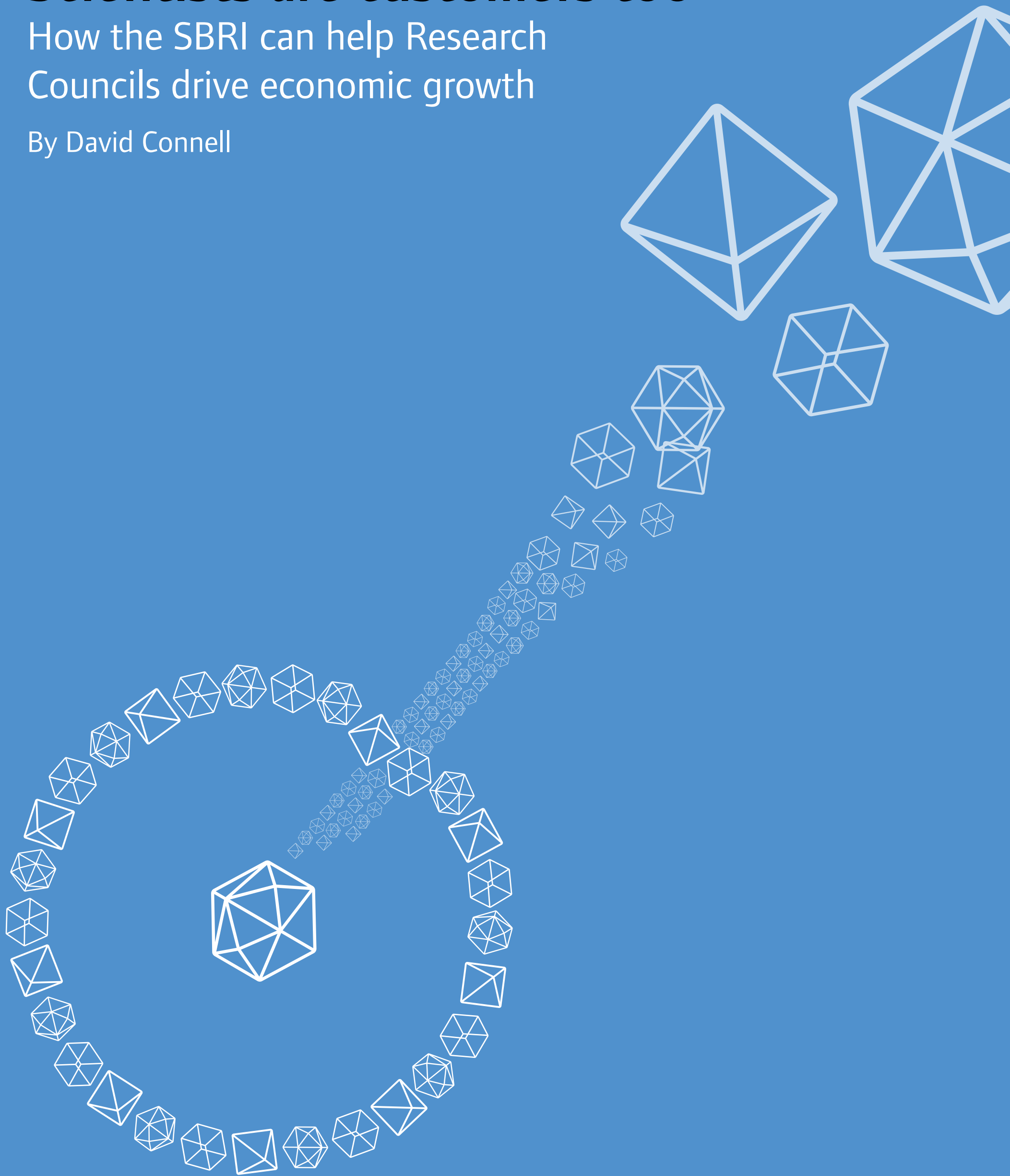
Provocation 13: March 2010

NESTA Making Innovation Flourish

Scientists are customers too

How the SBRI can help Research Councils drive economic growth

By David Connell



Contents

NESTA is the National Endowment for Science, Technology and the Arts. Our aim is to transform the UK's capacity for innovation. We invest in early-stage companies, inform innovation policy and encourage a culture that helps innovation to flourish.

NESTA's Provocations are regular extended essays by leading thinkers that showcase thought-provoking work on innovation. The views are those of the author and do not necessarily represent those of NESTA. If you would like to comment on this Provocation please e-mail research@nesta.org.uk

Foreword

Many of us in research-intensive universities have lobbied for a more effective approach to the UK Small Business Research Initiative (SBRI). This paper proposes a very practical way in which we could be better engaged both as customers for new scientific products and research tools, and as potential innovators in shaping those products.

But I should first explain why I became interested in this approach. I was involved in a start-up in Cambridge in the 1990s which was kick-started by an order from the US Naval Research Laboratories (NRL), and later acquired by a US company which itself had been kick-started by Small Business Innovation Research (SBIR) grants from NRL and other US agencies. Of course the NRL order to the Cambridge company was outside the SBIR scheme, but the mindset within NRL was such that acquiring innovative edge from an unheard of UK company was a completely normal practice. So let me say upfront, I am a fan of procurement as a driver of innovation.

Sitting within a university with a very strong basic research portfolio, in a climate where questions are being asked about the value derived from the public investment in basic research, causes one to consider the big picture. It becomes clear that the UK is not going to survive economically from economies of scale or cheap labour. Innovative lead must be a key, but each such lead will be transitory, lasting no more than a decade. We must continue to innovate, and that innovation must depend partly on basic research – if it is only on short-term targeted research, our competitors will beat us to it.

European universities often – I plead guilty here – respond to criticism about their inability to turn research into economic benefit by talking of the absorptive capacity (or more pointedly, the lack thereof) for innovation in European industry. David Connell's proposals go some way to reflect this back to the public research institutions – what is our own absorptive capacity?

Historically it has been quite high. Looking around the Physics Department at Cambridge, one finds corridors of display cabinets full of scientific instruments constructed in the 19th century to support fundamental research – a tradition that continues. The high-tech clusters around Cambridge and Oxford owe much to a knowledge base originating in the building of specialised equipment within the respective universities. Advances in physical sciences and engineering are having profound impacts on instruments used in biological research. There are opportunities.

There will be those who fear a lack of clarity about what should be developed within universities in building bespoke instruments and what should be done in emerging companies. I think this is a good problem to have; we are learning institutions after all.

Professor Ian Leslie
Robert Sansom Professor of Computer Science, University of Cambridge

March, 2010

Scientists are customers too

Why Research Council participation in the Government's SBRI Programme would help build a strong UK research tools industry

The perceived failure of the UK to turn its public sector investment in research into manufacturing jobs has been the subject of political hand-wringing for decades. But attempts to address the problem have largely ended up encouraging academics to collaborate more closely with companies in the hope that they will eventually become customers for the intellectual property that university research is supposed to generate.

But perhaps there is an easier way. Scientists are also customers themselves – they buy scientific instruments and other research tools. And when they act as innovative 'lead customers' – by defining or funding the development of the products they need – they give their suppliers the opportunity to create new products that can be sold internationally.

This process is both very common and economically significant; companies that start by selling specialist research tools into universities and commercial research labs sometimes go on to pioneer the development of major new global markets. Examples include Oxford Instruments in magnets for MRI scanning, Cisco in IT infrastructure for the Internet, and Cambridge Antibody Technology in pharmaceuticals.

This paper argues that the UK Research Councils could play a pivotal role in promoting the growth of the research tools industry in the UK by participating in the SBRI which the Department of Business, Innovation and Skills (BIS) is promoting across government departments. By doing so it could make a significant contribution both to UK exports and the economic recovery.

Introduction

The research tools industry comprises a diverse range of companies, many of them small and highly specialised. The industry supplies scientific instruments, materials processing equipment, reagents and other consumables, as well as analytical software. It is diffuse and ill-defined, and its influence with government is therefore weak. Nevertheless, its companies constitute a critical part of the supply chain underpinning all research and development laboratories in both the public and private sectors. And the capabilities they develop in serving these laboratories often provide the basis for much larger businesses as their technologies mature and are incorporated into mainstream products and manufacturing processes.

It is therefore exactly the kind of industry we need to support if we are to rebuild a UK manufacturing sector capable of competing with China, India and other sophisticated but lower-wage economies. There are two main reasons we should do so: first, because it would play naturally to the UK's strength in leading-edge research – we already have an innovative customer base to help define and pilot new products;[1] and, second, because the markets for individual products are often rather small, making them less susceptible to competition based on costs and economies of scale.

It is hard to quantify the overall market for research tools, but it is clear from its components that it is significant, with many fast growing subsectors. For example, US firms export well over $30 billion of scientific equipment each year[2] and the global market for proteomics equipment alone is expected to increase from $4.1 billion in 2008 to $13 billion in 2014.[3] The laboratory chemical reagent market is expected to reach $13.7 billion in 2010,[4] with growth largely driven by the *"continued shift of biotechnology research from the academic to the commercial sector."*

Furthermore, many important new technologies are first applied in research itself. Former research scientists and engineers, or their technicians, often start the first commercial companies to exploit their research and develop saleable products. Their initial markets may well be very small, but with experience, costs fall and functionality improves. New applications then tend to open up in progressively larger industrial and consumer markets.

For example, the first commercial nuclear magnetic resonance (NMR) spectrometers became available in the 1950s, a decade after the principle was demonstrated by US academics, and rapidly became a key tool for research chemists. Applications have since expanded into online process control in the petrochemicals industry and magnetic resonance imaging (MRI) scans in hospitals. Similarly, the CMOS imaging chip technology that we all have in our mobile phones was developed at NASA for space research while Photobit, the spin-off company that commercialised it, received some of its first funding from the US Department of Defense, which was looking for a way of monitoring missile launch tests. In biotechnology, Cambridge Antibody Technology, one of the UK's most successful biotechnology companies, earned its first revenues from selling research kits, developed and manufactured under contract to Pharmacia. The company went on to pioneer the development of antibody-based drugs.

The pivotal player in the development of the Oxford cluster of science-based companies, Oxford Instruments, started life as a supplier of high field magnets into the research sector, famously operating out of Sir Martin Wood's garden shed. When Wood started Oxford Instruments with his wife Audrey, he was working as a 'kind of service engineer' in Oxford University's Clarendon Laboratory, running its engineering facility. His company was established to provide equipment for other laboratories, often at the request of former Oxford PhD students. It was started with no external funding, and with Wood himself working part-time. Experience in the research tools market allowed Oxford Instruments to move progressively into superconducting magnets, NMR and mainstream industrial and medical markets; for many years it was the word's major supplier of magnets for MRI scanners. Today Oxford Instruments employs over 1,500 people and its alumni have played a key role in many other Oxford companies.

There is a remarkable parallel between the Oxford Instruments story and Cisco Systems, the world's leading supplier of computer networking products. Cisco was founded by Leonard Bosack and his wife Sandra Lerner. Bosack managed Stanford University's computer science department's laboratory and Lerner oversaw the computer facilities at the graduate school of business. They devised a way to connect the local area networks in their respective departments, which were 500 yards apart. After failing to sell their technology to existing computer companies, they set up Cisco in 1984 to exploit it. Like Oxford Instruments, no venture capital was involved at this stage and Lerner carried on working for another company to help pay the bills. Cisco's initial customers were also university, government and commercial research centres. When the commercial market for Internet networking began to develop five years later, Cisco was perfectly placed to exploit it.

So, helping new research tool companies get started can pave the way for them to develop into much bigger operations. The sector's start-ups and small companies should be prime targets for the Department for Business, Innovation and Skills (BIS) in laying the foundations for the industries of the future. The most effective way it could help is by ensuring that innovative research tools companies are linked into public sector research markets, so that government-funded universities and institutes can act as lead customers. This paper argues that a new Research Councils' Small Business Research Initiative (SBRI) programme should be established to facilitate the process.

The SBRI scheme is an innovation-based procurement programme designed to help public sector bodies to act as 'innovative customers.' It works by commissioning companies to develop new technologies to help meet policy goals and improve operational effectiveness. It applies across a range of areas from security and defence to healthcare and the environment. BIS, through the Technology Strategy Board (TSB), is the sponsoring department. Alongside other government departments it has been asked to show how it will deploy SBRI through its annual Procurement Innovation Plan.

After two failed attempts to get SBRI off the ground in 2001 and 2006, a substantially revised scheme was launched in March 2008, with strong backing from the Treasury and the BIS's two predecessor departments, DIUS and BERR.[5] Good progress has been made by the TSB in rolling out the approach across a number of public sector agencies, and many officials who have participated have become enthusiastic champions of its approach.

However, there remain some noticeable non-participants, including the Research Councils, which are a key part of BIS itself. And this is despite the historical success of similar discontinued schemes. With annual expenditures of over £3 billion, the Research Councils represent about 30 per cent of UK government research and development (R&D) spending and, through the universities and institutes they finance, should be prime candidates for participation in the SBRI programme. At a time when their ability to capitalise economically on the UK's academic research strength is under increasing scrutiny, supporting innovation and growth in the UK research tools industry – in specifying what is needed and as lead customer – would be one of the easiest and quickest ways of achieving this goal.

The US Small Business Innovation Research program: A role model for UK policy

The UK SBRI programme was established in 2001 and was intended to emulate the highly successful US Small Business Innovation Research program (SBIR).[6]

Introduced in 1982, the SBIR is underwritten by federal legislation and requires that all major federal government agencies spend a small proportion of their R&D budgets with smaller businesses through a tightly structured competitive process focused on each agency's requirements for innovative new technology. Total SBIR expenditure is now over $2 billion per annum, with a further $230 million in the closely related Small Business Technology Transfer (STTR) program.

The SBIR program is essentially a procurement-based programme with awards taking the form of 'contracts' covering 100 per cent of project costs plus a small profit element. Although some agencies, notably the National Science Foundation (NSF) and the National Institutes of Health (NIH), describe their awards as 'grants', they are effectively 'contracts'.[7] Key features of the programme are:

- It is a competitive process open to all businesses employing fewer than 500 people and which are majority owned by US citizens.
- Solicitations are advertised by each agency in groups, typically twice a year.
- Awards are phased: Phase I awards are typically worth $100,000 for a feasibility study; Phase II awards are typically worth $750,000 for development of a demonstrator or early prototype. (Awards sometimes exceed this guideline, especially those to biotechnology companies.)
- The contractor retains ownership of any intellectual property it creates during the project.
- There is no requirement for collaboration with universities or other companies; subcontracting is allowed within limits, but this is at the choice of the award winner.
- The process is swift, relatively simple, completely transparent and very competitive; roughly 15 per cent of applicants are successful at Phase I and roughly half of these go on to Phase II, thereby enabling sponsors to manage the risks associated with funding innovative developments.
- Multiple award winners are common.

It should be emphasised that the SBIR process represents just one of the ways that federal agencies place R&D contracts with small firms. Total expenditure on

R&D contracts with small firms is many times larger.

The SBIR program plays a major role in the funding of early-stage science and technology companies in the US, and is widely regarded as successful.[8,9]

Status of the UK Small Business Research Initiative

The UK SBRI was launched by the Department of Trade and Industry in 2001, and after poor participation by departments was re-launched in the 2005 budget by Gordon Brown. By March 2008 the programme had still failed to meet its objectives, with few, if any, technology development contracts advertised under the SBRI banner. The fundamental problem was the lack of recognition by senior officials in spending departments that government can benefit from funding the development and trialling of new technology as a lead customer, or that it has an obligation to do so if it wishes to encourage the growth of innovative new companies. This was coupled with the fragmentation of R&D budgets within departments and a procurement culture which inhibited anything smacking of risk-taking and dealing with small companies. As a result there has been a systematic and major disconnect between the intentions of Government ministers and the collective actions (or lack of them) by officials.

Since 2004, the author has been campaigning for the establishment in the UK of an effective US-style programme.[10] A restructured scheme, based on the author's proposals, was announced in the March 2008 Budget Report and accompanying DIUS and BERR White Papers. Government commitment to innovative procurement, including through SBRI, was re-emphasised in the October 2008 Pre-Budget Report. In December 2008, DIUS published guidance for departments on the preparation of the 'Innovation Procurement Plans' which each Department has been required to produce annually since spring 2009.[11] This states that *"these Plans will include details of how Departments will seek to increase their procurement of existing products and services, fulfil their commitments under existing initiatives such as the Small Business Research Initiative and how they will make use of innovative procurement mechanisms."*

The Technology Strategy Board (TSB) is taking a lead in coordinating the roll-out of the new SBRI across departments. Pilots were run with the Department of Health and Ministry of Defence in 2008. During 2009 the programme was extended to other departments and agencies, including the Home Office, Department of Transport and Department of Communities and Local Government.

The problems arising from the perceived inflexibility of procurement rules have largely been solved, so that a simple 'out-of-the-box' SBRI process, with standard contracts and competition procedures, is available for use by any government department or other public sector agency. The attractiveness of the process to smaller firms is illustrated by an SBRI competition organised by NHS East, which in June 2009 attracted 177 applications, a much bigger response than most other government R&D funding

A regional SBRI programme

An SBRI competition in the health sector was launched in the East of England in April 2009, to help industry bring new technologies to support the achievement of regional health priorities and increase the possibility of their adoption in the NHS. The competition, which attracted 177 proposals, was open to companies both inside and outside the health sector.

The programme was funded by NHS East of England and the East of England Development Agency (EEDA), together with the Technology Strategy Board (TSB) and the European Regional Development Fund.

The competition covered three topics:

• Managing long-term conditions – remote monitoring.

• Patient safety – improving health outcomes.

• Keeping children active.

Like all SBRI competitions, it operated as a procurement process aimed at developing the new technologies the NHS needs. So awards take the form of contracts rather than grants, and developments are 100 per cent funded.

Projects were selected through an open, competitive process in two phases, and the selection panels for each topic included senior clinicians and experienced technology developers. Winners are first awarded Phase 1 contracts to investigate project feasibility and undertake preliminary design work. These are for up to six months and £100k. Companies that successfully complete Phase 1 are then eligible to compete for Phase 2 funding of £250k – £750k for up to two years to take their technology to demonstrator or prototype stage, and possibly to enable user trials. All firms retain the rights to any intellectual property (IP) generated from the project, with certain limited rights of use retained by the NHS.

Eleven companies, mostly start-ups or early stage companies, have been awarded Phase 1 contracts, and it is expected that around half of them will go on to receive Phase 2 contracts. Examples of Phase 1 contracts include:

Eykona Technologies Ltd	3D imaging systems for objective measurement and characterisation of ulcers.

Exhalation Technology Ltd	Device for assessment of lung inflammation in inhaled breath for asthma-prone children.
Sonovia Ltd	Ultrasonic patch for targeted delivery of drugs for patients suffering from chronic musculoskeletal conditions such as arthritis.
Docobo Ltd	Remote monitoring telehealth system to enable individualized interactive chronic disease management in the home.
Oxford BioSignals Ltd	Monitoring cardiac and other vital signs in hospitals.
Anaxsys Technology Ltd	Respiratory rate monitor for use by paramedics in ambulances.

competitions, which tend to be less suited to smaller firms. (See box.)

The TSB hopes to build a programme worth £100 million per annum within three years.[12] But despite its effectiveness in marketing the SBRI concept to government agencies, and the enthusiasm of some individual officials, overall take-up is still well behind target. With public sector cost cuts likely, implementation will come under further pressure.

The role of R&D contracts for customers in the innovation process

The key benefit of the SBRI approach is that it replicates the process by which many innovative developments are funded in the private sector. Lead customers place contracts with firms to develop new technologies on their behalf or by paying in advance for prototypes, thereby effectively funding their development. This gives firms:

- A stimulus to innovation by defining unmet needs as well as customer problems and challenges.
- A strong steer on detailed user requirements through active engagement of an informed customer.
- One-hundred per cent funding, unlike all other government R&D support schemes which require an upfront commitment to matched funding.
- A mechanism for effective product testing.
- A reference site for future sales.

Existing single company government grants for R&D and collaborative R&D schemes do not carry these benefits. They don't suit small and medium-sized firms (SMEs), which often lack the matching funds required. Collaborative R&D, the dominant mechanism for funding R&D in firms, also has a number of other features that tend to make them unattractive to SMEs.[13] In particular, topics tend to be too far from market, and the involvement of multiple partners complicates project management and intellectual property (IP) ownership. Proposals are often put together by partners with very different objectives and time horizons, sometimes sharing only the desire to access government funding to subsidise existing research. And venture capital is appropriate only for businesses developing products with very large markets, the potential for rapid growth and fast execution. In fact, a large proportion (and possibly the majority) of successful UK technology companies have their origins in a 'soft' business model based on R&D contracts, before spinning out, or transitioning into a 'hard' product-based business.[14]

Even firms that raise venture capital to develop and market standard products frequently seek development contracts with lead customers. This kind of financial commitment is the best market research a firm can have and provides endorsement of the firm's technology to assist further sales or secure investment. It is particularly important for platform technologies, for which customisation is required for different applications, and where it is unclear which will have real commercial potential.

From the customer perspective, placing an R&D contract with an innovative firm represents a way of acquiring new technology designed to meet their requirements, and it gives the customer a lead over its competitors. In many cases, it will be in a customer's interest for contractors to supply the technology to other users (including competitors in due course) so that support, maintenance and upgrade programmes can be well resourced.

This process is very common for new instrumentation and other research tools used by the pharmaceutical industry. For many years, GSK Research operated a Technology Development Group, headed in the UK by Brian Warrington in Harlow, to give GSK a competitive advantage as first adopter of new drug discovery technologies. It was the first major customer for TeraView, the world's leading terahertz imaging[15] and spectroscopy company, which was spun out of Toshiba's Cambridge Research Laboratory, and for Syrris Ltd, a start-up company developing novel microchemistry equipment. In both cases it funded the development of products to meet GSK's requirements.

The Acumen Explorer, TTP Group's high-throughput, high-content, laser-based assay analysis system, is another product whose early development was funded by pharmaceutical company customers, in this case AstraZeneca and Rhone-Poulenc Rorer, This development provided the starting point for a new TTP subsidiary, TTP Labtech, today employing over 80 people and selling a range of instruments into global markets.

Lead customers continue to play a key role as research tool companies grow. The Automation Partnership, now the world's leading supplier of automated cell culture equipment, has developed nearly all of its major products under contract to a lead customer or industry consortia. This has enabled it to grow from a team of four people in 1988 to some 150 today.[16]

The practice is also common outside research tools. Sentec, a 30 person Cambridge company is now earning licensing revenues from innovative metering developments paid for by gas, water and electricity companies.

R&D contracts from UK government departments are very rare outside defence, though UK firms with a strong US shareholder base do occasionally win US government contracts. Owlstone, a Cambridge-based gas sensor business based on chip-scale field asymmetric ion mobility spectrometry, has won two Phase I SBIRs and a $3.7 million (non SBIR) R&D contract from the US Department of Defense.[17] The company did not win an R&D contract from the UK Government until the end of 2009, five years after its first US SBIR. Dr Helen Lee, a distinguished academic researcher at Cambridge University Department of Haematology, has established her exploitation company, Diagnostics for the Real World, in Sunnyvale, California specifically to access NIH SBIR awards, winning awards worth $8.5 million over five years.

Relevance of SBRI to Research Councils

Small science and technology companies are generally ill-equipped to undertake research. Commercial success requires a focus on developing new products and processes. Placing research projects with them that could be better undertaken in an academic environment makes no sense. However, there are strong arguments for a Research Councils' SBRI programme based on research tools.

The Research Councils have long outsourced the development of purpose-designed equipment for large-scale facilities. For example, through the UK Biobank, they have funded the development of The Automation Parnership's Polar sample store, placing it in a strong position to sell to the three other large-scale biobank facilities being planned worldwide, and making UK researchers world leaders.

However, when it comes to acting as lead customer for innovative research tools with more general applicability, the role of the Research Councils, and the research groups they support, has been more problematic. For example, despite the academic credentials of its founders - Professor Sir Michael Pepper is TeraView's Scientific Director - it was eight years before TeraView sold one of its terahertz spectrometers to a UK university, by which time it already had a strong installed customer base in US, Chinese and European universities. One example does not prove the argument, of course, as there may be good technical or commercial reasons for any failure to make sales. But there is widespread belief amongst British scientific instrument companies that they must look outside the UK for their first academic customers, even if lack of a UK reference site makes this more difficult.

There is a Catch 22 here. Research tools are usually purchased as part of a larger grant application which may need to reference pre-existing research results obtained with the technology. And part of the problem seems to be the understandable desire of grant applicants to concentrate funding on people rather than equipment and a preference for less expensive, laboratory-built equipment. Instruments and technology aimed at commercial users will always be more expensive to develop, but they also tend to be much more efficient, have less down time and be available for a wider range of users.

The experience of Cambridge Magnetic Refrigeration (CMR) illustrates these points. CMR was founded in 1999 by a Research Fellow at the Cavendish Laboratory to develop and exploit ideas for dry (helium-free) refrigeration systems for physics and material research. However, it was not until 2004 that its founder was able to persuade a former academic colleague – his PhD supervisor – to apply for an Engineering and Physical Sciences Research Council Instrumentation Grant to fund development. CMR received £180,000 out of a total grant of £730,000. Whilst the development was successful and proved the technology worked, securing the grant required his academic colleague to specify a temperature 100 times colder than necessary for a commercial product. Further funding, including a significant investment by the founder and down payments by customers, was therefore necessary before the product could be made commercially viable with the academic community.

CMR still has just six employees, but has already received £1.5 million in orders for the new product, mainly from the Far East. By eliminating the need for a helium logistics and management system, it is simplifying cooling to 100mK, and making low temperature research accessible to new disciplines interested in a wider range of applications. Had CMR been able to secure a SBRI contract in 1999, it would have had its 'Drygenic' product on the market six years earlier and been able to finance faster growth.[18]

An SBRI programme focused on innovative new research tools suitable for global marketing would address these problems, with benefits to both UK science and the economy at large.

Historic precedents

In the late 1970s and early 1980s, the DTI's Pre-Production Prototype Scheme (PPPS) played a rather similar role to the programme proposed in this paper. The PPPS was one of the best-regarded DTI programmes. Like SBRI, it provided 100 per cent funding to cover the purchase of innovative new equipment by lead customers.

For example, VG Scientific Ltd, now part of Thermo Fisher, the largest instrumentation company in the world, funded all of its major new instrument developments through PPPS. According to Alastair Smith, the company's Managing Director, *"VG Scientific was a small spin-out from Vacuum Generators Ltd and our first Escalab Surface Analyser included several important innovations. Developing it was a huge risk for the company. The PPPS mechanism was enormously important, financing the development and placement of the first instrument with a leading academic at Surrey University. This product fuelled VGS's growth and in the period I was MD (1983-1988) the company grew revenues from less than £7 million to over £25 million. While we never quite overtook the US market leader, we were by then No 2 worldwide, dominant in Europe, and with equal market share in the Far East."*

Furthermore, until 2006, the Biotechnology and Biological Sciences Research Council (BBSRC) was the only UK government department or agency to operate a UK SBRI programme, albeit with modest funding. This supported roughly ten projects a year and is highly regarded both by the benefitting companies and the BBSRC officials involved.

The BBSRC scheme was axed in 2006, following a decision by DTI (now BIS) officials that the Research Councils should opt out of the SBRI, in favour of their own new 'Small Business Research Scheme'. Though this is promoted on web sites, no projects appear to have been advertised or awarded under it.

DanioLabs is one Cambridge company to benefit from a BBSRC SBRI. The company was established in 2001 by academics from Cambridge and the University of California, San Francisco, with funding mainly from business angels, the University Challenge Fund and later, the Wellcome Trust. Its aim was to develop assays based on live zebrafish.[19] DanioLabs' early revenues came from R&D contracts with companies for sophisticated disease modelling and safety pharmacology services. It later went on to use its technology to test drug candidates for the treatment of neurodegenerative diseases such as Alzheimer's and Parkinson's. This was funded through both an SBRI contract and a LINK collaborative project.

The Daniolabs team found the SBRI programme to be very business-friendly, in particular over patent ownership;

they had experienced IP disputes in other collaborative project structures. DanioLabs was later sold to a UK competitor, Vastox, (now Summit plc), which continues to operate a zebrafish-based contract R&D business and also has its own drug development programme.

R&D contracts are surprisingly important in the bioscience arena. Examples of very successful UK drug discovery companies that have used this approach in their early years include Cambridge Antibody Technology and Chiroscience. Smaller Cambridge companies that could have benefited from an SBRI more recently include:

- BioWisdom which has developed data analysis and visualisation software tools for the pharmaceutical industry and academia.

- Horizon Discovery, which is exploiting isogenic cell lines developed at the universities of Cambridge and Washington as tools to accelerate the search for personalised drugs.

- Expedeon, which has developed innovative technologies and products for protein handling and analysis.

How a research tools SBRI might operate

Each SBRI programme needs to be fine-tuned to meet the needs of the sponsoring department or agency, whilst retaining the core principles. In the case of the Research Councils, key design features might include:

- A focus on innovative research tools which meet an unmet need or represent a significant improvement over existing commercially available technology.
- It being available to fund development of demonstrators and prototypes, purchase of prototypes, and user trials.
- One-hundred per cent funding; no requirement for matched funding.
- Calls advertised in batches twice a year.
- Each call specifying a number of research tool 'challenges', giving sufficient detail of functional requirements to describe the problem, but not the solution; aim to stimulate development of research tools which can be marketed to a broader group of customers internationally.
- Over time, challenges should reflect ongoing informal dialogue between entrepreneurs and businesses with concepts, and academics and research council staff with demanding research objectives.
- Awards in two phases: £50-£100k in Phase 1 for a feasibility/design study and £250k – £1 million in Phase 2 to fund development of a demonstrator or supply of prototype and to cover the cost of trials.
- IP ownership with the contractor.
- Contracts made to businesses (including start-ups).
- No requirement for collaboration; however, award winners will frequently wish to place a subcontract with an academic group for product review and testing, β-site research projects and to act as a demonstrator site for future customers.
- To comply with EU procurement rules, the competition should be open to businesses of all sizes, but as with the US SBIR, awards would be expected to go mainly to innovative smaller businesses, including start-ups, with new ideas; incremental product improvements would not be eligible.

What needs to be done next
Through the work of the TSB over the last year, a standardised toolkit has been created for running SBRI competitions within government departments. Over 25 competitions have now been run and over 370 companies awarded contracts.

So implementation within the Research Councils could be very rapid.

In the medium-term, given its share of overall Government R&D expenditure, it seems appropriate that the Research Council's should account for 20-25 per cent of the TSB's £100 million SBRI target. At £20-£25 million, this would represent less than 1 per cent of total Research Council expenditure, so would have a negligible impact on academic funding.

However, as with other spending departments, it would make sense to build up to this programme over two or three years. The programme might start with competitions worth £10 million advertised in the first year. Typically a £10 million programme could fund 25-30 Phase 1 contracts and 10-15 Phase 2s, though because of the way that SBRI projects are phased, the majority of the expenditure would be incurred in the second and third years.

The competition topics should be chosen by the Research Councils based on suggestions by individual academics. Evidence from the NHS East competition shows that the customers for new technology (in that case the clinicians who define the problem or requirement) rapidly become enthused and engaged in the process.

An SBRI programme of this kind would provide a useful mechanism to help UK academics stay ahead by giving them early access to innovative research tools and helping shape their development in small companies. It would also make it easier for scientists and engineers, including academics, with ideas for new commercial research tools to start businesses.

As we have seen, neither conventional grants nor venture capital are usually appropriate for funding R&D in the kinds of small companies involved in pioneering new developments in the research tools industry. They must therefore rely largely on customers to fund new products. A Research Council's SBRI would therefore fill a very important funding gap. As importantly, it would provide early reference sites for UK companies, making it easier for them to secure further customers, especially in overseas markets, thereby enabling faster growth.

During the current period of economic recovery this new programme could play a particularly important role in stimulating the growth of high value-added sectors of industry in which the UK has an inherent competitive advantage. This could make a significant contribution to export earnings and economic growth.

Endnotes

1. The key role of users in the innovation process in scientific instruments has long been recognised. See von Hippel, E. (1976) The Dominant Role of Users in the Scientific Instrument Innovation Process. 'Research Policy.' Vol. 5, pp.212-39.
2. US Department of Commerce, Industrial Trade Administration, Office of Industry Trade Policy, June 2004.
3. Proteomics Technologies and Global Markets, BCC Research, June 2009.
4. Laboratory Biotechnology Reagents: A Global Strategic Business Report, Global Industry Analysts Inc, as quoted in Drug Research.com, March 2009.
5. DIUS was the Department for Innovation, Universities and Skills and BERR the Department of Business, Enterprise and Regulatory Reform.
6. For a much fuller discussion of the US SBIR programme see Connell, D. (2006) 'Secrets of the World's Largest Seed Capital Fund: How the United States Government Uses its Small Business Innovation Research Programme and Procurement budgets to Support Small Technology Firms.' Cambridge: Centre for Business Research.
7. Not being subject to EU State Aids regulations, US government agencies have fewer hang-ups about using the word 'grant', whatever its terms or purpose.
8. There have been several independent reviews of the US SBIR, all positive. For the most recent and comprehensive, see Committee for Capitalising on Science, Technology and Innovation, National Research Council of the National Academies; Wessner, C.W. (Ed.) (2008) 'An Assessment of the SBIR Programme.' Washington DC: National Academies Press.
9. According to a study by Joshua Lerner at Harvard Business School, SBIR award winning firms created five times as many jobs as a matched sample of non-award winning firms over a ten-year period. See Section 7.2, The Bottom Line, 'Secrets' of the World's Largest Seed Capital Fund.' Op. cit.
10. The campaign was formally launched in December 2004, with Anne Campbell, then MP for Cambridge, and has had wide support. See for example 'MPs are Urged to Back Programme for Innovation for Small Businesses.' Letter to Financial Times, signed by 13 leading academics, entrepreneurs and venture capitalists, 19th October 2005.
11. DIUS (2008) 'Procuring for Innovation, innovation for procurement.' London: TSO.
12. In proportion to the relative sizes of their economies, this is rather smaller than the US programme.
13. Connell, D. and Probert, J. (2010) 'Exploding the Myths of UK Innovation Policy: How 'Soft' Companies and R&D Contracts for Customers Drive the Growth of the Hi-Tech Economy.' Research Report Commissioned by East of England Development Agency Science on Behalf of the East Of England Science and Innovation Council. Cambridge: Centre for Business Research.
14. 'Exploding the Myths of UK Innovation Policy'. Op. cit.
15. Terahertz has many potential applications, ranging from the analysis of polymorphism in pharmaceuticals research to the detection of explosives in airports and quality control in industrial processes.
16. The Automation Division of TTP originally had four people at the time of TTP's formation with a total start-up team of around 23. The Division was eventually spun out as a separate company.
17. The $3.7 million contract was placed outside the SBIR programme, but followed on from Owlstone's initial Phase 1 SBIRs which enabled it to attract the interest of the US Department of Defense.
18. Cambridge Magnetic Refrigeration's Founder, Dr Kurt Haselwimmer, was awarded the Institute of Physics' Paterson Medal in 2008 for 'the successful establishment of the scientific instruments company'.
19. An assay is a procedure in molecular biology for testing or measuring the activity of a drug or biochemical in an organism or organic sample.

David Connell

David Connell has been a Senior Research Associate at the Centre for Business Research at the University of Cambridge since 2006. He was previously founder and Chief Executive of TTP Ventures, a Cambridge-based venture capital fund specializing in early-stage science and technology-based ventures with funding from Boeing, Siemens and financial institutions. From 1989 to 1997, David was Head of TTP Group's Strategy Division. Today, he combines directorships with TTP Capital Partners and small technology companies with his academic research position. David's research interests include business models for new science and technology companies, technology commercialisation strategies, the role of intermediate research institutions, and government science and innovation policy. His research on the US Small Business Innovation Research (SBIR) program and other US procurement based policies has had a major influence on UK Government thinking and his detailed proposals form the basis of the revised UK SBRI programme launched in 2008. David is advising the Technology Strategy Board (TSB) on implementation.

Professor Ian Leslie

Ian Leslie is the Robert Sansom Professor of Computer Science at Cambridge. He is a previous Head of the Computer Laboratory and recently stepped down as Pro-Vice-Chancellor for Research at the university. His research interests are in communication networks, distributed systems, operating systems, and (recently) information technology to aid in energy demand reduction. He has co-founded two companies and continues to be interested in demonstrating the broad impacts that universities have on society.

NESTA

1 Plough Place
London EC4A 1DE
research@nesta.org.uk

www.nesta.org.uk

Provocation 13

ISBN 978-1-84875-078-4

9 781848 750784