The Institution of Engineering and Technology

Engineering and Industrial Design

Success through collaboration

How and why more of the UK's world-class engineering and manufacturing industries can raise their game by working with the UK's, equally world-class, industrial designers.

'Designer' is an extremely broad term that covers a huge range of different professional skillsets. The kind of designers used in each industry reflects the balance of technical and market risks in each. It is clear that successful furniture innovation requires different design skills than those required to design aircraft engines.

Innovation is also typically a collective activity. Within their worlds, designers will happily recognise the need to collaborate with other related design specialists. The wooden furniture designer happily combines with the textile designer. The engineer creating the thermodynamic cycle of a jet engine will happily collaborate with his peer in turbine blade design to achieve the best collective output.

Both industries aim to create outputs that will be bought by customers. The main difference is that the decision to select furniture, typically, has a strong intuitive component. By way of contrast, the decision to buy a jet engine will, typically, be based on extensive comparisons of quantitative performance data.

Design & Production

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Case Study
Brand co-ordination and design management

The Client: **BT**

The Brief:
As the market penetration of broadband grew, BT wished to create a device that would personify the added value proposition of BT Home Broadband, an icon that would proudly sit in a customer's home. Indeed, the name itself suggested advanced functionality and services beyond a conventional router.

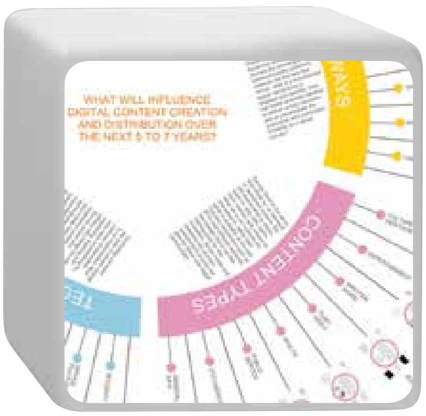
The Approach:
The BT Home Hub is designed as a wave, cradling the telephone handset at the centre. This reflects the central function that the BT Home Hub plays, delivering entertainment, Internet and voice. Featuring no external antenna, blue LED lights and a floating black gloss fascia, the BT Home Hub looks and feels a world apart from a typical wireless router, but perhaps the most powerful testament to the design is that the Home Hub was dual sourced – 2 separate OEM's produce the device, and while their respective internal architecture might be different, it is impossible to distinguish them – as both are produced to the same design specification.

The Result:
As broadband became more commonplace and components dropped in price and size (e.g. SOC - system on a chip etc), BT were able to provide new functionality on smaller chipsets at a lower cost.

The real challenge for innovation collaboration comes in industries, like automotive, where the buying decision is a complex mix of intuitive judgement and rational assessment of quantitative data. The stakes can be really high: if Jeremy Clarkson doesn't like the feel of the controls of a new model or doesn't think it has 'soul', billions of pounds of engineering and manufacturing investment is at risk.

This is where industrial designers come in to the picture. My background isn't uncommon. I trained as a car designer in the 80's but since then I've designed everything from cars to elevators, telephones, thermal imaging equipment, pro broadcast software and cloud services for assisted living. Many of the products I design these days didn't even exist when I was at university. In the last decade the scope of my work, like that of many others in the profession, has extended into the design of software and services.

In the car industry, the commercial importance of consumer behaviour is so well appreciated that industrial designers are entrenched in the innovation routine of the industry. But elsewhere things can be quite different. The why and how of collaboration between industrial designers and engineers isn't well understood. In fact, I would go even further and say that it is actually quite badly misunderstood, which means that many industries that might benefit from ID-engineering collaboration don't, because they fear a loss of control and underestimate the value creation potential.



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At a time when we are all trying to rebuild national competitiveness, this matters a lot because many of these industries are the niche B2B high-tech ones, in which UK engineering excels but where this technical excellence doesn't automatically lead to sales in tough global markets.

Successful companies like Apple clearly demonstrate that industrial design can be a source of great competitive advantage in consumer markets but as global markets get more and more challenging, even the most technology-led industries are using industrial designers to help achieve a stronger competitive advantage. UK ID professionals can demonstrate solid commercial benefits for UK 'technology-led' companies like E2V, Violia, Sonatest, Advent among many others. Our work has won Hollywood Oscar's, and Queen's awards for export achievement. Our profession's main design awards recognise commercial 'design effectiveness'. What sort of products? For example, The Alloy, the employee-owned ID consultancy I founded, has won awards for creating 'fireman-friendly' thermal imaging cameras (see E2C case study) and more recently helped MBDA (part of BAE systems) plan how their guided missile technology should be packaged and presented to infantry platoons. No pretty lampshades here.

The UK has a world-class industrial design sector, but sadly too many of our efforts are for overseas clients. To improve UK competitiveness, we need to get the UK's world class engineering and industrial design sectors working together, collaboratively. But I'm not sure we will achieve this simply by just throwing up a barrage of successful case studies. Although entirely valid, the problem with case study evidence is that it is too easy for any industry to say 'not relevant' to me. So I'm going to have a go at explaining, from first principles, what it is that industrial designers do that engineers don't, and how we can help our engineering colleagues achieve better overall innovation results. As someone with degrees in both engineering and industrial design and 28 years applied experience, I've probably got the minimum qualifications to do this!

Engineers are educated to create new things and systems that 'work': bridges that don't fall down; logic circuits that don't lock up. Yes, it is absolutely a creative activity but it tends to be a form of applied physics and commerce where the respected and prioritised goals are the clearly quantifiable ones. The main skillset of modern engineering is mathematical modelling, which, thankfully for anyone crossing a bridge or flying in a plane, has amazing predictive capabilities, thanks to the robust accuracy of the laws of physics, magnified by computer methods.

The problem for this 'maths-led' innovation skillset starts when success depends on human decisions 'to buy', 'to use' or simply 'to care'. Contrary to the hopes of classical economists, many engineers and accountants, these decisions are rarely, if ever, rational. They are overwhelmingly informed by our intuition, which stubbornly defies all attempts at mathematical prediction. Put simply: Human Behaviour is a failure mode that engineers aren't equipped to understand or address.

The executive summary of modern behavioural science is that human decisions are clearly 'biased' in many ways, vastly over emphasising what is experienced 'now' and jumping to conclusions based on previous direct experience. (A web search on behavioural economics and pioneers like Daniel Kanhneman & Gerd Geigenzeiger can provide more background.)

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Case Study
Optimising design around the needs of the user

The Product: **E2V Thermal imaging camera**

The Brief:
To upgrade the design for a thermal imaging camera used to fight fires incorporating digital technology such as enhanced sensor arrays and an opportunity to optimise the design around the needs of users.

The Approach:
The obvious challenge of understanding the needs of fire-fighters was a key issue when we discussed the project with the client. The industrial design team completed basic fire-fighter training to drive insight and empathy.

The time spent with fire-fighters and the insight gathered by the industrial design team directly informed the creation of a radically improved design, driven by the use cases and associated ergonomics of the fire-fighters themselves.

The process of identifying the most compelling insights is often highlighted as the key element, yet for a product design process, the most vital element is the conversion of insight into meaningful form and experience. This is what the industrial design team specialise in – the conversion of insight into attributes – features and elements that are directly inspired by user needs, and that become defining benefits of the new product.

In this case, the two most important insights were that:

1. Fire-fighters crawl into buildings (insight), which determined that the device needs to fit to the chest to provide easier movement. As a consequence, the depth of the device (how much it extended in front of the user) became the critical dimension (attribute).

2. Once inside, firefighters hand the camera between themselves to scan the environment (insight). As a consequence, the device needed to have a very clear handover choreography, a design that encouraged the users to do so in a particular manner. (attribute).

It is only when you try to pass such an expensive piece of equipment inside a burning room wearing fireproof gloves, hats, coats and glasses that you understand the emotionally and physically demanding context, and the resulting design challenge. Indeed, we approached the challenge as an inclusive design problem, as each fire-fighter was effectively disabled by their equipment and the environment in which the cameras were used.

The industrial design team sought to create a camera that would allow easier access when crawling on the ground and to provide clear handles to enable easier 'handover' while in a burning building. The same handles that enable handover also provide key protection for the camera to withstand a 6ft drop test required for such rugged equipment and provide a distinctive profile that clearly communicates the functional improvement to the E2V Thermal Imaging Camera.

Given that the industrial design was crucial to the performance of the product, a complete overhaul of the mechanical engineering contained within the camera was completed.

The Result:
The resulting product became hugely successful with the UK Authorities ordering thousands of units. This success was replicated across the world as new Governments and Authorities became aware of the benefits of the camera. The design was recognised numerous times globally including IDSA, iF, Design Week and many others.

Case Study
Integrated hardware design to deliver better user experience

The Client: **Grass Valley**

The Brief:
In 2005, Grass Valley had identified the opportunity for a new audio visual (AV) mixer product to satisfy the needs of the expanding mid-market professional AV market. Electronic and mechanical engineering teams in Germany had developed a functional prototype and proposed a basic plastic enclosure design. Product management and marketing teams in the USA, however, were concerned that the proposed enclosure design failed to respond to the specific needs of the market, lacked clear user benefits and didn't communicate Grass Valley's brand values or the innovative and high-quality nature of the device itself. Furthermore, due to its complexity, the proposed plastic enclosure design was found to be prohibitively expensive. The challenge was to deliver, within a five month period, a high quality user experience reflecting Grass Valley's high-end heritage, but at a lower price point that could respond to the unique needs of this new market.

The Approach:
Extensive in-field user research, experience mapping and customer profiling exercises were carried out to understand the specific motivations, needs and aspirations of the target market. This insight, together with a thorough understanding of Grass Valley's heritage and brand values, inspired not only a distinctive enclosure design but also a new, adaptable design language which better communicates Grass Valley's brand values through the outward appearance and experience of their products.

Factoring in the pre-determined control and component layouts, exacting heat management and electromagnetic interference (EMI) shielding requirements and tight bill of material (BOM) constraints, the industrial design team were able to add considerable value through the enclosure design and deliver an improved user experience. Notable design attributes included:

- An extended wrist support and ergonomic positioner pad for better comfort
- Improved graphics and illumination effects to communicate function and status
- A robust perimeter bumper for on-the-go use scenarios
- Secure grab points for portability
- A pocketed rear-panel to protect connectors
- Improved ventilation for more reliable operation
- Additionally, customers familiar with the traditional use of sticky tape to label their camera sources appreciated the inclusion of a handy write-on/wipe-clean label underneath the relevant source input buttons.

Besides these value-added features, the team's design for manufacturing (DFM) capabilities and understanding of plastic processes actually resulted in a significantly more cost effective enclosure design than that originally proposed by the mechanical engineering team.

Of course, another stand-out feature of the Indigo AV Mixer is the design of its large, integral touch-screen control surface with an intuitive, high-legibility user interface.

The Result:
The Grass Valley® Indigo™ AV Mixer is a compact, fully featured live production control panel intended for small-medium sized studio, rental, education and conferencing applications. The Mixer received positive reviews and multiple accolades from industry bodies and customers alike and quickly established itself as one of Grass Valley's best-selling products.

The practical business impact of all this is that the actual success of any innovation bought or used by people will depend hugely on, how these people make sense of the look feel and behaviour of their direct experiences interacting with the innovation. This effect is every bit as important for a fireman or pensioner as it is for cool '20-somethings'.

Industrial design helps organisations optimise the look feel and behaviour of the direct experiences they deliver. This adds value and removes risk from innovation projects. ID helps organisations uncover new sources of value by understanding users and customers in more detail and by making it possible to judge customer acceptance much earlier. This approach reduces the risk of expensive, late technical changes and makes it cost effective to explore a much broader range of possibilities.

One of the first myths to debunk is that designers are creative egos who direct innovation on a whim. As I explained in the opening example, this can be true of designers working in home decoration or fashion, but this approach has nothing to do with modern professional industrial design. Our creative inspirations are the aims of the organisation making the investment and the learning we get from direct observational research with users and customers. This gives us the deep user empathy we need to properly anticipate customer needs. I never cease to be amazed at how many ways of adding new value get overlooked because innovation leadership sets too few goals in their brief (usually based on classical 'tell us what you want' market research) and delivery teams limit themselves to doing no more than the brief asks for.

Industrial designers have, in the past, been dismissed as mere artists. In fact, 'images' should never be accepted as the end result of ID. The visualisations and mock-ups that we create, using a wide range of techniques, are in fact empirical tests that simulate how people might judge their interactions with future products. These take advantage of the same cognitive biases that make direct experiences so important. They 'trick the senses' just like movie sets. Users comment on these as if they were interacting with the real thing. The key project efficiency is that actual technical functionality isn't needed to get totally valid feedback well before technical development.

These simulations shouldn't be confused with the actual specification instructions that represent professional ID outcomes, these should be clear, precise, actionable instructions that engineers can understand. Best practice is actually for 3D ID computer form data and the 'top user interface layer' of computer software to be reused directly in the final production data set, without requiring re- creation by the engineers working downstream.

There is an obvious new risk in this approach: will the 'realistic' simulations be achievable within the cost and timing horizons no project can, or should avoid? Professional industrial designers fully understand the need to anticipate the downstream impact of their work and work closely with engineers, wherever necessary. As a profession we tend to be hired initially because of our creative abilities but retained over the longer term because of our ability to ensure successful implementation.

By doing all these things modern professional ID is able to help teams achieve a better balance between the three principal forces that control innovation success: the commercial aims of organisations, the behaviour of their customers, and the technological/operational means available.

This is what Apple does, helped in no small part by their head of customer experience: Jonathan Ive, a UK-trained industrial designer. Every UK company has the potential to achieve similar success by collaborating with Jonathan's many professional industrial design colleagues, back here in the UK.

This IET Design & Production Sector Insight was written by Gus Desbarats, Chairman of BDI (British Design Innovation) the trade body representing industrial designers involved in product, service and interaction design and Chairman and Founder of The Alloy, and a MDes RCA-qualified designer and BEng-Mechanical and Dipl-Imperial College systems engineer.

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