as special thermal and electrical properties. AMCs are also claimed to offer multiple advantages over polymer fibre reinforced materials, such as carbon composites. These include higher transverse strength and stiffness, a higher thermal operating range, better wear resistance, superior damage tolerance, and easier repairability.

The potential benefits of the materials that Alvant is developing mean they have possible uses in a wide range of engineering applications benefitting from their unique, light, stiff and strong attributes.

These applications cover electrified transport, renewable energy and healthcare but are equally suitable for high-end consumer products that need to be light, strong and capable of sustaining damage such as mobile devices, biomechanical prosthetics, sports equipment and personal mobility products including wheelchairs and folding bicycles.

Alvant believes that where safety and reliability are essential, AMCs could find use in applications in high-pressure seals, aircraft landing gear and seats. Where performance, efficiency and precision are vital, use cases include robotics, electric motors and automotive suspensions. And because AMCs are capable of withstanding extreme temperatures, they are suitable for components in high-voltage battery systems, unmanned aerial vehicles that fly at high altitudes and powertrains.

The increased pressure faced by the industry to identify ways to improve efficiency and performance, whilst simplifying manufacturing and overall cost, has also fuelled Alvant's recent involvement in a research programme looking at electric motor applications, called 'making it lighter for less', in collaboration with GE Aviation, YASA Motors and the National Composites Centre.

Alvant believes that as electrification increases, vehicle manufacturers are seeking to optimise motor efficiency maps; for example, by improving the efficiency as a function of torque and speed that ultimately determines the energy consumption for vehicles.

''Using AMCs, we have been able to attack the weight yet retain the stiffness of the electric rotor, to minimise parasitic mass, improving the power-to-inertia ratio and therefore efficiency and responsiveness,'' says Thompson. ''In addition, we can also offer better thermal resistance, up to 300°C, making AMCs a more suitable material than polymer composites for applications such as motors, batteries, energy recovery systems, fans and flywheels.''

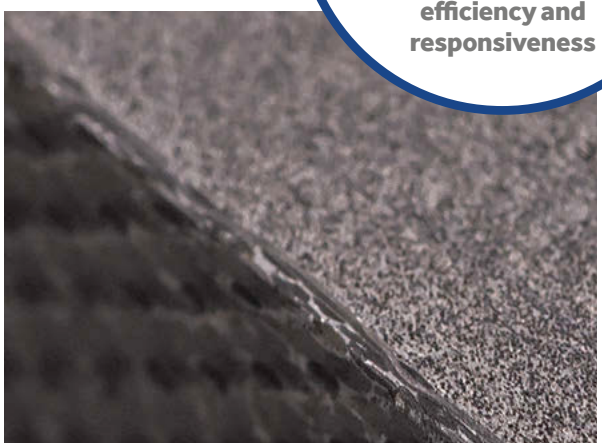
Alvant is now working on a customisable metal matrix composite (MMC) multi-phase material, offering a viable alternative to titanium and carbon sandwich composites.

Traditional sandwich materials are typically assembled from carbon composite or unreinforced metallic panes with a variety of honeycomb cores. The metallic pane sandwiches are typically flat, 2D panels, while carbon composite varieties can take 3D forms. Touted as a sustainable and capable alternative, Alvant's MMC is produced with a 'one-shot' manufacturing process and can significantly increase a component's strength and stiffness to weight ratios.

Above: Where safety and reliability are essential, AMCs could find use in applications in high-pressure seals, aircraft landing gear and seats.

Below: Alvant's metal matrix composite is produced with a 'one-shot' manufacturing process and can significantly increase a component's strength and stiffness to weight ratios.

Using AMCs, we have been able to attack the weight yet retain the stiffness of the electric rotor, to minimise parasitic mass, improving the power-to-inertia ratio and therefore efficiency and responsiveness



According to Thompson, product manufacturers are becoming more aware of how AMCs can sometimes be a better alternative than other composite materials or unreinforced metals, and the calibre of partners across aerospace and automotive sectors signing-up to new projects with Alvant is proof of this.

''A key objective of any project we undertake is to test and demonstrate as many technology advances as possible,'' adds Thompson. ''Alvant's AMCs are a sustainable solution that enhance product capabilities.''

''Aerospace and automotive industries face the challenge of finding suitable materials that will reduce weight whilst maintaining reliability and lowering whole-life ownership costs. AMCs offer an exciting potential to industries that need a step change in performance to meet ever stringent market and legislative demands. We are in the growth stages of an age of new materials, now is the time for the industry to stop relying on traditional technologies and embrace change.''

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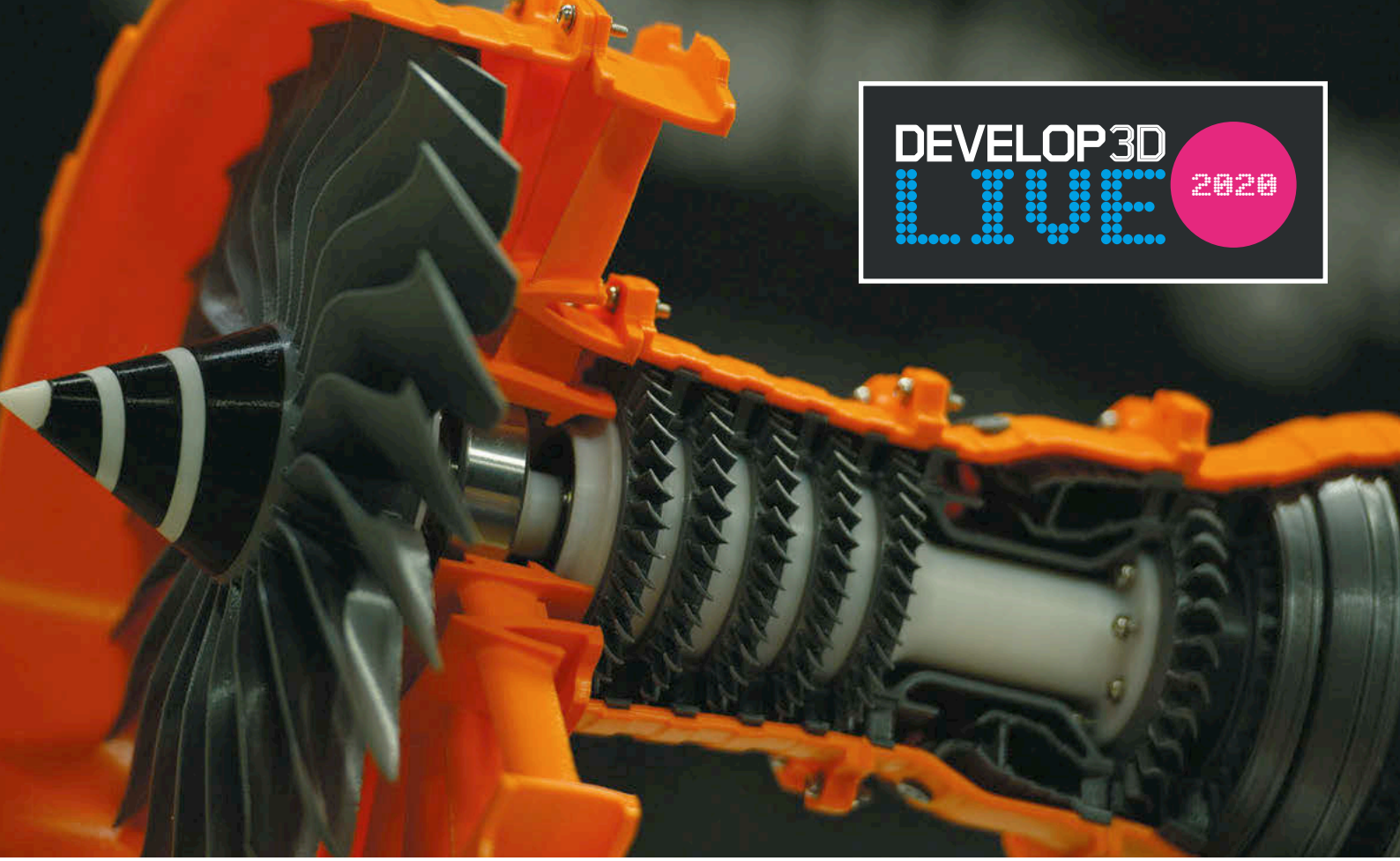

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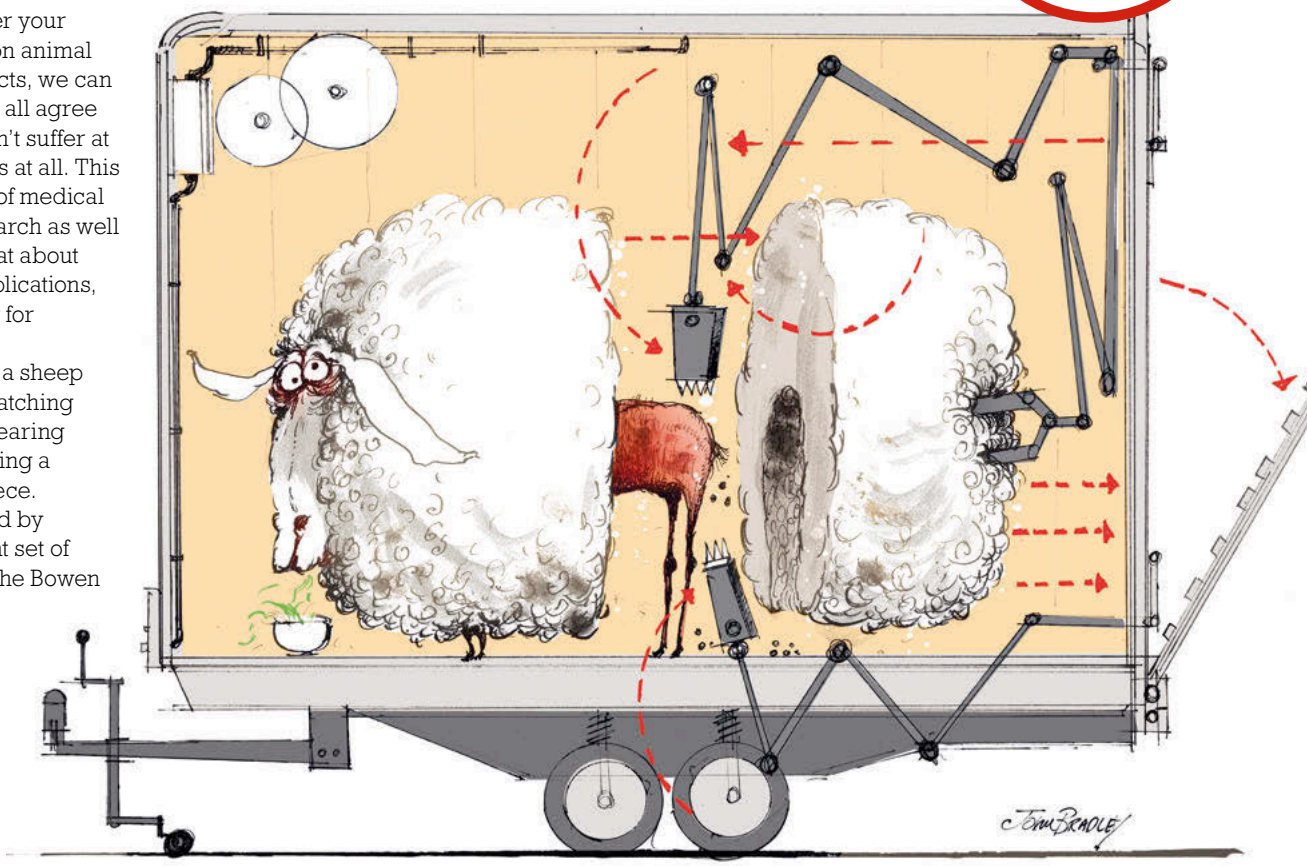

Whatever your view on animal products, we can surely all agree that animals shouldn't suffer at the hands of humans at all. This is obvious in cases of medical and cosmetics research as well as butchery, but what about more traditional applications, like sheep shearing for example?

During shearing a sheep is caught from the catching pen and put on a shearing board. It is shorn using a mechanical handpiece. The wool is removed by following an efficient set of movements, either the Bowen Technique or the Tally-Hi method. Sheep are said to struggle less using the Tally-Hi method, reducing strain on the shearer and there is a saving of about 30 seconds in shearing each one.

Most shearers today are paid per sheep rather than by the hour. Some manage to shear up to and even more than 200 sheep per day. This, added to the fact that there are no requirements for formal training or accreditation, has led animal welfare organisations to raise concerns over the welfare of the sheep as speed is prioritised over precision and care for the animal.

THE CHALLENGE

The challenge this month then is to come up with a form of technology that makes sheep shearing more efficient for the shearer and less stressful for the sheep. Let your imagination run wild with this one, the more out there the better!

As always, we have an idea in mind that will be published in the **April** issue of Eureka! Until then, leave your ideas in the comments of the **Coffee Time Challenge** section of the web site or email the editor: **paul.fanning@markallengroup.com**

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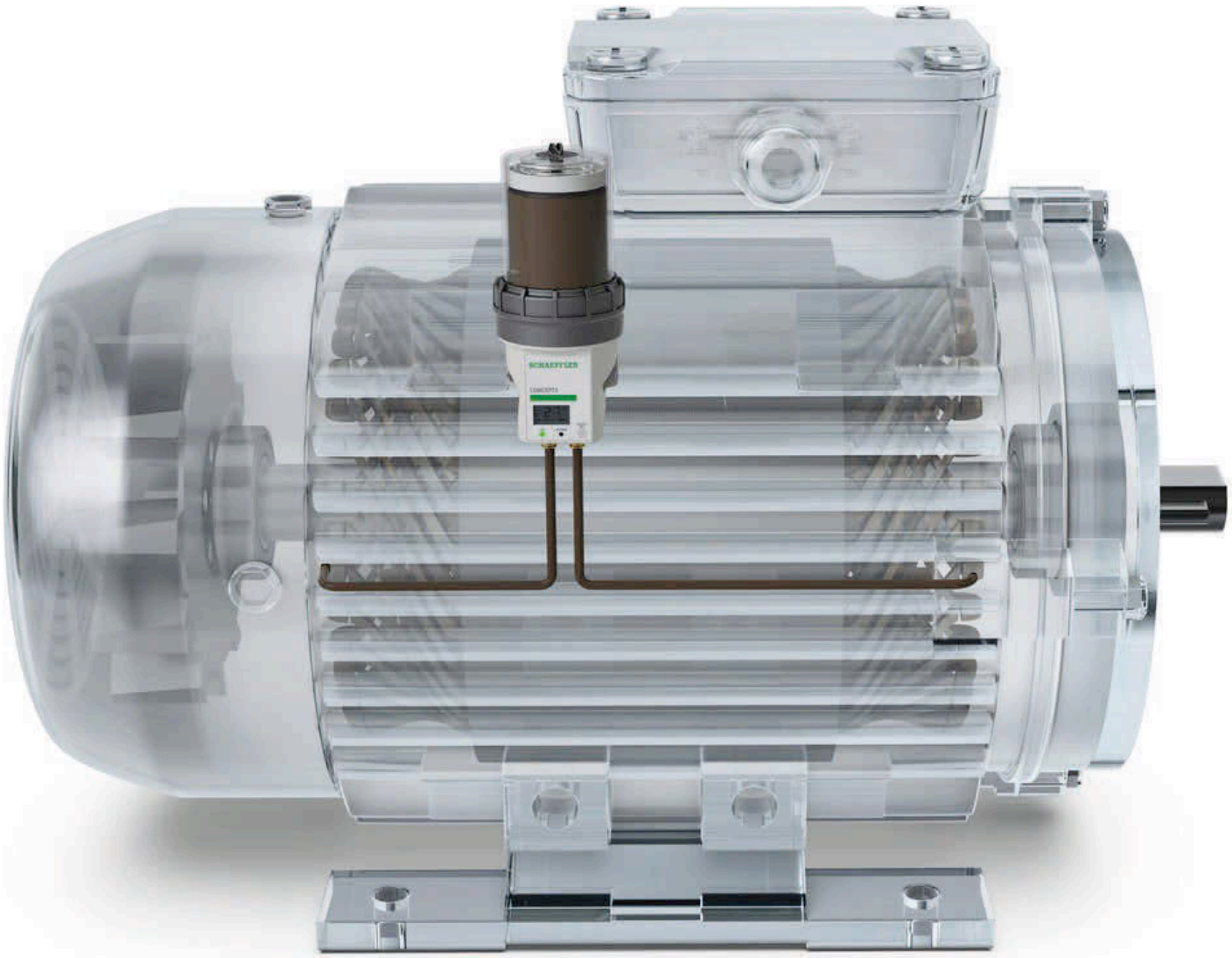

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