The journal of the Institution of Engineering Designers

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Cresting the waves at Snowdonia's man-made lagoon

Upskilling our engineers: time for new thinking

BLOODHOUND LAID BARE
INSIDE STORY OF THE 1,000 MPH QUEST

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Volume 42 Number 1

Preaching to the converted

Could engineering conversion courses be part of the solution to bridge the UK's acute shortage of engineers? IED Chair Tania Humphries-Smith considers the arguments – and also the imperative

I guess this will fall upon your doormat or into your 'inbox' just as we enter a new year – traditionally when we often take time to reflect upon our situation and make plans for change. The government, certainly, are looking for change within our sector. Following the publication of the Perkins' Review of Engineering Skills, it published its 'Science and Innovation Strategy' in December 2014. The Perkins report recognised the acute shortage of engineers and made a total of 18 recommendations. EngineeringUK in its 2015 report, 'The State of Engineering', confirmed these shortages: "Within the engineering-related demand, 56,000 jobs per year will be needed at level 3 (Advanced Apprenticeships) and 107,000 per year at level 4+ (HND/C, foundation degree, undergraduate or postgraduate and equivalent).

"Yet current figures show that only 26,000 people are entering engineering occupations with level 3 Advanced Apprenticeships and only 82,000 at level 4+," it stated.

The Perkins' report also advises: "…to tackle short-term pressures, we should invite employers to come forward with innovative proposals for developing skills in areas of shortage, for example by creating rapid conversion courses for those who have studied subjects other than engineering that nonetheless provide good foundations for engineering".

Following this recommendation, the Higher Education Funding Council for England (HEFCE) commissioned a report, 'Transition to Engineering: Engineering conversion courses for graduates with a non-engineering first-degree' (http://bit.ly/1lJFovh), published in September last year, while a call for universities to bid for funding to develop such courses has now closed.

It is interesting to note the EngineeringUK report also sets out the nature of engineering employment in the UK: "…most engineering enterprises (97.1%) are either small or micro and, overall, 86.9% of engineering enterprises have fewer than 10 employees. However, while companies with at least 250 employees represented 0.4% of all engineering enterprises, they employ over two fifths (42.4%) of those working in engineering enterprises".

So, what does all this mean for our profession? How do we feel about engineering conversion courses? Would you employ someone from a conversion course? The IED has always been open to non-standard registrants and is committed to working with higher education institutions to ensure such courses do produce graduates that meet the needs of industry and the requirements of Engineering Council registration. Potentially, graduates from non-traditional routes will offer a new and broader range of skills and approaches to the engineering sector.

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Come the evolution!

Colin Ledsome CEng FIED considers an intriguing take on how consumer products come of age

This book sets out to illustrate how different types of consumer product evolve in a pattern of similar phases and how to use that understanding to help make further design decisions. It begins by looking at those phases:

- A divergent experimental phase – here, a wide range of configurations are explored after an initial invention shows that ways of achieving the function are possible
- The dominant design phase – one particular solution is shown to be the most desirable (either as the most efficient or the one customers prefer) and becomes the only available choice. This evolves much more slowly, with only small, often cosmetic, variations from the main concept
- The innovative phase – here, new materials and manufacturing methods allow variations to the dominant design and the evolution of special designs for niche markets.

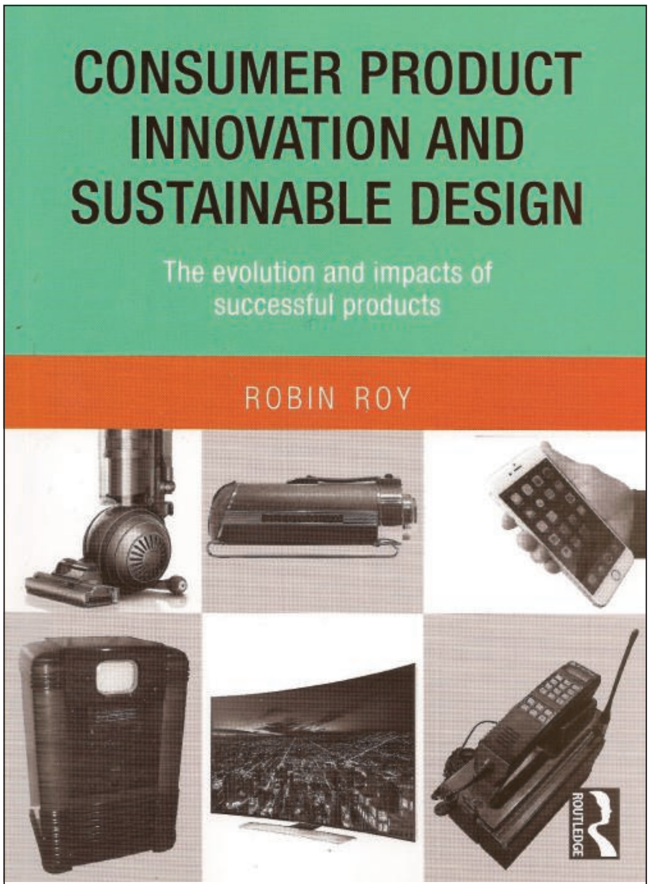
These phases are illustrated by the evolution of the bicycle: from the first 'Velocipede', via the diamond frame solution, dominant for 50 years, to modern carbon fibre racers and recumbent bicycles.

The main body of the book follows the same phases in some detail in the evolution of five familiar product types: washing machines, lamps and lighting, television, vacuum cleaners, and mobile phones. These examples are well illustrated with a range of early competing configurations, the reasons a particular design became dominant and the current options being explored, with their advantages and disadvantages compared to the dominant design.

The final chapter pulls all this together into clear messages, to designers and others, on the importance of identifying and exploring the current stage of the evolution of products. This should allow the prediction of the direction of change and indicate the factors contributing to a sustainable design likely to produce desirable products for the foreseeable future.

This book should be of interest to designers across the spectrum, and a useful text for product design and engineering courses. The patterns explored here are also familiar in most product types, from aircraft and bridges to trains and architecture. A good example is marine cargo transportation, with developments from random boxes through to bulk carriers and specialist liquid carriers, and the current dominance of the ubiquitous standard container.

Robin Roy is Emeritus Professor of Design and Environment at the OU.



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BLOODHOUND SSC

The Scent of Victory

BLOODHOUND SSC will aim to set a new land speed record of 800mph this year – exactly 19 years after the current record of 763mph was set. That goal achieved, it will have the 1,000mph target in its sights. Here, chief engineer Mark Chapman recounts to editor Brian Wall the journey taken to reach this historic moment

“This was never about increasing the world land speed record by, say, 20 to 30 miles an hour, which is more or less what the increments have been in the past, but to really push it out of reach – to 1,000 miles per hour.”

That statement of intent from BLOODHOUND SSC's chief engineer Mark Chapman sums up the way the team has approached this quest from the outset: to aim high and big. “The challenge is a mighty one, even to the point of, ‘Is it possible?’” he acknowledges. “The existing record is 763mph, so we're talking about a 30% jump, which would be the largest single leap in history.”

Chief engineer Mark Chapman: a massive drive to promote engineering to the next generation.

Yet there is never the hint of doubt in his voice that failure is an option. Indeed, the BLOODHOUND SSC team have demonstrated a dogged determination from the beginning to put together a car that leaves anything designed previously floundering in its wake. That car is now all but ready and the journey to the start line has been a compelling one, as Chapman recounts. “With 1,000mph the goal, we quickly discounted using the same engines as on Thrust SSC [two afterburning Rolls-Royce Spey turbofan engines]”. Thrust SSC holds the current World Land Speed Record, set on 15 October 1997, when it achieved that speed of 763mph and became the first car to officially break the sound barrier.

INSPIRATIONAL THINKING

The decision was taken to go to the then Minister of Defence Procurement, Lord Drayson, to see if he would support the project and get them access to a EURJET EJ200 engine, a highly sophisticated military turbofan normally found in the engine bay of a Eurofighter Typhoon and the most modern of its kind within the RAF at that time. “That wasn't possible,” he recalls, “but he suggested taking a different approach. Britain has a huge shortage of engineers, mathematicians, scientists and technicians. So, if the project's main aim was, rather than breaking the land speed record, to stimulate and educate kids about these professions, then he would see what he could do.”

With that agreed, the project was ‘go’. Soon BLOODHOUND SSC had the loan of three ex-Flight Test engines from the UK's Typhoon programme. “The reality is that we wouldn't be here today, aiming for this record, if we hadn't committed to this being an inspirational and open science project.”

Chapman came on board full-time in February 2008 and the project launched publicly that October – coincidentally, a few weeks after the Lehman Brothers financial collapse; not the best timing for going to

READY TO BE UNLEASHED

BLOODHOUND SSC was shown publicly recently in record attempt configuration, with its 2m high tail fin, required for stability at high speed, in place for the first time. Carbon fibre panels had been partially removed on one side, in order to show the technology inside the car, including the Rolls-Royce EJ200 jet engine and supercharged Jaguar V8 engine used to pump oxidiser into the Nammo rocket.

Inside the finished cockpit could be seen a huge and complex monocoque crafted from multiple layers of carbon fibre to produce what is probably the strongest safety-cell ever fitted to a racing car. Inside, there is a sophisticated digital dashboard, designed by driver Andy Green, as well as manual back-ups for the major controls.

The car has been created by a team of Formula 1 and aerospace experts, with assistance from the Army's Royal Electrical and Mechanical Engineers and technicians from the RAFs 71 Squadron, who built the tail fin.

After the long build-up, the time for action is not far off, as project director Richard Noble confirms: "With the car now built and the track in South Africa prepared, our focus is on racing in 2016. That part of the adventure starts with runway tests at Newquay Aerohub this Easter."

the traditional sources of corporate sponsorship. "Any potential prospects that we had at the time simply evaporated," Chapman confirms.

However, the total shift of emphasis away from the project being all about breaking the record to one that was far more altruistic in nature quickly blunted any perceptions of 'spin' that might have been laid at its door. "Instead, a momentum was created that has now seen young people coming through their A levels and into university courses whose ideas on what engineering and science represented was altered six to seven years ago when the BLOODHOUND SSC project was launched."

It was this approach that won the BLOODHOUND SSC project wide support, ensuring the funding needed was forthcoming, with sponsorship and donations from individual members of the public, right through to global enterprises. "Every last bit of money raised goes towards helping us create something special, with a lasting legacy of inspiration for our future generation of scientists and engineers," he states with some pride.

CHANGE OF DIRECTION

What of the car itself – how did today's sleek machine come into being? "In 2007, there was a very early scheme of the car, with myself and Brian Coombs [BLOODHOUND SSC Engineering Lead - Mechanical Design] brought in to come up with the detailed design. My background is aerospace and his motorsport, so we divvied up the car between us. But it became apparent the whole packaging that had been proposed wasn't going to work. It had a bifurcated intake, a bit like a Hawk jet-powered trainer aircraft would have, and, setting the quality of airflow to the fan-faced engine, we just couldn't get that to function properly.

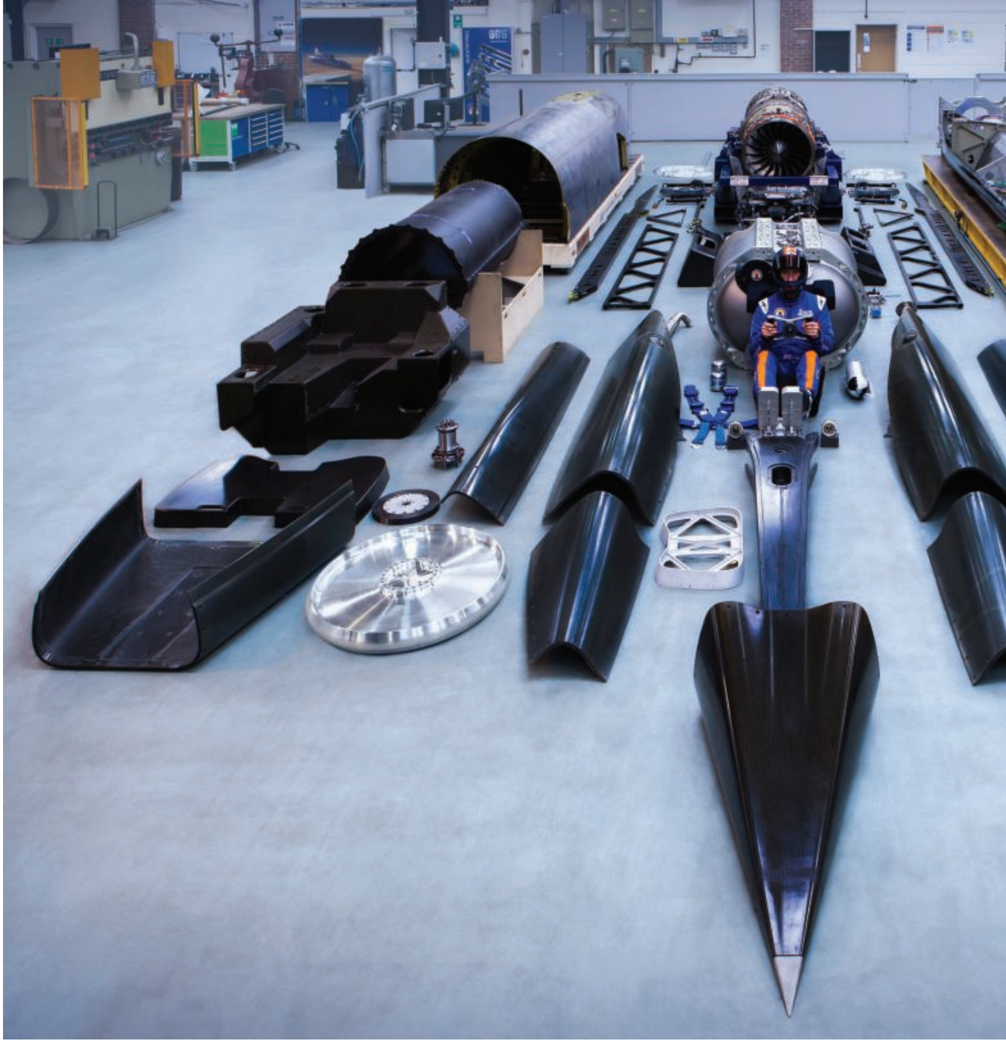
"The steering was very much like ThrustSSC, and it had tandem wheels, but this time it was at the front. As a package, that worked really well for getting a narrow-fronted area, but as far as the stability and dynamics were concerned, it was very challenging. So, between February and April 2008, there was a huge change in the concept of the car – from something that was over 20 metres long to a car that, if you squinted, looked pretty much like the one we have now, which is just under 14 metres. And that difference was mainly driven by the way the front wheels were laid out in the early version."

How hard was it to make these dramatic switches in thinking and then set off in a very different direction? "The beauty with a project like this and its delivery is that we have a very small decision-making team, five people, so you can make fairly radical changes very, very quickly, if you get consensus within the group," points out Chapman.

What was agreed at this point involved two major rethinks: changes to the front steering and wheel design, and also to swap over the configuration of the car. "The very early car had a rocket on top and a jet engine underneath, and we were struggling with some structural stiffness and stability issues when we turned the rocket on and then off. The question that emerged from that was: 'Why have you got the rocket on top?', to which the response was: 'Oh, it's always been that way.' Also, it had always been quite small, but, as the project progressed, it got bigger and bigger."

RECONFIGURED CAR

At the end of 2008-early 2009, the BLOODHOUND SSC team recognised it had to alter its approach. "We just said, 'Let's swap them [the rocket and engine] over.'



Within two weeks, we had completely reconfigured the car. If we had been a large organisation, there would have been trade studies and two or three separate teams working on the car, each with competing designs. With us, being a small team where everyone had an equal vote, you can very quickly shift and make radical changes, as we did."

The upshot was that the rocket came off the top of the car, to be repackaged underneath, while the jet engine was raised slightly. "That is the configuration we have now. What we'd been struggling with was the pitching movement of turning the rocket on. As you did that, you ended up with around 4 tonnes of download at the front, basically pivoting from a 27,000 lb thrust rocket, driving the nose into the ground."

That involved raising the front aerodynamic surfaces to generate lift, in order to hold the nose up. This is perfectly acceptable, states Chapman – provided that you don't have a systems failure.

"Then you would be in a situation where you are generating lift to keep the car stable and faced with the prospect that you are going to run out of fuel in 17 seconds; and you are generating 4 tonnes of lift at the front. So you would have a very unstable situation. From that perspective, the new configuration makes a lot of sense, but we'd always put it off, as we had assumed the centre of gravity would rise too much by putting the jet engine on top. But the way that the rocket packaged underneath, it fitted really nicely. The centre of gravity hardly moved up at all. Now we could put hoops all along the top of the structure, so the rear of the car started to look much more like a conventional aerospace structure – and that increased massively the stiffness of the car."

STABILITY CHALLENGES

But the most challenging aspect in getting the car's design right came immediately afterwards. "We had carried out ten aerodynamic design configurations to get a car that we thought was pretty much stable. However, when we turned the rocket and the jet over, all of a sudden the car became unstable and we couldn't work out intuitively where that instability was coming through. We had gone from a car that was relatively stable throughout the MACH 1 range to one that was generating 11 tonnes of lift – and we just didn't have the time to revisit all that work."

"A couple of changes were made that didn't make things a whole lot better. So

PRETENDERS TO THE CROWN

It's an extraordinary time for the World Land Speed record, with a number of teams globally aiming to run the world's fastest car over the next few years. "Suddenly, we're entering another 'golden age' for the world land speed record," says BLOODHOUND SSC's man-behind-the-wheel, Royal Air Force fighter pilot Wing Commander Andy Green, right.

"Between Thrust2 and ThrustSSC, Britain has held the record for just over 30 years and there's nothing quite like the promise of losing it – or actually losing it – to keep us focused. Great Britain has held the World Land Speed Record for longer than every other country, since the first record was set in 1898, and we're not going to let it go without a fight!"

"However, the importance of having challengers is much wider than just a nationalistic one. We are setting off on an 'Engineering Adventure', to inspire and excite a generation of young people about science and technology, and the competition will make the 'Adventure' so much more exciting. BLOODHOUND is our solution to the problem of the ultimate race car, but it's not the only solution.

"The wonderful and unique thing about this sport," adds Green, "is that there really are no constraints on car design – a very far cry from the over-regulated and over-argumentative world of Formula 1, where all the best technology is kept secret, design is constrained by the rules and they have to paint the cars different colours, so that we can tell them apart.... For BLOODHOUND, the more competition that we have, the bigger the variety of different solutions that we can discuss in our education programme."

we took a step back. We had used technical designer experiments on the wheel design, because it hadn't been easy to come up with something that would hold together. Happily, these experiments allowed us to come up with a wheel that was far more stable. So we decided to apply the same approach to the aerodynamics. Over the next 2-3 months, we carried out a set of studies to find the key parameters that drove the lift at the rear of the car. We came up with five design features that gave us that lift and used the designer experiments to come up with an equation that gave us the new design at the back of the car.

That was the breakthrough. "Within three weeks, we had gone from a car that had 11 tonnes of lift to one that was actually stable throughout the MACH number range. And it wasn't a shape that we would have been naturally drawn to, but you could think through logically why that one worked. We just didn't have the ability to iterate enough designs sufficiently quickly to be able to do that ourselves. Instead, we used a computer solution to come up with a suggestion and the idea was we would revise that. But, actually, what it came up with was so good that we stuck with it."

Of the six features that controlled the rear lift, one was so powerful the team had to set that to the optimum – and that was the rear wheel track. "This had the greatest significance on the lift at the back."

The other five were much more subtle, but mostly they related to the fact that the rear of the car tails in; so it was really all about where that started, and how far up and down the car, and that was sensitive to within 15 centimetres.

"If it was 15 centimetres out, you would have a car that generates a huge amount of lift. It emerged that the problem related to how the shockwaves were interacting on the rear structure of the car, with some very subtle alterations in angle and projected surface areas that were hugely powerful in generating lift or downforce."

CHOOSING THE MATERIALS

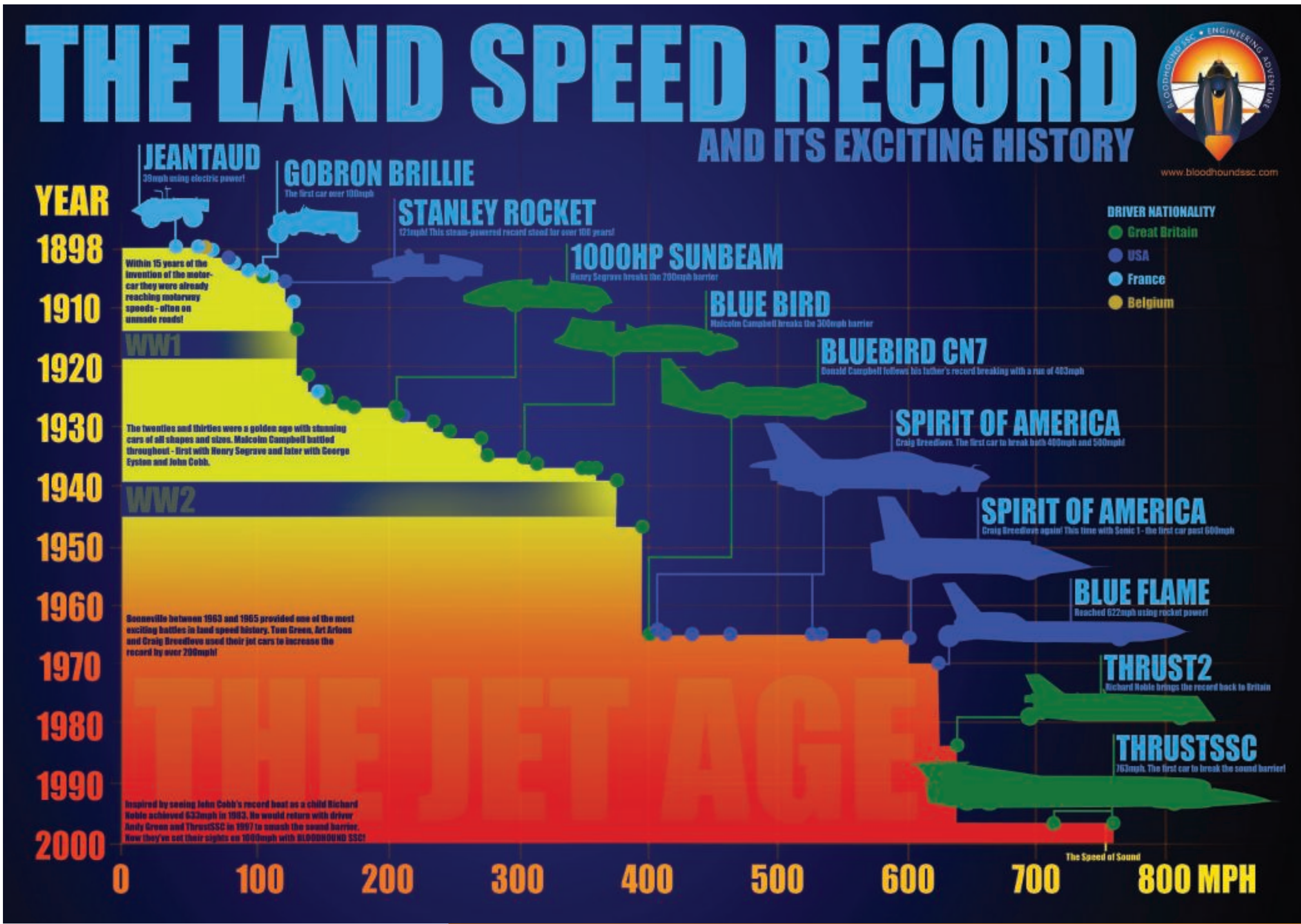
What about the materials selected for the car? "Material choice was a critical part of the whole project," he says. "When the original schemes were put together, the logical idea was to build it very much like a traditional land speed record car with a welded space frame chassis that would have bodywork panels attached – the quickest, simplest solution. Yet, by working with an array of high-profile partners and biasing the design towards their design skills, BLOODHOUND has been able to pick and choose from the best technologies when creating the optimum car to take on the 1,000mph challenge – something that would have virtually impossible, if it had tried to deliver the project on its own.

"So, for example, the rear end of the car was being made by an aerospace company. For the fin tail, we had come up with a tubular structure, but that was very much against how they would normally work. So we sat down with them and came up with a much more conventional aerospace-type construction that would fall into what their production line capability was.

"And so the whole car is, necessarily, a constant compromise throughout. But that is the reality. There is no point in giving a manufacturer a brief that is outside its normal remit. We work closely with a number of defence and motor sport contractors, and quite often it's the other way round, in that they will want to work to a level that gives us a far better product than we might have envisaged, while also being far more efficient for them."

SOFTWARE FACTOR

Not surprisingly, the BLOODHOUND SSC team also rely heavily on computational tools when working on the design of the car, such as Siemens PLM [product lifecycle management] and Altair Hyperworks for stress analysis. "Within Hyperworks, we also use Optistruct for structural design and optimisation.



SUPERSONIC AND BEYOND

The Land Speed Record is motorsport distilled to its most fundamental elements: distance versus time. First electricity and steam fought it out; then came the internal combustion automobile engine. That fell victim to its much more powerful aeronautical counterpart before that, too, was dismissed to the pages of history by turbojet and rocket engines.

Accelerate through from the record speed of 39.24mph set in December 1898 to more recent times and you see how the record – driven by giant technological advances – transformed this quest to be the best. In October 1970, Gary Gabelich's Blue Flame ushered in the rocket era with 622.407mph. Richard Noble's Thrust2 regained the record for Britain at 633.468mph on October 1983 and there things settled – until his ThrustSSC, driven by Royal Air Force fighter pilot Wing Commander Andy Green, reached 714.144mph in September 1997. That was just a prelude, however. On October 15, Green became the first man ever to exceed the speed of sound at ground level, at a blistering 763.035mph. He remains the only supersonic speed king in history.

Basically, we use these tools to a lesser or greater extent to get as close to an answer as possible, rather than having teams of people working on trade studies.

"We are also very fortunate to work with Swansea University, which has a suite of CFD [computational fluid dynamics] software called Flight 3D, which was actively validated off the back of ThrustSSC – the only code validated for supersonic flow and ground effect. BLOODHOUND has been able to tap into the university's research code, which is continuously being developed. So, when we start running in South Africa [at Hakskeen Pan in the Northern Cape], with 180 pressure sensors on the car, again we will be comparing, run per run, against what the CFD is predicting. And then we will update the models as we get real data and correlate what the computer is suggesting."

For Finite Element Analysis (FEA), the project uses Altair Hyperworks suite, as well as NASTRAN Annexe within the Siemens CAD software. "But, again, physically testing components is costly, both in terms of manpower and financially, so we only do that kind of testing on parts we see as absolutely critical. But also we aren't asking them to perform to their ultimate loads from day one. For example, when Andy Green starts to drive the car, he will be at 200mph in the UK, progressing to 800mph; then in year 2, up to 1,000mph. So, in a way, the car becomes the moving test bed." The front third of the car, the monocoque, is carbon composite; the lower rear is a steel skin on aluminium ribs and the upper car a titanium skin on aluminium ribs. "Stiffness and frequency is more important to us than the strength," says Chapman. "We are trying to make everything as light as possible. But ultimately stiffness is what is key. The car has 8.9 metres between the wheels, with some big suspended masses within that, as well as some slightly unknown input frequencies. If you were running an aircraft or a car, you would have an input spectrum of frequencies going into that.

Inside Andy Green's supersonic 1,000mph 'office'.

"However, we did some very early studies of wheel hop frequencies, and what chassis frequencies we could accept, and we really wanted to be in an order of magnitude of 10 away from a wheel hop frequency to a chassis mode primary frequency. With such a long structure, to get that order of magnitude separation you end up needing a very, very stiff structure, which has driven stiffness to be the main factor. Also, deflection is vital to this, because, with 8.9 metres between the wheel base, you don't need much deflection to make significant differences, in terms of how close the base of the car gets to the desert."

There are always design compromises along the way when it comes to what you would have in an ideal world and what you must settle for in the real one, he points out. "As far as the intake on the jet engine is concerned, we would like to have a different size, but we have chosen to optimise it at MACH 1.2. Below that, we are inefficient, in that we struggle to get enough air in; and, above that, we generate more drag. We are going for the option that allows us, hopefully, to achieve 1,000mph, but in a completely passive way. You can go through the car and see that it is never perfect in any area, but to aim for that would be the wrong thing to do, because then you will have hurt some other function you need. The idea was to have an aerodynamically neutral vehicle throughout the speed range." And is that going to deliver the dream? "The shape we have arrived at is the one we are building and we are confident that is the one that will get us the record this year."

That means breaking the current record of 763mph, set back in September 1997 by BLOODHOUND SSC's current driver, Royal Air Force fighter pilot Wing Commander Andy Green. It will be a momentous achievement – one vital step towards the ultimate objective. "Beyond that [exceeding 763mph], we are so far outside what is known when we go between 800 and 1,000mph. With ThrustSSC, when they broke the sound barrier, they had some real concerns about what the shockwaves would do when interacting with the desert, so we have a very good idea about that now. And we are unique, really, compared to the other world record attempts going on at the moment, in that we do have this huge core of knowledge within the team that has come from ThrustSSC."

At the same time, he admits there are bound to be things the team has not yet thought of – what he calls a huge list of 'known unknowns'. "We call the whole thing an adventure, recognising we will run into issues that will have to be dealt with as they come at us. This is the whole idea about having a progressive run programme from 200mph up to 800mph in 2016. We will find these out along the way."

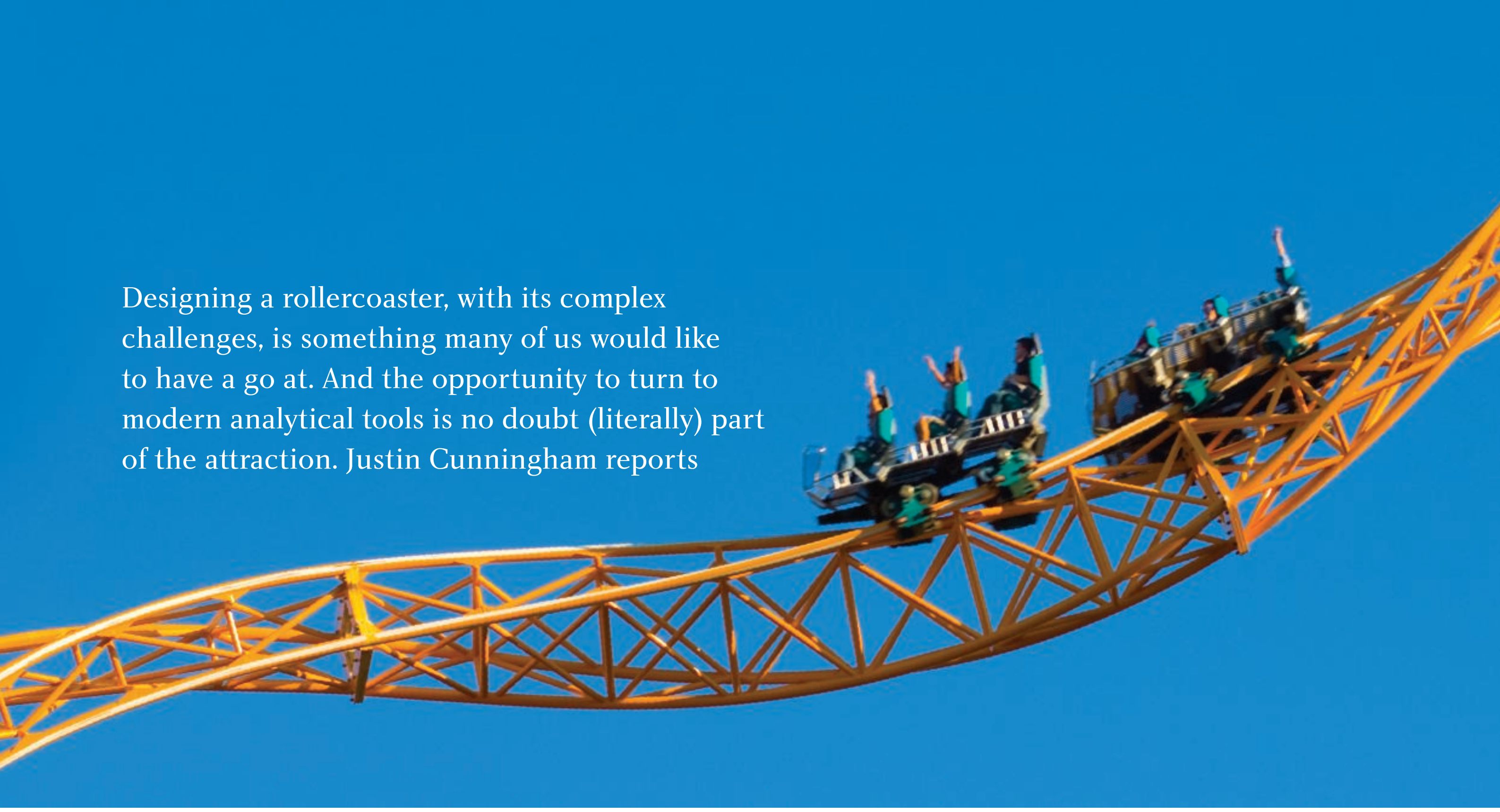
Testing to 200mph in the 'final' car will take place in Newquay, Cornwall. "After that, we will reconfigure the car, so it will be running with the jet alone, and we will also put in place the rocket system. Then we head off to the desert in South Africa towards mid-summer, with a view to breaking the current land speed record, gradually incrementing the speed across a 3-4 month window. We then come back to the UK, make the changes we need to – there's a larger thrust rocket we put in for year 2 – to take us up to 1,000mph."

June/July 2017 should see the beginning of BLOODHOUND SSC's assault on that formidable target, with the all-out assault likely to take place around October. But what if that target proved to be a step too far? What if the car 'only' reached, say, 908mph? "Our goal all along has been to inspire a generation. If we come out of this project showcasing how good British engineering is, that will be fantastic. And whatever that record is, it will have been the biggest leap in land speed history."

Amongst the unknowns, here is one certainty: the record achieved, it won't be easy for anyone to break that again. But it is the educational legacy that will matter most. "We don't need a generation of supersonic car designers. We do need a new generation of young people who are excited by science and engineering. That has been the greatest goal of all."

For more on the BLOODHOUNDSSC Project, go to: http://www.bloodhoundssc.com

See how BLOODHOUNDSSC was designed: http://www.bloodhoundssc.com/news/video-building-bloodhound



Designing a rollercoaster, with its complex challenges, is something many of us would like to have a go at. And the opportunity to turn to modern analytical tools is no doubt (literally) part of the attraction. Justin Cunningham reports

Engineering thrills

We all remember a good rollercoaster. The speed, bumps, twists and turns create a powerful feeling of elation and the urge to get back on. This is the hope, at least, for those whose day job it is to design and engineer rollercoasters.

It is a small club indeed, with relatively few companies and engineers actively involved in the design of rides around the world. It's surprising, especially considering that last year there were nearly as many rollercoaster passengers as global airline passengers: an estimated 1 billion people threw their hands up, screaming aloud, to enjoy that big first drop on the track.

"It is very difficult to enter into this field," says Marco Begotti, CEO of Ride Tex Engineering, an Italian-based rollercoaster design consultancy. "But it is also very difficult to exit from it, too. There are probably 20 engineers in Europe that do this job and only a few companies around the world." To them falls the challenge of coming up with the complex designs and engineering challenges – all tightly regulated and rightly so, of course.

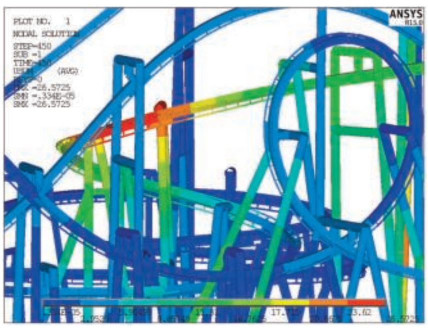
The centrepiece of any rollercoaster remains its slopes and what thrill seekers call 'airtime' – that is, the negative G-force experienced when the train reaches the top of those hills, giving that feeling in the stomach many have come to love. Now design engineers are having to answer the calls of those intent on building ever more thrilling rides. Faster, higher, more loops, various 'seating' positions – from being stood up to laying flat like superman – and even cars that rotate independently of the track. That means more options and more calculations to create a better ride and sensation than anyone else.

The starting point for a rollercoaster is often the footprint within which it is to be built. As theme parks look to replace rides, an idea of the space becomes available. Next, it is usually market forces that drive what the rollercoaster might be. For example, the park might want to bring in more families, so the ride will not aim to scare passengers quite so much. However, if the goal is to attract more teenagers, the ride will be that bit wilder, so that the thrill seekers get their 'airtime' hit.

"The design driver is to attract the most number of people to the park," adds Begotti. "If you think it is most important to catch families, you must improve those rides. If you have competitors around the area and want to do something really different, then you can create a new rollercoaster that is higher and faster. It isn't so much what the people want, but what is the best ride for this total environment." Ride Tek has had much success in delivering various rollercoasters to theme parks around the world. To date, Begotti has designed more than fifty, with countless patents to his name.

Tenders can arrive to Ride Tek with little more than what looks like a squiggle. This represents the layout of the track – often and unsurprisingly produced by a layman. The theme of the ride follows. This may be based on a film franchise or put together as a standalone theme, like Oblivion at Alton Towers, which introduces the 'experience' as customers queue.

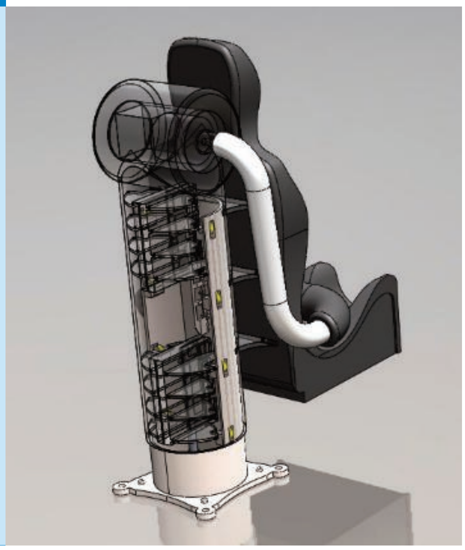
It is then up to Ride Tek to deliver a rollercoaster that satisfies both the design theme and a compelling track that is engineered accordingly. "Just having an idea is not enough," he points out. "You need to work inside rules and human factors, and such things. But the initial



ONE STEP BEYOND?

It's not about reinventing the rollercoaster as such – it's about reinventing the seat. This revolutionary design, on the right, from US-based Coaster Labs, will make riders feel as if they've just been ejected from their seat mid-ride. The coaster appears as a normal train. However, at some point in the track (probably during 'airtime') – where negative G is experienced – an 'Ejector Seat' will push riders up in to the air, by as much as a metre. The riders' feet will come completely off the floor and they'll feel like they've been fired way up into the sky.

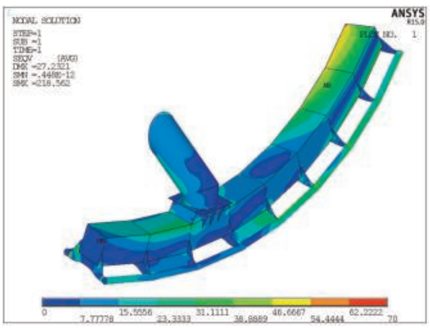
coaster-lab.com



idea is one of the beautiful parts of the design process, as you feel like you are creating something. But it is a mix between idea, creation and engineering that makes a good rollercoaster."

With rides now embracing everything from vertical drops to coasters that replicate the speed and acceleration of an F1 car, how do design engineers keep up to speed? You might think that turning a conceptual idea into a workable and deliverable rollercoaster design would be a drawn-out process, but it is as frighteningly quick as the coasters themselves (well almost), routinely taking three to four months to go from a rough sketch to delivery of all the engineering drawings to the manufacturer.

Modern design tools have had a huge part to play and for the several years Ride Tek has been working with software company Enginsoft to integrate its 3D CAD modelling software with a multi-body simulation package to make the design process faster, more efficient and allow more innovation. It works much like a plug-in and allows simulation to be carried out at the beginning of the ideas process, right up to the more detailed design phase. "This software we've created is unique and completely dedicated to our field," says Begotti. "When I'm in the design phase, I have all the information relating to the dynamics of the car and the people riding within it. I can understand immediately if there is a peak force on the head or neck, or any part of the body, and if something needs changing or optimising.



"So we can make changes and then recheck. When you arrive at the end of the process, you know that 90% of the time the rollercoaster is done. It is optimised for the best acceleration and ride for passengers."

With faster time to market, matched by bigger and better improvements, relatively large jumps are being made between design iterations, which multi-body software providers say is due to their computational powers. One key factor is the number of iterations ithat can be analysed and assessed in a short period of time.

"In the same time it would have taken 10 years ago to make one track, we can propose three or four different tracks, with different kinds of cars, and simulate them all," he expalins. "So the simulation process increases our ability to explore different ideas quickly."

And this is not only helping speed up the design and delivery of rollercoasters, but to push the physical boundaries as well. Yet with some coasters pulling a stomach-churning 1.7G, reaching a top speed of 150mph and accelerating from 0-60mph in less than 2s (that's faster than any production available supercar), surely there is not much more the average body can take without risk of injury? Yet many of those designing coasters, including Begotti, still feel there are areas left to exploit that will leave passengers even more awestruck.

COASTER COMMONALITY

One common attribute on rollercoasters globally is the steel lattice structure that supports the track as it weaves through the air above. "These huge structural steel parts are impressive. So using the multi-body simulation software, we know a certain layout and wall thickness of the steel tubes will last, for example, the life of the rollercoaster; maybe thirty years."

This is all part of the work to digitally verify designs right from the conception of a project. Here, any potential design is made into a virtual rollercoaster prototype, which provides immediate feedback on the longitudinal, transverse and normal acceleration forces felt by passengers and on the car, as well as any corresponding structural loadings and stress build-up in the steel structure as it rides along.

The complexity involved in multi-body and finite element analysis models can vary. In many cases, beam and shell models are used to assess the stress and strain exerted on the cars and the steel structure on a particular layout. In other cases, where more detailed analysis is required, finite element brick models can be developed.

"The numerical engineering simulation is fundamental for reliable consideration of the structures and components because life is at stake," explains Begotti.

Multi-body software provider Ansys highlights the importance of using simulation within the design process, as it allows realistic comparison to the real world. Gary Panes, European marketing director at Ansys, comments: "The fact is, the products you design have to fit into the real world. They will all experience multi-physical forces... and have to survive them. If you over design, you have higher material costs, higher cost to market, inflated fuel costs and you are not being competitive. If you under design, then it's worse: product failures, warranty costs, legal ramifications and negative public image."

www.ansys.com

www.ridetek.it

This article is reprinted courtesy of Eureka magazine.

Some UK-based universities are forming ever closer associations with their counterparts in other countries. Dr Brian Parkinson BA PhD CEng MIET FIED and EurIng Professor Kevin Edwards BEng(Tech) MSc PhD CEng FIMechE FIMMM FIED(PCh) report on how the University of Nottingham has taken this bold step

SPREADING THE

The accreditation of university degree courses by recognised professional bodies is an indication of assurance that the courses meet the standards set by the profession. Importantly, the accreditation process gives universities a peer review or independent means of evaluating and improving the quality of their courses.

In the UK, the Engineering Council (EC) sets and maintains the standards for the engineering profession and also determines the requirements for accreditation. The EC then licenses certain professional engineering Institutions (PEIs) to undertake accreditation within these strict requirements.

The IED is one of these institutions and uses the accreditation process to assess whether specific university engineering courses provide some, or all, of the underpinning knowledge, understanding and skills for eventual EC registration – for example, Chartered Engineer (CEng). It currently accredits engineering and product design courses at 42 universities, including six international ones. The engineering courses delivered by the University of Nottingham were already accredited by the IED and the university wanted accreditations for similar courses delivered at its new campuses in South East Asia.

OWN CAMPUSES

The University of Nottingham has taken the bold step of building and establishing its own international campuses, rather than go into partnership with existing universities. The university first opened a campus in Malaysia in 2000, before establishing a purpose-built campus in September 2005 in Semenyih, Malaysia. In September 2004, another campus was opened in the city of Ningbo, China, as part of a joint venture. Nottingham was the first foreign university to establish an independent campus in China. In November 2014, an IED accreditation panel – two volunteer members and one member of staff – visited these two campuses, in response to the university's request for accreditation.

It was in October 2008 that the IED first accredited engineering courses taught at the University of Nottingham, with a re-accreditation carried out in April 2013. Both accreditations were conducted jointly with IMechE and IET, organised by the Engineering Accreditation Board (EAB). However, 2014 was the first time that the IED had visited the university's international campuses, where the IED panel was joined by a similar IMechE accreditation panel. The courses for which IED accreditation was being sought by the universities were BEng (Hons) and MEng (Hons) Mechanical Engineering, and BEng (Hons) Product Design and Manufacture.

Both campuses are self-contained, offering a full range of academic and social facilities. All courses are taught in English, with support available where needed. Both academic staff and students demonstrated a good ability in communicating their ideas and intentions.

Walking around the campuses, it was particularly noticeable how the architecture of both sites reflected the characteristics of the UK campus – most of all the inclusion of a similar Trent Building clock tower built from Portland stone, showing only slight variations in style.

BETTER UNDERSTANDING

Being on the other side of the world, it must be said that the use of a strong corporate identity did feel strange and in complete contrast to the cultural variations experienced outside each campus.

While such differences were felt more significantly in China, we were assured that students had a better understanding of the international perspective and far greater ability for working as members of a team, when compared to students in other Chinese universities.

Engineering is one of three faculties at each of the campuses, with a Department of Mechanical, Materials and Manufacturing Engineering being common to all three centres. The engineering courses started in Malaysia in 2005 and in China in 2011. The courses reflect those delivered at Nottingham, with the same timetable, content and examinations. However, Malaysia and China do not yet allow students the flexibility of being able to choose between streams, offering specific subject variation built around

WORD

Acknowledgements
The panel members are grateful to Judith Grace, education and training manager, for the administrative support provided in organising the accreditation visits, which was both substantial and complex, and much more involved than normal visits.

Summary of accreditation visits in Malaysia and China
10-11 November 2014: University of Nottingham, Semenyih, Malaysia, Department of Mechanical, Materials & Manufacturing Engineering.
Head of Department: Dr Cheah Siew Cheong BEng (Hons) Mechanical Engineering MEng (Hons) Mechanical Engineering.
13-14 November 2014: University of Nottingham, Ningbo, China, Department of Mechanical, Materials & Manufacturing Engineering.
Head of Department: Dr Yong Shi BEng (Hons) Mechanical Engineering BEng (Hons) Product Design and Manufacture.

The Malaysia Campus in Semenyih. University of Nottingham established its own international campuses, rather than go into partnership with existing universities.

a core. Students may exchange between campuses for the second year of the BEng course, and second and third years of the MEng course. To date, only students from the UK have taken this option, with some deciding to study at the Malaysia campus. It is anticipated more students will be interested in exchanging when the courses are more established and student numbers grow.

The IED panel members covered some 16,500 miles during the two accreditation visits. Upon arrival in Kuala Lumpur – a busy city scattered with skyscrapers and six-lane highways – almost the first sight you get as you travel along the busy highway that connects the airport with the city is that of the Petronas Twin Towers, with the journey to the university campus at Semenyih about 30 km. The campus occupies a 101 acre site accommodating over 4,500 students.

Flying via Hong Kong, our next visit was to the campus in China, situated in the historic town of Ningbo, located near the eastern coast and south of Shanghai. Opened in 2006, this campus covers 140 acres and has 5,000 students. Both campuses offer a wide range of facilities, including residential housing for staff and students, restaurants and shops, dedicated sports complex, and fully equipped teaching and research facilities. University of Nottingham-based staff were also in attendance to support local staff at each campus visit.

The facilities shown on both campuses were of a high standard and included computing facilities with all the necessary engineering software. Workshops and laboratories offered a wide range of machines and equipment. The teaching and technical staffs were friendly and enthusiastic, and ready to answer questions raised by the panel.

In meetings with students, we found them to be generally supportive of the facilities offered on campus, and particularly complimentary regarding the approachability and support offered by the academic and technical staff.

POSITIVE INFLUENCE

A good level of industrial involvement was developing at both campuses, which was already influencing the teaching and learning practices employed. In common with most research-intensive universities, the research finds its way into teaching and is particularly evident in undergraduate student projects. There are Student Chapters at each campus, with the activities of the IED Student Chapter in China considered to be very impressive. The number of IED student members already at the China campus was also encouraging.

In summary, the quality of development and delivery of the courses at these international campuses reflects that already seen at the University of Nottingham UK campus. The example set may be one that others will choose to follow in the future.

Riding the wave

Wavegarden, the force behind the world's longest man-made wave, is creating ideal conditions for surfing, body boarding and kayaking. Now the first commercial lagoon using its technology has opened in Snowdonia. Brian Wall looks at the design factors behind this spectacular happening

Engineer Josema Odriozola and sports economist Karin Frisch had a long-held shared vision – that artificial wave technology was the future when it came to surfing. Both passionate surfers themselves, they wanted to recreate that same thrill and sensation for people not fortunate enough to have an ocean break nearby, or where ocean waves are too crowded or of poor quality.

Their expertise was in designing sports facilities – particularly skate parks – but they were equally convinced that world-class waves could be generated for any level of surfers anywhere in the world, no ocean required. Pursuing that goal of seeking to reproduce the experience of surfing a wave in the ocean under ideal conditions, in 2005 the engineering company Instant Sport was launched, dedicated to the design, construction and sale of the wave pool technology marketed under the brand 'Wavegarden'.

REALISTIC EXPERIENCE

"Our primary goal has always been to create the most realistic surfing experience in perfect waves – and even do it in locations far away from the ocean," state Odriozola and Frisch. "We knew if we could first develop an efficient and easy-to-maintain class of wave generator, we could overcome our biggest challenge: the high cost of building and operating a man-made wave.

"With this in mind, our research and development has remained focused on creating the new technologies required to minimise energy consumption, thus limiting the costs of ongoing maintenance and continued investment."

Different methods of producing man-made waves have been tried, including

"Preliminary computing simulations were nearly always used, but the majority of the tests were also run on real-size models. The underlying aim was to achieve the simplest, most efficient and reliable technology."

linear and 'endless' circular waves, which have all been tested on various bottom surfaces. "This has involved many models and on different scales," they point out. Nothing was left to chance. "Preliminary computing simulations were nearly always used, but the majority of the tests were also run on real-size models. The underlying aim was to achieve the simplest, most efficient and reliable technology possible."

Six years of intense R & D activity followed, including the construction of a test facility in Spain and testing on three evolving full-scale prototypes. A decade later, during which the duo combined their technical expertise with Wavegarden's ability to customise the size, shape and speed of the waves, the first commercial surfing lagoon using its technology opened to the public. Located in the lee of the Snowdonia mountains, next to the village of Dolgarrog, Surf Snowdonia has transformed a derelict aluminium works into one of the most innovative surf facilities. Visitors to the lagoon can ride waves ranging between 0.7m and 2m high at the 300m by 120m lagoon, with an impressive surfing experience of 16 seconds per wave.

THE SHAPE OF THINGS TO COME

Engineering Designer spoke to Wavegarden, the organisation behind the world's longest man-made wave and custom-designed surfing lagoons, for further clarification on a number of aspects:

ED: What are the influencing factors when deciding what the shape of the actual pool should be?

The most important factors are the type of wave that we want to make in a single lagoon (for experts, intermediates and beginners) and the length of the ride (in seconds) for each wave. Also, if we want to make waves every minute or so, we need to be able to dissipate the energy of the previous wave very quickly and that also has to be taken into account when designing the lagoon.

Environmental considerations are no doubt equally important to you. How are those factors taken into consideration when designing any specific piece of equipment?

Many pieces and components are designed taking into account that they will permanently be underwater and so they can't expel any damaging substance that can affect water quality or the environment.

And how do you compensate and allow for any long-term erosion that may result from the actual wave action itself?

We have taken into account the erosion in our designs, but it is extremely small.

“It’s more like the ocean, not like a wave pool” – Miguel Pupo, (Brazil) Pro Surfer.

VARYING WAVE PROFILES

At the push of a button, the Wavegarden generates perfectly formed barrelling waves that interact with contours on the bed of the lagoon to provide different wave profiles at different points in the lagoon. The waves – 2m, 1.2m and 70cm high – peel for up to 150m and are generated at a rate of one every minute. A precise design of the lagoon contour and bathymetry are vital for the successful functioning of the lagoon.

In particular, the lagoon’s bathymetry – the measurement of water depth at various places in a body of water – is responsible for determining wave formation in the various surfing areas.

Three different waves run simultaneously in distinct areas of the lagoon. An overhead ‘advanced’ wave, a waist-high ‘intermediate’ wave and the knee-high ‘beginner’ waves. Surfers on the advanced and intermediate waves work on a rotation basis (three per wave, so each surfer catches every third wave) and the wave runs every 90 seconds. Surfers in the beginner bays will get every other wave.

From the expert central area of the lagoon, two identical waves will break simultaneously left and right, with barrelling point-break type rides of up to 20 seconds long. Once the waves reach the beginners’ area at each end of the lagoon, the left and right hand waves will become smaller, more playful, whitewater waves, allowing all age groups to learn and improve their skills.

WAVEFOIL FACTOR

The secret to the Wavegarden’s success lies along the midline of the oval lake, hidden beneath the surface. The device, known as a ‘wavefoil’, is a large hydrodynamic blade that shares similarities with an aeroplane wing and the plough of a snowcat.

It moves at a speed of approximately 6 m/sec underwater from one end of the lagoon to the other and creates a clean swell. The energy of the swell interacts with the shallowing sections of the lagoon’s bed, causing it to build in size and then steepen.

As a result, the swell turns into a wave and starts to break. This produces surfable waves in various parts of the lagoon: on either side of the pier (expert), along the shoreline (intermediate), and at the end of the lagoon (beginners). Once the wavefoil completes a full run, it returns in the opposite direction to reproduce an identical set of waves.

The hydrodynamic design and robust construction of the wavefoil are key elements of Wavegarden’s patented technology. As for the length of the ride, there’s no limit: build a longer pool and you’ll get a longer wave.

Effectively, all that matters is that the pool is the right shape. There must be a certain angle between the swell and the shore – conditions that just don’t happen so often in the sea.

THE PROFESSIONALS’ VIEW

No engineering design project is home and dry – if that is the right expression in the case of a man-made wave and custom-designed surfing lagoon – until ‘those who know’ have delivered their verdicts.

DRIVE SYSTEM

The drive system is responsible for moving the wavefoil in a back and forward motion at the touch of button. The system is a gearless ropeway that uses a low-speed synchronous motor, with an output shaft directly linked to the pulley wheel. Foregoing a complex gear system has considerable advantages, in terms of its operation.

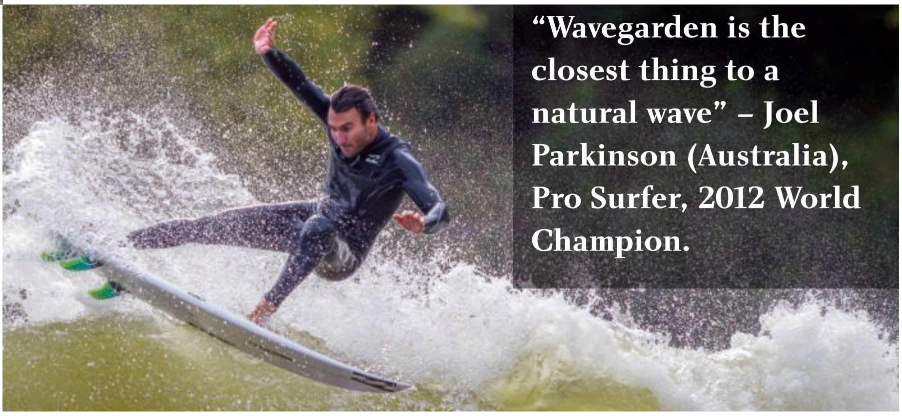
Inspired by ski lift technology, the design of the drive system is the result of a collaborative effort of a large multi-disciplinary engineering team, a large financial investment and several years of design and testing, according to Wavegarden.

A back-up engine integrated into the main design provides a highly reliable system, with “no risk of stopping while in use” – a must for any successful sports/leisure park business, especially in peak season. “The drive system is capable of producing the longest man-made waves in the world that hold their form and power over any distance; the only limit to the length of the wave is the length of the lagoon.”

CLOSE CONTROL

A control unit is used to operate the drive system and wavefoil. To make life simple, all operations are fully automated, with function diagrams displayed on an easy-to-use touch screen interface. Sensors on the wavefoil and drive system relay concise feedback in real time about the functioning of the system. Information is transmitted back to the operator in the form of a message; or, in the case of a

problem, an alarm with a diagnosis appears on the control unit screen. Positioned in the lagoon, the main pier serves two distinct purposes. First, thanks to the safety net lining both sides, the pier isolates and protects users in the lagoon from the moving parts of the wave-generating system. Secondly, very similar to a standard pier with wooden decking, it provides a first-class viewing area for spectators, cameramen and photographers.



"Wavegarden is the closest thing to a natural wave" – Joel Parkinson (Australia), Pro Surfer, 2012 World Champion.

DISSIPATIVE SHORES

With a sand-coloured finish, the dissipative shores are grid-like structures located around the lagoon periphery that reduce currents after a wave passes. Whitewater flows up the gently sloped shores and drops into the grill to reduce backwash significantly. Currents that occur during wave production negatively affect wave quality; therefore, settling the lagoon water in the shortest time is imperative to the frequent creation of quality waves.

Furthermore, the reduction of turbulence dramatically improves safety. Strong-flowing currents can be quite unsettling for users. Fitted with a layer of non-slip comfort mesh, the shores instantly diminish wave energy levels and lessen the impact of water currents on users in the lagoon in close proximity to the shoreline, or standing/sitting on the shoreline. The structures are pliable in comparison to concrete and, in the case of a fall, absorb a large amount of impact shock. As for the supply of water, this can come from a variety of different sources – ocean, river, lake, main pipes or underground bore. The source depends on what's available at any given site, determining the best option financially and environmentally. The exact volume of water required is dependent on the lagoon length, width and depth. In terms of surfing performance, there is no noticeable difference in usability between fresh or salt water.

Several hundred people have tested waves at the prototype facility in Spain, from beginners to world champions, with no reported perceivable difference in buoyancy or surfability. On average, the estimated energy requirement for the wave-generating technology is 710 kWh per hour. This level of energy can create between 150-200 waves per hour, ranging from 0.4m-1.9m high.

MACHINERY DESIGN

Based on European safety guidelines and European security directives, the wave-generating machinery is designed, manufactured and assembled to achieve the highest possible standards.

All facets are meticulously created to ensure the highest quality, guided by directives such as amusement park installations and swimming pool complexes. Each machine complies with the three key engineering directives: Machine Safety, Low Voltage and Electromagnetic Compatibility, and carries the CE mark to indicate they conform to European standards.

Environment is another primary consideration when embarking on a new project, Wavegarden states, by ensuring that the custom-made lagoon blends into the natural surroundings.

"The technology ensures each facility requires limited civil engineering work, with less concrete and much lower energy consumption than conventional wave pools. There is relatively no negative visual or auditory impact, with the only noise heard being the sound of breaking waves. Water treatment systems are based on technology that is safe and effective."

COMPUTATIONAL FLUID DYNAMICS

Conducted internally at Wavegarden, Computational Fluid Dynamics is used to generate accurate graphic simulations of the height, length, shape and forces of breaking waves throughout the various parts of the lagoon. Information and data collected from CFD simulations provide the basis for the design and creation of the wave-generating elements.

The first test of just how well Surf Snowdonia might stand up to intense scrutiny came when it hosted the world's first Wavegarden surfing contest. 'Red Bull Unleashed 2015' brought together some of the world's best surfers where the competitors surfed the same number of identical waves in a one-on-one elimination format.

"If we can build these things all over the world, surfing will become an international sport and I could see it [being part of] the Olympics one day," predicts pro surfer and 2015 world champion Carissa Moore.

Meanwhile, for the surfing fraternity at large, the days of looking out to sea in the vain hope of that next 'Grinder' showing up may well be a thing of the past.

Upskilling the **Engineering Workforce**

Dr Tania Humphries-Smith CEng CTPD MIED and Dr Philip Sewell CEng MIED MIMechE put the case for the introduction of a Professional Registration Mentoring Scheme

EngineeringUK (2013) highlighted the need to double the number of annual graduate recruits into engineering by 2020 to meet demand. The report also highlighted that only 30% of engineers in the UK economy are registered as Chartered Engineers (CEng) and 6% as Incorporated Engineers (IEng). The trend for the overall number of registered engineers is shown to be in decline (EngineeringUK, 2013, 'The State of Engineering' [online]. London: EngineeringUK). Yet Incorporated and Chartered Engineers are vital to the growth of the UK economy.

"Chartered Engineers develop appropriate solutions to engineering problems. They may develop and apply new technologies, promote advanced designs and design methods and introduce new and more efficient production techniques, or pioneer new engineering services and management methods." (http://www.engc.org.uk/ceng.aspx).

The above figures demonstrate the need to increase the number of engineering graduates and provide engineering employers with the opportunities to upskill the current workforce to increase the percentage of professionally registered engineers. It is clear that the engineering employers and employees would benefit by being provided with a scheme to mentor them through the professional registration application process. Many potential professional engineer registrants feel challenged by the application process.

Bournemouth University (BU) has piloted a scheme to help this process and encourage more professional engineering registrants with the Engineering Council through any of the licensed Professional Institutions (PIs). The pilot project was a collaboration between current BU MEng Engineering students on an Engineering Council accredited course and engineering employers to develop, launch and establish a Professional Registration Mentoring Scheme that will benefit all stakeholders. The mentoring component of the scheme was personalised to meet the requirements of the individual – and the workshop element to meet the requirement of the company; thus preparing the individual with key skills for the workplace and creating sought-after individuals who will be duly recognised as the future leaders in their fields.

In common with most HEIs, BU has a significant proportion of engineering-based academic staff holding Chartered Engineer status (CEng), with many already engaged with a range of PIs undertaking Professional Review interviews for membership and Engineering Council registration. It is therefore ideally situated to provide suitable mentors for such a scheme, although for this pilot a retired, but active, Professionally Qualified Engineer familiar with Professional Registration procedures was recruited to mentor students and help develop the scheme.

As a Chartered Engineer, Fellow and Member of Council of the IED, Fellow of the Institution of Mechanical Engineers (IMechE), and Engineering Council liaison officer for the Institution of Engineering Technology (IET), this person had broad experience of working within many

30%
of engineers in the UK are registered as Chartered Engineers (CEng)

6%
of engineers in the UK are registered as Incorporated Engineers (IEng)

professional engineering institutes (PEIs) – an ideal candidate for this project.

The pilot project commenced with an assessment of the employers of students on the MEng Engineering degree and it was identified that the Missions Systems division of Cobham PLC, based in Wimborne, Dorset, employed the largest number of students studying on the degree course. Five students (four at BEng level and one at MEng level) were identified as being employed by Cobham, which was felt to be an ideal company to work with, as it is the third largest aerospace and defence employer in the UK, with over 12,000 employees globally and 500 employees at the Wimborne site alone.

During an initial meeting to establish Cobham's requirements, a proposal for the structure of the Professional Registration Mentoring, together with a draft handbook for the scheme, was discussed. Feedback led to the mentoring scheme handbook being updated and requirements of the workshop element developed.

Three mentoring sessions were held over a five-month period at the Wimborne site to develop the students' applications for professional engineering qualifications. The sessions consisted of: presenting appropriate standards to the students; group discussions concerning the levels and skills required, and individual tutoring sessions to prepare and develop their applications for both Incorporated and Chartered Engineer (as appropriate); feedback and discussion provided of both the professional development of the industry-based students concerned and of the physical process of form-filling to achieve their goal. Feedback was secured to determine the scheme's success, with the findings suggesting:

- The scheme broadly met expectations about providing greater information on professional registration and also with previous experience of mentoring
- The importance of mentor visiting on the work site and in person was stressed, providing a more informal experience and opportunity to show things in the workplace
- Email, phone or Skype communications were not felt to be effective for mentoring
- The scheme was helpful in setting deadlines and providing motivation. However, the same deadlines did lead to pressure points when combined with full-time employment & academic study
- The timing of the mentoring scheme could be reconsidered to take place over the summer – that is, at the end of the academic study period – and also to be extended to allow a full draft application to be produced and hence a mock interview based on the application, rather than on personal knowledge
- The handbook was felt to be useful, in terms of providing initial information on professional registration and its benefits and eligibility. However, it is not something that was looked at after the start of the scheme.

The scheme would be recommended to colleagues and the company is aware of several who have completed their studies and with appropriate experience who would be interested in the scheme, if it were to run again and not be only for those engaged on an academic programme.The need to find the right champion for the scheme within the company was stressed.

The final scheme consists of:

- Publicity Material
- Scheme Handbook
- Scheme Structure (duration 6-12 months), including on site (for groups only):
  - Initial briefing on standards
  - Evidencing of competencies, including feedback
  - Completion of application forms, including feedback
  - Mock interview, including feedback.

In the near future, a case study will be developed once one of the students taking part in the scheme is in a position to fully complete their professional registration application. Initially, this scheme offered only regional impact by introducing it to companies through their employees studying on the MEng Engineering programme at BU. The scheme has now been integrated into this flexible learning engineering degree curriculum through the Level 6 unit Advanced Engineering and Level 7 unit MEng Project. Students studying on the degree will be mentored for up to a year after graduation to provide professional development opportunities by achieving professional registration.

It is now possible for practising engineers who are already academically qualified to enrol on the scheme for a fee. Once established, the plan is to secure recognition for the scheme from an appropriate professional body, such as the IED or IMechE.

Interested in this scheme or have any comments? Then contact either Dr Tania Humphries-Smith thumphri@bournemouth.ac.uk or Dr Philip Sewell at psewell@bournemouth.ac.uk.

Intellectual Property: Luke, I am your father…

Iain Colville, senior associate at Wright Hassall, considers questions of paternity and plot twists in the galaxy of intellectual property

The words 'No, I am your father' (addressed by Darth Vader to Luke Skywalker in 'The Empire Strikes Back') must be a contender for one of the most famous – and most misquoted – lines in film history. When those words were first heard in cinemas around the world in 1980, many audiences were surprised at this twist in the plot. Luke Skywalker's response was something like 'Noooooo!', so it would appear that he was caught on the hop, too. Unfortunately, this is also the reaction of many whose business or livelihood is dependent upon the ownership of intellectual property rights, upon learning that the rights that they thought belonged to them, in fact belong to somebody else.

WHO'S WHO?

All good stories begin by introducing the characters. First, there is the designer herself. In some contexts, the terms 'inventor' or 'author' might be more relevant, but this is the individual who creates the design, invention or piece of work. The designer may work for themselves, coming up with amazing ideas on their own or perhaps they work collaboratively in a team jointly creating works that may be shared between them.

Sometimes there may be another figure, standing just behind the designer – this person might be the originator of the conceptual idea or the commissioner of the act of creation.

Some designers are employees, working for an employer who exercises control over their daily activity. In general terms, a designer's or inventor's employer will own the intellectual property rights in their work, subject, of course, to the terms of the employment contract. Other designers, inventors and authors may work for others as self-employed contractors and so the position for them will depend upon the contractual agreement between the parties.

Other characters may also be brought into the mix, as intellectual property rights can be licensed or transferred to others who may or may not have any relationship to the inventor or designer. It is therefore vital to look at the whole picture and review any contractual documents that surround the design process.

PLEASE DESIGN ME A …

In the world of intellectual property, there are different stories, depending upon which intellectual property rights are involved. Some involve plot twists almost as complex as the Star Wars franchise. If you are sitting comfortably, let us begin with product designs, which UK and EU law protects, in terms of the outward shape and appearance of a product.

In the first instance, there will be an automatic form of protection (such as unregistered design right in the UK) that will initially belong to the designer who first records their design on paper, digitally or in the form of a model or prototype. If the designer is an employee, the unregistered rights will first belong to their employer.

However, if the design was created before 1 October 2014 and a third party commissioned (and paid) the designer,

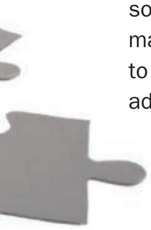
the unregistered design right will belong in the first instance to the commissioner, instead of the designer (subject to the terms of any relevant contract).

The next potential twist in the plot is that the owner of the unregistered design right may decide to obtain a more robust form of protection by registering their design. In the first instance, the registered right must belong to the person entitled to the unregistered rights. One benefit of registered rights is that a public register lists the owners of each registered design and changes of ownership should be recorded in the register.

WHAT A CLEVER IDEA!

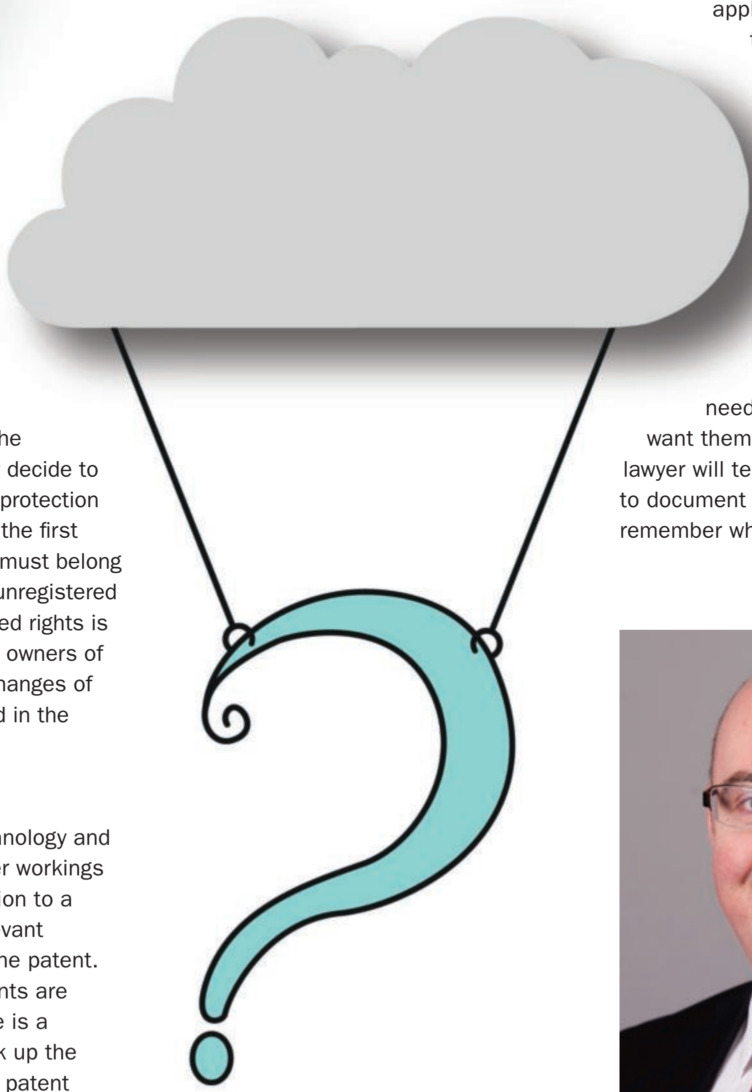
In the case of innovative technology and inventions – such as the inner workings of a new product or the solution to a technical challenge – the relevant intellectual property right is the patent. Like registered designs, patents are registered rights and so there is a register in which one can look up the owner. In the first instance, a patent application will be made by (and the resulting patent will belong to) the inventor(s) or their employer.

This person is known as the applicant or patentee. The prospective applicant can pass the right to make the patent application to a third party under a contract. A patentee can sell his patent, so it may pass into other hands, or they may choose to grant rights, or a licence, to third parties to exploit the patent. In addition, the individual(s) who came up with the invention has (or have) the right to be named in the patent as inventor(s).



TELL ME A STORY…

Copyright will protect many different forms of creative activity (generally regardless of artistic merit), such as written text, software code, drawings, photographs, sculptures, works of



architecture and works of artistic craftsmanship, films, broadcasts, theatrical plays, music and songs. The story here is broadly the same as for unregistered designs – the 'author' or creator of the work in question will be the first owner of the copyright, unless they are an employee or agree by contract that the rights belong to someone else.

IT'S GOT MY NAME ON IT!

Separately from any copyright in the graphical aspect of a logo, branding belongs principally to the party who is using it. Unregistered rights will arise as goodwill and reputation is generated in relation to a particular brand. Stronger, more easily enforceable, rights can be obtained by registering trade marks. Again, there is a register that states who applied for the trade mark and to whom it now belongs.

The key to unravelling the story of who owns which intellectual property rights (and avoiding any surprising plot twists) is to ensure that, right at the outset, you consider carefully what rights you may be creating (or need to register) and who you want them to be owned by. As any lawyer will tell you, it is always important to document all of this clearly – and remember where the document is kept.

About the author

Iain Colville, senior associate at Wright Hassall, is an experienced intellectual property & technology lawyer, specialising in disputes over the ownership or misuse of intellectual property rights. He has advised on product designs; branding and trade marks; copyright in software, training materials, photographs and music; inventions and patents; as well as confidential information and trade secrets.

Nick Rowan: championing the cause of GYM members

New GYM chairman Nick Rowan wants to see more young designers gain recognition and get valuable exposure right at the start of their careers

First, I would like to wish you all a happy and prosperous New Year.

My name is Nick Rowan and I am the new chairman of the Graduate and Young Members (GYM) group. Following on from the excellent work that Raymond did last year, establishing this group, I am looking to grow our membership and create a far more active network.

To this end, it is great to be able to share details on these pages of GYM member Jenny Watling's Bark! project, from De Montfort University.

Casting an eye ahead, I will be looking to present recent graduates' work in each subsequent issue of *Engineering Designer,* essentially to help young designers in their quest to gain recognition for their work and also secure valuable exposure right at the start of their careers.

So, if you would like to see your work featured in the future editions of the magazine, then please feel free to contact me through the IED, as I would really like to hear from you.

Please also keep a lookout on these pages, as we are hoping to build on the excellent industrial visits of last year, with some exciting new opportunities. For all of our members wishing to get more involved, we have a Basecamp discussion group set up that I would like to invite you to join. This will help you inform how our group grows and what we get involved in.

I look forward to bringing you more exciting GYM news in the near future.

AWARD-WINNING BARK!

PET PROJECT

Jenny Watling MDes considers how product design can help owners to be more connected to the needs of their dogs, thus ensuring their pets enjoy a far richer life

Jenny Watling: interested in the design of products available for pets.

I've always really liked animals and, having had pets throughout my life, I was interested in the design of the products that are tailored for them. It was also really interesting to see the variation of products actually available for pets – and dogs specifically.

The main thing that I noted from seeing all the other products was that not too many of them were really focused on the dog's needs. Not that they weren't good for the dogs, but it seemed the focus was to make dogs more human, rather than giving them the outlets they need as dogs – something we can all too easily overlook. That led me to thinking about how owners can be more connected to the needs of their pets and how these needs can be best addressed, with the overall aim of giving dogs a far richer life as a dog.

I have a sister who works in an RSPCA rescue centre, and it's so common for her to see dogs that are 'difficult' and have to be given up by the owner. However, but this 'difficult' behaviour is very often due to a bored or under-trained dog; a situation that is completely preventable.

This was one of the key issues I wanted to address with the product I designed and developed, but also there is an alarming amount of overweight and obese dogs in the UK (nearly half). This has the same effect on dogs as it does humans, increasing preventable diseases, shortening lifespan, causing joint issues and generally decreasing quality of life.

Bark! is a connected system focusing on four key needs of dogs: social, environmental, physical and mental. It breaks down the needs into actions. For example, physical would be going for a walk and these actions are read by a monitor fitted to the dog, much like the way Fitbit and Jawbone products do for people. However, unlike those types of products, Bark! logs social activities with humans and other dogs, and mental activities, such as training and puzzle toys, when they go somewhere new.

This is all then feedback to the owner via a dedicated app or the Bark! hub,

IN THE SPOTLIGHT

Meeting the DEMAND

DEMAND is a charity dedicated to helping people with disabilities that require bespoke equipment to help them with their everyday lives

DEMAND is a charity that is dedicated to transforming the lives of people with disabilities, helping them to overcome challenges in their lives with custom-made or modified equipment. Those with special requirements often find there is no suitable 'off- the- shelf' solution. From two engineering workshops, DEMAND's team of 20 staff modify, refurbish, design and manufacture equipment, tailored to an individual's needs, that makes daily life easier or enables them to enjoy sport and leisure activities.

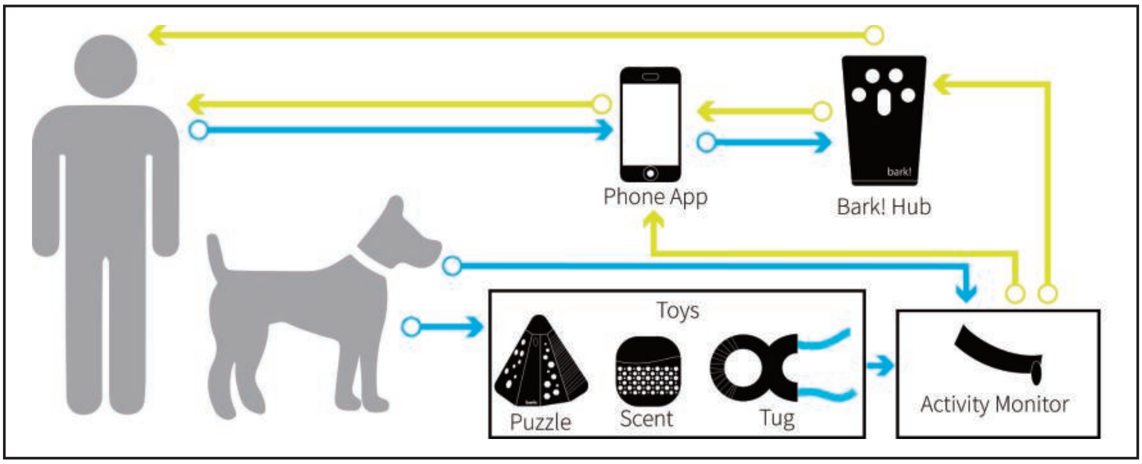
Each year, DEMAND takes on university students for 48-week placements as junior designers. Every student becomes skilled in its custom design process and often leads entire projects to completion towards the end of their time.

"We hope that letting people experience the way we work, and seeing at first hand the impact that our work can make, will inspire young designers to continue to create products empathetically; taking full consideration of people with mobility and cognitive challenges for the entirety of their careers," says DEMAND.

Students benefit from learning to consider design for disability in everything they do, which helps influence the thinking in their future design environments. As one of its students said on leaving: "It's been a life-changing experience." The hands-on opportunities to interact with end users and undertake design projects from conception and prototyping to final production are unique within the disability sector.

"My placement at DEMAND opened my eyes to the world of design for disability," says Daniel Tyas, BSc Product Design Engineering, Nottingham Trent University.
"I gained a real appreciation of designing for manufacture, working in tandem with craftsmen and practicing the skills myself.

"The satisfaction from witnessing a client achieve something new for the first time, with the help of something I'd designed, really sticks with me.'
More information: www.demand.org.uk.



showing what areas the dog is satisfied in and what ones may need more work. The system also includes a range of Bluetooth-enabled toys focused on meeting these different needs, which can be logged by the monitor. Overall, the system aims to give the owners the tools they need to ensure their dog has the best quality life they can, through giving feedback and advice on future actions. I studied MDes Design Products at De Montfort University for four years and graduated in July 2015 with a first class degree. After exhibiting work at New Designers and generating some interest around the product there, I was offered a job at a retail design company where I am now learning more about design in the real world.

I am, however, very enthusiastic about this project and, in my spare time, I'm developing the existing range, with hopes in the future to build a business around this core concept.

Recently, this project has been exhibited in Beijing, as part of the British Council Great Creator Graduate show, for winning awards within the university.

STUDENT POWER!

A team of engineering students from the University of Liverpool has broken the human-powered British land speed record three times. Now they are after the world record

The University of Liverpool Velocipede (ULV) team does not do things by halves. They designed and built their recumbent bicycle ARION1 from scratch with one goal: to capture the world record.

The students transported the bicycle to Battle Mountain, Nevada, and raced it in the International Human Powered Vehicle Association's World Human Powered Speed Challenge 2015. Aiming for that world record of 83.13mph, set at the same venue by a Dutch team in 2013, the team fell just short, but did surpass – indeed smash – the British record of 67.4mph set by Rob English at Battle Mountain in 2002.

There was early disappointment when all the male riders successfully qualified, but female rider Natasha Morrison was unable to hit the speeds required to make it through to the main event. Then, sadly, mixed weather conditions forced the abandonment of runs early in the week. However, with the sun back out, the ULV team clocked up a 69.7mph run by rider Ken Buckley to capture that British land speed record. But there was more to come. On the final day, fellow rider David Collins, a PhD student at the university, hit back with 70.6mph, only for that speed to be topped by Ken pushing to a new British human-powered land speed record of 75.03mph.

HIGHS AND LOWS

It was a rollercoaster week, with highs and lows for the team, reports ULV deputy team leader Patrick Harper. "Damage sustained to the exterior shell and steering after a high-speed impact meant working through the night on Thursday and Friday to make it possible for our riders to attempt breaking records again.

"On the final evening, the bicycle was in great condition, the riders were pumped and the weather provided perfect racing conditions. David and Ken were able to hit incredible speeds – the team were ecstatic," recalls Patrick.

So, how did they put together the machine that took them to a new British

Triumphant engineering students from the University of Liverpool.

record? Rob McKenzie, new team leader of the ULV Team, explains: “Our bike, the ARION1 [it weighs about 45kg and is 2.7m long], has a carbon fibre monocoque structure that was designed to give the most stiffness possible. This allowed the effort from the rider to be effectively transferred to the road and not into flexing of the frame. Much of the bike is made from CFP, including the seat and front frame structure.

“If you look at your bike, you might notice that something is missing – it has no windscreen. Instead, we opted to mount a camera at the top of the bike, which is connected to a pair of screens in front of the rider’s face. Two systems run in parallel, with one operating as a backup. On the front wheel, we use a Michelin solar car tyre. These tyres are well known for their incredibly low rolling resistance. However, they are quite wide. For this reason, on the rear we use Schwalbe Ultremo ZX, which has a much smaller profile and would disrupt the airflow at the back less.”

MASSIVE GEAR RATIOS

In order to get the bike up to speed, some massive gear ratios are required. “The main chainring has 104 teeth and is made by Royce,” states Rob. “We use two separate chains on the bike. The chain from the chainring goes down to a layshaft, mounted ahead of the pedals, which has a gear ratio of about 2:1. A chain then goes from the layshaft all the way back to the driven rear wheel.”

The shell was designed using computational fluid dynamics (CFD) and also taken to the wind tunnel at MIRA. “This allowed us to check our computer models against real data,” he says.

But what about the riders themselves – who was up to this enormous challenge? “We found our riders following a nationwide search. We eventually found the most powerful engines for the bike. The riders then went through the tough process of learning to ride a recumbent bike – which takes some serious skill. Finally, they were ready to learn to ride the

ARION1." One of the most difficult design challenges was to fit the bike as closely as possible to the rider, Rob reveals. "Aerodynamic drag is related to the frontal area; therefore we wanted to make the bike as small as possible.

"We made a mock-up of the bike, using a test rig built of aluminium profile. Using this fully adjustable rig, we took 3D scans of our riders. This then gave us a CAD model around which we could design components of the bike.

"To check the shape of the shell against the rider, we had some polystyrene blocks cut to the shape of the shell and built these around the test rig. Luckily, the riders fit it like a glove!"

As there was more than one rider for the bike, the shell had to be designed and made to fit the biggest.

What of the venue where the challenge was staged? "The World Human Powered Speed Challenge takes place on an ordinary road that is closed for 20 minutes every morning and evening," he adds. "The riders accelerate over a five-mile course, before reaching a 200m flat section where speeds are measured and recorded." One of the treasured moments must surely have been when David and Ken received commemorative speeding tickets from the Nevada sheriff for breaking the road's 70mph speed limit.

OUTSTANDING ACHIEVEMENT

Accompanying the team all the way to Nevada was Dr Tim Short, senior lecturer in the University of Liverpool's School of Engineering. "To break the British record three times in our first attempt at this challenge is an outstanding achievement for the whole ULV team," he says. "The students have worked hard, with enthusiasm, through what were difficult circumstances. The School of Engineering and the University of Liverpool are proud of what they've been able to accomplish."

Although the ULV team did not manage to trouble the 2013 world record on this occasion, it was topped by a Canadian team competing at the event when Todd Reichert and his AeroVelo team achieved a speed of 86.65mph.

This will be the target for the ULV team when they compete at next year's event. In fact, since returning from Nevada, the team has begun developing its second bike, the ARION2, based on lessons learned from the ARION1. "We believe we have an excellent chance of getting the world record next year," states Rob McKenzie. He adds: "We would like to thank Rathbones, our sponsor. Without its support, this wonderful project would not have been possible."

Rathbones' chief operating officer Andrew Butcher describes ARION1 as "a triumph of British education, industry and sport. As investment managers, we seek to invest in future technology and it is a privilege for us to help make possible the team's success in smashing the British record".

For more pictures and background on the contest, visit: **http://ulvteam.co.uk**.

Top of page: front end lay-up. Above and right: shell lay-up.

New Chartership for Product Designers is a roaring success!

CTPD is a unique Chartership now within the reach of IED members and it's already proving to be a winner. We would like to see even more members adding Chartered status to their credentials.

As you will probably be aware, the IED has been granted licence to award Chartered status to product designers by decree of the Privy Council; the Chartership is a competence–based registration, focusing on the abilities and skills of the designer.

Developed specially for designers working in product design, CTPD has the specific aim of providing professional recognition, support and registration to designers, on a par with their colleagues who register as Chartered Engineers, Chartered Scientists or Chartered Environmentalists.

Pictured here are some of the first IED CTPD registrants: Dr Ben Watson from 3M; Dr Caroline Simcock from Dyson; and Ian Callum, director of design at Jaguar. Ian Callum commented:

"The introduction of CTPD is a vital development for professionalism in the design community. The Chartership recognises and values the hard work, expertise and commitment to excellence demonstrated by product designers. It was an honour to become one of the first recipients."

To find out more, go to the IED website: http://www.institutionengineering-designers.org.uk/membership/ becomingamember.

Among the first CTPD registrants were, above from left: Dr Ben Watson from 3M; Dr Caroline Simcock from Dyson; and Ian Callum, director of design at Jaguar.

NEWS BITES

Honorary degree for our president

Congratulations to IED president Maggie Philbin on recently being presented with an Honorary Degree of Doctor of Science from the University of Bath.

Notice to members

Don't forget that this January is the month when the IED changes all members' subscription payments to renew annually. Each member will have been sent an email and a letter to explain how the change will affect them. If you have any questions, please do not hesitate to contact HQ on 01373 822801.

Career advancement

CPD is ever more important to a professional designer's career. All IED members are invited to sign up to our CPD management tool 'My Career Path'. Log on to the IED website and follow the link in the 'Benefits' section to the online facility, which can help you manage your Professional Development.

Elections & Registrations

Chartered Technological Product Designers

Neil Baker — Gloucester
Ricky Barnett — St Albans
Daniel Brendan Farrell — Bradford on Avon
Masayoshi Noguchi — Melbourne
Charlie Edward Park — Singapore

Chartered Engineer

Christopher Donovan Beeken — Norwich
Aleksandra Anna Papierkoswka — Bristol
Elliot Tanner — Montgomery
Alun Thomas — Blackwood
Kathryn Thompson — Rotterdam

Incorporated Engineer

Edwin George Coombs — Leamington Spa
Christopher Webb — Birmingham

Transfer to Fellow

Alec Milton — Northwood

Election to Registered CAD Practitioner

Adam Tiller — Andover

Election to Graduate

Noel Brandley — Hardingstone
Dale Comley — Ashbourne
Richard Elsmore — Birmingham
Thomas James Helliwell — Auckley
Sanjeeva Karunarathne — Sri Lanka
Mohammed Rafi Shaikh Omar — Trichy, India
William Peach — Wolverhampton
Jonathan Smart — London
Stuart Sykes — Nottingham
Samuel Twist — Bristol
Liam Watson — Manchester

Transfer to Graduate

James Oswald Atkins — Bristol
Ben Clarke — Wandsworth
Alice Gregory — Wilmcote
Lucy Harriet Pemble — St Albans
Toby Shelton-Smith — Westbury
Murray Wetton — Kirkby in Ashfield

Election to Student

Jemima Grace Barnes — Southampton
Peter Barr — London
Rene Camilleri — Imqubba Malta
Hannah Conn — London
Jack Marlon Curbi — London
Carlo Dunn — London
Shalom Emmanuel — Drogheda
Ciaran Finlay — Monaghan
Andrew Fitzgerald — Drimmagh
Reem Haneman — London
Payam Jameelpanah — London

Elections & Registrations cont.

Brent Le Roux Welwyn Garden City
Dinis Carlos Manuel London
Philip Mawdsley Liverpool
Amos Timi Oyedeji Ashford
Matthew Pace Msida Malta
Joshua Harrison Reeve Ibstock
Tharshan Thatparan Thornton Heath
Adam Winczewski Basingstoke
Jeff Whyte Dublin

Election to Student from Bournemouth and Poole College

Jack Alexander
Will Allen
Jack C Andrews
Jamie Arnold
Rowan Aylward
George Bailey
Davy Baker
Ashleigh Baker
Jake Bascombe
Lewis Belmont
Christopher Blundell
James Michael Boyce
Andrew J Brooks
Tomas Brown
Matthew R Calvert
Joshua Reece Campbell
Joshua Clark
Adam Cook
Greg Coope
Connor Court
Nathan Crane
Victoria Cuffe
Samuel Curtis
Joshua Dawson
Oliver Devereux-Burden
Ronan Fitzgerald
Georgia Foster-Symes
Lewis Francis
Benjamin Gamble
Karl Garrett
Ryan Gover
Peter Hanley
Bradley Heath
Oliver Holland
Konrad Horodecki
Benjamin Humphries
Hannah Huntley
Edward Inge
Greg Ives
Nicholas James
Dominic Jennings
Jack Christopher Jones
Iain Edward Jones
Thomas Laird
Benjamin Lane
Billy Love
Daniel Lovett
James Mainwaring
Robert Male
Michael Edward Ronald Marshall
Stuart Mole
Benjamin John Mosley
Ronaldo Nascimento
Andrew Neagle
Judi O'Ceallaigh
Nat Oxenbury
Edwin Page
Ryan Palmer
Sergiusz Pasalka
Marcin Pieta
Jack Purdue
Jareth Reeves
Ben Richards
Adam Charles Richardson
Sam Ruckley
Mark John Callum Sandford
Lewis Sandoe
Alex Seton
Jeremy Thomas
Kieran Michael Thorne
Darren Thorp
Joshua Tuffin
Matt Walker
Thomas Walker
Alex Watson
Ashley Whittaker
William Whitworth
Harry William Wilkinson
Thomas Charles Williamson
Tony Wilsher
Nicholas Wood
George Woolliss
Benn Wright
Stephen Youngson

Election to Student from Brighton University

Emmanuel Tetteh Nakotey Aidoo
Nicole Bonnie Andrews
Mehmet Emirzade Arican
Harry Kennedy Axten
Oliver John Bamsey
Dominic Besagni
Joshua Brady
Gordon Brown Jessica
Ashley Thomas Bunce
Sarah Burke
Jake Cable
Yasmin Miss Caon-Beik
Mowmita Chowdhury
Daniel Clark
Java Cooper
Rufus John Crewe-Henry
Danielle Fender
Alistair Arthur Gravett-Curl
Anna Rose Hampton-Reed
Elias Mohan Heath
Steven Thomas Hibbert
George Jump
Douglas Darren Kilby
Frederick William King
George McPherson
Carolyn McReynolds
Lauren Nicholson
Benson Pocock
Theodore Poole
Vlads Putjatins
Rhiannon Roberts
Elliott Karma Sidhu
Zacary David William Smith-Bubbi
Benjamin Francis Taylor
Jake Vita
Jonny Ward
Evie Weeks

Election to Student from Brunel University

Noah Abbott
Patrick Abdul-Ahad
Faith Abe
Emmanuel Adjei
Ipek Akarsu
Matthew Anderson
Danielle Anwan
Matthew Alpin
Yasemin Argun
Jack Baker
Yasmin Ball
Michael Barrett-Wright
Thomas Bell
Frederick Selby Bennett
Andrea Berenga
Frederick Billowes
Timothy Boxall
Rebecca Boxwell
Fernado Gomes Branaas
Joshua Breakwell
Bradley Brister
Eric Broadway
Sonny Brooks
Sorby Brown
Mary Cabrera
Joseph Cahoon
Jack Casey
Hakam Chana
Tzu Chen
Ajharul Choudhury
James Clayton
Nada Coles
Loius Cook
Gerogina Cox
Olivia Creaney-Birch
Caolan Creery
Natasha Dareshani
Valeria Reivera De La Torre
Sintija Deksne
Dhruv Dhanjal
Kimberley Dobney
Oskar Drobczyk
Alastair Ferron
Rute Pereira Crespo Fiadeiro
Jacob Fisher
Robert Foulds
Samuel Galbraith
Jessica Gami
Mladen Georgiev
Fe Go
Alicia Perez Gomez
Paras Gorasia
James Griffiths
Aled Griffiths
Nikita Gupta
Roshan Gurung
Jack Hagger
Denny Handley
Nicholas Hansen
Gemma Harvey
Ali Hassan
Eleanor Hayward
Eris Herbert
Taylor Heywood
Ryota Hochin
Joseph Howard
Nicholas Howard-Kishi
Elizabeth Hyatt
Ka Ip
Hasnain Iqbal
Mohammed Jameel
Samuel Jenkins
Libega Jeong
Anthony Johnson
Luka Jovanovic
Sophie Kelvin
Yanis Kheddouci
Gulsen Kocahal
Atanas Kovachev
Isaac Kweon
George Lane
Anton Larin
Kiwon Lee
Jiwoong Lee
Makenzi Lelliott
Hugo Lennon
Andrew Lloyd
Hannah-Marie Luce
Eleanor Mabbutt
Christopher Magoba
Jasper Mallinson
Chloe Man
Michale Mann
Marco Marin
Albert Marfa I Martinez
Alexandra Maryan
Toby Matthews
Beau McLaren
Mark Mitchell
Abdulaziz Mohamud
Parand Mojabi
Felix More-Burrows
Thomas Mortimer
Luke Murphy
Connor Musoke-Jones
Harry Nicholson
Daniel Oakes
Ruwan Opatha
Jake O'Sullivan
Toby Palmer
Jeskika Patel
William Pegler
Cil Tiam Poon
Samuel Price
Owen Purvis
Hugo Ramsey
Leutrim Ratkoceri
Trevyn Rayner-Canham
Natalia Rehakova
Thomas Rickard
Harry Rivett
Samantha Roberts
Kiah Robinson-Jarrett
Cerys Roche
Cameron Rogers
Jonathan Ruscoe
Harvey Rutland
Katarina Saunders
Ellen Shearman
Maximilian Shillan
Ciara Shine
Toby Sholto
Andrea Siakalli
Rytis Sideikis
Samuel Kirschstein Smith
Charles Sparks
Edward Spash
James Spencer
Iqbal Tanay
Panatiotis-Adonis Charalambous Therorides
Cerys Thomas
Louis Thompson
Benjamin Tinegate-Smith
Tsun Ting
Tasnia Uddin
Daniel Valentine
Olivier Verbiest
William Vickery
Bethany Wale
Joshua Ward
Charlotte Whitaker
Matthew Whitehead
Scott Willats
Jun-Sung Won
Amir Zakria
Melos Zhita
Cengizhan Ziyaeddin

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) and Chartered Technological Product Designers (CTPD). 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

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
? Write a professional review report, detailing what you do in your role in design. All applicants are assessed by a Committee of Members and via an interview.

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 Sue at the IED on 01373 822801 or send an email to: sue@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