

Boosting Finance for Engineering & Technology

Important
considerations
for the UK's
new industrial
strategy



A discussion paper by the Institution
of Engineering & Technology and the
ICAEW's Corporate Finance Faculty

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EXECUTIVE SUMMARY

This discussion paper comes at a time when the UK government, under prime minister Theresa May, has committed itself to developing and implementing a new industrial strategy.

The document is the result of a new collaboration between the IET and the ICAEW to stimulate discussion about how the government, market participants and the two institutes could together help boost public and private investment in innovative engineering and technology ventures. Members of the IET and ICAEW are very actively involved – at a senior level – in the vast majority of the UK's engineering and technology businesses.

Many growing engineering and technology businesses now need to diversify their sources of investment and become even more effective in accessing funding from a variety of investors and lenders – not least given the UK's impending departure from the European Union.*

To illustrate some of the challenges and opportunities faced by those who are shaping a new industrial strategy for Britain, we have interviewed CEOs and profiled seven quite different engineering and technology companies across the country – ranging from long-established, successful global businesses such as Rolls-Royce plc to high-growth, early-stage companies.

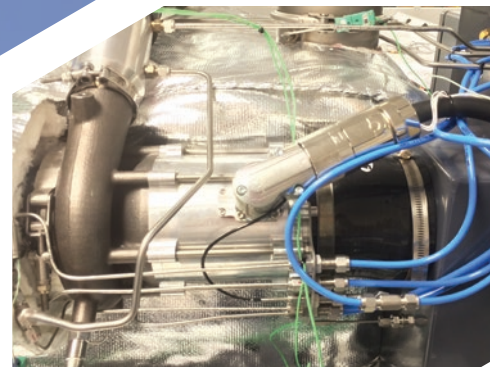
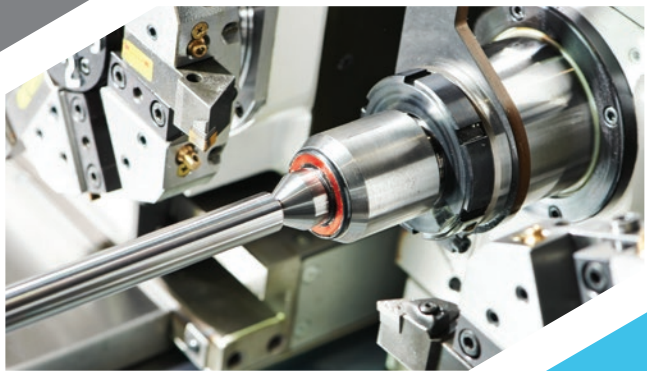
From these discussions with entrepreneurs, company directors, investors, lenders and advisers we have distilled seven key questions.

The IET's Innovation & Emerging Technologies Policy Panel and the ICAEW's Corporate Finance Faculty will be inviting company directors, technologists, academics, investors, business advisers and policy-makers to discuss these questions at a special forum to take place at the Institution of Engineering & Technology, Savoy Place, London. The IET and ICAEW will use the discussion as a basis for making recommendations to Government, industry and finance leaders on stimulating investment in engineering and technology.

The seven questions are as follows:

1. Given the sector's vital contribution to economic growth, skilled employment and productivity, how might the UK boost investment in engineering and technology? [see page 6]
2. How might the UK increase public and private investment in the commercial adoption and exploitation of R&D, expanding current government and private investment? [see page 8]
3. How might the government further support innovative early-stage businesses by co-financing, through Innovate UK thereby reducing risk to attract even more private investors? [see page 10]
4. How effective are the UK's current fiscal incentives for R&D, tech transfer and commercialisation? [see page 12]
5. What additional policy and practical measures could help emerging ventures to work with large corporations even more effectively? [see page 14]
6. Could more be done by the UK government, market participants and professional institutions to ensure a wide variety of sources of private investment – including debt and equity? [see page 16]
7. Could emerging advanced engineering and technology companies benefit from even better advice and information about sources of investment and raising finance? [see page 18]

*For definitions of and further information about the forms of investment and financial incentives referenced in this discussion paper (for example, 'venture capital', 'R&D tax credits'), please see the new edition of the *Business Finance Guide*, published by the ICAEW and the British Business Bank in June 2016 and available online at: thebusinessfinanceguide.co.uk



FINANCING ENGINEERING, TECHNOLOGY AND INNOVATION

Engineering and high technology play a central role in the UK's economy. Engineering represents the biggest single sector for UK exports and it is at the heart of Britain's international competitiveness, its R&D and innovation.

According to EngineeringUK, the sector contributed £455.6bn to the UK's GDP in 2014 – 27% of the total, and more than the retail/wholesale and finance/insurance sectors combined. The contribution by engineering was forecast (before the EU referendum took place) to increase to £608bn by 2022. Engineering directly employs more than 5.5 million people in Britain. ⁽¹⁾

The UK accounts for only 0.9% of the global population, yet it accounts for 3.2% of the world's R&D expenditure, 4.1% of its scientific researchers and 15.9% of the world's most frequently cited academic papers. The UK was listed second in the Global Innovation Index in 2015. ⁽²⁾

But that competitive advantage is under pressure. The current government has committed £5.9bn to its Science & Innovation Strategy, but the UK only invests the equivalent of about 1.6% of its GDP in R&D via business, the state and academia. In the US and Germany, the equivalent figures are each 2.8%, in France 2.2%, and they are also likely to be increasing in the emerging big economies across Asia. ⁽³⁾

At the time of writing (August 2016), the potential effects of 'Brexit' on British engineering companies are very difficult to predict, particularly given fluctuations in exchange rates, potential changes to tariff barriers with the EU, new trade deals with non-EU countries, and the UK's long-term engagement with the World Trade Organization (that is, as a non-EU member).

However, one of the first actions of the government under Theresa May was to announce the creation of a combined Department for Business, Energy & Industrial Strategy, led by new minister of state Rt. Hon. Greg Clarke MP.

It would be wrong to look to the government to provide all the answers – let alone all the money – when it comes to maintaining Britain's competitive advantage in engineering. Nonetheless, an important aim of this discussion paper by the IET and ICAEW is to suggest some of the most important considerations that should inform the new industrial strategy for the development of new engineering and technology in the UK.

Innovation in engineering has been financed in multiple ways, including university collaborations, EU-led programmes, banks, angel investment, venture capitalists, private equity and on capital markets, as well as from the reinvestment of companies' own resources.

It is a complex picture with many opportunities for the entrepreneur. The ICAEW and the British Business Bank collaborated to create a free online companion to their very popular *Business Finance Guide*. ⁽⁴⁾ That guide, first published in 2012, has so far been distributed to more than three-quarters of a million companies, advisers and investors.

Successive governments have provided financial help in many ways, including, most recently, via fiscal incentives such as the R&D tax credit and Patent Box, as well as more direct funding via Innovate UK and Local Enterprise Partnerships (LEPs).

Innovate UK has been central in enabling, de-risking and financing early-stage business opportunities that have emerged from the UK's science and technology in government, big companies and academia – providing £1.8bn since 2007, an amount more than matched by the private sector. Innovate UK has co-funded 7,600 businesses. ⁽⁵⁾

Naturally, there is a constant discussion about the effectiveness of government-funded programmes, all open to criticism even if they may be providing demonstrable benefits for the economy and society. For example, in its submission to the recent government call for ideas for a National Innovation Plan earlier this year, the CBI argued that Innovate UK 'remains under-resourced to fulfil its mission' and that the 'institutional infrastructure to support commercialisation remains underdeveloped'. ⁽⁶⁾ Meanwhile, as we outline on page 13, Patent Box has been criticised by some politicians, academics and organisations.

There are significant challenges if the UK is to finance the next generation of products, companies and industrial sectors. This discussion document aims to stimulate a debate about those challenges for all of us – engineering practitioners, financiers, business advisers and policy-makers.

POLICY AND PRACTICAL QUESTIONS FOR DISCUSSION

1. Given the sector's vital contribution to economic growth, skilled employment and productivity, how might the UK boost investment in engineering and technology?



““ *The venture capital and capital markets issues are the same: the investors judge businesses on a very short timeline. There's a timeline*

mismatch, given that even a seven-year horizon is 'long-term' for those investors. It's not only the development of the new technology we have to fund, but then its adoption.””

Warren East CBE,
Chief Executive, Rolls-Royce plc



““ *Brexit is going to be a big challenge. In the North East we've benefitted hugely from EU-led funds, such as JEREMIE.*

We'll need the government to act sooner rather than later for growth funding for businesses in regions like this to ensure that UK plc can thrive outside the EU.””

Alastair Waite,
Chief Executive, Altec Engineering

Britain's major trading partners (and competitors) across the world are thinking hard about their long-term commitment to investment in technology – and to expanding the global reach of their high-tech companies.⁽⁷⁾

Engineering and technology will have to take a big part in ensuring that Britain remains competitive and in solving the UK's 'productivity puzzle'. As the Bank of England has repeatedly pointed out, labour productivity growth has been persistently weak since the global financial crisis began in 2007–08. The reasons for this are various and complex – hence 'the puzzle'.⁽⁸⁾

HM Treasury's July 2015 policy paper *Fixing the Foundations: creating a more prosperous nation* called the UK's relatively low level of productivity growth 'the challenge of our time'.⁽⁹⁾ This 'productivity puzzle' is not only a British problem. Yet according to Paul Krugman, a Nobel Prize-winning US economist, "Productivity isn't everything, but in the long run it is almost everything."⁽¹⁰⁾

The Bank of England's analysis suggests that, significant causes have probably included 'reduced investment in physical and intangible capital'.⁽¹¹⁾ By the fourth quarter of 2015, physical investment in the UK as a proportion of GDP had dropped to 12.7%, ranking the UK at only 142nd out of 154 countries.⁽¹²⁾

Significant technological innovation and substantial capital investment could help to create a more dynamic economy.

Some of Britain's engineering and technology sectors, including auto and aerospace engineering, have actually seen productivity increase significantly in the past few years.⁽¹³⁾

According to the IET's Manufacturing Policy Panel, UK Trade and Investment (UKTI), was 'very good at engaging potential suppliers with actual buyers'.⁽¹⁴⁾ But the panel also suggested that large-medium companies (£25m–£250m turnover) could be even better supported by UKTI and the government could encourage more banks to work with UKTI on export growth finance and advice for SMEs.

In turn, a productive engineering sector depends on several things, including a robust science base, a reliable supply of technically skilled people to meet predicted demand, and a fiscal system that encourages existing businesses to flourish, new businesses to form, and many sources of private and institutional investment from the UK, as well as inward investment.

These success factors will become even more important as the UK leaves the European Union following the referendum vote in June 2016.

WHAT NEXT?

For high-tech industry to remain an area of UK competitive advantage, how might we improve the speed and coordination of the technology pipeline for new businesses?

UKTI will also continue to be very important as part of the new Department for International Trade; could its role be strengthened in markets offering the best potential for UK export growth?

This might include the provision of advice and market-based intelligence to even more companies that are seeking to increase their exports or enter new markets. It might also

involve encouraging a wider range of providers of export finance to support businesses once they are operating in a market.

How will the UK replace EU-originated funding, such as Horizon 2020, and EU structural funds that underpin regional and local funding of Local Enterprise Partnerships (LEPs) and growth hubs?

2. How might the UK increase public and private investment in the commercial adoption and exploitation of R&D, expanding current government and private investment?



“ Given the new situation in Britain, we now have to ask what money will be invested in technology-based small companies. Are younger companies just going to be told to get on with it, and possibly just fall over? Or is there going to be a new source of funds that’s essentially going to replace what the EU was doing? Our competitors in Europe will still be getting this funding. How’s the UK government going to fill that funding gap? ”

Steve Turley,
Chief Executive, Perpetuum

R&D investment is a crucial part of the UK's international reputation and competitiveness – including the country's development of engineering and technology. The UK was listed second in the Global Innovation Index in 2015.⁽¹⁵⁾ But that competitive advantage is under pressure.

The current government has committed £5.9bn to its Science & Innovation Strategy, but the UK only invests the equivalent of about 1.6% of its GDP in R&D via business, the state and academia. In the US and Germany, the equivalent figures are each 2.8%, in France 2.2%, and they are also likely to be increasing in the emerging big economies across Asia.⁽¹⁶⁾

WHAT NEXT?

To be competitive, the UK needs to invest more in R&D, especially in the context of Brexit. For example, it is estimated that about £1bn or 10% of the UK's science budget originates from EU funds and collaborations. Business also contributes heavily to matched funding in EU programmes. How might the new government funding mechanisms which replace the EU programmes attract more industrial investment?

Government and industrial funding also needs to be focused effectively on 'Innovation' – including technology adoption and commercialisation – to ensure the funding gap is bridged for businesses moving into production.



Sir John Kingman, chairman of the newly created combined body UK Research & Innovation (UKRI) has pointed out, world-class science should be integral to the government's definition of Britain's economic future and its ambitions for a new industrial strategy.⁽¹⁷⁾

As well as ensuring that the new UKRI agency is well resourced for science R&D, how do we also ensure that the development of new technologies and 'spin-out' businesses are well funded?

Innovative advanced engineering companies and technology developers require investment over the long term. For example, could the UK government help develop new capital markets instruments that are longer-term in nature than typical venture capital investment funds?

3. How might the government further support innovative early-stage businesses by co-financing through Innovate UK, thereby reducing risk to attract even more private investors?



“*Innovate UK is very, very good. I think it's got a conveyor belt for funding great projects, starting from SMART grants and building through to much bigger things. It's a good process. Innovation is 50% invention and 50% adoption. Without the adoption, it's not innovation.*”

Toby Peters,
Founder and Chief Executive, Dearman

There were 608,920 registered engineering companies in 2013/14 (the latest year for which figures were available), showing 5.6% growth on 2012/13. ⁽¹⁸⁾

Innovate UK has been central in enabling, de-risking and financing early-stage business opportunities that have emerged from the UK's science and technology in government, big companies and academia – providing £1.8bn since 2007 – an amount more than matched by the private sector. Innovate UK has co-funded 7,600 businesses. ⁽¹⁹⁾

Innovate UK's system of grants – including programmes for emerging and enabling technologies, manufacturing and materials, open funding competitions and innovation vouchers for small companies – has played a significant part in de-risking the development of many new technologies and ventures, also making them more attractive to external private investors and lenders. Innovate UK has also been responsible for UK access to EU funding through Eurostars and Horizon 2020.

The review of UK Research Councils by Sir Paul Nurse, published in November 2015, reaffirmed the government's big part in supporting innovation in private companies by means of technology-transfer mechanisms, public-private partnerships and R&D tax credits. ⁽²⁰⁾

In January 2016, the UK government announced that it would take up Sir Paul Nurse's recommendation to bring the seven Research Councils into one new body, UK Research & Innovation which will also incorporate Innovate UK. However, the CBI commented that 'a cogent case for the integration has not been made'. ⁽²¹⁾

Alongside this, the government also announced in the November 2015 Autumn Statement that it was seeking to shift the equivalent of about £165m of the £600m annual innovation budget away from grants to more loan-based programmes over the next five years, a proposal that has led to a great deal of concern in some high-tech, R&D-reliant sectors. ⁽²²⁾

It may be seen as reasonable that fully commercialised projects that have begun to generate profits – or at least significant revenues – would repay some government investment – although this has traditionally been at least partly recouped via corporate and income taxes.

WHAT NEXT?

A big challenge for the government is helping to reduce risk in ventures that may not otherwise attract entrepreneurs and private capital. More financial support is needed to link research with early development (proof-of-concept and proof-of market), as well as with later adoption and commercialisation.

Could alternative types of grant be more appropriate to underpin external equity funding for capital-intensive businesses that are seeking to scale-up R&D or go into operational production?

What would be the most effective role of Innovate UK as part of the new organisation UKRI? How might Innovate UK grants and loans work best for capital-intensive, high-tech businesses to develop over a timescale of several years?

4. How effective are the UK's current fiscal incentives for R&D, tech transfer and commercialisation?



“ We would not have raised start-up money from private investors without EIS and R&D tax credits. They don't get much good press, but HMRC have been brilliant to deal with on both. ”

Adam Le Van,
Chief Financial Officer, Bladon Jets

In recent years, the UK has seen several significant reductions in corporate tax rates (currently 20%, the lowest rate in the G20, with even more cuts planned, the current government planning eventually to reduce the rate to 15%). These cuts are aimed at encouraging business investment, which has been persistently weak in the past few years.

Alongside this, the Seed Enterprise Investment Scheme (SEIS) and Enterprise Investment Scheme (EIS) have become mainstays of private investment in many start-ups and early-stage ventures.

In areas of significant innovation, the UK's system of R&D tax credits, including specific reliefs for SMEs, has also proven to be an important additional source of funding to incentivise the development of new technologies by companies.

There appears to be a general consensus that the UK's R&D tax credits have been effective and appropriate – a consensus supported by academic research, including that carried out by HM Revenue & Customs.⁽²³⁾

Between 2000 when R&D tax relief was launched by the Labour government and the tax year 2013/14, about 120,000 claims had been made and more than £11.4bn in tax relief claimed. More than 33,800 different companies had made claims under the SME scheme and more than 7,800 under the large-company scheme. The total amount of R&D support claimed was £1.75bn.⁽²⁴⁾

The UK's Patent Box system, launched in April 2013, has provided a reduced rate of tax on profits from IP licensing or transfer – to encourage companies to commercialise their IP and utilise their patents.

The scheme faced criticism from a number of directions in 2013, including from German finance minister Wolfgang Schäuble – and from within the UK since then – that the reduced effective corporation tax levy of 10% it provided was merely eroding the tax base of countries ('profit shifting').⁽²⁵⁾

It has since been agreed under principles set out by the OECD that IP tax incentives should be very closely tied to R&D activity within the country where the tax incentive is granted. This means for example that all companies now have to track their R&D expenditure very closely in order to benefit from future tax relief. While these changes are less likely to affect UK SMEs that carry out R&D in this country, they might require more work to track and trace R&D expenditure.

New rules will also change how R&D tax incentives can be applied within larger and more complicated corporate group structures, how and where work is subcontracted and may even effect how acquisitions are structured.

WHAT NEXT?

Government policies and fiscal incentives need to support technology innovation as it becomes faster and more responsive to customers in new markets.

Are current incentives the best use of public money? For example, might R&D tax credits be not only preserved but enhanced?

To be agile and outward-looking, these incentives need to be developed in conjunction with industry experts and Innovate UK.

5. What additional policy and practical measures could help emerging ventures to work with large corporations even more effectively?



“Getting the right kind of engagement and partnerships with established industry players is one of the hardest things for SMEs to achieve. The best government programmes, such as the Catapults, can be very good at creating the environment for collaboration.”

Nick Edgar,

Senior Director – Growth Finance, Clydesdale Bank



Successful collaboration between emerging innovative ventures and large companies is a vital aspect of engineering and technology success. It includes corporate engagement for R&D, technical collaboration, operational support, corporate investment and commercial deals.

In R&D, the Advanced Manufacturing Research Centre at the University of Sheffield has been regarded as very successful on this count.

A growing network of Catapults is linking entrepreneurs and businesses with academic research and corporate R&D. These include Catapults for High Value Manufacturing, Digital, Energy Systems, Renewable Energy and Satellite Applications, which provide facilities, expertise and communications. This network has even been cited as a potential contributor to boosting UK productivity – although it's perhaps too early in its development to tell what effect it has had on this count.

For start-ups and early-stage companies in the UK, there is a fast-growing number of incubators and accelerators that provide various combinations of technical expertise, facilities, operational experience and small-scale development finance.

Some of the most prominent are backed by committed, large organisations – for example, Wayra (Telefónica) in high-tech and IDEALondon (Cisco, DC Thomson, University College London) in the creative industries.

As yet, there are relatively few incubators and accelerators specialising in advanced engineering and 'hard' technologies – one exception being the Innovation Accelerator in Redcar, managed by the Centre for Process Innovation.

WHAT NEXT?

Is there potential to develop more incubators and accelerators specialising in advanced engineering and 'hard' technologies, supported by large corporations to support new developers and emerging companies?

The IET and the ICAEW could work with the government, R&D agencies and commercial partners to assess the potential

to develop more incubators and accelerators specifically to support advanced engineering and technology.

6. Could more be done by the UK government, market participants and professional institutions to ensure a wide variety of sources of private investment – including debt and equity?



“There’s a particular problem in the UK in that there’s a big gap between the VCs who’ll do seed – sub-£5m – and the VCs and other funds who’ll do growth – typically £20m-plus. If you go to the US, there’s a huge amount of government funding for technology coming through all the different agencies into business, all very well coordinated with a very well-established VC industry that pretty well covers all levels of funding.”

Paul Barrett,

Co-Founder and Chief Executive, Bladon Jets

Access to private investment – underpinned by government support at a regional, national and EU level – has been a common success factor for the UK’s emerging engineering and technology successes over the past four decades.

Appropriate and affordable equity and debt investment is crucial for existing businesses to flourish, expand and re-invest – especially those that have significant scale-up potential to exploit their IP. ⁽²⁶⁾

Given the IP-intensive and capital-intensive nature of many early-stage engineering and technology companies, this will require more institutional investment – as well as attracting even more inward investment to the UK, especially post-Brexit.

The ICAEW’s Corporate Finance Faculty was a significant contributor to Tim Breedon’s industry-led working group on alternative debt markets (and his report *Boosting Finance Options for Business* was launched at Chartered Accountants’ Hall in London in March 2012). ⁽²⁷⁾

That report strongly influenced the creation of the British Business Bank. The government-owned organisation does not invest directly in companies, but has increased the supply of finance available to small businesses primarily by funding more than 80 banks, leasing companies, VC funds and online funding platforms (a ‘wholesale’ model).

Although London is a major global hub for venture capital, much of that tends to be focused on digital, online and social media start-ups. There are concerns that firstly, it has

remained more difficult for UK pre-profit, capital-intensive technology businesses to raise capital (particularly upwards of about £10m) to move into production – whether as equity or as ‘venture debt’. The timescales to fund such new technology from early development to adoption and commercialisation, which can require between several years and decades, would generally require backing from institutional funds that can commit with a medium- to long-term outlook.

Secondly, the European Investment Fund has been a feature of UK venture capital and growth-capital funds. In 2015, the EIF’s equity participations in Britain were worth €655.8m, supporting total capital of €2.9bn. ⁽²⁸⁾ But it is a European Union body – and therefore, like many other EU funding programmes, it is very unlikely to remain active in the UK.

Likewise, in terms of regional and local funding, business finance schemes run by Local Enterprise Partnerships and Growth Hubs that rely on European Structural Funds also face an uncertain future.

A number of banks – supported by the UK government and some regional agencies – have also provided ‘tooling finance’ or ‘tooling loans’ for manufacturers to fund the development of their tooling. These could be another form of finance that could be expanded.

WHAT NEXT?

Financial support from EU funding programmes should be replaced by well structured, national co-investment programmes – perhaps building on the work of the British Business Bank to ensure that new ventures and growing companies can access sufficient investment support during the development stage.

For example, could the UK’s nascent ‘venture debt’ market be substantially boosted to support a bigger number of

capital-intensive, pre-profit companies engineering and technology companies?

7. Could emerging advanced engineering and technology companies benefit from even better advice and information about sources of investment and raising finance?



“There are a lot of initiatives to help exciting start-up tech businesses in the UK. But we also need to provide support and advice for those businesses with scale-up potential.”

Jess Butcher,
Co-Founder & Director, Blippar.com

The provision of even better government advice, professional advice and information to early-stage and growing businesses is not merely about reducing their direct costs – it is also about reducing opportunity costs for companies as they work out how to develop technologies, commercialise them, grow and restructure.

This can include:

- (i) Enhancing financial planning and skills within engineering and technology businesses as they prepare to approach external funders, partly by employing skilled professionals such as chartered accountants;
- (ii) The provision of relevant and timely information and training about types and sources of funding;
- (iii) Access to appropriate professional advice, including accounting, tax, legal and corporate finance.

According to Nesta, a relatively small amount of the UK government's modest £9.8bn budget for direct help for companies goes to in-kind support. ⁽²⁹⁾

WHAT NEXT?

The IET and the ICAEW will continue to work together and with government, many other organisations and market participants to provide more specific information and advice about emerging forms of equity and debt finance that would be appropriate for engineering, high-value manufacturing and high technology.

For example, the IET and ICAEW could devise specialist guides, tailored seminars and bespoke online networks to inform advanced engineering and technology ventures,



Such in-kind support is particularly important for early-stage companies that cannot yet afford the salaries for pay management experience or substantial fees for external financial advice.

Government assistance includes cheap but effective information initiatives, such as the Knowledge Transfer Network (part of Innovate UK) and the recent 'Future of British Manufacturing' roadshows.

Government agencies such as the Intellectual Property Office also provide useful free information about the basic principles of management, protection, valuation and commercialisation, such as an online 'IP Finance Toolkit'.

But there was concern amongst many entrepreneurs, advisers and funders when the government suddenly closed the Business Growth Services (including the Manufacturing Advisory Service) at the end of 2015. ⁽³⁰⁾

working closely with their members, other institutions and government agencies.

ROLLS-ROYCE plc

rolls-royce.com

Operations:

Rolls-Royce is a FTSE-100 global company that develops, manufactures and supplies highly efficient integrated power and propulsion solutions used in aerospace, marine, energy and off-highway applications. It has operations in 50 countries and customers in 120 countries.

Founded:

1906

Headquarters:

London – with its largest UK base in Derby

Employees (global):

50,500

Turnover (2015):

£13.4bn



“There’s a great opportunity for the UK’s engineering sector to increase its contribution to national productivity and competitiveness. The Brits are pretty good at it.”

Warren East CBE

Chief Executive, Rolls-Royce plc

Rolls-Royce is a great example of a world-leading company with headquarters in the UK that is at the forefront of advanced engineering and technology. It therefore makes massive long-term investments in innovation and in its highly skilled workforce. Rolls-Royce employs more than 50,000 people in more than 46 countries. About 15,700 of these are engineers. Rolls-Royce files annually for more patents than any other company in the UK.

Rolls-Royce estimates that it contributes a total of £9 billion to the UK economy and accounts for £1 in every £50 of UK goods exports. The company directly employs about 24,000 people in Britain, and estimates that it supports a total of nearly 114,000 jobs.

Warren East CBE became chief executive in July 2015, joining from ARM Holdings plc, where he was CEO from 2001 until 2013. He is also a non-executive director at Dyson. As a highly successful chartered engineer who is a Fellow of the IET, innovation and technology have always been central to his career.

He's upbeat about the UK's engineering prospects – even in very uncertain political times for the country: “Over the past decade or so, companies – including ARM – have increased the influence of leading-edge technology and design on manufacturing. Rolls-Royce is at the forefront of taking that technological innovation into the manufacturing environment.”

East says Britain's always been good at innovation, but a big challenge is to ensure long-term public and private investment that will support the development of new technology from R&D right through to adoption. “Public commitment needs



to transcend the term of any one government. For example, development to adoption at Rolls-Royce can be a 15- to 20-year cycle. Our issue is not so much the quantum of support as the continuity over the long term.”

Rolls-Royce spends more than £1bn a year on R&D, and a large proportion of research investment is spent in the UK. The company has invested in 19 University Technology Centres at 14 UK universities. It also plays a key role in the AxRC, a network of seven Advanced Manufacturing Research Centres (five in the UK) that helps Rolls-Royce and other industrial partners to link companies, sectors and universities.

Another R&D collaboration came in July 2016 when Rolls-Royce announced that it will establish a new facility in Bristol for low-carbon aircraft engineering technology, as part of a £4m project backed by the Department of Business, Innovation & Skills, the Aerospace Technology Institute and Innovate UK.

East says the next big step for engineering is to speed up the introduction of new technology into manufacturing processes: “We could do a lot there – we struggle with adopting the new technology into processes fast enough. In some areas we might be 20 years behind the semiconductor industry in terms of adoption.”



BLADON JETS

bladonjets.com

Operations:

Bladon Jets has developed the world's first 12kW Micro Turbine Genset (MTG). The product offers clear operational, commercial and environmental advantages over conventional diesel gensets. The company's initial focus is on the telecom towers sector, but in the longer term it aims to be a leading player in the 'Distributed Power Generation' revolution that is bringing electricity to rural areas in the developing world and disruptive change to energy markets in the developed world.

Founded:

2002

Headquarters:

Coventry

Employees (global):

55

Turnover:

Development projects only to date – product sales commencing in 2017.



“ You can build a successful manufacturing business in the UK. There's a lot of added value in the manufacturing itself – and a lot of valuable IP comes out of developing manufacturing processes. Why outsource that when you can do it yourself? **”**

Paul Barrett

Co-Founder and Chief Executive, Bladon Jets



“ There's a particular issue as soon as you're trying to do anything sizeable in engineering and manufacturing, because it's capital-intensive. Many VCs in the UK now are looking for investments under £5m or £10m – and so they won't look at a business like ours. Bladon Jets is a completely different proposition to running a portfolio of software companies that are not capital-intensive. **”**

Adam Le Van

Chief Financial Officer, Bladon Jets

Bladon Jets – based in the West Midlands heartland of UK engineering – has the ambition to play a part in transforming a global market based on thousands of large gas turbine engines that each cost of millions of dollars into a market of millions of compact engines that each cost only a few thousand dollars. It has just won its first major contract – \$7m to supply its 12kW micro-gas turbine generators (MTGs) to power mobile telecoms towers across eastern and southern Africa.

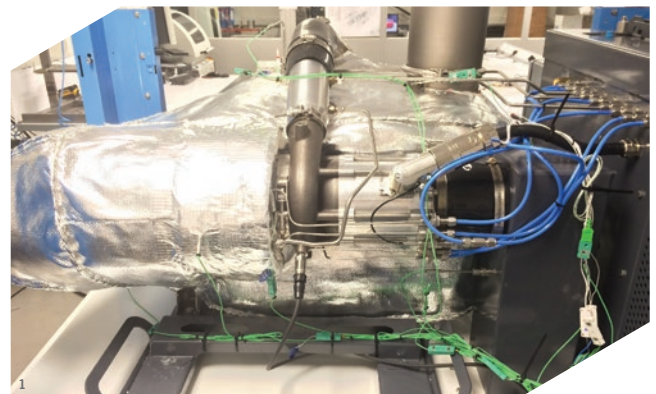
Bladon Jets was established as a business in 2008 – although the core jet engine technology was invented by the Bladon brothers, motorcycle engineers, in 2002. The company’s first commercial projects, in 2010 and 2011, were auto-related (with Jaguar Land Rover and others), before it shifted its focus to land-based power generation.

Paul Barrett, co-founder and chief executive, whose credentials include the ‘Barrett Algorithm’ used in cybersecurity, explains that the company realised there was a big market opportunity for an MTG that could compete with the one million 12kW diesel gensets sold across the world every year – 600,000 of which go into the telecoms market. “Our engines need no water and no oil and will run up to 8,000 hours without a service. With a diesel genset, you have to change the oil every 300 hours or so.”

Bladon Jets is now developing its multinational supply chain and an assembly plant in the UK – with a view to duplicating the capability in India in order to supply Asian markets. The company will retain ownership of all the specialist tooling and the manufacturing IP.

A range of investors have already seen the potential. The business has so far raised more than £20m in equity (plus £5m grants) from founders, business angels and from Indian industrial giant Tata. The Enterprise Investment Scheme (EIS) and R&D tax credits have been a vital part of its early-stage funding.

Chief financial officer Adam Le Van, who joined Bladon Jets from Jaguar Land Rover, raised £3.1m from the Regional Growth Fund (RGF) to develop the company’s in-house engineering capability. The company has also had two projects financed by Innovate UK. Le Van says that securing



the RGF funding quite rightly required work: “You have to prove that you’ve got a reasonably robust technology base, you’ve got a vision for the business, that you’re in control of your finances and you can scale. As public investors, they’re thorough in their due diligence, but pragmatic – and we would not have got to where we are today without RGF and Innovate UK’s support.”



CYBERHAWK INNOVATIONS

thecyberhawk.com

Operations:

Cyberhawk provides industrial inspections and land surveying using remotely operated aerial vehicles (ROAVs or 'drones'), including for major clients in oil & gas and electricity infrastructure.

Founded:

2008

Headquarters:

Livingston

Employees (global):

50

Turnover (2016):

£3m



“There can be great ideas. But you also need teams with the experience to commercialise a technology. You need that commercial edge combined with engineering experience.”

Richard Round

Chairman, Cyberhawk Innovations



“Cyberhawk is a great example of how there’s a great skills base on which the UK could capitalise beyond Britain – as a world leader in sectors such as oil and gas services.”

Andrew Carnwath

Associate, Scottish Equity Partners

Cyberhawk Innovations is an upcoming Scottish company that's already been responsible for many 'firsts' around the world. In 2009, it carried out the very first industrial inspection by a remotely operated aerial vehicle (ROAV). Since then it has deployed its 'drones' and proprietary 'visual asset management' software for close inspections of industrial assets such as flares, utility transmission towers and wind turbines for customers such as Shell, ExxonMobil, Statoil, BP and Centrica.



Power group SSE was an early backer of Cyberhawk, founded by Malcolm Connelly, and remains an important customer. Cyberhawk then raised £1.25m round of funding from Scottish Equity Partners and the Scottish Investment Bank. This was followed by a £2m loan from Clydesdale Bank's growth finance arm in March 2016.

Led by chief executive Craig Roberts, the company's international push includes offices in the Middle East and South East Asia – and later this year, in Houston, Texas. In addition to oil & gas and utility clients, Cyberhawk is working with Network Rail and for wind turbine operators. Its growth has already required recruitment and training of its own workforce of engineers, with the support of Scottish Enterprise.

Cyberhawk's chairman Richard Round, an experienced company director in energy, says: "The first challenge I see for technology and development is having the right skills to take businesses from seed through to venture capital investment. That can often be when early-stage ventures with great ideas fail."

Andrew Carnwath of Scottish Equity Partners picks up this theme: "We look for 'A-class' management teams. The later you're investing, the more complete you expect the management team to be. Where there are skills gaps – for example with financial management – investment can help a business to attract experienced finance executives. Venture capital will often help fund the development of a more rounded management team or help bring in an experienced non-exec chairman, all of which can position the company for growth."

Nick Edgar, a senior director in the growth finance arm of Clydesdale Bank and Yorkshire Bank, says that when a 'venture debt' lender assesses a company, they look for a good balance of IP and innovation, external equity support and a business model that supports scalable revenue growth. "We need to see that there's a real market there, that the business is solving an unmet need. Cyberhawk is in a very significant market." He describes Cyberhawk as providing "mission-critical" and innovative services that could save customers millions of dollars.



BLIPPAR.COM

blippar.com

Operations:

Blippar harnesses image recognition, augmented reality and computer vision technology to bring the physical world to life through smart devices. The Blippar app means that brands can interact with consumers through everyday objects to enhance brand communications and utility with digital experience, dubbed “blipps”.

Founded:

2011

Headquarters:

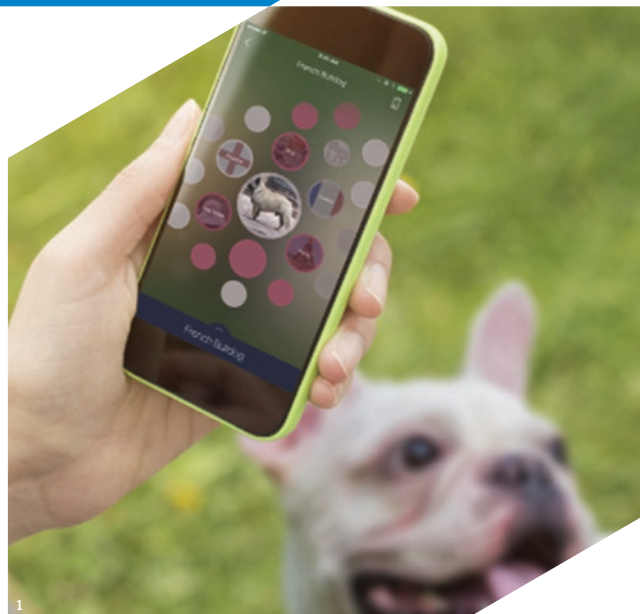
London

Employees (global):

300

Turnover (2016):

“Double digit millions of dollars”



“We had a vision to make this business more of a game-changer that could help unlock a lot of digital content, connect to social media and work with major brands.”

Jess Butcher

Co-Founder and Director, Blippar.com



“More success stories and game-changing companies in the UK and Europe will attract even more VC interest.”

Daniel Horner

Senior Vice President – Growth, Blippar.com

‘Fuel your curiosity,’ says Blippar’s website. And those who are interested in truly innovative technologies, developed in Britain but applied to fast-growing international consumer markets, will be curious – especially with brands like Coca-Cola, Argos, Justin Bieber, Heinz, Immediate Media, Little Mix, L’Oréal, Oreo, Perrier, Pokemon and Star Wars on the list.

In 2015, Blippar was ranked by CNBC as one of its “top 50 Disruptor businesses globally” (alongside the likes of Uber, Spotify and AirBnB).

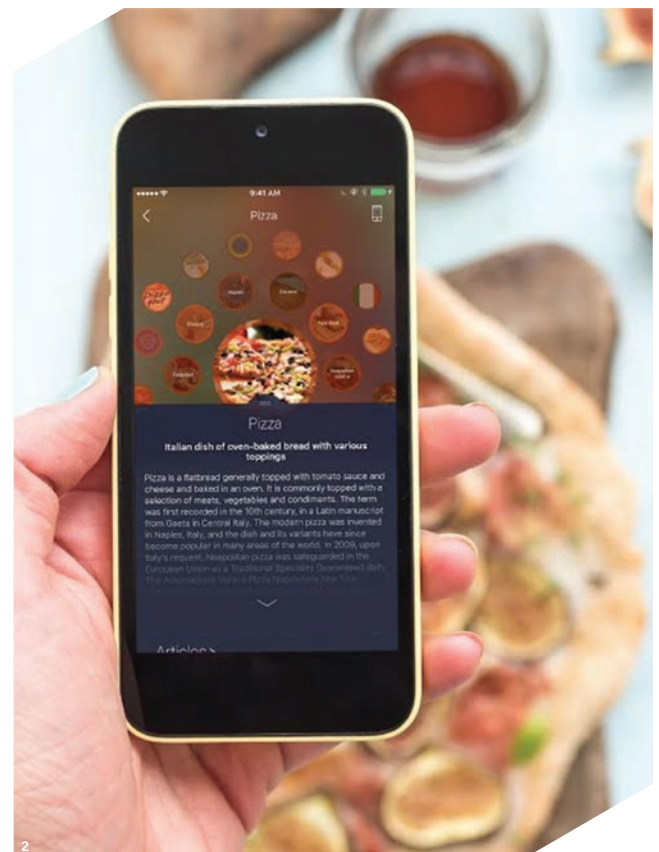
Founded in 2011 by Ambarish Mitra (now CEO), Omar Tayeb, Jess Butcher and Steven Spencer, the company now has ten offices across the world and employs 300. Mitra and Tayeb met while working at AXA, explains Jess Butcher: “They’d started to realise the great potential in terms of what augmented reality could do. That was the eureka moment about the technology. They then got Steven and me to work on how we could make this technology a business and develop a brand.”

Within six weeks, the start-up was working with Tesco, Cadbury, Heinz, Samsung – generating revenues, hiring and setting up its first office.

Blippar raised seed funding from corporate investor Qualcomm Ventures in early 2012. It’s now raised about \$100m in total, with its latest round of \$54m led by Khazanah Nasional Berhad. Other major investors include Lansdowne Partners and a wealthy private backer. It’s also acquired two smaller developers, in the US and the Netherlands.

Daniel Horner, Senior Vice President – Growth, explains “European VCs in 2011 and 2012 were unsure about augmented reality, it was unproven technology.” But since then family-office investors, financial institutions, high-net-worth individuals and sovereign wealth funds have all become interested. “The pools of capital in fast-growth digital technologies have diversified a lot in the past few years.”

As well as professional advice from Torch Partners (corporate finance) and law firms Garfield Smith (IP) and King & Wood Mallesons (fundraising), Butcher says the company’s also “received tremendous support from UK Trade & Investment, particularly pushing into the US”. Danny Lopez, British Consul General in New York and Director General for UKTI, will be joining Blippar as COO in August.



DEARMAN

dearman.co.uk

Operations:

Dearman technologies uniquely harness liquid air to deliver zero-emission power and cooling. “Dearman is committed to delivering positive economic, environmental and societal benefit.”

Founded:

2011

Headquarters:

Croydon

Employees (global):

70

Turnover:

Currently pre-revenue – the company has raised more than £30m in private equity and grant funding to date



“By 2030, we’re going to have 3.2 billion middle-class people in East Asia, India and Africa who are all going to want the consumerism that we take for granted. Energy efficiency is increasing. But it’s going to be swamped by demand. We need radical, accelerated transformational innovation to meet the societal demands whilst living within the sustainable limits of our planet.”

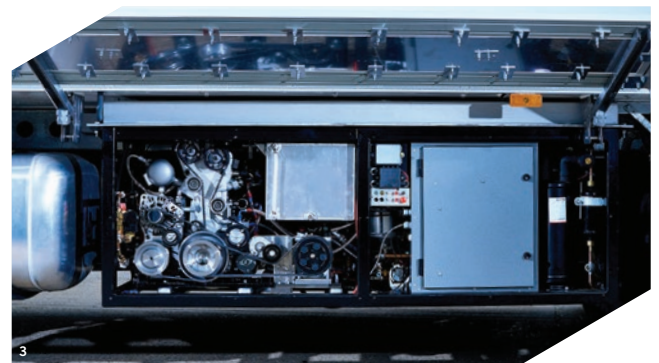
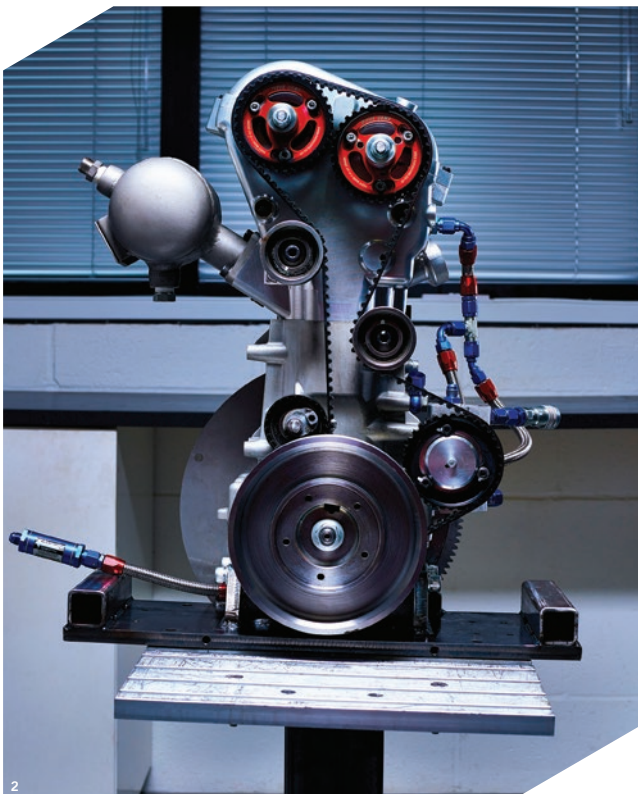
Toby Peters

Founder and Chief Executive, Dearman

Toby Peters, founder and chief executive of Dearman, set out to change how we think about demographics and energy use across the world. “Before I started, I don’t think people thought about the need for ‘cold’ and cooling in the energy debate. I think it’s fair to say that people are now thinking about how we deliver our ‘cold’. Do we need more energy delivered into a building or do we need cooling? The big industrial change now is coming from hot countries who demand cooling.”

As well as overseeing Dearman, Peters is visiting professor in Power & Cold Economy at the Birmingham Energy Institute, University of Birmingham. He’s proud to have so far helped secure in excess of £20m of UK grant funding for liquid air development, as well as a similar amount of inward investment into the UK.

Dearman – and Highview Power Storage, which Peters also co-founded – is based on the concept of liquid air as an energy storage solution for grid and transport. Dearman is developing cryogenic technology invented by Peter Dearman for use in transport refrigeration units.



By using the liquid nitrogen engine as a secondary engine in trucks for cooling (instead of a second diesel engine), diesel consumption could be cut by up to 25%. The Dearman engine is also zero-emission and the company says it could one day be used in mass-market vehicles and for back-up cooling and power systems in buildings.

Dearman’s technology has been tested extensively as a part of the Innovate UK-funded Cool E transport refrigeration project with HORIBA MIRA, Air Products and Loughborough University. In June 2016, Sainsbury’s announced it was trialling the Dearman engine in a vehicle based at its major distribution depot in Waltham Abbey.

Peters has already raised more than £30m in equity investment, including £16m from venture capital firm Park Vale Capital, money from Dutch-based industrial and energy group Transmark and a significant amount from wealthy individuals. Dearman has also secured a £2m Local Enterprise Partnership loan from Coast to Capital and several government grants, which Peters says all help to give private investors confidence about the technology and their own due diligence.

Dearman could be in full production by 2018. Innovate UK, which has also financed Dearman projects, says it could “bring thousands of jobs to the UK” – as it meets some of the global challenges that Peters has outlined.

ALTEC ENGINEERING

alteceng.co.uk

Operations:

Altec Engineering provides full-contract support for mechanical & electrical engineering, CNC precision machining and special-purpose machine design-and-build to a wide range of industries, including automotive, defence, aerospace, oil & gas and renewables. Its customers include Rolls-Royce, Caterpillar and JCB.

Founded:

1978

Headquarters:

Bowburn, County Durham

Employees (global):

175

Turnover (2016):

£16m+



“When we’re looking at potential acquisitions, we go right back to our strategy: what would make us an even better company

at that point? Then it needs a lot of research into the business you’re looking to acquire, and great timing. We don’t stray too far from our roots, but there are a lot of opportunities to buy businesses that can help you to grow fast – to make one and one equal three.”

Alastair Waite

Chief Executive, Altec Engineering



“As an equity investor, we’re keen to support manufacturing as a sector, and engineering within that. There are a decent

proportion of precision engineering businesses in Yorkshire and the North East with good growth prospects.”

Richard Taylor

Investment Director, Business Growth Fund

Altec Engineering, based in the North East of England, is a good example of established, profitable engineering manufacturers across the UK that could expand by attracting significant growth capital and by making acquisitions.

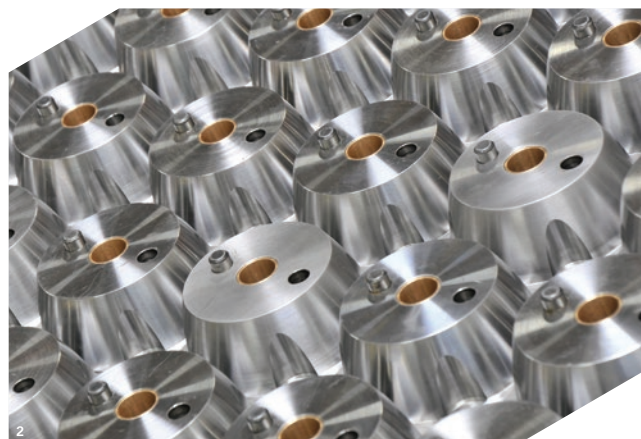
Altec raised £6m in equity investment from the Business Growth Fund (BGF) in July 2015. It used part of the investment to buy Ronco Engineering, a near neighbour in County Durham.

Altec is led by an experienced management team and majority shareholder Alastair Waite. Waite had previously been M&A director at Onyx Group, a Teesside IT consultancy that was acquired by private equity firm Livingbridge for £27m in 2011. He then took on the Altec business from his father Ron Waite MBE, who had founded it in the 1970s. The BGF (which is itself financed by several of the UK's major banks) backed Altec for a number of reasons.

Richard Taylor, who led the BGF's investment in Altec, says Alastair Waite's track record as a successful entrepreneur with a "history of creating equity value" was a big factor in the deal. "Altec's in a higher value-added, growing part of a fragmented market. For a buy-and-build strategy, there were plenty of opportunities out there for a pipeline of potential acquisitions."

Many of those are smaller, family-owned businesses with succession issues. They may also be reliant on a small base of customers and could therefore benefit from being part of a larger, broader group, such as Altec.

Altec was already on the acquisition trail before the BGF backed it – buying Sigma Technologies (ShIPLEY, West Yorkshire) in November 2014. More recently, it has acquired



North Shields-based Quick Hydraulics from the administrators in October 2015. That new subsidiary has since set up an operation in Teesside and in West Yorkshire. In March 2016, Altec acquired Hydrofit Alliance (Newton Aycliffe).

Waite recruited Simon McIntosh as a group finance director. The BGF introduced David Bailey, a former vice-president of Parker Hannifin Europe, as non-executive chairman following its investment last year.

The company has also been investing heavily in new equipment, expanding its facilities, recruiting design engineers, sales managers and apprentices.

Altec's on course to turn over more than £16m in 2016. Asset-based lender Shawbrook Business Credit has provided the business a £3m working capital facility, including an invoice discounting line and cash-flow loan.



PERPETUUM

perpetuum.com

Operations:

Perpetuum provides condition monitoring information to the rail market, based on its expertise in vibration engineering. It has developed proprietary 'Vibration Energy Harvesters' to power devices and provide data that enable trains to be safer, more reliable and more cost-effective to operate.

Founded:

2004

Headquarters:

Southampton

Employees (2016):

28

Turnover:

Not disclosed.



“ *You're always looking at the problem of getting companies across the 'valley of death' – where you don't yet have the sales. That's the risky time for early-stage ventures. If you've got sales, great, then you just need working capital and there are plenty of lenders around.* **”**

Roy Freeland

Co-Founder and President, Perpetuum



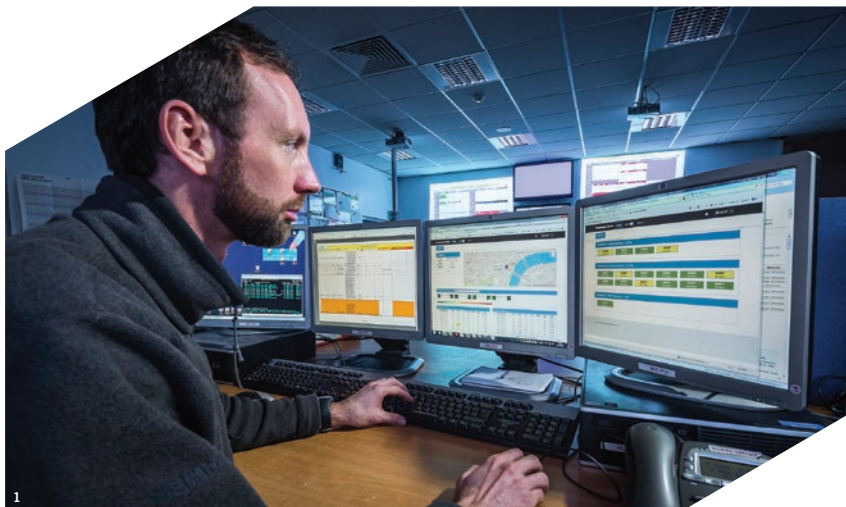
“ *The sheer time to get things developed, tested and into production can make innovation a very long game. It requires different, flexible investment strategies. The key part for early-stage ventures is often how they persuade that first big commercial customer to take a calculated risk – sponsoring the new technology and the new company.* **”**

Robert Whitby-Smith

Partner, Albion Ventures

Perpetuum says it is already the “world leader in vibration harvester powered wireless sensing systems”. It could be on the brink of becoming one of the most important companies that you’ve only just heard of.

The company was a spin-out based on patented technology that was originally developed at the University of Southampton’s School of Electronics & Computer Science.



Initially, the company worked with groups such as GE, Emerson and Honeywell on industrial applications. But, as Roy Freeland, co-founder and president, explains, he felt there were opportunities for rapid growth if the company diversified into new markets. Perpetuum needed to change direction.

Following Steve Turley’s appointment as chief executive in 2010, it started to focus on the rail market. Because Perpetuum’s devices are self-powering, they are compact and can be retrofitted to trains. That’s important because rolling stock might be run for up to 40 years.

“We looked at a range of markets the technology could address and analysed which ones could generate considerable revenues in an acceptable timescale,” says Turley. “Then we reached out to contacts in the rail market.”

Freeland and Turley developed Perpetuum from a company selling energy harvesters to a company selling systems – and ultimately selling condition monitoring information. The self-powering capability of its hardware makes it very easy to fit.

The algorithms that translate raw vibration data to condition monitoring information provide further differentiation in that they make the resultant information very easy to use.

Now the company has trials with train companies in Europe, North America and Asia-Pacific and has volume deployment in the UK with the Southeastern rail franchise and other train operators – a good example of how Perpetuum’s solution can be retrofitted to a major fleet.

It’s raised well over £10m over several years from a range of early-stage venture investors, as well as Innovate UK, EU consortia research projects and Horizon 2020.

Albion Ventures manages the Kings Arms Yard VCT (venture capital trust) which has so far invested £2.4m in Perpetuum in more than a decade. Albion partner Robert Whitby-Smith says that having a supportive syndicate of patient sources of capital is a critical success factor for innovative companies that are developing new products and new markets over several years. Investors like Albion can take a longer-term view because of the ‘evergreen’ nature of VCTs, which do not have to exit their investments within a limited timeframe.





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Shaun develops stakeholder and member communications for the Corporate Finance Faculty to support ICAEW's public policy and advisory work, particularly in the areas of 'access to finance', growing businesses and venture capital.

He devised, researched and co-authored *Creative Industries – Routes to Finance*.

Shaun previously worked in corporate finance research at BDO in London and was deputy editor of *Real Deals*, the international private equity and venture capital magazine.



Stephanie Fernandes

Principal Policy Advisor for Education & Innovation, IET

Stephanie is responsible for the Education & Skills and the Innovation & Emerging Technologies policy panels of the IET. She works closely with IET members to develop and communicate policy positions, alongside government, parliament, industry and academia.

As part of this role, Stephanie was seconded to the Department of Business Innovation & Skills to deliver the Professor John Perkins Review of Engineering Skills and call to action, which has since influenced UK government policy and investment programmes to boost engineering skills.



David Petrie

Head of Corporate Finance, ICAEW

David is responsible for the leadership and strategic development of all ICAEW activities in corporate finance and head of the Corporate Finance Faculty.

Formerly with PwC, he has advised on numerous transactions, with a total value of more than £4bn.

David is actively engaged in a number of public policy initiatives focused on increasing the variety and quality of funding available for growing businesses. He initiated and led a taskforce of 23 of the UK's leading business organisations to publish – together with the British Business Bank – the highly acclaimed *Business Finance Guide*, which he co-authored. He also led a high-profile initiative with HM Government on Cyber Security in Corporate Finance.



Dave Smith

Managing Director – Europe, Ricardo plc; Chair of the Innovation & Emerging Technologies Policy Panel, IET

Dave is an experienced manager of financially successful, high-technology organisations and a developer of many innovative, globally successful products in several markets.

Dave now leads Ricardo plc's automotive engineering consulting businesses, which operate throughout Europe and Asia. Previously, Dave was managing director of Roke Manor, one of the UK's premier R&D companies, which earned a Queen's Award for Innovation and multiple other awards for engineering. He then became global head of PA Consulting's technology consulting practice, centred on its Cambridge R&D labs.

He is chair of the IET's Policy Panel on Innovation & Emerging Technologies.



IET Innovation & Emerging Technologies Policy Panel

The IET is one of the world's largest engineering institutions with over 167,000 members in 150 countries. It is also the most interdisciplinary – to reflect the increasingly diverse nature of engineering in the 21st century. Energy, transport, manufacturing, information and communications, and the built environment: the IET covers them all. The IET is working to engineer a better world by inspiring, informing and influencing our members, engineers and technicians, and all those who are touched by, or touch, the work of engineers.

The Innovation and Emerging Technologies Policy Panel harnesses the expertise of its members to develop and communicate policy relating to:

- Innovation and research systems that act as a focus for technology research
- Barriers, risks and enablers of the innovation process
- Technologies that span more than one engineering discipline or sector
- New technologies which are not obvious or dealt with in mainstream

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ICAEW Corporate Finance Faculty

The Corporate Finance Faculty's professional network includes 7,000 members and more than 80 member organisations, drawn from major professional services groups, specialist advisory firms, companies, banks, private equity, venture capital, law firms, brokers, consultants, policy-makers and academic experts. More than 40% of the faculty's membership is from beyond ICAEW.

The faculty is ICAEW's centre of professional excellence in corporate finance. It contributes to policy development and many consultations by international organisations, governments, regulators and other professional bodies.

The faculty provides a wide range of services and media to its members, including its magazine *Corporate Financier* and publications such as the *Business Finance Guide*, devised with the British Business Bank and supported by 21 other leading UK business organisations.

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