UNIVERSITY OF Southampton

Royal Academy of Engineering
Dowling Review

Submission of Evidence and Information
by
University of Southampton

1. **What experience do you have of establishing, participating in or supporting long-term research collaborations between business and academia?**

The University of Southampton has extensive experience of strategic research collaborations spanning multiple decades and is engaged with companies, both large and small, bringing together a wide array of people, facilities and knowledge. The University is a major driver of innovation and the strategic partnerships with business offer a highly efficient mechanism for translation of both skills, through the enhancement of recruitment pipelines, and technology through a variety of mechanisms including licencing, knowledge transfer activity and alumni.

The University has in excess of 1000 active contractual collaborations on-going with business at any one time. Many of these lead to the creation of new products and services which in turn contribute to economic growth. Additionally, the University works with the LEPs and other economic development groups in the region to attract inward investment in the South of England.

The relationship between the University of Southampton and Lloyd's Register is an example of a relationship that has continued to develop over many years. The first interaction was in the form of a Chair in Ship Science which was established in 1969 and in 2010 the decision was taken to establish a Marine Centre of Excellence at the University, relocating the Marine Division of Lloyd's Register at the redeveloped Boldrewood Innovation Campus. This £150M collaboration secures long term research at the University includes a commitment of £75million over 20 years by Lloyd's Register and creates the largest industrial collaboration in UK higher education.

The decision to locate in Southampton was driven by the world class capabilities in marine engineering and naval architecture and their cross-university networks resulting in unique capabilities across a diverse range of areas from fluid dynamics and acoustics to the combination of arts, humanities and social sciences. The University has established the Southampton Marine and Maritime Institute which creates and excellent mechanism for engagement between the Universities academic community and the Lloyd's Register centre enabling additional benefit to be realised.

As well as the large scale collaborations, as exampled by Lloyd's Register, the University also benefits from long term relations with smaller organisations such as Ilika Technologies Ltd which was founded in 2004 as a spin-out from the University's School of Chemistry. The Company quickly established an international reputation for the rapid development of novel materials and secured commercial partnerships with a portfolio of blue-chip companies including Asahi Kasei, Shell, NXP and Toyota. The Company's growth has been financed by three rounds of venture capital, an initial public offering (IPO) on the London Stock Exchange in May 2010 and a Placing in April 2012. The company invents, tests and selects materials in the laboratory that can be scaled-up for everyday commercial use. Its unique process is far quicker and more efficient than traditional materials discovery processes and uses high-throughput, or combinatorial, techniques which involve the rapid synthesis of a large number of different structurally-related materials in a few automated steps. The relationship with Ilika continues to deliver benefit to the university through collaborative working, engagement with staff and access to facilities.

There are many other examples of long term collaborations with business of all sizes and across all sectors. The University ranks in the top 3 in the UK for

interactions with SMEs (HEBCIS) which can be explained through our approach of flexible engagement to address the needs of industry – from industrial units providing consultancy services and access to high-tech facilities through to large scale research collaborations.

It should also be noted that the University has long-standing strategic partnerships with the following organisations:

- Airbus – University Technology Centre in aircraft noise since 2008
- De Puy – International University Technology Partnership in bioengineering science
- Microsoft – Institute for high performance computing
- Network Rail – Strategic University Partnership in future infrastructure systems
- RLNI – Advanced Technology Partnership on maritime engineering and safety
- Rolls Royce – University Technology Centres in gas turbine noise and computational engineering

In addition to these corporate relationships, the University plays a vital role in the local and national innovation ecosystem through a very successful incubation programme and active involvement with our local LEPs. The University recognises its role in facilitating the innovation absorption capacity of businesses through the training of future industry leaders and collaborative working.

The University is working with the region's Local Enterprise Partnerships (LEPs) to inform their innovation strategies and ensure that each of them incorporates the appropriate business clusters and associated innovation opportunities in their strategic plans. The role of the University is the primary linkage among the region's LEPs and is providing much of the collaboration and coordination among the LEP strategic plans. The SETsquared partnership (http://www.setsquared.co.uk/) is another flagship incubation programme – ranked second in the world – in delivering effective business support for high-growth, high-risk technology companies. The iCURE programmei, piloted by the SETsquared partnership, complements these activities by offering academic researchers funding to validate their commercially-promising ideas in the marketplace.

2. What are the key success factors for building productive, long-term research partnerships between business and academia and how do these vary across sectors and disciplines?

Successful research partnerships have common features where both the business partner and the University have found mutual benefits and understanding to justify investment in time, people and resources, including:

- Common purpose and shared vision of success, which will include:
  - Creation and exploitation of opportunities to solve business and scientific challenges
  - Mutual knowledge creation and transfer
  - Enhanced profile within current and broader networks;
- Alignment of expectations and timescales;
- High-level support with connections at all levels of both organisations:
  - Engaging with the right people – it is vital to build personal relationships with key people in an organisation and develop and understanding of the decision making processes

    - Embedding industrialists in university group helps to develop real understanding of the technical and business challenges faced by industry and facilitates more effective knowledge transfer
- Technical synergies and cross-fertilisation;
- Shared understanding of business drivers and academic environment;
- Mutual flexibility to enable outcomes.

For sectors with very long product lifecycle development there are strong synergies with academic research activities which are more closely aligned with the company business models and goals. This close alignment facilitates the development of long-term collaborations once the initial successful engagements have delivered value. Examples of this include the partnerships with Rolls Royce and Airbus where the development of technology centres has been enabled by the alignments of objectives and vision.

The health sector has undergone a major transition over the last 5 years and has become more dependent on academia or biotech for the acquisition of technologies and access to the innovation pipeline. This has driven even closer interdependency and synergies between business and academic.

Companies operating in sectors with shorter lifecycles tend to be more focused on recruiting graduates with the right training and working with research groups to generate near-term benefit. Knowledge exchange is vital in this environment and is secured through the intensive engagement with trained people. It is important to establish a pipeline of people with the appropriate training and expertise who can transition into these organisations.

3. What barriers do individual businesses face in developing long-term research collaborations with academic partners and how can these be overcome?

In recent years there has been a trend for companies to seek support for technologies at higher TRL levels that are traditionally addressed through University research. One of the factors driving this change in focus is increasing trend for new products to be generated as a result of market needs and customer demands rather than as a result of the potential to exploit new technology developments and then seek a market.

A key barrier for developing strategic collaborations is the misalignment of corporate technology development strategies and academic research perspectives. Typically industry works to significantly shorter development cycles which require rapid technology development and insertion, in contrast to the academic community which works to much longer timeframes.

Despite the long term strategic visions presented by many businesses, the reality for many collaborations is that they are generally focused on solving relatively near term challenges. The consequence of this lack of long term perspective is that they are often unable to appreciate the benefit of even relatively short term research activity such as PhD programmes. Even the more business focused EngD programmes are often perceived as too long term for addressing the businesses immediate needs.

The importance of supporting senior (professorial) positions cannot be overstated and a number of mechanisms such as RAEng Chairs and direct industry funded fellowships are vital in bridging the interface between academia and industry.

In considering ways to mitigate this position further, greater utilisation of the student community should be considered, for example through e.g. group design projects and MSc level projects which can often yield quick low cost results for a business. Whilst these short term activities can often be a catalyst for future engagements, they should be seen as a tool for exploring the potential to build a more strategic partnership not a permanent solution.

Throughout all stages of collaboration development, it is incumbent on Universities to be innovative in their engagements and actively seek routes to demonstrate results to partners, both short, medium and long term.

Intellectual property is often reported as a barrier for engagement and whilst this is an issue that clearly must be addressed it should be recognised that ultimate ownership of IP is only one small issue in defining and managing collaborations. Businesses must approach this issue in a pragmatic manner such that the focus remains on maximising the impact of research activity rather than a legal discussion of final ownership.

Under the full economic costing model, the cost of commissioning academic research is often a major consideration for an organisation and can present a barrier to engagement. The role of government in supporting universities and the true costs of research must be better understood and accepted by business in order that the financial position of universities is sustainable.

4. What barriers do academics and universities face in developing long-term research collaborations with businesses and how can these be overcome?

With reference to the previous comments regarding the nature of industrial strategies for technology and product development there is evidence within universities of lack of understanding in Universities of these issues and the rapidly changing marketplace in which businesses operate. This is not a universal issue and clearly there are examples of excellence however this clearly presents a barrier to partnership development.

In contrast to the business community, the reward and recognition strategy of the UK academic system is founded on the basis of publications and peer review journals. This can present a significant challenge when defining collaborations as the necessity for publishing research results is often in stark contrast to the business goals and constraints around confidentiality. In order to overcome these barriers it is important to consider the value of the engagement in the reward process and to further develop methods of articulating the value and impact of research against these business drivers. The University has also created defined career pathways in 'Enterprise' and also include innovation and business engagement as promotion criteria on 'standard pathways.

The funding environment for academia is complex and does not always ease the process of business engagement. The issues around full economic costing has been discussed above and it is important to note that Funding schemes accessible to universities, such as those for supporting short-term knowledge transfer activity

have proved successful to get over the initial barriers for engagement. It is important that these schemes are appropriately administered and expanded but support for longer term collaborations must also considered.

5. **How effective are current incentives, policies and funding streams for promoting this type of collaboration? How could these be improved in order to scale up the range and impact of collaborations being undertaken nationally?**

The movement towards larger, longer-term grants is a very positive move for Universities, however it should be noted that programmes designed for specific government-driven initiatives have the potential to detract from the lower TRL fundamental discovery research.

In parallel with the shift in the funding landscape there has been an increased move towards establishing greater and deeper collaborative activity with industry. For these industry engagements to deliver the maximum potential it is vital that all stakeholders are fully engaged and have a common understanding enabling the development of achievable goals. The recently established Catapult centres are building strong relationships with businesses, however greater emphasis needs to be placed on engaging with academic research in order to realise the pipeline of innovations for translation.

Two specific funding streams that are particularly important in maximising the impact of collaborations are the Higher Education Innovation Funding from HEFCE and the Impact Acceleration Accounts through the Research Councils. In addition, the funding accessible through Local Enterprise Partnerships (LEPs) are important should have a positive and significant impact on business/academia interactions.

The CDT/DTC model works well for longer established relationships through PhD work but further consideration about this work or the EngD style of PhD might enable faster traction and deeper engagement. The model that tends towards courses in the first year and then engagement only in the later years does not necessarily deliver an optimum collaboration.

6. **How can progress under the Industrial Strategy be harnessed to stimulate collaboration between businesses and researchers in the UK?**

The development of the Eight Great Technologies and strategic industrial sectors provide a useful framework for focusing engagement towards innovation and economic development. This government led activity also provides a useful framework to map academic research capabilities onto key sectors.

In support of this, it will be necessary to deliver targeted funding, focused on early stage technology development, if real progress is to be realised. Aligned to the business priorities for higher TRL activity across the sectors this early stage funding will support the pipeline of technology development necessary to enable the development of long term partnerships between universities and business.

The Catapult centres have a key role to play in this ecosystem and best practice from previous activities such as equipment clusters, university-led centres for doctoral training should be harnessed and expanded upon.

7. Which models of collaboration have proved most successful for stimulating SME engagement with the research base in the UK? What additional action needs to be taken to strengthen UK performance in this area?

The most effective methods of engagement are those that are focused around facilitating the movement of people between academic and industry. For the SME community, people are the agents of knowledge and the Innovate UK knowledge transfer schemes have proved especially valuable.

In addition to the publicly supported schemes, the University of Southampton has established a number of Enterprise Units offering expertise across the spectrum of capabilities at the University. This provides simple entry routes to the University and access to the range of services offered such as consultancy services, joint research projects, access to specialist facilities and commercial project delivery.

In considering the action that should be taken to strengthen performance it is important to note that increasing the availability and range of low value voucher programmes does not in itself provide a solution to stimulating engagements. The key consideration is to establish mechanisms whereby SMEs with small numbers of employees can engage. Often the overhead of engaging is seen as too high when combined with the limited knowledge of how the collaboration could impact their business.

Central Government can play a key role in promoting effective collaborations by explaining more about the benefits to business of getting involved with their local LEP and sector based organisations in developing a smart specialisation strategy. Central Government should also work closely with LEPs as they develop their strategic plans to ensure strong alignment with national priorities and UK industrial strategy.

8. Which approaches/sectors/organisations – in the UK or internationally – would you identify as examples of good practice in business-university collaboration with the potential to be applied more widely?

The relationship between the University of Southampton and Lloyds Register is clearly an example of best practice with the close integration of the business and academic activity supported by the co-location or personnel on the Boldrewood Innovation Campus. Whilst on a smaller financial scale, the University Technology Centres with Airbus and Rolls Royce are equally important and are models that could be readily adopted more widely in business.

From an international perspective, a successful example is the relationship with Dalian Polytechnic University and the University of Southampton's Winchester School of Art. The success of these partnerships is contingent upon taking an active local role in the country or region and ensuring that the international activities are a clearly integrated part of the Universities strategy.
Another example of international collaboration is the EpiGen consortium, formed in 2006, between the University of Southampton, the UK Medical Research Council (MRC), the Liggins Institute of University of Auckland and AgResearch, New Zealand. The partners came together to develop and apply their joint research into

the early origins of chronic disease. More recently the Agency for Science Technology and Research's Singapore Institute for Clinical Sciences (SICS) and the National University of Singapore (NUS) joined the consortium.

In common with all the top research-intensive universities, the University has an associated science park which supports its enterprise strategy. The University of Southampton Science Park (USSP), which has links both to the University and the business sector, is uniquely positioned to further the University's aims in respect of science and innovation. USSP provides excellent opportunities for the University to interact with businesses and, as a vibrant entrepreneurial community it is a natural home for spin-out companies. A survey of Science Park tenants in 2014 indicated at approximately 12% of the workforce are graduates of the University.

As the University expands its vision of enterprise, the Science Park will have an increasingly important and expansive role in promoting the University's interests. The world-leading pharmaceutical, chemical and life-sciences company, Merck Chemicals, chose to site its research and development centre at the Park. The benefits to the company and the University have been many and varied with Merck funding equipment for the Schools of Physics and Chemistry, hosting PhD and vacation students and working closely with academic staff at the University on collaborative research programmes.

The University of Southampton and Network Rail have created a Strategic University Partnership (SUP) in Future Infrastructure Systems. This partnership builds on fundamental research carried out at Southampton to both lead and support Network Rail, in track and substructure related research and development. Building on this strong relationship, this the University is also engaged with the UK Collaboration for Research in Infrastructure & Cities (UKCRIC). The recent budget announcement of £138M of funding, subject to business case and substantial co-funding, could support the further development of the University's Boldrewood Innovation Campus with funding towards a new National Infrastructure Laboratory, with a major focus on rail. The activity would link to a number of major activities including the existing CDT in Sustainable Infrastructure Systems, the £3.1M EPSRC Programme Grant, Track21.

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[i] The ICURe – Innovation-to-Commercialisation Programme is a collaboration of the SETsquared Partnership, the Higher Education Funding Council for England (HEFCE), and Innovate UK (formerly the Technology Strategy Board), designed to move ideas and innovations out of universities and into the marketplace, where they will have the greatest impact