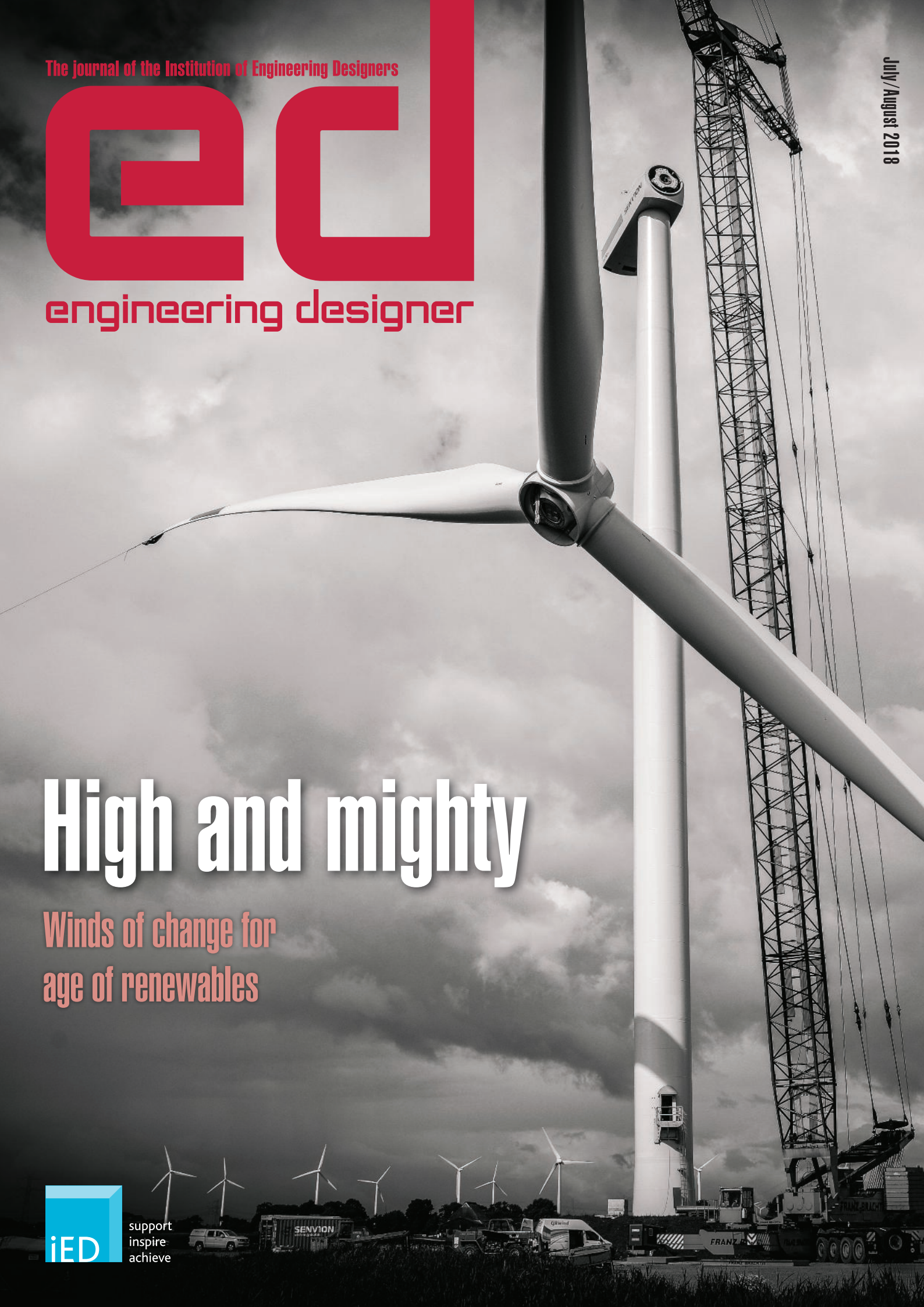
The journal of the Institution of Engineering Designers

ed engineering designer

July/August 2018



High and mighty

Winds of change for age of renewables

iED support inspire achieve

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Engineering Designer needs good articles on matters important to design. Why not write one? You will receive help from the editorial team, should you need it.

If you want to try your hand at writing a feature for *Engineering Designer*, please submit an abstract (around 200 words), explaining what your feature is about, with intended word count. (Features can be between 1,000 and 1,800 words.) It will then be forwarded to the IED editorial committee for consideration.

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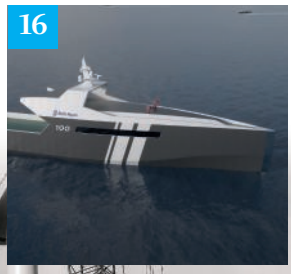

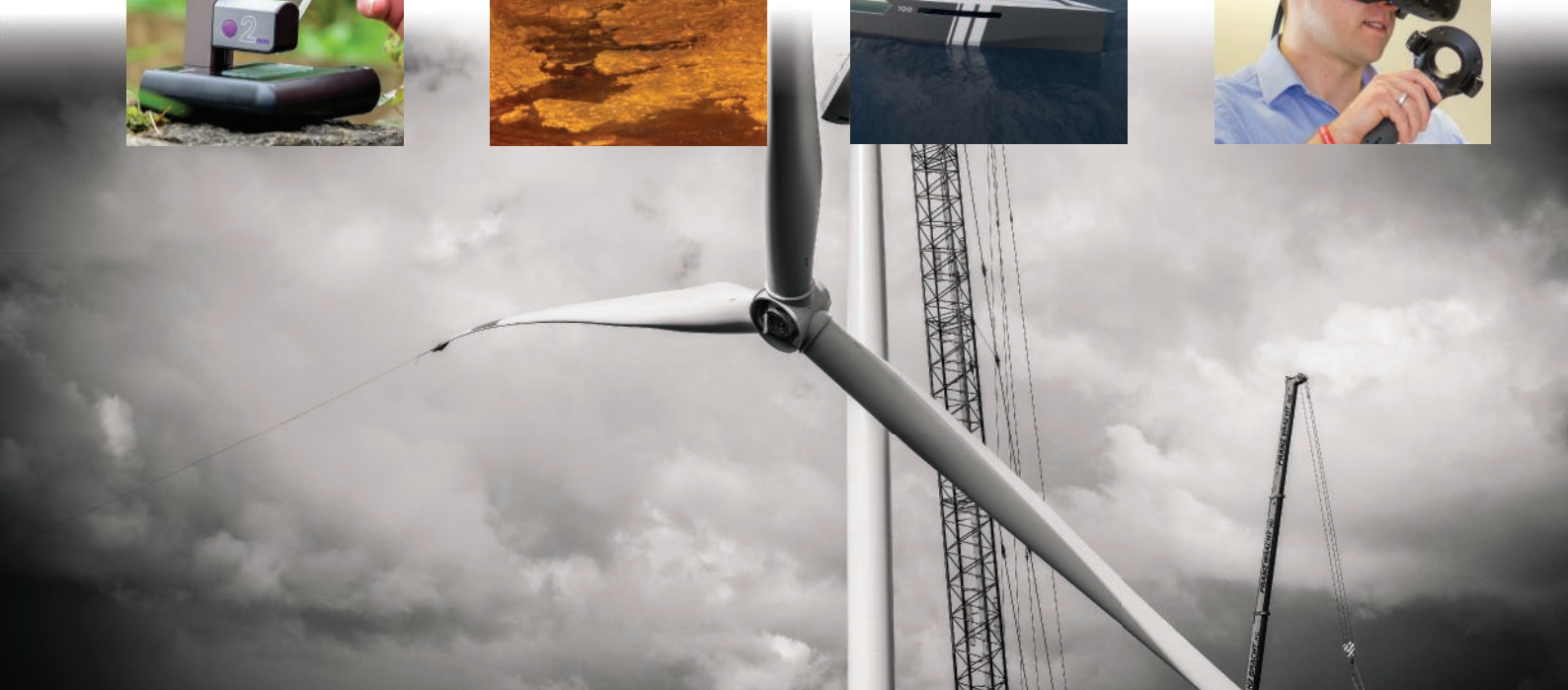

My eighteenth and last 'View'!

Tania Humphries-Smith looks back on her three years as Chair and the progress achieved collectively by the IED on that journey

Three years and 18 'Views' later, I reach the end of my time as Chair of Council. When I took on this role, I set out my trio of objectives:

1. to publicise the benefits of finally having a professional qualification at Chartered level to the Product Design profession

2. to develop the income portfolio of the IED to ensure a sustainable future

3. to get more members involved/build a closer relationship with members.

I would like to believe that we have made progress on all these fronts. Since decoupling membership from registration grades, membership is starting to grow and is also allowing a better discussion to take place with new members about the appropriate registration pathway. Our new Membership Secretary, Kim, has started visiting companies on a regular basis to discuss how Professional Registration for their employees can help their business.

We continue to promote the Institution as the only institution offering professional registration for Product Designers and accreditation of education provision in Product Design. We are also actively engaging with The Office for Product Safety and Standards to ensure the professional voice of Product Design is represented.

At the same time, we are actively progressing the development of the IED headquarters to 'work harder' for the Institution and ensure a sustainable future. We have, and continue to discuss, possible synergies with a number of other bodies related to product and engineering design. We have, of course, continued with our 'business as usual', such as securing a successful Licence Review by the Engineering Council, as well as moving our business forward by investigating degree apprenticeships and how the Institution may offer services as an end point assessor. So I feel a level of satisfaction with the current position of the Institution, but inevitably there is always more that can and should be done.

Finally, I would like to thank our CEO Libby and all the staff at IED HQ, many of whom have changed during the last three years, for their support and willingness to assist me and all our members. I wish all the best to the incoming Chair, Colin Ledsome, and new Vice Chairs, Neil Phelps and Dave Castle. I hope they feel the same amount of satisfaction and enjoyment in these roles as I have. I've also enjoyed working with our outgoing President Maggie Philbin, who has actively promoted the Institution in a range of arenas and wish our incoming President Pete Lomas an enjoyable and successful term in office.

**http://www.institution-engineering-designers.org.uk/Article/News/announcement-new-president-for-ied-from-july-2018 –*

*** https://www.raeng.org.uk/news/news-releases/2017/march/uff-review-of-engineering-profession-published*

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Admiral FitzRoy's Weather Glass

Weather glasses were once hailed as a way forward in forecasting what might lie in store for sailing ships. Sadly, this was not to prove the redeemer many hoped for, explains Colin Ledsome CEng FIED

Sailing ships were always at the mercy of the weather. Winds could blow a ship off course or get it to its destination, but a gentle breeze could reduce progress to a crawl. Storms could wreck a ship or keep it in a sheltered bay until it had passed. Forecasting the weather with any accuracy, even on land, was impossible until after the invention of the barometer by Torricelli in 1643.

HMS Beagle

It was soon noted that the pressure it measured varied in a way that could be correlated with changes in the weather. However, a delicate column of mercury in a glass tube could not survive long on a ship and the motion of the waves made it impossible to get accurate measurements.

In the first half of the 19th century, an unknown inventor found that a special liquid in a sealed tube would crystallise in different patterns, which were thought to predict the weather. The liquid typically consisted of a mix of camphor, potassium nitrate and ammonium chloride (sal-ammoniac) dissolved in alcohol and water, producing delicate white crystals.

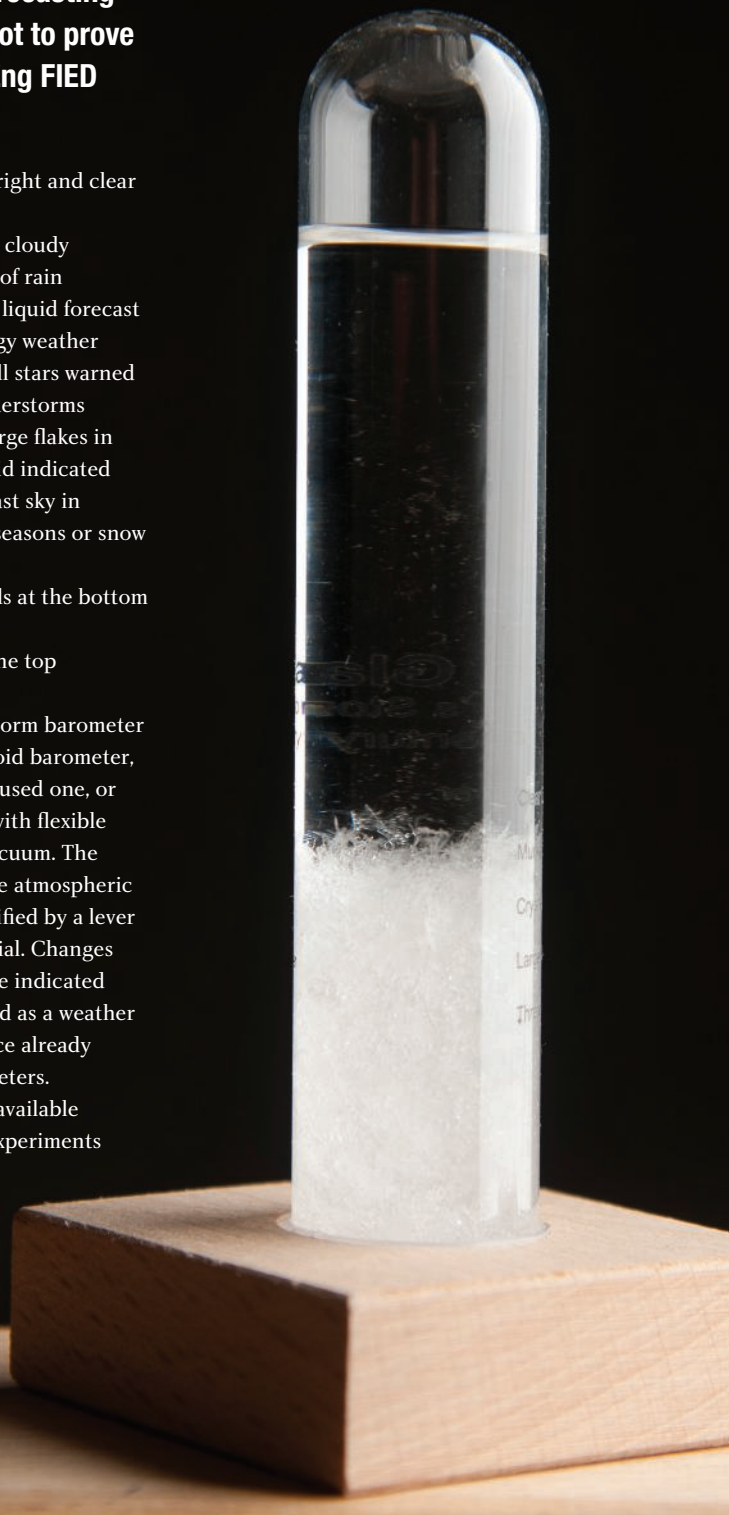
This mix was promoted by Admiral Robert FitzRoy and distributed to many British ports after storms in 1859, to be consulted by ships before setting sail. One weather glass went with HMS Beagle on the voyage that took Charles Darwin to the Galapagos Islands.

The instructions for interpreting the patterns of crystals were detailed:

- A clear liquid indicated bright and clear weather
- A cloudy liquid suggested cloudy weather with the possibility of rain
- Small dots in the liquid forecast humid or foggy weather
- Small stars warned of thunderstorms
- Large flakes in the liquid indicated an overcast sky in temperate seasons or snow in winter
- Crystals at the bottom meant frost
- Threads of crystals near the top suggested winds.

Eventually, the FitzRoy storm barometer was superseded by the aneroid barometer, first invented in 1844. This used one, or several, sealed metal boxes with flexible sides containing a partial vacuum. The deflection of the sides, as the atmospheric pressure changed, was amplified by a lever system and displayed on a dial. Changes in the pressure, as well as the indicated reading, could be interpreted as a weather forecast, using the experience already gained from mercury barometers.

Weather glasses are still available as a curiosity, but modern experiments have shown that the crystallisation is entirely dependent on temperature and is of no use in predicting the weather!



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Lighting the path

The evolution of the microscope has spanned four centuries, yet in its established history 2018 represents a transformative leap in revolutionising field microscopy

As the rapid pace of technological development impacts every corner of our lives, the compound microscope has now been brought into 21st-century investigations with a bang by two Hampshire-based inventors.

ioLight first entered the scientific scene in 2014 when chief executive officers Andrew Monk and Richard Williams teamed up to create the company. The flash of inspiration first came when co-founder Williams needed a quality microscope with a high resolution that was portable, lightweight and reasonably priced. After scouring the marketplace for a solution that would work, he realised that these attributes were at odds….until now. “That was the real lightbulb moment,” enthuses Monk. “The question on our lips then was, why hasn’t anyone done this before?”

The innovation for which they are responsible centres on being able to fold their microscope into a flat shape, so as to make it easy to transport and use. Yet the real challenge was achieving this folding mechanism with high enough precision to deliver 1 micron (µm) optical resolution.

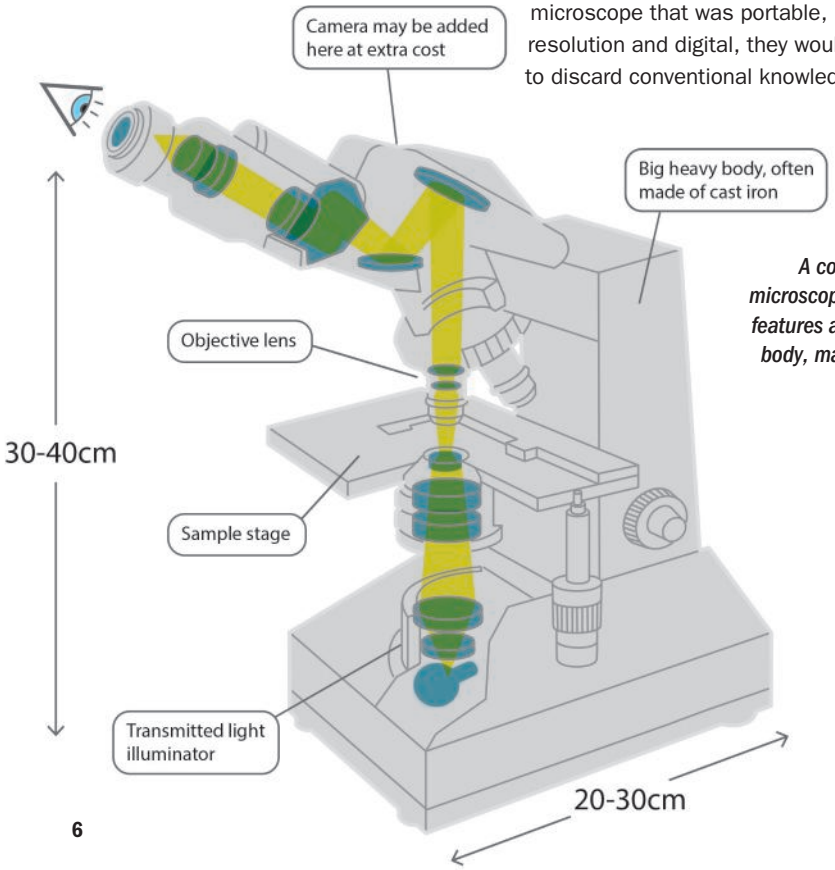
Having recognised a decades-old gap in the market for a microscope that fulfilled these criteria, while pairing scientific accuracy with instantaneous technology, the duo set to work on conceptualising and using design thinking, in order to form their first prototype.

BEYOND CONVENTION

Monk and Williams soon realised that to succeed in developing a foldable microscope that was portable, high-resolution and digital, they would have to discard conventional knowledge that constantly bemoans the ineffectiveness and poor resolution of foldable microscopes. From their point of view, overcoming the scientific doctrine that states how the terms ‘foldable’ and ‘microscope’ should not be used in the same sentence was counter-intuitive. Instead, for ioLight, it would serve as the first step towards making their high-resolution portable microscope a reality. “After realising that the answer did, in fact, lie with a folding microscope, the next question was how to make this possible, while retaining its portability, high-resolution and digital nature,” emphasises Monk.

Conventional microscopes contain an eyepiece that focuses on the virtual image below. This image is generated by the objective lens at the bottom of the microscope and focuses on the sample, which is located on the stage. Below that, there is a condenser that controls the light, followed by an illuminator. When it comes to the light path, a conventional microscope typically forms an image 160 mm above the objective, which the eyepiece then focuses on. This long optical chain creates the traditional tall and thin shape of microscopes that we have come to recognise and use.

However, as a result, microscopes require a cast-iron stand to create stability and rigidity. Big and heavy, these microscopes are difficult to transport to, and use in, the field environment. In other words, microscopes could not be made to fit into your pocket, without jeopardising the sturdiness of the unit, which is vital for high optical resolution. This brought the inventors onto their main design challenge: how to overcome this, and achieve a truly foldable and highly rigid design?



A conventional microscope typically features a big heavy body, made of cast iron.

ioLight ahead

Richard Williams, left, and Andrew Monk, the co-founders of ioLight. Above: the foldable microscope concept was a 'lightbulb moment'

The duo devised, designed and debated a variety of options, from tripods to unscrewable microscopes. They found that, with a tripod, it was difficult to create a neat fold, impacting the easy and clean portability of the device, while unscrewing the microscope led to connectivity problems. And so they were back to square one.

FULL CIRCLE

Having discounted a foldable microscope that could achieve high enough resolution, they began to re-explore this option using novel engineering methods. Camera chips, optical lenses and WiFi technology are all commonplace in today's devices, but utilising this technology in microscopy required entirely new engineering thinking. ioLight also needed to achieve high-definition video from the microscope. Without wires, naturally, to ensure the field-based microscope remained portable.

It is widely accepted in science that primary observations, made on samples, in their original habitat, are better than measurements made later in the lab. The primary measurement approach to absolute accuracy over lab measurements was a key driver to obtaining a patent for ioLight's folding design.

Microscopy is one of the few measurements in science where, until now, secondary measurement in a lab has been accepted. Instead of instantaneous analysis, technicians have taken samples found in the field and analysed and recorded these in the laboratory. Field microscopy is fundamental to prevent the degradation and deterioration of samples, death or the failure to spot changes in behaviour.

Perhaps surprisingly, mobile phones and new material applications have enabled ioLight to do the seemingly impossible and make foldability synonymous with microscopy in today's marketplace. Passionate about creating a new type of microscope, fit for the field, ioLight's inventors undertook an engineering feat to explore how they could manufacture a foldable and digital microscope with high-resolution.

The upshot is that ioLight's microscope removes the traditional optical chain design and replaces it with one that is flat and portable, while retaining its necessary robustness and rigidity. With the invention of the mobile phone, the same components can be used to enable the production of foldable microscopes at a much smaller size and lower cost. ioLight experimented with the use of mobile phone components and replaced the optical system with a camera, making the eyepiece redundant.

DIGITAL MICROSCOPY

Now that the inventors had moved over to digital microscopy, the remaining question was how to make the microscope foldable to enable it to fit in the pocket and be transported easily anywhere, but still deliver useful scientific resolution. Although the two men originally thought the folding design could achieve a useful resolution of ten, five or perhaps even two microns, "never in their wildest dreams" did they anticipate it would be able to provide resolution of better than 1 micron. This belief was fostered from a history steeped in the inability to pair portable, pocket microscopes with this level of definition and image quality.

After further experimentation, Monk and Williams questioned whether a hinge could give the device easy portability without impacting its ability to take high-resolution imagery and share these images. Happily, the answer was 'yes' and, after more questions and exploration, they settled on a single hinge design. It is this integrated, innovative thinking and application that their recently granted patent is based on.

ioLight carefully chose materials that could intuitively and easily fit into place to provide dimensional accuracy. After gathering parts and embarking on an experiment on the workbench, the

ioLight was recently granted a patent for its portable, high-res, folding, digital microscope

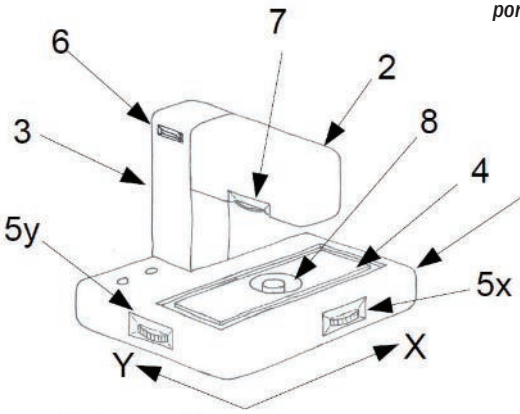


Figure 1

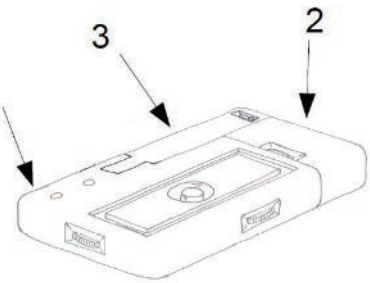


Figure 2

KEY BENEFITS

- Stability is achieved through its flat base and low centre of gravity
- Portability occurs due to its patented flat package and folding design
- Connectivity means it is excellent for metrology, teaching, home science and industrial test and measurement
- Low-cost mechanism for positioning a sample provides accuracy and speed
- Construction is compatible with high volume manufacturing
- Easy to store and share images through the ioLight app.

inventors then started to ask questions about whether it would be possible to use mobile phone parts to make a microscope. As a fairly new invention, after all, it was likely that the mobile phone would offer new opportunities.

ioLight soon realised that it could reconfigure mobile phone parts, and both the camera sensor and lens have been borrowed from the mobile phone.

"The first thought was to clip a lens onto the front of a mobile phone and indeed clip-on lenses are widely available," states Monk. "However, a mobile phone's optical system is not ideal for microscopy and we soon realised that to achieve the highest resolution we had to take the lens out of the phone and into a new optical system – the ioLight microscope."

ioLight utilised a Raspberry Pi compute module, a powerful and lightweight single board computer that provides excellent video processing capabilities. (Raspberry Pi will, of course, be well known to IED members, with its co-creator Pete Lomas HonFIED all set to be the Institution's next President.) This allows ioLight to stream high-definition video over a wireless link. However, while this is standard in home video streaming technologies, such as Chromecast and AppleTV, these introduce a delay of a couple of seconds to allow for error correction. A long interruption like this would make it impossible to navigate a sample or to focus the microscope – tasks which must be done in real time.

NEW WORLD OF DISCOVERY

To address this, the software team implemented video over WiFi in real time, providing connectivity with Android, iOS and other computers. Users can now store and share high-quality images and videos instantly, keeping science in the field, sharing it in the classroom and opening a new world of discovery.

In terms of selecting its physical materials, ioLight also sought mechanical parts that prevent instability and create rigidity. These include:

- The single hinge design itself
- The aluminium extrusion robust mast
- The glass stage.

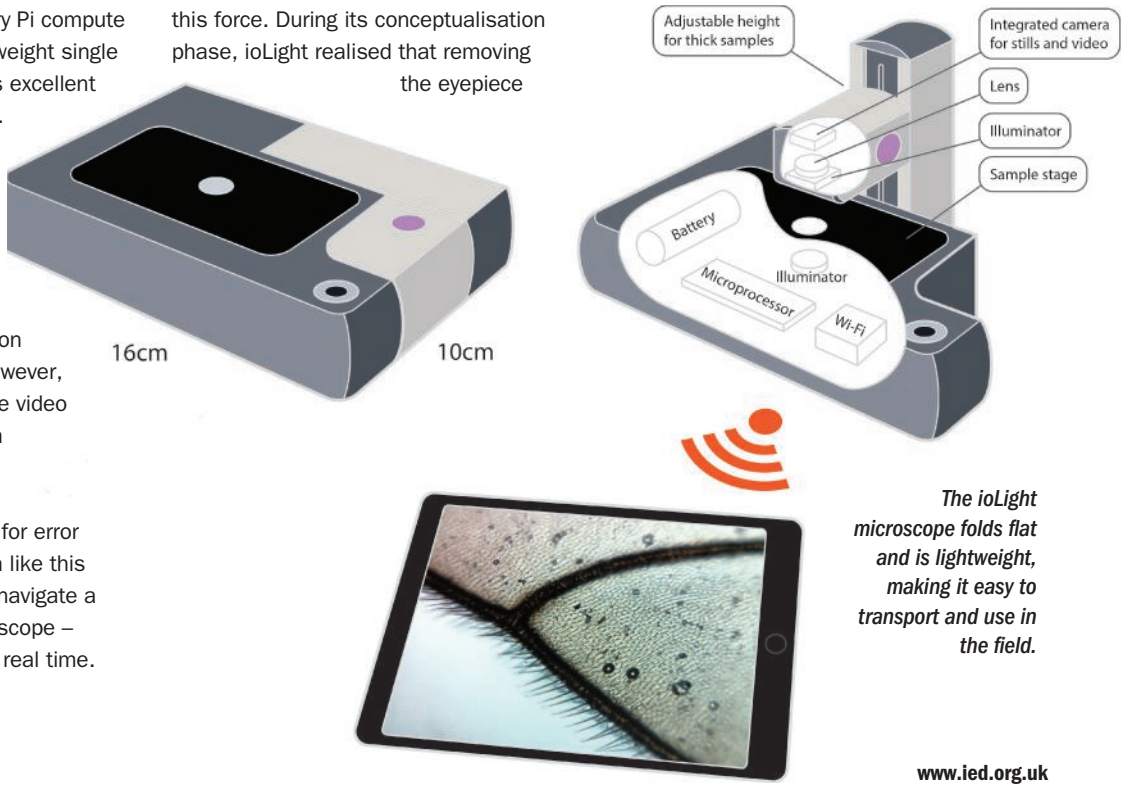
The glass stage is vital, as samples need to remain still, relative to the optical system, and stay firmly in place to ensure an accurate and clear projection of the image. Without a stand or clamps, this, on the surface, appeared very difficult to achieve. After troubleshooting, the stage provided the solution, as it enables the microscope to be portable and achieve a high resolution of 1 micron. Its glass stage was a core part of ioLight's design choice, as it enables easy handling while offering stiction — the combination of friction and stickiness — to ensure the slide can easily be positioned by hand.

With a traditional optical microscope, the user's eye rests on the eyepiece, causing it to move. As a result, the microscope has to be really solid to resist this force. During its conceptualisation phase, ioLight realised that removing the eyepiece not only eradicates the force on the microscope from the pressure of the user's eye, but also leads to the possibility of implementing a folding mechanism.

Today, we no longer have to rely on resting our eye on an eyepiece, which places unnecessary force on the microscope. Users do not have to squint through eyepieces, as everyone sees the same picture and is able to adjust the height for samples of up to 25mm thickness.

The instrument's foldability is, of course, the crucial factor in ensuring it is portable, lightweight and easy to use, while retaining its high resolution. It is the company's novel construction of the microscope that has given ioLight's Magnificent Mobile Microscope its patent (in May 2018) and industry recognition, supported by its European Product Design Award win in 2017. ioLight has been able to transfer field microscopy and answer the needs of those using microscopes for science, education or enjoyment; a feat that all hinges on... well, its hinge.

Since the inception of its first prototype and patent submission in 2014, ioLight has sold over 100 microscopes, has grown its business operations to include sales and distribution teams, and has cosmetically enhanced ioLight's Magnificent Mobile Microscope.



The ioLight microscope folds flat and is lightweight, making it easy to transport and use in the field.

TeenTech City - a truly exceptional experience

Hundreds of students, 80 teachers and 300 tech volunteers gathered recently to show London a vision of the future that bodes well for engineering design

TeenTech is renowned for running initiatives with a supporting award scheme to help young teenagers see the wide range of career possibilities in science, engineering and technology. It was founded in 2008 by Maggie Philbin OBE, outgoing president of the IED, and Chris Dodson to help the 'X Factor' generation understand their true potential and the real opportunities available in the contemporary workplace.

2018 is a very special year for TeenTech, marking 10 years since it was launched, and its reach goes from strength to strength, not least through its programme of interactive events, now in its sixth year. These events have earned a reputation for showcasing science and tech careers with powerful hands on opportunities for young people to explore ground-breaking work from companies, universities and colleges. Organisations are networking with their future talent.

A powerful demonstration of this in action took place recently at The Emirates Stadium where 540 students from 50 London schools, 80 teachers, including the IED, and 300 tech volunteers gathered to show London a vision of the future. From the latest AI to data science in archaeology, from virtual worlds to real world challenges, young people had the chance to meet people working at every level, from apprentice to CEO.

The event was sponsored by City of London, The Bank of England, Queen Mary's University London and Connect Wise, and more than 45 different companies brought their very latest technology to help students see how they could be part of making and shaping tomorrow's world.

Teachers said how the day increased their own awareness of career opportunities in STEM, stimulated fresh ideas for lesson plans and also provided useful contacts with regional employers.

'It was an exceptional experience for our students, especially among the girls," said one computing teacher from The City Academy, Hackney. "One of my primary motivations was to get the girls interested in this 'male dominated' computer science area. I can safely say that I think most of the girls that attended have now a different view, especially seeing other females lead and do exciting roles in STEM. Having asked a few of them, their attitude towards CS has changed."

Another teacher, from Welling School, was equally positive about the experience: "The whole day from start to finish was fantastic – from the ambassadors' help and guidance, the DIY inventor activities and workshops. Thank you."

VITAL SUPPORT

Organisations attending and running imaginative workshops included: A11yHacks, Accenture, Air Products, Atkins, BBC, Bank of England, Bloodhound, Bright Little Labs, British Army, Coderdojo, Computacenter, Creative Skillset ,Cummins, Cyber Security Challenge UK, DCMS, FDM Group, Gensler, GSK, Heathrow Airport, Institution of Engineering Designers, Imperial College London, Just IT, JVCKenwood, Kinnier Dufort, Microsoft, National Physical Laboratory, Ringway Jacobs, Royal National Orthopaedic Hospital, Symantec, Salesforce, Siemens, Softwire, Tarmac, Thames Water, Transport for London, Queen Mary College University of London, University of Chichester, University of Leicester, University of Warwick, University of Wolverhampton, Wellcome Genome Campus, XL Catlin and Young Rail Professionals.

If you would like to support the next TeenTech London event, please contact: natasha@teentechevent.com

ABOVE AND BEYOND

Using a drone to conduct landscape surveys might sound like a great idea, but how do you get a meaningful output? We find out how this baffled one engineer into seeking a solution

Having worked closely with farming professionals and utility firms, Circumspectis founder Christian Deas spotted what he saw as a gap in the market to improve the accuracy, cost and speed of landscape site surveys and inspections, using UAV technology.

However, the challenge came with the scanned data acquired from flying drones over the desired site. In order to make the scanned data useful, Deas first needed to import the data and convert it into a CAD model, which could then be delivered to his customers as an accurate site plan and construction drawing.

"I was using DraftSight [by Dassault Systèmes] to capture site layouts for the drainage layouts," he explains. "But, in 2D, I wasn't able to accurately show the lay of the land. Instead, I would have to get a 2D plan from the utility power networks and use it to measure the fall of the ground or soak away depth."

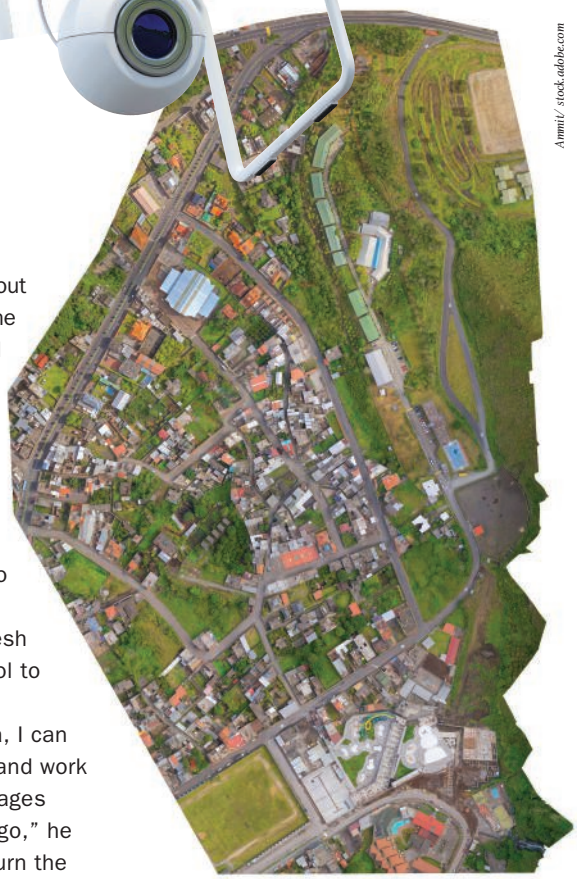
Deas realised that, if he could get a 3D topographical scan of the landscape into a CAD model, it would give a much deeper insight into specific landscapes. This makes the design process a lot faster for those involved, as the 3D visualisation of buildings and utilities allows for a more intuitive design and planning experience.

For Circumspectis to work as a business, he required a CAD package with specific tools, including Finite Element Analysis, a CAD library Toolbox, Rendering and a Product Data Management system. For his new droning venture, Deas uses SolidWorks ScanTo3D solution, which reduces the time required to build complex 3D models of real-world items. By taking 3D scan data, such as point clouds and mesh, SolidWorks ScanTo3D can quickly convert the information into 3D solids and surfaces.

RAPID MAPPING

"Traditionally, collecting landscape data is done via a theodolite for surveying sites, which can take many hours, even days to compile, depending on the acreage," he says. "It's a lot quicker, if you do it from the air. Using a DJI Phantom 3 Drone, I can map a site in 15 minutes with accuracy to the nearest centimetre. I can mark out the area, set the height at

Oleksandr Delyk / stock.adobe.com



Ammit / stock.adobe.com

which the drone can fly and work out a pre-set GPS flight plan. The drone does everything automatically and compiles hundreds of photos that can then be converted into accurate site plans," he explains.

Using SolidWorks ScanTo3D, Circumspectis can quickly import the scan data into 3D CAD and apply texture data to the mesh, refine imported mesh and use a Deviation Analysis tool to inspect for any discrepancies.

"With the imported scan data, I can see the contours of the ground and work out exactly where the steel spillages and filtrations systems need to go," he points out. "I can then quickly turn the scan into a mesh file and get a perfect 3D solid model, which we can pull into an assembly. It makes designing for agricultural and civil engineering projects a lot easier and faster.

"With SolidWorks, we can quickly convert the 3D scan data into useable surface CAD models. It's easy to use and our design processes are significantly faster, which means we can spend more time on innovation and discovering new design applications."

Manipulating drone data into accurate 3D models is now a real solution for architects, environmental agencies and civil engineers needing accurate site layouts.

"Whether you are building a phone mast, telegraph pole, bridges or measuring land erosion, the potential is huge," says Deas. "Drones are a cost-effective and risk-free way of inspecting buildings or areas that can be too dangerous to enter or access. We recently did a 3D scan near a beach by a clifftop and, because each drone mission is set on GPS co-ordinates, we can fly the drone using the same flight data to compare scans over various periods of time to measure how much subsidence or coastal erosion there is."

Circumspectis is also using the technology to map to scale archaeological digs to model ancient villages, tin order to show just what they would have looked like.

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Solidworks 2018 increases Design for Manufacture capability

Powered by Dassault Systèmes' 3DEXPERIENCE platform, SolidWorks 2018 aims to support all engineering activities from design to manufacture with solutions that simplify the interactions between disciplines across the product development workflow. This unified process leverages smart manufacturing — a connected and seamless flow of data that is available to all teams involved in product development whenever, wherever and in whatever format is needed, without having to port data from one system to another.

"Lots of designs involve welding plate and sheet metal parts, and most people use 'tab and slot' techniques for self-fixturing the parts for welding," says Edson Gebo, owner of Digital Detail & Design. "The new tab and slot feature saves a lot of time, versus having to create these features manually. This will really help get designs to the shop faster."

With SolidWorks 2018, teams can collaborate concurrently to more rapidly and cost efficiently design a product or part, validate its function and manufacturability, manage its data and related processes, streamline and automate its manufacturing, and even inspect it. Any changes in design or manufacturing are fast and easy to manage, and automatically flow to all related models, programs, drawings and documentation, thanks to intellectual property embedded early on in the design process.

A key feature of SolidWorks 2018 for this process is SolidWorks CAM, a new application that provides rules-based machining with knowledge capture to allow for the automation of manufacturing programming.

Designers and engineers can gain a greater understanding of how their designs are made, make more informed decisions, and quickly create prototype parts and manufacture in-house to control quality, cost and delivery. This application also enables teams to execute new 'build to order' strategies with custom parts that are automatically designed and programmed in seconds, rather than hours.

A pilot scheme to clean up rivers that have been heavily polluted by abandoned metal mines is delivering "staggering" results

Vertical flow pond removal

'DEAD' RIVERS

Modern Wales has often paid a heavy price for its industrial past, which has left its deep scars scattered across the landscape. Long-abandoned metal mines, which once produced lead, zinc and copper, are now the source of severe pollution whose toxic discharges can have a huge impact on the water quality of the surrounding area.

Metal mining in the UK peaked in the 18th and 19th centuries and, though they have all closed, their effect on the environment is still all too evident. As Peter Stanley, geotechnical engineer in geoscience, Natural Resources Wales (NRW), says: "Wales has the challenging record of being home to nine of the 10 worst metal mine polluted catchments in the UK and overall has more than 1,300 abandoned metal mines, which impact on over 600km of river and 67 water bodies. Nine of the 10 worst affected metal mine catchments in the UK are in Wales. At the Cwm Rheidol mine, near Aberystwyth, in Ceredigion the polluted water discharging there has been directed to filter beds since the 1960s, in an attempt to remove the metals, with little success.

Elentec unit during construction

(Photo courtesy of Elentec)

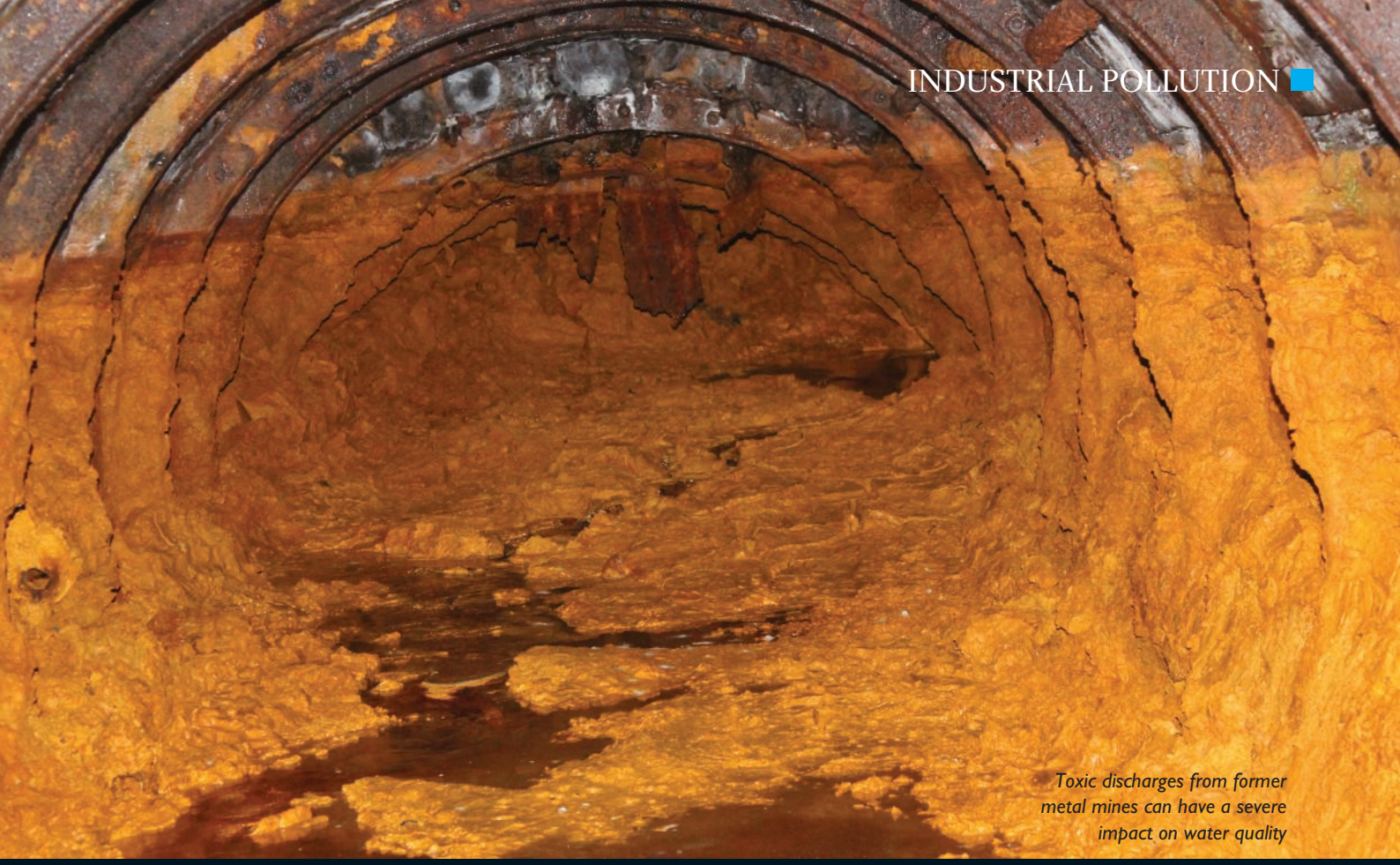
"More recently, treatment trials of a passive system (vertical flow pond, shown above) using a combination of compost, wood chips, cockle shells and digested sewage sludge over a limestone bed (by Dr Adam Jarvis of Newcastle University), have been more effective and subsequently scaled up at Force Crag, Cumbria," he adds.

"Yet implementing this technique at all major abandoned metal mine sites, in order to have a meaningful impact on the levels of pollution encountered, would require much more land than is available in, for example, this narrow, steep-sided valley," Stanley points out.

INNOVATIVE SOLUTIONS

The upshot is that NRW turned to the technology sector, asking companies if they could come up with an innovative solution. "Natural Resources Wales is responsible for tackling metal mine pollution and, over the years, we have earned the reputation for developing innovative and cost-effective solutions for dealing with such issues," states Stanley. "Two of our most successful innovation projects are at Cwm Rheidol and at Frongoch, and we recently took the opportunity to share our results with our partners in tackling mine water pollution."

That move is now paying dividends, with the fightback against such heavy



Toxic discharges from former metal mines can have a severe impact on water quality

brought back to life

pollution recently taking a major step forward. In fact, according to Stanley, a recent pilot scheme to clean up the rivers that have been so heavily polluted by the abandoned metal mines has delivered "staggering" results.

The treatment plant, which employs a sono-electrochemical technique, has been tested at Cwm Rheidol mine on a stretch of the river Rheidol. The area is popular with tourists for its scenic reservoirs, steam train and red kites, but it was once home to mines producing lead and zinc, which now discharge highly acidic, orange water into the river there.

Approximately eight tonnes of harmful metals, including zinc, cadmium, lead and iron, enter the Rheidol every year, impacting 11 miles (18km) of river, impoverishing its ecology. In extreme circumstances, rivers can be fishless.

Here's how it works. A portable treatment plant – the size of a car – is attached to a small generator. The system treats the polluted water discharged from the mine adits (entrances), using a combination of electrochemistry and 'soneco' ultrasound, correcting its acidity and precipitating metals. NRW reports that the new technology – thought to be a world-first – removed up to 99.5% of metals that impact water quality, with the technique being able to separate the metallic sludge, producing clean water as a result. According to NRW, this marks a potential "step change" in how the problem is handled.

CLEANING UP

Swansea-based Power and Water is the company behind the technology. "What we are able to do is to add a small amount of power onto an anode and cathode, which slowly dissolve into the [contaminated water]. That allows for a chemical reaction where any contaminants are removed and the clean water can safely be discharged," says chief executive Gareth Morgan.

The metallic sludge, which sinks to the bottom of the tank, can then also be removed safely. In future, it is hoped the sludge could potentially be sold and the metals extracted and re-used. The three-month trial – which cost approximately £90,000 – was funded by the Welsh Government's Contaminated Land Fund. Welsh Government has now given a further £3m of Revenue and Capital funding to NRW to tackle metal mine pollution.

Power and Water says it has been granted an international patent for the technology, which it hopes to install at other abandoned mines following the success of this trial. It reports interest from consultants working in Sumatra and Australia, as well as enquiries relating to mines in England and Scotland. "Not only are we looking to try to create a solution that is going to have a beneficial impact on these historical metal mines within Wales itself, but the potential to export outside of the country is exciting," adds Power and Water's Morgan.

So, what is the big advantage of the system trialled? "The mine is situated

Above: Floc on clarifying tank at Cwm Rheidol after set-up
Below: Tank after optimisation, with stirrer fitted

in a narrow, steep -sided valley," says Stanley, "which is unsuitable for traditional treatment processes, which require a considerable area of land." Preliminary laboratory results from tests carried out on the Power and Water system were encouraging, he adds, "and the small footprint of the equipment makes it particularly suitable to rugged upland locations where traditional passive pond systems simply will not fit".

MASSIVE REMOVAL RATE

Also, when NRW filtered the samples, it showed a 99.5% removal rate of metals, "which is quite staggering," adds Stanley. "I don't know how much more excited I could be, in relation to the results that have been shown here – it gives us a new tool in our armour to effect treatment at metal mines, particularly those in steep, challenging environments like this".

These independent laboratory results confirmed the treatment's success with raw samples, showing metal removal of 87%, while filtered samples confirmed 99.5% removal of metals. A full-scale system, benefiting from added filtration to reduce fine particulate matter, might well be expected to achieve 98% or more reduction of metal loading, he concludes.

Lying to the south east of Aberystwyth is Frongoch, another former lead and zinc mine that operated between the mid-18th century and 1905. Frongoch is the larger of the two sites and has already been the subject of extensive remedial

work, including intercepting and diverting streams, capping and landscaping much of the site to limit water entry and thus seepage, minimising the volume of polluted water entering rivers downstream.

While the work has dramatically reduced metals pollution, concentrations in the three discrete discharges from the site are still high. To combat this, trials are now underway with Elentec, a company located at Menai Bridge, which provides research-based water treatment solutions using an innovative approach involving an energy-efficient portable containerised electrochemistry unit. The unit is said to be ideal for upland terrain or adaptable for 'fly in, fly out' mine contracts abroad.

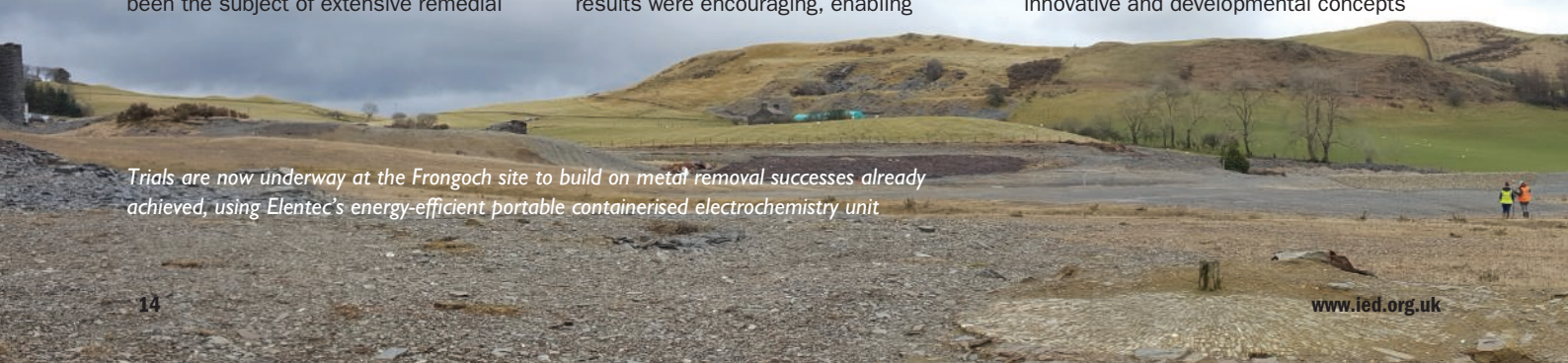
Says Stanley: "Two highly polluted sources which contribute 3.8 tonnes per year of zinc, lead and cadmium to Frongoch stream are collected and fed through the electrode chambers. The polluting metals are then separated from the water through precipitation in a purpose-built clarifying tank, allowing the treated water to be discharged. Preliminary results were encouraging, enabling optimisation of the treatment process to remarkably secure 99.9% removal of lead and 92% of zinc.

And there are spin-off benefits, too. "The success of the Cwm Rheidol and Frongoch trials has the potential to offer NRW and others interested in metal mine water remediation and the clean-up of metal mine process waters new tools for successfully treating harmful discharges. And it's not just the environment which will benefit from this technology; the Welsh economy could also receive a boost, as the companies involved in this work share the technology with overseas markets."

Ultimately, might remediation and/or metal mine water treatment prove to be cost neutral due, to the value of recovered metal? Sadly, not, confirms Stanley. "However, they can be used to offset costs and NRW is researching this with several R&D stakeholders. NRW's Metal Mine Team has used a Small Business Research & Innovation (SBRI) challenge-led competition [funded by Innovate UK and the Welsh Government] to assess varying technologies for metal mine water clean-up in steep upland terrain with a lack of infrastructure, such as transport and power."

Apart from Elentec's preliminary electrochemistry trial referenced above, this has included: use of iron ochre RAPS – Reducing Alkalinity Producing Systems – courtesy of Dr Devin Sapsford, Cardiff University; algae on which to harness metals by sorption (Steve Skill, Swansea University); and Allay (Algae & Clay) beads to use in a bed reactor to recover metals by sorption (Prof Chris Greenwell, Durham University).

"Being mindful of resource recovery as a means to offset remedial costs and by using interest expressed in the SBRI challenge, we developed a platform called the mineXchange for institutions, innovators, consultants and other interested parties to come together to learn of our programme and exchange innovative and developmental concepts



Trials are now underway at the Frongoch site to build on metal removal successes already achieved, using Elentec's energy-efficient portable containerised electrochemistry unit

in metal mine clean-up," adds Stanley. "The platform has been very successful in enabling R&D interests to be explored and tested for commercial applications."

MINDS ON MINES

The 'meeting of minds' has enabled the Metal Mine Team to collaborate, support and occasionally fund R&D research or developmental work. "We have supported the Cardiff University INSPIRE research project in the Resource Recovery from Waste (@RRfW6) programme." According to INSPIRE: "Societies have historically disposed of vast quantities of industrial, municipal, metallurgical and mining waste in the ground. Generally considered as a legacy waste issue, this research project seeks to reconsider waste repositories as 'resource hubs' for future recovery of valuable metals and energy."

Stanley adds: "Our objective is to explore whether energy and valuable metals can be recovered from landfills and mine sites in situ, thus avoiding the need to actively mine the material and thereby minimise ecological and environmental impacts." Precipitates from the Power & Water trial have also been supplied to Aberystwyth University, Cardiff University and Sheffield University for detailed chemical analysis, increase solid content of precipitates and assessment of resource recovery. The precipitate from the Elentec process has been supplied to SPECIFIC Innovation & Knowledge Centre at the College of Engineering at Swansea University, whom we have supported in Dr Darren Oatley-Radcliffe's successful bid with University of Vic (Catalunya) in their LIFE Demine project (http://mon.uvic.cat/life-demine/partners).

"They will assess particle size distribution, detailed chemical analysis, in order to understand improved harvesting of nanoparticulates, reduction of water content and resource recovery.

"Samples will be shared with Aberystwyth, Cardiff and Sheffield also, as the two discharges have significantly different characteristics, Cwm Rheidol being highly acidic pH ~3.0 and includes ~4T/yr Fe and combined concentration of Zn at ~17mg/l, whereas at Frongoch the discharge is circumneutral, includes very little Fe and combined concentrations of Zn at two groundwater discharges of 80-100mg/l," he explains.

Peter Stanley, of Natural Resources Wales: the Power & Water system showed a 99.5% removal rate of all metals, which is exceptional, offering new treatment opportunities

Stanley also reveals how Prof Barrie Johnson of Bangor University has considered biomining and sequential electrowinning for Parys Mountain, a huge open cast copper mine on Anglesey, which is unique to the UK in scale and metal loading discharge.

Both Johnson and Devin Sapsford (Cardiff University) have outlined opportunities to recover metals at Parys Mountain, in order to offset remedial costs and provide small-scale employment from artisanal creation of jewellery and cookery products.

At the same time, NRW remains interested in applications to recover enhanced products and is seeking to fund what it describes as encouraging work by Dr Sudhagar Pitchaimuthu (SPECIFIC IKC Swansea University). "This is novel to the UK, in developing organic waste-derived nanocomposite adsorbents to recover high value cadmium ions to produce nanoparticulate cadmium sulphide for use in thin film technology and photoelectrocatalysis, in treating metal mine water and breaking water, to produce H^+ energy."

NRW is also looking at aspects other than metal mine water treatment, such as: use of renewables; studies on bioaccumulation around Frongoch with Nottingham University; use of biochar and seed mixes at Frongoch and also Nant y Mwyn (varied R&D & commercial interests); synoptic sampling of small river catchments, by Dr Patrick Byrne, Liverpool John Moores University; and cultivating Canary Reed Grass and Miscanthus, with Dr Elaine Jensen and Dr Kerrie Farrar of IBERS, Aberystwyth University, to limit infiltration and erosion.

Clearly, NRW's vision when it comes to a cleaner, healthier environment, is a broad one. "As our programme develops, we also wish to trial and adopt IoT applications to measure performance of discharges, water quality and remedial systems, and help provide real-time data to colleges, schools and visitor centres," Stanley concludes.

SEA, NO CREW!

From RFID and drones to driverless vehicles, new technologies are starting to transform and enhance our world – now that focus is firmly on the seas and oceans

From driverless cars to automated subways, there is a seemingly unstoppable technological drive now impacting transport that is not only here to stay, but likely to take us into realms hardly imagined a few decades ago. However, while the focus has been largely on the many land vehicles that are being adapted to meet this rapidly altering landscape, marine transport is also staking a claim to the headlines. And it's no great surprise, given the need to embrace the many challenges that the industry faces around safety, sustainability and efficiency in particular.

A key driving force that lies behind the move is Rolls-Royce, which has set a target to have remotely controlled ships operating across international waters by 2025 – and, by 2035, these ocean-going 'intelligent' vessels ships are expected to be common sight on our oceans, travelling entirely unmanned.

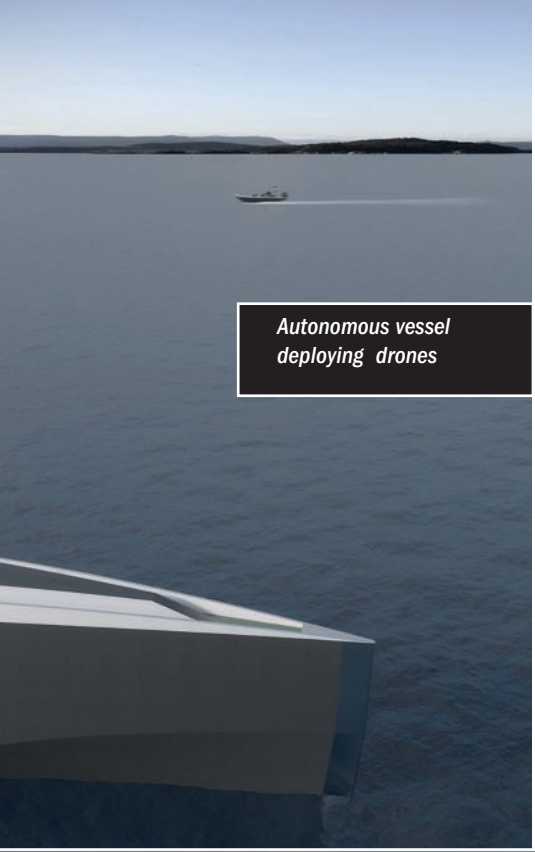
Rolls-Royce has mounted a joint industry project in Finland called Advanced Autonomous Waterborne Applications (AAWA), where the participants hope to create the technology for a remotely controlled or fully autonomous ship that will operate in coastal waters before the end of the decade.

And while it is seen as still too early for any specific engineering design strategy yet to be decided on, with regard to what the new breed of ships will look like, significant engineering design changes to vessels operating autonomously will be the inevitable consequence, it can be assumed. For example, with no humans on board, the design of autonomous vessels will differ significantly. According to IEEE Spectrum (the flagship magazine and website of the Institute of Electrical and Electronics Engineers), with no need for a deck house, crew quarters and heating, sewage and ventilation systems, the ships can have a larger cargo capacity, while also being lighter and sleeker, thereby cutting fuel consumption, and reducing construction and operating costs.

ON A MISSION

So, what exactly does Rolls-Royce have up its sleeve, so to speak? Recently, it revealed plans for an autonomous, single-role naval vessel, with a range of 3,500 nautical miles. The vessel concept suggests it would be capable of operating beyond the horizon for over 100 days, displace 700 tonnes and reach speeds above 25 knots. The 60m long vessel is designed to perform a range of single-role missions: for example, patrol and surveillance, mine detection or fleet screening.

At the heart of the vessel will be a robust and reliable power dense propulsion system. This combines Rolls-Royce's expertise in both gas turbines and diesels with a track record in electric propulsion, energy storage and propulsors. The initial design features a full electric propulsion system that requires fewer auxiliary systems (lubrication, cooling system etc) and is said to offer better reliability levels than mechanical counterparts. It features two Rolls-Royce MTU 4000 Series gensets, providing around 4MW electrical power to a 1.5MW propulsion drive. An alternative to diesel engines could be small gas turbines,



Autonomous vessel deploying drones

Marine transport is now also staking a claim to the headlines around autonomous 'vehicles'

further improving the system's reliability and reducing onboard maintenance.

Permanent Magnet Azipull thrusters, together with a bow-mounted tunnel thruster, will make the vessel highly manoeuvrable. To reduce fuel consumption and extend operational range, an additional 3000 kWh of energy storage will facilitate efficient low-speed loiter operations and the vessel will also be fitted with photovoltaic solar panels to generate power when the vessel is on standby.

According to Benjamin Thorp, Rolls-Royce, general manager Naval Electrics, Automation and Control: "Rolls-Royce is seeing interest from major navies in autonomous, rather than remote controlled, ships. Such ships offer a way to deliver increased operational capability, reduce the risk to crew, and cut both operating and build costs. Over the next ten years or so, Rolls-Royce expects to see the introduction of medium-sized unmanned platforms, particularly in leading navies, as the concept of mixed manned and unmanned fleets develops."

Larger manned ships will cover multi-role missions. By allowing fleet composition to be mixed in this way, navies will look to reap the operational and cost benefits offered by autonomous technology. The absence of crew increases the need for very reliable power and propulsion systems. Rolls-Royce's approach is to blend advanced Intelligent Asset Management and system redundancy in a cost-effective manner that avoids sacrificing the cost and volume savings achieved by removing the crew. A suite of autonomous support tools, developed by Rolls-Royce, such as Energy Management, Equipment Health Monitoring, and predictive and remote maintenance, will be tasked with ensuring the availability of the unmanned vessels.

PIRACY THREATS

The threat posed by piracy to ships and their crews would also be reduced, says the company. That's because uncrewed ships could be built so that they would be very difficult to board on the high seas. Even if pirates got aboard, it is argued, access to the controls could be made unavailable. Indeed, the computers in command could immobilise the ship or have it steam in a circle, making it relatively easy for naval authorities to reach the vessel and intervene. Recapture would also be easier than is usually the case in such situations, because there would be no crew to hold hostage. And without a captured crew to ransom, the target of the piracy is significantly less valuable.

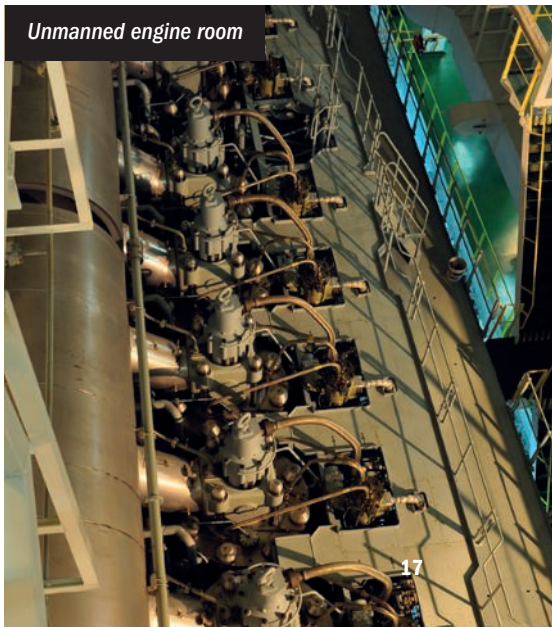
With AVs, the tasks of operating the vehicle are achieved using a remote-control mechanism. For instance, the ship's movements and operations might be controlled by a human operator, based on land. Autonomous vessels can also have advanced decision support systems on board, which drives all the operational decisions independently, without any intervention from a human operator. A pilot does go on board, however, at the end of a journey to guide the vessels into port.

The research project MUNIN (Maritime Unmanned Navigation through Intelligence in Networks) sees autonomous and unmanned vessels as a key element for a competitive and sustainable European shipping industry in the future. MUNIN is pursuing that vision by developing and verifying a concept for the autonomous ship where remote and automated technology are combined, in order to create the most successful ship. For example, MUNN emphasises the need for a range of sensor systems to detect unexpected objects in the sea, threats of collision and dangerous weather conditions. The challenge will be ensuring the sensors reliably detect dangerous situations and that these are acted upon appropriately. If an unforeseen situation takes places that the autonomous section of the vehicle cannot resolve, a request for support would be transmitted to a remote operator.

LEGENDARY STATUS

Interestingly, MUNIN is also a figure in the old Norse mythology. Here, the raven Munin flew around the world independently every day to gather information for its master, the Norse god Odin. In the evening, it would deliver the information – its cargo – safely and autonomously to wherever its master was located. The concept of an autonomous ship developed in the MUNIN project is, figuratively speaking, all about acting like its raven namesake: independently and safely bringing cargo to its intended destination.

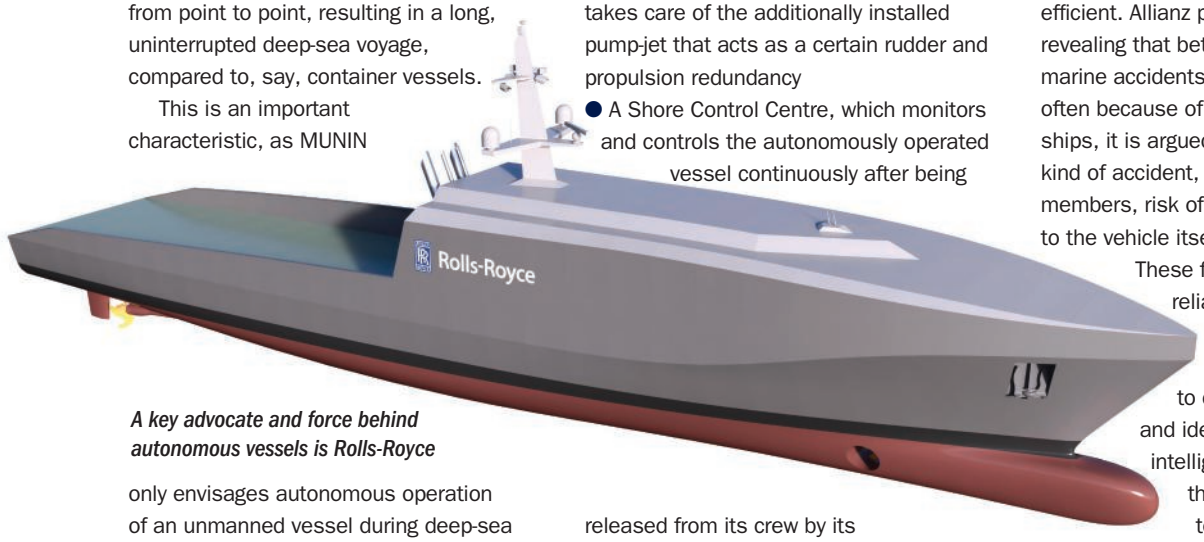
MUNIN itself emerged, not from Norse mythology, but from the strategic research agenda and implementation plan of Waterborne TP, a cluster of European maritime stakeholders, who published a vision paper for the future development of the maritime industry regarding competitiveness and innovation, while also considering safety and environmental requirements. A key outcome from that research was a commitment to the future of the autonomous vessel.



Unmanned engine room

The use case investigated by MUNIN in support of that agenda focused on a dry bulk carrier, operated in intercontinental trade. This type of trade bears a high attractiveness for the MUNIN concept, as additional cargo requirements are low, the appeal for slow steaming is high and dry bulk carriers normally transport cargo from point to point, resulting in a long, uninterrupted deep-sea voyage, compared to, say, container vessels.

This is an important characteristic, as MUNIN only envisages autonomous operation of an unmanned vessel during deep-sea voyage, but not in congested waters or during the approach. Those tasks would still be executed by a crew on board, though the deep-sea/voyage-length ratio is seen as an important economic factor for the operational efficiency.



A key advocate and force behind autonomous vessels is Rolls-Royce

NEW SYSTEMS ON BOARD

Restricted satellite bandwidth in certain regions and high communication costs make a simple remote-control solution unattractive, says MUNIN. Thus, it proposes a concept where the ship is autonomously operated by new systems on board the vessel, but the monitoring and controlling functionalities are executed by an operator ashore in the Shore Control Centre. Therefore, the MUNIN concept clearly defines the following systems and entities:

- An Advanced Sensor Module, which takes care of the lookout duties on board the vessel by continuously fusing sensor data from existing navigational systems, eg, Radar and AIS, combined with modern daylight and infrared cameras
- An Autonomous Navigation System, which follows a predefined voyage plan, but with a certain degree of freedom to adjust the route in accordance with legislation and good seamanship autonomously – eg, due to an arising collision situation or significant weather change
- An Autonomous Engine and Monitoring Control system, which enriches ship engine automation systems with certain failure-pre-detection functionalities, while keeping the optimal efficiency, and which takes care of the additionally installed pump-jet that acts as a certain rudder and propulsion redundancy
- A Shore Control Centre, which monitors and controls the autonomously operated vessel continuously after being released from its crew by its nautical officers and engineers.

The centre comprises, amongst other factors:

- A Shore Control Centre Operator, who monitors the ship operation of several autonomous ships at the same time from a desktop cubicle station and controls the vessels by giving high level command, such as updating the voyage plan or the operation envelope of the autonomous system
- A Shore Control Centre Engineer, who assists the operator in case of technical questions and who is in charge of the maintenance plan for the vessels, founded on a condition-based maintenance system, ensuring sufficient reliability of the technical system for the next autonomous journey
- A Shore Control Centre Situation Room Team that can take over direct remote control of one vessel in certain situations via a shore side replica of the unmanned vessels bridge, despite the physical distance of crew and vessel.

CONNECTED WORLD

The emergence of remote controlled and autonomous ships is, arguably, the inevitable result of increasing digital connectivity and intelligence. Developments in telecommunications, computing and electronic sensors have really driven the autonomous transport industry – planes, cars, trains and now ships. But what are the compelling benefits of these autonomous vessels?

First, it is predicted that they will be much cheaper to run, safer and more efficient. Allianz published a report in 2012 revealing that between 75% and 96% of marine accidents are due to human error, often because of fatigue. Self-driving ships, it is argued, would remove this kind of accident, reducing deaths of crew members, risk of injury and damage done to the vehicle itself.

These futuristic vessels will be reliant on multiple sources of information, of course; from weather reports to data about the position and identity of other ships, this intelligence will be crucial to the ability of these vessels to operate and navigate autonomously. While ship crews are already using many data sources on a daily basis, this will need to be stepped up a notch, in order for driverless ships to work.

Also, more sensors will be implemented on the ship – for example, embedded in its main engines, deck machinery and cranes. While data is important, the speed at which this is delivered is equally, if not more, pivotal, as autonomous/remotely operated vessels have a responsibility to transfer this data to shore in a timely manner. Constant real-time communication will therefore be essential.

While autonomous vessels are considered to be an exciting aspect of ocean-going travel in the future, the concept is still a long way from being home and dry, not least when it comes to the huge challenges that will have to be overcome around regulations and liability. Global shipping regulations are currently unclear about how these ships would be permitted and insured, while the industry is also facing concerns regarding who would be held legally responsible, in the event of an accident. However, as autonomous and remote-controlled ships come closer to reality, these issues are likely to be resolved. There just seems too much at stake for it to be otherwise.

World record attempt brought forward!

The time delay between conducting high-speed tests on the supersonic BLOODHOUND car and the first record attempt looks all set to be cut back. Richard Noble, project director, explains why

Two years' worth of discussions with a major third party has led, this month, to a very significant development – one that will greatly enhance BLOODHOUND's ability to raise funds and achieve its goals. We are in the middle of detailed planning, so can't divulge specifics, but we hope to be in a position to do so very soon.

There have been many false dawns over the life of the Project and we have, regrettably, but unavoidably, tested the patience of our friends, supporters and team. The BLOODHOUND leadership team firmly believes this development will be a game changer… but we want to prove this, not merely hope for it.

While intense fundraising activity has been ongoing, the Project has suffered a setback in the form of two important suppliers going into receivership before they were able to complete their work on BLOODHOUND.

In light of this, but with the very real prospect that our ability to raise funds is about to be transformed, the team has re-evaluated plans for running the car. The opportunity now exists to reduce the time delay between conducting the high-speed tests (known as 'BH500') and the first record attempt.

BLOODHOUND SSC will therefore be flown to Northern Cape, South Africa, in May 2019, ready to take advantage of a desert surface freshly conditioned by seasonal flooding. A record attempt will be made later in the year (October – November). The car will remain in South Africa between events, greatly reducing logistics costs.

Development of the mono-propellant rocket required for the first record attempt will resume in August 2018, with tests taking place at Newquay Aero Hub, scene of BLOODHOUND SSC's successful 200mph shakedown runs.

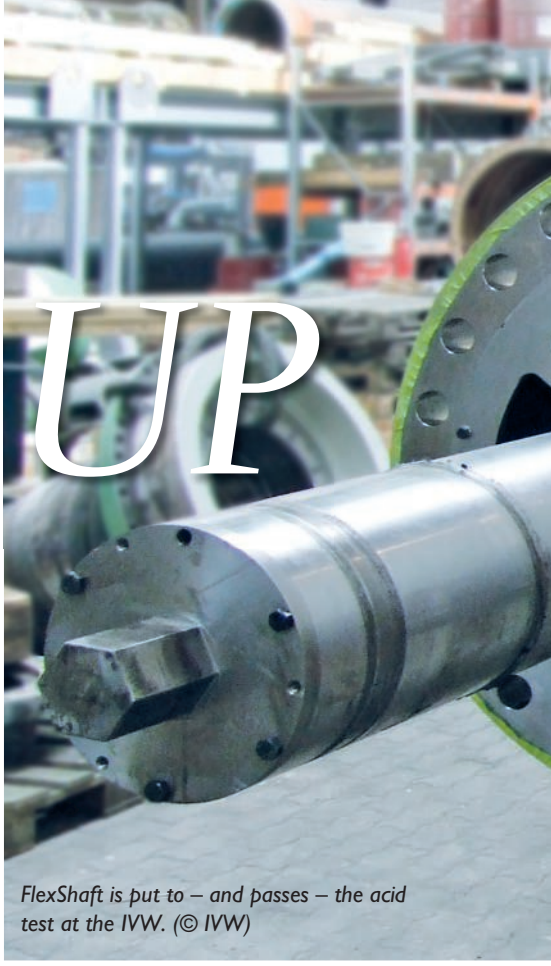
The BLOODHOUND Project is an international education initiative, focused around a 1,000mph (1,609km/h) World Land Speed Record. The primary aim is to inspire the next generation of scientist and engineers by showcasing STEM subjects (science, technology, engineering and mathematics) in the most exciting way possible.

BLOODHOUND SSC is a combination of fast jet, F1 car and spaceship. The Project is followed in over 220 countries and territories. At full speed, BLOODHOUND SSC will cover a mile (1.6km) in 3.6 seconds – that's 4.5 football pitches laid end to end, per second, or 300m in the blink of an eye. The World Land Speed Record of 763mph (1,228km/h) is held by Thrust SSC, a UK team led by BLOODHOUND's CEO Richard Noble and driven by Andy Green.

The Project engaged with over 130,000 students in the UK alone in 2017 and aims to deliver BLOODHOUND educational events to 3.5 million students around the world. Reassuringly, 65% of students engaged by the BLOODHOUND Education Programme would now consider engineering or science as a vocation (sample size: 1,804). Meanwhile, applications to study engineering at university have increased as a result of Project BLOODHOUND (sources: University of West of England; University of Swansea).

Powering UP

Lightweight construction and fibre composite technology make modern wind power systems even more sustainable and efficient, helping to lower energy costs and secure energy generation - and the technology is rapidly maturing



FlexShaft is put to – and passes – the acid test at the IVW. (© IVW)

Wind turbine technology has developed and matured over the years, and this technology now forms an increasingly important part of the UK's electricity industry. Renewable energy is vital in the fight against climate change and technologies such as wind energy can help in building a sustainable electricity generation system for the future.

Cost-effective and low-maintenance wind turbines are significant factors for the continued growth in the successful development and expansion of such energy initiatives. And with their low specific weight and high fatigue-resistance properties, fibre-plastic composites (FPC) play a key role in ensuring this continues.

In 2014, Germany's wind turbines supplied 35,678 MW of power. Europe-wide, in 2015 alone, 12,800 MW new wind power capacity was installed, an increase of 6.3%, compared to the previous year, according to Wind·Europe, formerly known as the European Wind Energy Association.

In the production of such gigantic rotor blades as are in action today (see panel text), glass fibre-reinforced plastic (GRP) is increasingly being replaced or supplemented by lighter and stiffer carbon fibre-reinforced plastic (CFRP). Other construction elements made of fibre-reinforced plastic (FRP) as the load-bearing material can include generator shafts, rotor hubs or parts in the tower and in the nacelle.

PIONEER OF POWER

An important pioneer in the use of composite materials in wind power generation was the engineer professor Ulrich Hütter. Under his overall control, in 1957 wind turbines were fitted with rotor blades made of glass fibre-reinforced plastic (GRP) for the first time. Back then, they were 17 metres long. Initially, the power produced was approximately 10 kilowatt; today, more like 8-10 megawatt (MW) is possible, even offshore. Modern turbines are up to 200 metres high; their rotor blades are up to 85 metres long.

BEARING FRUIT

The most urgent challenge is first to build large rotor blades, from 70 to 90 metres long. Their production currently still takes around 48 hours and thus accounts for 15-20% of the total costs. Cost and processing-optimised materials, and a corresponding process chain, are therefore required. At the same time, the blades must become more effective and their aerodynamic efficiency increased.

The way forward, it has been mooted, would be to develop bearingless rotors, optimise the CFRP production processes, automate blade production and operate integrated health monitoring. As far as bearingless rotors are concerned, the problem here is the size. Yes, there are lots of smaller versions now in use, but the scale that would be needed for this application puts it outside current experience. The reality is that there's a lot of development work to be carried out before reliable ones find their way into general use. Meanwhile, large potential also lies in further development of so-called 'smart blades' – ie, 'intelligent' rotor blades that adapt to the wind.

This corresponds with the findings of the Nova (Novel Offshore Vertical Axis) turbine project at Cranfield University Composites Centre. In general, the project was about understanding of the engineering performance and aerodynamic behaviour of the design in offshore operational conditions and the composite materials chosen. In particular, it was about designing a 10-MW offshore wind turbine. And a special one with, when built, two 160m arms supporting two 80m-long V-shaped sails. The central section box of each sail has two C spars with ribs and omega-shaped hat stringers to impede buckling. A smaller scaled prototype had already been carried out, with components made from multi-directional carbon fibre fabrics and epoxy resin using a vacuum infusion moulding process.

Bearing in mind the length of the scaled-up 10 MW wind turbine sails (ie, 80 m), every way of reducing weight in the overall sail design is critical.

Further developed composite materials have an important role to play in every respect. Schäfer MWN GmbH (:CCOR) and the Institut für Verbundwerkstoffe GmbH (IVW, Institute for Composite Materials) in Kaiserslautern, for example, jointly developed a heavy-duty, low-maintenance torsion shaft made of CFRP for a two-blade

ABOUT CARBON COMPOSITES E.V

Carbon Composites e.V. (CCeV) promotes the use, research, and economy of fibre composite materials in Germany, Austria and Switzerland. The network was founded in 2007 and now has around 300 members. Thus, CCeV is the largest German-speaking association of companies and research facilities covering the entire value-added chain of high-performance fibre composites.

The activities of CCeV concentrate on the "marketable high-performance fibre composite structures" product group. The focus is on the fibre composite structures with plastic matrices, as already familiar to the general public from a wide range of applications, as well as fibre composite structures with ceramic matrices which enable higher temperatures and wear resistance.

Envision offshore wind turbine with 3.6 MW output. This malleably designed FlexShaft can even transfer high torsional moments (torque) of up to 5000 kNm directly between the rotor hub and generator.

FlexShaft prototype with CFRP torsion shaft for two-blade wind turbines. (© Envirion)

HORIZONTAL VS VERTICAL

The advantages of lighter and more rigid CFRP components and carbon composites are universal, even if their consistent installation sharpens specific advantages of different technology versions, such as the case of horizontal and vertical rotors. Wind turbines with a horizontal axis have a higher efficiency at converting wind energy into electricity. As they supply more electricity, they are considered to be more economical and therefore have become dominant in the commercial wind power market. However, horizontal axis wind turbines have to turn towards the wind, mostly tower high in the air and, with their equally high nacelle, their maintenance tends to be expensive and time-consuming.

Vertical axis turbines, on the other hand, including their electrical generators, can be built significantly lower, so they are easily accessible – eg, for maintenance reasons. The very same feature makes them more suitable for smaller turbines; for example, in towns and cities, and for weak wind areas. They respond to wind from all directions, while not needing yaw mechanisms, rudders or downwind coning. Once operating – some vertical axis wind turbines are not self-starting – these types are considered safer than their 'bigger brothers', due to their lower rotational speeds. And, last but not least, vertical axis wind turbines are also often perceived to be 'more attractive' or visually more interesting. Both technology versions however benefit significantly from light and stiff, yet flexible, components made of CFRP materials.

SUCCESS FACTORS

The visual, or rather emotional, aspect mentioned above is also of high importance for another reason and in a different, not quite so obvious, way. How people feel about even seemingly minor aspects is important, because the basis of each further development is at least equally high acceptance for regenerative energy in politics and society. Crucial assistance for this lies in consistent and reliable information of experts and, above all, the public. This is an aspect that responsible networking groups, like the German Carbon Composites e.V. (CCeV), are persistently working on. More 'technical' optimisation potential is provided by the life and quality of the

Pride in production – Sinoi employees in front of the SI 50.3 rotor blade they made (© Sinoi)

materials themselves, bird and lightning resistance, corrosion and erosion, and the topics of remote monitoring, transport properties, installation, maintenance and recycling.

Experts anticipate significant further innovations and pilot projects for large turbines in offshore usage and in weak wind areas. Three other areas of work with large potential are wind power use for hydrogen production, for the production of methane gas through reaction with CO_2 and water, and the coupling of wind and hydropower.

RELIABILITY

Taking a step back, however, is it possible – or even wise – to put our reliance in wind energy? According to The British Wind Energy Association, there are many misconceptions about how this natural source is generated. "Wind generation is often described as intermittent, as the wind does not blow continuously. This is a misnomer, as it implies an 'all or nothing' delivery of energy. An individual wind turbine will generate electricity for 70-85% of the time and its electricity output varies between zero and full output in accordance with the wind speed."

The key point to be aware of here is that the combined output of the UK's entire wind power portfolio shows less variability, given the differences in wind speeds over the country as a whole. "Whilst the amount of wind generation varies, it rarely (if ever) goes completely to zero, nor to full output. In order to maintain security of supplies, a second-by second balance between generation and demand must be achieved. An excess of generation causes the system frequency to rise, whilst an excess of demand causes the system frequency to fall," the association points out.

The electricity system is designed and operated in such a way as to cope with large and small fluctuations in supply and demand. No power station is totally reliable and demand is also uncertain. "Therefore, the system operator establishes reserves that provide a capability to achieve balance, given the statistics of variations expected over different timescales. The variability of wind generation is but one component of the generation and demand variations that are considered when setting reserve levels."

Installation of 3.4 MW 114 turbines in the Schleswig-Holsteinian town of Nortorf. (© Senvion)

The GB system operator National Grid Transco states in its Seven Year Statement that "based on recent analysis of the incidence and variation of wind speed, we have found that the expected intermittency of wind does not pose such a major problem for stability and we are confident that this can be adequately managed".

A final word on wind turbines and the numerous reasons why the development of large machines is gaining so much traction. "Minimising the number of turbines in a wind farm leads to lower expenditure on electrical interconnections, roads, numbers of foundations and transport movements," states the Institution of Energy & Technology's David Milborrow. "In addition, tall wind turbines intercept higher wind speeds and so deliver more electricity."

INNOVATION AND EXPERTISE

Innovations in composite materials and structures are essential for the low carbon economy, for producing efficient, lightweight vehicles and components used for renewable energy generation at low cost.

With its advanced design and manufacturing capability, Cranfield University's pioneering Enhanced Composites and Structures Centre is an established partner to manufacturers and the members of their supply chains through short courses, consultancy and research. The centre investigates and develops materials and processing technology for lightweight and efficient structures, and combines an expertise in low-cost manufacturing with modelling, simulation and structural health monitoring technologies.

Its research into the development and processing of carbon fibre multi-axial fabrics is now part of the Airbus A380. The centre has also produced a complete unmanned aircraft airframe using low-cost composite manufacturing (FLAVIR Project); composite reinforcing techniques for aerospace landing gear; sensors for built-in detection of structural degradation; and a cost model for composite design and manufacturing.

The team designed and manufactured a successful experimental aircraft airframe, and an ultralight carbon fibre body for the Nissan UK hybrid supercar, demonstrated at the Goodwood Festival of Speed.

The centre is a core partner in the strategic EPSRC Centre for Innovative Manufacturing in Composites (CIMComp), supported by major manufacturers. (https://epsrc.ukri.org/research/centres/innovativemanufacturing).

Soaring through virtual aviation

A whole new vista is being opened on the world of aviation design – and it's only likely to take off even more from there

Stanley G. Weinaum described virtual reality (VR) back in 1930, long before the term was coined. In 'Pygmalion's Spectacles', he explored the idea of a pair of goggles that users would wear to experience fictional worlds. Now, virtual reality headsets are taking the world by storm; and not just across consumer electronics fields. Industries such as the aviation and manufacturing sectors are also starting to use VR during the design process in highly productive ways.

"By designing aircraft in virtual space, designers can explore a virtual mock-up of the entire aircraft and work to eliminate issues faster than normal," says Geoff Turner, business consultant at product lifecycle management (PLM) company Design Rule. "For example, should a vital gauge or access point be blocked by panelling, it can be easily adapted in a VR design in a space of hours, instead of taking weeks with prototyping and testing processes.

"As Robert Thierauf explains in his book 'Virtual Reality Systems for Business', VR systems can save millions in development costs by eliminating the need for full-scale prototypes. For example, Thierauf says: 'Boeing is using VR for use in designing and testing new commercial aircraft and has helped development teams address human-factor issues in preproduction designs.'"

It's not just the maintenance and engineering elements of aircraft that are being designed in virtual spaces. Airbus has been working with VR technology since 1997 and uses Ramsis, or the realistic anthropological mathematical system, for interior simulation.

According to Airbus engineer Dieter Kasch: "You can install a seat, calibrate it with the interiors theme, and then sit in the aisle or window seat and see different views of your cabin from these varying positions. The important thing is that clients can now see what they're going to get. Changes at a late stage cost time and money, so it helps us deliver our aircraft on time and on budget."

Not only does this way of working save time and money in the design process; it also means passengers will have a more comfortable and ergonomic journey, comments Turner. "The space for a passenger's knees and feet, for instance, can make the difference between a comfortable journey and an experience similar to being a tinned sardine. If these elements have been thoroughly checked and tested in the virtual design phase, it is more likely to increase passenger comfort levels in reality, too."

Virtual reality has extended the horizon of what design engineers can create and experiment with, without having to invest in costly and time-intrusive prototypes. This also enables quicker management decisions and the ability to adapt to industry innovations. Moving forward, organisations such as Airbus are already looking into virtual simulations, fully interactive elements and a developed sense of realism in the virtual world through integration of other senses, like touch and smell. "The use of virtual reality in the aviation sector isn't going to be landing anytime soon," concludes Turner. "In fact, it's only just taking off."

Engineering a BETTER WORLD

Globally, millions of newborns are at risk of lifelong disability and even death from what are recognised as easily treatable conditions. Solving these kinds of problems is exactly what motivates Design that Matters (DtM)

Founded in 2003, DtM is a non-profit organisation that is committed to innovative design that helps improve healthcare in underprivileged communities. The organisation began focusing on medical devices back in 2010 – collaborating with leading social entrepreneurs and hundreds of volunteers to solve problems in global health.

DtM is recognised as an international leader in human-centred design, rapid prototyping and low-volume manufacturing, which allows the team to deliver breakthrough global health technologies to niche markets at a fraction of the traditional R&D investment.

For DtM, rapid prototyping is crucial. The process gives the company the freedom to experiment with numerous iterations of the overall medical device form factor, user interface and key components. And, with the right hardware, this process reduces product development time. DtM recently started using the Lenovo ThinkStation P900 series, which allows the organisation to generate three or four renderings in the time it used to take to do one. This turnaround is mission-critical to ensure the team can conduct user testing more quickly in the field with doctors and patients to ensure they're delivering what they really need.

One example of this collaboration is DtM's work with medical device company Medical Technology Transfer and Services (MTTS). Since 2009, MTTS has used its local connections to direct DtM to hospitals in need for the testing of new medical devices. Now, DtM comes back to those hospitals to try out new device prototypes, knowing that doctors and patients will provide honest feedback that results in speedy adoption.

Over the years, DtM has developed several notable devices, including; Pelican, a portable pulse oximeter that allows low-skilled community health workers to diagnose pneumonia quickly in new borns; Otter, a simple and easily cleaned newborn conductive warmer that helps to prevent hypothermia; and Firefly, a newborn phototherapy device for low-resource hospitals, helping treat jaundice. This device has been used on a total of 35,000-plus newborns in more than 20 countries to date.

A newborn phototherapy device helping treat jaundice in low-resource hospitals

Based on experience, DtM has learned that people aren't going to use a device, unless it works within their context. Medical device standards are often written for US, European and Japanese use, but, when devices are placed in a rural hospital in Africa, there are often challenges to local adoption. For instance, large pieces of equipment with tiny casters assumes smooth floors and working elevators, which are often uncommon in underprivileged countries. To ensure products meet the needs of communities, DtM takes three steps: identify the opportunity, conduct design research and build partnerships.

First, the team looks at how the design of a device contributes to healing sick patients. Then the team researches everything, including how to solicit feedback from countries that do not speak their language. To get the answers they seek, the DtM team must know how to work with translators, frame questions and understand techniques for illuminating gaps between what people say and what they really do.

"One of the biggest challenges we see is that needs don't always equal markets," says Timothy Prestero, CEO of Design that Matters. "There are disconnects between the organisations

DtM is a small organisation making a huge impact, with the help of the right technology and hardware

or individuals that fund healthcare, those that select the medical equipment and those that use it. On top of this, hospitals routinely receive donations of equipment they cannot use. In fact, the World Health Organization estimates that up to 80% of donated medical equipment is never used," he states.

To combat this issue, Prestero and his team work closely with people in the communities they serve to ensure that every stakeholder is involved from the very beginning to avoid any miscommunication between the creators and the users. With this in mind, the team is able to consistently provide devices that meet the needs of those they serve.

To design these life-saving devices, DtM requires technology and hardware that is reliable anywhere – from its headquarters to rural clinics across the world. Along with its ThinkStation P900 series, Lenovo's mobile workstations offer DtM flexibility to do work in the field, allowing its members to share design updates on the fly.

"We're not simply sitting in an office, developing product; we're out in the field, understanding the environment it will be used in," he says. "Because of this, our hardware must be indestructible, with tremendous power, so we can prototype quickly – and ultimately get the devices out there to start saving lives."

DtM is a small organisation, making a huge impact with the help of the right technology and hardware. It also recruits numerous volunteers and students – exposing them to problems faced by poor communities and empowering them to realign their life trajectories to focus on careers in the social sector.

"DtM is committed to increasing our results and impact by building the next generation of social impact designers," adds Prestero. "We have a growing network of over 1,200 staff and volunteer alumni who have embraced the organisation's mission, and we will continue to recruit and train these future social sector leaders through our open, collaborative design process."

While DtM may be developing ground-breaking devices now, its overall vision is that each product developed will become the standard of care in low-resource settings, giving the non-profit body the ability to focus resources on even more high-burden global health needs. Prestero concludes: "We want to design for outcomes. Our mission isn't to make beautiful stuff – it's to make the world a better place."

Improving experience

Meanwhile, the use of metal-based additive manufacturing machines in hospitals is now enabling medical professionals to pioneer the use of

custom-made implants for use within the NHS, as Amy Davey, a reconstructive scientist at North Bristol NHS Trust, explains: “Additive manufacturing is a burgeoning technology in hospital environments. In the last few years, there has been a significant shift towards patient-specific implants (PSIs), which previously would have only been used for very complex cases.

“Today, they are beginning slowly to be used in everyday practice. PSIs can be produced by additive manufacturing (AM) in several different materials for medical applications; and it should be borne in mind that AM is still only a relatively new technology for the medical sector.”

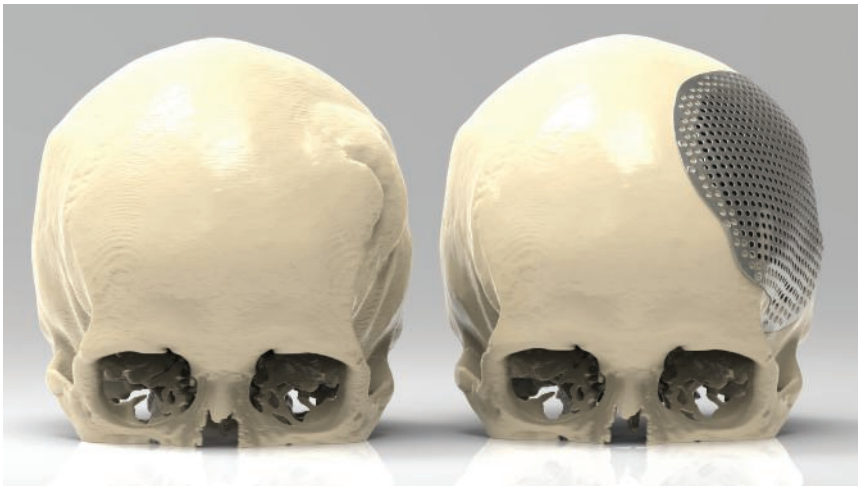
Why AM? “It offers several benefits over traditionally made implants, including fewer geometric limitations on implant design,” she points out. “Implants created using AM technology are built in layers from powdered metal, resulting in fewer restrictions on what can be manufactured. What were extremely complex structures are straightforward to manufacture using AM.

Once an implant has been designed, the hospital can send the design to a third-party company, such as Renishaw, for manufacture

“AM implants are now commonly used in Southmead Hospital, Bristol, for craniomaxillofacial (CMF) procedures. Prior to adopting the AM implant technology, the prosthetics team would produce a 3D model of the patient’s skull from a mould made of dental plaster and stone. This would then be employed to press a sheet of titanium to form the implant.

“Additive manufacturing eliminates the need to make a mould, as the implant is produced on an AM machine using digital data, speeding up both the design and manufacture processes. Models required for surgical planning can also be printed from a patient’s CT data and integrated with surgical planning software to produce a digital 3D visualisation,” Davey adds.

“From my experience, I have found it very straightforward to adapt to the new technology. However, it is important that work continues to develop on more advanced software packages, as current options require highly trained and experienced members of staff to do the design. In Southmead Hospital, we use a platform called Geomagic Freeform Plus to design the implants.”

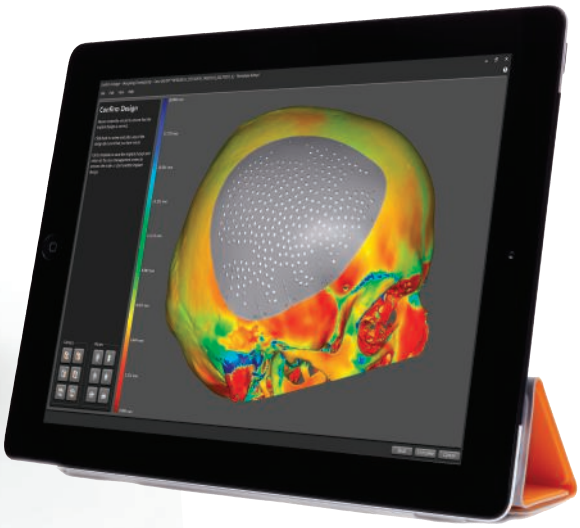


In future, software packages such as ADEPT, available from Renishaw, will make the design process even more straightforward, she states. “ADEPT is computer-aided design software that has been specifically created for the rapid design of craniomaxillofacial, PSIs by metal 3D printing.

“Once an implant has been designed, the hospital can send the design to a third-party company, such as Renishaw, for manufacture. Additive manufacturing produces precise guides, models and implants to the surgeon’s specification, which can improve the outcome for the patient as it allows for a quicker procedure, less surgery time and an accurate fit with good aesthetics.”

Opening doors

Additively manufactured implants are helping to improve treatment processes and decrease procedure revision numbers and times, which can also reduce costs for the NHS and provide better patient outcomes, comments Davey. “There can be greater benefits in more complex cases. However. AM technology can still help to streamline



surgery for less complex procedures. Surgeons are able to carry out careful pre-planning, which means they have reduced spans of problem solving during surgery."

Fewer procedures

The implants offer improved treatment processes for patients. "One major advantage is the reduction in the number of procedures a patient may need," she says. "Traditionally, if a patient had a particular cranium tumour, a surgeon would first have to remove the tumour and close the wound. The patient would then require further CT scans to determine the size of the cranial plate needed. The surgeon would then perform a second procedure to insert the implant.

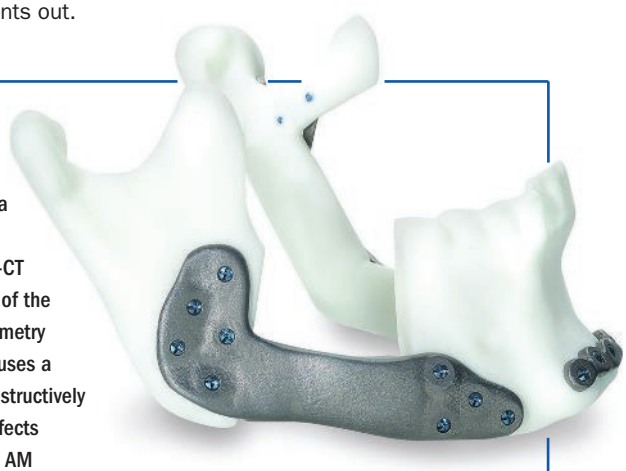
"By using surgical planning software and AM technology, the surgeon can pre-plan before surgery. Custom AM surgical guides and implants are also created before surgery. The guides allow the surgeon to remove the tumour and place the cranial plate, in one surgical procedure, with precision.

Improved surgical planning streamlines the surgery process, leading to a reduction in theatre time, which, in turn, can reduce NHS costs, Davey points out.

"In order for the technology to reach its potential, industry and healthcare need to work together to progress it further by developing a body of evidence demonstrating the efficacy and benefits both to the hospital and patients.

"It is also important that early adopters of the technology, such as the team in Southmead Hospital, apply their knowledge to drive the technology forward to also reinforce that the additive manufacturing of implants could improve not just patient care but could also be of financial benefit to health services."

CT scan data drives implant design



Replacement jaw implants have been made to treat temporomandibular joint endoprostheses, which severely reduces many facial senses.

Typically, implants are made from medical Grade-5 titanium alloy Ti6Al4V by direct laser metal sintering. For its surgical guides and implant models, a biocompatible polymer PA 2200 (also known as Nylon-12) is selective laser sintered.

Medical CT scans are the basis for preparing the CAD model, while inspection of AM parts is carried out with a Nikon Metrology industrial, high voltage, micro-CT scanner.

Milda Jokymaityte, clinical engineer at Ortho Baltic, explains: "To create anatomical models, 3D reconstruction engineers use the patient's radiological data to perform a 3D reconstruction."

A Nikon Metrology XT H 225 micro-CT scanner is used to monitor the quality of the final part and inspect the external geometry and internal structure. The inspection uses a 225kV micro-focus source that non-destructively reveals any voids, cracks and other defects of the complex internal features of the AM components.

Domantas Ozerenskis, product quality manager at Ortho Baltic, adds: "Micro-CT scanning is the only way to non-destructively check for voids and cracks inside a part.

"We considered a coordinate measuring machine, but it is inconvenient for taking non-parametric measurements and there is no possibility for inner structure investigation.

"The internal quality of implants is very important, as it determines the part's mechanical strength."

After 3D metal printing, post-processes such as sandblasting and polishing can remove thick surface layers up to 200µm – even more in the case of other manual processes. It means micro-CT data can also help adjust CAD models to reflect a part's final geometry.

Obituary
Ray Wadey CEng REngDes FIED

Ray Wadey will be known to many Members of the Institution – through his role as Chair of MemCo and his many interviews, talks, assessments and journal articles, Ray contributed greatly to the work of the IED over the past 60 years.

Ray started his career as an apprentice toolmaker in the aircraft industry. His National Service was spent with the Royal Navy where he trained to be an electrician. He went on to study at Croydon Technical College, gaining an HNC in Production Engineering and it's there that he caught the bug for design. His subsequent career was eclectic, including design work on: fork lift trucks, aircraft, medical equipment, televisions, earth-moving equipment, gas cookers, plastics and glass. He retired as Managing Director of his own consultancy, Micro-Precision Instruments, specialising in bioengineered orthopaedics.

He joined the IED in 1959, as an Associate, whilst working as Chief Designer at Mullard. By 1981, he had gained CEng registration, he became a Registered Engineering Designer in 1991 (specialising in electro-mechanical equipment in the surgical field) and was elected to Fellow in 2000. He joined the Membership Committee in 1974, on which he served for 30 years, including time as Chair. During that period, he carried out hundreds of assessments and interviews, wrote articles and technical papers for the journal, and represented the IED on other bodies. Ray was presented with the Founders Award in 2005 in recognition of his dedicated service to the Institution.

Ray was a gentleman, a stickler for standards and accuracy, a mentor and friend to many. He will be missed and our thoughts are with his family at this difficult time.

Elections & Registrations

Registration as CAD Practitioner

Karoly Geberta	Wiltshire
Jonathan Woolford	Hampshire

Election to Member

Alan Boyd	Belfast
Javier Ceballos	Scotland
Tom Channell	Southampton
Jacek Dyrlaga	Poland
Karoly Geberta	Wiltshire
Drew Kendrick	Flintshire
Caroline Keenan	Cheshire
David Kerr	Manchester
Chris Lamerton	Derbyshire
Jack Lennie	Midlothian
Karim Mahrach	Surrey
Mark Mihell	Hampshire
Daniel O'Connell	Hampshire
Max Pownall	Nottinghamshire
Paul Russell	Warwickshire
David Walker	Lancashire
Matthew Watkins	Nottinghamshire
Timothy Whitehead	Leicestershire
Ian Wise	Monmouthshire
Jonathan Woolford	Hampshire

Election to Student Member

Macau University

Sau Man Lau	Hong Kong

Open University

Waldemar Stanislaw Kwolek	Wiltshire

University of London

Thomas Childs	Hertfordshire

Runshaw Adult College

Dominic Howorth	Lancashire

University of Middlesex

Edward Anderson	London
Tommy Arno	Middlesex
Yash Akhani	Middlesex
Mubarak Bahwan	London
Benjamin Brook	Somerset
Will Davis West	Yorkshire
Jenson Gurung	Hampshire
Marlon Gwira	London
Muhammad Javed	London
Steven Landeta	London
Raj Manandhar	London
Joana Miranda	London
Daniel Newton	London
Chibulke Okpaluba	Warwickshire

University of Strathclyde

Bethany Ripley	Surrey

Manchester Metropolitan University

Maximilien De Ville De Goyet	Belgium
Harris Richards	Lancashire
Scott Richardson	Leeds

University of Nottingham Malaysia Campus

Mohamed Amsal	Maldives

Election to Affiliate

Elizabeth Dallinger-McConville	Merseyside

Hopes soar for fire-ravaged Mackintosh building

News Pictures / Alamy Stock Photo

Hopes have been raised that Glasgow School of Art's Mackintosh building, which has been gutted by fire for the second time in four years, can be saved.

Conservation experts believe that a fresh recovery project could build on the detail, skill and knowledge accumulated during the restoration of the treasured Mackintosh Library, which was almost destroyed by a blaze in May 2014.

But there were also warnings of the scale of the task. One expert estimated that, even if any such work was possible, the cost would be at least £100 million.

Claudio Divizia/adobestock.com

Disbelief and sympathy has been expressed across the world over the misfortune of the building, considered the masterwork of the art nouveau architect and designer Charles Rennie Mackintosh, after it was engulfed in flames for a second time. More than 120 firefighters and 20 fire engines were called to tackle the blaze. An investigation into the cause was underway as Engineering Designer went to press.

Meanwhile, a spokesperson for the British Automatic Fire Sprinkler Association stated that plans for a fire suppression system to be activated were well advanced when the blaze tore through the building. Keith MacGillivray, chief executive of the British Automatic Fire Sprinkler Association, told BBC Scotland: "The pumps for the fire suppression system were there at the school of art the day before the fire. They are very large pumps, so they were delivered in component parts. It would have taken some weeks to reassemble the pumps and connect up the pipe work and obviously the water tanks would have had to be connected and put in place as well. Everything would also would have had to be tested thoroughly before being made operational."

To be hit by two fires in four years is a double tragedy. The Mackintosh building was at the centre of a £35 million restoration project when the latest blaze broke out. The earlier fire began when flammable gases from a foam canister used in a student project were ignited accidentally. A report by the Scottish fire and rescue service concluded that old ventilation ducts helped it spread into neighbouring studios and upwards through the building.

Some of those who viewed the site after the latest inferno have raised concerns about whether the building's stonework would survive a second round of intense heat. But Miles Glendinning, professor of architectural conservation at the University of Edinburgh, told The Guardian newspaper: "When a building has multiple fires, it doesn't mean that it can't be saved, so long as the shell is still there it is still possible to do." Glendinning pointed to the extensive post-war reconstruction undertaken in Germany, where many key public buildings were damaged by fire – some more than once."

He said a combination of photographs and very detailed measurements were used to create a 3D image of the whole building, which could now be converted into contract drawings for restoration architects.

Dundee schools wow judges in eco-science challenge

Pupils from schools in Dundee, Scotland, recently celebrated completion of a competition designed to launch them into stellar careers in science, technology, engineering and maths (STEM).

The Go4SET competition 'Celebration and Assessment Day' was held at the spectacular venue of Abertay University and pupils got the chance to showcase their hard work to a panel of expert judges, plus guests from industry, government and the pupils' families.

Pupils from Baldragon Academy, Morgan Academy, Montrose Academy, Perth High School, Brechin High School, Webster's High School, Monifieth High School and Mearns Academy attended the competition. Prizes awarded on the day included Best Teamwork, won by Monifieth High School, and the Pupils' Choice Award, which went to Montrose Academy. The judges awarded the overall prize to Webster's High School for producing the most innovative project and professional report. The team will now go on to compete in the National Final, supported by their mentor company BEAR Scotland.

The Go4SET competition encourages S2 pupils to "go for it!" and pursue further education, apprenticeships or careers in science, engineering and technology, getting them out of the classroom and giving them first-hand experience of the workplace.

For a total of 10 weeks, 12–14 year olds work in teams of six with an industry mentor on STEM-themed projects that are based around real-world problems which need to be solved - ranging from environmental issues to finance and technology.

Young engineers triumph

In another cause for celebration for Dundee, a team of young engineers from the city's Grove Academy have seen off their rivals in an annual competition at Robert Gordon University (RGU) and will now travel to Seattle to take place in the international final.

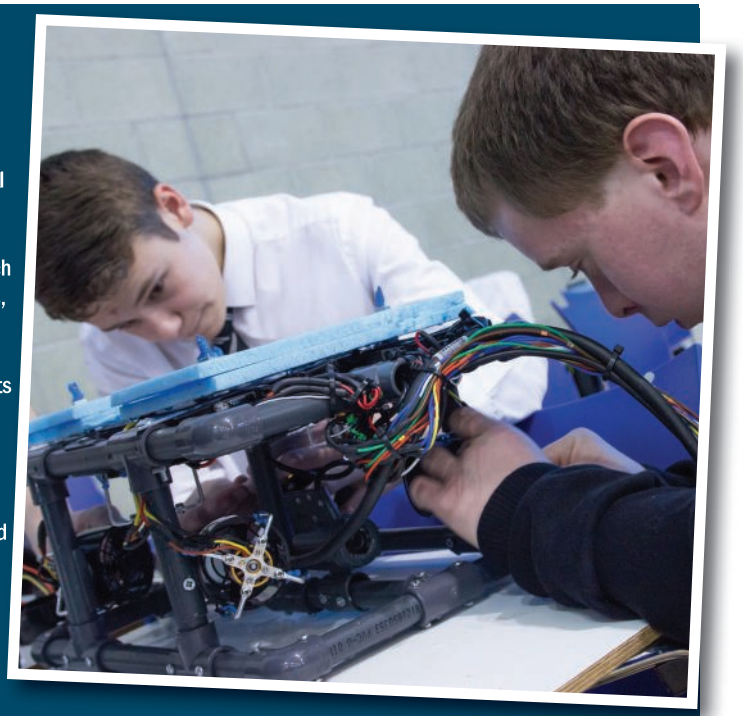
The team were taking part in the Scottish MATE ROV (Remotely Operated Vehicle) competition, co-ordinated and hosted by RGU, which saw nine school teams from around the country put underwater robots, which they had designed and built, through a series of missions for a place in the international final.

Grove Academy emerged victorious, after a panel of industry experts scored the teams on how well they completed the missions, as well as taking into consideration the technical reports, poster displays and engineering presentations the pupils were required to produce.

This year, the pupils were responding to a task based around aircraft, earthquake and energy, and had to create an ROV which could operate in the salt and fresh water areas in the Pacific Northwest.

The specific tasks for the 2018 challenge included locating the wreckage of a vintage airplane and returning its engine to the surface; installing or recovering a seismometer; and installing a tidal turbine and instrumentation to monitor the environment.

The major STEM initiative aims to inspire future engineers through hands-on experience of designing (ROVs) used underwater in the oil and gas, defence, oceanology and marine renewables industries.



Underwater robots were put through a series of missions, in a bid to secure a place in the US international final

AEROSPACE | MECHANICAL ENGINEERING | ARCHITECTURE | AUTOMOTIVE | IT & COMPUTING | DESIGN EDUCATION | PRODUCT DESIGN

Who are we?

This journal is produced by the IED for our Members and for those who have an interest in engineering and product design, as well as CAD users.

The IED, established in 1945, incorporated by Royal Charter in 2012, is a licensed body of both the Engineering Council and Society for the Environment and we register our suitably qualified Members as Chartered Environmentalists (CEnv), Chartered Engineers (CEng), Incorporated Engineers (IEng) or Engineering Technicians (EngTech), Chartered Technological Product Designers (CTPD) and Registered Product Designers (RProdDes). We also offer professional recognition to Product Designers, CAD Technicians, and those who teach and lecture in design or CAD.

We represent our Members' interests at the highest levels and raise awareness of the professional standards of our Members, whilst providing a resource and information service, and a friendly and approachable route to assessment and registration.
www.ied.org.uk

iED

support
inspire
achieve

"For any design engineer hoping to pursue a career in industry, membership and registration shows commitment to continuing professional development and promoting good practice in those with whom we interact on a daily basis. The IED provides a natural home for those whose roles encompass a diverse range of skills."
BH, Chartered Engineer

Why become a member of the IED?

Membership of any professional body gives you professional recognition and status, and an acknowledged code of conduct to work to. Membership of the IED gives you the added credibility of being acknowledged for the role you play in Design and Innovation, and helps to develop your skills and knowledge in these areas.

As well as the various registrations, membership of the IED gives you the opportunity to meet with other designers and discuss issues particular to your field of expertise or interest. Many of our Members prefer to communicate primarily through the discussion forums on our website, as this lends itself to the busy work schedules – however, we also run seminars, meetings and events where Members can carry out CPD and meet up.

The IED is the only Institution that represents designers in all Engineering and Product Design fields, plus those who teach these skills.

How do you join?

We have made the application process as simple as we can. To maintain the high standards of membership, we need all prospective members to:

- Complete an application form
- Submit a CV and details of relevant educational qualifications. All applicants are assessed by a Committee of Members.

If you are a designer who would like to gain formal professional recognition, or work in an organisation which employs designers, and would like to have your employees gain membership and professional recognition, contact Kim at the IED on 01373 822801 or send an email to: kim@ied.org.uk to discuss your next step.

Engineers Without Borders

Engineers Without Borders-UK is an international development organisation that removes barriers to development through engineering. Our programmes provide opportunities for young people to learn about technology's role in tackling poverty.

We are always on the look out for new volunteers, so to get involved or make a donation please visit out donations page at http://www.ewb-uk.org

engineers without borders uk