Confidential

Submission to:

Labour Green Paper on Science and Innovation, 2014

Date:

27th August 2014.

From:

The Association of Innovation, Research and Technology Organisations (AIRTO).

Contact:
Professor Richard Brook OBE, FREng
President
AIRTO
Tel.: +44 (0)20 89436600
Email: enquiries@airto.co.uk

Introduction

This response is from AIRTO (The Association of Innovation, Research and Technology Organisations), following a meeting held with Scientists for Labour in spring 2014. AIRTO's members comprise:

- Public Sector Research Establishments (PSREs)
- Non-profit distributing member and non-member based research and technology organisations (RTOs)
- 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

All AIRTO's members are engaged to a significant extent, and in various different ways, with the translation of new ideas, research outcomes and technological advances into innovative products[1], both for commercial markets and public services. Their work is undertaken both for businesses and industrial clients responding to market pull, competitive pressures and evolving regulation by introducing new technological products, and for clients exploiting research to create new offerings and new markets for technology. As demonstrated by a new Oxford Economics study due to be published shortly, this contributes significantly to the UK's economic growth.

Innovation – what is it and what do AIRTO's members do?

INNOVATION in the context of this discussion is the translation of new ideas into successful products (and services). The TSB defines innovation as "the successful exploitation of new ideas - because it drives economic growth".

AIRTO's members provide the professional scientific, technical and business support essential for those wanting to explore new ideas and introduce innovative developments for their businesses and operations for all the reasons outlined above. There is a strong emphasis on the practicalities of implementing innovation programmes. Members provide access to essential skills, experience, facilities, development capacity and training, including providing assistance with obtaining finance, and culminating in proving compliance with regulation and standards and at scale demonstrations of performance and benefit to end users. These work programmes are part of the progressive risk reduction that has to take place between TRLs 3 and 7 on the Technology Readiness Level scale, whether the original idea and technological innovation comes from a business or from academic research.

Most members have varying degrees of interaction with both private and public sector clients and sponsors for their work. The balance and type of involvement varies from member to member according to need, circumstance and availability of finance.

The Innovation Sector – what is it and what is AIRTO's role within it?

The INNOVATION SECTOR comprises professional organisations and companies which supply the essential specialist services required to realise innovations as successful value adding products, services or processes in the commercial marketplace or within the public sector. As noted above, these services include relevant activities in applied research, design, development, technology translation/adaption, testing, proving, project management and financing. These services generally lie between TRL 3 and TRL 7 on the Technology Readiness Level scale. They add value by bringing to bear the necessary combination of professional attitude and approach, skill set, experience and specialist facilities which AIRTO members specialise in providing.

[1] In this context, 'products' includes new technologies and technology enabled services.

Client needs for these services vary sector by sector and according to circumstance. Therefore the various organisations that comprise the Innovation Sector specialise in different types of work and different areas of application; some specialise in serving particular industries (e.g. automotive), others in providing expertise in particular technologies (e.g. composite materials), others in tackling particular multidisciplinary challenges (the various Catapult Centres for example) and some provide support for business processes (e.g. planning, staff development and risk and project management, in the particular context of innovation).

The innovation sector therefore embraces the community of organisations that play an essential role in embedding advanced technologically based developments in commercial or other forms of product for end user uptake. AIRTO is the membership network for these organisations. AIRTO's network helps members to stimulate innovation, develop and exchange knowledge and best practice between organisations and foster connections between business, academia, sources of finance and government.

Headline areas for action

There are significant risks involved in carrying through innovation programmes. Working in the innovation sector where new cutting edge technologies are continually being introduced requires partnership between public and private sectors. The challenge for the UK's next and future governments is to mitigate the risks involved in adopting new technologies and first use of innovative developments to the point where private finance has the confidence to take on the remaining risks and commercial exploitation. Spanning the TRL gap (or 'valley of death') from a policy perspective is therefore a matter of creating an appropriate and well-balanced 'public/private partnership'.

In this context, for the sector to function efficiently and maximise contribution to growth, two things are required from any government:

1. Assistance with replenishing physical and intellectual capital as established technologies are transferred to industry and new leading edge technologies move ahead. Without renewal of capital facilities and associated skills in this TRL 3 to TRL 7 domain (and beyond the capital resources required by universities for their research) it will not be possible for the UK to exploit fully the fruits of its investment in research and industry will be at a disadvantage in terms of its ability to test and demonstrate new, competitive and innovative products, services and technologies.

2. Application of the leverage available through the purchasing power of public sector procurement to pull through innovative products and services into every-day use. Providing purchasing contracts, to innovative SMEs in particular, will to help raise the level of private investment in r&d and thereby increase SMEs' resources for growth and job creation. SBRI should be used more extensively for this purpose, with placement of procurement contracts for research through to supply of demonstrators and prototypes. R&d tax credits will further incentivise innovation and should be made widely available, but they are not a substitute for procurement initiatives as they do not provide such a direct underpinning for investment decisions.

Britain's innovation organisations

Britain has a large and thriving innovation sector, which contributes significantly to our national capabilities[1]. The organisations that AIRTO represents are a significant component of the UK's innovation ecosystem employing over 40,000 scientists, engineers and technical staff, comparable in size to approximately twenty research intensive universities. A current study underway by Oxford Economics, for completion later in 2014, indicates that the members from this sector that AIRTO represents have a combined turnover in excess of £5.5 billion, over three times the size of the Fraunhofer institutes in Germany. The primary objectives, strengths and capabilities of the innovation sector are centred on the introduction of new technology into commercial products and public

services. In its' 2011 'Innovation and Research Strategy for Growth', BIS recognised the UK's sector as an 'under-utilised asset'[2]. AIRTO welcomes the consultation that Labour is now undertaking with stakeholders to review future strategy, particularly in regard to the constituents of the innovation sector.

AIRTO's position

AIRTO's response to the questions posed by the Green Paper is as follows:

Science Investment

How can we make better use of the UK's resources to support science and innovation?

The UK should adopt a three pronged approach, dividing its resources into three approximately equal and ring fenced sub-funds, to ensure the availability of adequate resources on a continuing basis to underpin:

a) global pre-eminence in curiosity driven and fundamental research

b) continuity of participation in long-term international collaborations (e.g. space)

c) campaigns to apply and exploit ground breaking new science and technologies as they emerge (e.g. graphene)

The UK needs to plan for both project and institutional investment which helps to translate scientific discovery into national benefits in a timely manner.

Responsive mode funding which is available at present is not, in the main, strategically 'joined up'. Adopting more of a challenge-led, 'road map' based approach (although complex to achieve and implement) is the most effective way to enable a strategically joined up investment approach to be implemented for the long-term. Approaches currently employed by the MRC and EPSRC reveal some good examples of how this can be achieved. Adopting a challenge-led approach is also beneficial. It can connect various otherwise individual projects at a range of Technology Readiness Level (TRLs), supporting enhanced exploitation between academia and industry. Britain's research and technology organisations (RTOs) play a key role in such multi-disciplinary collaborations and can stimulate new more fundamental research projects by linking researchers to challenges in the field. Societal challenges such as 'efficient resource use' or 'resilience' are good examples – requiring a mix of multi-disciplinary engineering and more fundamental science.

At the same time a reasonable proportion of the total funding should continue to be made available for individual academics to underpin a critical mass of 'blue skies' research.

Strategic decision making bodies have to prioritise over 10 year or longer timescales to ensure continuity of participation in international programmes which enable the UK to remain a global player in major scientific and engineering advances e.g. at CERN and in Europe's Space Programmes. A particular issue in planning commitments for UK participation in such large international programmes is the need to factor in allowance for fluctuations in currency exchange rates and to avoid 'raiding' funds intended for national programmes when rates move against the UK.

Likewise, some headroom needs to be provided to enable the UK to respond to application opportunities which need investment in capital infrastructure in order to embed new scientific advances and technologies within the innovation ecosystem, both within and beyond the universities. 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. Decisions around such emerging, near term opportunities need to be made on a case by case basis, in the context of:

• the relative strengths and weaknesses of the UK's innovation infrastructure (i.e. existing national capabilities and expertise mean that inevitably the UK is better positioned to respond and perform with regard to opportunities in aerospace, transport, agri-food, pharmaceuticals and other priority industry sectors;

• the case for return on investment (both short-term and long-term);

• the potential for societal and humanitarian impact;

• the capacity of the UK to bring emerging technologies to market and compete;

Overall, this means balancing the long-term need for the UK to remain committed in international collaborations and fundamental science with the imperative of obtaining an economic and societal return on investment. This balance should reflect the fact that the costs of developing, engineering and exploiting technology in most instances far outweigh 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 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.

The rationale for suggesting three approximately equal categories of international, basic research and application capital spending is that

a) the international programmes deliver attractive incentives for people to take up careers in science and technology and the develop advanced engineering skills

and capabilities that have widespread application;

b) fundamental science is a UK strength and provides early sight and a knowledge base in advances that may have a major impact in the future;

c) applications of new advances in a sustained and well-coordinated manner is crucial for the UK's economic prosperity and for generating the returns needed to

pay for investment in the categories above and for continuing application development. The infrastructure needed to underpin such applications requires equipment and facilities for independent testing, validation, accreditation and demonstration of new technologies and systems.

It is hard to see that any one of the three categories should be less generously funded than the others without risking damage to the continuity and capabilities needed for UK scientific and economic success in research and innovation.

Do you believe the previous Labour government's 10 year approach was a success and how can we learn from this in the future?

Part of the previous Labour government's approach was to encourage universities to be more outward facing in regard to working with industry. There are numerous examples of where this has worked well.

In addition to this, towards the end of the last Government the Hauser Review paved the way for the creation of new technology & innovation centres, which resulted in the formation of Catapult Centres under the current Government. AIRTO has welcomed the way many of the Catapults have sought to engage and work with existing research and technology organisations (RTOs). Those such as the High Value Manufacturing (HVM), Connected Digital Economy (CDE), Satellite Applications Centres, and most recently the Transport Systems (TS) Catapult have all sought to engage with other established RTOs to share best practice. The UK's existing applied R&D community, into which the Catapults have entered is a long established and complex network, and it is essential that the foundations for good collaborations with existing RTOs are well laid. Inevitably the movement from setup phase to full operations has been slow as the Catapults have become established. The Centres have, by necessity, been inwardly focussed initially to become established, which could have been a potential barrier to early industry engagement. Generally the wider ranging a Centres' scope, the longer it can take to become established, understood and accepted by the wider innovation community. Our perception is that wider industry has been wary of competition, and

therefore finding their 'niche' in the innovation ecosystem has been a large, though perhaps not unexpected, challenge for the Catapults. This challenge is not unique to the Catapults. Like existing and long established RTOs the Catapults have had to carefully navigate a pathway to balance public and private revenue streams. Our perception is that industry wants more open access to the Catapults and their capabilities. Mechanisms to achieve this include using existing/ establishing new knowledge communities, to facilitate networking and engagement.

Much of what was done to encourage and fund r&d by the previous Labour Government was very good indeed, however as noted in the section above, whilst investment and concentration on the role of universities dominated and until the emergence of the Hauser review towards the end of the decade, the community beyond government providing risk mitigation services and technological support between TRLs 4 and 7 seems to have been largely ignored, to the detriment of the UK's capacity to exploit its excellent research (see also below).

How can we unlock greater levels of private sector investment?

Britain has numerous universities represented in the top 50 institutions world-wide, partly reflecting the strong level investment in early stage research (technology readiness levels 1-3), competing well against nations like Germany. However, fundamentally Britain has an R&D investment gap with competitor nations that can only be achieved if the UK does more to tackle the need for greater investment in mid-stage R&D (technology readiness levels 4-7). There are in reality two principal challenges within the end-to-end process of commercialising scientific and technological research that, taken together, constitute the so called 'valley of death'.

The first such area is the industrialisation of the research results themselves i.e. turning the outputs of work aimed at the generation of new knowledge into fully understood technology that will be capable of surviving and operating in the challenging user environments required by commercialisation. This adaptation to harsh user environments, such as those found on production lines, in transport systems, in the natural environment, in space, on the battlefield and even in the home, just to cite a few examples, is beyond the remit and capability of most university laboratories that often lack the requisite infrastructure. (RTOs on the other hand do often have access to requisite infrastructure and could be better utilised in this regard). Those engaged in commercialisation frequently do not discover what is unknown about the technology until they start the process of industrialisation. Additionally, in many instances, challenging cost targets for the eventual product or service have to be met. This is a risk both to those who are taking on the process and those who are financing it.

The second area of challenge is the process of defining and implementing a competitive business model and the execution of a viable business plan. The risks here include uncertainty over: eventual take-up in the marketplace, reaction from competitors, ability to assemble a management team and changes in general economic conditions, amongst other things.

The main difficulty in approaching the 'valley of death' is overcoming the perceptions of those financing a commercialisation (be that industry licensees, early stage venture capitalists, lenders or in-house "sponsors") that the risk of losing their investment is too great. This is frequently compounded by a significant communication barrier between innovators and investors (or those responsible for making investment decisions). The innovators frequently don't understand the language and fears of investors, particularly those from the private equity and venture capital domain, and the investors don't have the knowledge or tools to properly evaluate the development risks or market diffusion potential of innovative technology, unless it is pretty obvious.

Summarising the above, the main uncertainties creating such investor perceptions of risk for any given research-related commercialisation opportunity are generally that:

- the market need remains unproven;
- the intellectual property is not sufficiently protected or secure;
- the appetite for the proposed innovation in the supply chain providing the route to market is unclear;
- there is not a credible team to manage the commercialisation;
- expensive (and possibly unknown) technology development issues may remain which will have to be tackled and which will require additional time and finance to resolve;

- the very early stage investors may find themselves at significant risk of extreme dilution in later rounds of investment in a new venture. This is particular acute with long timescale developments, which are typical of, for example, the biotech sector.

These problems are compounded by:

- communication difficulties and lack of mutual understanding between innovators and investors;
- insufficient availability of financial resources to follow on from research with de-risking 'proof of concept' activities;
- insufficient availability of management expertise with experience in early stage commercialisation
- insufficient availability of financial resources to support skills development (including human resource skills) amongst aspiring entrepreneurs. This is a significant challenge given the variety of perceptions and attitudes found amongst researchers to commercialisation of their work;
- uncertainties over the size of investment required, the likely magnitude of the eventual return and the timescale required to obtain that return.

Such difficulties can be overcome by increasing efforts to raise levels of investor confidence prior to moving on to complete reliance on mainstream privately sourced development effort and finance. This can be achieved by:

- continuing the support provided through programmes such as the forthcoming Business Coaching for Growth programme from BIS, particularly the investment readiness and investor readiness components;
- increasing support for pre-commercial 'proof of concept', seed stage equity and loan funding (probably with a combination of public and private sector provision);
- making more use of post-research incubation capacity and assistance, especially that which facilitates access to harsh user environments, potentially available through RTOs (as recommended in the recently released BIS Research and Innovation Strategy), including the new Technology and Innovation Catapult Centres;
- reducing excessive dilution risks for very early stage investors by providing liquidity for such very early stage investments, particularly those in longer term developments, possibly through new specialist secondary funds. This will also avoid premature loss of support from public sector financing and avoid excessive dilution of early stage public sector investments, as experienced by previous Early Growth and similar government supported funds.

By taking the steps outlined in the above four bullet points and by continuing to provide financial incentives by means of r&d grants and tax credits, the Government can help to reduce risk and increase confidence in innovative developments to the point where private investment will take on more opportunities and thereby increase the level of private r&d spend as a percentage of the UK's GDP. Also, as noted earlier, public sector procurement and early adoption of innovative products and services will help to underpin investor confidence and increase the successful take up of venture capital by early stage companies.

Strengthening British science

What more can be done to improve the way science is driven by British universities?

Maintaining a strong science base in universities is essential to the future global competitiveness of UK plc. It should be understood that meeting requirements for research capital investment has the potential to support the long-term strength of the UK's skills base in science and technology, as well as delivering scientific discoveries and potential innovations of important economic significance. The right facilities, if provision is made to ensure they are well sustained and utilised, should be considered key to the development of advanced research skills to help the UK to remain globally competitive.

Consequently, as well as considering the equipment needs of the research itself, the capital budget for the HE estate should support the delivery of outcomes to business and industry in terms of access both to the equipment and the provision of graduates and postgraduates with knowledge of the equipment and facilities base and of the research that can be undertaken using it.

Examples of good-practice that model collaboration between HEIs and other organisations with mid-TRL level capabilities should be replicated. For example, Brunel University and TWI have collaborated (with other key academic institutions also) to establish a Structural Integrity Research Centre using HEFCE funding. This provides research facilities, alongside important post-graduate training opportunities that extend well beyond the Technology Readiness Levels (TRLs) of 1-3 usually provided for in a purely academic environment and right across levels 4-7. This is arguably a way for the UK to get a better return on investment by developing postgraduates with a broader and more commercially applicable skill set. RTOs and public sector research establishments (PSREs) are well placed to partner with Universities to achieve this.

Challenge led research should be encouraged and supported by the funding bodies (Research Councils and HEFCE) as it has the potential to develop collaboration both between universities, and between universities and the application communities in the Innovation Sector (including AIRTO members), public service providers and business. In order to emphasise relevance and the potential for impact, greater involvement of external innovation expertise and appropriate business people should be sought for peer review panels and to support activities and governance roles within universities. Finally, the balance of government research capital investment across 'blue skies' research, challenge led and mission oriented research and translational application activities (as referred to earlier) will have a helpful impact on ensuring that science is driven by the universities in the most useful direction for the UK.

What does the UK need to do more of to place science at the heart of government and policy making?

A stakeholder engagement approach to shaping policy is essential. This needs to encompass the full breadth of the UK's science and innovation landscape. The innovation component of that landscape should not be considered in isolation from the science component - they are part of a continuum that facilitates the translation of science into commercial technologies. This was part of the rationale behind the creation of the Catapult Centres.

A portfolio management approach should be deployed to invest in science and innovation across the priority areas that the UK has already committed to in recent years (i.e. those in the BIS industrial strategy and the 'Eight Great Technologies'). As part of this, opportunities for collaboration, equipment sharing, and industrial involvement should be core to the strategy for each area of investment.

Allocating resources, particularly those needed for development, testing and demonstration, should be concentrated on those organisations and establishments having large, established industry networks and the business processes that develop such networks. This is a key feature of RTOs and IROs which, alongside the Catapults, rely on such networks to deliver their services and goals. Data being obtained from a current study of the innovation sector by Oxford Economics shows IROs to be particularly well connected to industry in this manner. The Knowledge Transfer Networks should also be used to bring their networks into play to facilitate collaborations in key technology areas. Placing resource in RTOs and IROs will encourage collaboration through usage with universities and will assist in the transfer of knowledge and expertise to a wider industry base than can be reached from the university on its own, as is the case with the Catapults, but on a larger scale since more organisations will be brought into play.

It is important to consider carefully where advice on the portfolio management of investments is coming from. Peer Review is not always necessarily the best approach. The UK should look to models of portfolio management which have assembled skill sets based on experience and know-how (not merely representation of a relevant community). It is essential to incorporate transparency into the process. Sourcing expertise from the business community should be core to the Government's investment strategy. Business expertise can assist in managing uncertainty and help ensure the UK remains globally competitive.

Measures should always be put in place to ensure that vested interested (potentially both academic and private/commercial) do not dominate decision making processes.

Finally, it goes without saying that greater understanding of science and innovation, how it works, the issues involved and its impact on the economy and social wellbeing in the UK are vitally important. Both MPs and officials should be encouraged to interact with the science and innovation communities (and vice-versa) in order to obtain better mutual understanding, to be better able to develop and critique relevant policies and better able to manage public opinion where its influence is critical to important developments. The network of Chief Scientific Advisors is an asset and should be broadened and strengthened if at all possible. Its capabilities should be harnessed to assist with this task.

What more can the UK do to ensure that science is embedded in our international relationships? What steps would help deliver a joined-up approach to science that plans for the world of 2030?

Focussing very high cost infrastructure on international investment where no one nation can provide everything on its own, e.g. with big physics programmes, is the best way to approach global collaboration. The potential benefits of joining up UK investments with their equivalent centres overseas should always be considered an option. For example, the proposed investment in big data to link genotype with phenotype will be well served by linkage with research centres across the globe. However for such programmes to show a good return on investment, particularly given the time taken for research to translate into long-term solutions, capital expenditure must be balanced with sufficient operational expenditure. If the UK is to make large investments it is essential that these assets are heavily utilised, and that only occurs if adequate consideration is given to the source of operational expenditure as well.

Benefits of such collaboration include the impact that the UK's science contribution will have on the reputation of the UK overseas, the resulting 'soft power' and the attraction that is thereby generated for overseas businesses, researchers and students to want to work in the UK with and ultimately buy UK products and services. Such considerations should become part of UK foreign policy development in conjunction with BIS and other relevant government departments. It would seem sensible to suggest that the network of Chief Scientific Advisors should take on the task of joining up the global science picture where there are inter-departmental considerations. To ensure that there are incentives to act, appropriate departmental targets should be set, to embed science in international relationships (for FCO, BIS and other departments as relevant).

In considering major international projects it is important to achieve a good balance of projects that enable Britain to deploy its relative strengths in both science and engineering. At present, the projects identified in current consultations are weighted heavily towards using the UK's pure scientific capabilities. Valuable engineering opportunities may exist in collaborations which focus on challenging applications, future cities for example. They should also be included in this discussion. Significant business opportunity resides globally with large engineering projects supporting developing nations and there are a growing number of global thematic research clusters developing around these topics - the UK must be able to engage with these. This would require the extension of UK capabilities to ensure the outputs from research are state of the art. This particularly involves large infrastructure builds for the utilities (including civil nuclear energy) and transport and validation of structural methods, which require significant test and evaluation capabilities. The UKTI Large Value Opportunities programme seeks to identify those international projects which will ultimately offer significant UK business opportunities (>£250m), but they can also act as a catalyst for the exploitation of research outputs and the development of further research projects since many are 10+year programmes overall. This mechanism may act as a platform for developing links to overseas capabilities and other sources of leading edge research, at the same time connecting the UK science base to these clusters. It is not clear that the UKTI interface to the rest of BIS and other government departments works as well as ideally desirable for these purposes.

Another important task is to seek engagement with international projects designed to enable the public and private sector to join forces to tackle problems where there is a strong demand for innovation, but where a commercial market is still undeveloped. An example of this is the growing challenge of anti-biotic resistance. The increasing demand for new treatments for resistant infections is being heralded as a growing major threat to global health and prosperity. However the inherent need for carefully rationed use of any future new medicines emerging from R&D programmes limits the capacity to recover costs, and removes commercial incentive for industry to tackle the problem without public investment (including capital investment) being made. Through MRC investment in the last century, Britain rose to the challenge of tackling bacterial diseases and trail-blazed the discovery of penicillin and its translation into clinical practice, thereby transforming global human and animal health over subsequent decades; it is this kind of ambition and vision to apply science and engineering to global challenges that the UK must continue hold to maintain its position as a world-leading nation; provision must be made from capital budgets to support the necessary research and trials programmes.

<u>The Rungs on the Ladder</u>

What additional policy measures are needed to ensure the UK has a strong pipeline of stems skills? How can the UK ensure there are inclusive routes into stem careers?

AIRTO members build their businesses around the application of innovative ideas and technologies for a broadly defined client base. They are therefore particularly dependent on being able to recruit versatile scientists and technologists. Potential recruits must have an interest in both science and technology and its application both in business and elsewhere in the economy and society.

To develop a pipeline of potential talent, many members, including organisations like ARUP, AWE, BMT, BRE, MIRA, NPL and QinetiQ , already operate apprenticeship, graduate or postgraduate development schemes, and a number are involved in schools outreach, with most offering work experience opportunities and/or internships to young people. About half of AIRTO members work with higher education institutions to deliver training. Examples of this include TWI's Structural Integrity Research Foundation (with UCL and Universities of Brunel, Manchester and Cambridge), the BRE Trust (with Universities of Cardiff, Bath, Strathclyde and Edinburgh) and NPL's emerging metrology partnership with Universities of Surrey and Strathclyde. RTOs tend to have a very broad client base, which includes businesses from diverse sectors, industries of widely differing types and public sector organisations of various kinds, supported by extensive contacts with academia, financiers and funding bodies. This provides an ideal environment within which to develop a rounded skill set; only really large corporations are able to offer anything comparable, and then generally only in the context of tightly channelled commercial interests.

More Government intervention is needed to capitalise on the sector's capabilities to develop skills. A particular area of interest for AIRTO members is the skill set needed to work successfully on the commercialisation of research. This is an area where there is a clear shortage of people with the multiple skills, including the vitally important 'soft/people skills', needed to deal with this critically important challenge for the UK. An apprenticeship programme for such individuals ideally might comprise a series of secondments, each for a period of six to eighteen months, to academia, the finance sector, departments of government (such as BIS) and commercial industry, much along the lines of a traditional fast track graduate development scheme in a large enterprise. Such a scheme, or a suitable variation on the concept, would require financial support but would quickly produce a younger generation of multi-skilled practitioners ready to carry on the challenge of capitalising on the UK's strong research and innovation base. The sector would be very well placed to host this kind of programme, working in conjunction with their networks of commercial enterprises, universities and Government departments. This would capitalise on the vital role that the sector already plays in contributing to the development and retention of the UK's skills base by providing scientists, engineers and technologists with:

• professional development of talented graduates and PhDs;

• training through apprenticeships and internships

• defined career pathways

• job mobility

Engaging the RTO sector as a training partner at apprenticeship level and recognising the role the sector has to play in employability of the graduate workforce should be a central component of the government's strategy for better utilising the UK's assets for accelerating innovation.

More generally, attracting young people in to STEM related careers is important. Universities and industry/business are well represented in the public consciousness, but the roles played and work done in other parts of the Innovation Sector (in PSREs, and RTOs for example) have largely been overlooked by government for some time and have therefore dropped out of public view. This is true also of professional institutions, where the assumption is that the government is interested only in universities and industry and hence that is where their attention is focused also. The problem is exacerbated by the huge shrinkage in the number of large scale company r&d facilities that used to exist. The effect is to limit the public perception of the types and variety of STEM career opportunities potentially available. The government could usefully take steps to remedy this deficit with a campaign to explain the full range of establishments working in STEM related areas and the diversity of career opportunities available.

Issues around STEM skills are deliberated in further detail in AIRTO's Position Statement on Skills.

Declaration of interests

This submission is made by the Association of Innovation, Research and Technology Organisations (AIRTO). The organisation represents research 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 Ltd. is a company limited by guarantee registered in England No. 1217006, registered 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
AMRC
Animal Health and Veterinary Laboratories Agency (AHVLA)
ARUP
AWE
Axillium Research
BCIS (The Building Cost Information Service of the Royal Institution of Chartered Surveyors)
BHR Group
BM TRADA
BMT Group Ltd
BRE
BSRIA Ltd
Campden BRI
CIRIA
City University London
Connected Digital Economy Catapult
CPI
C-Tech Innovation Ltd
East Malling Research
FERA
FIRA
Fraunhofer UK Research
Fripp Design & Research
Health & Safety Laboratory
High Value Manufacturing Catapult
HR Wallingford
Institute for Sustainability
Leatherhead Food Research
LGC
Lucideon
Medilink
MIRA
MTC
NIAB
NNL
NPL
National Composites Centre
NNFCC
Nuclear AMRC
PA Consulting
PERA Technology Limited
QinetiQ Ltd
QUOTEC Ltd
Satellite Applications Catapult
SATRA
STFC
Smith Institute
Thames Innovation Centre Ltd
Thatcham
The Scotch Whisky Research Institute
Transport Systems Catapult Ltd
TWI Ltd
University of Greenwich
University of Surrey
WMG

[1] Study of the impact of the Intermediate Research and Technology Sector on the UK Economy; Oxford Economics, May 2008
[2] Innovation and Research Strategy for Growth; BIS, December 2011