



House of Commons
Science and Technology
Committee

**Technology and
Innovation Centres**

Second Report of Session 2010–11

*Volume I: Report, together with formal
minutes, oral and written evidence*

*Additional written evidence is contained in
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The Science and Technology Committee

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Summary

The need to support innovation and the translation of scientific advances and ideas into products for the benefit of the UK economy and society has long been recognised. Previous initiatives, including the Faraday Partnerships, have been unsuccessful. Both Government and the Technology Strategy Board (TSB) have assured us that they have learnt from history and the new Technology and Innovation Centres (TICs) will not repeat the mistakes of the past.

Initial signs are encouraging. The TICs initiative has been broadly welcomed by all who contributed to this inquiry and all recognise that it is imperative that TICs build on the existing expertise in research centres working on technology and innovation, many of which have been funded in part by the Regional Development Agencies.

The TSB will identify those existing centres in the UK that will become TICs. The primary criterion must be the quality of the science and the economic benefit to the UK.

We do not expect all TICs to carry out the full range of activities set out in the TSB's TICs prospectus. Each TIC should adapt to the needs of the sector it is supporting—by setting a clear vision, defining its objectives and outlining its method of operation—quickly and responsively. This should be developed in conjunction with business and academia. We are attracted to a hub and spoke model to spread the economic benefit of TICs throughout the UK, providing that a mechanism is put into place which clearly recognises and empowers the hubs to provide leadership to the spokes.

One of the problems with the Faraday Partnerships was the lack of reliable core funding. The promise of £200 million core funding over the next four years from the Government is an acceptable foundation for the TICs initiative in the current economic climate. It is important that the money is not spread too thinly and we consider that an initial target of six to eight centres to be sensible. However, the level of public funding should be reviewed regularly, in order to increase investment in areas where the results justify it. Beyond the medium term the Government should investigate an innovation endowment fund and it should seek a cross-party commitment that gives confidence to the TICs, business and investors.

Funding sources should also remain in balance and TICs should have a clear objective to follow the “one third, one third, one third” funding model, that is one third public funding, one third competitive public-private sector funding and the final third from private sector contracts. There should be a cap on the amount of private sector funding each TIC can access in a given year, as this will promote a more creative approach to innovation. We recognise that it may take some time to achieve, especially where Government funding is required to establish new centres that need to build a reputation with business. However, attaining and maintaining this funding model is a good measure of the performance of individual TICs in the medium to long term.

We are concerned by the possible effects of the TICs initiatives on the wider funding activities of the TSB. TSB grants will form a part of the funding for TICs and other centres through open competitions. While it is inevitable that TSB competitive grants will be in

line with the priorities of TICs, it is important that the limited funds for innovation are not monopolised by the TICs. Funding for innovation must be available to those outside TICs, as their work may be the basis of TICs of the future.

One other concern was the lack of knowledge in the business world regarding existing UK capabilities. Businesses will benefit from an online catalogue, maintained by the TSB, of centres that are ready and willing to work with business, in particular SMEs, in specific technology areas.

We recommend that the network of TICs be called “Turing Centres”, after the founder of computer science, Alan Turing. We consider that this country owes him a debt of obligation for the way in which he was treated. It is important, however, to remember that it will take time for TICs to build a reputation. The brand and reputation must be well managed by the TSB.

The TSB has made a good start in outlining the concept of TICs in its prospectus. We have made a number of recommendations based on the evidence we have received, which we hope will prove useful to the TSB as it produces a detailed strategy and implementation plan.

1 Introduction

Background

1. On 9 March 2010, James Dyson published a report, *Ingenious Britain*, commissioned by the Conservative Party. The *Dyson Report* set out a number of proposals to make Britain the leading high tech exporter in Europe. The report had five themes:

- i. Culture: developing high esteem for science and engineering
- ii. Education: getting young people excited about science and engineering
- iii. Exploiting knowledge: collaboration, not competition between universities, companies and not-for-profits
- iv. Financing high tech start-ups: turning good ideas into world beating products
- v. Supporting high tech companies: creating the right conditions for R&D [research and development] investment.¹

Within the “exploiting knowledge” theme, the *Dyson Report* included the proposal that “new university/industry research institutions capable of becoming centres of excellence in a particular research field should be given Government sponsorship”.²

2. A few weeks later, Dr Hermann Hauser published a report, *The Current and Future Role of Technology and Innovation Centres in the UK*, commissioned by the then Labour Government. The *Hauser Report* looked in greater detail at how the UK could learn from other countries’ innovation networks. It proposed that the UK develop “an elite group of Technology and Innovation Centres [...] that aim to exploit the most promising new technologies, where there is genuine UK potential to gain competitive advantage”.³

3. Both reports acknowledged the strength of the UK’s science base as second only to the United States whilst highlighting that there was a need to do more to capitalise on research by the commercialisation of ideas. The *Hauser Report*, in particular, argued that closing the gap between universities and industry was integral to creating a “knowledge-economy” and that “other countries benefit greatly from a translational infrastructure that bridges this gap”.⁴

International comparisons

4. The *Hauser Report* explored the role of Technology and Innovation Centres (TICs) in 12 countries: Germany, South Korea, Sweden, France, China, Denmark, USA, Japan, Singapore, Israel, Belgium and the Netherlands. It summarised its findings:

1 James Dyson, *Ingenious Britain: Making the UK the leading high tech exporter in Europe*, March 2010, p 4–5

2 *Dyson Report*, p 38

3 Department for Business, Innovations and Skills, *The Current and Future Role of Technology and Innovation Centres in the UK: A report by Dr Hermann Hauser*, March 2010, p 1

4 *Hauser Report*, p 1

The specific role of TICs varies according to the innovation system and economic and social landscape of the countries they operate in.

However a shared rationale exists for developing TICs that bridge the gap between academic discovery and commercial exploitation.

It is common for TICs to be focused on sectors or technologies which capitalise on local and national strengths rather than have a wider spread of institutes in many technology or sectoral fields.

Most [TICs] benefit from long-term, sustained and predictable flows of public funding, although the level and type of funding varies significantly.

The workforce is recruited from the academic and private sector and possesses research, technology development and commercialisation skills.

The TICs are expected to supplement core funding by winning additional income from public and private sector contract research, and through the commercialisation of IP [intellectual property].

Strong governance structures are in place in many [TICs] to provide strategic direction and ensure the quality of services provided to business.

Almost all operate with a high degree of autonomy to manage the achievement of their objectives.

A strong brand has been found to reinforce a TIC or network of TICs by making them a more attractive partner to the private sector and for international collaborations.

International collaborations are widely undertaken with many within the EU, leveraging significant funding from the Framework Programme.⁵

5. The German model of Fraunhofer Institutes is often referred to as one of the most successful examples of a national network of TICs. From our inquiry we established that it had many of the characteristics summarised in the *Hauser Report*. The Minister of State for Universities and Science, Rt Hon David Willetts MP, took the view in his first appearance before our Committee on 22 July 2010 that Fraunhofer Institutes “have been a key part of Germany’s success in advanced manufacturing and high grade engineering”.⁶

Our inquiry

6. On 20 October 2010, the Chancellor of the Exchequer announced in the Spending Review that the Government would provide support for manufacturing and business development, including funding for “an elite network of research and development

5 *Hauser Report*, p 8

6 Science and Technology Committee, Session 2010–11, *Setting the scene*, HC 369, Q 54

intensive technology and innovation centres”.⁷ That same day, our Committee announced an inquiry into TICs, issuing a call for evidence on the following questions:

- What is the Fraunhofer model and would it be applicable to the UK?
- Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?
- What other models are there for research centres oriented toward applications and results?
- Whose role should it be to coordinate research in a UK-wide network of innovation centres?
- What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?

7. We received 85 submissions in response to our call. We would like to thank all those who submitted written memoranda.

8. During December 2010 and January 2011, we took oral evidence from four panels of witnesses, to whom we are grateful:

- i. Dr Tim Bradshaw, Head of Enterprise and Innovation, Confederation of British Industry (CBI); Professor Ric Parker, Director of Research and Technology, Rolls-Royce Group; Dr David Bembo, on behalf of the Association for University Research and Industry Links (AURIL) and Universities UK; and Patrick Reeve, Chair of the Venture Capital Public Policy Committee, British Private Equity and Venture Capital Association (BVCA);
- ii. Pam Alexander, Chief Executive of the South-East England Development Agency (SEEDA), for the Regional Development Agencies (RDAs); Professor Richard Brook, President, Association of Independent Research and Technology Organisations (AIRTO); Professor Nigel Perry, Chief Executive, Centre for Process Innovation Ltd (CPI); and Professor Keith Ridgway, Research Director, Advanced Manufacturing Research Centre (AMRC);
- iii. Iain Gray, Chief Executive, Technology Strategy Board (TSB); and
- iv. Rt Hon David Willetts MP, Minister of State for Universities and Science.

9. We also supplemented our evidence with a short visit to Berlin, Germany (7-8 December 2010) in order to: explore the German research and technology and innovation institutions, including Fraunhofer, Helmholtz and Leibniz centres; identify best practice for fostering innovation and the commercialisation of research; and learn about the funding and coordination of applied research in Germany. We would like to thank all those individuals and organisations that took the time to meet with us during our visit.

7 HM Treasury, *Spending Review 2010*, October 2010, Cm 7942, p 52

2 The UK innovation landscape

UK public-private funded research centres

10. Research and Technology Organisations (RTOs) is the term given to “specialised knowledge organisations dedicated to the development and transfer of science and technology to the benefit of the economy and society”.⁸ A number of independent RTOs existing in the UK today can be traced back to the Research Associations (RAs) of the 1920s–1940s, which were set up to access Government funding from the then Department of Scientific and Industrial Research and private funding from industry. RTOs now “operate on both a commercial and not-for-profit basis with a focus on more routine and commercially lucrative laboratory and technical consultancy services, as a result of gradual withdrawal of public funding from Research Associations”.⁹

11. Bodies both inside and outside of Parliament have been concerned about innovation and the transfer of science for the benefit of the UK economy and society for a number of years—for example, our predecessor Committee published a report in 1994, *The routes through which the science base is translated into innovative and competitive technology*.¹⁰ The UK began to explore an equivalent to the German Fraunhofer model with Faraday Partnerships in the 1990s. This initiative suffered from poor support from industry,¹¹ a “piecemeal approach” and a “variety of governance models”.¹² Professor Richard Brook, President of the Association of Independent Research and Technology Organisations (AIRTO), explained to us that Faraday Partnerships “started up in a very uneven way”.¹³ He said that the Engineering and Physical Sciences Research Council (EPSRC) provided some ring-fenced research money but the then Department of Trade and Industry “did not find the budget to provide what would be the core funding”, and that when the ring-fenced money was used up, the Faraday Partnerships had to apply for peer-reviewed research grant funding “along with everybody else”.¹⁴ Professor Brook added: “as industry wanted to pull research towards the applied end, the scores that were being obtained from the peer review system progressively got less”.¹⁵ This suggests that it became increasingly difficult for Faraday Partnerships to access public money as they shifted towards carrying out research that industry was more interested in paying for.

12. Rt Hon David Willetts MP, the Minister of State for Universities and Science, acknowledged that one of the lessons learnt from the experience of Faraday Partnerships was “that you do need reliable core funding”.¹⁶ Iain Gray, Chief Executive of the

8 “About RTOs: Research and Technology Organisations”, *European Association for Research and Technology Organisations website*, www.earto.eu/about-rtos

9 Ev 37 (Department for Business, Innovation and Skills), para 15

10 Science and Technology Committee, First Report of Session 1993–94, *The routes through which the science base is translated into innovative and competitive technology*, HC 74-I

11 Ev 50 (Advanced Manufacturing Research Centre)

12 Ev 40 (Association of Independent Research and Technology Organisations), para 2.8

13 Q 43

14 *As above*

15 *As above*

16 Q 119

Technology Strategy Board (TSB), also recognised that previous initiatives had not been focussed enough and “money that was invested was perhaps spread too widely, too thinly”.¹⁷ One other point made by Mr Willetts was that “having a physical centre with physical kit that is of particular value to SMEs [...] at the core of the new centres is [also] quite important”.¹⁸

13. We are reassured that both the Government and the Technology Strategy Board (TSB) appear to have drawn on history to identify the problems with previous initiatives, such as the Faraday Partnerships.

Recent Government sponsored interventions

14. The Faraday Partnerships were replaced by the “more limited knowledge exchange focussed activities of the Knowledge Transfer Networks (KTNs) from 2004”.¹⁹ KTNs are one of a number of core Government sponsored business support interventions, managed by the TSB:

- i. **Collaborative Research and Development** (designed to assist the industrial and research communities to work together on R&D projects in strategic areas);
- ii. **Knowledge Transfer Networks** (national networks, in specific fields of technology or business application, which bring together people from businesses, universities, research, finance and technology organisations in order to stimulate innovation);
- iii. **Knowledge Transfer Partnerships** (the placement of a high calibre, recently qualified individuals into a business to work on innovation projects); and
- iv. **Small Business Research Initiative** (uses Government procurement to drive innovation by bringing innovative solutions to specific public sector needs and engaging a broad range of companies in competitions for ideas that result in short-term development contracts).²⁰

Existing centres in the UK

15. AIRTO explained that the UK network of applied research centres currently comprised organisations based on a range of business models:

Public Sector Research Establishments (e.g. National Physical Laboratory).

University “spin offs” (e.g. Warwick Manufacturing Group, Advanced Manufacturing Research Centre).

17 Q 82

18 Q 119

19 Ev 40 (Association of Independent Research and Technology Organisations), para 2.8

20 “Delivering Innovation”, *Technology Strategy Board website*, www.innovateuk.org

Independent Research and Technology Organisations configured as companies limited by guarantee or charities, governed by industry (e.g. Building Research Establishment, Campden BRI, The Welding Institute).²¹

Privately owned, commercial research and development organisations (e.g. QinetiQ, Cambridge Consultants, PA Technology).

Corporate research functions and laboratories (e.g. Arup, Tata, IBM, GSK).²²

16. In recent years, the Regional Development Agencies (RDAs) have funded over 60 centres promoting regional economic growth.²³ The RDAs funded four types of centres:

- i. **Technology push centres**—for example, the Printable Electronics Technology Centre;
- ii. **Industry demand centres**—for example, the Advanced Manufacturing Research Centre;
- iii. **Centres to link research and business**—for example, the Knowledge Centre for Materials Chemistry; and
- iv. **Geographical centres**—for example, the Harwell Science and Innovation Campus.²⁴

17. Dr Tim Bradshaw, Head of Enterprise and Innovation at the Confederation of British Industry (CBI), told us that many existing centres in the UK were supported by RDA money. He explained that “there is a danger, with the RDA money disappearing, that some of the excellent centres that we’ve got working at the moment will find themselves with the best staff wanting to leave”.²⁵ Dr Bradshaw added:

Their funding is likely to run out in March [...] once you start to get that climate of uncertainty within those organisations, you start to have problems. I urge the Government to look at this and think about how we can make sure that those centres remain stable in the short term.²⁶

18. When we asked the Minister what could be done to stabilise existing centres in the short-term, he replied: “we are working flat out on what should happen to the assets and activities for which RDAs have been responsible. There are some that could become the core of a Technology Innovation Centre”.²⁷

19. We expect that some existing research centres that are part funded by the Regional Development Agencies (RDAs) may become a part of new Technology and Innovation

21 Others would include EA Technology

22 Ev 40 (Association of Independent Research and Technology Organisations)

23 Ev 37 (Department for Business, Innovation and Skills)

24 Ev 56 (Regional Development Agencies), paras 29–37

25 Q 2

26 Q 3

27 Q 126

Centres (TICs), but many will not. There is a risk of losing much of the expertise built up with public resources over recent years. The Government should have, by now, set out further details of what will be done to support existing centres that are losing RDA money in March 2011. The Government should ensure that in the short-term any changes do not reduce the overall research and development spend in the regions. In the long-term it should be the Government's objective to increase the overall research and development spend at both the regional and national level.

Coordination of existing UK capabilities

20. The *Hauser Report* highlighted that the approach taken to date in the UK “does not currently have clear prioritisation, long-term strategic vision, or coordination at a national level”.²⁸ The Government acknowledged that “the mechanisms for identifying the sectors or technologies which would benefit from such support have had no formal role for [the TSB] despite its role to develop and deliver a national technology strategy”.²⁹ Dr Bradshaw, from the CBI, considered that nobody “really knows” what already existed in the UK, that is, “where the potential centres are and what areas they are in”.³⁰ Dr Bradshaw highlighted that this was particularly a problem for small and medium enterprises (SMEs):

SMEs, in particular, often do not know where the best facilities are that they could go and tap into, where there is research going on from which they can benefit and where there is best practice from which they could learn. Part of setting up the TIC model ought to be to try to work out a better model of getting that information out to the community that might actually want to use this.³¹

21. Dr David Bembo, who provided evidence to us on behalf of the Association of University Research and Industry Links (AURIL) and Universities UK, explained:

In carrying out a mapping exercise I think it might be helpful to identify some of the existing centres, the existing investments, which do and can work with industry from a university base very successfully, which may not need to be augmented or have their funding added to through this process, but which could be catalogued and their presence and willingness to work with industry could be better advertised to the private sector.³²

22. Professor Brook, from AIRTO, indicated that it was his understanding that the TSB intended to “understand the map of capabilities” of what already exists against the UK strategic needs. He added that “the TICs should fill in and provide what is missing. It may well be that the main role is to connect up a number of existing organisations in a hub-and-spoke model³³ [...] more effectively to the supply chain”.³⁴

28 *Hauser Report*, p 22

29 Ev 37 (Department for Business, Innovation and Skills), para 18

30 Q 4

31 Q 27

32 Q 4

33 See paragraph 46 for a definition of the hub and spoke model.

34 Q 46

23. Iain Gray told us that the TSB had identified “a long list of nearly 100 centres around the UK” and that there are probably a couple of dozen that are currently operating at a “reasonably good regional, maybe even national, level” but that the aim of the TICs programme was to identify six to eight “that can operate on a world stage”.³⁵

24. It is imperative that TICs build on existing centres and expertise. We found a lack of knowledge in the business world regarding existing UK capabilities. In assessing potential TICs, the TSB has already identified a list of nearly 100 centres operating in the UK. We recommend that the TSB maintain a public list in the form of an online catalogue of centres that are ready and willing to work with business, in particular SMEs (small and medium enterprises), in specific technology areas.

3 The role of a Technology and Innovation Centre

Managing expectations

25. The Government told us that the role of the Technology and Innovation Centres (TICs) would be “to support business activity focused on the development and commercialisation of new technologies that originate in the research base and for which there is business demand”.³⁶ This will be achieved through:

- conducting in house R&D [research and development];
- providing access to skills and equipment which might not otherwise be within their reach;
- helping to scale up manufacturing processes and producing technology demonstrators;
- helping to develop value and supply chains;
- informing businesses about the potential of new technologies; and
- helping early-stage SMEs [small and medium enterprises].³⁷

26. Iain Gray, from the Technology Strategy Board (TSB), explained that the TIC was quite a “specific concept”. It is a physical centre which may be co-located at more than one location.³⁸ He explained that “the concept of a Technology Innovation Centre [...] is to provide funding into something that can provide longevity in terms of world-leading skills and world-leading equipment and that provides capability to which smaller companies can’t otherwise afford access”.³⁹ Mr Gray added that other centres, which were not TICs, would continue to exist and fulfil their own specific roles. He cited as an example “Innovation Knowledge Centres, which are focused more at the science and research end, working with universities”.⁴⁰

27. The TSB described what a TIC would do in more detail in its prospectus. A TIC would:

- provide businesses with access to world-leading technology and expertise;
- reach into the knowledge base for world-leading science and engineering;
- be able to undertake collaborative applied research projects with business;
- be able to undertake contract research for business;

36 Ev 37, para 5

37 *As above*

38 Q 87

39 Q 88

40 Q 87

- be strongly business-focused with a highly professional delivery ethos;
- create a critical mass of activity between business and the knowledge base; and
- provide skills development at all levels.⁴¹

28. The TSB's prospectus also states a desire for TICs to "attract work from a wide cross section of businesses ranging from multinationals to small businesses".⁴² Iain Gray confirmed that SMEs are "at the very heart of" TSB thinking in terms of how to provide a facility with equipment and skills that SMEs can access.⁴³ **We welcome the assurance from the TSB that SMEs are at the very heart of TSB deliberations on TICs in terms of how to provide facilities with equipment and skills that SMEs can access.**

29. Dr Tim Bradshaw, from the Confederation of British Industry (CBI), noted that "the critical thing that [TICs] shouldn't do is to be involved in teaching basic research, policy development and things like that".⁴⁴ Professor Ric Parker, Director of Research and Technology at Rolls-Royce, agreed, stating that TICs should not be set up as teaching and skills centres. He explained that "if the centres are working well they will generate the skills by default".⁴⁵

Technology push versus market pull

30. Technology Readiness Levels (TRLs) are a technology management tool that provide a measurement to assess the maturity of evolving technology.⁴⁶ The Government told us that TICs will "primarily operate at TRLs 4 to 7, bridging research and technology commercialisation and de-risking this process for business".⁴⁷

41 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 5

42 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 4

43 Q 98

44 Q 10

45 *As above*

46 A full definition of TRLs is given in Annex 1 to this Report.

47 Ev 37, para 4

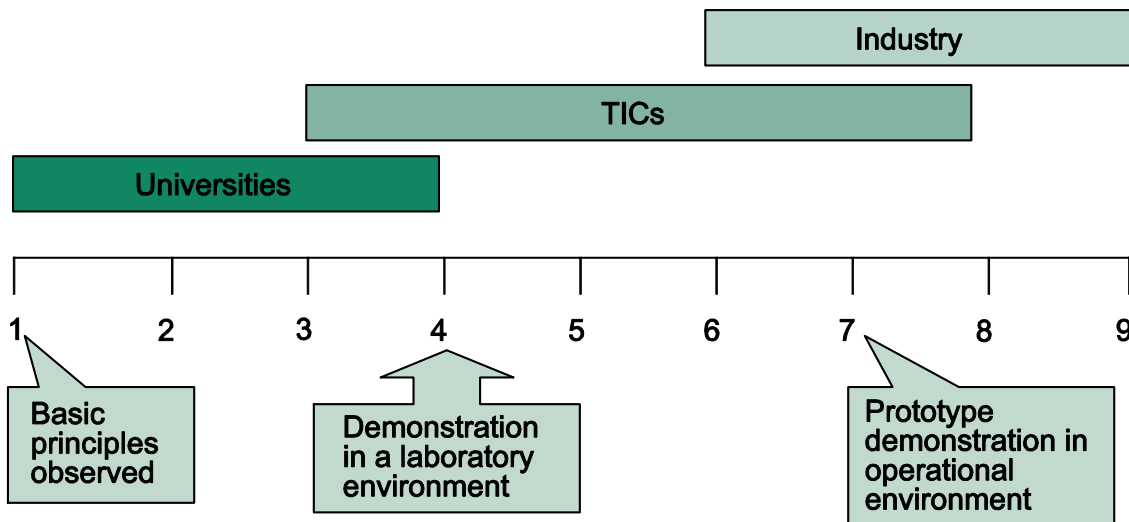


Figure: Technology Readiness Levels⁴⁸

31. Iain Gray told us that, in terms of TSB’s overall strategy, “over the last three years, we have worked consistently towards more of a pull [with] the emphasis [on] commercialisation and looking at it from a business pull perspective”.⁴⁹ However, he noted that approximately 80% of the TSB’s existing collaborative R&D programmes had involved universities to some degree.⁵⁰

32. Patrick Reeve, from the British Private Equity and Venture Capital Association (BVCA), suggested that there was an important role for universities to play in relation to TICs. He explained the idea of TICs being “a nexus”:

universities [would] use it as a tool for increasing commercialisation of their early-stage proof-of-concept research, and [...] commerce [would use it] as a testing ground and a source ground [...] of new ideas for business areas.⁵¹

33. The need for a combination of technology push from the research base and market pull from business was also expressed by AIRTO and the Centre for Process Innovation Ltd (CPI).⁵²

34. The benefits of a technology push model were highlighted in a written submission by Icon Medical Technology Development, a global consulting company, as the process by which innovation can occur in its “highest impact mode”, that is, with the development of “disruptive” new ground-breaking technologies, rather than incremental improvement to existing ones.⁵³

48 Ev 37 (Department for Business, Innovation and Skills)

49 Q 96

50 As above

51 Q 9

52 Q 56

53 Ev w211

35. Others, for example the Advanced Manufacturing Research Centre (AMRC), considered that the emphasis of TICs should be more on market pull. This was a view shared by the CBI; Dr Tim Bradshaw expected the TICs to operate closer to market.⁵⁴ He explained that “the focus [of TICs] ought to be on development, demonstration, pull through to commercialisation and all the things that are required around that space”.⁵⁵ The Judge Business School, University of Cambridge—which has been working on a project to examine how academic research in the physical sciences could be commercialised more effectively—also took the view that TICs should be commercially driven.⁵⁶

36. We found not only when we visited Germany but more widely that the Fraunhofer Institutes were seen as straddling effectively the gap between universities and business. However, the Manchester Institute of Innovation Research (MioIR), Manchester Business School told us:

the Fraunhofer institutes do not so much transfer knowledge from university to industry [...] Rather, Fraunhofer institutes generate relevant application-oriented knowledge themselves on demand from their clients. While this may often be strongly linked to research in universities (many leading scientists at Fraunhofer institutes are active also in universities), it nevertheless constitutes a knowledge creation sub-system of its own.⁵⁷

MioIR suggested that the Fraunhofer model only worked in areas with clear industrial demand, a willingness to pay and an ability to absorb advanced technological knowledge. Furthermore, Fraunhofer Institutes tended, in MioIR’s view, to reinforce industrial strengths rather than build up entire new technologies; they transferred knowledge from the university science base only very indirectly.⁵⁸ MioIR implied that they work more on a market pull than technology push model.

Articulating a clear vision

37. Given the breadth of activities and objectives, set out in paragraph 27, in which a TIC could be involved, there is the potential for the centres to mean very different things to different people. Durham University told us:

The TICs need to determine whether they wish to focus on a bilateral relationship with industry, occasionally using university research groups as partners and using joint university-TIC positions to provide strong collaborative links or to focus on providing the bridge between university research and industry. The two processes and activities are very different and the funding models therefore need to differ. In the former model, a funding structure not hugely dissimilar to that operated by the TSB would work well [...] In the latter, early stage venture funding must play a role as industry is loath to invest significantly in technologies at readiness level [TRL] 4.

54 Q 9

55 Q 10

56 Ev w38

57 Ev w15, para 7

58 Ev w15, para 8

Most importantly, the TICs must not try and fulfil both functions using a single funding methodology.⁵⁹

We will return to funding issues later in this report. However, it is clear that in order to avoid confusion a clear description of the exact role of TICs must be determined. University College London (UCL), in its written memorandum, summarised the issue succinctly:

If for example the principal role of the TIC is to develop technology that supports external businesses and enhances their competitiveness then that suggests a heavy bias toward a service provision for industry. If however there is a strong desire to commercialise/exploit intellectual property to generate new products then this would suggest a different balance of developmental/translational research vs contract research and service provision.⁶⁰

38. The same approach may not fit every sector. As the Russell Group explained, “different TICs may [...] need to adopt different approaches or mixes of activities, depending on the area of technology [each TIC] covers—a one size fits all approach will not be appropriate”.⁶¹ The TSB itself recognises this and told us: “every technology area and market operates in a slightly different way and therefore the best approach for a centre to help address the barriers to adoption of new technologies by business will be different in each area”.⁶²

39. The AMRC attributed much of its success as a centre to its “clear vision”.⁶³ Professor Nigel Perry, Chief Executive of CPI, agreed, stating that centres need “a constant strategic vision”.⁶⁴

40. In his evidence to us, Iain Gray quickly emphasised that the planned network of TICs was merely one tool in TSB’s innovation toolbox:

The Technology Innovation Centres initiative is not an initiative that sits over in right field on its own. It’s very much part of an integrated landscape. It is one of the tools that has been identified as being a gap in that landscape. It sits alongside tools like collaborative R&D funding, public sector/private sector funding into joint collaborative R&D proposals, Government procurement tools, particularly tools like SBRI, the Small Business Research Initiative, and other tools like Knowledge Transfer Partnerships and Knowledge Transfer Networks.⁶⁵

41. We expect the method of operation of each TIC will adapt to, and therefore vary, to meet the needs of the sector it is supporting. For example, TICs operating in sectors which focus on service provision for a particular industry may operate at higher

59 Ev w11, para 7

60 Ev w48, para 3.2.1

61 Ev w153, para 1.7

62 Ev 62, para 16

63 Q 48 (Professor Ridgway)

64 Q 49

65 Q 81

Technology Readiness Levels than others. The key issue is that each TIC will need to make the best use of existing resources in the sector. It follows that the work carried out in a TIC should reflect both the history of research in the sector it serves as well as an assessment of future demand within that sector.

42. We welcome the list of activities and objectives the TSB has set for TICs in its prospectus. However, it is not reasonable to expect all TICs to carry out the full range of activities. Each TIC should adapt to the needs of the sector it is supporting—by setting a clear vision, defining its objectives and outlining its method of operation—quickly and responsively. This should be developed in conjunction with business and academia. Furthermore, for the purpose of clarity, each TIC should set out the specific activities it will, and indeed will not, engage in.

The regional agenda

43. In the past, the nine Regional Development Agencies (RDAs) and the three Devolved Administrations (DAs) have selected innovation priorities, with the advice of their Science and Industry Councils within each area.⁶⁶ The priorities of each are set out in Annex 2.⁶⁷

44. The RDAs told us:

The location of TICs will be critical as TICs will build relationships with organisations at different spatial levels. While all the TICs will need to develop an international reputation, they will also need to work with local organisations, including small and medium enterprises (SMEs) and local authorities, and across the UK with relevant businesses, universities and public bodies. A hub and spoke model is likely to be of most benefit to achieve this.⁶⁸

45. Others took a different view. Imperial College London considered that “a national TIC strategy should not be used as an instrument of social policy. A regionally focused approach will dilute funding and is unlikely to ensure that TIC locations will resonate with industrial need.”⁶⁹ Others, such as Birmingham City University, advocated regional institutes concentrating on two or three key areas of regional strength.⁷⁰

The hub and spoke model

46. The RDAs have used a “hub and spoke” approach to existing centres. This combines a strong hub as the focus for new activity, with relevant research spokes across the UK. These links operate in both directions, with spokes offering an access point to the hub for local businesses, particularly SMEs, across the UK. This helps to include all areas of the country in Government investment.⁷¹ Pam Alexander, Chief Executive of the South-East England

66 Ev 56 (Regional Development Agencies), paras 51–53

67 Annex 2 is drawn from Technology Strategy Board, *Accelerating business innovation across the UK*, February 2010, p 9

68 Ev 56, para 5

69 Ev w92, para 16

70 Ev w6, para 11

71 Ev 56, paras 41–42

Development Agency (SEEDA), explained that “we need to create hubs and spokes [...] that make the best of all of the resources that we have [...] we should focus on the hubs that are the Technology Innovation Centres, but have them very well networked into centres of excellence across the country”.⁷² She added that this model worked well with renewable energy in the north-east linked to opportunities in the south-west and Daresbury, which was well connected to Harwell.⁷³

47. When we asked Rt Hon David Willetts MP, the Minister of State for Universities and Science, whether a TIC could have multiple locations, he replied that he had discussed the hub and spoke model with the TSB and that, while it might not be an appropriate model for every TIC, they seemed to be “strongly attracted” to it.⁷⁴ The Minister added that the key criterion for identifying the location of TICs had to be excellence.⁷⁵ He told us:

I don’t think that we or the TSB can plan this as an arm of regional policy. I very much hope, especially with this hub and spoke model and the Knowledge Transfer Networks that the TSB have, that the benefits of these [centres] reach out across the UK as a whole.⁷⁶

Iain Gray also confirmed “there is not a regional allocation aspect to [TSB’s] agenda”.⁷⁷

48. Other organisations, such as the National Nuclear Laboratory and the University of Manchester’s Dalton Nuclear Institute favoured the hub and spoke model.⁷⁸ The National Composites Centre (NCC) supported a hub and spoke model “where a number of current centres work in the same topic area”.⁷⁹ To us this implies that newly built centres for which there is no current UK capability may be less likely to benefit from the hub and spoke model. The NCC advised that “it needs to be clear which centre is the hub, and it [the hub] should be empowered through funding control and other means, to ensure it can operate this way and provide overall leadership of the cluster”.⁸⁰

49. Other organisations were against the hub and spoke model. Durham University, for example, described this “inadequate” model as “suffer[ing] from poor and slow communication [...] unfit for the necessary rate of communication across science and technology areas, and the rapid building and reforming of multidisciplinary teams that the emerging science based technologies demand”.⁸¹

72 Q 53

73 Q 55

74 Q 120

75 Q 125

76 *As above*

77 Q 94

78 Ev w24, para 9

79 Ev w112, para 26

80 *As above*

81 Ev w11, para 5

Local Enterprise Partnerships

50. The successors to the RDAs will be the Local Enterprise Partnerships (LEPs). In the past, the RDAs played a role in funding research and innovation. We asked the Minister to clarify what role the new LEPs would play in relation to TICs. He told us:

The TICs are national centres, but I hope one thing that LEPs will bear in mind, if it is an activity in which a particular area is strong at, is that they are absolutely candidates for having a peripheral operation or getting plugged into the Technology Innovation Centre in some way. We think the initiative for that will lie with the Local Economic Partnerships.⁸²

51. We wished to establish whether, as a consequence of RDAs being replaced with LEPs, the DAs would have an advantage in determining regional innovation priorities and the location of the TICs. Iain Gray told us that the TSB has “put in place a process that we believe engages business across the UK. It engages trade organisations across the UK that have different regional aspects. I believe that we are getting the right regional input into our decision-making process”.⁸³

52. We appreciate that in locating the TICs the TSB and the Government must be careful not to compromise economic objectives. In an ideal world, there would be a good regional spread of centres, but this may not happen. The primary objective—when the TSB identifies which existing centres in the UK will become TICs—must be the quality of the science and the economic benefit to the UK. We consider that a hub and spoke model is useful in connecting existing centres working on similar areas, across the country. This model will be a good way to spread the economic benefit of TICs throughout the UK. Where the hub and spoke model is used, we would like the TSB to put into place a mechanism by which the hubs are clearly recognised and empowered so that they can provide leadership to the spokes. Where existing capabilities do not exist and new centres are required, it may be more appropriate for the TSB to consider regional strengths as set out in the regional innovation priorities table (see Annex 2).

Identifying candidate areas

53. The TSB’s TICs prospectus draws on the *Hauser* and *Dyson* reports in identifying the criteria that potential centres will need to meet, in order to become a TIC and secure funding. These criteria are that:

- the potential global markets which could be accessed through the centre are predicted to be worth billions of pounds per annum;
- the UK has world-leading research capability;

82 Q 127

83 Q 95

- UK business has the ability to exploit the technology and make use of increased investment to capture a significant share of the value chain and embed the activity in the UK;
- technology and innovation centres can enable the UK to attract and anchor the knowledge intensive activities of globally mobile companies and secure sustainable wealth creation for the UK; and
- technology and innovation centres should be closely aligned with, and essential to achieve, national strategic priorities.⁸⁴

54. Based on these criteria, the TSB expects to assess proposals for potential centres. In the first phase for centres coming into existence in 2011–12 (a second phase of centres is planned for 2012–13) the TSB proposes to select up to three or four centres from an initial list of six candidate areas:

- i. High value manufacturing;
- ii. Energy and resource efficiency;
- iii. Transport systems;
- iv. Healthcare;
- v. ICT; and
- vi. Electronics, photonics and electrical systems.⁸⁵

55. The TSB has acknowledged that the list represents six very broad areas and it would expect the majority of centres to have a tighter technical focus and definition within, or across, these broad areas. It is also possible that some areas may warrant more than one centre.⁸⁶ Iain Gray explained that this list of six candidate areas was not definitive. Whilst the areas aligned with the TSB’s priorities, Mr Gray told us that the TSB was seeking views from the business world on these areas.⁸⁷ The TSB was, however, seeking to fast track a centre in the area of high value manufacturing.⁸⁸

56. There was broad agreement amongst the witnesses that appeared before us on the criteria used to assess potential centres and identify candidate areas. Professor Ridgway, from the AMRC, considered that it was important to concentrate on “industries that can actually produce results”;⁸⁹ Pam Alexander, from the RDAs, added that we should look to areas where “we have the industry that is ready and willing to take those opportunities and exploit them”;⁹⁰ Professor Brook, from AIRTO, was of the view that it would be useful to

84 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 7

85 *As above*

86 *As above*

87 Q 85

88 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 7

89 Q 52

90 *As above*

“follow the model that you are investing in a company [...] the process of defining markets, the route to market, strengths, weaknesses and competitive edge”;⁹¹ and Professor Perry, from the CPI, summarised that:

The critical importance here is the potential impact on the UK [...] That will be in one of three areas: an area where there is existing economic activity, but innovation is required and needs to be supported by industry to get to an inward investment position or to support existing companies; a technology area that promises great potential, which has started to be exploited, but needs to be kicked that little bit further to get it there; or the difficult area of technologies that are still coming, but do not have any economic activity around them.⁹²

57. When we asked Mr Gray whether the Government was imposing a view on which candidate areas to invest in, he told us:

Government has had a view in terms of its work with business on things like the innovation growth teams, and the Chief Scientific Advisers have a view in terms of future priorities. Our business works with Government to try and understand what the future priorities are. So Government is involved in an interactive way right through this process [...] Our strategy [...] will be [...] signed off, by the appropriate Minister in BIS.⁹³

58. The University of Lancaster highlighted, in its written memorandum to us, that the Government Chief Scientific Adviser had recently taken a view on future priorities in the Foresight report, *Technology and Innovation Futures: UK Growth Opportunities for the 2020s*.⁹⁴ This report identifies no less than 53 individual technologies which can be readily grouped into 28 clusters.

59. The Minister explained to us that, much in line with the criteria drawn from the *Hauser* and *Dyson* reports, the candidate areas “should be areas where there are big global markets, where we already have a strong research capability in Britain and where we believe that British business has the capacity to exploit the technology [but] it will be for the experts in the TSB to listen to the business and research communities that put forward proposals for specific Technology Innovation Centres in specific sectors”.⁹⁵

60. We do not comment on the candidate areas identified by the TSB, nor has the Government. We simply encourage the TSB to consult widely and transparently with industry and academia to ensure that the chosen candidate areas are the correct priorities.

91 Q 52

92 As above

93 Q 92

94 Ev w53

95 Q 124

4 Funding model

61. Following the *Spending Review 2010*, the Government set out, in the *Blueprint for Technology*, that over four years it would provide “more than £200 million of funding to establish an elite network of Technology and Innovation Centres [TICs] through the Technology Strategy Board”.⁹⁶ Rt Hon David Willetts MP, the Minister of State for Universities and Science, confirmed that this “£200 million will be a specific budget line for the TSB that has to be spent on this initiative”.⁹⁷

62. Dr Bradshaw, from the Confederation of British Industry (CBI), acknowledged that £200 million was “a drop in the ocean” when compared to the amount of money invested in Germany via the Fraunhofer Institutes.⁹⁸ Professor Parker, from Rolls-Royce, urged us to be realistic about the financial scale: “the Fraunhofer network today costs €1.6 billion a year to run [...] we are not going to replicate the German system overnight”.⁹⁹ He added, however, that £200 million over four years was “a start”.¹⁰⁰

63. Iain Gray, from the Technology Strategy Board (TSB), indicated that the £200 million over four years would be used to fund six to eight TICs:

In quantum terms, £200 million spread across six to eight centres is not dissimilar to the Fraunhofer funding model in terms of funding per centre [...] There is no reason why that could not grow into the future, but it is very important that the amount of money we have is invested wisely and is not spread too thinly across a very large number of centres. I acknowledge, compared with Fraunhofer, that it is a small number, but that number spread across that number of centres is very similar to the investment that goes into the Fraunhofer Institutes.¹⁰¹

Dr Bradshaw agreed that “critical mass is absolutely important. Don’t try and spread the money too thinly. It’s going to mean that there will be some hard decisions to be taken.”¹⁰²

64. We asked the Minister whether the level of funding provided by the Government would be sufficient. He told us:

It is very likely that as the bids come in, as reactions to the prospectus come through, there will be a long list of candidates and the TSB won’t be able to afford to fund them all within a £200 million budget over four years. They may not all meet the criteria, anyway. I think this aim of six to eight [centres] is a good one to have.¹⁰³

96 HM Government, *Blueprint for Technology*, November 2010, p 9

97 Q 136

98 Q 30

99 Q 12

100 Q 30

101 Q 106

102 Q 29

103 Q 150

65. In the light of the current economic climate the £200 million over four years for TICs is welcome and provides an acceptable foundation for this new initiative. It is important that the money is not spread too thinly and we consider that an initial target of six to eight centres seems to be sensible. Given the potential for these centres to stimulate economic growth, we also recommend that the funding for TICs be reviewed regularly, in order to increase investment in areas where the results justify it as well as in areas of emerging technologies in which the UK has developed strengths. In the longer term, when compared with the level of investment in Germany, there is a strong case for widening the network of TICs and substantially increasing funding.

Adopting the Fraunhofer funding model

66. The TSB explained that the Fraunhofer funding model was “one third, one third, one third”, that is:

Approximately one third of the funding is granted by the German federal government and Lander; one third is collaborative research and development type funding, including funding won competitively from EU programmes, and the remainder is directly contracted commercial revenue.¹⁰⁴

67. Several organisations that submitted evidence to our inquiry were in favour of the TICs adopting a Fraunhofer-type funding model, including, the Association of Research and Technology Organisations (AIRTO), the Regional Development Agencies (RDAs) and the Judge Business School, University of Cambridge.¹⁰⁵ Dr Bradshaw, from the CBI, told us the funding model was one of Fraunhofer’s strengths and that long-term funding and a central core funding from Government “acts as a catalyst to bring in additional funding and helps to de-risk some of the investments that others make”.¹⁰⁶

68. The TSB’s TICs prospectus indicated that this funding model would be adopted:

Under this model centres would be required, when fully established, to generate their funding broadly equally from three sources:

- business-funded R&D contracts, won competitively
- collaborative applied R&D projects, funded jointly by the public and private sectors, also won competitively
- core public funding for long-term investment in infrastructure, expertise and skills development.¹⁰⁷

69. Professor Perry, from the Centre for Process Innovation Ltd (CPI), told us that this funding model “is not something that you can magic overnight”.¹⁰⁸ He explained that CPI

¹⁰⁴ Ev 62, para 4

¹⁰⁵ Ev 40, para 1.14; Ev 56, para 8; and Ev w38, conclusions and recommendations

¹⁰⁶ Q 12

¹⁰⁷ Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 5

¹⁰⁸ Q 70

“started 100% publicly funded and [...] after seven years, we are operating at about 80% public funding and 20% private funding”.¹⁰⁹ The RDA, One North East, also recognised that diverse income streams took time to develop and pointed out that “commercial income only can be generated with marketable expertise and services”.¹¹⁰ The Minister accepted this: “We have to be realistic. You could not expect [the TICs] to get to a third, third, third split in year one or year two”.¹¹¹ However, some organisations with the characteristics of TICs have been able to achieve a greater share of private sector funding. The Advanced Manufacturing Research Centre is operating at approximately 50% private funding.¹¹²

The first third: core public funding

70. Iain Gray told us that the one third of funding from the public sector represented “a long-term commitment to provide sustainable world-leading skills and world-leading equipment”.¹¹³ The TSB’s TICs prospectus further explained that the £200 million core funding would, on the basis of international experience, be sufficient for six to eight centres at £5–10 million per annum per centre.¹¹⁴ Professor Parker, from Rolls-Royce, agreed that £5-10 million per annum per centre was sensible for “development of infrastructure and central support”.¹¹⁵

71. The Minister confirmed that there would be no further funding for capital: “The £200 million includes our contribution to start-up costs”.¹¹⁶

The need for permanent public support

72. The TSB’s TICs prospectus recognised that core public funding ensured that centres were sustainable and gave business the confidence to invest. The TSB anticipated that core funding would be provided “initially for five years, and renewable in similar increments”.¹¹⁷

73. Professor Brook told us that AIRTO’s existing member organisations were majority private funded. He suggested that “the TICs, in due time, will probably go towards a majority of private funding over public funding, but it will take time, and I think the core funding needs to be there until the market failure has gone away”.¹¹⁸ We asked him whether this meant TICs only needed core public funding in the short to medium term.

109 Q 70

110 Ev w142, para 23

111 Q 158

112 Q 72 and footnote

113 Q 105

114 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 5

115 Ev 67, para 23

116 Q 148

117 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 5

118 Q 70

Professor Brook responded: “We should be looking for the same continuance of public funding.”¹¹⁹ He pointed out that:

the Fraunhofers [...] have evolved, changed and migrated—if you look at them now and 15 or 20 years ago, they are doing different things. They are changing and adapting to the needs of the market, in terms of the function that they perform.¹²⁰

Professor Perry, from the CPI, added that like the Fraunhofer Institutes, the “technology agenda” of TICs would evolve over time.¹²¹ Pam Alexander, from the RDAs, considered that the issue of sustainable public funding was crucial.¹²²

74. Professor Parker was reluctant to encourage the TICs to become self-funded. He explained that this was one of the lessons learnt from the Faraday Partnerships of the 1990s (paragraphs 11–12) and that:

you have to recognise that we are in this for the long term [...] We should recognise that Government money will always be necessary to drive them forward, or they should cease to exist if they are not performing. I think it is unrealistic to expect everything to stand on its own two feet.¹²³

75. Dr Bembo, representing the Association for University Research and Industry Links (AURIL) and Universities UK, agreed.¹²⁴ Iain Gray told us that one of the big differences between TICs and Faraday Partnerships was that TICs would align to TSB strategic priorities and that, to an extent, the sustainability of a centre in gaining both public and private sector funding would depend upon it continuing to work in line with those priorities.¹²⁵

76. A number of organisations were clear that public funding of TICs should be a long-term commitment, including the Russell Group and the CBI.¹²⁶ Iain Gray explained that this is “difficult [...] in terms of the political budget timetable”¹²⁷ but that “we certainly need the longer-term commitment [as] these Technology Innovation Centres are not just here for three to four years”.¹²⁸

77. The Minister acknowledged that addressing the issue of continuing long-term public support was critical, but that the TICs already had good cross-party support.¹²⁹ We asked

119 Q 71

120 *As above*

121 *As above*

122 *As above*

123 Q 12

124 *As above*

125 Q 99

126 Ev w153, para C.ii. and Ev 47, para 8

127 Q 107

128 Q 108

129 Qq 140–43

whether this could be solved by creating an “innovation endowment”, to which the Minister responded, “that is an interesting thought”.¹³⁰

78. The dangers of centres suffering from a lack of core public funding and becoming too dependent on commercial income are exemplified by the Faraday Partnerships. We recommend that the Government provide permanent core public funding to keep the centres innovative and to give business the ongoing confidence to invest. If the centres become self-funded, we fear that the research priorities would be set by those providing the funding, rather than aligning with strategic national priorities. Whilst we acknowledge the difficulties in committing to funding beyond the next election, we consider that the Government should further investigate whether an innovation endowment would prove a practical solution to this problem. The Government should seek a cross-party commitment that gives confidence to the TICs.

The second third: competitive public-private sector funding

79. The second third of the funding model, as described by Iain Gray, is “competitively won public-private sector funding against competitions [...] European funding competitions [...] UK funding competitions [and] Technology Strategy Board funding competitions”.¹³¹

UK funding

80. Iain Gray explained that, in terms of accessing UK-based funding, the fact that the TICs aligned with national strategic priorities would be important because it “ensures that there will be a succession of competitions that the centres will have access to in a competitive sense. They need to win it, but there will be competitions in the themed areas in which the centres are involved”.¹³²

81. If competitive grants are aligned with TICs’ priorities, it raises the question of whether TICs may have an unfair advantage over other centres seeking to access competitive funding for innovation projects. This was an issue raised by the Knowledge Centre for Materials Chemistry:

there are significant risks from seeking to concentrate innovation resources in a limited number of TICs without simultaneously ensuring a high level of continuity with existing industry science and innovation networks.¹³³

The Institute of Physics was concerned that an indirect effect of setting up the TICs “may well be to put further pressure on the universities which use research contracts as alternative sources of funding”.¹³⁴

130 Q 142

131 Q 105

132 *As above*

133 Ev w178

134 Ev w207

82. We asked the Minister to clarify the TSB's Spending Review 2010 allocation. He explained that there would be four budget lines:

- the overhead costs for the TSB, where we are looking for efficiency savings;
- the core funding of the activities of the TSB so far which [the Government] can't exempt from savings [this would include TSB funding competitions which TICs and other centres could apply for];
- then there is the R&D grant regime which is taking over some of those responsibilities from RDAs;
- and then, fourthly, there is this very important initiative on Technology Innovation Centres.¹³⁵

83. A reduction in core funding of the TSB's activities concerns us. Indeed, we have heard from the CPI that "in the UK the amount of public funding going into the innovation step is insufficient to ensure that value is created from the UK's excellent science and technology research".¹³⁶ The CBI also told us:

Part of the problem which the proposed technology and innovation centres are aimed at addressing is the balance of public funding between the substantial level of support for research and the much lower figure for innovation. The Technology Strategy Board, for example, currently enjoys core funding at a level which is about one-twentieth of the budget for university research dispensed by the Research Councils and the higher education funding bodies such as [...] the Higher Education Funding Council for England. The resulting bottleneck in exploitation of research outcomes puts UK business at a competitive disadvantage internationally, and this is likely to be exacerbated by the disappearance in England of the innovation funding support disbursed hitherto by the RDAs—a total of about £350m.¹³⁷

84. There is already an imbalance in public funding between research and innovation. We are concerned by the prospect of further reductions in the core funding of TSB activities. We consider that, when it comes to innovation, the Government should not expect "more for less" from the TSB. While it is inevitable that TSB competitive grants will be in line with the priorities of TICs, it is important that limited funds for innovation are not monopolised by the TICs. The Government's and the TSB's funds for innovation have to be available to those outside TICs, as their work may be the basis of the TICs of the future.

European funding

85. The CBI told us that the Fraunhofer Institutes in Germany have "an important role in facilitating business engagement in the European Framework Programme for Research and Technological Development".¹³⁸ Universities Scotland explained that "the lobbying

135 Q 136

136 Ev 43, para 2.5

137 Ev 47, para 4

138 Ev 47, para 6

power of the Fraunhofer Institutes at the European level should not be underestimated and should be a force to be reckoned with if similar institutions wish to influence or benefit from European initiatives in Research and Development”.¹³⁹ Dr Bembo, from AURIL and Universities UK, added that “the Fraunhofers have tapped into European Regional Development Funds [and] last year they drew down tens of millions of Euros to establish new capital facilities. That is certainly something we should explore in the UK”.¹⁴⁰

86. Professor Parker, from Rolls-Royce, explained that the TICs could apply to win competitive European funds themselves and also assist industry to access European funds directly.¹⁴¹ Some centres in the UK are already trying to do this. Professor Perry, from the CPI, told us “we will be developing a dedicated team inside CPI, whose sole target will be to identify and target [European] framework programmes”.¹⁴² We asked Iain Gray if this was an approach that the TICs might take. He explained that each centre would need to understand the themed area that it worked in but not necessarily have its own in-house grants team. The Minister also considered it might be better if a dedicated team was provided centrally, possibly through BIS or the TSB.¹⁴³

87. There is a huge opportunity for TICs to obtain European funding for themselves and to assist businesses trying to access this money. We conclude that, from the outset, TICs must have mechanisms in place to enable this to happen. We agree with the Minister that there should be a central team in either the TSB or BIS that provides, at the least, general guidance and assistance to the network of TICs. We consider that the TSB should ensure that there is a named individual within each TIC who understands the international funding opportunities within his or her area, and takes responsibility for liaising with the central team.

The third third: private sector contracts

88. The final third of the funding model will come from contracts won from the private sector. Iain Gray explained that “a successful Technology Innovation Centre could see that part of the funding stream actually grow, and over time it could grow quite significantly”.¹⁴⁴ We found his words encouraging.

89. During our visit to Germany we learnt that the Fraunhofer Institutes put a cap on the amount of private sector funding that each institute can earn in a given year. This is to prevent them from becoming “too commercial”, on the grounds that if there is a bias toward private funding, institutes become too business-oriented and risk averse, whereas a balance of private and public funding generates a more creative approach to innovation. Professor Perry, from the CPI, explained:

139 Ev w80, section 1

140 Q 35

141 Q 34

142 Q 76

143 Q 146

144 Q 105

If we move a centre to be sustained wholly by its activities in the private sector, all that we have succeeded in doing is setting up an SME that will then behave exactly like an SME [...] It is very important that there is creative tension. The comment also applies the other way. It is very important that this thing does not become public sector dominated. It has to operate in this interface between public and private sectors.¹⁴⁵

90. AURIL and Universities UK suggested that “a threshold of engagement should be agreed—for example, 30–40% income from industrial partners which, if not secured, resulted in a proportion of the core funding returned for re-deployment. In essence, embed a financial claw-back system”.¹⁴⁶ Iain Gray told us he had not come across this concept and said:

As a network, it is important that we put in place the right performance metrics so that if something is not working we can either correct it or stop it [...] we need to have the mechanisms that make sure that [...] if a centre is underperforming, we can stop that. That, for me, is a different approach. Frankly, I don’t see how a claw-back mechanism could work.¹⁴⁷

91. We pressed Mr Gray on the wider issue of a cap on private sector investments, specifically whether TICs would benefit from the Fraunhofer approach. He told us he would not put a cap on private sector funding but added that “the element of long-term commitment from the public sector [...] is an important part of the funding model”.¹⁴⁸ The same question was put to the Minister, he told us that:

I don’t envisage a cap [on commercial income], but if you were able to finance yourself entirely out of commercial income, [...] it would certainly change the nature of the operation quite a lot.¹⁴⁹

92. We conclude that there should be a cap on the amount of private sector funding each TIC can access in a given year. This will promote a more creative approach to innovation. TICs should have a clear objective to follow the “one third, one third, one third” funding model. We recommend that when a TIC earns the majority of its income from the private sector it cease being a TIC and no longer receive core public funding.

Engaging small businesses

93. In both Germany and the UK there is general agreement that in working with the private sector to fund innovation, it is important that TICs engage not only with large companies but also with small businesses.

145 Q 79

146 Ev 64, para 1.4

147 Q 113

148 Q 105

149 Q 139

The nature of work

94. Dr Bembo, from AURIL and Universities UK, told us that the nature of work of the university sector with SMEs is different to that with large companies. He explained that “we see a lot of consultancy take-up from the SMEs [and] we see SMEs wanting to access university facilities [particularly] large scale equipment [...] There will be different offerings that appeal to the different sizes of company”.¹⁵⁰ Patrick Reeve, from the British Private Equity and Venture Capital Association, agreed that access to facilities was important.¹⁵¹

95. Direct access to facilities is not the only way an SME can use a TIC. A number of organisations stressed the benefits to SMEs of working with large companies. Professor Parker, from Rolls-Royce, explained that “many of our successful SMEs don’t have a route to market in their own right [...] They rely on larger integrators to take their products, their ideas and build it into a system or product that eventually does go to the market.”¹⁵² Professor Ridgway, from the Advanced Manufacturing Research Centre, agreed that SMEs were often looking for a market and a business to take their idea forward rather than a grant.¹⁵³ Iain Gray also acknowledged the “role that large companies can play in developing the supply chain and actually pulling small companies through”.¹⁵⁴

Finance

96. Barclays Bank explained that the evolution of SMEs in the technology sector could be divided into three phases: (1) proof of concept; (2) commercialisation; and (3) profitability. On the financial challenges faced by SMEs, Barclays Bank explained that:

In stages (1) and (2) the risks of failure are high and the funding model remains an equity one. This equity is obtained from a number of areas including personal resources, friends and family, wealthy entrepreneurs and specialist tech and VC [venture capital] funds. The role for bank funding (i.e. loans and overdrafts) really only applies once the business moves into stage (3) and this is where Barclays continues to be very active.¹⁵⁵

97. Professor Brook, from AIRTO, considered that “SMEs find it difficult to get bank loans [...] but there are now early-stage funds that will invest modest amounts into an SME for a minority stake, either as equity or as a convertible loan.”¹⁵⁶ Pam Alexander, from the RDAs, added that: “we have regional funds, which are helping to bridge that gap, particularly on the early-stage commercialisation funding. Those should be brought

150 Q 26

151 *As above*

152 *As above*

153 Q 56

154 Q 98

155 Ev w210

156 Q 75

together under the new umbrella of Capital for Enterprise Ltd, but should still be available at regional level”.¹⁵⁷ The Minister told us that:

Capital for Enterprise as an NDPB [non-departmental public body], although we pass money through it, does not itself directly allocate funding. It in turn passes the money on to organisations like Amadeus that then take the decisions about how the money should be spent. That would be the level where you might see decisions being taken to fund activities at Technology Innovation Centres rather than at Capital for Enterprise itself.¹⁵⁸

98. Iain Gray explained that the TSB was already working very closely with Capital for Enterprise on the TIC model.¹⁵⁹ He acknowledged that the TICs would help encourage investors to take a long-term view on SMEs. The Minister hoped that “SMEs’ involvement with Technology Innovation Centres does strengthen their financial base and increases people’s confidence in their commercial performance”.¹⁶⁰ Mr Gray continued, however, that “a Technology Innovation Centre is not necessarily the only answer to how [TSB] support small businesses”.¹⁶¹ A small customer who went to a venture capital firm or a bank with a Government procurement contract (funded through the Small Business Research Initiative) was “worth an awful lot more than [a customer] saying that [they] are doing a bit of work in a Technology Innovation Centre”.¹⁶²

99. Like the Minister, we hope that SMEs’ involvement with TICs will strengthen their financial base and increase lenders’ and financiers’ confidence in their commercial prospects. We are pleased that the TSB is already working with Capital for Enterprise on the TICs initiative. We encourage the TSB to consult more widely with financial organisations, including venture capital providers and banks, to ensure that there are no barriers to SMEs engaging with TICs. We also expect lenders to engage with TICs to help develop a better understanding of the economic potential of technologies that SMEs are involved with.

157 Q 75

158 Q 149

159 Q 111

160 Q 149

161 Qq 111–12

162 Q 112

5 Operational model

Governance

100. The Fraunhofer Institutes in Germany rely on “simple and uniform corporate governance principles” and a “high level of autonomy of the individual Fraunhofer Institutes”.¹⁶³ The Technology Strategy Board (TSB) appears to have taken these principles on board. The Technology and Innovation Centres (TICs) prospectus proposes a governance structure with three main elements:

- i. Oversight Committee—which will oversee the network of Technology and Innovation Centres and will report to the TSB's Governing Board;
- ii. Management Board—an autonomous business-led board for each centre that will oversee the programme of work; and
- iii. TSB Programme Team—a small team within TSB to support the Oversight Committee and provide day-to-day delivery of the core funding programme.¹⁶⁴

Oversight

101. Dr Bradshaw, from the Confederation of British Industry (CBI), explained that although TICs “need to operate at arm’s length from Government [...] an element of co-ordination” was needed to ensure TICs did not end up duplicating work carried out by others.¹⁶⁵ Professor Parker, from Rolls-Royce, agreed that oversight from TSB should prevent centres from overlapping with work done elsewhere”.¹⁶⁶ Dr Bradshaw added that the governance structure had to allow TICs to “link in with other parts of the innovation system”.¹⁶⁷ Iain Gray, from the TSB, told us that the TSB would put in place an oversight board that would have “strong representation from both the business community with some representation from the academic community—big hitters”.¹⁶⁸

102. Professor Perry, from the Centre for Process Innovation Ltd (CPI), added that it was important to recognise that TICs would be “delivering value to the public sector in terms of economic benefit [...] and therefore it’s appropriate that the public sector is also represented in the governance process”.¹⁶⁹ We asked Rt Hon David Willetts MP, the Minister of State for Universities and Science, what the Government’s role would be in overseeing the network of TICs. He told us that:

What we are envisaging is these autonomous business-led management boards for each individual Technology Innovation Centre and an oversight committee that will

163 Ev w166 (Fraunhofer Gesellschaft)

164 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 6

165 Q 23

166 Q 24

167 Q 23

168 Q 97

169 Q 61

be within the Technology Strategy Board [...] However, ultimately, the TSB answers to Ministers and, of course, we are answerable to the Commons and bodies such as this one. So the overall strategic decisions and performance will be discussed with and cleared with Ministers.¹⁷⁰

103. The TSB should coordinate the oversight of the network of TICs. We conclude that the Oversight Committee should consist of major players—with expertise in technology commercialisation and innovation—in business, academia, and from the public sector.

Management board

104. Patrick Reeve, from the British Private Equity and Venture Capital Association (BVCA), argued that strong management of each centre was necessary to “make decent commercial decisions in a fast-changing market and not be overly stifled by the supervisory boards”.¹⁷¹ As such, each TIC would need an autonomous management board that would oversee its programme of work, independent of the Oversight Committee.

105. Professor Brook, from the Association of Independent Research and Technology Organisations (AIRTO), explained that TICs needed representation from the “constituency” to which they were accountable.¹⁷² A number of organisations told us that the management board should include representatives from both business and academia.¹⁷³ Dr Bradshaw, from the CBI, suggested that business, in particular, had a very strong role to play in helping to lead the TICs.¹⁷⁴ This was a view shared by Professor Ridgway, from the Advanced Manufacturing Research Centre (AMRC).¹⁷⁵ The Minister agreed that the board needed “a very strong business element”.¹⁷⁶

106. Professor Perry, from the CPI, told us:

It’s quite critical to recognise that the TIC is delivering value to the private sector, and therefore the private sector has a very significant role in the governance process, so that’s the business-led, large corporate and SMEs, because there are different challenges in those.¹⁷⁷

107. We asked the Minister about the balance of those represented on the board. He told us that he was trying not to specify things like the balance of the composition of a board.¹⁷⁸

170 Q 128

171 Q 25

172 Q 61

173 Ev w7 (University of Leeds), para 4.5; Ev w32 (DREM Ventures Ltd, Optopreneurs Ltd, Pinacl Solutions UK Ltd and Grounded Innovation Ltd), para 54; Ev 43 (Centre for Process Innovation Ltd), para 3.8; and Ev w153 (The Russell Group), para 4.5

174 Q 23

175 Q 61

176 Q 131

177 Q 61

178 Q 131

108. **We agree with the Minister that each TIC must have a very strong business element. While we understand his reluctance to specify the balance of the composition of the board, we recommend that, to ensure the interests of SMEs are fully taken into account, at least one board member represent small businesses.**

Leadership

109. The TSB recognised that the performance and culture of a TIC would inevitably come down to “a few key individuals, such as the CEO, Chair of the Board and other senior staff, who must have the right blend of enthusiastic entrepreneurial spirit, industrial experience and knowledge of the academic base”.¹⁷⁹ The TSB has stated that it is committed to working with each centre, to create an appropriate framework for the appointment of these key individuals to ensure the TICs are effectively run.¹⁸⁰

110. We asked Iain Gray if it would be beneficial for the TICs, like the Fraunhofer Institutes, to be run by an individual who is also an academic, such as a professor at a university, thus providing a link between the centre and the academic base. Mr Gray did not see this as “mandatory”.¹⁸¹ The Minister said that “it is not something we would forbid [nor do we] envisage that as a requirement”.¹⁸²

111. **The successful launch and operation of TICs will require individuals at the top of the organisation who are not only talented managers but can build bridges between business and academia. While it may be going too far to require chief executives of TICs to be active academics, we encourage the TSB to help centres find suitable individuals who are well connected to the relevant research base.**

The business model

112. The TICs prospectus indicates the TSB’s expectation that each centre, once established, will be “an independent legal entity, constituted on a ‘not for profit’ basis separately from any host organisation or other major partners”.¹⁸³

113. We took oral evidence from representatives of two existing centres, CPI and AMRC, and asked them to explain their own business models to us. Professor Perry told us:

CPI is a company limited by guarantee [...] and, as such, we can’t receive private sector or financial institution investment [...] so you need to create devices which, basically, are companies limited by shares, and that is where our spin-outs come in. We are trying to generate spin-outs for a number of reasons. First, so that we can attract private investment. Secondly, those spin-outs are using technology that we have developed and they will, therefore, reward that technology. Thirdly, at some

179 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 6

180 *As above*

181 Q 102

182 Q 130

183 Technology Strategy Board, *Technology and Innovation Centres: a prospectus*, January 2011, p 6

point those companies will be sold and there will be equity proceeds for CPI in total.¹⁸⁴

114. Professor Ridgway told us AMRC is “not a company limited by guarantee”.¹⁸⁵ Its finances are administered by the University of Sheffield. The advantages of this were the ability to “get—if you’re going for European funding—better returns on grant rates and overhead rates”.¹⁸⁶

115. Professor Brook, from AIRTO, added that:

When you look at trying to bring something like this [a TIC] into existence [...] the model you generally come back to is the company limited by guarantee, at least to start with. You’re then not beholden to a particular set of shareholders. You re-invest whatever surpluses you make rather than distribute them to the shareholders. Your assets can’t be distributed to shareholders if the organisation does get into trouble.¹⁸⁷

116. We asked the Minister if the TSB’s expectation that centres would be independent legal entities would preclude some existing centres from becoming TICs. He told us he did not think it would be a barrier.¹⁸⁸

117. We recommend that the TSB set out details of a preferred business model, including legal structure, for TICs. This model should draw on the experiences of existing centres and be capable of amendment as time goes on.

Managing intellectual property

118. With TICs having a remit to work across business and academia the effective management of intellectual property (IP) will be crucial. Professor Perry, from the CPI, told us:

It is a very important art form that the TIC is able to work with IP without leaking it and is able to work both pre-competitively and post-competitively. Pre-competitively is somewhat easier. Post-competitively, you are dealing with quite significant levels of investment and quite significant levels of knowledge, which need to be protected.¹⁸⁹

119. Patrick Reeve, from the BVCA, considered that this was not such a problem in some sectors. He highlighted the pharmaceutical industry as a sector that had a good model for managing IP rights: “drug licences are often shared between more than one of the large pharmaceutical companies and [...] also with the universities as well”. He added that the

184 Q 74

185 Q 67

186 *As above*

187 Q 65

188 Q 123

189 Q 59

ultimate share of intellectual property was simply a question of who reduced the risk of the investment and at what point.¹⁹⁰ Dr Bradshaw, from the CBI, told us:

Establishing a framework early on is critical. We do have a very good starting point with the Lambert model agreements, one of which is around contract research. There are others around consortium research, which the TSB already uses.¹⁹¹

120. AMRC explained that it had dealt with IP rights in a unique way:

the [AMRC] model [...] requires every partner to buy into the benefits of funding and undertaking generic research, the fruits of which can be shared, on a free licence basis, by the whole partnership. The knowledge developed is also available to the wider industrial community but a commensurate charge is levied to contribute to the ongoing research costs.¹⁹²

AMRC added that industry partners were also able to pay for additional research outside the collaborative agreement. The IP rights would then be held by the company (or companies) commissioning the research.¹⁹³

121. Dr Bembo, representing the Association for University Research and Industry Links (AURIL) and Universities UK, told us “horror stories [...] tend to be fairly few and far between [...] the negotiations over intellectual property often fall down in part on issues of costing and pricing of work”.¹⁹⁴ However, Professor Brook, from AIRTO, warned that:

The more partners there are in a network [e.g. in a large hub and spoke network], the more complicated things can become. Then it is a matter of who is managing that network and who manages the TICs and what they do in disseminating best practice out to the spokes and how they want them to work [...] to get this co-ordinated will take some time and effort.¹⁹⁵

122. Iain Gray recognised that a “consistent set of rules” needed to be established and “the Lambert report provides a template that has worked between business and universities”.¹⁹⁶ The Minister, however, told us that whilst IP rights would have to be negotiated, he was not sure that there would need to be “a national requirement” and that it would probably be set out on a per case basis.¹⁹⁷

123. The management of intellectual property rights will be crucial to an effective working relationship between TICs, academia and business. We ask the TSB to set out principles for IP management, including an outline of current best practice, in its TIC implementation plan but we reject the need for prescription.

190 Q 19

191 Q 20

192 Ev 50 (Advanced Manufacturing Research Centre)

193 *As above*

194 Qq 19–20

195 Q 59

196 Q 103 and HM Treasury, *Lambert Review of Business-University Collaboration*, December 2003

197 Qq 132–33

6 Assessing success

124. With £200 million being invested in Technology and Innovation Centres (TICs), there will eventually be a need to assess whether the centres have provided a good return on public investment. The Technology Strategy Board (TSB) stated that:

Effectiveness must be when a centre enables economic activity that far outweighs the public investment. Effectiveness must be helping to stimulate a vibrant industry around the centres. This is long-term and difficult to measure. The only near-term measure can be the eagerness of industrial partners and customers to invest time and money in the centres.¹⁹⁸

In contrast, Pam Alexander, from the Regional Development Agencies (RDAs), told us that the TSB and Government “need to be very clearly setting the parameters within which they [TICs] operate and what the success criteria are”.¹⁹⁹

Progress towards the three thirds funding model

125. During our visit to Germany, we heard from the Federal Ministry of Education and Research that Fraunhofer Institutes were assessed, in part, by how much money they drew in from the private sector. Dr Bradshaw, from the Confederation of British Industry (CBI), agreed that “the amount of commercial income they are bringing in” would be a good measure of success for TICs. He added that another key criterion of success was whether TICs were bringing in repeat business; which he saw as “a mark of quality”.²⁰⁰

126. In addition to using commercial income as a marker for success, Professor Brook, from the Association of Independent Research and Technology Organisations (AIRTO), added that it was about broader progress towards the one third, one third, one third model, including “how much the TICs are enabling industry to recover from European programmes”.²⁰¹ Rt Hon David Willetts MP, the Minister of State for Universities and Science, shared his view:

A good measure is the one that they use in Germany of, “Is there a service that businesses are willing to pay for?” The fact is that this third, third, third funding model is a very good way in itself of monitoring performance and ensuring that it’s worthwhile, because if they are not getting specific grants by research councils or others, and if they are not getting businesses wanting to use the facilities and pay to use the facilities, then there is a problem. But if they are getting those two flows of funding in alongside the core funding, that, to me, is a pretty encouraging sign that they are meeting a need.²⁰²

198 Ev 62, para 12

199 Q 61

200 Q 36

201 Q 78

202 Q 154

The Minister recognised, however, that TICs would need to build a good reputation with business. As we noted earlier, he said: “We have to be realistic. You could not expect [TICs] to get to a third, third, third split in year one or year two”.²⁰³ In contrast, Iain Gray felt that in the relatively short term (12 months) businesses should be queuing up at the doors.²⁰⁴

127. Progress towards the “one third, one third, one third” funding model may be slow, especially where new centres are established that need to build a reputation with business. However, attaining and maintaining this funding model is a good measure of the performance of individual TICs in the medium to long term. The “one third” of funding that is drawn in from the private sector, in particular from repeat business, will be key.

Additional measures of success

128. Professor Parker, from Rolls-Royce, emphasised that “output focused metrics, not just activity metrics” should be used to measure success.²⁰⁵ Dr Bradshaw, from the CBI, told us that patenting outputs could be included, as well as “how much of their work has gone through into commercialisation”.²⁰⁶ He added that he “wouldn’t look at things like academic publications [...] so that the people involved are not feeling they need to produce something for an [Research Assessment Exercise] equivalent. It is focused on that commercial side.”²⁰⁷ Pam Alexander, from the RDAs, and Professor Richard Brook, from AIRTO agreed that interim measures of success could include output in terms of patents and spin-out companies.²⁰⁸ Professor Brook explained:

I would probably also look at skills and what happens to the people, because the TICs are potentially routes for people to do a great apprenticeship in this intermediate commercial exploitation business, and then to move out either to set up their own businesses or to move into the industrial supply chain [...] Secondments—the ability to have mobility between the industrial partners, the TIC and the academic sector—and the flow of people are some of the things that I might look at to see whether they are being done effectively.²⁰⁹

129. Professor Parker explained the four basic metrics Rolls-Royce used to assess the success of its 28 University Technology Centres:

- First, what did you deliver to the company in the last year? We ask our own people on the staff, recognising that there is a time frame in all of this, of the ideas and technology that that centre has delivered in the past.

203 Q 158

204 Q 117

205 Q 36

206 *As above*

207 *As above*

208 Q 78

209 *As above*

- [Second] What have we actually put into a product this year? That might be a four or five-year lapse in itself.
- [Third] We ask them how many patents we've got between us on the work done, and
- [Fourth] we ask how many people have actually been recruited from those centres into the company.²¹⁰

130. Iain Gray told us that “the success [of TICs] is around the commercial exploitation [...] It is the number of spin-out ideas that move forward into the marketplace that will be the key litmus test to this”.²¹¹ He added that there is a much broader question about how the benefit of investment in innovation is measured:

A considerable piece of work has been done by NESTA on the Innovation Index. We are looking in a much broader context at how we measure the success when we might not see the success for five, 10 or 15 years. The ultimate success is jobs, economic benefit, inward investment, large corporations choosing to invest in the UK that might not otherwise have done so, corporations that currently exist in the UK continuing to keep their R&D base here in the UK, and small companies that are here in the UK growing into the next big FTSE 250, FTSE 100 businesses. Those types of longer-term success criteria will be as associated with TICs as they are with anything else.²¹²

131. The Minister accepted that “we have to be a bit patient on performance. A year or two down the track, if we have not had some brilliant commercial success immediately [...] it would be a pity if we were getting terribly impatient with [the TICs]”.²¹³

132. There are a number of potential short to medium term measures that can be used to show whether TICs are working satisfactorily. The framework used by Rolls-Royce to assess its own centres is typical of how a business will judge TICs. Businesses will want TICs to prove that they are meeting their needs. The best judge of this will be demand from businesses for TICs' services, in particular, if they offer repeat business to TICs. In the longer-term, innovation is notoriously difficult to measure. As the Minister suggested, the Government and the TSB must be patient in attempting to assess the success of TICs. In the light of the long-term importance of this initiative and of the need to make a convincing case to the Treasury for increasing investment, we recommend that the Minister regularly report progress to the House.

210 Q 17

211 Q 97

212 Q 116

213 Q 140

7 What's in a name?

133. There has been much speculation about the name that will be given to the network of Technology and Innovation Centres (TICs). The name Fraunhofer resonates across the world and is widely associated with an impressive network of German technology and innovation centres. The *Hauser Report* recommended:

The Government should consider the value of a unique brand for these elite national TICs, which recognises their core role in the UK's innovation system. This could help clearly articulate areas of national priority to both UK businesses and promote the UK's innovation offer overseas. The brand should recognise and commemorate a significant UK contribution to science such as the work of James Clerk Maxwell whose unified theory of electromagnetism is the basis of the whole IT industry.²¹⁴

134. Iain Gray, from the Technology Strategy Board (TSB), appeared to share this view:

You may say, "What's in a name?" I would say that Fraunhofer is a great example of what's in a name, because I believe that the centres we have in the UK are every bit as good as the Fraunhofer Centres. What we do not have is a collective that allows us to sell that to the rest of the world. So I believe that a brand name that we can all buy into and use is a very powerful mechanism for the UK.²¹⁵

135. Dr Bradshaw, from the Confederation of British Industry (CBI), was not so concerned about the name. He said that "a name is just a name. The important thing is having a brand, and you only get brand with reputation".²¹⁶ Professor Brook, from the Association of Research and Technology Organisations (AIRTO), added "the brand will need managing [...] because if we have variable performance among the TICs, industry will start to regard some of them as not quite what it needs [...] somebody needs to [...] make sure that the image and the performance reinforces the brand".²¹⁷

136. Rt Hon David Willetts MP, the Minister of State for Universities and Science, invited us to suggest a name for the network of TICs.²¹⁸ There are a number of excellent British inventors to name the TICs after.²¹⁹ One that we are particularly attracted to is the mathematician and computer scientist, Alan Turing, who is often considered to be the founder of computer science and is known for playing a significant role in the creation of the modern computer. He defined the concept of the "Turing machine", a theoretical device which can be used to simulate the logic of computer algorithms. Turing is also known for his work as a cryptographer at Bletchley Park during the Second World War. We consider that this country owes Turing a debt of obligation for the way in which he was treated. It is important, however, to remember that it will take time for TICs to build a

²¹⁴ *Hauser Report*, p 27

²¹⁵ Q 104

²¹⁶ Q 40

²¹⁷ Q 61

²¹⁸ Q 135

²¹⁹ See Annex 3 for examples; this is not an exhaustive list.

reputation. The Fraunhofer brand has had decades to establish itself. It is unlikely that at the time it was chosen much of the general public could have explained who Joseph von Fraunhofer was or what he did.²²⁰

137. We recommend that the network of TICs be called “Turing Centres”, after the founder of computer science, Alan Turing. We consider that this country owes him a debt of obligation for the way in which he was treated. It is important, however, to remember that it will take time for TICs to build a reputation. The TSB must ensure that the brand and the reputation are well managed. If the centres are effective at doing their work, they will be recognised across the world by business as being the place to go to innovate in the UK.

220 The Fraunhofer Institutes takes their name from Joseph von Fraunhofer (1787–1826), a Munich researcher, inventor and entrepreneur. Fraunhofer was a glass-grinding apprentice who became the director of glass manufacturing at the Optical Institute. He was responsible for the development of new methods of glass production and processing. The optical instruments Fraunhofer developed, including the spectrometer and the diffraction grid, allowed him to conduct fundamental research in the fields of light and optics. He was the first to measure the spectrum of sunlight and characterise the dark absorption strips it contains: the “Fraunhofer lines”. His work won him great acclaim from industry and government. (“Joseph von Fraunhofer”, *Fraunhofer-Gesellschaft website*, www.fraunhofer.de/en/about-fraunhofer/joseph-von-fraunhofer/)

8 Conclusions

138. The TICs initiative has been broadly welcomed by all who contributed written and oral evidence to this inquiry. The promise of £200 million over the next four years from the Government shows a commitment to working towards a knowledge economy through investment in innovation and we hope it will command cross-party support.

139. The TSB has made a good start in outlining the concept of TICs in its prospectus. We have made a number of recommendations based on the evidence we have received, which we hope will prove useful to the TSB as it produces a detailed strategy and implementation plan.

Conclusions and recommendations

Making the best use of existing capabilities

1. We are reassured that both the Government and the Technology Strategy Board (TSB) appear to have drawn on history to identify the problems with previous initiatives, such as the Faraday Partnerships. (Paragraph 13)
2. We expect that some existing research centres that are part funded by the Regional Development Agencies (RDAs) may become a part of new Technology and Innovation Centres (TICs), but many will not. There is a risk of losing much of the expertise built up with public resources over recent years. The Government should have, by now, set out further details of what will be done to support existing centres that are losing RDA money in March 2011. The Government should ensure that in the short-term any changes do not reduce the overall research and development spend in the regions. In the long-term it should be the Government's objective to increase the overall research and development spend at both the regional and national level. (Paragraph 19)
3. It is imperative that TICs build on existing centres and expertise. We found a lack of knowledge in the business world regarding existing UK capabilities. In assessing potential TICs, the TSB has already identified a list of nearly 100 centres operating in the UK. We recommend that the TSB maintain a public list in the form of an online catalogue of centres that are ready and willing to work with business, in particular SMEs (small and medium enterprises), in specific technology areas. (Paragraph 24)

The role and operation of Technology and Innovation Centres

4. We welcome the assurance from the TSB that SMEs are at the very heart of TSB deliberations on TICs in terms of how to provide facilities with equipment and skills that SMEs can access. (Paragraph 28)
5. We expect the method of operation of each TIC will adapt to, and therefore vary, to meet the needs of the sector it is supporting. For example, TICs operating in sectors which focus on service provision for a particular industry may operate at higher Technology Readiness Levels than others. The key issue is that each TIC will need to make the best use of existing resources in the sector. It follows that the work carried out in a TIC should reflect both the history of research in the sector it serves as well as an assessment of future demand within that sector. (Paragraph 41)
6. We welcome the list of activities and objectives the TSB has set for TICs in its prospectus. However, it is not reasonable to expect all TICs to carry out the full range of activities. Each TIC should adapt to the needs of the sector it is supporting—by setting a clear vision, defining its objectives and outlining its method of operation—quickly and responsively. This should be developed in conjunction with business and academia. Furthermore, for the purpose of clarity, each TIC should set out the specific activities it will, and indeed will not, engage in. (Paragraph 42)

7. We appreciate that in locating the TICs the TSB and the Government must be careful not to compromise economic objectives. In an ideal world, there would be a good regional spread of centres, but this may not happen. The primary objective—when the TSB identifies which existing centres in the UK will become TICs—must be the quality of the science and the economic benefit to the UK. We consider that a hub and spoke model is useful in connecting existing centres working on similar areas, across the country. This model will be a good way to spread the economic benefit of TICs throughout the UK. Where the hub and spoke model is used, we would like the TSB to put into place a mechanism by which the hubs are clearly recognised and empowered so that they can provide leadership to the spokes. Where existing capabilities do not exist and new centres are required, it may be more appropriate for the TSB to consider regional strengths as set out in the regional innovation priorities table (see Annex 2). (Paragraph 52)
8. We do not comment on the candidate areas identified by the TSB, nor has the Government. We simply encourage the TSB to consult widely and transparently with industry and academia to ensure that the chosen candidate areas are the correct priorities. (Paragraph 60)

Long-term public sector funding

9. In the light of the current economic climate the £200 million over four years for TICs is welcome and provides an acceptable foundation for this new initiative. It is important that the money is not spread too thinly and we consider that an initial target of six to eight centres seems to be sensible. Given the potential for these centres to stimulate economic growth, we also recommend that the funding for TICs be reviewed regularly, in order to increase investment in areas where the results justify it as well as in areas of emerging technologies in which the UK has developed strengths. In the longer term, when compared with the level of investment in Germany, there is a strong case for widening the network of TICs and substantially increasing funding. (Paragraph 65)
10. The dangers of centres suffering from a lack of core public funding and becoming too dependent on commercial income are exemplified by the Faraday Partnerships. We recommend that the Government provide permanent core public funding to keep the centres innovative and to give business the ongoing confidence to invest. If the centres become self-funded, we fear that the research priorities would be set by those providing the funding, rather than aligning with strategic national priorities. Whilst we acknowledge the difficulties in committing to funding beyond the next election, we consider that the Government should further investigate whether an innovation endowment would prove a practical solution to this problem. The Government should seek a cross-party commitment that gives confidence to the TICs. (Paragraph 78)

Access to competitive funding

11. There is already an imbalance in public funding between research and innovation. We are concerned by the prospect of further reductions in the core funding of TSB activities. We consider that, when it comes to innovation, the Government should

not expect “more for less” from the TSB. While it is inevitable that TSB competitive grants will be in line with the priorities of TICs, it is important that limited funds for innovation are not monopolised by the TICs. The Government’s and the TSB’s funds for innovation have to be available to those outside TICs, as their work may be the basis of the TICs of the future. (Paragraph 84)

12. There is a huge opportunity for TICs to obtain European funding for themselves and to assist businesses trying to access this money. We conclude that, from the outset, TICs must have mechanisms in place to enable this to happen. We agree with the Minister that there should be a central team in either the TSB or BIS that provides, at the least, general guidance and assistance to the network of TICs. We consider that the TSB should ensure that there is a named individual within each TIC who understands the international funding opportunities within his or her area, and takes responsibility for liaising with the central team. (Paragraph 87)

Private sector funding

13. We conclude that there should be a cap on the amount of private sector funding each TIC can access in a given year. This will promote a more creative approach to innovation. TICs should have a clear objective to follow the “one third, one third, one third” funding model. We recommend that when a TIC earns the majority of its income from the private sector it cease being a TIC and no longer receive core public funding. (Paragraph 92)
14. Like the Minister, we hope that SMEs’ involvement with TICs will strengthen their financial base and increase lenders’ and financiers’ confidence in their commercial prospects. We are pleased that the TSB is already working with Capital for Enterprise on the TICs initiative. We encourage the TSB to consult more widely with financial organisations, including venture capital providers and banks, to ensure that there are no barriers to SMEs engaging with TICs. We also expect lenders to engage with TICs to help develop a better understanding of the economic potential of technologies that SMEs are involved with. (Paragraph 99)

The operational model

15. The TSB should coordinate the oversight of the network of TICs. We conclude that the Oversight Committee should consist of major players—with expertise in technology commercialisation and innovation—in business, academia, and from the public sector. (Paragraph 103)
16. We agree with the Minister that each TIC must have a very strong business element. While we understand his reluctance to specify the balance of the composition of the board, we recommend that, to ensure the interests of SMEs are fully taken into account, at least one board member represent small businesses. (Paragraph 108)
17. The successful launch and operation of TICs will require individuals at the top of the organisation who are not only talented managers but can build bridges between business and academia. While it may be going too far to require chief executives of

TICs to be active academics, we encourage the TSB to help centres find suitable individuals who are well connected to the relevant research base. (Paragraph 111)

18. We recommend that the TSB set out details of a preferred business model, including legal structure, for TICs. This model should draw on the experiences of existing centres and be capable of amendment as time goes on. (Paragraph 117)
19. The management of intellectual property rights will be crucial to an effective working relationship between TICs, academia and business. We ask the TSB to set out principles for IP management, including an outline of current best practice, in its TIC implementation plan but we reject the need for prescription. (Paragraph 123)

Assessing performance

20. Progress towards the “one third, one third, one third” funding model may be slow, especially where new centres are established that need to build a reputation with business. However, attaining and maintaining this funding model is a good measure of the performance of individual TICs in the medium to long term. The “one third” of funding that is drawn in from the private sector, in particular from repeat business, will be key. (Paragraph 127)
21. There are a number of potential short to medium term measures that can be used to show whether TICs are working satisfactorily. The framework used by Rolls-Royce to assess its own centres is typical of how a business will judge TICs. Businesses will want TICs to prove that they are meeting their needs. The best judge of this will be demand from businesses for TICs’ services, in particular, if they offer repeat business to TICs. In the longer-term, innovation is notoriously difficult to measure. As the Minister suggested, the Government and the TSB must be patient in attempting to assess the success of TICs. In the light of the long-term importance of this initiative and of the need to make a convincing case to the Treasury for increasing investment, we recommend that the Minister regularly report progress to the House. (Paragraph 132)

Branding and reputation

22. We recommend that the network of TICs be called “Turing Centres”, after the founder of computer science, Alan Turing. We consider that this country owes him a debt of obligation for the way in which he was treated. It is important, however, to remember that it will take time for TICs to build a reputation. The TSB must ensure that the brand and the reputation are well managed. If the centres are effective at doing their work, they will be recognised across the world by business as being the place to go to innovate in the UK. (Paragraph 137)

General conclusions

23. The TICs initiative has been broadly welcomed by all who contributed written and oral evidence to this inquiry. The promise of £200 million over the next four years from the Government shows a commitment to working towards a knowledge

economy through investment in innovation and we hope it will command cross-party support. (Paragraph 138)

24. The TSB has made a good start in outlining the concept of TICs in its prospectus. We have made a number of recommendations based on the evidence we have received, which we hope will prove useful to the TSB as it produces a detailed strategy and implementation plan. (Paragraph 139)

Annex 1: Technology Readiness Levels

Technology Readiness Levels (TRLs) are a technology management tool that provides a measurement to assess the maturity of evolving technology. The Ministry of Defence defines these levels as:²²¹

| | |
|--------------|---|
| TRL 1 | Basic principles observed and reported. |
| TRL 2 | Technology concept and/or application formulated. |
| TRL 3 | Analytical and experimental critical function and/or characteristic proof-of-concept. |
| TRL 4 | Technology basic validation in a laboratory environment. |
| TRL 5 | Technology basic validation in a relevant environment. |
| TRL 6 | Technology model or prototype demonstration in a relevant environment. |
| TRL 7 | Technology prototype demonstration in an operational environment. |
| TRL 8 | Actual Technology completed and qualified through test and demonstration. |
| TRL 9 | Actual Technology qualified through successful mission operations. |

221 "Technology Readiness Levels (TRLs) in the Project Lifecycle", *Ministry of Defence website*, www.aof.mod.uk/aofcontent/tactical/techman/content/trl_applying.htm

Annex 2: RDA and Devolved Administration Science and Innovation Priorities supporting National Priorities as at February 2010

| | |
|---|---|
| Advantage West Midlands | Transport Advanced Materials Energy Medical & Healthcare Technologies Digital Media & ICT |
| East of England Development Agency | Lifesciences, Healthcare & Wellbeing Energy & Environment ICT Creative Industries |
| East Midlands Development Agency | Healthcare & Bioscience Food & Drink Sustainable Construction Transport |
| London Development Agency | Bioscience Nanotechnology Low Carbon Economy Digital Technologies Creative Industries |
| Northern Ireland | Agrifood Connected Health Renewable Energy Advanced Engineering |
| Northwest Development Agency | Biohealth Chemicals Aerospace Nuclear Energy & Environmental Technologies Creative & Digital Industries |
| One North East | Offshore Energy Low Carbon Vehicles Networks & Microgeneration Biomanufacturing |
| Scotland | Lifesciences Energy Creative Industries Financial & Business Services Food & Drink Tourism Enabling Technologies |
| South East England Development Agency | Advanced Materials Communication Technologies Healthcare Technologies Sustainability Technologies |
| South West Regional Development Agency | Advanced Engineering & Aerospace Renewable Energy Marine Clean Technologies Digital Media/Creative Industries Microelectronics |
| Wales | Digital Economy Low Carbon Advanced Engineering & Manufacturing Health & Biosciences |
| Yorkshire Forward | Advanced Engineering & Manufacturing Digital & New Media Environmental Technologies Healthcare Technologies Food & Drink |

Annex 3: Examples of British inventors

Charles Babbage: A mathematician, philosopher, and mechanical engineer. He invented the Difference Engine, the first information processor and the precursor to the computer.

John Logie Baird: An engineer. He invented the world's first practical, publicly demonstrated television system and the first fully electronic colour television tube.

Henry Bessemer: An engineer, inventor and businessman. He developed the Bessemer process, the first inexpensive industrial process for the mass-production of steel. His many other inventions include the embossed stamp, cheap lead pencils and the spinning mortar shell.

Isambard Kingdom Brunel: An innovative engineer. He is famous for his bridges and for constructing the first major British railway.

Christopher Cockerell: An engineer. He invented the hovercraft.

Humphry Davy: A chemist and inventor. He is known as a pioneer in the field of electrolysis and for the discovery of new elements, including potassium and calcium. He also invented the Davy Lamp, for use in coal mines.

Paul Dirac: A theoretical physicist. He is one of the founders of quantum mechanics and quantum electrodynamics.

Michael Faraday: A chemist and physicist. He made major contributions to the fields of electromagnetism and electrochemistry. He also invented electromagnetic rotary devices which form the foundation of electric motor technology.

Alexander Fleming: A biologist and pharmacologist. He discovered the enzyme lysozyme and the antibiotic substance penicillin.

John Ambrose Fleming: An electrical engineer and physicist. He invented the first thermionic valve, also known as a vacuum tube. These were critical to the development of electronic technology. He also invented the right-hand rule, used in mathematics and electronics.

John Harrison: A self-educated clockmaker. He invented the marine chronometer, which can be used to determine longitude by means of celestial navigation, revolutionising long distance sea travel.

Ada Lovelace: A writer. She produced notes on Charles Babbage's early mechanical general-purpose computer, including what is recognised as the first algorithm intended to be processed by a machine. She is regarded as the world's first computer programmer and she foresaw the capability of computers to go beyond mere calculating or number-crunching.

James Clerk Maxwell: A theoretical physicist and mathematician. He developed a unified theory of electromagnetism which is the basis of the IT industry.

Isaac Newton: A physicist, mathematician, astronomer and philosopher. He built the first practical reflecting telescope and developed a theory of colour based on the observation that a prism decomposes white light into the many colours that form the visible spectrum. He is best known for describing universal gravitation and the three laws of motion.

Percy Shaw: An inventor and businessman. He patented the reflective road stud or “cat’s eye” and set up a company to manufacture the invention.

George Stephenson: A mechanical engineer. He built the first public railway line in the world to use steam locomotives. The subsequent development of the railways acted as a stimulus for the industrial revolution.

Thomas Telford: An engineer, architect and stonemason. He is known for his work on roads, bridges and canals.

Henry Tizard: A chemist and inventor. He devised the concept of octane numbers and championed the development of RDF (radio-direction finding), which later became more familiarly known as radar.

Alan Turing: A mathematician and computer scientist. He provided a formalisation of the concept of the algorithm and computation with the “Turing machine” which played a significant role in the creation of the modern computer.

James Watt: A mechanical engineer. He improved the steam engine by introducing a design enhancement which radically improved the power, efficiency, and cost-effectiveness. He also developed the concept of horsepower. The standard unit of power, the Watt, is named after him.

Frank Whittle: A British Royal Air Force engineer. He developed the jet engine.

Formal Minutes

Wednesday 9 February 2011

Members present:

Andrew Miller, in the Chair

Gavin Barwell
Stephen Metcalfe
David Morris
Stephen Mosley

Pamela Nash
Graham Stringer
Roger Williams

The Committee considered this matter.

Draft Report (*Technology and Innovation Centres*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 139 read and agreed to.

Annexes and Summary agreed to.

Resolved, That the Report be the Second Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for printing with the Report (in addition to that ordered to be reported for publishing on 15 December 2010, 12 January 2011 and 2 February 2011).

Written evidence was ordered to be reported to the House for placing in the Library and Parliamentary Archives.

[Adjourned till Monday 14 February at 4.00 pm

Witnesses

Wednesday 15 December 2010

Page

Dr David Bembo, Member of Council, Association for University Research and Industry Links, **Dr Tim Bradshaw**, Head of Enterprise and Innovation, Confederation of British Industry, **Professor Ric Parker FEng**, Director of Research and Technology, Rolls-Royce Group, and **Patrick Reeve**, Chair of the BVCA Venture Capital Public Policy Committee, British Private Equity and Venture Capital Association

Ev 1

Monday 20 December 2010

Pam Alexander, SEEDA Chief Executive, Regional Development Agencies, **Professor Richard Brook**, President, Association of Independent Research and Technology Organisations, **Professor Nigel Perry**, Chief Executive, Centre for Process Innovation Ltd, and **Professor Keith Ridgway**, Research Director, Advanced Manufacturing Research Centre

Ev 12

Wednesday 12 January 2011

Iain Gray, Chief Executive, Technology Strategy Board

Ev 23

Rt Hon David Willetts MP, Minister of State for Universities and Science

Ev 30

List of printed written evidence

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| 1 | Department for Business, Innovation and Skills (TIC 00) | Ev 37 |
| 2 | Association of Independent Research and Technology Organisations (TIC 12) | Ev 40 |
| 3 | The Centre for Process Innovation Ltd (TIC 28) | Ev 43 |
| 4 | Confederation of British Industry (TIC 34) | Ev 47 |
| 5 | Advanced Manufacturing Research Centre, University of Sheffield (TIC 35) | Ev 50 |
| 6 | The British Private Equity and Venture Capital Association (TIC 54) | Ev 53 |
| 7 | Regional Development Agencies (TIC 66) | Ev 56 |
| 8 | Technology Strategy Board (TIC 67) | Ev 62 |
| 9 | Universities UK-AURIL joint submission (TIC 77) | Ev 64 |
| 10 | Rolls-Royce (TIC 82) | Ev 67 |

List of additional written evidence

(published in Volume II on the Committee's website www.parliament.uk/science)

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| 1 | Loughborough University (TIC 01) | Ev w1 |
| 2 | Edinburgh Instruments Ltd (TIC 02) | Ev w2 |
| 3 | University of Bath (TIC 03) | Ev w3 |
| 4 | Birmingham City University (TIC 04) | Ev w6 |
| 5 | University of Leeds (TIC 05 and 05a) | Ev w7, Ev w10 |
| 6 | Durham University (TIC 06) | Ev w11 |
| 7 | Scottish Agricultural College (TIC 07) | Ev w13 |
| 8 | Professor Marc Desmulliez (TIC 08) | Ev w14 |
| 9 | Manchester Institute of Innovation Research, Manchester Business School, University of Manchester (TIC 09) | Ev w15 |
| 10 | Manufacturing Technology Centre, University of Nottingham (TIC 10) | Ev w19 |
| 11 | National Physical Laboratory (TIC 11) | Ev w21 |
| 12 | National Nuclear Laboratory and Dalton Nuclear Institute, University of Manchester (TIC 13) | Ev w24 |
| 13 | National Renewable Energy Centre Ltd (trading as Narec) (TIC 14) | Ev w27 |
| 14 | Professor Lord Bhattacharyya (TIC 15) | Ev w29 |
| 15 | UK Business Incubation (TIC 16) | Ev w31 |
| 16 | DREM Ventures Ltd, Optropreneurs Ltd, Pinacl Solutions UK Ltd and Grounded Innovation Ltd (TIC 17) | Ev w32 |
| 17 | Professor Peter Dobson (TIC 18) | Ev w37 |
| 18 | Centre for Business Research, Judge Business School, University of Cambridge (TIC 19) | Ev w38 |
| 19 | Smith Institute for Industrial Mathematics and System Engineering (TIC 20) | Ev w45 |
| 20 | University College London (TIC 21) | Ev w48 |
| 21 | Kingston University (TIC 22) | Ev w51 |
| 22 | University of Lancaster (TIC 23) | Ev w53 |
| 23 | University of Liverpool (TIC 24) | Ev w55 |
| 24 | University of Strathclyde (TIC 25) | Ev w59 |
| 25 | University of Warwick (TIC 26) | Ev w60 |
| 26 | Professor Andy Hopper (TIC 27) | Ev w66 |
| 27 | Research Councils UK (TIC 29) | Ev w68 |
| 28 | UK Computing Research Committee (TIC 30) | Ev w69 |
| 29 | Professor L Gladden, University of Cambridge, and Professor D Begg, Imperial College London (TIC 31) | Ev w71 |
| 30 | University of Edinburgh (TIC 32) | Ev w74 |
| 31 | Brunel University (TIC 33) | Ev w77 |
| 32 | University of the Arts London (TIC 36) | Ev w79 |
| 33 | Universities Scotland (TIC 38) | Ev w80 |
| 34 | University Alliance (TIC 39) | Ev w85 |
| 35 | University of Sheffield and University of Sheffield's AMRC with Boeing (TIC 40) | Ev w88 |
| 36 | HDR Architecture (TIC 41) | Ev w90 |

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| 37 | Imperial College London (TIC 42) | Ev w92 |
| 38 | University of Bristol (TIC 43) | Ev w95 |
| 39 | PraxisUnico (TIC 44) | Ev w99 |
| 40 | N8 Research Partnership (TIC 45) | Ev w104 |
| 41 | Maddison Product Design (TIC 46) | Ev w105 |
| 42 | Royal Society of Chemistry (TIC 47) | Ev w108 |
| 43 | Health Protection Agency (TIC 48) | Ev w111 |
| 44 | National Composites Centre (TIC 49) | Ev w112 |
| 45 | Food and Environment Research Agency (TIC 50) | Ev w116 |
| 46 | Industrial Strategic Advisory Board of the University of Bristol and Bath University Systems Centre (TIC 51) | Ev w117 |
| 47 | Chemistry Innovation Knowledge Transfer Network (TIC 52) | Ev w119 |
| 48 | United Kingdom Science Park Association (TIC 53) | Ev w121 |
| 49 | The Media Institute (TIC 55) | Ev w122 |
| 50 | The Work Foundation (TIC 56) | Ev w125 |
| 51 | TWI Ltd (TIC 57) | Ev w129 |
| 52 | Harper Adams University College, Newport (TIC 58) | Ev w132 |
| 53 | University of Leicester (TIC 59) | Ev w136 |
| 54 | Surrey Research Park, University of Surrey (TIC 60) | Ev w137 |
| 55 | LGC Ltd (TIC 61) | Ev w138 |
| 56 | University of Plymouth (TIC 62) | Ev w140 |
| 57 | One North East (TIC 63) | Ev w142 |
| 58 | Society of Motor Manufacturers and Traders (TIC 64) | Ev w146 |
| 59 | Cancer Research UK (TIC 65) | Ev w147 |
| 60 | Loughborough University (TIC 68) | Ev w151 |
| 61 | The Russell Group (TIC 69) | Ev w153 |
| 62 | The Biochemical Society (TIC 70) | Ev w161 |
| 63 | Fraunhofer-Gesellschaft (TIC 71) | Ev w166 |
| 64 | General Electric (TIC 72) | Ev w170 |
| 65 | Cambridge 100 Group (TIC 73) | Ev w174 |
| 66 | Plastic Electronics leadership Group (TIC 74) | Ev w175 |
| 67 | Sciovis Ltd (TIC 75) | Ev w177 |
| 68 | The Knowledge Centre for Materials Chemistry (TIC 76) | Ev w178 |
| 69 | BIA Regenerative Medicine Industry Group (TIC 78) | Ev w181 |
| 70 | Technical Strategy Advisory Group (TIC 79) | Ev w191 |
| 71 | Design Council (TIC 80) | Ev w197 |
| 72 | Institution of Chemical Engineers (TIC 81) | Ev w200 |
| 73 | C-Tech Innovation Ltd (TIC 83) | Ev w206 |
| 74 | Business and Innovation and Science Boards, Institute of Physics (TIC 84) | Ev w207 |
| 75 | Retail Asset and Deposit Products, Barclays Bank (TIC 85) | Ev w210 |
| 76 | Icon Medical Technology Development (TIC 37) | Ev w211 |

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2010–11

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| First Special Report | The Legacy Report: Government Response to the Committee's Ninth Report of Session 2009–10 | HC 370 |
| First Report | The Reviews into the University of East Anglia's Climatic Research Unit's E-mails | HC 444 |

Oral evidence

Taken before the Science and Technology Committee on Wednesday 15 December 2010

Members present:

Andrew Miller (Chair)

Gavin Barwell
Gregg McClymont
Stephen Metcalfe
David Morris

Stephen Mosley
Graham Stringer
Roger Williams

Examination of Witnesses

Witnesses: **Dr David Bembo**, Member of Council, Association for University Research and Industry Links, **Dr Tim Bradshaw**, Head of Enterprise and Innovation, Confederation of British Industry, **Professor Ric Parker FREng**, Director of Research and Technology, Rolls-Royce Group, and **Patrick Reeve**, Chair of the BVCA Venture Capital Public Policy Committee, British Private Equity and Venture Capital Association, gave evidence.

Chair: Welcome, gentlemen. Thank you for agreeing to come this morning. Just for the record, I would be grateful if the four of you would introduce yourselves.

Dr Bembo: I am Dr David Bembo. By day I am research development manager at Cardiff University. I am here representing the Association for University Research and Industry Links and Universities UK.

Dr Bradshaw: I am Tim Bradshaw from the CBI. I am the head of the Enterprise and Innovation Policy Group at the CBI, which covers science and technology, manufacturing and small businesses.

Professor Parker: Good morning. I am Ric Parker. I am Director of Research and Technology for the Rolls-Royce Group. Part of my accountability is the university research centres and advanced manufacturing centres that Rolls-Royce runs around the patch.

Patrick Reeve: Good morning. My name is Patrick Reeve. I am a managing partner of Albion Ventures, and I am also Chair of the British Venture Capital Association public policy venture committee.

Q1 Chair: Thank you very much, gentlemen. As you know, following the work of Dr Hermann Hauser, James Dyson and the Government's announcements recently in relation to Technology Innovation Centres, we are looking at the proposition. We have looked at how the German model works. A group of us were in Berlin recently, where we met your colleagues in Rolls-Royce, Professor Parker. We also met people with some financial expertise as well as expertise in the sector. So we are now looking at this from a UK perspective. Perhaps I can ask you all this question. What principles should be followed in identifying technology areas or industry sectors in which we ought to be investing via proposed Technology Innovation Centres? Who would like to start with that?

Professor Parker: I think one of the imperatives for these new centres has to be to stimulate growth, so we should focus on those areas where that is likely to be most rapid. They should be areas where there is a world market that is large and accessible to the UK,

where the UK has the leading research strengths already in its universities—we don't have time to grow these new centres from scratch—and where UK industry is well positioned to pull through that technological capability. So those are the criteria that I would apply. Given the need to stimulate economic growth, things with a strong focus on pull through to manufacturing, as opposed to doing research that's interesting, has to be a major theme. High value added manufacturing, in particular, is an area where the UK has the capability to develop these areas and an area where the TICs would be very useful.

Q2 Chair: Just before we go on the others, aside from your obvious passion for aerospace, what other sectors would you want included?

Professor Parker: As we look at the resurgence of nuclear energy in the UK, we have to decide whether the UK is simply going to buy all that from abroad or whether we can stimulate an industrial base to generate that internally. I believe we have the basis to do that. The whole area of renewable energy, again, is ripe for the picking. If we are going to meet the Government's targets, then, again, we have to have not just some bright ideas but an industrial base to deliver that by the end of the next decade.

Patrick Reeve: Could I add to that? I think growth is the key. In a pretty fast-changing world, there are certain areas broadly globally that are changing and developing. I would say that the environmental area is quite important. It is areas such as food sustainability as well as water sustainability. Such areas have long-term growth prospects across the globe, not just in the UK, but equally where the UK can make a difference. Another area, clearly, is regenerative medicine.

Dr Bradshaw: If I could follow on from that, I thoroughly agree. We must focus on business demand and building industrial capability within the UK, so that we can compete internationally. Just to go back a little and think about the situation we have at the moment, we have some centres already existing doing things like advanced manufacturing. Many of them

are supported by RDA money at the moment. So when you are talking about establishing criteria for selecting new centres, I urge you to look at the transition from where we are now to a future situation as well because I think, particularly at the moment, there is a danger, with the RDA money disappearing, that some of the excellent centres that we've got working at the moment will find themselves with the best staff wanting to leave, there is uncertainty and they don't know what their future is. So before we start getting down the road and looking for long-term future new centres, let's look at the existing ones and let's look at how we can support those through that transition phase.

Q3 Chair: Have you any evidence that backs that up, Dr Bradshaw?

Dr Bradshaw: Their funding is likely to run out in March. If you have some very high calibre people working in those organisations who are thinking, "Well, my job's uncertain after March. I should be thinking about what else I could do," once you start to get that climate of uncertainty within those organisations, you start to have problems. I urge the Government to look at this and think about how we can make sure that those centres remain stable in the short term.

Dr Bembo: In terms of potential candidate areas, defence, safety and security issues are clearly a major market for the UK and are growing markets globally. Somebody has already mentioned water and food sustainability, and I would include security of supply of food chains and utility supplies, which is a growing concern. Another area which has strong possibilities is ICT in general, so utility of high performance computing capabilities, grid and cloud computing and some of these emerging technologies. Also there is the digital economy more broadly, not ignoring some of the strong capabilities in the UK university sector in areas such as digital media, for example, where there are enormous and growing markets. For example, there have already been three major investments by UK research councils in digital economy hubs across three parts of the UK. We should lever from those original investments.

Dr Bradshaw: Chairman, can I just come in on the types of centres that you might support? I purposely did not say that in my piece, because we have heard many examples. I could add another, probably, half a dozen—regenerative medicine, renewables, composites, advanced manufacturing and process industries. They are all potential candidate areas. I suppose our concern is that there is only a finite sum of money available, and one has to take some very hard decisions to make sure that centres that are supported are done so at a critical mass, so that they are effective. I didn't want to put in a long, long list, because I know there is a long list. We all have our own favourites. The key thing is to work with industry and to look at the ones which really will have the potential rather than us trying to give you a list over the table now.

Q4 Chair: You are absolutely right. There is a relatively small sum of money that we are dealing

with at the present time. Therefore, there are going to be winners and losers in this process. It, therefore, follows that it is critically important that the TSB conducts itself in an open and transparent way to demonstrate that the benefit to UK plc is at the top of the list rather than somebody's personal favourite. How would you do it if you were here as the TSB?

Dr Bradshaw: Again, I am a little further back from the process, but you need to start in terms of mapping what we have already, because I don't think anybody really knows what we've actually got in the UK—where the potential centres are and what areas they are in. Then you need to talk to business and work out what their needs are. There are various ways of doing that, directly with business, through the old innovation and growth team-type model and through some of the councils and groups that were set up as a result of innovation and growth team work, such as the Automotive Council, for example. They all then have to take some judgments on priorities themselves within an internal process about how they decide which will have the most economic impact. The focus needs to be not the "Nice to have research" but "Will it actually make a difference to business on the ground?"

Then there are some other challenging issues because there are already existing centres in the commercial space, operating commercially, which we do not need to replicate or tread on the toes of. We need to think where something new needs to be added or where we've got a nascent centre that needs to be developed a bit further. So there are a number of steps we need to go through.

The last phase is that, if you have mapped the centres and what business needs and you can't map those two things together and develop something you have already got, then go down the route of developing something entirely new. The problem with that is that it takes a lot of time to get these new centres established. If we are trying to get an impact on growth and commercial return quickly, then it probably is better to start, by and large, with things we have already and build from those.

Professor Parker: I think the TSB already has a very good track record, I might say. It has been distributing over £300 million of funds. It has a very good feel from the competitions that it has already run, where those competitions are heavily over-subscribed and, therefore, in which areas there is strong industrial demand for industrial research. It has also inherited some schemes from the past that were less than successful. If you look at the £50 million the UK invested in nanotechnology centres, we tried to create 32 centres with £50 million. Frankly, it was a bit of a disaster, because you are not going to create any critical mass of activity if you spread it that thinly. So I think there are some good lessons to be learned.

I agree with Tim that, if we are going to hit the floor running, then, first, look at existing models and existing centres, and, secondly, build outwards from our strong universities, those with a good science base and with a good track record of working with industry. We can't afford greenfield sites if we are going to make any real impact on this. There are some very good examples where I think our university system

15 December 2010 Dr David Bembo, Dr Tim Bradshaw, Professor Ric Parker FEng and Patrick Reeve

has filled the vacuum left by gradually dismantling our base of national research centres over the past 25 years. We have a very good university system that's used to dealing with industry and can work with industry.

Patrick Reeve: I add, though, that you also need to work back from global demand and global competition as well. With a small amount of money, there is not a huge amount of point in putting it into areas where Britain is never going to be able to compete. So I think you need to work backwards as well.

Dr Bembo: I would like to add one point to that. In carrying out a mapping exercise I think it might be helpful to identify some of the existing centres, the existing investments, which do and can work with industry from a university base very successfully, which may not need to be augmented or have their funding added to through this process, but which could be catalogued and their presence and willingness to work with industry could be better advertised to the private sector.

Q5 Chair: None of you have described a particular type of centre. You are saying centres that could exist as part of universities and independent of universities.

Professor Parker: I can give you a couple of specific examples. The Advanced Manufacturing Research Centre at Sheffield is something we have been heavily involved with, with Boeing, since its inception. It is an extremely successful model. I think there are many industrial partners involved there. All the IPR issues have been sorted out. I am not saying that that should become a Fraunhofer, a Faraday or whatever we are going to call them overnight, but certainly that model is a good and well tried model. There are others. The Energy Technologies Institute is a different model. It is a club of people sponsoring research and putting in Government money and industrial money side by side. There is the Dalton Nuclear Institute at Manchester. Again, I think that is a good building block to build outwards for a future TIC.

Patrick Reeve: Could I give an example, which I don't think is formally a TIC? It is the Rutherford Appleton Laboratories at Harwell with a synchrotron, clean room facilities and, really, a huge amount of capital investment. They are facilities that, for instance, the nearby universities and, indeed, the nearby commercial businesses could not afford by themselves. So it becomes a nexus both of facilities and of expertise which is used by the universities and commerce. To me that is an interesting model. We certainly have one or two companies that are based there, that are using their facilities, where we have put in venture capital finance.

Q6 Chair: The success of Rutherford Appleton isn't on a single site. It is two sites working in partnership.

Patrick Reeve: Correct. It is part of a broader partnership. It is Rutherford Appleton, yes.

Q7 Chair: In that particular example, you have a lab which operates on two substantially separate sites.

Patrick Reeve: Absolutely.

Q8 Chair: But you would see it as fitting the model?

Patrick Reeve: I would. Both of those units, north and south, work very well and have good input from universities.

Dr Bradshaw: I have just two points on whatever model you operate. One would be that we ought to learn from best practice and not try and re-invent the wheel if we have some good things that work, and they may well be different for different sectors. The second is to run it on commercial lines so that they are focused on engaging with business and pulling things through to commercialisation.

Q9 Stephen Metcalfe: Touching on what sort of model should be adopted, there has been some discussion on whether it should be a technology push or an industry pull model for the various TICs. What are your individual views on that, and do you think that that should vary depending on which particular sector the TIC is focusing on, for example, regenerative medicine or manufacturing improvement? Should those sort of things vary depending on sector?

Dr Bembo: The science base is obviously a very important element of this. Jim Dyson made a plea for sustained funding of the basic science infrastructure in his report. I quite like the notion that comes out of the Fraunhofers that their basic science funding is to support science which is informed by industry. Therefore, it is not blue skies in the classical university sense. In terms of a model for investment, that seems to be the basis of the university technology push, if you like.

Dr Bradshaw: I think we would expect these centres to operate closer to market than the TSB with higher Technology Readiness Levels, working with business demand and trying to do our best work to meet their needs. When you go down that route, you have to think more of the pull side of this rather than the push side. Maybe in some sectors there will be more of the new science coming through, but I think the majority ought to be on the pull, working with business to try and bring as much as possible out of the science base that meets their needs.

Professor Parker: I think there has to be strong industrial engagement from the start with these centres. It won't work if you set them up and then expect companies to come along and use them later. You have to get a core group of companies around each individual technology that are willing to invest themselves and willing to pull, and it does have to be a strong pull. Having said that, I think the universities have to do a bit more to advertise their wares. They are being encouraged at the moment, and I welcome that, to think through the impact of what they do and be able to express that more coherently. It is not saying that every single piece of research has to be in Woolworths by Christmas—Woolworths is a bad example these days—or has to be in the shops by Christmas. Certainly people should think through what the impact and the applicability is, and then be able to express that in ways that industry can understand.

Patrick Reeve: In a spirit of compromise, I am keen on both push and pull. Coming back to the idea of

TICs being a nexus, from the universities they use it as a tool for increasing commercialisation of their early-stage proof-of-concept research, and from commerce as a testing ground and a source ground as well of new ideas for business areas.

Q10 Stephen Metcalfe: The Government has told us that the TICs will have quite a wide variety of services that they will be providing from conducting their own R and D, access to schools and equipment to help scale up manufacturing. Do you think that is too broad an expectation from the TICs? Do you think we are asking too much of them based on a relatively limited budget?

Dr Bradshaw: I think the focus ought to be on development, demonstration, pull through to commercialisation and all the things that are required around that space. From our point of view, the critical thing they shouldn't do is to be involved in teaching, basic research, policy development and things like that. There is a danger that they might drift into that space. We need to be very clear that that's not their role. They are closer to market. They are pulling through technologies and developing technologies with business.

Professor Parker: I think they will create some of the portable skills as they do their jobs, so if these centres are working properly you won't get academics or students going there and living there all their lives. They will actually develop something and want to take it through into industry themselves. Technology transfer tends to work best when it goes on two feet and somebody's brain goes with it. I think if the centres are working well they will generate the skills by default, but I agree that they shouldn't be set up as teaching and skills centres. They are there to develop research and demonstrate its industrial relevance in a way that industry can pull on it and take it out into the world.

Q11 Chair: Should they engage with PhD students?

Professor Parker: Definitely, yes. I think that's a vital role. Again, the EngD programmes that we have around us already encourage PhD students to work with and in industry as part of doing their PhD. You would see a lot of the people in those centres working for and getting a PhD with it.

Patrick Reeve: I think you could go further than that and have secondees from the academics and the universities as well as part of the role in increasing commercialisation.

Q12 Stephen Metcalfe: As you have heard, we have already looked at the German system quite closely, and particularly the Fraunhofers. Do you think that our Technology Innovation Centres should be based along the same lines? Should they have the same scope as those or should we develop our own particular model?

Dr Bembo: The funding model for the Fraunhofers is interesting. I have already referred to this one-third budget that they have for basic research, which is industrially focused. A level of basic funding is very helpful in this instance for these sorts of industry-focused centres and institutes. One of the reasons for

that is that, if you tried to establish these kinds of undertakings and make them financially sustainable from the word go or within a fairly short time window, then you would find that they may concentrate on the types of activities that are going to generate income to keep the wolf from the door rather than concentrate on the targets and the areas on which you would like them to work with industry. We have certainly had direct experience of that from setting up similar centres in the UK, which had, maybe, biased their activities in the wrong way just to achieve financial sustainability.

Patrick Reeve: I think the core difference between Britain and Germany is that the British universities have strong technology transfer organisations within their universities which manages their research and focuses their research. Going back to your previous question, it is the research that needs to be done by the universities and it is the commercialisation in the TICs. That is the key difference, I think.

Professor Parker: You have to see the German system as a whole system, as you are probably well aware from your visit. You have the Max Planck Institutes, you have the Helmholtz Institutes, which are at the industrial sector level, and then the Fraunhofer Institutes. Those three bits of the network work well together and ensure the whole thing works.

You have also got the financial scale. We have got to be realistic about this. We are talking about £200 million over four years. The Fraunhofer network today costs €1.6 billion a year to run, and the Helmholtz is an even bigger sum on top of that. So we are not going to replicate the German system overnight. Can we see best practice there? Yes. I think there are elements of how they work and engage that are good. I think, equally, we've got some good models in the UK. As I've said before, I think our UK university system, and certainly some of the key universities, has a very good track record already of working with industry, so we do not want to put extra barriers in the way of that.

Dr Bradshaw: I absolutely agree with you. The German and UK innovation systems are very different. The Fraunhofers have evolved to suit that system. You don't need to just put that straight into the UK. I don't think it would work. I don't think we could afford it. As Ric has said, the scale is entirely different. As to the three best practice points, they are focused, they have long-term funding and they have a central core funding from Government, which acts as a catalyst to bring in additional funding and helps to de-risk some of the investments that others make.

Patrick Reeve: Can I add in one other key difference that I would suggest, which is that the TICs should be sustainable over the long-term, whereas, clearly, the Fraunhofers aren't? They are reliant on a continued stream of funding. I think sustainability creates a certain discipline and focus on what you do. It's not going to happen at once and it may take 10 years to achieve, but as a goal the TICs should be sustainable.

Professor Parker: I think we have learned that lesson already with the IMRCs and other things. We've set them up with a five-year budget and expected them to stand on their own two feet at the end of it, and they fall over and disappear. How many of the Faraday

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Institutes that we set up in the '90s still exist? There is only one in the guise of Begbroke Science Park at the Materials Centre there. You have to recognise that we are in this for the long term. If we are going to set up these centres, we need a 10-year contract to start with. We should recognise that Government money will always be necessary to drive them forward, or they should cease to exist if they are not performing. I think it is unrealistic to expect everything to stand on its own two feet. The German system certainly doesn't.

Dr Bembo: I would agree with that. I think the centres need to be the subject of performance review, and certainly the Fraunhofers drop areas of activity if they are not performing or if they are no longer industry-valid. I think that is important, too.

Q13 Stephen Mosley: In your responses to previous questions you have mentioned the existing centres of applied science and research in the UK. I want to explore that more fully to see if there is anything that we can learn from those in order to enable the Technology Innovation Centres to deliver what is required out there. Dr Bradshaw, I have seen in some CBI written evidence that you talk about the National Composites Centre and you highlight that as a particularly good model. Could you just explain why?

Dr Bradshaw: I think because it is engaging broadly with a wide range of businesses. It is obviously something for which the UK has a capability need for the future, and it is not just one sector. We have aerospace, renewable energies and vehicle manufacturers all wanting to be involved. I think that is a good model. It is taking that capability and R and D and taking it out broadly into the UK industrial base. It is rather an open model. That is one thing I would like to stress. I don't think we want to see the Technology Innovation Centres set up as a club where only one or two companies can get involved. We do need to be able to open them up so that a wide range of businesses can tap into it.

Q14 Stephen Mosley: That is quite interesting. I know in your evidence you also say that advanced manufacturing research is not seen by all companies as fully open as an open Innovation Centre.

Dr Bradshaw: I think that is more a case of it being early days where there are a couple of companies that have a very good link into the centre and one could see how you might build on that for the future and bring other companies in as well. So some of the things will evolve with time. You might end up with five or six companies that always end up being the ones making the most use of a centre. That doesn't mean that there shouldn't be others who can tap into it, help to work in partnership and do things with them.

Q15 Stephen Mosley: One of the important things we have heard is about the sustainability of the TICs. Are the current centres sustainable?

Dr Bradshaw: We haven't looked into that in any great detail.

Professor Parker: The longest running one is the AMRC in Sheffield. Of the manufacturing type

research centres, the Advanced Forming Research Centre at Strathclyde has only just opened and the National Composites Centre won't open until next year. So the best model we have is that centre at Sheffield. It is on its third building now. It's outgrown two of them, but it has only achieved that with significant investment from Yorkshire Forward, and, as was said earlier, there is a concern where that support comes from in the world going forward and with large TSB and the EPSRC contracts. So it is sustainable in that sense, but it is not sustainable as a wholly industrially funded centre.

Patrick Reeve: Could I give an example of one which I think is sustainable or getting towards it? Correct me if I am wrong, but I think the Medical Research Council comes under the TIC category. They have managed to get a considerable amount of licence income through their research activities. Creating that independent income stream, independent of Government grants over the long term, is where TICs should aim. I understand your concerns that this may not be possible, but I think it is an aim that they really should have. Because they interact with commerce and they are not universities, they need to be focused on commerce, income and, ultimately, over the very long-term, profit or sustainability from that point of view.

Q16 Stephen Mosley: Has the Government consulted any of you on the current proposals for TICs or are you aware if the Government has gone out and consulted industry, academia or venture capital at the moment?

Professor Parker: The TSB has been talking to many people. I chair the UK's Aerospace Technology Strategy Group. They sit on that group and they have certainly brought their preliminary thoughts on TICs to us, shared those and got our feedback. So, yes, through TSB, we have been talking to Government. I don't think we have been approached directly, but again we have talked with members in BIS about what shape and form these might take.

Dr Bradshaw: Ditto. TSB has been to a couple of CBI committees where we have had members saying, "Look, these are the sort of things we want you to focus on, so make sure they are business led; there's critical mass; they do map into research excellence in universities but they are commercially focused".

Q17 Stephen Mosley: In Rolls-Royce, we have a company which is currently investing in the UTCs—the University Technology Centres. How do you as a company measure the success or lack of success of those centres?

Professor Parker: There are four very simple metrics for our centres. First, what did you deliver to the company in the last year? We ask our own people on the staff, recognising that there is a time frame in all of this, of the ideas and technology that that centre has delivered in the past, what have we actually put into a product this year? That might be a four or five-year lapse in itself. We ask them how many patents we've got between us on the work done, and we ask how many people have actually been recruited from

those centres into the company. They are the four basic metrics on which we run our 28 centres.

Q18 David Morris: How can we encourage Technology Innovation Centres to work and co-operate with industry and universities? How should intellectual property rights be managed between industry and University Technology Centres? Industry could be sceptical of their technology being transferred to another company. How can their property rights be managed between the various centres of university and industry?

Professor Parker: Again, there are plenty of good models around us. We shouldn't re-invent the wheel. The Lambert Report laid out a number of model contracts for university-company interaction and many people use those today. I think it has stood the test of time. Again, the Manufacturing Research Centres have an IPR structure where the full level subscribers, as those companies that put in a significant amount of money each year to the centre, share all the IPR done from the core work, but it's possible for an individual company, whether a member or a non-member, to come in and pay for a specific contract where they will own the IPR and have some control of it.

I think that ownership of IPR is not the starting point. Usually with a university it works best if you sit down and say, "What do you want to do with IPR and what do we want to do with it?" If you have that debate in a grown-up way you come to the right answer. The critical thing that most companies want is competitive advantage. That is why they are in the world. What they don't want is to work with a centre to develop a piece of IPR that the next day is on sale to their competitors. That is the only protection that they are looking for. If the centre wants to use the same IPR in a totally different domain with a different company and in a different sector, fine. With our centres, we already work with them to help them do that.

Q19 David Morris: Do you think that Technology Innovation Centres should be aligned with partner universities to specialise in one particular area to address this problem?

Professor Parker: I think that they should have a very strong link to and ideally grow from a university with a strong research base in the technology area concerned and with a good track record of working with industry. I think if you can tick those two boxes then it will get off to a very good start.

Patrick Reeve: A sector that has quite a good model for IPR sharing is the pharmaceutical industry where drug licences are often shared between more than one of the large pharmaceutical companies and, indeed, also with the universities as well. It is simply a question as to who reduces the risk at what point gets what ultimate share of the IPR. I think people can work together on these for mutual benefit.

Dr Bembo: Horror stories over IPR negotiations between universities and industry on a protracted basis tend to be fairly few and far between but they tend to be the ones that are highlighted. In general, for these large scale undertakings, such as those which we are contemplating here, you would negotiate a robust

framework for management ownership of IPRs at the outset. In general, you don't tend to see problems working downstream. What university and industry want to do with IPRs in terms of publishing for universities potentially, and exploitation protection for companies, are often very compatible and the time lines can be agreed. So I don't anticipate that there should be anything of a sticking point in terms of the TIC structure.

Q20 David Morris: If the UK does adopt a Fraunhofer Institute-type model, you think that if we have a robust framework to begin with to protect industry—to hold on to its secrets, for want of better terminology—that will enable the new model to move forward and not fail like the Faraday model did?

Dr Bembo: I think so. The negotiations over intellectual property often fall down in part on issues of costing and pricing of work. There is a whole raft of issues here which relate to financial sustainability of the TICs in terms of how they would price their work for industry and the extent to which the universities would be involved with them. I think we can distinguish a TIC model from a company working one-on-one with a university where there may be an individual negotiation over publication, over intellectual property rights, etcetera. So I would anticipate a rather different model more geared to the needs of industry. For example, if a company works with a university on a consultancy or a contract research proposal, then it is very rare that there is an issue over things like publication, because if industry is paying the full economic cost for work then there is not an issue with the rights to the results sitting with the industry partner.

Dr Bradshaw: I absolutely agree. Establishing a framework early on is critical. We do have a very good starting point with the Lambert model agreements, one of which is around contract research. There are others around consortium research, which the TSB already uses.

Since we are moving closer to the commercial side of things, I wouldn't rule out also looking at some of the models used by some of the RTOs and commercial operations to see if we can learn some best practice from them. So the MIRAs, TWIs and BREs of the world, C-Tech Innovation and a few others have good models on how they deal with business on a regular basis. Let's get the framework right, let's open them up, look at the models and get that set early on. That will give the businesses confidence to engage.

Q21 Chair: That is the whole of the independent research organisations?

Dr Bradshaw: They have got some interesting models about how they do it; they are very commercially orientated and obviously much closer to business. If there are some extra things we can learn from that, then we should do at this early stage.

Q22 Gregg McClymont: Can I ask about the Faraday partnerships and why they failed? Can you elaborate on why they may not have worked so well in England?

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Professor Parker: They were not set up to be sustainable and yet they were supposed to be sustainable, so they had engagement but they didn't have strong enough engagement with industry, so industry were observers rather than being committed to the centres in a true financial sense. As I say, the only one that has really flourished is what has become the Materials Centre at the Begbroke Science Park in Oxford. I think that has made the transition to a successful centre. It is probably not quite in the original Faraday model, but you can trace the roots of the Faraday in what is there today. Many of the others didn't have that commitment from industry from the outset. They did not engage with industry in the right way, so there was this belief that you could lay out the market stall, put all your technology on it, people would come in, buy things and go away again. I think it really has to be a true partnership if it is going to work, and that's what we must ensure with these TICs.

Dr Bradshaw: I think part of that comes back to the governance structure. If you have a management structure which is led by business, then that is going to help.

Q23 Gregg McClymont: That brings me to the question of how the TICs are to be governed. What kind of structure do you envisage? Obviously, there is a tension between, say, Fraunhofer, which has strong corporate governance, but also maintaining autonomy for independent individual institutes. How do we manage that tension, if it is a tension?

Dr Bradshaw: I think certainly autonomy. Organisations need to operate at arm's length from Government and get on with the job of commercialising research and technology with business. I think an element of co-ordination is still needed so that we don't have TICs which end up, as they evolve, duplicating work that is going on elsewhere, when they could instead bring in new ideas and new technology from other parts of the system. So they are co-ordinating with other TICs, they are co-ordinating with TSB activities (and perhaps their innovation platforms) and are co-ordinating with the Research Councils. You need a governance structure which also allows for co-ordination and that they are not just set up as completely independent commercial operations. They have got to link in with other parts of the innovation system. So I think the management board needs to be able to have those links with the university research side as well. But I would urge that the governance structure includes business as a very strong part of that and helping to lead the organisation.

Patrick Reeve: If I could add to that, if you set a TIC a task of addressing a certain sector, that is fine, but sectors do develop and change dramatically over time. I think that the TIC needs to have the autonomy to go and develop its own path for success in any individual sector, and maybe even partially lead it as well, if necessary.

Dr Bembo: We have seen an increasing flexibility in the basic research funders in the UK, primarily the UK Research Councils, in supporting work which crosses their remits. There is "discipline hopping", as it is often called. I think that is important in terms of the way that the TICs are set up so that there is scope

for them to carry out projects which cross two or more TICs and they don't end up as silos of technology.

Q24 Gregg McClymont: Would the management board then be the appropriate level to make the decision about what sectors to focus on, because clearly that is going to be key but it is always tricky? I guess the logic of what you are saying is that business is in the best place, probably, to make the decisions about what the growth areas are likely to be.

Professor Parker: Certainly, if we are going to follow this one third, one third, one third model, so that one third of the money is coming directly from business, then business, clearly, has to have a strong say in how that money is spent and whether it is spent well. So setting these boards up from the outset with a good business presence is important, but I think also some slightly more remote level of oversight from TSB itself to just keep an eye on the centres and make sure that you don't get too much scope creep and they don't go off into areas that those centres weren't supposed to go off into and start overlapping or duplicating what is done elsewhere. It is always useful. It has got to be, probably, a dual level of oversight. I think the TSB itself can bring some insurance that the centres stay within their remit but also that they are encouraged to work together where it is appropriate.

Q25 Gregg McClymont: Finally, Chair, the make-up of the board in terms of the representatives would be very important in that, presumably, people are likely to favour their own industry as one that has scope for growth. Would that be a fair point? Does somebody have to hold the ring?

Professor Parker: As with any board, as a shareholder you're interested in the interests of your sponsoring company. As a board member your interests are in the well-being of the company you are asked to manage. I am often in both of those positions in some of the joint ventures we have. People from industry do understand those tensions but I think we have to ensure a broad enough spread to start with. As I say, if you are expecting industry to put in a lot of money and other sectors of industry are not willing to invest, then to direct a centre to do more work for those centres of industry that are not investing is a little unreasonable. So it will gravitate towards those people who would get the most benefit from the centre and are willing to invest most, I would suggest.

Patrick Reeve: I would urge you to have strong executive management who can make decent commercial decisions in a fast-changing market and not be overly stifled by the supervisory boards.

Q26 Chair: One of the important groups of customers in such centres will be the small and medium size enterprises. There does appear to be evidence that the existence of the institutional support in Germany is one of the reasons why there is slightly longer-term finance for developing companies in Germany. One sees more organic growth of businesses there than here. The SMEs have a hugely important role, yet we have tended to talk about companies the size of Rolls-Royce. How do you see SMEs fitting

into the structure and being part of that governance as well?

Dr Bembo: The nature of the support that university-linked activities can provide to SMEs is very different from the type of support that we can give to large businesses and multinationals when we work with them. What you might find is that there is a differentiation in the types of services that would be offered to SMEs as opposed to take-up from larger businesses. For example, we see a lot of consultancy take-up from the SMEs that we work with as universities. We see SMEs wanting to access university facilities, so large scale equipment, for example, and other infrastructures that they couldn't invest in as individual companies, as opposed to getting involved with larger scale demonstrator projects and development on a larger scale. There will be different offerings that appeal to the different sizes of company.

Professor Parker: I think the other thing to recognise is that many of our successful SMEs don't have a route to market in their own right. They don't just go out on the street and sell their wares. They rely on larger integrators to take their products, their ideas and build it into a system or product that eventually does go to the market. That is true in most sectors—the motor industry and our industry. I think there is a good record of larger companies being able to take their SMEs from the supply chain with them into these activities, recognising that most SMEs tend to have a much shorter timescale focus. If you say, “Oh, look, there's this European programme we really ought to do. It'll start in two years time and last five years”, then most SMEs glaze over and say, “Come back in six years' time and we'll have a look at it.” I think you have to be willing to take the SMEs with you and also create a flexible structure so that they can engage later in the day, perhaps. The big companies might be willing to sign up for something on day one that is a 10-year programme. We've done it with the Energy Technologies Institute. We have committed our money for the next 10 years. But most SMEs wouldn't do that. You've got to create a structure that is not closed at the outset but that can bring SMEs in and can find novel ways for the SMEs to engage.

Patrick Reeve: Our experience is that the number of SMEs that we come across have a long-term need for capital intensive facilities that they have no access to otherwise. That comes back to my idea of a nexus, whereby it is a facilities as well as an advice and services-led opportunity which SMEs can plug into for quite a long period of years and maybe even be co-located with.

Q27 Chair: This is where your Rutherford-Appleton example comes in.

Patrick Reeve: This is the example we have heard, yes.

Dr Bradshaw: I agree with all of those points. I have ticked them all off my list. The one other issue, I suppose, that SMEs have time problems with is knowing where to go to start off with. Even some large companies find that is a bit of a problem, but SMEs, in particular, often do not know where the best facilities are that they could go and tap into, where

there is research going on from which they can benefit and where there is best practice from which they could learn. Part of setting up the TIC model ought to be to try to work out a better model of getting that information out to the community that might actually want to use this.

Q28 Gavin Barwell: Can I bring you back to the issue of funding which a couple of you have touched on during the course of the evidence that you have given? In terms of annual core funding from the Government, what's your view about the level that a typical Technology Innovation Centre will require?

Professor Parker: My own view is that the starting point is about £10 million per centre per year in terms of the core funding. I think that the one third, one third, one third model is a reasonable one to aim for. You have to recognise that if one third of it has to come from winning grants and one third of it has to come from attracting industrial members, they are not all going to be there on day one, so the Government may have to face up to the fact that the pump priming needs considerably more than one third of the money in the first place and it then settles down to that model with time.

Patrick Reeve: It also depends on what is there already. So if it is an existing facility with, maybe, an existing commercialisation income stream on top of that, maybe it will be less, but I think you do need to have a 10-year horizon. I know that Ric may not agree, but I do think that after 10 years, if you can see your way towards doing without Government funding, then so much the better.

Dr Bradshaw: I think the £10 million figure is probably a sensible starting point, but some centres may well be more capital intensive and they may require more than that. Others may be able to operate with less than that. Over time I think you would see them evolve to a level of funding that makes them more sustainable. I thoroughly agree that it does need to have long-term core funding. The sort of balance of about one third business or a bit more, maybe one third to a half, and one third also Government and maybe contracts from Government delivery bodies, Agencies, Departments and things like that, might also be useful. I don't want to specify exactly what it should look like, but that seems broadly about right.

Dr Bembo: Again, working from the figure of £10 million per annum, I think it highlights that we need to work from existing capital investments; so, where there are infrastructures have been put in place in TIC-like installations already and/or in universities, then we need to capture those. It may be that some of the TIC investments may be based around distributive facilities so that there may be capabilities in a number of universities in a region, for example, which could be brought together.

Q29 Gavin Barwell: There are two issues that come out of that. The Government have given a budget of £200 million over four years, so it is about £50 million a year. So, clearly, you have all made the point that we may not be talking about all new centres. Some of it may be based around existing infrastructure. What number of centres do you think that we are going to

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get for that £200 million based on what you have said about what you think the core Government funding required is?

Professor Parker: I would have thought five to eight. Eight is certainly the maximum you should try and deal with with that sort of funding. We are more likely to get a bang for our buck if we stick closer to the five end.

Dr Bradshaw: I am not going to pick a number. I said at the very beginning that critical mass is absolutely important. Don't try and spread the money too thinly. It's going to mean that there will be some hard decisions to be taken. That may well then mean that with a limited budget you can only fund five centres properly or maybe eight or 10 at the most. You need to start with the actual business need first and work upwards, rather than thinking, "I've got £50 million. Let's try and spread it thinly over as many centres as possible."

Q30 Chair: That's a drop in the ocean compared with 59 Fraunhofers in Germany plus all of the other institutes.

Dr Bradshaw: Yes.

Professor Parker: It's a start.

Q31 Gavin Barwell: The other issue I wanted to pick up on was this issue of length of funding, certainty, as it were, and providing sustainability. The TSB has told us that the effectiveness of some of the existing centres has been hampered, in part, because the RDAs have only been able to commit to three years' funding. In terms of the Government's current position, you've got a four-year spending window that the Chancellor has set out. How do you think Government can balance this issue? Clearly, on the one hand, Professor Parker, you said that a 10-year contract would be the ideal from your point of view. Clearly, on the other hand, if the previous Government had been making public spending commitments 10 years ago, given what's happened in the world economy, it is difficult for Government to make commitments on that length and scale. How do you think we strike a balance between those two tensions?

Professor Parker: I think a good example is that the Energy Technologies Institute was set up by the previous Government to run for 10 years, and industry and Government signed up for that at the time. Clearly, you must have success criteria. There has to be, probably, a mid-term review point at which you say, "If this isn't working, we are not going to just all fund it for another five years," so I think a five plus five model is quite viable. With anything less than that, if you are really talking about these things getting a head of steam up and delivering something, then with a three-year horizon you are just about getting something working by the time somebody says, "Well, is it working? Shall we stop it? Shall we start it?" To get good quality staff to sign up to go to a new centre for a reasonable period of time, then to be able to offer them at least a five-year contract is valuable.

Q32 Graham Stringer: Can I just go back to what I think lay behind some of David Morris's questions? There are some excellent examples of the exploitation

of academic ideas both commercially and technologically. Is there a real cultural problem in taking ideas out of academia in that the academics' interest is in getting papers published as quickly as possible, whereas commercially you want to keep things secret, patent them and develop them? Is that a problem, and if it is a problem how can TICs help to address that issue?

Professor Parker: I think there are two issues. There is what is usually called "The Valley of Death" where an academic has got bored with something because he has been working on it for three years and thinks he understands it, but it is still a sticky black mess in a test tube and somebody in industry can't see it being a product. The TICs have a vital role in bridging that gap, in taking something out of academe that is past the academic curiosity point but not yet applicable as a product.

The other point on publication versus patenting is that one of the benefits of the, at times, difficult debate on IP ownership with the universities over the past five or 10 years has been that they do recognise the value of IP now. We may not all agree on ownership but certainly universities are switched on to the fact that you shouldn't just put the idea out into the public domain and then say, "Oh, gosh, I wish I'd patented that." So we work very closely with the universities with which we have contacts. We help them patent. We often pay for the patenting. We reward the individuals through our own inventors' reward scheme for the patents they generate. I think that encourages them. It does not proscribe publishing. It doesn't actually stop publishing. It just says that you need to have a mature discussion on what's going to be published and when, and just lay out that map in time. Once you have filed the patent, then they can go ahead and publish because, effectively, it's in the public domain anyway.

Q33 Graham Stringer: But it is still a problem, is it?

Professor Parker: We very rarely have problems with the academics we work with in terms of any tension between them wanting to publish and our trying to stop them publishing. I can only think of a couple of instances where we have absolutely embargoed something and they were both for national security reasons and not for commercial reasons.

Dr Bembo: If I could make a point, in around 15 years of working in this area, I have been through some quite protracted negotiations on what goes into an agreement between a company and a university on publication, on IP ownership and exploitation. In reality, in all but less than a handful of cases, actually, the agreement goes into a drawer somewhere and there is an effective working relationship between the academics in question and the company or companies. There is no barrier to publication and to exploitation of the science. I think this is a slightly overblown issue and it comes back to the point we were talking about earlier on about having effective frameworks in place for the TICs so that everyone knows the ground rules when they start a particular piece of work.

Q34 Graham Stringer: If we can go back to finance, I think the CBI has said that the Fraunhofers give

Germany a bigger impact for funding with European Union funding streams. Can TICs help business get into those European funding streams?

Dr Bradshaw: There is certainly a role for them to do that. We find that universities in the UK are actually very good at tapping into the EU framework programmes, but business rather less so. As Ric very neatly pointed out, it's very much the SMEs that get turned off because of the bureaucracy involved and the wait—the length of time of process—before being able to get any money out of the system. If we have TICs set up as national recognised research centres that can bid into EU funding and help to co-ordinate and organise some of that, I think that would be a very good role as part of their function.

Professor Parker: If I could just add to that, one of the biggest single programmes at the moment in Europe is the Clean Sky Joint Technology Initiative. There is €1.6 billion of funding. A lot of that goes to the national research centres in Germany and in France—DLR and ONERA. What have we got? Well, we've done away with our National Aerospace Research Centre. It's now QinetiQ, which is a private company, which can only go into these things if it brings its own money along or if industry pays for it as a sub-contractor. So we are losing out today. I think the TICs can only help by not just helping industry get that money but actually winning that money themselves to fund the research and the pull through that they need to do them.

Patrick Reeve: The other source of finance for the TICs and their activities is clearly venture capital, where there is and continues to be a growing use of venture capital by the university TTOs, and you have seen the new fund raising by Innovations earlier this week or last week. I think that is potentially an area that could increase quite sharply over the years.

Q35 Graham Stringer: You have just answered my next question. Basically, how should the overall capital investment in TICs be funded? You have mentioned venture capital as an important source. Where should all of the capital funding come from? How should it be funded?

Patrick Reeve: The capital for the facilities?

Graham Stringer: Yes.

Patrick Reeve: My view is that the £200 million should be geared towards setting these things up. The running costs should, over time, start to be more self-funding.

Dr Bembo: I noticed that the Fraunhofers have tapped into European Regional Development Funds for those areas which can access ERDF. Certainly last year they drew down tens of millions of Euros to establish new capital facilities. That is certainly something we should explore in the UK.

Dr Bradshaw: Again, the existing centres did do quite well out of the RDAs for their capital support, so whatever this new structure is, it needs, at the very least, to provide a similar mechanism. One of the things that has been quite successful in the Advanced Manufacturing Centres is that the equipment suppliers themselves see these centres as a showcase for their equipment, so they often give the equipment free of charge. They say, "You use it in this centre, and if

everybody comes here and figures out that this is the best tool to do their job on then they'll want to buy it from us." So it doesn't have to be all funded from the centre.

Q36 Stephen Metcalfe: By what criteria do you think Technology Innovation Centres should be judged to be successful?

Dr Bradshaw: Professor Parker had a very good list of things that they already use for their University Technology Centre, which sounds like a useful mechanism. I think a few other things that you could add into that are commercial income—obviously the amount of commercial income they are bringing in, and are they bringing in repeat business, because that will show that there is a mark of quality in that centre that others want to come back and use them again. I think those would be two central ones. I would look at things like patenting and other output measures—how much of their work has gone through into commercialisation. I wouldn't look at things like academic publications. That is something I am trying to rule out from this exercise so that the people involved do not feel they need to produce something for an RAE equivalent. It is focused on that commercial side.

Professor Parker: I would agree with Tim. The critical thing and the lesson from the past is to make sure that these are output focused metrics, not just activity metrics. Too many of the RDAs' innovation activities were measured by advice to industry. They ticked the box, 500 instances. Was it good advice or bad advice? Did the industries get better as a result or worse? We need to ensure that there is an output measure but also recognise that cause and effect in the research arena have a long time span, so expecting to put money in on day one and at the end of that year be able to measure what that particular slug of money has done isn't going to happen. It's got to be over a three or four-year period that you are making these assessments.

Q37 Stephen Metcalfe: Do you, therefore, envisage the TICs having a life expectancy so that they would, perhaps, peak having looked at a particular area and then decline again as things change?

Professor Parker: It depends on whether the technology itself is long standing or whether it is a transient, emerging technology that will become established and embedded. We have set up centres around advanced casting. Casting has been around since the Babylonians, so it is not a new technology, yet we are still learning about it today. I think there will always be a need to progress the basic methods, the basic computational tools that industry needs and the basic manufacturing tools, but individual technology areas will become transient, well-established and move on.

Dr Bradshaw: I've got a very good example of that. If you wanted to look at things like mobile phones, you might want to set up a mobile phone technology and innovation centre—well, fine. It will probably become an expert at producing mobile phone technology. But as we all know, the world has moved on rapidly and, instead of phones per se, effectively

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we now all use mobile computers operating with a content rich environment and tapping into things that you used to do on a desktop. They just now happen to have a mobile phone chip in these devices. So you wouldn't want a centre which just sits there and does its one thing ad infinitum without realising that technology has changed and that the commercial realities have changed. These centres have to evolve. They will have a time stamp, but some may well be long term. They may be 20 or 30 years. Some may well come in and do a peak of activity and then go out again. So long as you have a review system that identifies that and you have a business-led board which is saying, "No. Things have moved on. The commercial opportunities are now very different. We have got to build capability in a different area", then that should be part of your process.

Q38 Stephen Metcalfe: It is not inconceivable that centres will come and go depending on whether they meet their assessment criteria, they are judged as being successful and that they are performing a need, but, as long as there is a system in place to judge that, then that will continue to work?

Patrick Reeve: They will change over time, as indeed markets change.

Q39 Stephen Metcalfe: Yes. And if they don't?

Patrick Reeve: Then it's curtains.

Q40 Stephen Metcalfe: Finally, do you think that calling them TICs is the right name? Can you come up with an alternative?

Dr Bradshaw: I think the naming is a detail, a second order point, at this stage. A name is just a name. The important thing is having a brand, and you only get brand with reputation. I think you will have that established over time. So whatever you call them, if

they actually do a good job and they are recognised by business as being the place you have to go to if you want to commercialise, then you build a brand, and that's what's important.

Dr Bembo: I actually think whatever you call them is very important because there are a number of offerings out there at the moment. We have already highlighted a number of examples of existing centres and institutes around the UK. So, giving these a strong brand, a strong label, is going to be important. I think the Rolls-Royces of this world will recognise what they are because they are involved with things like ETIs and all of the other pseudo TICs around the UK already. But the SME community and the smaller businesses will need to recognise what they are getting into when they are working with these sorts of centres. I think, actually, it is very important. Also differentiating what we are talking about now from what's already in the market, for want of a better term, is also very important.

Professor Parker: I think that "TICs" is rather unfortunate, so finding a good name quickly for these would be quite useful. I agree with Tim that it is about brand management. It's about them having a strong brand and one that people associate with, so finding an inspirational figure to name the centres after would help people understand what those centres are trying to achieve. So Henry Royce Centres would be a good start.

Dr Bradshaw: Surely, Andrew Miller Centres.

Chair: As we are at the end of the session, maybe we should invite you to spend your Christmas pondering that last question. Maybe the folk who are listening to our exchanges externally might come up with some bright ideas that we could feed into our reports. Thank you very much for your attendance this morning and for being so frank. It's been an extremely helpful session. Thank you.

Monday 20 December 2010

Members present:

Andrew Miller (Chair)

Gavin Barwell
Stephen Metcalfe
Stephen Mosley

Graham Stringer
Roger Williams

Examination of Witnesses

Witnesses: **Pam Alexander**, SEEDA Chief Executive, Regional Development Agencies (RDAs), **Professor Richard Brook**, President, Association of Independent Research and Technology Organisations (AIRTO), **Professor Nigel Perry**, Chief Executive, Centre for Process Innovation Ltd (CPI), and **Professor Keith Ridgway**, Research Director, Advanced Manufacturing Research Centre (AMRC), gave evidence.

Q41 Chair: I welcome you here this afternoon, and thank you particularly for coming on what is clearly going to be a difficult travel evening. We shan't keep you overly long. Thank you very much for attending. As you know, the Committee is looking at the Government statement on technology innovation centres, which stems from the work of Hermann Hauser and James Dyson and the advice that was given to the two Governments. We're looking at how that fits in to the British context, and we're particularly looking at the Fraunhofer institutes in Germany and the appropriate model to develop here in the UK. We've been looking at this for a little while and have taken evidence in Germany, but your evidence is critical to this inquiry.

First, I invite you all briefly to introduce yourselves, for the record.

Pam Alexander: I am Pam Alexander, chief executive of the South East England Development Agency—SEEDA—and am speaking for the eight RDAs outside London.

Professor Brook: I am Richard Brook, president of AIRTO, which is the Association of Independent Research and Technology Organisations, representing some 40 existing RTOs, PSREs and similar organisations.

Professor Perry: I'm Nigel Perry, chief executive of the Centre for Process Innovation, which is located in the north-east of England, and its nascent TIC, which is focused on the process industry.

Professor Ridgway: I'm Keith Ridgway, research director and one of the founders of the Advanced Manufacturing Research Centre—AMRC—at the University of Sheffield.

Q42 Chair: Thank you very much for that.

Why do you think that it's only now that something's happened, when this idea has been around for some considerable time? When I was first on this Committee in the early 1990s, people were talking about the need for us to look at the Fraunhofer model.

Professor Brook: AIRTO has been saying that we should have something like this for as long as I can remember—20 years or so. I think there has been a perception about the key components of the infrastructure [for achieving economic growth from research]—on the one hand industry and on the other hand universities—and if you enable them to come together you will get economic growth as a result. It

has not been acknowledged that there is a task to be done between the research and the innovation and taking it into commercial exploitation, and that requires a special set of skills and some focus and dedication to achieving the industrial output as a priority. We have been advocating this kind of approach for a long time, comparing it with what happens overseas, particularly in Germany, but I don't think the message has been taken. Last year Lord Mandelson lighted upon the Fraunhofers. He took the message seriously and instigated the Hauser review, and now I think it's moved forward a long way in 12 months.

Professor Ridgway: We recognised 20 years ago that it was necessary. The universities have had a system of appraisal and monitoring that has been a bit averse to work in the industrial sector. It rewarded publication and pure research rather than work within industry. That has been a factor.

Professor Perry: CPI was set up seven years ago. We had Fraunhofer on our pre-incorporation board, and it's only because of the aggregated success story that CPI has become over the past seven years that it has actually been able to be exemplified in this field. We were fortunate to have Lord Mandelson come and see us. We also made quite a significant input to the Hauser report, so I think we've had a practical demonstration for the first time instead of a theoretical explanation of what is needed. You can come and look at CPI and take it to bits and understand how it operates.

Pam Alexander: There's also an increasing focus on the need for high-growth companies to drive jobs and wider economic development. The NESTA report, for example, which demonstrated that between 2000 and 2008 6% of the highest growth companies produced half of the jobs, has meant that that has become a real focus for both the previous Government's and this Government's approach to driving economic development.

Q43 Chair: The last time we as a country dabbled in this area was with the Faraday Partnerships, and things didn't quite work out as planned. What lessons can be learned?

Professor Brook: If I can start again, having run one of the first Faraday Partnerships. It started up in a very uneven way. In the early '90s we had Post-graduate Training Partnerships, which were one component of

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the mix. We then had EPSRC come in with some ring-fenced research money to act as a means for the universities to become involved. The Department of Trade and Industry at the time did not find the budget to provide what would be the core funding, so that started up quite a bit later. Then, when the ring-fenced research council money was used up, the research councils said, "The Faraday Partnerships can address the normal research grant application process and be peer-reviewed along with everybody else." Progressively, as industry wanted to pull the research towards the applied end, the scores that were being obtained from the peer review system progressively got less, because it was not really the glamorous research that industry wanted doing. There was not a particularly well-defined governance model, so a number of the Faraday Partnerships had different forms of governance. Some were run by universities and some were run by intermediate organisations. Most of them were bottom up, responding to an open call for proposals, rather than top-down and strategic. I don't think there was support for the brand development in the way that is being called for now. There were quite a number of things. It was a valiant effort, but it was too piecemeal and things didn't happen in a properly synchronised and co-ordinated fashion.

Professor Ridgway: That's very true. They didn't take the centre sufficiently out of the universities system. It was just going for basically the same funding. Funding was provided for a commercial director for the Faraday, and very little else when it got into a steady state. People went back to the funding mechanism, as has just been said, but it didn't differentiate.

Q44 Chair: Let me push you on that. Many of the Fraunhofer institutes appear to have a professor from a university leading a piece of research. What makes it different?

Professor Ridgway: The big difference is the funding mechanism that the Fraunhofer takes, which is roughly a third from the state, a third from the region and a third from industry—that's the model. It does not have to go back to pure basic funding to earn its income. With the Faradays, the problem eventually was that they had to go back to the EPSRC to get more funding. The Fraunhofers are quite safe in their funding longer term, with those three separate pots of money to take.

Chair: We'll no doubt come to that later on. Does anyone have anything else to add?

Q45 Graham Stringer: Professor Brook, what happens to all these institutes if the TICs are a great success? What happens to the existing centres?

Professor Brook: It's very important that the new centres fill in gaps in what currently exists, otherwise we would have the crazy situation of duplicating some of the expertise that already exists in the existing centres. Therefore, the TICs need to be able to link up the expertise and capability of the existing centres to deliver something that, at the moment, is not possible.

Q46 Graham Stringer: Who would make sure that there wasn't overlap? Whose responsibility would that be?

Professor Brook: That would be by taking a top-down view. One of the things that the Technology Strategy Board wishes to do, in my understanding, is to understand the map of capabilities that already exist and to identify—against the UK strategic needs—what is missing. The TICs should fill in and provide what is missing.

It may well be that their main role is to connect up a number of existing organisations in a hub-and-spoke model and connect them more effectively to the supply chain.

Q47 Chair: Including some of your members, presumably.

Professor Brook: Yes, I would think so. It's very clear that the money should not be used just to continue funding what's already being done. The TICs need to fill the gaps and address what's missing.

AIRTO's members already do quite a lot of what's needed. They don't have the core funding though. What then happens is that they behave very commercially. One of the issues is how you engage small businesses. Without the core funding, any organisation that is striving to be sustainable will turn its attentions to large companies, which can afford the research and the work that's being done. It will also turn its attention more to services and things that industry is prepared to pay for without risk.

A number of AIRTO's members do not do as much research as they used to, even though they would like to, because they do not have the means to fund it. That is where the core funding needs to come in—that is what the Fraunhofers have got, which UK organisations don't have.

Q48 Graham Stringer: Professor Ridgway, AMRC attributes its success to having a very clear vision and, I suppose, objectives. Can you elaborate on that?

Professor Ridgway: It was clear when we started working with Boeing, Rolls-Royce, BAE Systems, and so on, that the vision was to create wealth for all—for everybody within that partnership. In the AMRC, the university doesn't take out of the partnership. Within it, the money generated from partnership contributions and research projects funded by industry stays within the AMRC. But we have a very clear vision that everybody who is there is trying to improve their performance, get more work, take a larger share of the supply chain, and become a better supplier to somebody else in that supply chain.

Q49 Graham Stringer: I'll ask a similar question to Professor Perry: what is the key to the CPI's success? You have set up 11 spin-off companies. Can you explain how you have been so successful? Are there lessons that other people could learn?

Professor Perry: Yes. I think a combination of a number of factors has led to that success. First off is that we understand that innovation is a market-led process—it is an investor-led process. It is important as you move forward in innovation that you reduce

the risk to get to the stage where the investor will make that investment decision.

We work closely with the market. We are business led, like Keith, and we focus on delivering business benefit. Another way of looking at us is that we sit between the inventor and business, so it's not necessarily exclusively between academia and business. We find that collaboration is absolutely critical. We bring players together—industry and academia—into collaborative projects. It's that collaborative approach and the ability to exploit the results of those projects for all that is crucial. We have some brilliant people. We have been able to build a huge cadre of 1,600 years of experience in the process industry, which is available to and valued by industry. We have a very important set of assets—it is the assets that allow the process of innovation to be de-risked.

I think, if I was to put that all in a nutshell, you need to ensure that you have the assets that the industry you are serving requires and the people who are skilled and knowledgeable in commerce, business and marketing, as well as in academic research. You also need a constant and strategic vision about where you are going—it is a market-led process.

Q50 Chair: Is there any evidence that that approach results in the financial sector taking a slightly longer-term view with such SMEs than with companies without the kind of support you are able to give them?

Professor Perry: That's a very important question. CPI is a young organisation. It's seven years old now, and you have got to look at it compared with the Fraunhofers that are more than 50 years old. We are still establishing our own track record, but one of the things that we are saying to the private sector is that we can de-risk—we can carry out much more effective due diligence on the companies that we both spin out and work with, which will de-risk your potential investment. It's too early to point to a number of compelling examples where that's happened, but discussions are happening in real time, in which we are talking to finance houses, members of the BVCA, and so on, with exactly this proposition, and we are getting a lot of traction and a lot of interest.

Q51 Chair: You might be interested to hear that in Germany the senior civil servant, who was previously a banker, gave a one-word answer to that question when I asked him the other day. He said, "Yes." It will be interesting to see, in a few years' time, whether you can say that—whether the TICs produce the same kind of record.

Professor Perry: I am hoping it'll be in two, three or four years and not much longer, because those discussions are going on in real time, as we speak, and there is a lot of traction.

Q52 Stephen Mosley: In Dr Hauser's review, he identified a number of technology areas that he thought would benefit from having a TIC set up in them. I am sure that all of us in this room could come up with our own ideas, and I would be interested to hear what sort of areas you think would be useful, but when it comes to feeding that into the process, how

do you think that the Technology and Strategy Board should decide what areas these TICs should concentrate in? What sort of process should it use to ensure that it's transparent and open?

Professor Ridgway: It's fairly important that we get to industries that can actually produce results, so that we can see benefits within the time—the relatively short time—that people in industry have to get those results. High-value manufacturing has been mentioned a number of times as being an obvious candidate—aerospace, the nuclear industry. These are big markets to go for, and we can get results and demonstrate those results fairly quickly.

Pam Alexander: I think it's crucial that we have the world-class research base in that area, but also—as has just been said—that we have the industry that is ready and willing to take those opportunities and exploit them. We must be aware that it is a growing global market—it's a real opportunity that we can get fairly instant results from.

The independent review that PricewaterhouseCoopers carried out of Regional Development Agencies' innovation work suggested that we got an £8 return for every £1 that we were putting into the innovation infrastructure. That is something that we might use as a benchmark as we look at success for the future—but it does mean that there needs to be real potential. We also need to ensure that we are getting out into the business world—not just to the primes, as Richard said, but down the supply chain, to support the small businesses that can grow and become that opportunity for the future. That means looking at the whole ecosystem of innovation, not only the technology innovation centres themselves, but the venture capital funds, which will be co-ordinated by Capital for Enterprise Ltd, the business support structures and whatever support we are going to give high-growth businesses in the future. That has been the basis for the RDAs' support for the sorts of organisations that we have here today. It has been about putting the whole ecosystem together, not simply one end of it.

Professor Brook: I think that you need a business plan for investment. I would follow the model that you are investing in a company, so you would say, "where is the market and where is the need?" You would evidence that, and look at routes to market, how you are going to get there, what the strengths and weaknesses are, what resources can be brought to bear, how much it will cost, and the return on investment. I see a lot of merit in following the practices that we would apply if this were a company in which we were investing. Clearly, it is a broader enterprise than a company, but the process of defining markets, the route to market, strengths, weaknesses and competitive edge is entirely valid. I would want to see such a plan underpin each of the TICs.

Professor Perry: I agree. The critical importance here is the potential impact on the UK. Part of that equation has to look at the competitive position for the UK. If we are successful in establishing these TICs, we will recover some ground against some of our competing nations—that is crucial. It is very important that we understand where the UK can benefit from these. That will be in one of three areas: an area where there is existing economic activity, but innovation is required

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and needs to be supported by industry to get to an inward investment position or to support existing companies; a technology area that promises great potential, which has started to be exploited, but needs to be kicked that little bit further to get it there; or the difficult area of technologies that are still coming, but do not have any economic activity around them. If those three different types of activity can develop an investment plan, as Richard is advocating, we will begin to see where the sense is and where these things should be, but we have to do that in the complex competitive landscape in which UK plc is operating.

Q53 Stephen Mosley: In the past, the regional development agencies and the devolved assemblies have had their own science and innovation priorities. When the Government are drawing up their proposals for the areas and the geographic locations that the TICs will go in, should they be looking at the previous RDAs' or devolved assemblies' priorities, or should they look at new priorities or new areas?

Pam Alexander: Over the past three years, RDAs have looked at our strengths and priorities very much from a perspective of UK plc, as has just been said, because if we are not able to grow those international markets, we will not be succeeding. The work RDAs did with the Technology Strategy Board 18 months ago, which started setting out the different strengths around the UK, including the Devolved Administrations, has been the basis for a lot of the investment that has gone on since then in the different centres around the country. We are beginning to see those unique propositions, but I absolutely agree with what Richard said at the beginning—we need to create hubs and spokes. We are not going to have low carbon concentrated only in one part of the country. What will be really important is to invest in the hubs and spokes across the country that make the best of all of the resources that we have, whether it is business or university, without spreading the jam thinly. In other words, we should focus on the hubs that are the Technology Innovation Centres, but have them very well networked into centres of excellence across the country.

Q54 Stephen Mosley: The Chairman and I, as north-west MPs, have got a big issue that a lot of this investment always goes into the golden triangle between Cambridge, London and Oxford. I can understand that, because that is where the expertise is. However, we also have regional development aspects as well. Which do you think is more important for the location of the hubs: the regional development aspect or the centre of excellence?

Pam Alexander: I think that there are centres of excellence in the north-west where the RDA has invested substantial sums of money. They are real centres of international excellence. I am sorry I cut across you, Nigel, but maybe that was what you were going to say.

Professor Perry: I was going to say a number of things. First, I will hark back to the questions on Fraunhofer and the attachment between a Fraunhofer and an individual university. There is a compelling argument, which is that having the TICs independent

of the university knowledge base is quite important, because the TICs can go to as many universities as are world leading in the science that they are trying to access. That frees up the centre from having to put in a geographic location next to a university. I suggest that the next most sensible place to put it is next to the concentration of the industry, because it is the industry that, through its market pull, will provide the greatest tension in the centre and set its agenda. Pam is quite right that in the north-west you have the knowledge centre for materials chemistry at Manchester and Liverpool, and in associated universities. We work directly with that centre as a national centre in the north-east of England.

My final point is that the UK is a great country, but it is also relatively compact. We can move around it with relative ease, and we have got a good transport system. Modern communication processes do not mean that we need to sit next to each other to work with each other. We can move all round the country virtually and physically, if we need to, relatively easily. It is conceivable for us to have national TICs in, say, north-east England very easily. They do not have to be constrained by a geography that means we cannot move around the UK.

Professor Brook: I think it's very important to keep the fact that global growth of our market share for the UK is the key thing here. This is quite a complicated enterprise, so we ought to keep the message for the TIC itself as simple as possible. The north-east and the north-west come into play when we look at where the SMEs and other companies that spill out of this enterprise will go. I have another hat—being involved in investing in early-stage companies. The schemes that are available to support those early-stage companies in the north-east and the north-west are much more attractive, in many respects, and have much greater funds and capability than down here. So, for growth of jobs and new companies and enterprises, making those regions as attractive as possible to set up in, as you start to exploit the output from the TICs, is the most important thing in terms of how we can benefit those regions. Where should the hub be? I think it just needs to go where the best resources are.

Professor Ridgway: I think that our experience has been that companies have actually come to the expertise, and you should back the expertise.

Q55 Chair: In your case, it happens to be in a university.

Professor Ridgway: We're on the edge of the university, yes.

Pam Alexander: Could I just come back and say that there are already examples of where we are making the hub and spoke work. Renewables energy in the north-east is very closely hooking into the opportunities that we have in the south-west with Wave Hub. Daresbury is very well linked with Harwell. There are already collaborations going on across the country, which I hope means that this is not a choice between investing in the golden triangle and investing in the rest of the country. It is absolutely about getting economic growth that will spread across the industries throughout the UK.

Q56 Stephen Metcalfe: Let us explore the role of the TICs a little further. You talked about a pull model from industry. Do you think that that is the only model that can work? Should some models be the push model, and would that be in different sectors?

Professor Brook: I think it is about right, frankly. I think you need both, and you need them to work together. In the Faraday Partnerships, we successfully brought industries together and got them to articulate what they needed and were looking for, which was the pull. We got the academics together—actually, in the same meeting—and got them to articulate what they were doing and where their research was going. We then facilitated the matches between the pull and the push, to put together project consortia to take things forward. It needs to be both: without the push, you may not get as much innovation as you would like; without the pull, you run the risk of generating something for which there is no customer need. So, it's a balanced model, but it needs facilitation somewhere in the middle to make those two things join up.

Professor Perry: I agree that it's a combination of market pull and technology push. We have to remember that, as I said, CPI sits between the inventor and the business. I use that form of words deliberately, because universities contribute some of the inventions, but a lot of the inventions that are exploited by industry actually come from industry. There has been some excellent work at the Judge Business School at Cambridge, which has demonstrated what level of invention comes from our universities. It is quite a small number, but the key thing is that that's actually transformational invention—it changes the rules of the game. But the large amount of innovation and invention that comes from business is ongoing, and it is a daily activity. So we see a supply chain. We see the universities, a TIC and industry, but we also see the TIC interacting directly with industry and pulling in science where it needs to from the universities in a reactive mode.

Professor Ridgway: I think universities have been very good at the push model in the past; we've done that very well. I think we need to go over the top on pull. You will find, with a lot of the things that are pulled through, that SMEs then come in at the bottom end of the TRLs and provide that innovation down there. It is not necessarily universities. It is SMEs and people who sometimes have the mad ideas that you can bring through, because the leadership is there.

We really like to work with big companies, because I think they create the market for the SMEs. SMEs quite often want to see a market and a business. If they can see that, they don't necessarily want a grant. If they can see a market and a business, they will go for it.

Pam Alexander: The funding that we are talking about—a third, a third and a third—absolutely requires the private sector to see the commercialisation opportunities here. Otherwise they won't come in with the contracts that are needed to make this work. The commercialisation end is absolutely crucial.

Q57 Stephen Metcalfe: Do you think that the model will change from sector to sector, that there will be

some where there is more push and some where there is more pull? Also, you've talked about small and medium-sized enterprises. They are going to be quite important, I imagine, to make this successful and in the actual creation of growth. Is there a particular model that suits them better? You talked about pull—they want to see the market. Is it as simple as that?

Professor Ridgway: I think that sometimes working with big companies, for example Rolls-Royce, which is developing Trent 1000 or Trent 900, is creating a huge market. SMEs can start to fill that demand. You want to machine down the supply chain and providing materials at all levels. I think it's very hard to generate that level of economic development by SMEs coming and growing. For an SME to grow by six or 12 people is quite a task, but for Rolls-Royce to put 2,000, 3,000 or 4,000 people on its new engine programme is relatively easy. That creates work everywhere.

Professor Brook: I have two comments. We got customers into Faraday Partnerships by getting the big guys there. If they [the SMEs] knew they were going to meet the big guys at the meetings, they would come along, because they're potential customers.

It isn't one size fits all, though. It depends how well developed the supply chain is. If you're trying to insert innovation into an existing supply chain, you'll have one model. If the market isn't fully matured and if the supply chains haven't evolved, it needs a different model. I think it [in the latter instance] needs some technology push, but a lot of entrepreneurialism, and the key factor there is finding the guys whom investors can back to build businesses into spaces where supply chains don't yet exist, and that's where a lot of the great opportunities will be.

Q58 Roger Williams: The success of technology innovation centres will depend on how they work with industry and universities, particularly in terms of how confident each partner is about intellectual property rights. Have you got a vision of how TICs should work alongside companies and technology transfer organisations in universities? How will that look?

Professor Ridgway: We have a partnership model, which people sometimes criticise, but gives us a very clear IPR model that we can use. Basically, if IPR comes from partner funding, the university owns and protects it. The partner is allowed free royalty to exploit it. If a company wants to take its own idea forward, it pays extra, takes it and owns it. Quite a lot of companies much prefer that model, because as a university we tend to patent only the one thing that is important to us, whereas large companies put blocking patents out. We can't afford to do blocking patents. That relationship is quite important. So I think that we have to develop a relationship with the companies that's of value to us as a partnership; universities can exploit it. This is very valuable to one sector. The UK companies and industry will take it and protect it. The other thing is that protection is very expensive. We have found it quite difficult as a university to cope with that. We have sold things early to the companies to take on and protect.

Q59 Roger Williams: It has been suggested sometimes that universities would like to rush into

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publication before companies have the opportunity to maximise on the investment that they have put into the partnership. How can that be managed or how is it managed at the moment?

Professor Ridgway: It can be managed with collaborative agreements. We have collaborative agreements in place. Probably most of our organisations have that method of working where we allow the companies a certain length of time before anything is published. It may be two or three months before work can be published. I think it is relatively easy to manage on that basis.

Professor Brook: There are established procedures. In fact two of AIRTO's members are universities. I am on the intellectual property exploitation board of one of them. There are invention disclosure processes and it is a process of educating the academics about the relative advantages of publication, delay or protecting it [their IPR] and when to patent and when not to patent. Increasingly, awareness of these processes is being put in place. There is exchange of best practice between our members and universities and between the universities themselves, which is helping this process to become more established.

But if you look at the Research Assessment Exercise—the RAF as it now is—people are striving to produce publications because that is what goes into the assessment of the university's performance. If you are trying to tell people not to publish, that does not necessarily go down too well, but then you can usually find something that allows a publication but does not disclose the key thing that needs patenting. So with a bit of work you can probably get the best of both worlds, which is a respectable publication but also still the potential to patent. But it takes time and effort, and that costs. That is one of the things that is time and cost consuming.

Chair: And a bit more challenging in the hub and spoke model that has been described?

Professor Brook: I am not sure that is necessarily the case.

Chair: The more partners there are in a network—

Professor Brook: The more partners there are in a network, the more complicated things can become. Then it is a matter of who is managing that network and who manages the TICs and what they do in disseminating best practice out to the spokes and how they want them to work. Yes, to get this co-ordinated will take some time and effort. It is one of the things that the core funding is needed for.

Pam Alexander: But also since part of this is about the differences of culture between universities and small businesses in particular, the ability to reach out and help across that bridge is quite an important part of that mix.

Professor Perry: This is a key area. The objective here is to get knowledge that is exploited in the UK for the benefit of the UK. You've heard Keith talk about the importance of collaboration and the flexible model. That is certainly something that we would approach and recognise. It is a very important art form that the TIC is able to work with IP without leaking it and is able to work both pre-competitively and post-competitively. Pre-competitively is somewhat easier. Post-competitively, you are dealing with quite

significant levels of investment and quite significant levels of knowledge, which need to be protected. So what we do is work a very flexible model according to the collaborations and the organisations that we are working with. Sometimes it is very tight, where everybody is very clear what they can and can't do. Sometimes it is a little more open where there has been more flexibility.

The other thing is to recognise, particularly in the process industry, that intellectual property is protected by know-how rather than patents. I recognise the behaviour that Keith describes about blocking patents and such like because where we do patent, that issue exists as well. You have to be clear that there are different IP models in different sectors. It is important to be flexible. If you go in with a rigid model, you will come up against a large company's IP department which has very significant resources and you'll end up doing it its way. You also need to be flexible with the universities and recognise that they are rewarded through publishing knowledge. That again is a discussion and an agreement about when you can release that knowledge, if indeed you can ever release the core parts.

Q60 Roger Williams: It has been suggested that each technology innovation centre should be directly aligned to a particular university, and that that should be reinforced by a professor in that university being a director of the centre. I can see someone shaking their head already.

Professor Perry: We've worked with Fraunhofer. You have to recognise that there are 59 Fraunhofer institutes, so they can be attached to 59 universities. We're looking at a budget that doesn't extend to that number of institutes—we're talking about five to eight. I have discussed at length with Fraunhofer that there are very significant merits in a model that is UK-oriented and developed, in which the TIC is able to go to any number of universities from which it can get world-class research. In our research-funding process, we don't concentrate resources through a single university: we encourage competition between universities. We certainly take benefit from the fact that we can engage with any number of universities where there is that world-class science. That is what our industrial clients expect us to do.

Professor Brook: Actually, it's what the industrial clients want. They want the TIC to take apart their problem, source the science or the technology from wherever it best exists, and then put all that back together as a solution to the problem. I don't see any reason at all why there shouldn't be students, professors or academics on secondment, or whatever, into a TIC from a number of different universities. With the Faraday, one of the things that worked was that we developed a number of very good relationships with academics from at least a dozen universities, who felt part of the partnership.

Professor Ridgway: I think that the big loss of the RDAs is the investment that we've been able to attract over the years to do world-class industrially based research. I think that if the TICs need to do that, and on a split model, where a TIC is basically subcontracting to a number of universities, that

doesn't allow us to build that critical mass and that centre of excellence with the equipment and everything in it. So, I prefer the model that we are running now—I find it much better.

Q61 Gavin Barwell: I want to pick up where Roger left off and talk a bit about governance issues and also about branding. What measures do you think need to be put in place to ensure that the TICs have strong central governance and yet have that crucial institutional autonomy?

Professor Brook: I'm used to working with companies that are limited by guarantee and which therefore don't have a shareholder interest but do have a constituency of industrial and, with the Faraday model, academic stakeholders. You therefore need representation from the constituency to which you're accountable, but within that you need an executive board with perhaps one or two volunteers from the council—if you like—of stakeholders to do the day-to-day business. You formulate a group of stakeholders to whom the institution is accountable, and then it justifies its existence, and if they don't like what they're seeing or it's going in the wrong direction, the executive management gets fired.

But what's crucial is a clear vision of what the institute is trying to achieve, and that that is held consistent for a good period of time and doesn't keep wandering about because different people with different visions get involved. To my mind, it's very much like operating as a company, but you're accountable to a community of people rather than to shareholders.

Pam Alexander: If we're looking at this as a network that has a brand, it's going to need some strong driving from the centre to set up the terms of reference in the first place for the technology innovation centres. They need to be set by Government at the centre, and then by the Technology Strategy Board in more detail. They need not to be doing the governance for the TICs: they need to be very clearly setting the parameters within which they operate and what the success criteria are if they are to be seen as technology innovation centres for the future. We believe that the models we've been developing and supporting as RDAs have been very strongly business led. We see business as central to the governance, which needs to involve particularly small business, not just a few primes, alongside the other elements that are going to be in that mix to make it a successful centre.

Professor Brook: In my constituency—the Institute for Sustainability is an example—you've got the big guys in there. You need the big guys to be members because they will subscribe and help with support, but you also need representatives of the small companies to be in there as part of the mix in the community that you're accountable to.

Professor Ridgway: We need to be industry led, where we have an industrial board. This is my personal view. We need a federal structure, where we're given autonomy. Above that industrial board, where we have the basic TICs, we need probably a management board, possibly the TSB and some other people who can then take that overarching view of where things are.

Professor Perry: It's quite critical to recognise that the TIC is delivering value to the private sector, and therefore the private sector has a very significant role in the governance process, so that's the business-led, large corporate and SMEs, because there are different challenges in those. It's also important to recognise that it's delivering value to the public sector in terms of economic benefit—that's the whole purpose of it in that sense—and therefore it's appropriate that the public sector is also represented in the governance process. The proposition of the TSB being the overall co-ordinating body is entirely sensible, therefore, because that does bring industry and the public sector together. There's much merit in following the model that we use at CPI of having that also reproduced at the individual TIC level. It mirrors comfortably, then, the way in which not just the Fraunhofers are operated but also VTT in Finland, TNO in Holland, etc, and in fact most of the devices that we're looking at across our competing nations.

Professor Brook: I think the brand will need managing, by the way, because if we have variable performance among the TICs, industry will start to regard some of them as not quite what it needs. The brand will not have the power and the strength that it needs, so somewhere in the governance at the top level, somebody needs to look after the brand and make sure that the image and the performance reinforces the brand.

Q62 Gavin Barwell: Perhaps I could pick up on a couple of those little points, and then I have one general question for all of you at the end. Professor Brook, you were talking about companies limited by guarantee. Is that just for clarity? That's the governance model that the independent organisations that your association looks after tend to use?

Professor Brook: Not exclusively. In fact, I've got everything from universities through to shareholder-owned companies. QinetiQ is a member. We've got companies limited by guarantee. We've got a charity—the Institute for Sustainability. So, actually, the legal formulation is not key. It's what those organisations do that matters.

Q63 Chair: An employee-owned company.

Professor Brook: An employee-owned company, yes BMT.

Q64 Chair: BAE.

Professor Brook: One of the things that came out of AIRTO was a company that I have an involvement in. It invests in early-stage companies, raises funds and is shareholder-owned.

Q65 Gavin Barwell: A wide range.

Professor Brook: Yes, a wide range of different governance models. But when you look at trying to bring something new like this into existence, and you don't want it to fall too much into any particular—dare I say it?—vested interest, the model you generally come back to is the company limited by guarantee, at least to start with. You're then not beholden to a particular set of shareholders. You reinvest whatever surpluses you make rather than

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distribute them to the shareholders. Your assets can't be distributed to shareholders if the organisation does get into trouble. It positions organisations in that centre ground, albeit you don't have the ability to go out and maybe raise funds in the way that a shareholder-based company would.

Q66 Gavin Barwell: Professor Ridgeway, AMRC has stated in its evidence that it's a centre directed by a board of industrial partners.

Professor Ridgeway: That's right.

Q67 Gavin Barwell: Is the board purely made up of industrial partners or are there academics also represented?

Professor Ridgeway: There are 20 industrial members of the board. Three are from the university. It's actually owned by the university—as a university department. It's an institute in its own right. So it's not a company limited by guarantee. Although the finance is governed through the university, it does give us the advantages of being able to get—if you're going for European funding—better returns on grant rates and overhead rates. There is a lot of advantage in being a university from that point of view.

Q68 Gavin Barwell: Do any of you have views on what this network should be called? There seems to be a general recognition that branding is important. Do any of you want to take the opportunity to express a view on that?

Professor Brook: I haven't got a clue.

Professor Perry: I think we should remain silent.

Pam Alexander: I agree.

Q69 Chair: We said this to our witnesses and the public last week: we are looking for good ideas from you, so think about it over Christmas.

Professor Perry, you talked about the numbers that would emerge given the available budgets. You said about eight, but somewhere between five and 10 is possible if you look at the available monies. Is that going to be enough?

Professor Perry: The reality is that it's a great start, but I'm not sure that it is enough. We've done a lot of benchmarking across Europe with CPI, and what we see is that the average institute across Europe has about €25 million, or £25 million, and about 200 people. You've been to see the Fraunhofers. There are 59 there, and that is the average size of those 59. If you look at the £200 million, we mustn't forget that in the one third, one third, one third model, that should, with time, grow to have the economic impact of around £600 million effectively. On that scale, I think it is a great start, but it has some way to go yet.

Q70 Chair: Do you think we'll get that financial model off the ground, with a third from each partner?

Professor Perry: I think it is a target that we have to go for very hard. One of the assessment processes around that core funding has got to be to on the framework of the one third of the joint public-private projects, and also the commercial projects. But it is not something that you can magic overnight. We've been going for seven years. We started 100% publicly

funded, and we're now at 80:20. The arithmetic consequence of the one third, one third, one third model is 50% public and 50% private. We are targeting CPI towards a 50:50 private-public partnership. After seven years, we are operating at about 80% public funding and 20% private funding. We have to pursue that private funding. That's what gives you the benchmark that says, "You're doing the right things." We have to pursue the framework and TSB programmes because that again is evidence that you're doing the right thing. I think you have to do it. There's no question. It is part of the model.

Professor Brook: Most of AIRTO's existing RTOs are very much more towards the majority of private funding, with a minority of public funding. What they're missing is the core funding element, which allows you to regenerate your expertise, because you can't make the margins out of collaborative projects and work in this kind of space which would allow you to reinvest adequately.

I think that the TICs, in due time, will probably go towards a majority of private funding over public funding, but it will take time, and I think the core funding needs to be there until the market failure has gone away. If you stipulate that the core funding will be there for five, or even 10, years, then you take it away, and the market failure is still present, the TIC will move towards a more commercial model, and you'll lose the behaviour in terms of supporting small companies and engaging with more research as they seek a more conventional commercial model. The behaviour that I think we're looking for, in order to try to address the market failures that exist, relies on having that element of core funding on a continuing basis, at least until the problem has gone away.

Q71 Chair: Can I just stop you there, before I call in the other witnesses? You almost implied there that the public sector only needs to have a moderately long horizon, but the Fraunhofers, for a long period, across different Governments, have maintained a very significant chunk of public money in the structure.

Professor Brook: That's true, and I think we should be looking for the same continuance of public funding in these instances. But the Fraunhofers, of course, have evolved, changed and migrated—if you look at them now and 15 or 20 years ago, they are doing different things. They are changing and adapting to the needs in the market, in terms of the function that they perform.

Professor Perry: There are two issues here to be considered. The first one is that the technology agenda of a TIC will evolve. To use Richard's terminology, as that technology market failure is solved, then the centre will evolve to look at a different technology. But the issue of longevity of public participation in these things is very significant and very important, particularly if you are using the Fraunhofer as a model. You have to think, perhaps, of private sector investment. Capital is mobile—it can go to any country in the world. The process industry is a particularly internationalised industry. I would suggest that it's very important that we offer similar capabilities to other countries, in which process industry companies can invest. I think that the market

failure is probably a fairly long-term one in that sense—in the technology sense, it evolves and moves on.

Pam Alexander: Yes, the sustainability point seems to me a really crucial one, and it's one of the reasons why we believe it's important to be building on the investments that have been made over the past few years, because we have been putting about £170 million a year into the infrastructure of the centres that Regional Development Agencies have been supporting. Some of those have made great strides towards finding different sources of funding but, clearly, there is not going to be that much going in future. As has already been said, it is really important to keep the funding continuous and to make sure it gives confidence for the future.

Q72 Chair: Professor Ridgway, it would be helpful to know, in your case, what the percentage of private money is.

Professor Ridgway: It's at least a third, a third, a third—but it's probably higher for private sector funding. The reason is that we have a partnership model, so the partners pay £200,000 a year, in cash or the equivalent in kind—only in kind if it comes off the bottom line, if it's equipment we need. So, between a third and about 40%¹ is private sector funding.

Q73 Chair: In your written evidence, the AMRC said that three-year instalments of funds are sufficient, while the RDAs and Rolls-Royce, among others, argued for longer-term commitments. Do you think that the Government should really think longer term?

Professor Ridgway: I think we need long-term funding. Our problem in being with the RDAs is this big capital investment that allows us to be world-leading in, say, machining, where we need machine tools at £1.5 million a time. The RDAs were very helpful and allowed us to get those, and to work with the leading companies on that type of commitment. The projects are probably three to four years on those, which is fine, and that is the level of funding that we need to be continually updating and taking our equipment forward in the future. It's a continual need that we have.

Chair: It's a rolling need.

Professor Ridgway: That's exactly right.

Q74 Gavin Barwell: To follow on from the Chairman's questions in relation to core funding, I would like to look at where the additional funding for TICs will come from. How can strong links be forged between TICs and financial organisations? What are the best methods for doing that?

Professor Perry: The model we're pursuing recognises that. CPI is a company limited by guarantee—referring to an earlier question—and, as such, we can't receive private sector or financial institution investment. You just can't do it, so you need to create devices which, basically, are companies limited by shares, and that is where our spin-outs come in. We are trying to generate spin-outs for a number of reasons. First, so that we can attract private investment. Secondly, those spin-outs are using

technology that we have developed and they will, therefore, reward that technology. Thirdly, at some point those companies will be sold and there will be equity proceeds for CPI in total.

That is the model that we have worked out to bring public money into what we call the top company, which is CPI, and to bring private money into our enterprises operation. It is an organism—it is a symbiosis, with the private money getting the benefit of the public money, and the public money getting the benefit of the private money.

Q75 Chair: Is that always loans, or is it sometimes equity stakes?

Professor Perry: At this point in time it is almost exclusively equity stakes and not very much of them, which is why, earlier, I said that this is still real-time conversations that we are trying to develop.

CPI as a company cannot borrow money; we are precluded from borrowing money at all. We cannot collateralise our public assets or anything, whereas our spin-outs can. But they need a proposition that a bank will raise debt finance for them against that—that could be a business plan, intellectual property rights, or whatever.

Professor Brook: I think SMEs find it difficult to get bank loans—that is another conversation. But there are now early-stage funds that will invest modest amounts into an SME for a minority stake, either as equity or as a convertible loan. With my other hat on, we do that—and in the north-east.

Professor Perry: I know.

Pam Alexander: We have regional funds, which are helping to bridge that gap, particularly on the early-stage commercialisation funding. Those should be brought together under the new umbrella of Capital for Enterprise Ltd, but should still be available at regional level.

Q76 Gavin Barwell: In terms of accessing funding at European level, what role would you see them having in facilitating business engagement in that?

Professor Perry: This is a crucial role for the TIC. We have a device within us, which was originally funded by Europe, called the Enterprise Europe Network, which is to download euros. We have brought down up to €80 million for industry and for ourselves in that process.

As we move forwards we will be developing a dedicated team inside CPI, whose sole target will be to identify and target those framework programmes. That is critical, because the scale of the framework programmes is ambitious, as you are aware.

Also, the scientific contribution that the UK makes to Europe, if not the world, is very significant. We are regarded as a huge scientific contributor—we now need to leverage that out as a benefit through the framework programmes.

Professor Brook: It's a major role for the TICs, which can do a lot of good in helping in collaborations going to Europe.

Professor Ridgway: It adds to the problems of IPR management. Going into these large European programmes, where you have developed expertise yourself, you are now in a sharing situation with

¹ Note by witness: The figure is approximately 50%

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European companies—maybe they will be competitors of the British companies that you are already working with. It takes a little bit more thinking out to get right.

Professor Perry: If you look at Fraunhofer—I hope I don't burn my boats in my relationships with Fraunhofer with this comment—VTT, and other similar interposing organisations across Europe, they are extraordinarily successful at downloading European money. They have devices and mechanisms, and they behave as though that is a critical objective.

Q77 Gavin Barwell: Is it your view that the UK has not been extraordinarily successful thus far?

Professor Perry: You could say that, yes.

Professor Brook: We do well on the academic front; we do proportionately less well on the industrial front. The TICs can help, I think.

The process of applying for framework projects is quite painful in many respects and puts industry off. SMEs find it particularly hard to bear the risk that is involved. The TICs can be the champions of helping them into Europe.

Pam Alexander: The other element, of course, is the collaborative research and development grant funding, which enables coalitions to come together and share the costs and the pain of those applications. All RDAs have been involved in encouraging that, and, as we go forward, we will see whether the growth hubs or the Technology Strategy Board are able to give that same support.

Q78 Stephen Metcalfe: We've covered a fair amount of how we should view the TICs as successful. Perhaps you could summarise what you think are the indicators that they are being successful.

Pam Alexander: From our point of view, I think it is going to be about impacts on economic development, which is always the most difficult to measure. The GVA measure, which I mentioned at the beginning, of our return on investment of £8 to £1 is about jobs created. That probably makes the link between the different parts of the country and the need to create jobs for UK plc across the country. Those outcomes are going to be the bottom line, although along the way we will undoubtedly measure outputs in terms of patents and spin-out companies and, I'm sure, some of the inputs as well.

Professor Brook: The impact is the key thing, so I would say: progress towards the “a third, a third and a third” funding model; how much the TICs are enabling industry to recover from European programmes; and effective exploitation, which would come down—I hate to say this—to measures of patents or spin-outs, and the impact of those. I would probably also look at skills and what happens to the people, because the TICs are potentially routes for people to do a great apprenticeship in this intermediate commercial exploitation business, and then to move out either to set up their own businesses or to move into the industrial supply chain. My problem was that it was so attractive that I stayed there for my whole career. Secondments—the ability to have mobility between the industrial partners, the TIC and the academic sector—and the flow of people

are some of the things that I might look at to see whether they are being done effectively.

Professor Perry: CPI has been measured and assessed quite relentlessly since it was created, using the national tasking framework, which basically measures the economic impact in terms of jobs created or protected, leveraged investment and such like. Those give very hard and very auditable numbers—for example, CPI has leveraged in £500 million of investment and created or protected about 2,300 jobs, which are significant impact statements. You have to combine that with progress towards the strategy as well, very much as Richard was advocating. We are not going to wake up on day one of a TIC to find that it is a third, a third and a third, and we have to measure that progress.

There are some very important, if I may say, non-quantitative or qualitative measures, which relate to your stakeholders. That is the group of people involved in the process, both public and private, academic and industrial. They have to be convinced that the technologies that are being pursued are correct, that the centre is approaching them in the correct way and that it is actually adding benefit. There has to be a combination of those very hard national tasking framework numbers with progress towards the strategic goal and the stakeholder assessment of progress.

Professor Ridgway: The KPIs are very important and very difficult to get. In some cases, jobs created is not a good measure. High value added by high-value manufacturing is one thing. We need to be more competitive, so sometimes we might lose jobs for a while in some industries to become competitive. The fact that, as a nation, we can let companies go out to win large international orders and bring that wealth creation in is a big factor that we have to bear in mind. We keep partners within our organisations because they have created wealth, so we have obviously created wealth for everybody involved with us. Our suppliers throughout the supply chain, if they are willing to come and pay, will know the value and they will not pay for charitable reasons. We are not the only country thinking of this. We have been approached by 22 countries to go and give lectures about this type of model. We know of nine AMRCs that have been set up around the world already. Once people start to copy us instead of Fraunhofer, that will be a good indication that we are doing quite well.

Q79 Stephen Metcalfe: Professor Perry, I think there has been a statement that CPI's view is that the centres should be discouraged from becoming too private sector dominated. Do you want to expand on that a little for us?

Professor Perry: This is the point that Richard was making, which is that if we move a centre to be sustained wholly by its activities in the private sector, all that we have succeeded in doing is setting up an SME that will then behave exactly like an SME. The second point is that the private sector interests are those of multinational investors as well as SMEs, and we have to remember that part of what is going on here is to enrich UK plc. It is very important that there is creative tension. The comment also applies

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the other way. It is very important that this thing does not become public sector dominated. It has to operate in this interface between public and private sectors.

Q80 Stephen Metcalfe: Thank you for that. My final question is whether you consider that the TICs have a life expectancy. Do you see them going on for ever, or do you think that they will change and adapt, that some will disappear and that new ones will be created to adapt to the needs of the market? Do you think the Government should be taking into consideration any decommissioning costs for TICs as they reach the end of their life expectancy?

Professor Brook: I don't think that there are many decommissioning costs. If the company is limited by guarantee, the assets pass to another organisation with similar objects. Therefore, I do not think that you need to think about decommissioning costs. I would expect some TICs to stay in existence and migrate. I think that they will need to migrate—if you stay static, you are not doing the job. Some may well be wound up, and that will be down to the constituency that they are serving. If the industrial parties say “job done” and that they have lost interest, they may well decide to wind one, two or three of them up. In the long term, if TICs stay in existence they will need to adapt, but it is down to the industrial constituency as to whether it wants to carry on supporting the TIC or whether it feels that it has done its job and therefore wants to wind up the TIC.

Professor Perry: The concept has enormous longevity, but each individual centre needs to be

cognisant of the fact that it has to perform and that the consequences of non-performance are merger or desistance—whatever the appropriate word is. You will see things change and adapt, but it is very important that the concept is maintained over a considerable time, because it will take considerable time for the true economic benefit to emerge.

Professor Ridgway: In the sectors, you can see the TICs continuing as far as we can see. Within those TICs, you can see the themes that they work on developing, dying off and being replaced by new technologies coming through and their gradual replacement. The TICs will gradually change over time, but they will still serve the same sector.

Pam Alexander: It won't just be because of new technologies, it will also be because of changes in global markets and demands and the opportunities for exploiting those technologies. It will be about the changing outputs as well as the changing nature of the landscape.

Chair: Thank you very much for your attendance this afternoon, it has been extremely helpful. If you have any other thoughts, feel free to write to us. We are still in thinking mode on this, although we want to be able to publish our report before the Government say something too definitive. We have gathered some useful pieces of evidence, including today's, which will help inform the Government's decision-making process. Thank you very much for attending. I wish you a safe journey home on a difficult evening. The compliments of the season to you all.

Wednesday 12 January 2011

Members present:

Andrew Miller (Chair)

Gavin Barwell
Stephen Metcalfe
David Morris

Stephen Mosley
Graham Stringer
Roger Williams

Examination of Witness

Witness: **Iain Gray**, Chief Executive, Technology Strategy Board (TSB), gave evidence.

Q81 Chair: Welcome, Mr Gray. Thank you for coming this morning. As you know, we are continuing our Inquiry on the proposed Technology Innovation Centres. The Committee has taken evidence from a wide range of people and we have also had a look at some of the German models. How do you think that the Technology Innovation Centres will fit into the existing, rather complex UK innovation landscape?

Iain Gray: First, thank you very much for the opportunity to provide oral evidence on what for us is a very important issue. I would like to say upfront that we are looking forward to the findings from the Committee in terms of influencing how we move forward.

In response to the question, the Technology Strategy Board is very much looking at how we successfully promote and exploit technology-enabled innovation for UK business benefit. I guess, if you look at it in three contexts, who are we doing it for? We are looking across business—small businesses right through to large multinational businesses. If you look at what we are doing, the type of themes that we have been engaged in, we are working across a number of priority themes that go from healthcare, low carbon energy through to manufacturing. In terms of an organisation as to how we do things, we have a number of different tools available in our toolkit developed over the years working with business. It is important to put it into context. The Technology Innovation Centres initiative is not an initiative that sits over in right field on its own. It's very much part of an integrated landscape. It is one of the tools that has been identified as being a gap in that landscape. It sits alongside tools like collaborative R and D funding, public sector/private sector funding into joint collaborative R and D proposals, Government procurement tools, particularly tools like SBRI, the Small Business Research Initiative, and other tools like Knowledge Transfer Partnerships and Knowledge Transfer Networks. So it's a tool very much aimed at developing a small number of world-leading, elite Technology Innovation Centres. But I would emphasise right at the outset that it is that. It is a tool in a much broader landscape.

Q82 Chair: We have tried to create tools not dissimilar to this before in the Faraday Centres, but that did not quite work. Why not?

Iain Gray: Centres, in its own right, is not a new tool. In fact the Technology Strategy Board plays a role in supporting other types of centres. For example, the research councils have the Innovation and Knowledge

Centres in which we play a key part in terms of early stage science and research. Things like the Faraday Research Centres are an example of something that perhaps hasn't worked. It is important to note that centres can mean many things to many different people. The Technology Innovation Centres are going to be something focused very much around our strategic priority areas. Perhaps one of the issues in previous initiatives was that it was not focused enough. It was not focused around strategic priorities. Money that was invested was perhaps spread too widely, too thinly, and because it was not linked in with national priorities perhaps there was not necessarily the sustainable funding that sat behind it, that would make them successful and give them longevity. It was not necessarily what business was looking for either. The Faraday Partnership model was before my time in the Technology Strategy Board, but, as I understand it, it effectively evolved into more of a knowledge transfer-type mechanism rather than a centre which is a world-leading physical centre, which had people, equipment, skills and which business would go into. For me, we are looking at a very different type of model from the Faraday Partnership model.

Q83 Stephen Metcalfe: Good morning. You mentioned strategic priorities. What progress has the TSB made in mapping our existing capabilities against those strategic needs? Could you identify some of the gaps for us?

Iain Gray: Stephen, are you talking specifically in the "centre" context or are you talking in a much broader context?

Q84 Stephen Metcalfe: I could widen the question out slightly. We have a range of centres at the moment doing different things, and where do you identify the gaps? What is missing if we are going to meet our strategic needs? Therefore, looking at those existing centres that we have, how are they going to play their part when we have set up some elite Technology Innovation Centres?

Iain Gray: In the context of what exists today, and it is worth putting on record that the Technology Innovation Centres concept is a UK-wide initiative, there has been a lot of focus in the last six to nine months on particularly the English RDA funded centres. But it is worth saying that Technology Innovation Centres are UK wide.

Over the last three years we have worked very closely with the devolved Administrations and with the

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English RDAs to understand what centres exist and what their capabilities are. It is fair to acknowledge that there are some very good centres operating within the regions today. A much bigger gap is the fact that they are sub-scale and that they have not been operating in a joined-up way, focused around UK-wide national priorities. So you could probably take each of the thematic areas and pick out some good centres operating at a regional level in each of them. The issue has been more a process of lifting the bar and lifting the game. We are not putting sufficient focus on centres to make them world-leading, to operate on an international scale. That is what the role of the Technology Innovation Centres is trying to perform.

We have looked at a long list of nearly 100 centres around the UK. There is probably a shortlist of a couple of dozen that are operating at what I would call a reasonably good regional, maybe even national, level, but what we really want to do is to identify a small number of world-leading centres—six to eight—that can operate on a world stage.

Q85 Stephen Metcalfe: Would you see the six that you have identified as becoming TICs? Is that what you are saying?

Iain Gray: No. It would have been naïve not to understand the current landscape, so we have looked at what does exist. In fact, we have been actively involved over the last few years in some of them in terms of what has gone into those projects. This is a timely hearing in some respects, although it's slightly out of sync in terms of exactly where we are in our process. As of last week, so this is subsequent to the first two witness sessions, we have launched a prospectus, which contains four questions and a timeline. Two of the questions are relevant to your question. We have given our view on six fairly broad priority areas. They line up with our own priorities. Question 1, which is essentially out to the business world, is: Have we got it right? Are those the six priority areas? Have we missed something? Is there something else that should be considered? We are seeking responses to that question, effectively, by the middle of February.

With regard to question 2, what we've listed is titled at a pretty high generic level. When we come to launch Technology Innovation Centres, what we would expect to see is something which is a level down from that, a much more definitive focusing in on a specific theme. Again, we've asked for feedback from the business community by the middle of February. We have not made any pre-judgments in terms of what the Technology Innovation Centres will be. We have our own views on what the strategic priority themes are. Our starting position is that we have a reasonably good understanding of what the current existing landscape looks like, but we've not pre-judged in any regard.

Q86 Stephen Metcalfe: And you don't see the set-up of the Technology Innovation Centres as a threat to what we already have in place? Do you see them working together?

Iain Gray: I think that is a different question. Over the last few years considerable effort has been put into a number of regional centres. It is not our role, and it is quite specifically not the role of the Technology Innovation Centres, to rescue existing centres that, perhaps, are underperforming or not working in strategic priority areas. Our role is to identify a small number of what we can see to be genuine, world-leading elite Technology Innovation Centres. If in doing that we can take advantage of the investments and the centres that already exist, we would clearly like to do that. What we do not want to do is to start this whole process off by putting a whole load of new bricks and mortar into new centres. We want to maximise what we have available already, but it is starting from a different position.

Q87 Stephen Metcalfe: I understand that. We need to recognise that there will be these six to eight centres. What, I suppose, we don't want to do is to lose the good base that we already have by focusing too much on those, or do you agree that we need both? We need to maintain and protect what is there when it is performing, agreed.

Iain Gray: The Technology Innovation Centre is a quite specific concept. It is a physical centre. It may be co-located at more than one location, so we may have a centre which in its own way includes a number of sites across the UK. Six centres doesn't necessarily restrict us to six physical locations, but our starting position, identifying what we need from a UK perspective, is world-leading Technology Innovation Centres. Let's start with that as the question. Our objective is to get international world-standing Technology Innovation Centres.

Around the UK—this is where the word "Centres" can mean different things to different people—there will continue to be things like Innovation Knowledge Centres, which are focused more at the science and research end, working with universities. There will continue to be clusters around science parks. There will continue to be business parks and things like that. They are not Technology Innovation Centres. I would expect that they would continue to exist in various ways, but they are not Technology Innovation Centres.

Q88 Stephen Metcalfe: I have one final question. You have stated that in the past 20 years we have seen the disappearance of a large number of public sector and corporate laboratories in the UK. What effect has this had and how do we ensure that the TICs don't suffer the same fate?

Iain Gray: There is no doubt that, in terms of international comparison and comparison with other European countries, some of our Government-funded laboratories are now set up in a different governance arrangement. In some regards, that has disadvantaged us in some international conversations. It has given a different market perspective to those centres. Some have gone on to be very successful in their own right. The concept of a Technology Innovation Centre, however, is to provide funding into something that can provide longevity in terms of world-leading skills and world-leading equipment and that provides capability to which smaller companies can't otherwise afford

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access. It can really maintain UK competitiveness. It is a different model and there are questions that will be asked, perhaps even in this Committee, about funding and what the funding model is. But for me the key thing we want to try and provide is a sustained public-private sector funding model that gives a long-standing world-leading capability in the UK.

Q89 Graham Stringer: In your prospectus you have set out different criteria. Do you have any views about particular industrial sectors that you would be looking at for a TIC?

Iain Gray: Yes, and those views take advantage of both the conversations we have had with business over the last few years and the feed that we are getting from things like the innovation growth teams and the sector growth teams. So there are important sectors in the UK. Let's pick on manufacturing as one of those sectors or a capability.

Q90 Graham Stringer: That covers a multitude of sins, doesn't it?

Iain Gray: That was going to be my point.

Q91 Graham Stringer: It is huge.

Iain Gray: For me, high value manufacturing is one of the themes that we have picked up in the Technology Innovation Centre. What is important for me is that what we do in that regard provides spin-off between things like aerospace, automotive and pharmaceutical into diagnostics. In terms of manufacturing, what the Technology Innovation Centres should be doing is helping to provide the bridge between different sectors. What happens in one sector—let me take something like carbon composite materials in manufacturing—has applicability in the renewable energy sector, the motor sports sector, big applicability in the aerospace sector, and it also has applicability in the instrumentation and electronics sector in terms of products and goods. From a sectoral point of view, we are taking the inputs for technology road maps that have been developed by sectors, but for me the important thing about the Technology Innovation Centres is something that can provide capability read-across from one sector to another.

Q92 Graham Stringer: Will the Government have a view? Will the Government try or have they tried to lean on you and say, "You should be in renewable energy or nuclear power", or whatever it is? Have you had any pressure from Government? Do you expect Government to have a view on this?

Iain Gray: I would expect Government to have a view and I would expect it to be a bit of an interactive play. I would expect the recommendations and decisions as to what we do to be with the Technology Strategy Board and that is something that we will work out with business. Government has had a view in terms of its work with business on things like the innovation growth teams, and the Chief Scientific Advisers have a view in terms of future priorities. Our business works with Government to try and understand what the future priorities are. So Government is involved in an interactive way right through this process in

helping us to understand priorities and understand where policy is going.

Will Government put pressure on us in terms of the specific recommendations on centres? I am convinced we will receive local lobbying from people, but, in terms of the recommendations, I see them as being the Technology Strategy Board's recommendations. Our strategy, per se, will be bought off, signed off, by the appropriate Minister in BIS, which is the case and was the case last time round in terms of our overall strategy.

Q93 Graham Stringer: On a day-to-day basis how do you interact with Government? How often do you meet Ministers and get their views? At what level of the Civil Service do you meet? How is the flow of information between Government and yourselves conducted?

Iain Gray: As an organisation, the Technology Strategy Board comes under the sponsorship of BIS. We have a sponsor team in BIS and the interaction with that sponsor team is very good. The interaction is at least daily. In terms of meetings with Ministers inside BIS, I meet Ministers very regularly. On this particular issue, which obviously has been a priority issue over the last couple of months since the launch of the Technology Innovation Centre proposal, I have met Ministers at least once a week to discuss the progress that we are making.

I think it is also worth reinforcing, however, that the Technology Strategy Board works across Government and works with other Government Departments. So on a very regular basis I am meeting officials from the MOD, the Department of Health, DCMS, CLG and the Department for Transport. We are interacting not just with our sponsor Department but across Government Departments.

Q94 Graham Stringer: Are you considering a regional strategy alongside a sectoral strategy? Some of us think that there is an imbalance where new technology or science money goes in this country. A lot of it goes into the south-east. Do you have a regional arrow in your quiver?

Iain Gray: We will make our decisions based around where we think there is the best opportunity to have world-leading capability. There is not a regional allocation aspect to our agenda. My personal view is that when you look at capability around the UK and where centres of expertise, universities and business exist, quite naturally there will be a spread of centres. They will not all be co-located in one part of the country. My personal view of what the outcome will be is that there will be a reasonably good spread. We do not have an agenda which sets out with the objective of having a regional allocation to this. We are looking for world-leading capability, world-leading Technology Innovation Centres.

Q95 Graham Stringer: With the absence of Regional Development Agencies, do you think the Welsh and Scottish Administrations will have more sway as to where these TICs go?

Iain Gray: It's an important dynamic in the next few months in terms of how we interact with businesses

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across the regions. We have had very close interactions, for example, with the English RDA Science and Industry Councils. We continue to have interactions in that regard, but there is a dynamic. If you ask the devolved Administrations, they would actually turn the question round the other way: can they have an assurance that they will be involved in the process? From my perspective, we have put in place a process that we believe engages business across the UK. It engages trade organisations across the UK that have different regional aspects. I believe that we are getting the right regional input into our decision-making process. It is something we are very cognisant of and we will make sure that the process we have is as inclusive as we can make it.

Q96 David Morris: Should the UK TICs model be based on technology push mainly from the research base or technology pull from the business sector? How would you see that panning out with our model?

Iain Gray: It comes back to an overall objective of the Technology Strategy Board. As I said at the outset, I think it is important to recognise that the Technology Innovation Centre model is just part of a broader range of tools. In that regard, over the last three years, we have worked consistently towards more of a pull. We work in what is called Technology Readiness Level areas 3 to 7. It is pre-commercialisation. It is building on the science base. We work very closely with the research councils. Around 80% of our existing collaborative R and D programmes involve universities one way or another, but the emphasis has been around pull and commercialisation and looking at it from a business pull perspective.

Q97 David Morris: How would you police this particular scale? Would you say that it would go more towards the academia or university side, or more towards the business side? How could you ensure that it would be kept on an even keel within the TICs framework?

Iain Gray: To a certain extent, you are starting to get into the governance aspects of how we manage the Technology Innovation Centres. In that regard, we would put in place a management oversight board which I would see as having strong representation from both the business community with some representation from the academic community—big hitters. Each of the centres itself will have a level of autonomy in terms of how they operate within a set of rules and guidelines under the governance arrangements that we put in place. I would draw it back into the overall category of what success looks like for these centres and for us. The success is around the commercial exploitation. It is going to be the number of businesses that are queuing up to use these centres. It is the number of spin-out ideas that move forward into the marketplace that will be the key litmus test to this. If it was a question of which end of a spectrum it is going to be, it's the business pull end of the spectrum and the overall measures and metrics that we put in place, which are applicable across our wider toolkit, will be the litmus test. Is it working for business? Is business queuing up to use it? That is the key litmus test for me.

Q98 David Morris: In the early stages of any ideas in technologies coming through, would the TICs programme be applicable to small and medium-sized enterprises? A classic case in point is the Dyson case. He could not get funding over here. He couldn't get any companies to take him on. I think he has been instrumental with Dr Hermann Hauser on trying to figure out an input into working on the framework of the TICs programme. How would you see it going for small and medium-sized enterprises?

Iain Gray: That is at the very heart of our thinking on the Technology Innovation Centres. How do we provide a facility? How do we provide equipment and skills through Technology Innovation Centres that small and medium-sized companies can have access to? That is going to be one of the fundamentals of the way we set these Technology Innovation Centres up. It will provide open access to small companies.

I think it is important, having said that, to acknowledge the role that large companies can play in developing the supply chain and actually pulling small companies through. It's not a case of saying that we'll focus on small companies and ignore large companies or that we'll focus on large companies and ignore small companies. How do we create an environment that draws small companies in, using the role that large companies can play in pulling them through, recognising the small spin-out companies that develop ideas that have come out of a university base? So it is both ends of that spectrum. Small companies are at the very heart of our thinking.

Q99 Roger Williams: You have already said that these Technology Innovation Centres are going to be strongly aligned to the six priority areas that you have identified. That assumes, in a way, that there is going to be strong central governance, but we also know that if you have successful organisations and bodies they must have autonomous control at a local level. How do you see those two different forces working together for the most optimum outcomes from the TICs?

Iain Gray: One of the earlier questions was about Faradays and why those centres didn't succeed. I see a big difference in the Technology Innovation Centres in that, by aligning the centres to our strategic priorities, you are, almost by definition, aligning opportunities to seek funding to work with businesses in areas that are of a priority in a different direction. From a sustainability point of view, the fact that you are focused on priorities becomes a bit more self-fulfilling. The funding is there to sustain the Technology Innovation Centre because you are all working in a joined-up way towards what we have all bought into as the strategic priorities. To a certain extent, the sustainability of the centre gaining public and private sector funding will depend upon it continuing to work along that grain of strategic priorities.

When we put in place a management oversight board, we will put in place a series of measures and metrics according to which we will judge, on a reasonably regular basis, whether the centres are still performing. If they are not, we are not in the business of supporting underperforming centres. Are they still working in the right strategic areas? Are we still doing

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the right things? Have the strategic priority areas shifted? There will be a series of points where we will work with the management teams in these centres under the auspices of an overall management oversight board to calibrate where we are against those questions.

Q100 Roger Williams: You have already identified your six priority areas, and we have heard you speak very enthusiastically about high-value manufacturing. But there are some other manufacturing sectors that are probably not so fashionable but yet contribute a huge amount to employment in this country and probably to a greater part of the economy in a way. For instance, there is food manufacturing. It does not appear to me that food manufacturing would be one of your priority areas. How can you justify that in the sense that food manufacturing makes a very large contribution to the economy as a whole?

Iain Gray: Perhaps I did not explain myself particularly well in answer to an earlier question. When I talked about high-value manufacturing, one of the points I was trying to make was that I see such manufacturing in a very broad sense, and I cited aerospace, automotive and pharmaceutical. I would have included food manufacturing in that from a process point of view, so it does feature in our thinking very much. I saw manufacturing in that broader sense.

Your question is slightly wider, and in response I would say that there are many manufacturing businesses in the UK that will continue to prosper and work extremely well but which do not actually need the support of the Technology Innovation Centres. We are not saying that the Technology Innovation Centres is the answer to everything. We are saying that the Technology Innovation Centres are part of a much broader toolkit to help support UK businesses, and the Technology Innovation Centre is addressing a very particular need in terms of providing access to skills and equipment that small businesses might not otherwise be able to access. So there are other ways and means of supporting other types of manufacturing businesses as well. Food manufacturing is part of the manufacturing agenda as far as we are concerned.

Q101 Roger Williams: I visited the John Innes Institute and they spoke very enthusiastically about bringing together funding partners like the RDA, the local authority and the university with the research councils, obviously. That model will be harder to achieve with the RDAs changing their form and local government probably not having the capacity to invest in those things. Is that a model that you have looked at in terms of TICs at all?

Iain Gray: There are two dimensions to the question. One dimension is the research aspect and another dimension is the regional aspect. We work very closely with the research councils. BBSRC has some excellent centres—the Babraham Institute and the John Innes Centre—it supports. We work quite closely with BBSRC on a number of initiatives and we are looking quite closely at their governance models, best practice, what works and what doesn't work. So we are working closely with the research community. The

regional aspect to your question I think I answered earlier, but we acknowledge that it is important to work with the community right across the UK and we will use every device we can to make sure we are doing that.

Q102 Roger Williams: When a TIC partners up with a university or a university department, is it important that, for instance, an individual could be a leading member of the department in the university and a director of the TIC? Do you see that as a good way of enhancing that arrangement?

Iain Gray: You may be alluding to the observation from the German Fraunhofer model where it is one of the rules of engagement that the director of the institute is a professor at the university. We don't see that as mandatory from our perspective. We see this as very much a business-led initiative, but we do see strong engagement with universities and we do see universities commissioning research that goes into the centres. One of the key differences between the German model and the UK model is just that broader aspect of business engagement with universities. Businesses engage with universities in many different ways in the UK, so I don't see that as being a mandatory requirement at all.

Q103 Roger Williams: Some people have seen the intellectual property rights issue as a difficulty. Do you have any good practice as to how intellectual property rights could be managed between the business sector and the academic sector?

Iain Gray: We see intellectual property as one of the key things to work through over the next few months. A whole industry has developed around intellectual property. For me, the key question is: what do people really want to do with the intellectual property? Let's set up a consistent set of rules that we can work to here. There are templates. The Lambert report provides a template that has worked between business and universities. So we need some clear simple rules. What we do not want to create is an intellectual property industry. Let's work out what we want to use the intellectual property for. What does business want to use it for? What's the simplest and most effective way of getting that introduced in a consistent way?

Q104 Roger Williams: Another key question, as people have told us, is that branding is an important aspect of all of this. So what is the UK network of TICs to be called?

Iain Gray: The prospectus, as I said, has a number of questions in it. Two of the questions I have described already. The third question relates specifically to fast tracking high-value manufacturing, but the fourth question is an open invitation for suggestions on name. You may say, "What's in a name?" I would say that Fraunhofer is a great example of what's in a name, because I believe that the centres we have in the UK are every bit as good as the Fraunhofer Centres. What we do not have is a collective that allows us to sell that to the rest of the world. So I believe that a brand name that we can all buy into and use is a very powerful mechanism for the UK.

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Q105 Chair: If we could move on to funding, Nigel Perry from the CPI told us that the Fraunhofer funding model is not something you could magic overnight. How do you see the funding structure working? Should a structure be imposed to start with or is it one that we should move towards? Should there be a target of the institutions becoming, in time, self-funding?

Iain Gray: People talk about funding in two different ways. They talk about it in a quantum sense and they talk about it in a public-private sector partnership sense. In terms of the funding model, one of the good things that we have seen in the Fraunhofer model, which we like, is this so-called third, third, third funding model. Essentially, one third of the funding is public sector, which is a long-term commitment to provide sustainable world-leading skills and world-leading equipment. I believe that one of the successes of the Fraunhofer model has been that it has been a long-term commitment, by which I mean over a number of decades.

The second aspect of the one third funding model is, effectively, competitively won public-private sector funding against competitions, maybe European funding competitions, maybe UK funding competitions, maybe Technology Strategy Board funding competitions. One of the reasons I believe that lining up the Technology Innovation Centres with our own strategic priorities is so important is that that, in its own right, ensures that there will be a succession of competitions that the centres will have access to in a competitive sense. They need to win it, but there will be competitions in the themed areas in which the centres are involved.

Then the third one third of that funding model is funding that is effectively won through the private sector. I think a successful Technology Innovation Centre could see that part of the funding stream actually grow, and over time it could grow quite significantly. I wouldn't put a cap on that, but the element of long-term commitment from the public sector funding towards ensuring that we maintain and sustain world-class skills and world-class equipment is an important part of the funding model.

Q106 Chair: Because it is going to take some time—this sounds like a contradiction in terms—before the third third starts to grow and there is an opportunity for the institution to be well established and have the potential to draw in additional funding, it really means that at the outset the £200 million is not going to go very far, is it, compared with the Fraunhofer funding model?

Iain Gray: In quantum terms, £200 million spread across six to eight centres is not dissimilar to the Fraunhofer funding model in terms of funding per centre. The very big difference is that there are more than six to eight Fraunhofer Institutes in Germany. From the way we have set up this particular model, what is important is that we maintain the philosophy of having the money dedicated to a relatively small number of centres, so we don't take that amount of money and spread it so thinly that it doesn't make a difference at all. I believe that six to eight very successful Technology Innovation Centres would show the way and there is no reason why we couldn't

grow that model moving forward and beyond the £200 million and the six to eight centres. There is no reason why that could not grow into the future, but it is very important that the amount of money we have is invested wisely and is not spread too thinly across a very large number of centres. I acknowledge, compared with Fraunhofer, that it is a small number, but that number spread across that number of centres is very similar to the investment that goes into the Fraunhofer Institutes.

Q107 Chair: The other part of the Fraunhofer is, of course, longevity. Because the German political system doesn't fluctuate anything like our system does, that is perhaps one of the reasons why there has been this long-term continuity. How would you anticipate ensuring that that was built into the UK model?

Iain Gray: It is a very difficult question in terms of the political budget timetable that we work to, which tends to be a three, four or five-year cycle. We need to think of these Technology Innovation Centres in a much longer-term context. My vision would be that we should be thinking of a successful Technology Innovation Centre that is doing the right things, that is performing well and is operating on a world stage as a centre that is going to be here in 10 or 20 years' time.

Q108 Chair: So you would need a commitment from the Chancellor and, indeed, the shadow Chancellor that this quantum of money was available over a long period of time.

Iain Gray: We certainly need the longer-term commitment to this intent. These Technology Innovation Centres are not just here for three to four years.

Q109 Chair: In your prospectus you say: "Each technology and innovation centre is expected to be an independent legal entity." Does that present a problem for successful centres such as the Advanced Manufacturing Research Centre?

Iain Gray: It's probably too early to answer that question. We have issued the prospectus. We are getting some good responses back and we would see a period in our timeline between the end of January and March—in the first quarter of this year—when we will enter into some very serious conversations with centres that have expressed an interest. I don't know whether the Sheffield centre—the AMRC centre that you referred to—will register an interest or not. I assume and expect they will probably register an interest.

Q110 Chair: But both in areas like that and one can envisage some of the centres of excellence in healthcare where the third sector is involved, why do they have to be, according to your prospectus, separate legal entities? What is the explanation for that?

Iain Gray: The Technology Innovation Centres is a model that is going to mean something very specific. It comes back to some of your comparisons that you make with the Fraunhofer model and with other

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existing centres around the world. It means something quite specific and it means something that is very important for those centres that are part of a Technology Innovation Centre network. We, as a Technology Strategy Board, firmly believe that there should be a level of autonomy. We do not want to build a central organisation that is micro-managing these centres, but it has to mean something to be part of the centres, and part of that is that it does exist under an overall governance arrangement. Part of that is that it does have an independent board but it does report back to an oversight board. That ensures that whatever it does remains consistent with the goals of the Technology Innovation Centre network, that it is lined up with the national priorities and that it is working for the greater good of the UK economy. So, for me, it is an important part of being a Technology Innovation Centre. It does not mean to say that every centre or every physical entity that exists today is not a meaningful centre if it is not a Technology Innovation Centre, but it means something very special to be part of that network.

Q111 Stephen Mosley: In your answers to the Chairman's questions you talked about core funding a bit. I would like to move on to the third share that is going to come from the private sector. I know a lot of issues that we have come across on this Committee have been the issues facing companies wanting to develop new products and finding it difficult to attract the funding. I know that David mentioned Dyson and the problem that he had initially when he set up. How will you, the TICs, and organisations like Capital for Enterprise work together with financial institutions to ensure that the finance is available for SMEs in particular to be able to start providing some of that third that is going to come from the private sector?

Iain Gray: Again, it comes back to my point that I see the Technology Innovation Centres as being part of a much broader innovation toolkit. We are already working very closely with Capital for Enterprise in terms of how we can work together on the TIC model. In terms of the re-organisation inside, I would pick on the inward investment sides of the UKTI, the Capital for Enterprise aspects, working in a more joined-up way so that the Technology Innovation Centres are just seen as part of that broader toolkit. I can think of small businesses where the Technology Innovation Centre is not the answer to their problems. It is important to recognise that it is not the be-all and end-all. It is not the only answer to supporting small businesses. One of the roles of the Technology Strategy Board is building communities to understand the different types of things that can help different types of businesses in different stages of their development or in different sectors. So a Technology Innovation Centre is not necessarily the only answer to how we support small businesses.

Q112 Stephen Mosley: I know that one of the things we heard when we were in Germany speaking to the Fraunhofer Institutes is how they tend to believe that the banks and the financial institutions do have a longer-term view. We are very keen to try and encourage our banking and finance sector to do

something similar. I have heard you say that TIC is not the panacea or the solution to everything, but do you think it would help encourage more long-term planning?

Iain Gray: Yes. I am saying that it is a very, very important part of a toolkit. All I was trying to emphasise was that, because there is a real focus on it at the moment, there is a tendency to think it is the only answer to the innovation landscape. I have seen in the last 12 months in small businesses that we have had huge success in things like using Government as a lead customer through procurement—the SBRI process. A small customer who goes to a VC or a bank with a contract is worth an awful lot more than saying that you are doing a bit of work in a Technology Innovation Centre. Different companies have different types of requirements.

There are some aspects—and you can think of themes such as healthcare, regenerative medicine and access to high-value manufacturing composites-type facilities—where to develop capability you need access to very expensive kit and skills and capability that you can't otherwise afford. That is what the Technology Innovation Centre will do. It provides small businesses with access to capability that they couldn't otherwise obtain. But there are many, many other ways to assist. In terms of a longer-term commitment, I am sure that the financial investment community would welcome the fact that there is that longer-term support, but, from my perspective, SBRI is another very important part of our toolkit.

Q113 Stephen Mosley: We have heard from Universities UK and from the Association for University Research and Industry Links that they believe there should be some sort of floor, such as 30% to 40% of income from the private sector, and if that floor is not reached there should be some sort of claw-back mechanism for the Government or yourselves to recover some of the funding that you put into the TICs. Do you think that some sort of claw-back mechanism should be introduced?

Iain Gray: I had not picked up on that particular dimension. As a network, it is important that we put in place the right performance metrics so that if something is not working we can either correct it or stop it. What we do not want to do is continue to sustain non-performing centres. Again, that comes back to the governance, to the management oversight board and how we manage these centres moving forward. We need to have the mechanisms that make sure that, if the world has changed, if some disruptive technologies come along and make something obsolete or if a centre is underperforming, we can stop that. That, for me, is a different approach. Frankly, I don't see how a claw-back mechanism could work.

Q114 Stephen Mosley: We have talked about the core funding, the private sector, and then there is the other third of funding which you imagine coming from Europe and other national competitions, and so on. Do you imagine that each TIC would have its own dedicated team looking at this funding or would it be run on a more national basis, maybe by yourselves or a wider organisation?

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Iain Gray: I would anticipate each centre understanding the themed area that it works in. If, for example, there was an ICT competition area, an energy or healthcare area, then the centre would have the skills and capability to understand how it can engage with its business community. Again, by definition, the very fact that we have said that the Technology Innovation Centres should align with our strategic priorities means that there is a community out there to help support it. There are Knowledge Transfer Networks that can help support that. There will be technologists inside our own organisation that can help support that. Because we are working with the grain, the competitions that come along, both in a European context and a UK context, should fit very well the themes of the Technology Innovation Centres, but I would envisage them working with business across the UK in terms of making competitive bids for those competitions.

Q115 Stephen Mosley: Lastly, the £200 million is, basically, a revenue stream that is coming in over five years. How do you envisage any capital funding being funded?

Iain Gray: That is an open question. At the moment, we have put out a prospectus that seeks responses from the community. The very first competition fast track is high-value manufacturing. Whilst I do not pre-judge what interest we get or what we get back, my anticipation is that in that particular area we will see responses that embrace centres that already exist. That is one of the reasons why we have chosen to fast-track that particular competition.

Chair: A final brief question, Stephen.

Q116 Stephen Metcalfe: Thank you, Chairman. I just wanted to expand on some of the comments you made earlier about how we assess the value of the centres. One of the areas that you thought was important was the amount of business interest there

was, the number of businesses using them and the number of spin-outs that were created. Are there any other metrics that you think we can use to assess the value? Does everyone agree that those are important or are those just your view?

Iain Gray: That was my view. I think there is probably a consensus that says that those are things that can be measured in the relative short term, but it is a much broader question about how we measure the benefit of investment in innovation. A considerable piece of work has been done by NESTA on the Innovation Index. We are looking in a much broader context at how we measure the success when we might not see the success for five, 10 or 15 years. The ultimate success is jobs, economic benefit, inward investment, large corporations choosing to invest in the UK that might not otherwise have done so, corporations that currently exist in the UK continuing to keep their R and D base here in the UK, and small companies that are here in the UK growing into the next big FTSE 250, FTSE 100 businesses. Those types of longer-term success criteria will be as associated with TICs as they are with anything else. So I chose those specific examples more as things that I think will be quite visible and quite measurable in the relative short term.

Q117 Stephen Metcalfe: What would you call the “relative short term”, bearing in mind that the funding is only fixed for four years?

Iain Gray: In terms of businesses queuing up at the door to be part of a TIC, you could almost see that happening within the next 12 months on the Technology Innovation Centres that we nominate and establish. If we are doing the right thing, business will be queuing up to be part of it.

Stephen Metcalfe: Thank you very much.

Chair: Thank you very much for your attendance this morning. It has been extremely helpful.

Examination of Witness

Witness: **Rt Hon David Willetts MP**, Minister for Science and Universities, gave evidence.

Q118 Chair: Good morning, Minister. Thank you for attending this morning. As you know, we are continuing our Inquiry into the proposed Technology Innovation Centres. We are developing our views based upon evidence we have taken here and in Germany. Given the rich innovation landscape that exists in the UK, why do you think a new network is needed?

Mr Willetts: The case was made most eloquently in Hermann Hauser’s report for the previous Government. I am happy to say, on a cross-party basis, that I think it was an excellent report, commissioned by the previous Government, and we are broadly implementing it. It is that classic critique of the performance of the British economy that we have excellent academic research, we have some strong businesses but we are not as good as we should be at making the link between the two. It is what Hermann Hauser calls in his report the “Technology Readiness

Levels 4 to 7”. That gap does need to be plugged, and Hermann Hauser’s report, I thought, was very important in describing how that could be achieved.

Q119 Chair: Obviously, we have dabbled in this area in the past with the Faraday Partnerships and so on, but things did not go as well as expected. What lessons have you learnt from Faraday, the Research Associations and so on? How do you intend to ensure that this approach will survive the test of time?

Mr Willetts: Nobody can be absolutely sure. We have to accept that every policy has to be judged by its performance, but some of the lessons that have been learnt are, first of all, that you do need reliable core funding, and the Faraday scheme did not have that. Although we are not copying Fraunhofer—things are different—that model of money coming in, in three tranches of roughly a third each, of core funding from the public sector, a third then coming from business

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and a third coming from bidding for specific grants and programmes, is quite similar to Fraunhofer. We think that funding model is a good way of securing a longer-term future. Secondly, some of the previous initiatives were a bit too virtual. We think that having a physical centre with physical kit that is of particular value to SMEs, which might not be able to afford it themselves, at the core of the new centres is quite important. I hope we can learn the lessons from previous attempts.

Q120 Chair: A physical centre at a single location or multiple locations, or both?

Mr Willetts: I know, of course, that you have just been putting questions to Iain Gray. Some of these decisions do, rightly, reside with the TSB. We don't want, as Ministers, to micro-manage it, but the TSB have been talking to me about a kind of hub and spoke model. You might have one key centre but with links to others in some kind of network. It may not be the same structure in each sector of the economy, but that certainly seems to be one of the models to which they are strongly attracted.

Q121 Chair: Is it your expectation that existing centres highlighted in your response will become TICs?

Mr Willetts: We certainly think that there are some activities that have been, perhaps, sponsored by RDAs where you can build on an inheritance and create a Technology Innovation Centre, and Advanced Manufacturing, which is being fast-tracked, is the classic example. That seems to be a sector which would naturally benefit from this type of initiative and where we have probably had rather a lot of initiatives of sub-critical scope which we could bring together. That is what the TSB are fast-tracking. I hope, in addition, that there will be new areas, as listed in the prospectus, which don't particularly have a Technology Innovation Centre at the moment, in areas like ICT or electronics, photonics and electrical systems.

Q122 Chair: I was going to come to this later, but as you have touched on it, I will bring it up now. In the prospectus that TSB put out, it says: "Each technology and innovation centre is expected to be an independent legal entity." How does that square with an institution like AMRC?

Mr Willetts: I am sorry, but you will have to take me through it. Why is that a problem?

Q123 Chair: It is part of an existing institution and not an independent new institution.

Mr Willetts: We are envisaging that, eventually, each Technology Innovation Centre will require its own legal identity. If there are activities that are already happening that we want to bring within it, it would have to enter into this new legal entity—a "not for profit" Technology Innovation Centre. There are some interesting questions about what is happening to some of the assets of the RDAs, which have not been fully resolved yet. You may find that some things that currently belong to someone else, such as a university

or an RDA, could become part of this new legal entity. I don't think that's a barrier.

Q124 Stephen Mosley: You mentioned the technology areas within the prospectus. I know that Dr Hauser lists them as well. In the evidence that we have received a number of different areas have been suggested. What role do you think the Government should play in determining or identifying which technology areas we should take forward?

Mr Willetts: There are certain key criteria which we have agreed with the Technology Strategy Board. They should be areas where there are big global markets, where we already have a strong research capability in Britain and where we believe that British business has the capacity to exploit the technology. So we have agreed some of the criteria. As I say, there are some then which immediately clearly tick all the boxes and where you have the capacity, which is why we are fast-tracking Advanced Manufacturing. For the rest, the TSB then prepared this list. They will look at the evidence that they have in response and consider whether there are other sectors that could benefit, where people don't think that they can create a Technology Innovation Centre. It will be for the experts in the TSB to listen to the business and research communities that put forward proposals for specific Technology Innovation Centres in specific sectors.

Q125 Stephen Mosley: When you are looking at the geographic location of these centres, will there be any push from the Government at all to encourage regional development effectively, or will they just have a strict criterion that the location will be based upon centres of excellence when they are identifying the areas to invest in?

Mr Willetts: This is a very tricky one. I have to say that the crucial criterion has to be excellence and the economic criteria that are listed. I don't think that we or the TSB can plan this as an arm of regional policy. I very much hope, especially with this hub and spoke model and the Knowledge Transfer Networks that the TSB have, that the benefits of these reach out across the UK as a whole. But I think it would be dangerous if we set ourselves a target that, if you look across the country, by the time you had a centre for each Technology Innovation Centre, you see they are perfectly matched with one per region or something. Then we would be in danger of compromising the economic objectives.

Q126 Stephen Mosley: Up to now the regional development agencies have been pursuing their own agendas and centres, effectively. The RDA money, of course, starts to disappear in March. Have you any intention or ideas of how to stabilise the funding for the existing RDA-backed centres in the short term?

Mr Willetts: We are working flat out on what should happen to the assets and activities for which RDAs have been responsible. There are some that could become the core of a Technology Innovation Centre. As I said, one reason why Advanced Manufacturing is being fast-tracked—there are many arguments for it—is that you can see that there is some stuff that

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RDA's have done that can now be picked up and put into that Technology Innovation Centre. So, yes, that can happen on some occasions, which is one of the things we are looking at.

Q127 Stephen Mosley: Do you envisage that LEPs will have any interaction with the TICs at all?

Mr Willetts: The TICs are national centres, but I hope one thing that LEPs will bear in mind, if it is an activity in which a particular area is strong at, is that they are absolutely candidates for having a peripheral operation or getting plugged into the Technology Innovation Centre in some way. We think the initiative for that will lie with the Local Economic Partnerships.

Q128 Stephen Metcalfe: Governance seems to be quite an issue in terms of how we are going to make the TICs work and how we are going to get the most out of them. Do you envisage Government having a role? For example, should there be a ministerial involvement in the oversight of the TICs?

Mr Willetts: What we are envisaging is these autonomous business-led management boards for each individual Technology Innovation Centre and an oversight committee that will be within the Technology Strategy Board. One of the strengths of the TSB is that it has established credibility with the business community because people see that it is not micro-managed by Ministers. However, ultimately, the TSB answers to Ministers and, of course, we are answerable to the Commons and bodies such as this one. So the overall strategic decisions and performance will be discussed with and cleared with Ministers.

Q129 Stephen Metcalfe: So that will be via the Technology Strategy Boards?

Mr Willetts: Correct. It will be one of the functions of the Technology Strategy Board. The Technology Strategy Board will have the advisory oversight committee. In the normal process in which the TSB reports to and deals with Ministers, it will include an account of how the Technology Innovation Centres are doing.

Q130 Stephen Metcalfe: Do you feel that the centres should be aligned with universities and perhaps that their heads should have a dual role along the Fraunhofer model as a professor but also as the head of a TIC?

Mr Willetts: That is certainly an attractive idea. It is not something we would forbid. It is true to say that in Germany, despite the strengths of their economy, their universities do not have such strong direct links to business as have already been developed in the past decade or more. We don't envisage that as a requirement but there are very enterprising academics at universities who might want to do that dual role.

Q131 Stephen Metcalfe: Therefore, do you think the Board itself should lean more to academia or more to business?

Mr Willetts: This is the great challenge. The whole idea is that they should straddle that divide. There is a very strong business element. These are resources

for the business community. These are for SMEs or even larger businesses that wouldn't necessarily, for example, be able to afford a piece of capital equipment or where there are advantages for skills being shared and expertise being developed. So it does have to meet the needs of business. I am confident that universities will be beating a path to their door, but we are trying not to specify things like the balance of the composition of a board. We do not think that some of those rules, which they do have in Germany, are necessary in a British context.

Q132 Stephen Metcalfe: Obviously, one of the things that businesses will be interested in having, hopefully, gone to the Technology Innovation Centres, is where the intellectual property rights will then lie of any developments that come out of that. Where do you view they should lie?

Mr Willetts: I think that is a tricky one on which we have not yet reached a final view. The Technology Innovation Centres will certainly have responsibility for intellectual property. To what extent they own the intellectual property or to what extent it belongs, for example, to an individual company using the facility would have to be negotiated. Let me pick an example. The trouble is that you have to be so careful and I am not indicating it is necessarily bound to happen. I have visited at the University of Leeds a centre on regenerative medicine, which is doing some very interesting work in that sector. At that centre some individual companies are trying to develop forms of regenerative medicine, where they take, say, a piece of tissue and get rid of the DNA and the things that would cause the human body to reject it. They are able to transplant it into a body without the need for the recipient to take drugs for the rest of his life. That is a layman's explanation but that is what they are doing.

If you are a company using the resource of a Technology Innovation Centre to do that on a greater scale than is currently possible at Leeds, you would obviously want to have some IP. You would want to own some of the ideas that you generate as a result of using the centre. The TIC, itself, might want to have some claim. That would have to be negotiated. I am not sure that we would need to set a national requirement.

Q133 Stephen Metcalfe: So it will be on a per case basis, in your view?

Mr Willetts: That is my instinct, yes. The Technology Innovation Centres will have responsibility for sorting out the intellectual property regime. I suppose they could say, "We want to own all the IP that is generated in this facility." You could imagine them going the other way, and adopting the practice of the University of Waterloo in Canada, which I think the University of Glasgow¹ is now copying, and saying, "We are not going to claim any IP at this Technology Innovation Centre. Anybody who turns up here, don't worry, you can have all the IP. We're not going to negotiate with you at all." At the moment, I am quite open-minded on that.

¹ Glasgow University's approach is similar in important respects to that of the University of Waterloo.

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Q134 Stephen Metcalfe: I think we are all quite excited about the idea of the Technology Innovation Centres. The problem is that “Technology Innovation Centres” is quite a mouthful.

Mr Willetts: It is.

Q135 Stephen Metcalfe: Can you come up with or have you had any thoughts on what the network should be called?

Mr Willetts: That’s a very good subject. Perhaps this Committee could help. You are absolutely right. There are various ideas around. Hermann Hauser says Clerk Maxwell. They are not exactly Fraunhofers. I think it would be wrong just to think that we are lifting the German model. “Technology Innovation Centre” is rather clunky. I would very much welcome the Committee’s advice on a better name.

Chair: We could cover that for a long time.

Q136 David Morris: Minister, when the TSB settlement under the 2010 Spending Review is to be published, do you think it will be comparable to previous years? Also, is the £200 million over the next four years for TICs ring-fenced from other TSB innovation programmes? Do you think that would be a going concern, or do you think the money will be going elsewhere?

Mr Willetts: Yes. That £200 million will be a specific budget line for the TSB that has to be spent on this initiative. We hope to publish in the next few weeks the grant letter for the TSB—the figures have not yet been finalised—which will have, I guess, four main areas: the overhead costs for the TSB, where we are looking for efficiency savings; the core funding of the activities of the TSB so far which we can’t exempt from savings; then there is the R and D grant regime which is taking over some of those responsibilities from RDAs; and then, fourthly, there is this very important initiative on Technology Innovation Centres. I expect those four budget lines will be separately identified. I expect and understand that the Committee will want to interrogate me on them when those figures are out. We see this as genuinely additional funding for a new initiative that draws on work commissioned, as I say, by the previous Government.

Q137 David Morris: Do you think there is still an expectation that the Research Councils and Local Enterprise Partnerships will continue to provide contributions to the TSB? If there is, how will it be ensured?

Mr Willetts: Yes². With this kind of three thirds model, that third of bidding for funding for specific projects may well be for research council activities. The research councils are not the only source of

funding, the TSB programmes and EU are important sources for example, but it’s possible that they would be a source of money. It would probably not be the Technology Innovation Centre doing it on its own, but as part of a consortium with academics, they may well be beneficiaries of research council funding and I guess the others as well.

Q138 Chair: Sticking on this structure, Nigel Perry from CPI told us in December that the Fraunhofer funding model is not something that you can magic overnight. As time goes on, at least one of the thirds could be an income generating stream, but we have got to grow to the size that is necessary for the particular sector. How do you see that actually happening?

Mr Willetts: This relates, if I may say so, Mr Chairman, to your opening questions. One of the problems, as we understand it, with the Faraday Partnerships was that they were asked to become self-financing. That probably was too ambitious. One would certainly hope that the Technology Innovation Centres might enjoy commercial revenues, but it is almost within the design features of a Technology Innovation Centre that there should be a gap which could not simply be plugged by commercial activities where you are a bit too far away from the market or individual businesses could not feel that they were able to capture for themselves the full benefits of the activities.

Q139 Chair: Would you put a cap on the commercial income, as happens in Germany?

Mr Willetts: I think they do in Germany, don’t they? One of their criteria, as I understand it, is that if your commercial income has risen above a certain amount then you are no longer a Fraunhofer, because part of their definition of a Fraunhofer is this mixture of funding. I don’t envisage a cap, but if you were able to finance yourself entirely out of commercial income, taking the economic case that is made in the Hauser report for this gap that needs to be plugged, there wouldn’t be a gap that needed to be plugged. It would certainly change the nature of the operation quite a lot, I would have thought.

Q140 Chair: One of the weaknesses we have is ensuring that projects like this have a long life. You were quite right in saying that Hauser was welcomed on a cross-party basis, as was the Dyson report that your own Government commissioned. How do you think we can ensure longevity?

Mr Willetts: That is one of the key tests. One of the things I take heart from is that, in all the inevitable changes when a new Government comes into office, we took a deliberate decision that the Technology Strategy Board created by the previous Labour Government was working well, it had the confidence of the business community, and the last thing we wanted to do was to weaken something that was working. The fact that we are using an institution—the TSB—that was inherited from the previous Government, and we are implementing a report that was commissioned by the previous Government, as you rightly say, with a very interesting parallel with

² In answer to the specific question as to whether the Research Councils will continue to work with the TSB, the recent allocation of science and research funding stated that there will be ongoing collaboration and noted that “Going forward the Research Councils and the TSB have identified a number of strategic priority areas within the broad themes of high-value manufacturing; healthcare; digital; low carbon; energy and resource efficiency. The Research Councils will also work with the Technology Strategy Board to help deliver Technology and Innovation Centres.”

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Sir James Dyson's thinking, already means that it has quite a good cross-party foundation.

We have to be a bit patient on performance. A year or two down the track, if we have not had some brilliant commercial success immediately as a result of the activities of the Technology Innovation Centres, it would be a pity if we were getting terribly impatient with them. We have to give these time to perform, but the fact is that we have a TSB funding arrangement that will last over the next four years, through to the next election. It is hard for a politician to see even further than beyond the next election, but they have four years, which is itself an improvement on the slightly shorter annual budget cycle that affected them in the past.

Q141 Chair: It is always a problem in our system to think beyond an election, but actually the harder question is in persuading the Treasury of the merits of the approach. Do you think you have done that?

Mr Willetts: I think the Chancellor is a great believer in all of this. The Chancellor is one of the key people who is backing this. Consider the reason why? Look at the CSR. It was an incredibly tough public expenditure round. As we have discussed separately, we had a very good settlement for science and research and we were able to identify this initiative as one of the areas where we got extra funding from the Treasury. That shows how they back it.

Q142 Chair: Perhaps we need a pact between the Chancellor and the shadow Chancellor to give longevity, or even an endowment like NESTA was based on.

Mr Willetts: Yes. That is an interesting thought. What I would hope is that, if the Technology Innovation Centres change, it would be because the world changes, not because politics changes. The world will move on. There may be some things that are on this list that in 10 years' time we think, "Gosh, imagine being excited by photonics." Who knows how the world will change. We cannot fossilise or fix a set of industrial sectors; those will change. That should be what drives Technology Innovation Centres expanding or perhaps individual centres not continuing rather than political whim.

Q143 Chair: That is something that we may come back to, but I think it is quite clear from all of the evidence we have gathered that solving that longevity problem is going to be mission critical.

Mr Willetts: Yes.

Q144 Chair: If it is seen to be something that has a very short life, it won't succeed.

Mr Willetts: I accept that.

Chair: Can we move on from that and bring in Gavin?

Q145 Gavin Barwell: Minister, I would like to ask you some questions about the additional funding for the TICs beyond the core public funding of £200 million over the four-year period. How do you see links being forged between the TICs and financial

organisations in order to supplement that core public funding?

Mr Willetts: Of course, you are absolutely right that the £200 million is only part of the funding of the Technology Innovation Centres. Indeed, one of the criteria that the Technology Strategy Board will be using is precisely that businesses step forward and say, "We need one of these centres. We are willing to put funds in to do it." If it looks like it is entirely dependent on public money, then that is a very good argument for them not going ahead. It tells you that it is not meeting a business need. Obviously it will be looking for business backing. It will be able to access through bidding for funds, as I mentioned earlier, TSB programmes and Research Council funding perhaps. Also, there is the EU where, in some areas, I hope it will help us do even better in accessing EU funding, but, without getting too carried away, the EU likes initiatives that stretch beyond national boundaries. I wouldn't rule out an individual Technology Innovation Centre perhaps working with a Fraunhofer and making a joint bid for EU funding as well. That is something else I would encourage.

Q146 Gavin Barwell: Picking up on the EU funding issue, do you see each TIC having a dedicated team to try and identify European funding programmes that they can bid for?

Mr Willetts: We certainly need to do it. Whether the individual Technology Innovation Centres would have the resource to do that, I'm not sure. That might be better if it is something with which the TSB or BIS itself can help. But we certainly do need to be active in trying to build links with centres in other countries in bidding for EU money.

Q147 Gavin Barwell: You talked about the fact that if a particular TIC was wholly, or almost wholly, dependent on public funding that would almost be a sign that it was not working. Obviously, there is an initial start-up phase. But if in the medium term that was the case, do you envisage some kind of claw-back mechanism where public funding would be recovered if a centre was not accessing an agreed level of income from other sources?

Mr Willetts: Going back to the Chairman's previous line of questioning, I hope there will be political stability behind the overall programme, but we can't guarantee the continued existence of individual Technology Innovation Centres. If they had become highly dependent on public money, that would suggest that something was going wrong and they would not really be meeting the challenge that Hermann Hauser set out. So I don't think we would wish to continue to fund them if that's what had happened to an individual TIC.

Q148 Gavin Barwell: In relation to capital for new facilities to be built or for the maintenance of existing facilities, will the Government provide any capital funding in addition to the £200 million that has been identified?

Mr Willetts: No. The £200 million includes our contribution to start-up costs. In tough times I don't immediately see extra public funding, but you never

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know. There is an interesting balance to strike between, on the one hand, signalling that this is a new initiative and moving into new sectors where there isn't a facility at the moment, and, equally, perhaps, take Advanced Manufacturing, considering some excellent existing centres. Again, I have to be so careful because I don't want to pre-judge a process that is going on and I know the Committee has visited individual centres. But if existing centres become part of the Advanced Manufacturing Research Centre, then there is kit that already exists and buildings that already exist, you don't have to spend a lot of the budget building new buildings, and that, I think, is an advantage.

Q149 Gavin Barwell: Finally, I want to ask a couple of inter-related questions about the interaction between TICs and SMEs. When we went to Germany, the Civil Service in the Federal Ministry of Education and Research said that the nature of German innovation support, including the Fraunhofer Institutes, enabled the financial sectors to take a longer-term view of investment in SMEs. Do you hope that the establishment of TICs will build that kind of confidence in the financial sector in the UK? Slightly interlinked with that, in terms of enabling SMEs to access funds, do you see any role for Capital for Enterprise?

Mr Willetts: Yes, that's a very interesting question. First of all, I hope that SMEs' involvement with Technology Innovation Centres does strengthen their financial base and increases people's confidence in their commercial performance.

On your second question, Capital for Enterprise as an NDPB, although we pass money through it, does not itself directly allocate funding. It in turn passes the money on to organisations like Amadeus that then take the decisions about how the money should be spent. That would be the level where you might see decisions being taken to fund activities at Technology Innovation Centres rather than at Capital for Enterprise itself.

Q150 Chair: How do you cope with the situation, if it occurs, that, following the publication of the prospectus by the TSB, business came back and said, "These six aren't enough. We need eight, 10 or 12"? In the short term there is only £200 million. You accepted yourself that as time goes on some new areas may emerge anyway, new technologies yet to be thought of. The £200 million isn't going to be enough in the long term, is it?

Mr Willetts: It is very likely that as the bids come in, as reactions to the prospectus come through, there will be a long list of candidates and the TSB won't be able to afford to fund them all within a £200 million budget over four years. They may not all meet the criteria, anyway. I think this aim of six to eight is a good one to have.

Down the track, who knows? If they are operating fantastically, one could look to find the funding to do more. As one of the lessons from some of these previous initiatives is that they have sometimes been underfunded, and we have had too many initiatives all sub-critical, I think it is right to be absolutely ruthless

and say that there are going to be six to eight. There is a limit. I would hate to go to 20, but none of them were quite big enough or properly funded enough to make a real difference. So we are going to have to limit the numbers. The TSB will take a view. If there are other sectors that make a strong case, then, yes, we would somehow have to see if we could raise extra money.

Q151 Gavin Barwell: In terms of making the case in the longer term to the Treasury for further support for this, have you already given thought as to what research might be done to measure the success of these centres and to demonstrate an economic return for them because at some point, you will have to go back and ask them?

Mr Willetts: Yes. That is an interesting point. Of course, we will be evaluating their performance as part of our normal process of annual discussions with the TSB about how they are doing. The TSB is due for a quinquennial review, I think, in 2012, which would be a very early opportunity to take stock. I could imagine some enterprising academic or research team, the IFS or someone putting in a bid for the SLC, saying that they would like to do an economic evaluation of how these Technology Innovation Centres work. Yes, that would be very interesting.

Chair: I think Roger wants to follow that point.

Q152 Roger Williams: Thank you very much, Chairman. Just before we go straight on with that point, earlier this morning, Iain Gray gave evidence and he spoke very highly of the relationship that the TSB has with the sponsoring group in your Department and, indeed, with yourself. What are your expectations about the TSB setting out a plan for the establishment of the TICs, and what is your assessment of the work so far?

Mr Willetts: I think they have moved very fast. Obviously, people are impatient for them to move even faster, but I think the decision to fast track the High Value Manufacturing Centre was the right one. They are moving on a very brisk time scale with this prospectus. After all, the money was only allocated—it was a big financial decision—less than three months ago. So I think they have moved fast. This Committee will understand that there is a legitimate process of public accountability for public money. Ultimately, I am accountable to this Committee and more widely to the Commons for how money is spent in BIS. So Ministers can't completely disengage. On the other hand, we do understand that the TSB decisions have to be business-led. The Whitehall expression is that there should be "a process of interplay" between the business decisions that the TSB take but they have to keep Ministers in touch. Vince and I need to know overall what's going on. We are entitled to feedback and to give some strategic steers but try not to micro-manage.

Q153 Roger Williams: Earlier in your evidence you said that, when some assessment of the achievements of a TIC were made, it may be inappropriate after four years to say that there has not been any huge great breakthrough, and yet we have had evidence from Ric

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Parker of Rolls-Royce, who said that when they are assessing their university technology centres they say, "What was delivered to the company last year? What has been put into a product this year? How many patents have been produced?" Is there a difference in expectation between the third, third, third funding by the people investing in these and will that be difficult to reconcile?

Mr Willetts: That is a contrast with the usual fear that it is we politicians who are the short-termists and the advice from the business people is that they want a longer perspective. Of course, Rolls-Royce themselves say to us that they are now generating revenues from bits of research or patents that were done 20 years ago. There are very long lead times. I want to give these time to grow. This is a new initiative. I think it would be a pity, again learning lessons from the past, if we redesign them or become too impatient with them. I think we must give them a decent run of time, which I hope will stretch beyond the next election.

Q154 Roger Williams: I suppose it is a matter of whether we should look to output or activity as a measure of success and achievement.

Mr Willetts: I think a good measure is the one that they use in Germany of, "Is there a service that businesses are willing to pay for?" The fact is that this third, third, third funding model is a very good way in itself of monitoring performance and ensuring that it's worthwhile, because if they are not getting specific grants by research councils or others, and if they are not getting businesses wanting to use the facilities and pay to use the facilities, then there is a problem. But if they are getting those two flows of funding in alongside the core funding, that, to me, is a pretty encouraging sign that they are meeting a need.

Q155 Roger Williams: We have been told by the Judge Business School at the University of Cambridge that: "Consideration should be given to a normal TIC life expectancy of 15 years." That seems a bit strange to me considering they are not even set up yet. They go on to say that after 10 years there should be a thorough evaluation of what has been achieved and then one should look either to disbanding the TIC or perhaps privatising it. What was your reaction to that?

Mr Willetts: I am not itching to privatise them. This is where we have been influenced by Fraunhofers. What makes a Technology Innovation Centre is precisely that it is at these Technology Readiness Levels where you can't expect them all to be done simply by private commercial activity. You may find that a sector matures so much that regenerative medicine, to take that example again, ends up becoming a mainstream biotechnology activity and there are large biotech firms that are doing it in their own research centres, so you don't need a Technology Innovation Centre because it has gone mainstream. I can envisage that happening. We recognise that, as the economic structures change and advance, it would be odd if in 15 years' time you were doing exactly the same as you are today.

Q156 Roger Williams: But by setting those sort of time scales, do you think that is a real incentive for, perhaps, senior personnel or perhaps even junior personnel to be involved in these types of organisation if, at the beginning, you are setting these time frames?

Mr Willetts: For this environment where the pace of innovation is so fast, that is a time scale where people could think that would be a really worthwhile thing. It would be able to make a big impact. Yes, I think that would be the kind of time scale.

Q157 Chair: Could I just point out a little conundrum? You used the phrase, "Is there a service that business is willing to pay for?", and that is a question that is derived from the German model. The reason, I suspect, that the German business is prepared to pay is that there is this virtuous circle—the relationship between the institute, the company and their banks—which you touched on earlier in answer to questions. There isn't going to be that in the first place, is there? The early-stage development needs to have some other series of measure, does it not?

Mr Willetts: I am trying to think through an example. I can imagine an SME that wanted to use a facility. Let's take something that already exists, which is widely seen as one of the successes, The Welding Institute, TWI. So you are an SME and you can't afford to develop new welding techniques in-house but you think that by using TWI you will get some assistance that you could use. I am absolutely not a businessman capable of assessing this, but I can imagine you are going to a bank, not just a venture capitalist, and saying, "Look, we need £100,000 to get this programme run through TWI. This is why it's worthwhile for our business. It's part of delivering our business plan. Will you lend us £100,000 so we can do it?" I wouldn't rule that out as something that even commercial banks would do.

Q158 Chair: Yes, but once the reputation of the TICs is in place, the likelihood is that the German model of longer-term finance stemming from that, especially for second phase developments and subsequent phases of development, becomes stronger. My point is that there is a start-up problem for the TICs. Until they have got street cred with the finance sector, your measure may not be the right one.

Mr Willetts: Yes. That is a fair point. Certainly we see that the funding is partly to help meet some of the start-up costs. We have to be realistic. You could not expect them to get to a third, third, third split in year one or year two. There are some upfront costs. The TSB will advise us on that, but we recognise that we have to help with that at a higher proportion than 30%.

Q159 Chair: And these are things we need to work through as time goes on?

Mr Willetts: Yes.

Chair: Minister, thank you very much for your time this morning.

Written evidence

Written evidence submitted by the Department for Business, Innovation and Skills (TIC 00)

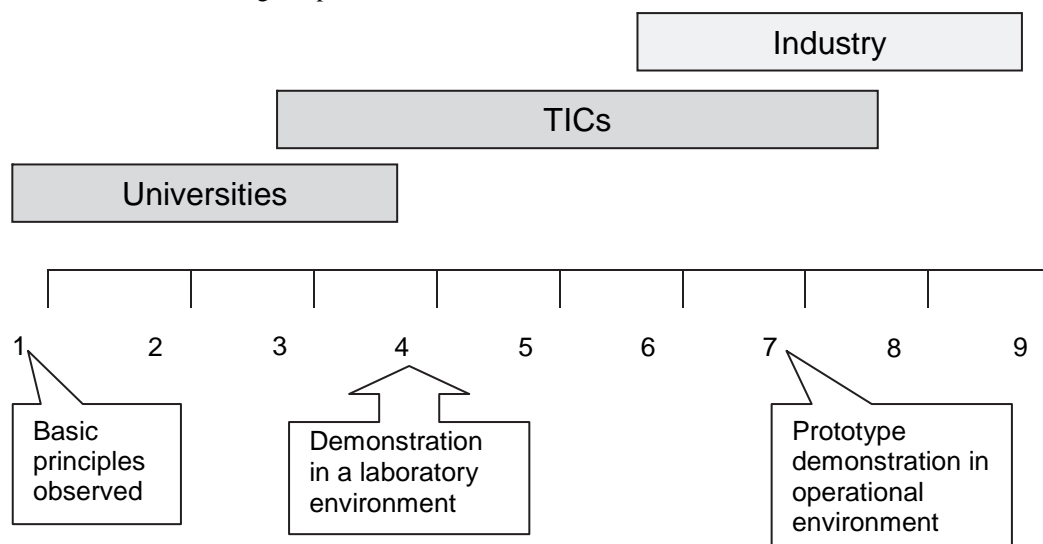
BACKGROUND

1. Public investment in R&D is required because the results of research are difficult for any one firm or organisation to fully appropriate, and firms may not be able to mitigate the substantial technical and commercial risks involved in innovation projects entirely through market mechanisms.

2. Government support for R&D enables the private sector to undertake projects with significant overall benefits for the economy that it would not be able to fund or manage itself.

3. Direct, targeted, government incentives for business led R&D and knowledge transfer is currently provided primarily via the BIS sponsored Technology Strategy Board, through a wide range of economically robust business support interventions including Collaborative R&D, Knowledge Transfer Networks, Knowledge Transfer Partnerships and the Small Business Research Initiative (SBRI).

4. Technology and Innovation Centres (TICs) will complement these approaches, by providing a business led, capital intensive infrastructure, that enables business to exploit new and emerging technologies, by providing a capability that primarily operates, at Technology Readiness Levels 4 to 7, bridging research and technology commercialisation, de-risking the process for business.



5. TICs will perform tasks that business and universities, left to their own devices, often cannot or will not perform in sufficient quantity and/or quality. This helps make new technologies investment ready and able to attract VC or other forms of investment, shortening the time to market. The role of the TICs is to support business activity focused on the development and commercialisation of new technologies that originate in the research base and for which there is business demand. This is achieved through: conducting in house R&D; providing access to skills and equipment which might not otherwise be within their reach; helping scale up manufacturing processes and producing technology demonstrators; and helping develop value/supply chains. They inform businesses about the potential of new technologies and help early-stage SMEs. In some cases, these centres also act as the focal point for clusters of companies in particular sectors.

6. Other countries have powerful capabilities such as these, and this has had a transformative effect on their industrial base including ITRI creating the electronic display screen industry in Taiwan, and ETRI establishing South Korea as a major semiconductor producer. The most famous network of centres, the Fraunhofer Gesellschaft in Germany, has for example developed the MP3 licence, which alone generated €100 million of revenue in 2005 (the network received total licensing income of €83 million in 2008). ETRI in South Korea received £134.8 million in licensing revenues between 2004 and 2008.

7. The Spending Review announced the provision of over £200 million of funding for TICs over the next four years, with the overall network of centres to be established and overseen by the Technology Strategy Board.

What is the Fraunhofer model and would it be applicable to the UK?

8. The Fraunhofer Society (FhG) is one of Germany's four non-university research organisations and focuses on applied research. They undertake contract research for the public sector, government, and industry, including small and medium-sized enterprises (SMEs), which lack the critical mass to carry out their own R&D.

9. In terms of research strategy, the Fraunhofer Society directs its efforts toward as-yet-undeveloped markets for products that might take over five years to mature. Institutional funding is provided by the federal and state

(Länder) governments. This funding leverages additional public-sector project grants from federal and states sources and the EU, alongside industry funding from contract research.

10. The German Fraunhofer model is not unique however as the innovation systems of all of the OECD economies are characterised by a variety of non-university research organisations that perform tasks that business and universities, left to their own devices, often cannot or will not perform in sufficient quantity and/or quality.

11. The UK is amongst those who have established such structures beginning in the 1930s and 1940s, when the UK Government encouraged the establishment of Research Associations that served the needs of specific industrial sectors.

12. More recently, the Regional Development Agencies in particular, have established a number of these intermediate institutes, focused on driving regional economic growth.

Are there existing Fraunhofer-Type Research Centres within the UK, and if so, are they effective?

13. In the UK, a range of public sector bodies have invested in research centres to address objectives aligned with their core remit.

14. Research Councils have established centres primarily aimed at supporting excellent academic research, often with a clear requirement to address business or societal needs or opportunities. Examples include the Innovative Manufacturing Research Centres (IMRCs) and more recently UKCMRI at St Pancras. These are however distinct from the TIC model and operate at earlier TRL levels.

15. The UK also has a number of independent, Research and Technology Organisations (RTOs) that fulfil a similar function—these organisations trace their origins to the Research Associations established in the 1930s and 1940s, and operate on both a commercial and not-for-profit basis with a focus on more routine and commercially lucrative laboratory and technical consultancy services, as a result of a gradual withdrawal of public funding from Research Associations.

16. Furthermore, as noted above, the Regional Development Agencies have also funded over 60 centres focused on driving regional economic growth during the current spending review period (CSR07).

17. The effectiveness of these centres with a range of objectives cannot be easily compared, but where these are primarily about delivering to business needs and requirements (i.e. the RDA funded centres and independent RTOs that fulfil a similar function), examples of success include:

- The Advanced Manufacturing Research Centre (AMRC) in Sheffield, which is a £100m partnership between academia, government and industry,
- The New and Renewable Energy Centre (NAREC), which is recognised in the renewable energy industry as one of the lead centres of excellence worldwide for offshore wind technology development,
- TWI, which has 157 granted patents on its books, with its income from licensing activities exceeding £1.8million in 2008; and
- The Centre for Process Innovation (CPI) which has resulted in 11 spin-out companies and 14 filed patents since its establishment.

18. As highlighted in the Hauser review however, the approach taken to date in the UK to establish and support business focused centres has not had the clear prioritisation, long-term strategic vision, or coordination at a national level that is needed. The mechanisms for identifying the sectors or technologies which would benefit from such support has had no formal role for Technology Strategy Board despite its role to develop and deliver a national technology strategy.

19. The current UK approach has therefore often resulted in sub-optimal and dispersed investments with the lack of long-term funding certainty damaging the ability of the established centres to: engage with business; realise the full potential of their assets; invest in long-term capability; recruit and retain the best staff; and commercialise leading edge research.

20. A review commissioned by the Technology Strategy Board and the RDA and Devolved Administrations on the Micro and Nanotechnology (MNT) programme for example concluded that while the development of open access facilities for business was undoubtedly beneficial, the investment was thinly spread across a number of centres, resulting in “sub-critical” activity that compromised the ability of the centres to achieve world-class capability.

21. This compromises the ability of the UK to establish or build on existing capabilities, and make the best use of potential synergies with industrial partners located in existing manufacturing clusters. It also makes it difficult to provide business with information about the centres which exist, assure them of the quality of their service and enable access.

What other models are there for research centres oriented toward applications and results?

22. Most countries studied in the Hauser review identified the need for an ‘intermediate sector’ as a critical element to deliver governmental, or wider public sector, policies and strategies to promote innovation.

23. The specific role of TICs varies according to the innovation system and economic and social landscape of the countries in which they operate.

24. Centres in many countries frequently focus on a sector or technology rather than have a wider spread of investments in many technology or sectoral fields which, whilst being highly successful for the Fraunhofer Institutes in Germany, is less common.

25. ITRI in Taiwan is credited with helping to create the electronic display screen industry there, ETRI in establishing South Korea as a major semiconductor producer, while the Inter-University Micro Electronics Centre (IMEC) in Belgium was established with a view to operating three to 10 years ahead of industrial needs and to foster the development of the local industrial base through the creation of spin-out companies, promoting R&D collaboration and developing technology skills with business.

Whose role should it be to coordinate research in a uk-wide network of innovation centres?

26. The Technology Strategy Board is a BIS sponsored, business-led non departmental public body that plays a cross-Government leadership role in delivering a national technology strategy and advising on policies which relate to technology innovation and knowledge transfer.

27. Joint working between the Technology Strategy Board and the Regional Development Agencies and partners across Government, has to date, enabled businesses to utilise the centres currently in existence when undertaking projects funded by the Technology Strategy Board.

28. However, as highlighted in the Hauser review, the dispersed approach taken to establishing and funding these centres has resulted in there being no formal process for oversight, coordination, promotion and prioritisation of investment in centres at a national level to ensure alignment with national technology priorities or strengths. Furthermore, it was also noted that in establishing centres, the prospect of competitively tendered project-based funding from the Technology Strategy Board and the EU was often envisaged, but the plans for such activity beyond the period of the initial investment had not taken account of the level of funding required to develop and maintain the capability of the TIC, or its role within the long term technology priorities of organisations such as the Technology Strategy Board for which it was critical.

29. Having the Technology Strategy Board establish and prioritise investments in centres in the context of its wider programme of work will address the key issues highlighted in the Hauser review and ensure that the TICs can engage with business; realise the full potential of their assets; invest in long-term capability; recruit and retain the best staff; and commercialise leading edge research.

30. Individual centres within the network will operate with a high level of autonomy, to give them the flexibility to respond to business needs and market opportunities.

31. However, the overall network of centres will therefore be established and overseen by the Technology Strategy Board who will develop a national strategy for managing these centres as part of the UK’s innovation system, linking these with other institutions, programmes and funding streams.

32. The Technology Strategy Board has begun the process of identifying, with a view to developing, existing RDA funded centres which are excellent, and will also look to establish new centres in the context of its overall programme of work.

33. It will publish a strategy and implementation plan for TICs by April 2011, and have created a network of TICs by April 2012 as highlighted in the BIS Business Plan.

What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?

34. TICs are business focused, mission-driven organisations that are focused on the exploitation of new technologies, through an infrastructure which bridges the spectrum of activities between research and technology commercialisation.

35. Typical activities and outputs of the new TICs therefore include the development and scaling up of manufacturing processes, and the production of technology and application demonstrators (see Figure 1)

36. They are therefore distinct from, though complementary to, University and Research Council funded centres and Public Sector Research Establishments (PSREs), which are funded through a separate funding stream (the Science budget and Departmental R&D budgets) and already co-exist with the over 60 business focused TICs that received funding during the current spending review period.

37. Close working between these parties is however critical and we will incentivise the centres to link with, and draw upon, the outputs of the research base and PSREs where appropriate.

38. Such models of cooperation already exist—examples include the involvement of the University of Sheffield in the Advanced Manufacturing Research Centre, and the memorandum of understanding between the Printable Electronics Technology Centre and four university based centres (Welsh Centre for Printing and Coating, part of the School of Engineering at the University of Swansea; Cambridge Integrated Knowledge Centre; Organic Materials Innovation Centre in the School of Chemistry at the University of Manchester; and the Imperial College Centre for Plastic Electronics) to provide a focused cluster for technology development and prototyping, aiming to translate UK strengths into the industries of the future

39. This is also consistent with the broader model of collaboration and alignment of activity between the Technology Strategy Board and the Research Councils that seeks to enable increased economic benefit for the UK, by ensuring investments in research are more closely informed by business challenges, and businesses are more able to exploit the outputs of leading academic research.

Department for Business, Innovation and Skills

1 December 2010

Written evidence submitted by the Association of Independent Research and Technology Organisations (AIRTO Ltd) (TIC 12)

1. What is the Fraunhofer model and would it be applicable to the UK?

1.1. The Fraunhofer model is used by 59 institutes operating in Germany under the umbrella of the Fraunhofer Gestellshaft. These institutes have an annual budget of €1.6 billion and employ 17,000 staff.

1.2. The funding of these institutes is 2/3 from industry and publicly funded projects, and 1/3 core funding from federal and state sources. The core funding allows the institutes to invest in infrastructure in the form of facilities, capital equipment, and underlying technology. This allows the institutes to support the strategic aims of the region or overall nation, and also to make significant changes in technical focus where this is required by regional/national strategy or the needs of industry. This core funding also allows Fraunhofer Institutes to participate in EU Framework research projects, where the level of funding from the EU project is a percentage of the full cost and the remainder must be met by the institutes' own resources.

1.3. Fraunhofer Institutes claim to work at every Technology Readiness Level¹ (TRL) from 1 to 9, but their main area of interest is between the academic work of universities and the production activities of industry—ie TRL 3 to 7.

1.4. Fraunhofer Institutes have a clear focus on delivering to an industry agenda, with project timescales and outputs that are specifically and carefully designed to be readily assimilated by industry.

1.5. Each Fraunhofer Institute has a specific technology focus, but operates across a range of industrial sectors.

1.6. Each Fraunhofer Institute is aligned with a specific university that has strength in the technology focus of the Institute. The head of the Fraunhofer Institute is a professor at the university, although the majority of their time is spent at the Institute.

1.7. The core, permanent staff are a minority at the institute (typically 20–25%) with the majority of researchers being PhD students or post-docs. The normal expectation for these latter researchers is to stay at the institute for ~ 5 years, and then move into industry. This has advantages in that there is a flow of qualified researchers into industry, but does limit the long-term core continuity and competences of an institute.

1.8. The overall Fraunhofer Gestellschaft has an independent institutional status, and provides cores services and interacts with the federal government. However, each Fraunhofer Institute has a significant level of autonomy. This can lead to overlapping of technical focus between institutes, but this is controlled and minimised by liaison between individual institutes and groups of institutes, and can be beneficial where specific institutes are serving their local or regional industry.

1.9. The “Fraunhofer” brand is strongly promoted. This has not always been the case, and the parallel Helmholtz Institutes in Germany do not have an equivalent strong branding.

1.10. The Fraunhofer model does require a major, continuing investment of public funds at both the state and federal level.

1.11. Attempts have been made to set up Fraunhofer Institutes or centres outside of Germany (in France and the USA for example). These have not achieved the success of the institutes in Germany.

1.12. There is a significant level of collaboration between UK research organisations and Fraunhofer Institutes, particularly through working together on EU Framework projects.

¹ Technology Readiness Level—a classification system devised by NASA, see http://www.nasa.gov/topics/aeronautics/features/trl_demystified.html

1.13. Adopting the Fraunhofer model in its entirety in the UK is not appropriate, as it would replicate an already existing, successful infrastructure of applied research organisations.

1.14. What is needed is a set of measures to increase the effectiveness of existing UK applied research resources to meet the strategic aims of the UK and its industry. This will be achieved by implanting the core funding component of the Fraunhofer business model and the activities that it entails with the best of the existing UK applied research organisations. In these instances, access to a core funding stream will significantly increase the impact which these existing bodies can make on industry, wealth creation and economic growth.

1.15. Public investment in the best of the existing UK applied research organisations will be far more cost effective than introducing a new network of Fraunhofer type institutes. Furthermore, the highly organised and strongly branded German model is not appropriate in the UK, where industry needs for applied research vary from sector to sector, and no “one size fits all” model will give optimum efficiency.

1.16. However, there are already some elements of the Fraunhofer model that are the same as those used in UK applied research organisations, and some Fraunhofer Institutes did consult with UK research organisations early in their development to understand how to work with industry. Common elements are effective collaboration with industry and working with relevant universities for the provision of underpinning academic research. The missing component in the UK applied research organisations is the 1/3 core funding, which in Germany comes from federal and state sources.

2. Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?

2.1. There are no direct equivalents of the Fraunhofer institutes in the UK, but there is a network of applied research organisations that undertake a similar role.

2.2. This UK network comprises organisations based on a range of business models:

- Public Sector Research Establishments (eg NPL).
- University “spin offs” (eg Warwick Manufacturing Group, AMRC).
- Independent Research and Technology Organisations configured as companies limited by guarantee or charities, governed by industry (eg BRE, Campden BRI, TWI).
- Privately owned, commercial research and development organisations (eg QinetiQ, Cambridge Consultants, PA Technology).
- Corporate research functions and laboratories (eg ARUP, Tata, IBM, GSK).

2.3. The first three categories are driven by an overall mission to support their specific technology or technologies, and to work to the long-term benefit of industry in general. They also maintain a strong symbiotic relationship with UK academia.

2.4. Many of these organisations are extremely successful, working with industry worldwide. A report from Oxford Economics commissioned by AIRTO² demonstrated the economic impact of these organisations on the UK. It concluded that they contribute at least £3 billion per annum to UK GDP. They are particularly good at linking up supply chains from which the aforementioned report and earlier reports show that much of industry’s innovation is derived.

2.5. Where they differ from the Fraunhofer Institutes is the lack of core funding from government. This limits their ability to:

- Liaise with academia.
- Renew core knowledge.
- Invest in new facilities and equipment.
- Address the evolving strategic needs of the UK and UK industry.

2.6. None of these necessary and very important activities can be fully financed from margins on collaborative and single client industry projects alone. By their very nature, applied research organisations do not have product businesses from which profits can be taken to fund such core activities.

2.7. Some public sector research organisations do receive core funding from government, but this funding is not targeted at the strategic needs of industry. Rather it is to perform a national service, such as the responsibility for standards and measurement performed by NPL.

2.8. It is worth noting that the UK began to explore an equivalent of the Fraunhofer model with Faraday Partnerships in the 1990s. However, with a piecemeal approach and a variety of governance models, the initiative was not uniformly successful and was replaced by the more limited knowledge exchange focused activities of the Knowledge Transfer Networks (KTNs) from 2004. KTNs are now administered by the Technology Strategy Board, and have a very different mission from that of the Faraday Partnerships. Therefore, they are of limited relevance to the current debate on Technology Innovation Centres and the Fraunhofer model.

² Study of the Impact of the Intermediate Research and Technology Sector on the UK Economy”, Oxford Economics, May 2008, see <http://www.airto.co.uk/oxfordeconomics.pdf>

3. *What other models are there for research centres oriented toward applications and results?*

3.1. As discussed above in 2.2, there are a number of existing models for applied research centres in the UK. The generic term used for such centres in the UK (and particularly in Europe) is Research and Technology Organisations (RTOs).

3.2. A number of the independent research and technology organisations were originally formed as Research Associations in the 1920s and 1940s. As discussed above, they are now generally companies limited by guarantee or charities with specific constituencies of industrial interest. These are successful institutions operating in a commercial world, often with clients worldwide. Their involvement in research to support the needs of UK national strategy has declined over the last twenty years, with the move to concentrate core public funding for research on the universities. However, they are equipped and willing to resume this “national” role.

3.3. Industry owned research centres have been in decline, and many have been closed in favour of contracting with universities. An example of the latter is the Rolls Royce University Technology Centre (UTC) network. However, Rolls Royce has realised that this network does not fill its need for applied research, and has recently been developing organisations specifically to bridge the gap between academia and industry.

3.4. A number of new organisations have come into existence to address the need for applied research and for bridging the gap between academia and industry. These organisations have a similar role to the existing organisations discussed in 3.2, and are based mainly on new technologies or application domains. The setting up of many of these has been supported by the Regional Development Agencies (RDAs), but they are also often compromised in their strategic work by the lack of a core funding stream. Examples of these organisations are the Institute for Sustainability (London), the International Space Innovation Centre (Harwell), the Advanced Manufacturing Research Centre (Sheffield), the Manufacturing Technology Centre (Midlands), the National Composites Centre (Bristol), and TWI regional centres (Middlesbrough, Sheffield and Port Talbot).

3.5. There are also the commercial research and development organisations and consultancies. These are generally targeted at high TRL development projects directly for industry, and are not structured to operate as open research and application centres. They are therefore of limited or no relevance to this current debate on TICs and the Fraunhofer model.

4. *Whose role should it be to coordinate research in a UK-wide network of innovation centres?*

4.1. The logical organisation to undertake this role is the Technology Strategy Board (TSB). This would be congruent with government policy and the current role of the TSB.

4.2. This coordination could be undertaken by the Department of Business, Innovation and Skills, but this would represent a u-turn in policy and potentially cause a conflict in roles with the TSB.

4.3. A third party organisation could be set up to administer a UK-wide network of innovation centres, but again this would seem to duplicate and conflict with the role of TSB.

5. *What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?*

5.1. There will be little or no effect on PSREs and other existing research establishments if the proposed investment in such institutes is based on the existing infrastructure to enhance the activities of organisations with an already proven track record of excellence. New organisations would only be required where there is no current provision.

5.2. The development of such centres based on the existing infrastructure could benefit other UK research organisations, as it will exploit the already existing collaborative links.

5.3. However, if a new network of Fraunhofer-type institutes was introduced, ignoring the capabilities of the existing infrastructure and duplicating resource, there would be a massive effect on the viability of both the new and existing research organisations, with a corresponding detriment to UK efficiency.

6. SUMMARY

6.1. The Fraunhofer model demonstrates how the effective use of core funding for applied research organisations can support the national industrial strategy.

6.2. The UK has an existing, comprehensive infrastructure of applied research organisations working for industry worldwide, but maintaining strong links with UK academia. The combination of this existing infrastructure with core funding will enable the UK to meet the strategic needs of national industry in an effective and cost efficient way.

6.3. There is a similar situation in France, where they have developed a system of “Institute Carnot” which involves selected existing research organisations receiving core funding to allow them to address national strategic issues.

7. DECLARATION OF INTERESTS

7.1. This submission is made by the Association of Independent Research and Technology Organisations (AIRTO). The organisation represents research organisations and technical consultants, 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. They are largely funded by industry, but do undertake competitively bid projects supported by UK and European public funding programmes. AIRTO currently comprises 37 independent organisations, employing more than 20,000 scientists and engineers, with a combined annual turnover in excess of £2billion.

The members of AIRTO are:

Aircraft Research Association Limited (ARA)
 ARUP
 Atcare
 BMT Group Limited
 BRE Group
 The Building Services Research and Information Association (BSRIA)
 Campden BRI
 CERAM Research Ltd
 City University London
 CIRIA
 E-Synergy Ltd
 FIRA International Ltd
 Halcrow Group Ltd
 Health and Safety Laboratory (HSL)
 HR Wallingford Group Ltd (HRL)
 Institute for Sustainability
 ITRI Limited
 Leatherhead Food Research
 LGC
 MIRA Ltd
 The Motor Insurance Repair Research Centre (MIRRC)
 National Metals Technology Centre (NAMTEC)
 National Physical Laboratory (NPL)
 National Nuclear Laboratory (NNL)
 The Paint Research Association (PRA)
 Pera Group
 QinetiQ
 Quotec
 SATRA Technology Centre
 The Scottish Whisky Research Institute (SWRI)
 The Smith Institute
 Smithers Rapra Technology Limited
 The Steel Construction Institute (SCI)
 Thames Innovation Centre Ltd (TIC)
 TRADA Technology Limited (TTL)
 TWI Ltd
 University of Surrey

Professor Richard Brook
 President
 AIRTO

November 2010

Written evidence submitted by The Centre for Process Innovation Ltd (CPI) (TIC 28)

1. INTRODUCTION AND DECLARATION OF INTERESTS

The Centre for Process Innovation (CPI) is an innovation centre that serves the Process Industries. The Chemistry Innovation KTN notes that the chemistry using industries in the UK turnover over £800bn/yr and directly employs over 2.3 million people (see appendix).

CPI is based in the North East of England and serves the Industrial Biotechnology, Advanced Manufacturing, Printable Electronics and High Temperature sectors. It is an intermediate technology institute that sits between academia and industry. CPI has an open access capital asset base of over £55m and employs over 120 people from a wide range of business and technology disciplines. It works with SMEs, large corporates, universities and the finance community to link market pull with technology push and has so far supported the creation of over 120 new businesses and provided a return of some 780% on the public investment into the centre.

CPI is seeking to become one of the first elite independent technology innovation centres (TICs) announced in the recent comprehensive spending review that work between invention and the commercial market.

2. What is the Fraunhofer model and would it be applicable in the UK?

2.1. The Fraunhofer model is part of the German research, innovation and development system. There are 59 Fraunhofer Institutes grouped into 7 major technology areas. They operate between invention and commercialisation. Their role is to link researchers and industrial companies. In a typical year the Fraunhofer network turns over €1.6 billion. A third of this is contributed directly from the German federal and Länder regional governments. The other 67% come from a combination of private organisations and from publicly financed research projects. The additional public funding comes from German technology projects and other public organisations such as the EU. Total public funding from all sources is around 50%. Although linked to individual Universities the network operates as separate businesses with different skills.³

2.2. Public investment in science and technology development must be affordable. If there is inadequate return, continued investment is difficult to justify. Currently the UK favours knowledge creation over the development of products and services. Insufficient resource is placed onto transforming research into market ready products, processes and services that create significant value in the economy.

2.3. Public investment is required for research and discovery (knowledge creation) where risks are highest and uncertainty is greatest. This is needed to further scientific understanding and to discover ideas that *could* create economic value. The UK is one of the acknowledged world leaders in creating knowledge through its public investment in research and discovery.

2.4. In the UK's competitor countries public investment is also used to identify research work that could be developed into commercial products and to catalyse private investment. The development and commercial demonstration of the technology is also supported, leading to subsequent exploitation by the private sector.

2.5. This is the Innovation Phase that is filled by the Fraunhofer Institutes in Germany (similar organisations operate in other countries such as VTT in Finland). In the UK the amount of public funding going into the innovation step is insufficient to ensure that value is created from the UK's excellent science and technology research. The UK does not have enough public/private innovation centres like the Fraunhofers.

2.6. The conclusion from the comparison with Germany is that the UK needs to invest to fill the innovation gap between research and commercial exploitation. The proposal to establish a network of elite independent technology innovation centres (TICs) is both sensible and appropriate. These would combine technology innovation assets with incubation facilities and have strong links with financial organisations (such as a Green Investment Bank) that are willing to fund the development of early stage technology businesses.

2.7. In some markets, this research, innovation and commercialisation supply chain is referred to in Technology Readiness Levels (TRLs). TRLs range from 1 to 9. Universities typically work in level 1 to 3 and commercial businesses at level 8 and 9. The innovation gap is in TRLs 4 to 7.

2.8. TICs could resemble the Fraunhofer Institutes, but CPI's view is that the UK should follow a model where a small number of centres are focused on technologies in which the UK has a high chance of global economic success. This model gives the UK centres greater access to cross disciplinary skills from a number of universities, allows the centres to develop deep expertise in the technologies, and is more market driven. This approach would bring greater focus and market drive than the fragmented Fraunhofer approach.

2.9. The centres need to be independent from universities and co-ordinated by a central body (the Technology Strategy Board). An ideal structure would be to have 10 or 12 key technology innovation centres each with 5 to 6 satellite centres rather than Fraunhofer's 59 centres working in 7 groups.

3. Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?

3.1. CPI is an example of a technology innovation centre in the style of a Fraunhofer Institute. Although just over 6 years old, (Fraunhofer and VTT are each more than 50 years old), CPI is already recognised as a TIC by the equivalent organisations both in Europe and around the world. Fraunhofer-Gesellschaft was a member of the CPI pre-incorporation Board and contributed to setting-up the organisation.

3.2. CPI uses market knowledge and technology understanding to develop products and processes quickly and efficiently with minimal risk to its public and private sector partners. It works in Technology Readiness Levels 4 to 7.

3.3. CPI is a not-for-profit company limited by guarantee. It is an independent company created in April 2004 by One North East, the regional development agency for the North-East of England, to address the innovation gap in the process sector.

3.4. CPI's goal is to be national in scale and importance with a strong international positioning. We operate to world class standards to ensure that international companies have the choice of working with the UK, and SMEs have access to competitive and benchmarked world-class capability.

³ CPI Internal Benchmarking Study June 2009 and Fraunhofer website

3.5. CPI has ambitious plans to grow its two technology areas to revenues of some £50m per year, and employing more than 300 staff by 2020. Even at this scale, each of these areas will only be of *average* size compared to a single Fraunhofer Institute.

3.6. Initially 100% funded by One NorthEast, CPI is targeting a 50:50 public:private partnership (the same as the Fraunhofer model). In the 6 years since inception, it has diversified its sources of public funding to include Europe, the Technology Strategy Board, and BIS amongst others, and reduced its dependence on One NorthEast to well below 50% of its revenues. Its commercial revenues have grown from zero to some 15% of the total (£2.5m).

3.7. The CPI business model develops processes and technologies that meet an identified market need. It has already delivered substantial benefit because it links the needs of business to CPI assets and technology expertise. The approach combines *business pull* with *technology push*. The model is to:

- Carry out market analysis with businesses or partners that have technology or a defined market need;
- Set-up a team of technology, market and commercial professionals to design assets to develop a range of technologies which meet the market need;
- Find a combination of private and public investment to build and operate the development assets;
- Private companies—both SME and large companies—use the assets and CPI expertise to prove, develop and scale-up their technology until it is ready for commercialisation;
- Companies then invest their own funds to take the technology to market and create value;
- The development assets are retained and developed by CPI for use by other companies and projects to build a UK capability in the sector.

3.8. CPI is driven by an independent, business-led Board and which includes representatives from academia. The Board and the CPI Executive management team are assisted by a company technology advisory committee (TAC) and each technology area is advised by specific technology and innovation advisory groups (TIAGs). The TAC and the TIAGs are independent advisory groups comprising recognised expert representatives from industry, academia and the public sector. This approach ensures CPI is being advised by the best.

3.9. CPI creates partnerships between public organisations, academia and private industry to deliver capability not available to any individual organisation. This is delivered by a team of 120 highly qualified scientists, engineers and other staff, who have extensive management, project management and commercial experience.

3.10. The CPI team has consistently delivered innovation assets and leading edge development programmes on time and to budget. Since inception, it has grown at over 60% per year and now serves many major clients including Arup, Tata, Croda International, Ensus, DeLaRue, Dr Reddy's, Johnson Matthey, Unilever and Thorn Lighting.

3.11. It has far outgrown its regional beginnings and has created a national and international reputation in two technology areas which are strategically important to the UK:

- Advanced Manufacturing for the Process Industries—CPI develops advanced manufacturing technologies for the energy, high value chemicals, carbon capture and pharmaceuticals markets amongst others with a combined potential future economic impact for the UK of between £4bn and £12bn by 2025⁴. This business unit houses the National Industrial Biotechnology Facility (NIBF), the Industrial Biotechnology Demonstrator (IBD) and the Anaerobic Digestion Development Centre (ADDC). All have significant funding from the Department for Business Innovation and Skills (BIS) and the Department for Energy and Climate Change (DECC).
- Printable Electronics—CPI is home to the National Printable Electronics Centre (PETEC) where experimental processes are transformed into manufacturable products for a market expected to be worth some £4bn to the UK economy by 2020—Assuming the UK takes 5% of the global market⁵. The asset base has been created with significant support from BIS. It targets barrier coatings, advanced material deposition processes, printable electronic materials, printable circuits for high resolution display and smart packaging applications, solid state lighting and organic photovoltaics: all areas where UK industry can develop value from the global printable electronic supply chain.

3.12. At CPI, these technology areas have a capital asset base of over £55m. This has been largely funded by the public sector and is available on an open access basis.

3.13. CPI and its assets feature largely in the collaborative projects. Many are stimulated by the Technology Strategy Board's technology competitions.

3.14. The CPI model has been developed and tested to serve the process industries. It is now being applied to high temperature processing in collaboration with Tata Steel to develop a centre for gasification and pyrolysis technologies.

⁴ IB 2025: Maximising UK Opportunities from Industrial Biotechnology in a Low Carbon Economy, BERR, May 2009

⁵ Plastic Electronics: A UK Strategy for Success, BIS, December 2009

3.15. CPI works with a number of businesses that have been spun out of Universities such as Imperial and Cambridge.

3.16. CPI is strongly networked with academia and works with many of the leading research intensive-universities in the UK. Examples include Cambridge, Imperial College, Manchester and Swansea on Printable Electronics. In Industrial Biotechnology, CPI is working with many universities including Durham, Manchester, Newcastle, York and Robert Gordon and links are developing with other leading UK institutions. We also have a number of important relationships with overseas universities.

3.17. One of the main challenges facing process technology businesses in the UK is that of raising the early stage finance necessary to support long term development. To help alleviate this problem CPI is working with the investment community to develop collaborative cross sector funding models that address this issue. This has been discussed with the British Venture Capital Association (BVCA) and work is in progress to develop an investment model that links TICs with the private sector to support investment in early stage businesses.

3.18. The UK has only a small number of potential technology innovation centres that work in the innovation space, but most of the UK competitor countries have purpose-built centres or institutes that fill this space. In addition to the Fraunhofers, others include VTT in Finland, and TNO and ECN in the Netherlands. Potential UK examples include the Advanced Manufacturing Park in Sheffield serving the engineering manufacturing industry and the National Renewable Energy Centre, NaREC, providing testing services for the renewable energy industry. The Hauser Review¹ gives examples of other centres.

4. *What other models are there for research centres oriented towards applications and results?*

4.1. In CPI's view there are three fundamental models that can be followed:

4.1.1. The creation of application development centres in individual or groups of Universities. The advantage of this type of centre is that the innovation process is located close to the source of the invention. However, the disadvantage is that it can only support the output of the university or universities it serves. It is a technology-pushed model, and assumes that the university grouping is doing market relevant research. It limits the value creation opportunities for the UK and does not support the wide range of inventive organisations that also produce technology ideas. These include SMEs, large companies, individuals and government organisations;

4.1.2. The development of single company based innovation centres that focus on the technology of a specific company. This type of centre can support the development of growing businesses and keep them at the forefront of international technology generation and thus create value for the company. The disadvantage is similar to that of the university centres as it limits the value creation opportunities to a specific company, is fraught with state-aid potential, and does not support the wide range of inventive organisations that also produce technology ideas. This is unlikely to create the best value for the UK from a public intervention;

4.1.3. The creation of independent technology innovation centres that serve selected nationally important technology platforms or industry bases. The advantage of this type of organisation is that it becomes skilled at all aspects of the innovation process and can serve a wide range of inventors/researchers. It can work with a number of universities and companies within the technology space and can support SMEs and inward investors as well. This larger national centre can build up a flexible reconfigurable asset base that can service a range of innovation ideas and processes. The challenge for this type of centre is retaining the confidentiality of the wide range of partners the organisation works with. This is a manageable process with well proven mechanisms.

4.2. CPI's conclusion is that the independent technology innovation centre model is the most sensible approach to creating wealth for the UK as a whole. In our experience, the centre is also likely to spin-out companies to seed the process of building a cluster of companies, supported by the centre.

5. *Whose role should it be to coordinate research in a UK-wide network of innovation centres?*

5.1. The UK needs a mechanism to set the long-term strategic direction for science & technology. Such a body should be drawn from departments in Government and combined with senior figures from industry, finance and the third sector. The role would be to define target markets and work collaboratively to cover all the technology readiness levels. The strategic technology areas should match national policies and needs. Such a body could be established under the aegis of the Department for Business, Innovation and Skills to provide guidance to the Technology Strategy Board.

5.2. Once the technology target areas have been set and funding decided a national body could be tasked with implementing the strategic plan. This body should be independent of the research councils and direct government management. CPI believes that the appropriate body to co-ordinate TICs in the UK would be the Technology Strategy Board (TSB). It would need additional resource to deliver this function, but strengthening and developing the TSB would deliver value to the UK.

5.3. The TSB must coordinate and not control the TICs. A performance management framework is essential, such as in the Fraunhofers, where more public funding rewards greater acquisition of private sector revenue

up to a limit (to discourage the centres from becoming too private sector dominated), and failure results in less funds. Such a process will allow the centres to nurture an entrepreneurial approach.

5.4. It is also important that the TICs play a significant coordination role with academia and other TSB initiatives such as the Knowledge Transfer Networks. The explicit collaboration that the TIC model brings between the Research Councils, the TSB and Industry must be continued through to individual universities, the TICs and their industry partners.

6. What effect would the introduction of Fraunhofer-type institutes have on the Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?

6.1. The challenge is not to decrease or diminish the amount of work done in the UK's Public Sector Research Establishments and other centres. It is to ensure that the UK fills the innovation gap between invention and commercialisation. As such the establishment of technology innovation centres should be seen as adding greater strength to the UK value creation process by addressing a market failure.

7. OTHER ISSUES

7.1. The European Union has a large number of collaborative research, innovation and demonstration programmes that are well funded. These include the Framework programmes and the strategic energy technology (SET) plan. The UK contributes to these programmes, but has no systematic strategy for securing and using these funds to assist in its innovation activities. The TICs should provide a focus and a strong base for bringing UK industry together and creating a collaborative strategy with our European partners that also secures funding to assist UK companies.

Nigel Perry, FEng
Chief Executive Officer

Dr Graham Hillier, CEng, FRSA
Director of Strategy and Futures
Centre for Process Innovation Ltd

1 December 2010

Written evidence submitted by the CBI (TIC 34)

SUMMARY

- There is a strong case for giving additional support and coordination to structures which facilitate commercial exploitation of research.
- A major priority is to ensure the numerous existing centres are more fully mobilised to contribute maximum benefit to the economy.
- The growing imbalance between the levels of public funding for research and for innovation causes a bottleneck which puts UK business at a competitive disadvantage internationally.
- This is exacerbated by the difficulty business encounters in seeking to locate sources of useful skills, knowledge and expertise within the university system.
- Strengths of the Fraunhofer model include:
 - Explicit commitment to a core purpose of pursuing knowledge of practical utility
 - Substantial and stable long-term core funding from government, enabling institutes to commit themselves to sustained investment in long lead-time technologies
 - Exposure to market-driven incentives to provide services to business for which business is willing to pay.
- The Technology Strategy Board is well placed to oversee the machinery for promoting applied research in order to create economic benefit, but it is already inadequately resourced to fulfil its existing mission.

INTRODUCTION

1. The CBI welcomes the opportunity to submit evidence to the Committee's inquiry. The CBI is the UK's leading business organisation, speaking for some 240,000 businesses that together employ around a third of the private sector workforce. CBI members also include about half of the UK's universities, among them most of the more research-intensive universities.

2. Both the Hauser Review and *Ingenious Britain*, the report of the Dyson review, highlighted the mismatch between the quality of the UK's university research base and the weakness of the infrastructure for commercialising its output to give economic impact. There is a strong case for giving additional support and coordination to structures which perform the function of linking university research to commercial exploitation, though the need for a wholly new infrastructure of technology and innovation centres in the UK is less clear-cut.

3. A major priority is to ensure the numerous existing centres are more fully mobilised and suitably structured to contribute maximum benefit to the economy. This should include improving access to facilities and expertise within existing publicly-funded research establishments. New centres should be established if that is demonstrably the best solution, for example based around a large piece of shared physical infrastructure.

4. Part of the problem which the proposed technology and innovation centres are aimed at addressing is the balance of public funding between the substantial level of support for research and the much lower figure for innovation. The Technology Strategy Board, for example, currently enjoys core funding at a level which is about one-twentieth of the budget for university research dispensed by the Research Councils and the higher education funding bodies such as HEFCE (the Higher Education Funding Council for England). The resulting bottleneck in exploitation of research outcomes puts UK business at a competitive disadvantage internationally, and this is likely to be exacerbated by the disappearance in England of the innovation funding support disbursed hitherto by the RDAs—a total of about £350m.

5. An obstacle to innovation which is regularly reported by CBI member companies, both large and small, is the difficulty of locating appropriate sources of suitable skills, knowledge and expertise within the university system—sometimes described as the lack of a ‘catalogue’. A more coherent landscape of support for commercialisation of technology and innovation could alleviate this problem by ensuring that an initial port of call is easier to identify.

Question 1: *What is the Fraunhofer model and would it be applicable to the UK?*

6. Others are likely to be better equipped to describe the Fraunhofer model in detail. From the CBI’s perspective the main relevant features include:

- Explicit commitment to a core purpose of pursuing knowledge of practical utility.
- Substantial and stable long-term core funding from the federal and state governments, accounting for about one-third of revenue, and enabling institutes to commit themselves to sustained investment in long lead-time technologies.
- A similar proportion of revenue from public sector project income and from the EU.
- A further third of revenue earned through contract research for German and other companies.
- A core funding model which strongly incentivises institutes to earn between 25% and 55% of their revenues from contract research for industry, and gives additional rewards for income from the EU.
- A strong orientation towards working with SMEs, which account for one-third of industrial contract research income.
- An important role in facilitating business engagement in the European Framework Programme for Research and Technological Development.
- Close links with universities while retaining distinct institutional character, identity, mission and incentives.
- Great breadth of scope in activities which support technology deployment, including technology assessment, training for customers’ staff, and other support services extending beyond the initial phases of a new process or product.
- A strong generic brand and corporate governance model combined with institutional autonomy. The strength of the brand may however distract attention from the great range of variation across institutes: this variation includes variation in effectiveness.
- Very positive perception by German science, engineering and technology students as a potential employer.

7. There are some aspects of the Fraunhofer model from which the UK can usefully learn, but the culture, history and innovation infrastructures of Germany and the UK are different, and an indiscriminate attempt to apply the model wholesale would be inadvisable even if it were practically possible and fiscally affordable.

Question 2: *Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?*

8. There are many centres conducting contract research and collaborative research with industrial partners. Many but by no means all are based in, or attached to, universities. Centres which are wholly embedded in universities can sometimes have difficulty operating effectively in a commercial environment and adapting to market incentives. Many centres have been created with funding from RDAs, but even before the decision to abolish the RDAs it has never been possible for this support to be guaranteed over the kind of period for which Fraunhofer institutes’ core funding is stable. Lack of substantial and stable long-term core funding has been an obstacle to the effectiveness of centres in the UK, as its existence has in general been a source of strength to the Fraunhofer institutes—though opinions vary about the extent to which some Fraunhofer institutes may have succumbed to the gradual decline in the relevance of their programmes which can afflict publicly funded laboratories.

9. The effectiveness of such centres varies widely—some of them are excellent, and benefit from the unique UK model of cooperation between Research Councils, RDAs, business-facing universities and industry. A prominent example is the Advanced Manufacturing Research Centre (AMRC) in South Yorkshire, though this is not seen by all companies in the sectors concerned as a fully ‘open innovation centre’. A still better model may be exemplified by the National Composites Centre being developed in the Bristol area.

10. A merit of the Fraunhofer model is that institutes are obliged to earn a substantial proportion of their income by performing research for business customers: since such customers are free to choose where and whether to spend their money the system ensures that institutes have to be able to demonstrate the commercial value of their services. Research and technology organisations in the UK such as MIRA and C-Tech Innovation are similarly obliged to demonstrate their effectiveness to business customers—but they are not funded to support the kind of long-term investment in future technologies which the Fraunhofer model permits.

Question 3: *What other models are there for research centres oriented toward applications and results?*

11. A different model exists in the United States, where there is an extensive network of national laboratories such as those of the Department of Energy, Department of Defense, Department of Agriculture, and National Institute of Standards and Technology (NIST) of the Department of Commerce. Some of these laboratories are operated by the Battelle Memorial Institute, which is also part of the consortium managing the UK National Nuclear Laboratory, along with Serco and the University of Manchester, on behalf of DECC. Serco also manages the National Physical Laboratory under the GOCO (government-owned, company-operated) model, which has been demonstrated to provide significant operational efficiencies with strong scientific outputs.

Question 4: *Whose role should it be to coordinate research in a UK-wide network of innovation centres?*

12. A measure of coordination could help avoid the risk of multiple centres in different sectors, regions or technologies, dissipating resources by pursuing parallel paths with sub-critical mass. There is also scope for facilitation of innovation across centres, linking-up research in complex areas, and coordination of skills development activities, as well as sharing and disseminating good practice of various kinds.

13. The national body which is best fitted to oversee the machinery for promoting applied research in order to create economic benefit is the Technology Strategy Board, which has rightly been given the role of investigating the potential for implementing recommendations of the Dyson and Hauser reviews in this regard. It is less clear that the TSB has been adequately resourced to fulfil this addition to its mission.

14. A point worth bearing in mind is that the branding or badging of an existing centre within a national framework, subject to appropriate quality and other controls, may convey benefit and enhance impact without the need to commit additional resources.

Question 5: *What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?*

15. If existing centres are doing their job well and efficiently there is little obvious benefit in establishing and subsidising new competitors. Even if they are not functioning optimally there may be much more cost-effective means of remedying this. But it is important to bear in mind that the prime merit of the Fraunhofer model from a business perspective is that the Fraunhofer institutes are designed to help reinforce the competitive strength of the economy through the work they do for industry. If one focuses on government-sponsored research one risks losing sight of this fundamental fact. However, the example of the National Physical Laboratory shows that private sector operation can release the potential of government assets to support innovation in the economy based on government-sponsored research.

CONCLUSION

16. Experience in the UK and overseas suggests that centres can only fulfil their mission if they are driven by business demand. The appropriate model is likely to vary according to business sector—a hub and spoke system with a small number of centres tapping into a much wider network works well for engineering and physical sciences, but in life sciences the most appropriate model may be one with many specialised research centres that business can tap into directly. But any new developments should take account of and build on the best of the existing apparatus and business models, and ensure that existing centres are fully mobilised to contribute maximum benefit to the economy.

Enterprise and Innovation Group
CBI

30 November 2010

**Written evidence submitted by Advanced Manufacturing Research Centre (AMRC),
University of Sheffield (TIC 35)**

1. *What is the Fraunhofer model and would it be applicable to the UK?*

The Mission Statement reflects the Fraunhofer-Gesellschaft operation.

- The Fraunhofer-Gesellschaft promotes and undertakes applied research of direct utility to private and public enterprise and of wide benefit to society as a whole.
- By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their region, throughout Germany and in Europe. Their research activities are aimed at promoting the economic development of our industrial society.
- As an employer, the Fraunhofer-Gesellschaft offers a platform that enables its staff to develop the necessary professional and personal skills that will enable them to assume positions of responsibility within their institute, in industry and in other scientific domains.

It has long been recognised that the UK fails to create sufficient wealth from the world-class research carried out in its top universities. If a survey were to be conducted amongst its manufacturing companies, one would find only small percentage able to cite tangible benefits they had derived from academic/industrial collaboration.

Equally, one would find it difficult to identify a government backed “centre” or organisation that could display massive sustainable UK wealth derived from its activities in this arena.

There is little wrong with the UK’s curiosity-driven research, but there is a gap between what universities research and what industry can access and exploit in order to create sustainable wealth. That gap even extends to companies who organically develop their own initial ideas, only to abandon them as they struggle to maintain R&D costs and become disillusioned with difficulties in obtaining help. Everyone appreciates the wealth of expertise and experience within our academic base but equally, everyone knows how difficult it is for industry to tap into and exploit the same for commercial gain. This situation, though long recognised as a problem, has prevailed for decades despite numerous government initiatives spanning several administrations.

Most of the nation’s manufacturing companies—even those previously fat and resistant to change, are now lean. They would all cite their willingness to adopt or develop new tools, techniques and technologies if there was an affordable and timely means available to do so. The majority of UK firms suffer from a lack of significant funds required to implement the same, when compared to companies in countries where the state provides direct financial assistance and others where the banks have a mandate to take a longer-term view of return on investment.

As such, on the face of it, a government funded Fraunhofer type facility, with a mandate to actively “help” industry grow through exploiting affordable applied research, would surely be beneficial to UK industry. However, one has to question why such model hasn’t been directly commissioned or created before?

Lord Heseltine, during his tenure as President of the Board of Trade, commissioned an extensive review of Fraunhofer Institutes to determine their applicability to the UK. The conclusion is summed up admirably in a statement from the then science minister Mr. William Waldergrave:

“We have studied the Fraunhofer institutes closely, and Sir David Phillips has led a team to look at them. The House of Lords Select Committee, as the Hon. lady no doubt knows, also studied the subject, and it came down against setting up similar institutes. On balance, the Government took the view that the noble Lords were right in that decision. It is not true that all the German Fraunhofer institutes are successful. There is a wide variation among them. Some are, some are not. Our view was that, rather than doing the characteristically British thing of inventing new institutions, we should do the more difficult but far more important thing and get our science and engineering capacity more closely related to industry. We can do that.”

Hansard: Science, Engineering and Technology. HC Deb 26 May 1993 vol. 225 cc923–37.

In 1997 the first Faraday Partnerships were launched as the UK’s response to the German Fraunhofer Institutes. Unfortunately, despite ongoing government support they failed to achieve the level of buy-in from industry that was apparently enjoyed by the Fraunhofer Institutes. This can only be because the partnerships did not provide what industry required, despite the best efforts of the academics involved. The reason for this is that the university departments establishing the Faraday Partnerships did not change their priorities or indeed their way of going about business; they merely added a remit to work more “closely” with business. In 2000, Sheffield University recognised this problem and followed a radical route creating the AMRC; a centre directed by a board of industrial partners with the sole aim of utilising applied research to identify technology driven solutions to create ongoing and sustainable wealth for *all* involved.

Since day one, in 2001 this centre has significantly grown its industrial partner base year on year achieving global recognition as “best in class”. Rolls Royce and Boeing have both promoted the AMRC as being the best university/industry collaborative model available anywhere in the world. Between them they have supported centres operating to the same model in 9 other countries. In all cases, these foreign centres have commissioned the AMRC to assist them and their governments in setting up the facilities. An example was

last year, when Denmark opened its own Danish AMRC—a collaboration between Aarhus University, the Government and Vestas where the focus is on building their expertise in the wind Energy sector. The Danes investigated many models but chose the AMRC's and commissioned over £100,000 of consultancy from the Sheffield team.

In 2008 the AMRC won the prestigious Queen's Anniversary Prize for Education.

When other countries around the world are considering their prospective centres they always ask the AMRC's founders what the "secret" of success is. They all receive the same response: Agree and articulate a simple, clear Vision as to what exactly you hope to achieve over how long? Then instill an overriding guiding principle into all the work that is undertaken: 'Is what I am doing or about to do, going to get the centre nearer its objective or create sustainable wealth for the partnership?

A unique feature of the model is that it requires every partner to buy into the benefits of funding and undertaking generic research, the fruits of which can be shared, on a free licence basis, by the *whole* partnership. The knowledge developed is also available to the wider industrial community but a commensurate charge is levied to contribute to the ongoing research costs.

2. Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?

The AMRC asked its key industrial partners for their opinions on this question. They all cited the AMRC as being the only centre/model that could be mentioned as being comparable to the Fraunhofer.

Though not *directly* following the Fraunhofer model, the University of Sheffield's AMRC has several similarities. But why has the AMRC achieved such success and provided the model for several look-alike centres around the UK and the world? What is different about the AMRC compared to all the other attempts to create wealth from the UK's knowledge base? Why does it leverage considerably more private sector revenue than other centres and the Faraday Partnerships achieved?

Part of the answer must lie in the fact that the AMRC model entails a radical departure for university departments; traditionally, these are steeped in an academic culture where peer acceptance is a key motivating factor associated within curiosity-driven research. Wealth creation for all stakeholders is the driving force of the AMRC. The intention is not to replace blue-sky research groups, nor should they. Blue-sky will always underpin and be an integral part of the work undertaken by AMRC and the research must be regarded with equal status and funded accordingly. Blue-sky research will seldom be heavily supported in its infancy by industry as shareholders and board members have goals that are becoming increasingly near-sighted. However, blue-sky needs industry as its ultimate route to market. Industry also provides a motivation to accelerate the research's outcome. This is where the AMRC's model fits perfectly, as industry, academia and government all work together to create a "who shares wins" approach to delivering affordable and effective solutions. Such a global solution is not realistic when parties work in isolation.

The AMRC leverages in huge private sector investment because companies feel they are an integral part of the centre, working alongside academics. They provide equipment, people, experience and, of course, funding. By following a research agenda they and other partners have an influence in, business becomes part of a team that collectively gains considerable returns on their investment—a problem shared is a cost halved!

They like the idea of creating both competitive and most importantly what the AMRC calls, "*repetitive*" advantage.

3. What other models are there for research centres oriented toward applications and results?

As previously stated it is difficult if not impossible to identify a UK or indeed global university led "research" centre that can be said to "orientated towards [industry] applications and [industry benefitting] results".

It has long been the claim that UK universities or independent government backed consortia fail to significantly exploit [create mass wealth] from their internationally significant research. This is hardly surprising given that the measures of success from basic University driven research are more geared towards academic prowess than commercial exploitation. With Governmental led consortia/initiative the feeling from industry is that good news stories are the "measures of success".

It is very rare that basic research, [rather than applied research] provides the oven-ready solutions that companies can incorporate immediately in to their manufacturing processes. However, today's solutions are the bi-product of research undertaken in the past. Therefore, basic research is, of course, the foundation on which applied research now builds and the catalyst through which wealth is created. By neglecting either strand, sustainable wealth creation cannot be achieved. Future TICs must provide funding within their centres for both forms of research.

Business should and does contribute to some blue-sky research—particularly in the medical field. It will be noted that such a spend in global terms is in itself a *major* industry. It stands to reason that companies will invest where they see a world class centre—one with a reputation for delivering value and results. To create such a centre requires huge funding and even the largest companies in the world will not pay to a level that will totally fund a world-class research facility.

However, the AMRC has proved that once established, through a relatively modest public sector contribution to core activities, centres can develop the capacity and capability they require in order to attract and keep a more than fair share of the Global research and development budget of a given sector. Through Governmental “pump priming”, agreement of a simple clear Vision and the appointment of the *correct* leadership, a world class facility can be created, capable of attracting the best brains and the best companies committed to exploiting research to the mutual benefit of all involved.

There are several centres in the private sector and several who originated from or were legacies from the National Research Centres such as CTI, TWI, CERAM, NPL. These are essentially different to the AMRC model as they are not part of the UK wide University technology knowledge base—still a vast untapped resource. The AMRC is still fundamentally a University department and as such it operates as a neutral, unbiased, research/technology solution provider.

4. *Whose role should it be to coordinate research in a UK-wide network of innovation centres?*

This role should not be given to an existing so-called technology provider acting as a pseudo-intermediary. Nor should it be given to intermediaries working solely to support their own organisation’s well-being and stature. There needs to be an end to pursuing nonsense such as promoting the obvious, discussing “technology translation” as though there is an issue in breaking through an impenetrable barrier between academia and industry. Too often initiatives have failed because co-coordinating organisations have failed to understand or overcome the real problems faced by industry. TICs must understand this and have a Vision and motivation to actually do something rather than talk about it.

Centres capable of attracting considerable support from industry *should* be supported from the public purse as the government, along with all other partners, must provide monies if it expects to see a return on investment.

There should be a degree of freedom in the way public funding is spent in TICs as priorities will change depending on the industrial sector targeted and the length of time the centre has had to establish its niche. It has been the AMRC’s experience that a relatively modest grant of £5.9m over four years was sufficient to construct a new building and start the centre, allowing it to grow into a 70 staff entity. Further public sector support was given once results had been achieved—one of which was the centre’s fundamental role in help Dowty of Gloucester win a multi million contract on the new Boeing 787 aircraft program. This contract also benefits the dozens of UK based companies who supply into Dowty. Recent work on disk machining with Rolls-Royce (and funded by TSB) has justified the construction of a new disk manufacturing facility in Sunderland and there are numerous examples of SMEs in the Yorkshire and Humber Region benefiting and receiving large orders from blue chip companies.

All public sector support should be matched by the private sector, either cash or in kind. A public sector contribution of around £5m a year would, following the start-up phase, ensure a centre was capable of providing solutions comparable to anywhere in the world and encourage the most highly qualified academics to spend some time carrying out both Blue-sky and applied, wealth-creating research.

The organisation administering the public funding, should have a thorough knowledge of industry as a pre-requisite, which suggests the Technology Strategy Board is the most appropriate organisation as it host a wealth of in-house experts covering all aspects and sectors of manufacturing and industry.

They should agree a set of targets at the outset and then manage a level of core public funding to allow the centres to maintain their “world-class” status whilst delivering the “goods”.

Funding should be provided in three-yearly installments and only continue beyond that point if results justify it. Those results must be wealth created by UK companies as a result of collaborating with the TIC.

There is also a major role for the research councils and they should work alongside TSB and make use of the resource provided within the TICs. Although applied research should always be a TIC’s primary focus, core funds should be made available to attract the world’s best researchers into the centres. World class status and the ongoing innovation within there requires that there opportunities to carry out industry and market driven related blue sky research. There is no reason why such research cannot ultimately be exploited by UK industry and what better place to facilitate this than an environment driven by results. Seeing basic ideas developed to a level of sophistication where they can be deployed in manufacturing companies in shortened time-scales should act as a wake-up call to all researchers.

POST-SCRIPT AND SOME FACTS

It should be noted that the AMRC does not create “direct” wealth for the University of Sheffield. However, indirectly it creates great value through ensuring the institution gains worldwide recognition and respect for its world class facilities as well as its 5* research status. Partners have said that a key facet of a centre’s success dealing with industry is that it is able to react and respond to demands. Traditional University/government multi-layer reporting structures do not accommodate this. Centres must report directly to the Government body managing/auditing the funds.

Basic Facts:

1. The AMRC has 65 partner organisations.
2. Half the partnership are tier 1 member companies each paying £200k pa in cash or in-kind.
3. Half are tier 2 member companies each paying £30k pa in cash or in-kind.
4. Partner contributions fund generic research—Intellectual Property is held by the AMRC but is shared amongst the partnership but is also made available to the wider community at a commensurate cost.
5. The AMRC started with just eight staff in 2001
6. The AMRC now has 150 staff—mostly highly qualified Masters or PhD researchers. On average 25 industry partners are also working in the centre each day.
7. Partners pay for additional research outside the collaborative agreement Intellectual Property is held by the company (or companies) commissioning the research.
8. Non-member companies can and do commission research from the AMRC.
9. AMRC membership is open to all companies.
10. The AMRC has raised industrial support at a ratio of 6/1 over Government funds.
11. The centre[s] would cost £45 million to build and equip at today's prices. The buildings and the equipment are a University asset on the balance sheet.
12. The AMRC "model" is working across other industrial sectors in the world e.g. Singapore: Surface engineering; Denmark: wind energy; Madrid: Air traffic controls; Germany: Rapid Prototyping / Manufacturing; Holland; Composite materials; Australia: Advanced Manufacturing.

Advanced Manufacturing Research Centre
University of Sheffield

2 December 2010

Written evidence submitted by The British Private Equity and Venture Capital Association (BVCA) (TIC 54)

About the BVCA: The British Private Equity & Venture Capital Association (BVCA) is the industry body and public policy advocate for the private equity and venture capital industry in the UK.

The BVCA Membership comprises over 230 private equity, midmarket and venture capital firms with an accumulated total of approximately £32 billion funds under management; as well as over 220 professional advisory firms, including legal, accounting, regulatory and tax advisers, corporate financiers, due diligence professionals, environmental advisers, transaction services providers, and placement agents. Additional members include international investors and funds-of-funds, secondary purchasers, university teams and academics and fellow national private equity and venture capital associations globally.

As a result of the BVCA's activity and reputation-building efforts, private equity and venture capital today have a public face. Venture capital is behind some of the most cutting-edge innovations coming out of the UK that many of us take for granted: the medical diagnostic services we use in hospitals, the chips in our mobile phones, the manufactured components of our cars, and the bioethanol fuels that may run them in the future. Likewise, private equity is behind a range of recognisable High Street brands, such as Boots, Phones4U, Birds Eye, National Grid and Travelodge.

1. The UK has a strong track record when it comes to scientific research and investment in innovation. Indeed as the Hauser Review notes, we are currently 2nd in the G8 only to the US for excellence in research⁶ and we have three universities (Cambridge, Imperial and Oxford) that regularly appear in the world's top 10.⁷ The UK is regularly ranked near the top for innovation in the EU (though the latest report presents our current position as one of stagnation).⁸ However the BVCA's own analysis suggests that despite this strong base in research and innovation, the market for commercial investment in high growth companies is not as burgeoning as it could be.
2. In the UK, the state of the capital markets is usually found at fault when it comes to early stage venture. A BVCA/NESTA report (2009) found that this was both a demand and a supply problem. They dubbed this "thin markets" where limited numbers of investors and entrepreneurial growth firms within the economy cannot get together at low cost. This analysis is less applicable to say the US which is characterised by deep markets.⁹

⁶ International Comparative Performance of the UK research base, September 2009 http://www.dius.gov.uk/assets/biscore/corporate/migratedd/publications/i/icpruk09v1_4.pdf

⁷ Times Higher Education Supplement rankings, see <http://www.timeshighereducation.co.uk/world-university-rankings/2010-2011/top-200.html>

⁸ European Innovation Scoreboard 2009

⁹ From Funding Gaps to Thin Markets: UK Government Support for Early Stage Venture Capital, BVCA, 2009

In comparisons with other countries, investment in early stage companies in number of investments and quantum of investment does not reflect our relative strength in r&d.

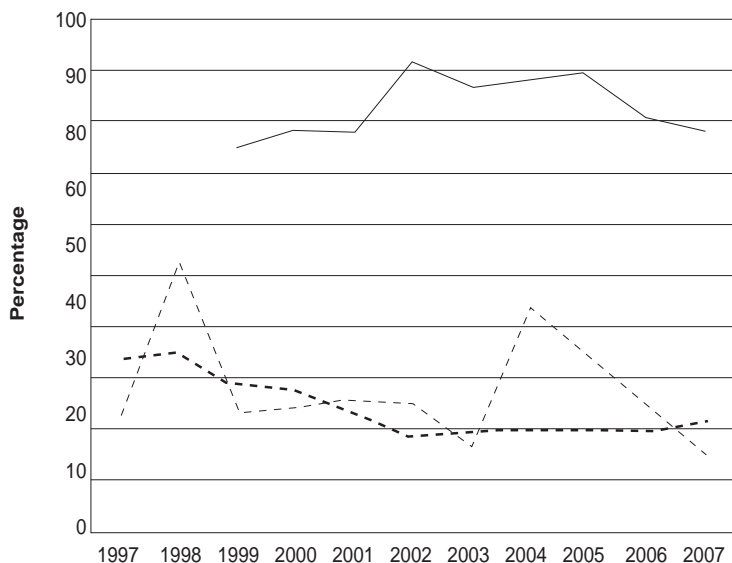


Figure 5:
Early stage Investments as a % of total VC Investment

Source: BVCA, IVC, NVCA

--- US
--- UK
— Israel

- As can be seen from the above, whilst neither the UK nor Israel could hope to compete with the US in absolute terms, neither do we compete in relative terms in early stage and have recently fallen behind the US¹⁰.

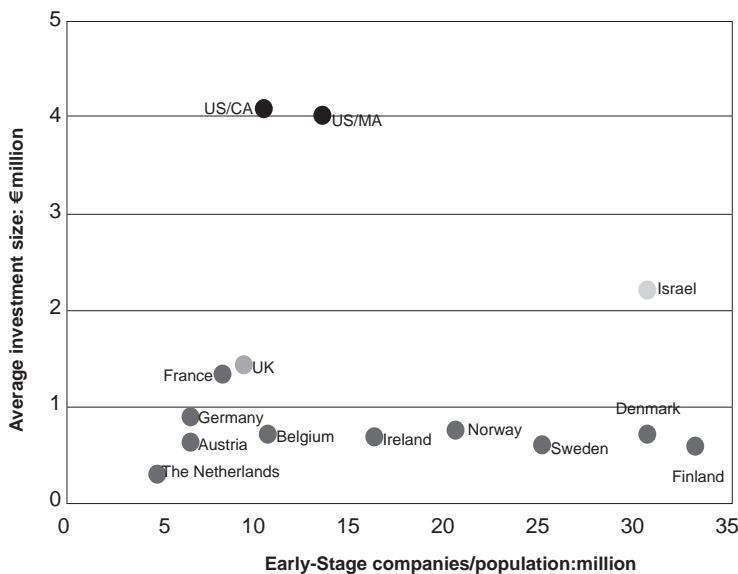


Figure 6:
Investments per early-stage company

Source: Maula et al. (2007)

- In terms of the size of investments made (and the quantum), the UK and France are very close together as is Germany. But the US invests much more per investment as does Israel. This suggests investment in UK and EU early stage is spread much too thinly¹¹.
- Regression analysis in the benchmarking report highlight three determinant factors in explaining levels of activity; higher levels of entrepreneurial activity, R&D expenditures as a percentage of GDP and visible success stories on the stock market affect early stage and total venture capital activity. The analysis suggests that the supply side is attracted by success stories, while opportunities for entrepreneurs arise from technological exploration (reflected in the R&D measure). In-depth analysis shows that entrepreneurial activity in the UK is the most important of the three factors. We would expect that if entrepreneurial activity (in terms of creating high growth oriented ventures) was increased it would have a significantly higher impact on VC activity in the UK. Therefore one of the first areas of attention for policy makers is to increase entrepreneurial activity.

¹⁰ Benchmarking UK Venture Capital to the US and Israel: What lessons can be learned? BVCA, 2009

¹¹ *ibid*

6. This is backed up by a 2010 survey conducted by Deloitte which says that in terms of what is important in fostering VC activity, 60% cite an improving entrepreneurial climate as key and 59% cite a strong R&D climate, supported by Govt. Only 35% cited tax and regulation as the most important element¹².
7. The BVCA welcomed the commitment in the Comprehensive Spending Review to protect the science budget but as the analysis above suggests, we must do more at the next stage when it comes to fostering entrepreneurial activity and turning research into commercial opportunities. Thus the £200m to be invested in Technology and Innovation Centres has merit as this will cut to the heart of the problem.

FRAUNHOFER AND THE UK

8. The Hauser Report¹³ described work done in other countries to add capacity through TIC-like institutions in the so called 'intermediate sector'. In France Carnot Institutes set up in 2006 foster links between a renowned research base and industry. In Germany Fraunhofer Institutes perform a variety of functions listed by Hauser as
 - undertaking basic research;
 - carrying out applied research in the innovation chain between university generated initial discovery and industrial development to realise its commercial potential;
 - enabling SMEs to innovate through provision of knowledge, equipment and applied research;
 - providing technical and commercialisation services to large and small companies; and
 - developing a highly skilled workforce.
9. The Fraunhofer Model, is comprehensive in scope and geographical coverage with over 80 institutions (of which 58 are fully fledged Fraunhofer Institutes) with total funding of € 1.6 billion annually. It is clear that with initial investment of £200m we are not looking to create that scale here in the UK and nor should we. As Hauser notes

*the role and rationale of TICs is therefore context dependent, which also includes the presence and nature of other academic or business centres of excellence; the balance of business sectors; and the importance attached by the public and private sector to innovation within a particular nation. This is an important point to bear in mind when considering the transferability of a 'model' from one country to another.*¹⁴
10. Fraunhofers also tend to focus upon "Technology Readiness Levels" (called TRLs) 4 to 7 (industry/ applied contracts and government projects), whereas UK universities are traditionally strongest in TRLs 1 to 3 (blue sky and early stage translational research). However, in the best research intensive universities, there is a strong overlap, both in people, equipment and funding bodies between the TRL 1–3 stage and the TRL 4–5 stage.
11. This is a major strength in the UK and leads to better and more creative outcomes. We should not then see Fraunhofers as filling a completely empty gap, as there is already good work being done in that space by the best universities. These are precisely the universities which also tend to have critical mass/active technology transfer offices with dynamic and productive VC links, such as at The University of Manchester, Cambridge and UCL.
12. The Fraunhofers, as a specific initiative, have more recently championed and catalysed a number of Translational Innovation Clusters, which look to build upon existing areas of expertise and contacts, in regions and fields of critical importance to the relevant national economies in which they are based. So promoting clusters in which venture capital and universities can "sit" together as part of an enterprise landscape and add value together is worthwhile. This aspect of the Fraunhofer model would be welcome—especially if centred in those areas which could pick-up and build upon existing activity—particular consideration should be given to existing sectoral expertise as can be seen from the examples below.
13. So we need to be particularly mindful of overlap when it comes to implementation because it is clear from the list of Fraunhofer functions above, that the UK already has existing capacity in many of those areas and any new provision through TICs must dovetail effectively with it. University of Manchester Intellectual Property is engaged in activity that would certainly fall into Hauser's 'intermediate sector', for example managing IP created at the University and then following evaluation, helping to commercialise it via sale, licence or spin-out. They have helped raise hundreds of millions for spinouts and are now licensing at a rate of 20 per annum
14. **Case Study—UMIP and NanoCo:** with VC partners, UMIP raise some £175M into spin-out companies in the last 5–6 years. This represents 85 transactions during a very difficult economic climate and of which about half were in the very early venture space (seed capital). From selling shares in some of those spin-outs (and from other sources) they have been able to initiate about 100 proof-of-principle programmes in new tech transfer intellectual property projects, which will give rise

¹² 2010 Global Report on Trends in Venture Capital, Deloitte 2010

¹³ The Current and Future Role of Technology and Innovation Centres in the UK, BIS 2010

¹⁴ *ibid*

to many new start companies/spin-outs and licences over the next 5–6 years. An example of a Manchester University spin-out starting life as a proof-of-principle project is NanoCo. Although originally set-up in 2001, it received its first seed capital injection in late 2004. It makes and commercialises fluorescent nano-crystalline particles (quantum dots) of semi-conductor materials that have unique chemical, electronic and optical properties, due to their small size. The dots are so small that 80,000 of them can fit across the width of a single human hair, and have applications in biological marking, flatscreen TVs, security and clean-tech. Having received two rounds of institutional venture capital following the 2004 university and VC seed round, NanoCo now has partnerships with major industrial firms and is today valued on the stock-market at £200M.

15. Case Study—UCL and pharmaceuticals:

GSK: UCLB have announced partnerships with GSK on a three year strategic collaboration to investigate new compounds to treat potentially sight-threatening disorders.

Pfizer: They have also announce a collaborative project with Pfizer Regenerative Medicine to research a better understanding of stem cell-based therapies for certain ophthalmic conditions.

AstraZeneca: UCL and Astra Zeneca have entered into a collaboration to develop regenerative medicines for diabetic retinopathy (DR).

SUMMARY AND CONCLUSION

16. BVCA research suggests that there is work to be done in turning a world class research base into a burgeoning market for high growth companies that can attract venture finance and become the global titans of tomorrow. Whilst closing this gap has many facets, one such facet is further provision in the intermediate sector through institutions like Fraunhofers and our own TICs. However, the wholesale application of such a network of institutions is not financially viable (with £200 million) nor is it practically necessary because of extensive existing provision. Before deciding on how to deploy this capital, an audit of existing provision is essential so that a clear understanding of coverage and best practice is gleaned and where appropriate, this can be replicated where provision is currently lacking. This may involve investing in new standalone institutions or it may involve adding to existing capacity. Government should not be wedded to either approach but should simply deploy the money where it will be of most use. An extensive consultation with the university, venture and business angel sectors should be the starting point.

The British Private Equity and Venture Capital Association

2 December 2010

**Written evidence submitted by the Regional Development Agencies
(TIC 66)**

SUMMARY

1. This submission has been prepared by the South East England Development Agency (SEEDA) on behalf of the eight Regional Development Agencies (RDAs) outside London. The RDAs promote and enable economic growth in England's regions by creating the conditions to grow businesses and by helping to create additional, better quality, higher-paid jobs. Because of London's unique governance arrangements, this response only represents the views of the RDAs outside London.

2. The RDAs support the Government's ambition to build a network of elite Technology and Innovation Centres (TICs) in the UK. We would like to make a number of points to the Committee.

3. First, it has been widely noted that the Fraunhofer model cannot be copied directly to the UK, as there are significant differences between the UK and German economies and the way that companies engage with universities on innovation. The focus, therefore, should be on how the UK network of TICs can achieve the same overall objectives as the Fraunhofer network. TICs in different technologies, relevant to different sectors, may need to be markedly different to be most effective. A thorough and convincing assessment of the business demand for the services of each TIC will be an important criterion to be met before public funding is committed to the centres.

4. Second, TICs will engage with innovative companies, many of which are the high-growth, job-creating companies that are of most benefit to the UK economy. As public support becomes increasingly focused on high-growth businesses, there is a clear rationale to connect TICs and Growth Hubs where this can increase the effectiveness and efficiency of both bodies.

5. Third, the location of TICs will be critical as TICs will build relationships with organisations at different spatial levels. While all the TICs will need to develop an international reputation, they will also need to work with local organisations, including small and medium enterprises (SMEs) and local authorities, and across the UK with relevant businesses, universities and public bodies. A hub and spoke model is likely to be of most benefit to achieve this.

Q1. *What is the Fraunhofer model and would it be applicable to the UK?*

6. The German Fraunhofer Society describes itself as undertaking “applied research of direct utility to private and public enterprise and of wide benefit to society”. The research develops technological innovations and novel solutions in collaboration with customers to further the economic development of the regions and the country. It also brings social and environmental benefits through spillovers from the resulting innovation.

7. The Fraunhofer Society is the largest organisation for applied research in Europe and has more than 80 research units, including 60 Fraunhofer Institutes, across Germany. Two thirds of the research revenue is from public and private contracts. The remaining third of revenue is core funding from the national and regional governments.

8. It would benefit the UK to adopt the funding model of the Fraunhofer Centres. The core funding provides sustainability for the centre, while the contract basis of the remaining two thirds of funding drives a customer and results focused approach to research, accelerating innovation for the benefit of funders and the country.

9. In addition to applied research, the Fraunhofer Society has assumed the task of conceiving and implementing innovation clusters and developing a highly-skilled workforce. This is a key element of the German government’s high-technology strategy.

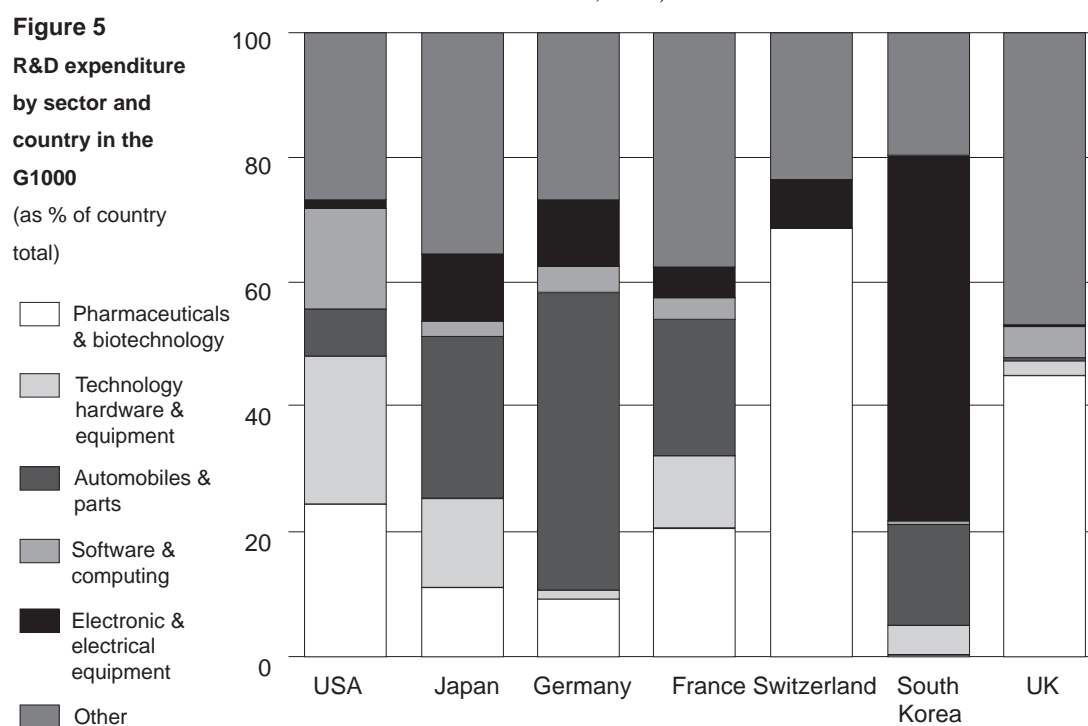
10. This element of the Fraunhofer network is also relevant to the UK as the TICs must be integrated into the UK’s innovation ecosystem, alongside effective existing bodies, to support innovation and economic development.

11. While the incentives for applied research offered by the Fraunhofer network are very relevant to the UK, the implementation in the UK must be different to take account of the significant and critical differences between the two countries.

12. First, business research in Germany is built around the physical sciences and engineering, whereas the UK business strength is underpinned by life sciences. This is illustrated by Figure 1, taken from the 2010 R&D Scoreboard, which shows that nearly half of UK research is in the pharmaceutical and biotechnology sectors, compared to around half of research in Germany in the automobiles and parts sector.

Figure 1

**R&D EXPENDITURE BY SECTOR IN THE LEADING R&D COUNTRIES OVER FIVE YEARS
(2010 R&D SCOREBOARD, DEPARTMENT FOR BUSINESS, INNOVATION
AND SKILLS, 2010)**



13. This is also confirmed by research from manufacturers’ organisation EEF published in November 2010 that found just 1.2% of UK manufacturers employ more than 250 people, compared with 2.1% in Germany and 2.9% in the US.

14. The difference in the business research base is critical as, for example, the route to market for pharmaceuticals is very different in risk, timescale, barriers and rewards from that for advanced manufacturing.

15. Therefore, the focus should be on how the UK network of TICs can achieve the same overall objective of incentivising applied research as the Fraunhofer network. However, the specific barriers to innovation in technologies and sectors should be understood before a TIC is established.

16. It is also notable that of the countries presented in Figure 1, the UK has the largest proportion of R&D outside the major global sectors, i.e. over half the expenditure is in the “other” category. As well as the major sectors, companies in the top 25 UK R&D funders include aerospace and defence; banks; food producers; oil and gas producers; fixed line telecommunications; media; mobile telecommunications and tobacco.

17. This unusual diversity of research-funding sectors in the UK economy presents a challenge in supporting research through a network of focused TICs, as there will be sectors or technologies that could benefit from a TIC that are not covered by the limited number of centres in the network.

18. Rather than diluting the focus of the TICs, it would be possible to offer multi-sectoral support alongside the TICs, and to help companies to make links with relevant technologies for their sectors.

19. Second, the network of Fraunhofers is well established in Germany; and has a defined role alongside the fundamental research carried out by the Max-Planck institutes. It is a very different proposition to establish a new network in the UK, since the UK already has a variety of public, hybrid and private research centres that contribute to the rich innovation ecosystem in the UK.

20. This means that successful TICs will drive significant changes in the way that businesses collaborate with the knowledge base. In some cases this will be at the expense of existing centres in both the public and private sectors, which have local relationships and networks. These local links can be maintained through a “hub and spoke” approach to the TICs.

21. Third, to create a network of genuinely Fraunhofer-type centres in the UK would require large and sustained Government funding, substantially longer than that currently proposed. Whilst funding has been allocated for four years, the Hauser Review recommended that funding should be sustained over a ten-year period to deliver meaningful benefit, so the real and sustainable benefits of TICs can only be realised by continued funding across Spending Review periods.

22. Fourth, given that two thirds of the funding for a TIC will be from contracts, it is necessary to consider the particular needs of UK sectors and public bodies for applied research and near to market support, and to tailor the formation and operation of a TIC to meet that need. This should include a thorough assessment of the scale of business demand for research from the centres.

Q2. Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?

23. The overall objective of the Fraunhofer Centres is to incentivise applied research of direct relevance to private and public bodies. While there are no centres in the UK that are identical to the Fraunhofer Centres, there are a variety of internationally respected centres that use different approaches to achieve the same objective and, arguably, may be more relevant to the UK economy.

24. The RDAs have been instrumental in developing these centres to stimulate and incentivise applied research with business. (The drivers for these centres are discussed in the answer to Q3.) The *2009 Annual Innovation Report* reported that in 2008/2009, the RDAs spent over £300 million on supporting innovation, over half of which was invested in innovation infrastructure, including Centres. We strongly recommend that wherever possible the network of TICs should build on RDA investments in centres.

25. The effectiveness of RDA investments in science, R&D and innovation infrastructure was assessed in *The Impact of RDA Spending* report prepared by PricewaterhouseCoopers in 2009. The scope of this category includes physical centres, as well as collaborative research, innovation support for SMEs, and skills projects on innovation; all of which are within the scope of the Fraunhofer Centres.

26. The study investigated the value for money of the RDA investments by focusing on the ratio of Gross Value Added (GVA) to cost, i.e. the GVA return on investment. The increase in GVA reflects the increased contribution to the economy of a business as a result of the RDA intervention.

27. The study found that while the annual return for investments in science, R&D and innovation infrastructure was 1.1, this increased to 3.4 when the potential persistence of the impacts is considered. As would be expected for interventions to increase business innovation, future potential returns are particularly significant for science, R&D and innovation infrastructure investments. This takes the GVA return on investment to 8.3.

28. This means that each £1 million of RDA spending on science, R&D and innovation infrastructure adds over £8 million to regional economies.

Q3. *What other models are there for research centres oriented toward applications and results?*

29. The RDAs funded four types of centres, developed in support of their primary objective to create sustainable economic growth in their regions, which are:

30. *Technology Push* centres that support technologies that could have significant disruptive effect or substantial economic benefit for businesses taking it up, but industry is not yet recognising the opportunity.

31. Examples of this type of centre are the Printable Electronics Technology Centre (PETEC) in Sedgefield, the Institute for Sustainability in the Thames Gateway, and iCON in Daventry.

32. *Industry Demand* centres which address feedback from businesses that there are technologies or markets that are too risky for them to enter alone. The barriers to entry are identified and may be addressed through facilities at a centre.

33. Examples of this type of centre are the Advanced Manufacturing Research Centre in Rotherham, the Manufacturing Technology Centre in Coventry, and the International Space Innovation Centre in Oxfordshire.

34. Centres to *Link Research and Business* bring together single or multiple universities to offer expertise to a clearly identified group of companies operating in an important sector for a region.

35. Examples of this type of centre are the Knowledge Centre for Materials Chemistry in the North West and the Centre for Low Carbon Futures in Yorkshire.

36. *Geographical Centres* offer physical premises to enable open innovation around a knowledge base resource (or anchor business) as a focus for a cluster of businesses.

37. Examples of this type of centre are the Harwell Science and Innovation Campus in Oxfordshire and Stevenage Bio-Park.

38. In addition, there are a variety of centres that bridge academic research and business, including centres funded by Research Councils and the Higher Education Funding Council for England, as well as the independent intermediate sector, including Research and Technology Organisations.

39. Given that there are existing and sustainable centres across the UK, and that these Centres have excellent links to both university and business research, and across supply chains, there is a sound basis for developing a hub and spoke model across the UK.

40. These spokes would help to address the difficulties that SMEs may encounter in engaging with an elite network of TICs, as the TICs may find it easier to work with large corporates that will be attracted to the world-class research and have the investment required.

41. The RDAs have often used a “hub and spoke” approach to centres. This combines the benefits of a strong hub as the focus for new activity, with the recognition that there will be relevant research spokes across the UK, which in turn enhance the hub.

42. These links operate in both directions, with spokes offering an access point to the hub for local businesses, particularly SMEs, across the UK. This helps to include all areas of the country in Government investment in new technologies.

43. For example, if the International Space Innovation Centre at Harwell in South Oxfordshire were a TIC for the space sector, spokes could include the National Centre of Earth Observation in Reading, the GNSS Research and Applications Centre of Excellence in Nottingham, the Mullard Space Science Laboratory in Surrey, the Advanced Space Concepts Laboratory in Glasgow, and the UK Astronomy Technology Centre in Edinburgh.

44. The RDAs have also recommended to Government that the Department for Business, Innovation and Skills (BIS) should create a national innovation system offering an integrated approach and focused on high growth/high impact businesses and key sectors of the future.

45. This includes recommending that the network of Growth Hubs is connected to existing and new Centres of Excellence (including TICs), Innovation Centres and Science Parks, to provide comprehensive geographical coverage across England. This would join up private and public innovation and growth support for SMEs, which are recognised to be hard to access, but critical for employment growth.

46. This will also enhance collaboration with universities by creating opportunities for collaboration with all relevant universities, rather than just the local university. This allows enhanced multidisciplinary research, as well as bringing in intermediate sector research bodies.

47. Each Centre could have a “front office”, offering the Growth Hub service (comprising, at a minimum, support for open innovation, coaching, understanding finance, high-growth start-up) to companies with high-growth potential from whatever sector. It would also act as a portal to a bigger network, thus connecting the Growth Hub and the Technology & Innovation Centre ideas.

48. The TIC does not become the Growth Hub and the Growth Hub does not become a TIC. Each would have a clear identity, but they may be able to work together to deliver strong support for high-growth businesses.

Q4. Whose role should it be to coordinate research in a UK-wide network of innovation centres?

49. We recommend that BIS should develop a national strategy for TICs, aligned with a national growth strategy, to be implemented by the Technology Strategy Board (TSB). In developing a national strategy for TICs, BIS should work with Research Councils and other research funders, as well as with business representatives of large, medium and small businesses.

50. In terms of implementing the strategy, the TSB will need to engage with sub-national and local partners to develop an implementation plan that recognises national strengths. The success of a national strategy will critically depend on drawing on intelligence from around the UK, and implementation through partners with local knowledge and relationships. TICs will be most successful where they build on genuine innovation strengths in a location.

51. All nine of the RDAs (and all three Devolved Administrations) have selected innovation priorities, developed with the advice of their Science and Industry Councils within each region, which include senior representatives from industry, universities and the public sector. These priorities differentiated the activity of each of the RDAs based on an evidence case of business and university strengths in the regions.

52. These innovation priorities provided an excellent starting point to assess the needs of key sectors and to identify and critically evaluate the role that each region’s asset base can play in maximising the benefit for the UK. These innovation priorities are summarised in the Annex.

53. This is in contrast to the approach adopted in the 2003 Micro and Nanotechnology Manufacturing Initiative where all the RDAs were asked to invest in facilities in their region, resulting in a lack of focus and critical mass.

54. While the economic development structure in England will look radically different in the future, there will still be a need for an objective assessment of the local strengths in a national context, and intelligence sharing to allow non-contiguous economic areas to collaborate on common opportunities.

Q5. What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?

55. It is essential that the approach taken is cross-Governmental to create synergies, and not competition, with other publicly funded research centres. Currently, research centre funding originates from many departments, with differing objectives e.g. climate change or animal health. However, whatever their primary objective, all of these research centres have the potential to improve the UK’s business competitiveness.

56. Previously the RDAs have engaged with all such centres in a region and they are included in the Regional Economic Strategy implementation plans. Hence, there is a real risk of fragmentation and missed business opportunities with the abolition of RDAs, unless this role is continued by the new economic development structures.

57. If the TICs are to be successful, they will need to draw in public funding from other bodies and centres, and Government should acknowledge the potential for displacement of businesses from around the country to be located near a TIC. While this may well be desirable from a national perspective, there may be adverse effects for individual locations and bodies.

58. These potential issues can be addressed by the Government Office for Science maintaining a cross-Government perspective on public investment in applied research to ensure coordinated action across Government, while the adoption of a hub and spoke approach will ensure that the benefits of the TICs are accessible across the UK.

SEEDA, on behalf of the eight RDAs outside London

2 December 2010

RDA AND DA SCIENCE AND INNOVATION PRIORITIES SUPPORTING NATIONAL PRIORITIES AS AT FEBRUARY 2010



Written evidence submitted by the Technology Strategy Board (TSB) (TIC 67)

1. The Technology Strategy Board is a business-led organisation with a leadership role to stimulate technology development and innovation in the areas which offer the greatest potential for boosting UK growth and productivity. We promote, support and invest in technology development and innovation for the benefit of UK business. We spread knowledge, bringing people together to solve problems or make new advances. The Technology Strategy Board is the prime channel through which the Government incentivises business-led technology innovation.

2. Declaration of Interest: The Technology Strategy Board, sponsored by the Department for Business, Innovation and Skills, has responsibility for establishing and managing a network of Technology and Innovation Centres to help commercialise new and emerging technologies. This follows the announcement by the Prime Minister on 4 November 2010 that over £200m will be invested in Technology and Innovation Centres over the next four years. The Technology Strategy Board also has responsibility for publishing a Strategy and Implementation Plan for Technology and Innovation Centres in the UK by April 2011.

3. We welcome the opportunity to respond to this inquiry and have set out our response below against the questions set by the Committee.

What is the Fraunhofer model and would it be applicable to the UK?

4. With fifty nine institutes and an annual turnover of 1.6bn Euros, the Fraunhofer Group (FhG) is one of the largest applied research organisations in Europe. Positioned between Universities and industry, they have a strong reputation for making scientific and technical excellence available to German industry. The funding model is often expressed as 1/3, 1/3, 1/3. Approximately one third of the funding is granted by the German federal government and Lander; one third is collaborative research and development type funding, including funding won competitively from EU programmes, and the remainder is directly contracted commercial revenue. There is a very strong Fraunhofer “corporate brand” but within that each of the institutes has considerable operational autonomy.

5. The way in which a particular model is deployed is often dependent on the context and the environment in which it will operate. The German and UK innovation systems are different in both structure and the way they operate. The German innovation system has evolved with an expanding Fraunhofer network firmly embedded at its heart. Taking the Fraunhofer model and deploying it in the UK without modifying the approach to take account of the context of the UK innovation system is likely to result in sub-optimal performance. Centres alone cannot stimulate innovation and wealth creation in any economy. They must form an integral part of a structured programme with a strategic vision.

6. There are however specific elements of the Fraunhofer model, as well as similar elements from other international examples, which are less context dependent. They therefore translate more easily into the context of the UK innovation system. Such elements include the 1/3, 1/3, 1/3 funding model; having critical mass in an area; a large measure of autonomy for individual centres, subject to performance; and, the need for a strong brand presence.

7. The sustained, predictable long-term public investment in Fraunhofer Institutes has made it easier to deliver critical mass. This is a long-term view that recognises that the payback to the economy accrues over many years and should not be viewed as something which will deliver economic growth in the short-term.

8. Finding the right balance of national control and operational autonomy of the Technology and Innovation Centres is very important. The German funding model is fairly sophisticated, giving more core-funding to Institutes as they increase commercial revenue.

9. Robust working links to a strong and well supported scientific research base are a pre-requisite, as is the ability to draw from across the pool of talent in the whole of the UK. Getting the incentives and interfaces right will be critical to successful cooperation between Technology and Innovation Centres, Universities and industry. In Germany, many Fraunhofer Institutes play an important role in linking German Universities with industry. The situation in the UK has developed in different ways with different performance incentives for Universities and business. It will be important that future UK Technology and Innovation Centres establish the right linkages with the full range of talent and expertise and that existing strong relationships between business and UK Universities are also supported.

10. There is a requirement for business-focused Technology and Innovation Centres in the UK to make it easier for UK industry, particularly SMEs, to access world-leading research and technical capability. The centres can play an important role in helping businesses solve their technical and commercialisation challenges. The centres should have:

- reach into world-class science
- capability to undertake collaborative applied R&D with business
- capability to undertake contract research for business

- strong business focus with a professional delivery ethos
- critical mass of activity between business and knowledge base
- expertise in skills development
- access to world-leading knowledge.

Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?

11. There are a large number of centres and other organisations that operate in the UK to bridge the gap between Universities and industry: there are the RDA and DA funded centres (Eg AMRC, AFRC, CPI, and MNT centres); the Research and Technology Organisations; Contract Research Organisations and technical consultancies; and, coming from the other direction, there are University centres (including centres such as the Innovation and Knowledge Centres funded by the Research Councils and Technology Strategy Board) and other public sector research organisations. However, we don't believe there are any centres currently in the UK fully meeting the requirements we believe necessary to be seen as a Technology and Innovation Centre.

12. Effectiveness must be when a centre enables economic activity that far outweighs the public investment. Effectiveness must be helping to stimulate a vibrant industry around the centres. This is long-term and difficult to measure. The only near-term measure can be the eagerness of industrial partners and customers to invest time and money in the centres.

13. The effectiveness of UK centres could be much better and has to date been hampered by a number of things, including:

- a lack of long-term strategic integration and co-ordination with other public investment measures and no overarching brand;
- a piecemeal approach to investment in centres has not helped long term investment in capability—the RDAs for instance could only ever commit to three years of funding aligned to Spending Review periods;
- the scale of many centres has been too small to have an impact on the national economy, let alone achieve international recognition.

14. Public funds for centres can only be justified if they are providing something special that the private sector will not fund or is beyond the resources of an individual company. Many centres have been established with injections of public capital and then asked to become sustainable. This appears to result in two main outcomes: either the centre approaches public funding bodies for further ad hoc injections of capital investment for major equipment refresh programmes, or the centre evolves to compete against commercial players in more lucrative markets and ceases to be "special". Centres require long-term investment which is strategically managed and which enables the centre to invest in higher risk areas in anticipation of business needs.

What other models are there for research centres oriented toward applications and results?

15. There are many variations of research centres. As well as the Fraunhofer Institutes, there are a number of European and international centres which provide a range of slightly different approaches. These include the Inter-University Micro Electronics Centre in Belgium; the Industrial Technology Research Institute in Taiwan; the Electronics and Communications Research Institute in South Korea; the Torch Centres in China and the Carnot Institutes in France. More detailed explanation of these centres is set out in the review conducted by Hermann Hauser and so we have not sought to provide detail here.

16. Every technology area and market operates in a slightly different way and therefore the best approach for a centre to help address the barriers to adoption of new technologies by business will be different in each area. Most centres however seek to reduce financial and technical risk making it easier for companies to adopt new and innovative technologies. This would include making available expertise and equipment that requires an investment that no individual company could justify either because of the size of the investment or the length of the pay-back period.

17. Early stage, less mature technology areas (for example those still looking for robust commercial applications and models) may be more suitable for university based centres, such as the Innovation and Knowledge Centres (IKCs) which are jointly funded by the Research Councils and the Technology Strategy Board. The IKCs focus more on emerging technologies in areas of research excellence where scientific breakthroughs have been achieved and where there is the potential to accelerate early commercialisation.

18. Some technology areas may need smaller, more local centres that drive the adoption, rather than the development of a technology. Other markets may need a greater emphasis on start-up incubation facilities, or increasing knowledge transfer and sharing through virtual centres. In establishing Technology and Innovation Centres in the UK, an important point worth stating is that they will not be the right answer for every one of the UK's priority areas and other approaches may be more suitable.

Whose role should it be to coordinate research in a UK-wide network of innovation centres?

19. No matter how excellent, a UK-wide network of innovation centres working alone would not be effective in stimulating economic activity and anchoring the activity of global companies in the UK. Investment in Technology and Innovation Centres is one piece of a jigsaw. A strong research base on which to draw is a pre-requisite. A business community willing to invest time and money is essential. Public funding bodies with investment programmes in relevant technologies and application areas are vital to stimulate long-term activity.

20. The UK's investment in Technology and Innovation Centres must be an integral part of a structured and coordinated innovation system. The Technology Strategy Board, as the lead innovation organisation in the UK, will be looking to take a much more proactive leadership role in bringing coherence to the UK innovation system. We will do this through working with a range of partners and stakeholders. We believe we have the broad view and the experience to ensure that Technology and Innovation Centres are integrated and seen as part of the bigger picture and have the ability to leverage other investments.

21. The activity delivered by each Technology and Innovation Centre must be informed by its industrial customers and public sector partners. The advantage of a model where the majority of the funding must be won through competitive routes is that it keeps the centres focussed on providing services that remain relevant to business. It is important to set technology and application areas in which the centres operate but within those bounds each centre must have a reasonable degree of autonomy in how it operates.

22. We believe the Technology Strategy Board is best placed to provide the coordination and drive a UK network of Technology and Innovation Centres.

What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?

23. The Technology and Innovation Centres will not be direct competitors for PSREs or other UK research centres. Their coverage and focus must be different but complementary. The past 20 years has seen the disappearance of a large number of public sector and corporate laboratories in the UK. The establishment of a network of Technology and Innovation Centres in the UK will help to fill the gap which now exists.

24. The primary objective of the Technology and Innovation Centres is to make leading edge technology available to businesses that would otherwise be beyond the reach of individual companies and to solve the development, scale-up and other technical challenges that face many innovative companies as they seek to bring new products and services to market. The research that is carried out by the Technology and Innovation Centres should be aimed primarily at improving their offering to industry, and informed by their interaction with industry.

25. In future, what is important is to get the shape and position of the Technology and Innovation Centres right in the UK innovation landscape so that they complement the PSREs. They need to be appropriately incentivised to work with existing research establishments and the wider research base and innovative companies.

Technology Strategy Board

2 December 2010

Written evidence submitted by Universities UK- AURIL joint submission (TIC 77)

UNIVERSITIES UK (UUK)

Universities UK (UUK) is the representative organisation for the UK's universities. Founded in 1918, its mission is to be the definitive voice for all universities in the UK, providing high quality leadership and support to its members to promote a successful and diverse higher education sector. With 133 members and offices in London, Cardiff and Edinburgh, it promotes the strength and success of UK universities nationally and internationally.

ASSOCIATION FOR UNIVERSITY RESEARCH AND INDUSTRY LINKS (AURIL)

Association for University Research and Industry Links (AURIL) is the largest professional association that represents all knowledge transfer practitioners in the UK, working to ensure that the new ideas, technologies and innovations flowing from their organisations are taken up for the benefit of economy and society.

AURIL and UUK have welcomed the opportunity to respond to this inquiry. For both organisations, the main issues are that, whilst there are independent research institutes which work closely with business, the UK currently has nothing that looks like a Fraunhofer system in terms of volume, scale and approach, and the government does not seem to be committed to funding long term projects of this kind. The scale of proposed investment in innovation activities is welcome, provided that it does not ignore the track record and experience that Higher Education Institutions (HEIs) can demonstrate.

1. What is the Fraunhofer model and would it be applicable to the UK?

The Fraunhofer-Gesellschaft model is that of an applied or industry focused research and development centre on an ambitious scale, funded by a blend of government grants and (a majority of) private sector and government contract support. It is an integral part of the German innovation system and has an annual research budget of approximately €1.6 billion. Of this budget, €1.3 billion is generated through contract research (two thirds is derived from contracts with industry and from publicly financed research projects). One third is contributed by the German federal and Länder governments in the form of institutional funding.

1.1. The Fraunhofer platform encompasses more than 80 research units (including 59 Fraunhofer Institutes) at different locations in Germany, although there are research centers and representative offices in Europe, USA, Asia and in the Middle East. The Institutes are closely aligned with Germany's research active universities and the Max-Planck Institutes (an independent not-for-profit research organisation) who carry out basic research and host large scale research infrastructures.

1.2. In comparison with the UK, Germany therefore hosts a far more differentiated research and innovation ecosystem with defined roles for each group. In contrast with the German HE sector, UK universities have well developed capabilities in knowledge and technology transfer and excellent relationships with industry, and have been supported in developing these via successive rounds of government support (through mechanisms such as HEIF). Any development of Fraunhofer type structures in the UK environment would have to take account of and adapt to these distinctions in order to complement and augment existing R&D and innovation mechanisms.

1.3. Although the Fraunhofer network could be applied to the UK, there are a number of pre-existing structures and boundaries that need to be acknowledged and taken into consideration in the development of the TICs network. Arguably, there is an embryonic Fraunhofer infrastructure emerging in the UK as a result of successive rounds of Government support through mechanisms such as HEIF and focused innovation funding via the Research Councils. For example, the Advanced Manufacturing Technologies for Photonics and Electronics IKC, funded via EPSRC based at University of Cambridge.

1.4. Any development of Fraunhofer type structures in the UK environment would have to take account of, and complement existing R&D and innovation mechanisms and funding should be deployed in a manner which provides additional investment for some existing structures, and pump-priming for others. Therefore, an element of funding should be ring-fenced for competitive allocation. In addition, a threshold of engagement should be agreed e.g. 30–40% income from industrial partners which, if not secured, results in a proportion of the core funding returned for re-deployment. In essence, embed a financial claw-back system.

1.5. The significant scale of the Fraunhofer network in Germany and the level of year-on-year national investment mean that any UK development would initially be a fraction of the size (assuming the £200 million proposed budget). Only a limited number of specific initial investments could be made on this basis and care should be taken to ensure that funding is not spread too thinly within any UK network.

1.6. In the UK context, there are a number of further considerations that need to be borne in mind:

1.6.1. Any consideration of the value of the Fraunhofer model needs to proceed from a clear understanding of what purpose such Institutes will serve in the UK. The success of Fraunhofer Institutes as elite organisations which provide a business-focused capability that bridges research and technology commercialisation needs to be understood within the broader environment within which they exist in Germany. Any development of a network of similar institutes in the UK needs to be sensitive to the particularities of this context. Effective implementation will require careful consideration of how a network of institutes will map onto and complement the UK's current innovation "culture" and its existing "infrastructure".

1.6.2. It is worth noting that the most successful and effective existing research centres in the UK have universities at their centre, such as University of Sheffield's Advanced Manufacturing Centre with Boeing. We would argue strongly that universities have a central role in the new TICs, no least for the research expertise they can bring, but also as a source of highly-trained people with the capability of bringing a multidisciplinary diversity often absent from independent technology centres or research institutes.

1.6.3. We understand that it has been suggested that the new TICs should house capital equipment that individual HEIs may not be able to afford. This would be hugely costly in terms of capital, revenue and balance sheet (via rapid depreciation). In light of the levels of investment proposed, we would argue strongly that the focus of the new institutes should be on people rather than equipment and costly infrastructure. TICs should look to utilise and build on the sharing of existing infrastructure where possible.

1.6.4. It will also be important to give close consideration to the levels of core funding which will be provided to the new TICs. The new centres would require significant, long-term investment to have the capacity for significant outcomes, which would in itself take some time to build and emerge. They would therefore need a sustainable business model which recognises the level of funding required to develop and maintain the capability of the TIC from both public and private sources. On the latter, it is essential that the new centres supplement core public funding by winning additional income from sources such as contract research, commercialisation and subscriptions as reliance on

demand from end users is crucial to encouraging innovation and boosting efficiency. To assist with this objective, minimum targets might be set for engagement (e.g. achieving 40% income from industry within a reasonable timeframe). When establishing this approach, it should be borne in mind that experience of similar ventures in other countries suggest that institutes become focused on the short-term and are ultimately unsustainable if they are required to generate too great a percentage of their revenue from commercial sources.

1.6.5. Care should be taken to ensure that the UK's *design thinking* research expertise is taken into consideration when formulating TIC components. This would enable a broader range of universities to engage with the innovation agenda which would greater benefit UK Plc. The UK has, in its diverse HE sector, a real and valuable strength which must be reflected in developing the new TICs, not only housing some very strong world-class research intensive universities but also with institutions with excellent records in innovation and knowledge exchange, as well as niche areas of world-class research. It is therefore essential for the UK global research base to be able to access and utilise the pockets of expertise that exist in a diverse range of institutions without dilution of critical mass funding. Similarly, the new centres should be multi-disciplinary in their total offering—a wide range of disciplines are critical in supporting the new knowledge economy which includes, but is by no means limited to, STEM disciplines.

1.6.6. Within the UK, it is not clear how the Local Enterprise Partnerships (LEPs) will be able to contribute to the TICs in some areas, especially if, as in the Greater London area, there is a question about the availability of Regional Growth Funding (RGF) to support development. Until the full extent and range of the LEPs and RGF become evident, the TIC funding and leverage assumptions linked to regional development should be acknowledged, but not incorporated into any funding model until the future is clearer. Whilst the Technology Strategy Board (TSB) should lead the co-ordination of the TICs (see paragraph 4.1), it is essential that there be a joined-up national and sub-national innovation strategy (for example, through the new LEPs) to avoid a disconnect between the two approaches.

2. Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?

2.1. There are a number of existing UK university research infrastructures that are similar to the Fraunhofer business model, that is, large scale interaction with business. For example, the Advanced Manufacturing Research Centre in Sheffield with Boeing and Rolls Royce is a world-leading research centre dedicated to developing innovative technology solutions for advanced materials, cutting-edge technologies and providing practical solutions to manufacturing problems.

2.2. The Eco-design Centre (EDC) University of Wales Institute Cardiff, conducts international best practice research in eco-design and eco-innovation and support knowledge exchange with industry and other key stakeholders (e.g. educators, policy-makers). EDC undertake applied research; participates in UK and international networks and collaborative projects and international best practice scanning. EDC have been working with Fraunhofer on various levels over the last number of years and are starting a new collaborative FP7 project with them in January.

2.3. Similar facilities operated by the University of Liverpool have benefited from having a physical, rather than a virtual, presence. This provides an opportunity for researchers and businesses to work on projects side-by-side. The ability to undertake short-term work in a flexible manner is important as it helps to build relationships and establish trust between partners. This can be achieved through core funding for post doctorate-level staff capable of delivering large, as well as smaller, commercial projects. A second important lesson is that initiatives will only succeed where there is a focus upon a sustainable area of technology in which the barriers for business to undertake projects themselves are too high. There are of course many further research institutes in the UK working to a similar business model as Fraunhofer institutes, involving both universities and businesses, which are too numerous to list here.

2.4. However, what these centres lack is the long term government commitment to core ring-fenced funding which is fundamental to the sustainability of the Fraunhofer model. Without this, such ventures may represent a potential financial risk to their host institutions if appropriate operational frameworks are not adopted.

3. What other models are there for research centres oriented toward applications and results?

3.1. A more common model observed in the UK is that of major university research centres backed by significant funding won in competitive processes from RCUK and other sources, working in conjunction with KT support from central or devolved university resources. In particular, the highest quality STEM research activities tend to attract industry contract research, collaboration and co-investment which operate alongside, and are complementary to, basic research support from RCUK (e.g. research funding charities, EU Framework Programmes, etc.).

3.2. This is fundamentally different to the Fraunhofer model, yet has advantages in terms of cross-fertilising industry focused activities with the newest and most cutting-edge research concepts and results.

3.3. Previously, the UK innovation system has also included former Government research facilities such as those of MoD/DERA. In that instance, the loss of specific capabilities, capacity and expertise which

followed privatisation and the creation of QinetiQ can be viewed as a key example of why ongoing government co-investment is needed in order to maintain R&D resources of national importance.

4. *Whose role should it be to co-ordinate research in a UK-wide network of innovation centres?*

4.1 This coordination activity should fall to the TSB, which is ideally positioned to take advice from its Knowledge Transfer Networks (KTNs). KTN membership is broad based and includes academic, industry and public sector inputs—all of which have useful experience to offer. The views of RCUK are also key if TICs are to be introduced in a manner which enhances the knowledge transfer activities of the university sector.

4.2 By delivering competitive advantage, innovation centres have the potential to anchor knowledge-intensive activities of globally mobile companies and form part of a wider-ranging innovation architecture within given localities. In this respect, it is essential that consideration be given to how any co-ordinating body will engage at local level to ensure that growth opportunities and the benefits to the UK of location in a given area are maximised; there is also a corresponding imperative that localities establish how they wish to engage with any UK network. The new TICS are likely to be a very strong magnet for inward investment, a factor that should be carefully considered when determining TIC location and specialisation.

4.3 Similarly, Universities UK and the Association for University Research and Industry Links (AURIL) have key experience and expertise in a wide range of structures and frameworks for managing innovation activities and would be pleased to act in an advisory capacity.

5. *What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake government sponsored research?*

5.1 Government would need to ensure that the Fraunhofer or TIC offering in the UK is distinct and builds on existing capacity, as opposed to duplicating it. There is also a risk associated with diverting scarce government funds from proven, successful research models, with the risk of disrupting and compromising the relationships and linkages enjoyed with business partners (potentially to the considerable detriment of private sector stakeholders).

5.2 Engagement between a UK co-ordinating body and LEPs will be important; the presence of senior HE representation, as well as business leaders on LEP boards, should therefore be viewed positively. The connection between local growth agendas and UK innovation policy suggests that consideration should be given to how TIC funding may be leveraged against the Regional Growth Fund to maximise economic impact and assist the transition towards sustainable private sector-led prosperity.

5.3 The German model tends to be one dimensional and linked to a particular organisation/institution when the PSREs look to bring various organisations—HEIs/companies etc—together to collaborate often on an interdisciplinary basis e.g. the International Space Innovation Centre (ISIC) at Harwell and the Cockcroft Institute at Daresbury at which the partners are Universities of Lancaster, Liverpool, Manchester, and the North West Development Agency).

5.4 The UK's academic community has a strong entrepreneurial spirit and this could be harnessed if Institutes provide attractive opportunities for development and career progression. A crucial consideration therefore—beyond the relationship between centres—is how academic staff will view their relationship with the Institutes and what opportunities they will provide for career development. The orientation of UK and institutional performance systems can militate against academics engaging in knowledge exchange activities. The establishment of a high-profile UK network will not alleviate this by itself and should therefore be considered within the context of broader UK HE policy.

Universities UK (UUK)

Association for University Research and Industry Links (AURIL)

6 December 2010

Written evidence submitted by Rolls-Royce (TIC 82)

INTRODUCTION

1. Rolls-Royce welcomes the opportunity to submit evidence to the Committee's inquiry. As one of the leading engineering companies in the UK, we have significant experience in pulling through innovative new technology into high value products and services. This experience has taught us that to do this and to compete effectively in a global industry requires partnerships with our suppliers, academia and government.

2. The Hauser Review highlighted the need for an effective mechanism for commercialising the rich and original output of our national university research base. However such mechanisms must be targeted to ensure they deliver technology and innovation that the UK industrial base is able to exploit and they must be adequately funded over a sufficient period to make them stable, desirable locations in which to foster our brightest and best scientists and engineers.

3. The Fraunhofer model suits the conditions of the German industrial base and although we believe that while the Fraunhofer model is not a direct fit for the UK it offers a good example of how such a mechanism

can work for the benefit of academia, industry and government. A slightly more focussed model is a priority here, building on where the UK is already strong, or has a clear opportunity to be so, both academically and industrially.

Question 1—*What is the Fraunhofer model and would it be applicable to the UK?*

4. The Fraunhofer model is the product of more than fifty years of consistent investment in establishing a broad technological base for manufacturing industry in Germany operating across 59 centres. However, it is costly to establish and operate, currently running at €1.6 billion per annum. A distinctive aspect of the model is that it is largely research led and takes considerable time and effort to transfer technology concepts into industrial applications. Such a model makes sense in a nation with many leading engineering and manufacturing firms. However, there is some overlap between centres—with consequent funding inefficiencies.

5. The UK's recently developed Advanced Manufacturing Research Centre model is more based on industry pull, compared to technology push with the Fraunhofers. The UK model is largely focussed on application engineering to deliver best in class quality and cost solutions. This more selective and affordable approach with closer connections to markets, reflects our narrower industrial base and the urgent need to improve competitiveness. It derives its speed to market from linking strong University research directly with industrial sponsors.

6. The German system has a clear hierarchy of Government Research Institutes:

- (a) Max-Planck-Gesellschaft—for large-scale, basic science research.
- (b) Fraunhofer-Gesellschaft—technology-focused research centres.
- (c) Helmholtz-Forschungszentren—research centres focused on industry sectors.

Rolls-Royce works closely with the German Aerospace Research Centre, DLR, which is a Helmholtz institute.

7. However, the overriding lesson from Germany is that such centres must be funded consistently and at significant scale over time if they are to deliver the economic impact of which they are capable. In such a position they have been able to develop a strong reputation for performance and delivery, built up over decades, which is vital to their success. In contrast, the UK has, over the past 25 years, consistently dismantled its national research centre base with the loss of the Royal Aircraft Establishment, Marchwood and Leatherhead CEBG Centres and many others. It has also significantly reduced the scale and scope of remaining centres such as Culham, The National Physical Laboratory and the National Engineering Laboratory.

8. The funding of the Fraunhofer model is quite balanced with around one third of their budget coming from national or regional government directly, a further third aimed to be generated from public research projects bid for competitively and a final third from research contracts with the private sector. Expectations of continuous support—balanced by strong performance measures—are crucial to attracting and retaining high calibre people. Importantly we understand in Germany funding commitments are made for periods up to 15-years with exit points to cover non-performance. Some 50% of the funding for Helmholtz (eg The German Aerospace Institute, DLR with €750m p.a. turnover) comes as a block grant from central government and a further 30% from public research projects. Any UK Centres should be given 10 year grants with annual metrics and a 5-year review point.

| <i>Fraunhofer Business Volume</i> | | 2009 |
|--|---|--------------|
| Contract Research | | |
| | Industrial revenue (excluding license fees) | 329 |
| | License-fee revenue | 78 |
| | Federal and Länder governments | 317 |
| | European Commission | 65 |
| | Other sources | 127 |
| | | 916 |
| Base funding including reserves | | 424 |
| Defense research | | 87 |
| Major infrastructure capital expenditure | | 190 |
| Total (€m) | | 1,617 |

Reference: Fraunhofer Annual Report 2009, With Renewed Energy

9. Effective governance is critical for effective technology centres. Fraunhofer Institutes have a fairly complex structure including a general assembly and a Senate, which can set strategic direction, research activities and carry out performance evaluation. However despite this, as individual Institutes have a high degree of autonomy to set their own research priorities and pursue commercial opportunities, they can compete with each other to win funding resulting in potential overlap and inefficiencies.

10. The scale, complex governance and relatively slow technology transfer of the Fraunhofer models does not make them ideal for application in the UK, but the focus on applied technology working with industry and focusing on key technologies certainly represents elements of a model worth replicating.

Question 2—*Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?*

11. Rolls-Royce has led the development of two different types of research centre in the UK, University Technology Centres (UTCs) and a network of Advanced Manufacturing Research Centres (AxRCs).

11.1. Since the 1980s Rolls-Royce has pursued a policy of developing long-term relationships with selected universities and funding University Technology Centres. Close contact with the best academic institutions gives us access to a wealth of talent and creativity and protects our capability in the future. We aim to balance Rolls-Royce needs with academic advantages for the University. We now have 28 UTC's worldwide with 19 in the UK.

11.2. UTCs are very beneficial for both parties as they provide the Universities with real-world problems and challenges requiring original and innovative solutions. Conversely Rolls-Royce gets access to an independent but focussed research groups, with appropriate protection in terms of intellectual property and commercial sensitivity. By agreeing longer term (typically five year rolling contracts) the UTC is able to make long-term investments and commitments, and provide security to researchers.

11.3. Such partnerships provide an effective means of generating new technology and investigating new ideas specific to Rolls-Royce, but are less good at providing wider engagement with our supply chain to leverage those technologies not solely relevant to Rolls-Royce.

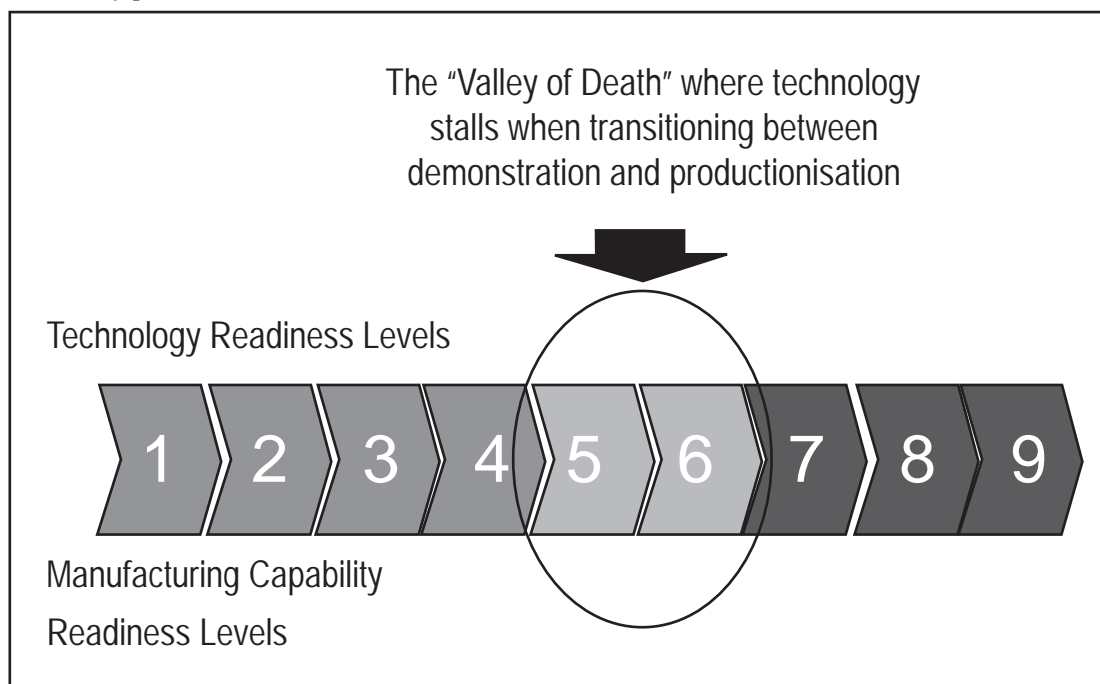
12. The network of AxRCs was established to stimulate and promote high value manufacturing and manufacturing competitiveness. There are currently five committed centres in the UK, the Advanced Manufacturing Research Centre (AMRC), Sheffield; the Advanced Forming Research Centre (AFRC), Strathclyde; the Manufacturing Technology Centre (MTC), Ansty; the Nuclear AMRC, Sheffield; and the National Composite Centre (NCC), Bristol. The first two of these are fully operational.

12.1. The AxRC model is unique, delivering “near to market” technology based on strong industrial pull and utilising the full range of consortium capabilities including underpinning scientific knowledge, equipment and technology providers’ expertise. The pull ensures a high level of relevance to UK industry and makes exploitation of the developed technology in the UK economy much more likely.

12.2. The AMRC, Sheffield, already provides many good examples of the effectiveness of this model with newly developed methods being transferred rapidly into real production facilities.

12.3. The public policy attractions of the AxRCs model include the stimulus to dissemination and adoption of new manufacturing methods across multiple sectors, companies and supply chains thus helping positively to drive the well recognised and large scale spill-over effects associated with R&D.

12.4. The AxRC model has a number of key characteristics. Individually, the centres specialise in a range of manufacturing process technologies (with limited overlap between centres). Their activities are focussed by an industrial membership that collectively funds (shared) generic research but also sponsors wholly commercial or grant supported research programmes. The centres operate in the traditionally difficult space for manufacturing innovation where university research is applied and developed in conjunction with full-scale capital equipment, overcoming the “Valley of death” between technology validation and productionisation. They are very closely aligned to industry needs and are configured to deliver at industry pace.



12.5. Whilst the AMRC model has worked well for manufacturing technology, it is not limited to manufacturing. The same model could be used for other near-to-market, cross-cutting technologies, for example hybrid electrical systems, autonomous systems and control, advanced simulation and synthetic environments, etc.

13. We are supportive of the concept of “Maxwell” Technology Innovation Centres (TICs), as outlined in the Hauser report, but note that simply branding does not in itself provide substance to such institutes. Equally it is important to retain autonomy, avoiding overarching superstructure of government control that would discourage the pace and drive for results reflected in today’s centres. While a simple formula may not exist for successful centres, the following are considered amongst the desirable characteristics:

- (i) Strong industrial drive and market pull.
- (ii) Cooperative industrial leadership.
- (iii) Measures and incentives to recognise and encourage engaged patterns of behaviour by academics (including changes to the Research Assessment Exercise).
- (iv) Mechanisms that encourage recruitment of world class specialists and leaders with entrepreneurial skills, including from overseas eg Engineering and Physical Sciences Research Council (EPSRC) Star Appointment scheme.
- (v) Strong links to University research base and alignment of objectives.
- (vi) Assured long-term funding both at infrastructure (capital) and programme (capital and revenue) levels but without capping any upside.
- (vii) Structure that is friendly to EU research or reconstruction and development funding and other external sources.

14. It is important that in the changes to the regional business support structure, the research centres retain their fundamentally national role. The aim must be a network of national centres, regionally deployed, and not multiple, competing local centres.

15. It is suggested that the existing AxRC network could form the basis of the first Maxwell centres focussed on Advanced Manufacturing in the UK. This configuration would provide an ideal umbrella to:

- (i) Integrate technical capabilities, process knowledge and improvement techniques.
- (ii) Leverage consortium membership to exploit product, process and equipment knowledge.
- (iii) Facilitate the leadership of large, well structured and delivery efficient, research programmes.

This framework will maximise impact across sectors and through supply chains by exploiting its direct alignment to current and future needs of UK industry.

16. The continued effectiveness of the current AxRCs is dependent upon maintaining their growth momentum through access to grant supported research programmes from sources such as the EU and the Technology Strategy Board (TSB). It is essential that large scale, near market collaborative programmes such as Strategic Affordable Manufacturing in the UK through Leading Environmental Technologies (SAMULET), continue to attract public funding and that subsequent follow-on programmes are also supported.

Question 3—What other models are there for research centres oriented toward applications and results?

17. The U.S. government sees its role in research as primarily supporting basic research of fundamental technologies in which industry does not see a near-term opportunity to capitalize upon. A large amount of R&D funded by the Government is focused on military applications. Our major US competitors benefit significantly from such programmes (often 100% funded by Government). They have become very adept at turning this military-derived technology into civil application to great commercial and competitive advantage. The US Agency DARPA funds longer-term research on new concepts.

17.1. NASA has a multi-billion dollar annual budget for space and aviation research throughout its network of research centres. American companies have wide access to the research generated. They can also engage at favourable costs in joint programmes through the “Space Act Agreement” in which companies carry their own costs, but get access to NASA’s considerable facilities and expertise free of charge.

17.2. The federal government does fund significant applied research if it encourages activity in a particular area, such as energy efficiency green technologies. It also supports more applied research if the funding would spur the growth and development of a small business through the Small Business Innovation Research (SBIR).

17.3. State governments in the US however are more inclined to provide funding for applied research. For example, it is common for a state government to fund applied research in a particular technology area, such as life sciences, in an effort to attract large corporations to make a matching investment in their state. In this instance, the state would create a fund and allow companies to bid for research support, provided they pledge a certain amount of matching investment and/or job creation.

18. The French government has utilised existing institutes to deliver the Carnot Programme aimed at supporting the development of research in partnership with industry by bringing closer public research actors

to the socio-economic world while facilitating and bridging the gap from fundamental research to industrial application.

18.1. While the Carnot Institutes Network consists of existing public research institutes they gain additional funding based on what they raise from contractual research with industry.

18.2. There are 33 Carnot Institutes with a budget of €1.3 billion. €530 million is spent on research in partnership industry with funding roughly 50:50 public and industry money.

18.3. However the emphasis of the Carnot is primarily partnership between existing public institutes and industry and not explicitly on the pull through of any developed technology for industrial and wider economic benefit.

19. The Dutch TNO organisation is independent but acts to help the Netherlands government and industry (including international industry) to innovate by applying scientific knowledge.

19.1. Its budget of €576 million is sourced roughly one third directly from the Dutch government, a further quarter from Dutch public bodies and the remainder from international (23%) and Dutch (18%) industry.

19.2. While an independent and semi-autonomous body, TNO works closely with government, SMEs International companies and its own spin-off companies. As such it has a very wide range of interests and does work across the research and technology spectrum from developing applied research to creating start-up technology companies. However it does differentiate itself from pure research institutes by emphasising value-adding tangible applications and innovations for customers, and through a customer-focussed approach, improving competitiveness of companies and assisting governments with policy matters.

20. The Electronics and Telecommunications Research Institute (ETRI) in South Korea is a government funded institute with an explicit objective of technology transfer, through commercialisation of growth technologies for industries. It has been focussed on electronic and telecommunications research since its inception in 1976 and that focus has led to South Korea becoming a major semi-conductor producer.

Question 4—*Whose role should it be to coordinate research in a UK-wide network of innovation centres?*

21. The Technology Strategy Board (TSB) has already been created to provide leadership in business innovation. It has been effective in working with different parts of Government to simplify and connect the innovation landscape and has tried to develop the UK's capabilities in underpinning technologies, addressing the major challenges in creating new business opportunities and investing in people, networks and creating a culture supportive of innovation.

22. We would support the TSB playing a bigger role in managing the Government's contribution to R&D—such as through Technology Centres. But there is an issue of scale with the core funding of the TSB perhaps 5–10 times too small. The UK's level of R&D as % of GDP is low and falling and a long way from the last Government's 2.5% GDP target or the EU goal of 3%. Should the UK wish to raise UK R&D from 1.8% to 2.5% of GDP, there would need to be a further national investment of c £10 billion each year. If a third of this were to come from public stimulus through the TSB then the TSB's budget would in turn have to be around £3 billion a year compared with its current core budget of £300 million today.

23. However, with this body already well placed and focussed on these tasks it would seem both best qualified and best placed to coordinate research in a UK-wide network of innovation centres. As such we would welcome TSB's involvement but would request:

- (i) Not to overlay a structure of government control that destroys the pace and clock-speed of the AxRC model. We need the centres to operate in a federation in which market incentives can operate.
- (ii) To ensure there is an adequate scale and continuity of funding to the centres. We think the Hauser suggestion of around £5–10 million per year, per centre makes sense for continued development of infrastructure and central support. In addition there is a need for public support for programmes through TSB (also replacing the Regional Development Agency (RDA) money). The returns to the economy from this sort of intervention are significant. Rolls-Royce has looked in detail at the issue of the economic spill-overs from R&D in conjunction with Oxford Economics and believes that there is strong evidence that the wider economic returns to R&D are very large and more so when referenced to public intervention required to stimulate R&D investment.

Question 5—*What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments (PSRE) and other existing research centres that undertake Government sponsored research?*

24. The impact on PSRE and other research centres should be positive, as the new institutes will operate as a means to develop and apply a wide range of technologies (many of which will have been initially developed in the UK PSREs) into innovative, exploitable capabilities and concepts.

25. The creation of Fraunhofer-type institutes and even more so the open innovation environment created in AxRCs, is one where all stakeholders in research and innovation can participate and bring their relevant expertise.

Rolls Royce

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