



**Confidential**

**Submission to:**

**BIS; Dame Ann Dowling's Review.**

**Date:**

**5<sup>th</sup> March 2015.**

**From:**

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## **Introduction**

This response is from AIRTO (The Association of Innovation, Research and Technology Organisations). AIRTO's members comprise representatives from:

- Public Sector Research Establishments (PSREs)
- Non-profit distributing member and non-member based research and technology organisations (RTOs), including Catapult Centres
- Privately held research and technology companies (including Contract Research Organisations - CROs)
- Universities (Enterprise/Technology Transfer Departments)
- R&D departments of industrial companies
- Business support (including Access to Finance) and early stage technology-based venture capital companies

AIRTO's members generally operate in the private sector but with varying degrees of interaction and financial involvement from the public sector. All are to a significant extent involved in aspects of the translation of ideas, research and technological advances into the commercial arena, for clients in both the private and public sectors.

## **Overview**

**AIRTO welcomes this review and is keen to contribute to the debate on business-university R&D collaborations. Organisations in the innovation, research and technology (IRT) sector play a pivotal role in collaborations between universities and businesses, frequently acting as the aggregator of scientific and technological demand from businesses and markets. Such organisations typically work at the mid-technology readiness levels (TRLs) and are well placed to understand company and sector based innovation strategies, where they are optimally positioned to facilitate interactions involving academic partners, SMEs and large organisations to approach challenge-led innovation projects.**

**The UK stands to benefit from the scientific and engineering expertise residing in its university base to support innovation, but suffers from having relatively few remaining large, research intensive industries capable of funding substantial research at university level. Mid-cap and smaller companies (including those operating in the sectors and technologies identified in the Government's industrial strategy) generally find it difficult to put aside the necessary time and money and to find in-house expertise to match the requirements of funding university work.**

**Britain has a large and thriving IRT Sector, which contributes significantly to our national capabilities<sup>1</sup>, with the economic impact for UKplc now estimated to stand at £32-36 Billion pa. The Research and Technology Organisations (RTOs) that AIRTO represents are a significant component of the UK's innovation ecosystem, but differ from universities in their primary objectives, strengths and capabilities, which are centred on commercial translation of applied research. In its 2011 'Innovation and Research Strategy for Growth', BIS recognised the sector as an 'under-utilised asset'<sup>2</sup>. Both universities and RTOs have vital and complimentary roles to play in leveraging publically funded research to drive economic growth. The best outcomes for the UK will be achieved by supporting these two crucial sectors, working together, to operate at the TRL levels where they excel. Interactions between universities and RTOs are**

many and varied and can be very successful. However, there is currently no systematic, strategic UK public support for underpinning such collaborations. To exploit synergies and maximise the impact of publicly funded research, it is crucial that all players in the innovation ecosystem are involved and therefore collaboration between universities and RTOs should be encouraged and better supported.

RTOs are well equipped in many instances to help companies seeking mid-TRL research capabilities, either on a self-sufficient basis or in conjunction with university partners. Many RTOs already work with universities in this manner, but approaches vary locally, and the UK could benefit from adopting a more defined, systematic framework of support. The recently launched Catapults (which are effectively new RTOs) are intended to provide a better match to the research needs of business in specifically identified areas of technology and application. Building new partnerships between universities and RTOs would benefit academic institutions directly, through enhanced leverage for their knowledge and technology transfer by exploiting synergies in expertise, skills and research infrastructure. Because AIRTO members are all heavily involved in the translation of ideas, research and technological advances to market, we particularly welcome the inclusion of organisations undertaking publicly funded research outside the universities (e.g. PSREs) in the consultation being carried out as part this review.

Finally, by working extensively with business, RTOs have a wealth of experience in discussing strategic issues with commercial clients engaging in research and they therefore possess an excellent level of awareness of the barriers facing universities in opening up such dialogues with business.

**AIRTO's response to the specific questions posed is as follows:**

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

AIRTO members have extensive experience over many years of establishing, managing and participating in research partnerships with universities. This activity has included tackling long-term research objectives in the context of long range, business lead application challenges. Some examples can be found in the original purposes for which RTOs were established, largely to address areas not being tackled by universities, through to Faraday Partnerships and more recently the Catapults. In each of these instances the work has stimulated longer term research projects as the nature of the challenge has been explored. Furthermore, being embedded in collaborations that frequently involve more than one university and multiple businesses working in partnership, AIRTO and its members have developed an excellent overview of the way that academia and business approach such collaborations.

Those members that are Public Sector Research Establishments (such as NPL) themselves undertake long-term research (in NPL's case in the context of standards for the most precise measurements). NPL for example collaborates with multiple universities in order to serve the long term needs of business for better measurement capability.

It is worth noting that three quarters of AIRTO's non-academic member organisations do a significant amount of business with universities, valued at over £80 million per annum<sup>1</sup>.

## **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?**

The matching of partners depends very much on the people involved, their interests, capabilities and experience. To some extent it is difficult to generalise, even within a sector. Variations in people are probably much more important than variations between sectors and trying to characterise individual sectors is possibly of secondary significance.

Clearly there is a pull on researchers to follow current trends and 'in the spotlight' topics/subject areas. This can influence the willingness and availability of researchers to tackle areas that would be priorities for business. The extent of the alignment and stability of the research priorities set respectively by government, research funding bodies and businesses therefore becomes important. New topics need to be matured by researchers to the point at which business can take them on before the priorities change again. Keeping the various stages of research, translation, incubation and adoption in step and in phase with one another is critical, otherwise business will feel that research is always moving on to the next breakthrough before it has delivered results that it can use without having to make risky investments on its own account to explore further the underlying science and technology.

Moving to more detailed considerations, there are many steps in the translation of innovative ideas into the successful adoption of new products, new services and new business practices, all of which have to be tackled in order to ensure success. Business will want to have visibility of how it can navigate this journey from research to commercial value before it commits to a future direction of travel and research beyond that which can be justified by "keeping its options open".

It is absolutely necessary to establish at the outset of a new research partnership:

- Trust
- IP agreements
- Restraints on publication and dissemination
- Expectations on delivery and exchange of information
- Understanding of respective motivations
- What constitutes value and usable outcomes for the business partner

The extent of the preparatory work necessary depends upon the size of the company, its prior experience with universities and the way the sector works, with aerospace and pharma being most suited and experienced at one end of the spectrum and small manufacturers and construction at the other end.

If the requirement is only to identify general topics for research, without any commitment to ongoing partnership, then it is conceivable that agendas could be set through industry sector growth partnerships with academia, or by similar means, without tackling many of the listed issues, but also without requiring substantial funding from business either.

RTOs can play a key role in partnering with universities and business to bring commercial and market understanding to bear in dealing with some of the potential problems outlined above and to facilitate more of a seamless translation from research outcome to commercial adoption.

AIRTO therefore believes that RTOs should work alongside universities to aid their partnerships with business. Smaller companies are often highly innovative but lack resources making it harder for them to interact with academic programmes. RTOs can add particular value to SME interactions by leading and managing collaborations, aligning goals and enhancing communication. Larger companies sometimes have bureaucratic and unwieldy management structures, making internal buy-in harder to achieve, acting as a barrier to collaboration. RTOs can help bridge the gaps in capability that individual companies and universities each bring to collaborations. This is one of the many ways that RTOs can help make the UK one of the best places for exploiting innovation.

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

And

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

It is important to be mindful that universities and business have different missions and objectives. In general, businesses that are technologically focussed do not perceive the pursuit of science as their end goal. Academics engaged in scientific research, do. Therefore, there is a significant cultural difference between businesses and universities. Collaboration is preceded by encouraging maximal dialogue and stakeholder engagement. Differences can also be overcome to some extent by improving exchange of people and skills between the two environments. RTOs already have the skills needed to commercialise and apply new research and the associated technology. Increasing the number of partnerships between universities and RTOs should to be encouraged as a means of driving long term strategic research. This will also enhance the transfer of key non-technical skills required to facilitate subsequent applications. It should be noted that RTOs also have an important role to play in taking skilled graduates in STEM subjects from universities, providing further employment, training and skills enhancement. The IRT sector employs over 57,000 scientists, technologists and engineers in the UK – the same as the number of academics employed by the entire Russell Group.

A good recent example of an initiative designed to improve skills, undertake industry-led research and remove barriers is TWI's partnership with Brunel, Cambridge and Manchester Universities (and now others), part funded by HEFCE, to establish a post-graduate structural integrity research centre<sup>3</sup>.

There is anecdotal evidence that the barriers between academia and business have led to commercial benefits from UK scientific breakthroughs going outside the UK. A low appetite for risk in the UK is a significant factor in this and is also a barrier to the type of long-term research partnership being sought. For example, significant overseas investment in plastic electronics has threatened to take exploitation off-

shore. Companies may choose to support research outside the UK where there is both equivalent research quality and better support for commercialisation or where regulatory requirements stipulate technology validation in global territories (e.g. in pharmaceuticals). There are many reasons for multinationals to operate in multiple territories, many of which are to do with spreading of risk and differences in local economic conditions; their globalisation does however confer freedom to move activities and assets from territory to territory and the extent of local support for the riskier stages of commercialisation may be one such factor.

A significant additional problem is that UK interests frequently cannot hold on to ownership of innovative research and technology being commercialised in spin outs from universities once early investors need to seek a first exit point and the enterprise needs to move on to more substantial growth. Vulnerability to loss of UK ownership is brought about by a combination of a) the tendency to undercapitalise new enterprises, b) the need on the part of many investors to churn their capital and to demonstrate early returns and c) the attitudes of UK financial institutions to risk and, for example, the inability to hedge such risks in unquoted investments. These factors all tend to mitigate against long term stable research partnerships between UK business and academia. That is a wider discussion beyond the scope of this particular review and response.

#### **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 development of strategies for industry sectors, including the determination of research needs, is a step forward but there is relatively little help for mid-cap and smaller companies to tackle the challenges of bridging cultural differences with academia. These strategies need to be backed with funding that is available exclusively for partnerships that address these research priorities. The public funding made available needs also to enable recovery for all partners of the overhead involved in engaging across the cultural divide. It should also incentivise RTO involvement where this accelerates progress and lessens the time and cost of establishing the necessary working relationships. Without financial resources and incentives directed specifically at these objectives and modes of operation it is likely that nothing will change.

For SMEs, the Small Business Research Initiative (SBRI) has worked extremely well, including in efforts to engage SMEs in academic collaborations (via the old Faraday Partnerships in a pilot that was not continued when the Faraday Partnerships were changed to KTNs). Some EU programmes have also proved to be successful in facilitating collaborations, where RTOs have a role in managing collaborations in these programmes. KTPs involving applied research have proved successful for many years, but more opportunities for secondments and graduate training programmes in the RTO sector in association with universities would be beneficial.

Ensuring that business can agree terms and conditions with universities is key, and much has been done in recent years to ensure universities are better equipped at contract negotiation, but this must continue and much remains to be done, including on the ownership of IP rights.

In 2014 the Transport Systems Catapult announced it had awarded £1 million for activities across 14 UK universities to improve collaboration with business – from major companies to SMEs. The projects will focus on developing products and solutions that make transport more seamless and connected, aimed at the global Intelligent Mobility market, estimated to be worth £900bn per year by 2025<sup>4</sup>. This initiative followed a call based on the needs of the centre and its industrial partners for underpinning research. This is as an example of where a policy of letting RTOs act as an industry representative in funding university research is very effective, and such mechanisms of interaction could be extended further across the RTO sector.

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

There is no doubt that the Catapult Centres and established RTOs have a role to play here. AIRTO members manage extensive networks of business contacts, including many SMEs. IRT organisations act as pollinators, match cultures and act as agents for disruption where existing supply chains lack innovation to carve out new supply chains. Many are vast membership organisations themselves, spanning entire industrial sectors, e.g. MIRA, and have a proven track record in driving partnerships with business. The review should look at how Local Enterprise Partnership (LEP) funding for innovation can be used to encourage more partnerships of this kind which will lead on to formulation of longer-term research agendas.

The space sector is also a good example of progress, where the Satellite Applications Catapult Centre is playing a central role in the Space Innovation and Growth Strategy.

In terms of the regional development of the industrial strategy, the research base is important in attracting talent to particular regions, and much of it comes from abroad, where the UK's global reputation in research and the English language make them attractive destinations. If steered in a strategic manner, this can serve as an important vehicle for bolstering and enriching the skills base for particular sectors in given regions, as graduates and academic staff alike remain local and move into employment locally after their time in academia has come to an end. By working with LEPs and local partners to identify local skills gaps, universities can help fuel a critical mass of skills and expertise for key sectors which can then act as an important driver for creation of regional technology clusters, inward investment, job creation and economic growth. Government can stimulate such involvement of universities by defining challenges, influencing calls and inviting universities to tackle them in partnership.

## **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?**

Some schemes e.g. Innovate UK's innovation vouchers, can be useful as a mechanism for allowing SMEs to initiate engagement with universities and RTOs. The KTP scheme is a good example of where SME engagement with the research base has been successfully stimulated, albeit in nearer term, applied

research and knowledge transfer. Crucially this model of collaboration involves people exchange. However such schemes are small with limited capacity for impact and a more holistic approach to stimulating collaboration needs to be taken e.g. via SBRI, which has been shown to be a useful vehicle for SMEs to engage in larger and more strategic research with universities (see reference to SBRI in the answer to 5 above). Horizon 2020 is following the SBIR/SBRI model and this too should be encouraged.

SMEs will find it easier to engage productively with universities if the subsequent stages of exploitation are adequately provided for. This means long term capital investment, both In and beyond universities (including in RTOs), in development and testing capacity, to enable the UK's SMEs in particular to respond to technological application opportunities to embed new scientific advances and technologies in their products and operations. Priorities in this area need to be responsive to signs of emerging potential and uptake within industrial and commercial applications. Investment capacity needs to be managed to ensure that the UK has the ability to follow up with development of the application infrastructure without undue delay.

Overall, this means balancing the long-term need for the UK to remain at the forefront of scientific research with the imperative of obtaining an economic and societal return on investment. This balance should reflect the fact that the costs and risks of developing, engineering and exploiting technology in most instances far outweighs the costs of the initial research; but recognising also that beyond the capital infrastructure needed to support exploitation, private sector interests should be able to finance much of the applications work required. The capital infrastructure needs for these application activities extend beyond the universities across the entire research and innovation sector. Given the breadth of requirement for capital investment through most of the stages of encompassed by the TRL stages, it seems clear that a significant prioritisation will be necessary in terms of which industry sectors, applications and emerging technologies to support. The BIS industrial and 'great' technologies strategies are therefore to be welcomed. Without such concentration on key areas it is inevitable that resources will become too thinly spread and disjointed to provide an effective return on investment.

#### **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?**

Britain's research intensive universities are contributing to the sectors and technologies in the Government's industrial strategy through furthering scientific understanding and progress in these key areas, and through contributing to the emergence of early stage technologies (typically technology readiness levels (TRL 1-3). In certain sectors some universities are providing limited coverage for the mid-TRL level R&D/test bed work needed to take forward translation to market application. (A good example is the Aeronautics Centre at Cranfield University, Shrivenham, which curates wind tunnels for consultancy and R&D for the aerospace and automotive sectors.)

As mentioned in 6 above, the space sector is also a good example of progress, where academia, businesses and RTOs are working together to deliver on the Space Innovation and Growth Strategy supported by Government, Innovate UK and the Research Councils.



Other sectors like medicine and aerospace, where Government is procuring innovative new products and there are large, research intensive UK-based companies are also good examples. Areas of national infrastructure like transport systems are beginning to show signs of demonstrating the same leverage e.g. development of driverless vehicles. In a similar vein, recent work by DEFRA to review public procurement of food, has sought to identify leveraging opportunities for innovation by linking with the Agri-Tech Strategy to bring together the supply chain with Research Technology Organisations and government funders to identify and advance the innovation required to improve competitiveness<sup>5</sup>. The built environment could be another area that stands to benefit considerably by having procurement intent backed up with research/evidence (delivered through academic/ industry collaboration).

## **Summary**

The UK science base is a huge national asset. It does work well with industry in some areas, but there is always the risk that excessive 'pushing' for universities and industry to collaborate, could have a negative effect on the science base. The UK's IRT sector plays a pivotal role of interfacing between universities and industry, involving partnership, translation, development and co-ordination. However, the IRT sector represents an underused asset for the UK. To ensure that university/IRT sector/industry collaborations work even more effectively, and make better use of the science base, there is a requirement for improved strategy and communication, good exemplars, and in some instances new programmes and catalytic funding.

## **References**

<sup>1</sup> The impact of the Innovation, Research and Technology Sector on the UK Economy; Oxford Economics, November 2014

<sup>2</sup> Innovation and Research Strategy for Growth; BIS, December 2011

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/332756/food-plan-july-2014.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332756/food-plan-july-2014.pdf)

<sup>3</sup> [www.nsrc.co.uk](http://www.nsrc.co.uk)

<sup>4</sup> <https://ts.catapult.org.uk/documents/10631/145554/pdf/7ae2be98-c8ae-4d0c-acf3-1601226c75ae>

<sup>5</sup> A Plan for Public Procurement: DEFRA, July 2014

## **Glossary**

AIRTO - the Association of Innovation, Research and Technology Organisations

IRT sector - Innovation, Research and Technology sector

LEP - Local Enterprise Partnership

PSRE - Public Sector Research Establishment

RTO - Research and Technology Organisations

TRL - Technology Readiness Levels

## Declaration of interests

This submission is made by the Association of Innovation, Research and Technology Organisations (AIRTO). The organisation represents research and technology organisations operating in the space between the academic research of universities and the commercial needs of industry. AIRTO members undertake research and development, and knowledge and technology transfer. This submission does not necessarily represent the views of individual member organisations. AIRTO currently comprises organisations, employing more than 40,000 scientists and engineers<sup>1</sup>, with a combined annual turnover in excess of £5billion (AIRTO Ltd. is a company limited by guarantee registered in England No. 1217006 Register office address: National Physical Laboratory, Hampton Road, Teddington, Middlesex, TW11 0LW. AIRTO is a not-for profit organisation funded by membership subscriptions, and managed under contact by NPL Management Ltd.). The members of AIRTO currently are:

AFRC	LGC
AMRC	Lucideon
Animal Health and Veterinary Laboratories Agency (AHVLA)	Medilink
ARUP	MIRA
Axillium Research	MTC
BCIS	NIAB
BHR Group	NNL
BM TRADA	NPL
BMT Group Ltd	National Composites Centre
BRE	NNFCC
BSRIA Ltd	Nuclear AMRC
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