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Catapult to Success: Be Ambitious, Bold and Enterprising

Learning from European technology and innovation centres

Birgitte Andersen and Etienne Le Blanc



The research into what a high performing UK Catapult looks like has been an open innovation project par excellence.

It is a joint initiative of the Big Innovation Centre and three key partners: Technology Strategy Board, IET and ESRC.

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Enquiries regarding this report, contact:

Professor Birgitte Andersen, Director of Big Innovation Centre
bandersen@theworkfoundation.com



The Big Innovation Centre is an initiative of The Work Foundation and Lancaster University. Launched in September 2011, it brings together a range of companies, trusts, universities and public bodies to research and propose practical reforms with the ambition of making the UK a global open innovation hub as part of the urgent task of rebalancing and growing the UK economy, and with the vision of building a world-class innovation and investment ecosystem by 2025. For further details, please visit www.biginnovationcentre.com.

Catapult to Success: Be Ambitious, Bold and Enterprising

Learning from European technology and innovation centres

CATAPULT

This report aims to establish what a well performing UK Catapult centre looks like, reviewing evidence from similar initiatives in other European countries. The research was carried out by the Big Innovation Centre between May 2012 and January 2013.

With support from the Technology Strategy Board, the Institution for Engineering and Technology (IET) and the Economic and Social Research Council (ESRC).

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Foreword



Britain has been experiencing relative economic decline for most of my adult life. The period between 1992 and 2007 when Britain rose up the economic league tables turns out to have been unsustainable. The country, as everyone across the political, financial and business spectrum recognises, now faces a prolonged period of retrenchment and restructuring.

However while these may be a necessary precondition for recovery and growth, alone they are insufficient. In particular there is a growing consensus that Britain needs to pay more attention than it has done historically to the intermediate institutions that support investment and innovation. It is plain that compared to other successful advanced economies Britain has many gaps in its institutional framework so that both business risks are higher and fewer innovative opportunities seized than our competitors – despite the relative strength of our science base.

One omission in particular is that too few institutions or processes concern themselves with closing the vast gaps between conceptualisation of a business idea and its full commercialisation – arguably the most central function of a fast moving, knowledge based economy. I have been pointing to this omission to which other countries have provided institutional responses for more than two decades.

So I am delighted that the Coalition government, and Business Secretary Vince Cable in particular, have put their weight behind the idea. Seven so-called “Catapults” have already been announced so far in areas ranging from satellite applications to the digital economy, all of which look extremely promising. I am confident that more will follow which, with the degree of cross-party support the concept now has, should become permanent parts of the British landscape.

But we need to make sure they are as effective as possible as soon as possible – and that we don’t go down too many wrong turnings. Britain can turn its late arrival to this cause to its advantage, and to scale up its response as fast as it can. We need to make sure that Catapults insert themselves into the existing British institutional nexus, are close to market and have diverse sources of funding to ensure both their resilience and sensitivity to real business challenges.

This report is designed to help policy-makers, funders, the first teams creating Catapults and their users get things right from the start. Borrowing from international examples, it sets out a clear vision of ‘what good looks like’ along with a matrix of actions, metrics and benchmarks that hopefully will contribute to Catapults’ initial success. The sooner Catapults can establish a virtuous circle of lifting innovation, thus justifying more investment and support, the sooner Britain can re-establish growth – and rise up the economic league table in a sustainable way.

A handwritten signature in black ink, appearing to read 'Will Hutton', with a large, sweeping flourish at the end.

*Will Hutton,
Principal of Hertford College, Oxford University
and Chair of the Big Innovation Centre*

Executive summary

The creation of a series of technology and innovation centres for the UK – called Catapult centres – was confirmed in the Government’s Innovation and Research Strategy for Growth, in December 2011.

With a public and private sector investment of more than £1bn over the coming few years, the Catapults are a major long-term investment which aims to transform the pace of innovation and so accelerate economic growth.

The seven announced Catapult centres to date are:

- Cell therapy
- Connected digital economy
- Future cities
- High value manufacturing
- Offshore renewable energy
- Satellite applications
- Transport systems

All the Catapults will be operational in 2013.

“Much of the inspiration behind what we’re doing has come from looking at this internationally, at international best practice and how best the UK can compete...We are an open country – open to foreign investment, open to foreign ideas, and I think that is one of the great strengths of this country.”

*Rt Hon Dr Vince Cable MP,
Secretary of State for Business, Innovation and Skills*

This report aims to establish what a high performing UK Catapult centre looks like, by reviewing examples from all national initiatives in Europe, including the German Fraunhofer Institutes, the French Carnot centres, the TNO centres in the Netherlands, the Finnish Technical Research Centre (VTT) and SHOK-TEKES centres, the Danish Advanced Technology Group GTS centres, the Norwegian SINTEF centre, and the Spanish Tecnalia centres.

By collecting evidence (via an online questionnaire) from 32 European technology and innovation centres (26% of the total 125 surveyed) – plus in-depth case accounts on ‘what

good performance looks like' from centre directors and stakeholders – this report establishes the important role UK Catapults can come to play from conception to commercialisation of technologies and ideas in innovation ecosystems:

- by anchoring into markets, universities, finance and capital structures;
- in the way they move businesses and other users of Catapults in the innovation ecosystem beyond their own capabilities, skills and constrained resources;
- in the way they are linked to delivering their country's research, science, innovation and growth plans.

Be ambitious, bold and enterprising

The international evidence is unambiguous – to be successful Catapults need to be ambitious, bold and enterprising.

European technology and innovation centres generate success in separate ways:

- They contribute to and deliver their national policy for growth;
- They operate with a critical mass regarding activity, people, and competencies;
- They de-risk innovation and help firms to go beyond their existing capabilities and what they can achieve with their own resources by:
 - providing a range of support services from idea to market,
 - assuming risk on early-stage innovation,
 - acting as anchor institutions and catalysts to build new markets, innovative sectors, clusters and networks;
- They enable knowledge, resources, IP and skills to flow between businesses with speed and intensity;
- They realise financial stability through multiple flexible sources of funding.

Contributing to and delivering their national policy for growth: European centres contribute to the delivery of national research and innovation policies for growth, and most of them are involved in their design and development.

Operating with a critical mass regarding activity, people, and competencies: European centres are generally classified as medium to large, with two third being research-staff of which about forty per cent holds a PhD.

De-risking innovation and helping businesses go beyond their existing capabilities or resources in a variety of ways:

- **Providing a range of services from concept to commercialisation:** European centres provide business and technological services that are beyond the reach of many companies. This includes applied R&D services as well as other activities close to the market such as consulting, training, testing and certification, or market research.
- **Assuming risk on early stage innovation:** European centres concentrate on where they can help the most, which is to reduce risks in early-stage innovation, whether radical or incremental, basic or applied or even application innovation.

- **Acting as anchor institutions and catalysts for new markets, innovative sectors, clusters and networks:** European centres provide an anchor for collaboration between universities, government, and business. They co-create and work together to de-risk innovation and create technological opportunities. They also collaborate with other organisations, such as regional and local authorities, vocational training institutions, science parks and business associations. They provide hubs for SMEs to go beyond their capacity and provide a unique environment for innovation.

Enabling knowledge, resources, IP and skills to flow with speed and intensity:

European centres use a variety of tools to engage with external partners. First and foremost they support collaborative research. But they also share knowledge in other ways through organising joint conferences, workshops or publishing. They exchange staff and support business start-ups and spin-offs. Almost all are also strongly engaged in higher education and training for PhD students and other skills levels.

They realise financial stability through multiple flexible sources of funding: Core funding represents a relatively small proportion of European centres' income (on average, about one third of their funding comes from public sources). Yet they do all receive other competitive public, or strategically allocated, funding from both national and international sources, making the total public support approximately half of the centres' total income (this figure varies across centres). International collaboration and competition (from both business and the EU) help centres remain at the cutting-edge of technology and allow economies of scale in their activities. Centres benchmark themselves globally as well as nationally and regionally.

European centres work with businesses of all sizes. Work for SMEs is considered essential (and accounts for half of their income), and focuses on providing access to infrastructure and meeting capability gaps. Large businesses use the centres for more specialised work.

Performance metrics for what good looks like

Ambitious, bold and enterprising Catapult centres will also need to test out new business models – some of which will not succeed, but they should not be afraid of failure. They therefore need a clear definition of success and a transparent framework against which they can monitor performance so that weaknesses can be quickly identified and action can be taken swiftly.

In the past, the performance of technology centres has often been measured through traditional indicators such as turnover, size, volume of R&D or IP registered and licensed. These indicators fail to fully capture the role centres play in their innovation ecosystem and new metrics are needed to measure, for example, the quality of their relationships with businesses, universities and markets; their convening power; how they leverage their resources; and how they identify and manage risk.

The ecosystem approach – recommendations for public policy and Catapult management

1. UK Catapults must be a core element of future UK growth policy (including the innovation and research strategy) and contribute to rebalancing the economy. Catapults should be integrated in the Government's ambitious infrastructure investment plans and provide an essential element in the UK knowledge infrastructure for manufacturing, transport, energy, cities, communication, and more.
2. UK Catapults need to be multifunctional in their provision of services to solve the real problems faced by companies in commercialising products – from providing new competencies or specialised skills, applied R&D, testing & certifying, to providing access to resources and investment networks, as well as other consultancy and perhaps even sales. One of the early challenges for UK Catapult centres will be to identify what businesses and markets they are in, what the challenges are, and where they can add value.
3. UK Catapults must mitigate many of the risks associated with investing in innovation – particularly where international competition is strong, R&D costs are high and goods and services are complex, or where the technologies are disruptive to existing markets and business models.
4. UK Catapults must be horizon scanners identifying new technological opportunities, and then use their own convening power, as well as their capabilities and technological and financial resources, to work with others to anchor new technologies in the UK.
5. UK Catapults must find mechanisms to become brokers that build trust, confidence and absorptive capacity among the myriad of actors in the innovation ecosystem, including businesses, knowledge institutions/universities, funding bodies, government, science parks, regional growth centres and others. They should achieve synergies and overcome barriers to collaboration and joint action. Using this convening power in the innovation ecosystem they must help companies go beyond what they can do unaided. They need to be open, networked and absorptive of external ideas themselves. The better they understand their role in the innovation ecosystem, and their role is understood, the better they can underpin it.
6. UK Catapults must speed up the flow of knowledge, ideas, resources, IP and skills within their target sectors, by finding appropriate platforms to best connect external partners. They should use a range of mechanisms – for example shared research projects, open workshops, training programmes, sharing equipment, staff placements, intellectual property exchanges, joint publications, business spin-offs and more. They must also find ways to minimise barriers to the wider use and dissemination of information and knowledge.
7. UK Catapults must draw on the best from across all UK universities to enhance their role, and build bridges with the best universities abroad.
8. UK Catapults must do business in both national and international markets and collaborations (including EU initiatives) with businesses of all sizes. Four benchmarks can be derived from European norms or aspirations:

- Revenue from small and medium sized firms located in the UK should aim to account for at least half of the commercial revenue arising from UK business engagement;
 - Core Government funding (both unconditional and conditional) should, in the long run, not be expected to exceed one third of total public funding to ensure a sustainable competitive focus. Remaining public funding can come from competitive national and EU funding.
 - Commercial income from businesses should aim to account for at least 50% of the centres' total income, and should aim to increase over time.
 - Total international operations (commercial and public) should aim to account for at least 20% of the total revenue.
9. Key performance indicators (KPIs) of UK Catapults must not be assessed merely through traditional measures such as turnover, size, patents granted or suchlike, but through the difference they make as catalysts and co-creators in open innovation ecosystems. The dimensions to this approach, and introductory variables, are contributed by this report.
10. Every centre is different, but all UK Catapults must operate with a critical mass regarding activity, people, and competencies. Government cannot have a one size fits all policy approach. UK Catapults should develop their own set of metrics and measures consistent with this report's recommendations which reflect their own strategic targets and the role they intend to play in the innovation environment of their sector.

This is certainly an ambitious agenda for the UK Catapult programme. However, UK Catapult centres do not start with a blank sheet – there are successful models in Europe from which to learn. The challenge is to ensure that second rate institutions in this space do not discredit the model. Catapults could also fail if they lack sufficient resources, scale and capability, but, as currently configured, the Catapult centres represent an extremely promising start.

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1. Introduction

1.1 Aim of report

The establishment of technology and innovation centres (TICs) for the UK – now called Catapult Centres – was announced by the UK Government in October 2010 and implemented by the Technology Strategy Board, which published its strategy for Catapults in May 2011. The initiative was reiterated in the Government’s Research and Innovation Strategy for Growth, December 2011.

The seven announced Catapult centres to date are:

- Cell therapy
- Connected digital economy
- Future cities
- High value manufacturing
- Offshore renewable energy
- Satellite applications
- Transport systems

This report aims to establish what a high performing Catapult centre looks like by reviewing evidence from similar initiatives in other European countries, including the German Fraunhofer Institutes, the French Carnot Centres, the Organizations for Applied Scientific Research (TNOs) in the Netherlands, the Finnish Technical Research Centres (VTTs) and Finnish Funding Agency for Technology and Innovation (SHOK-TEKES)’s centres, Denmark’s Advanced Technology Group (GTS), Norway’s Foundation for Scientific and Industrial Research (SINTEF), and Spain’s Tecnalia. It is not an aim to review the governance and ownership structure of the international catapults.

Origin and concept

The Hauser Review of Technology and Innovation Centres (TICs) provided the basis for the establishment of the UK Catapult centres. The Review identified some weaknesses in the hitherto UK approach to TICs, such as the “sub-critical” level of investment in that initiative, the lack of a coherent national strategy, and the insufficient attention paid to business requirements and the location of relevant expertise. The report called for a step change in the approach, increasing the investment and effort put into TICs by focusing on a relatively small number of elite centres in prioritised areas.

The Current and Future Role of Technology and Innovation Centres in the UK. A Report by Dr. Hermann Hauser For Lord Mandelson, Secretary of State Department for Business Innovation & Skills. (March 2010)

Origin and concept

In October 2010, Prime Minister David Cameron announced investment of £200m in a network of technology and innovation centres, and in May 2011 the strategy and implementation plan for the network was published by the Technology Strategy Board. The stated objective of the UK Catapult Initiative was to “close the gap between concept and commercialization”.

The argument is that the UK research sector is one of the top performers worldwide, but this research excellence fails to translate into business opportunities, and that the domestic economy does not reap the full benefits from its research base.

The strategy and implementation plan also recognised the need to focus scarce resources in a few globally competitive areas with tangible potential for growth, establishing five criteria against which to assess Catapult candidates. Priority areas exist where:

- Predicted global markets are worth billions of pounds;
- The UK has a world-leading research capability;
- The UK business base demonstrates the necessary absorptive capacity to exploit the technology developed;
- The UK can attract and anchor the knowledge intensive activities of global mobile companies; and
- They deliver national strategies.

Technology and innovation centres. Closing the gap between concept and commercialisation. Technology Strategy Board, Strategy and implementation plan, May 2011.

There are many examples of alternative business models of Catapults on our doorsteps, and the UK's Catapult centres have often been compared to Germany's much-admired Fraunhofer institutes. However, while it isn't about transplanting what works elsewhere to the UK, we can still learn a great deal about how institutions across all of Europe and beyond reflect their national environment, and gain useful intelligence on how performance is assessed in such organisations and what a good centre looks like.

1.2 Indicators of what good looks like

As the UK Catapult centres are now opening for businesses, policymakers confront the task of translating what good looks like into concrete, operational measures of success. An effective system of monitoring and evaluation is crucial for accountability and ensuring value for money; but it is more important to provide insights into what works and what does not

with a view to improving and supporting future interventions.

It is important that the right performance indicators are chosen. Often they concentrate on aspects that are measurable quantitatively but do not capture many intangible effects. Metrics for many quasi-public institutions, derived from the private sector (usually scale and turnover) and traditional approaches to innovation (often blunt indicators as ‘patents produced or licensing income’ or ‘number of companies assisted’) have their uses, but indicators must also explicitly recognise the broad and complex role of Catapult centres. We need to ensure that we do not assess performance on narrow performance measures. Also, is there an ideal size for these organisations?

The headline objective of the centres is to close the gap between concept and commercialisation (Technology Strategy Board 2011 Strategy and implementation plan, p11). Beyond this, a number of specific success criteria are identified, including the extent to which centres are:

- a. Enhancing business access to cutting-edge technology and expertise;
- b. Reaching into the research base for world-leading science and engineering;
- c. Undertaking collaborative applied research projects with business;
- d. Undertaking contract research for business;
- e. Strongly business focused with a highly professional delivery ethos;
- f. Creating a critical mass of activity between business and research institutions;
- g. Providing skills development at all levels.

“It’s important to have the freedom to operate for 3, 4, 5 years.”

Søren Stjernqvist – Director of Danish Technological Institute – commenting on upstarts of technology and innovation centres

For each of these objectives, it is possible to design high-quality indicators that are clear, relevant, economic, adequate and monitorable (CREAM). In any individual case, Catapult centres will need to align their own performances and architectures with these objectives from the outset. For example, the extent to which Catapults “undertake contract research for business” (role d) can be assessed by measuring the number or value of business contract research contracts. On the other hand, it is difficult to assess or quantify the level at which a critical mass (role f) of activity between businesses and research institutions is attained.

At any rate, these new bodies are going to play an incredibly important, yet subtle and multifaceted role in our economy, and they are most likely to look very different as they

become anchor institutions servicing different sectors with inherently different characteristics.

Ultimately, insight into how well they serve the open innovation ecosystem needs to be translated into performance metrics or key performance indicators for Catapult centres to be

“The ecosystem approach – towards a policy agenda

Aim to have the most globally sophisticated national network of technology and innovation centres (TICs) organised as far as possible on open innovation principles and committed to supporting open innovation business models. As a first step, bring forward the next wave of TICs, matching funding of £200m announced in Budget 2010.”

Making the UK a Global Innovation Hub. How business, finance and an enterprising state can transform the UK (Andersen, Brinkley and Hutton 2011)

assessed against, as first put forward by Andersen, Brinkley and Hutton (2011).

Thus, performance indicators of Catapults should be related to how well they underpin the linkages within the innovation ecosystem. Building upon the innovation ecosystem approach put forward in Andersen, Brinkley and Hutton (2011¹) they include:

- **Market links** – How well do they support innovation and entrepreneurship by nurturing innovative markets, places and networks? How far does their reach extend beyond their organisational boundaries? Are they developing as useful anchor points for their particular specialism?
- **University links** – what are the new and unique links enabled by the centre that simply are not possible in other models of university–business collaboration?
- **The capital dimension** – what is their relationship with forms of finance? One could imagine a world in which a SME’s relationship with a Catapult centre offers access to funding networks and perhaps even works as a ‘kite mark’ of an innovative business. How can the centre generate increasing returns to finance and investment?
- **Skills** – innovation ultimately depends on the capacity of individuals within our economy to develop and commercialise ideas and run organisations capable of bringing them forward. What are the Catapult centres doing in this space? Are they moving actors in the innovation ecosystem beyond their own capabilities?

¹ Making the UK a Global Innovation Hub. How business, finance and an enterprising state can transform the UK (Andersen, Brinkley and Hutton 2011)

- **Embedded into an enterprising state** – how well are these centres linked to the delivery of the government’s growth strategy?

For the purpose of this research piece, we aimed to map the performance of international technology and innovation centres in the four ecosystem dimensions classified above with respect to how they anchor into the ecosystem areas mentioned above, including:

- **Markets:** Focus on major work functions; innovation services
- **University and knowledge institutions:** Focus on collaborations; types of interactive knowledge sharing; intellectual property management; publications
- **The capital dimension and finance:** Focus on turnover; sources of funding; internationalisation; public funding; commercial revenue; business engagement
- **Skills:** Focus on size of workforce; research capacity; doctorates
- **Embedded into the enterprising state:** Focus on national and innovation strategies

The more detailed variables feeding into the mapping — based upon roles, functions and sources of funding — are presented in Annex 1, Tables a) to e). They were decided upon by synthesising three key reviews: (i) the objectives of the UK Catapults as set out in the Catapult strategy and implementation plan of the Technology Strategy Board², (ii) the annual reports from the European technology and innovation centres invited to contribute to the evidence base for this research (see Section 1.3), as well as (iii) the output from an international evaluation of the Danish GTS system³ (where one of the authors (Andersen) participated on the international panel, including one of the background documents for this evaluation⁴). This classification of variables into Andersen, Brinkley and Hutton’s (2011) ecosystem typology combines a holistic picture (putting together partial intellectual methodologies with practical approaches) to be underpinned by a fit for purpose ecosystem policy and Catapult management. The list is not exhaustive but simply an account of the dimensions of proposed key performance indicators (KPIs) of UK Catapults, including the introduction of a range of variables. Clearly, benchmarking what good looks like per centre is contextual as well, and the dynamic input or ‘drivers’ for success need to be extrapolated.

Please note that this ecosystem classification is different from the **practical or operational** results regarding what a successful European technology and innovation centre looks like

² Technology and Innovation Centres. Closing the gap between concept and commercialization. Strategy and implementation plan, May 2001. Technology Strategy Board.

³ A Step Beyond: International Evaluation of the GTS Institute System in Denmark, Report to the Danish Agency for Science, Technology and Innovation. Published by the Ministry, Copenhagen March 2009. International panel of five including Birgitte Andersen, Rapporteur: Erik Arnold, Technopolis.

⁴ Mapping the Danish knowledge system with focus on the role and function of the ATS net, Report to the Danish Agency for Science, Technology and Innovation. Published by the Ministry, Copenhagen 2008. Damvad.

(see Sections 2 to 6), which has emerged from the wider analysis. The organising principle in the remaining report is around these practical or operational results, which is that successful technology and innovation centres are ambitious, bold and enterprising in several ways:

- They contribute to and deliver their national policy for growth
- They operate with a critical mass regarding activity, people, and competencies
- They de-risk innovation and help firms to go beyond their existing capabilities and what they can achieve with their own resources by:
 - providing a range of support services from idea to market
 - assuming risk on early-stage innovation
 - acting as anchor institutions and catalysts to build new markets, innovative sectors, clusters and networks
- They enable knowledge, resources, IP and skills to flow between businesses with speed and intensity
- They realise financial stability through multiple flexible sources of funding.

1.3 Evidence base

Survey:

An online questionnaire (core questions set out in Annex 1, Tables a to e) gathering intelligence on international technology and innovation centres' contribution to their innovation ecosystems was targeted at directors of 125 individual centres and coordination bodies⁵ in Europe, including

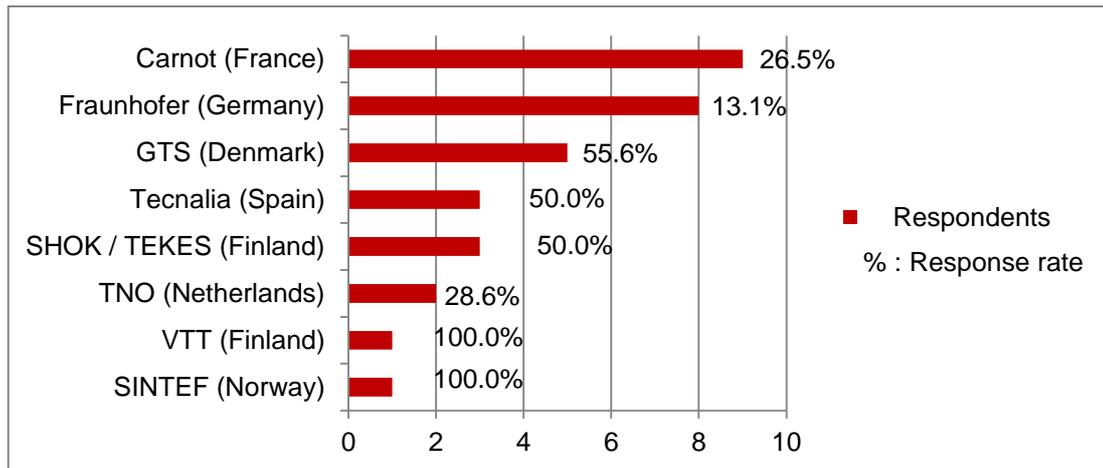
- the German Fraunhofer Institutes (61 centres),
- the French Carnot Centres (34 centres),
- the Organizations for Applied Scientific Research (TNOs) in the Netherlands (7 centres),
- the Finnish Technical Research Centre (VTT) (1 centre)
- the Finnish Funding Agency for Technology and Innovation (SHOK-TEKES)'s centres (6 centres),
- Denmark's Advanced Technology Group (GTS) (9 centres),
- Norway's Foundation for Scientific and Industrial Research (SINTEF) (1 centre), and
- Spain's Tecalia (6 centres).

Thirty two directors (representing 32 centres) participated in the full survey (representing

⁵ By coordination bodies, we mean the entities responsible for overseeing the network of Technology and Innovation Centres, such as the Fraunhofer Gesellschaft, the Carnot Association or the TNO headquarters.

26% of the total), and they form part of the evidence base in what follows. Figure 1 provides the number of respondents and response rates by national organisations.

Figure 1: Number of respondents and response rate by technology and innovation centres initiative



International conference: ‘What does success look like for technology and innovation centres?’

In addition to the thirty two directors who participated in the full survey, the evidence base is supplemented with supporting examples presented by senior representatives from major European innovation and technology centres at an international conference on ‘What does success look like for innovation and technology centres?’

The group behind this initiative (Technology Strategy Board, BIC, IET, and ESRC) convened at an international all day event on the 22 October 2012 at the Institution of Engineering and Technology in London. An invited audience of 100 participants were involved in developing and using the new UK network of Catapult centres. This included keynote addresses from the Secretary of State for Business, Innovation and Skills, Dr Vince Cable, and Chairman of the Technology Strategy Board, Phil Smith. The Technology and Innovation Centre directors and consultants from Denmark, Finland, France, Germany, the Netherlands and Sweden provided individual case accounts, which are included in this report. For more information on this event see Annex 2 or

<http://www.theiet.org/policy/panels/innovation/catapult/webcasts.cfm>

2. Technology and innovation centres contribute to and deliver their national policy for growth

In the past, innovation has been the key motor behind economic upswings. But the steps from concept to commercialisation of technology and ideas do not take place in an institutional vacuum – they need coordinated action. They involve a complex web of technologists and scientists, businesses, finance, demand (markets), universities, skilled workers, public agencies, government and other institutions that interact in innumerable different ways.

Economic policy is now focusing on putting in place the conditions and frameworks that will enable UK businesses to be the most innovative on earth, and make Britain a global hub for innovation. As stated in the UK Government's Research and Innovation Strategy for Growth, the UK Catapults are established to be at the core of the UK Government's effort to stimulate innovation and grow the economy. Elsewhere in Europe, technology and innovation centres also play a key role in their countries' innovation and research strategies: 100% of respondents state that they contribute to these strategies, and 89% are or have been involved in their actual design (see Table 3). Looking forward, a radical approach might be to allow technology and innovation centres to prepare their own policies in parallel to the government strategy as part of the overall strategy development process.

"We are trying to put these institutions within a wider framework of an industrial strategy. Whereas most companies want to get on and do their business and get government out of the way, there are other companies for whom it is crucially important to have a long-term planning perspective and linked to that to have partnership relations with government. For instance, if you are in the aerospace or oil and gas sectors, you need to think decades ahead"

*Rt Hon Dr Vince Cable MP,
Secretary of State for Business,
Innovation and Skills*

**Table 1: Does your institute contribute to national innovation and research strategies?
Are you or have you been involved in defining these strategies?**

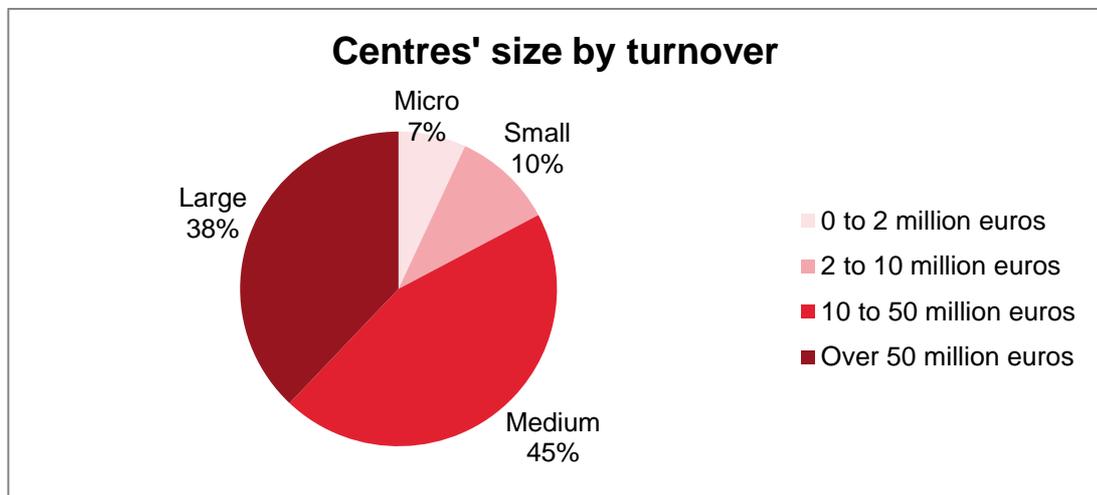
	Yes (percentage share of Centres)	No (percentage share of Centres)
Contribution to national innovation and research strategies	100%	0%
Involvement in the definition of these strategies	89%	11%

Clearly, the UK Catapult centres should remain a key element of rebalancing the economy and restoring growth. There is an opportunity to integrate the Catapults in the ambitious UK Government's National Infrastructure Plan, first announced by the British Prime Minister David Cameron in 2011 and moved up the agenda in 2012. This would put the UK Catapults to work right away, allowing them to develop relationships close to markets and to the science base and beyond.

3. Technology and innovation centres operate with a critical mass regarding activity, people, and competencies

The 32 European technology and innovation centres which took part in the survey can be classified according to their size, both in terms of employment and turnover. Figure 2 breaks down the size distribution of the analysed centres, for which we have used the EU definition of small, medium and large companies.

Figure 2: What was the total turnover of your Centre last year?



More than 80% of the centres surveyed achieve turnover in excess of 10 million euros, with almost half classified as 'medium' companies (with a turnover between 10 and 50 million euros). This is the category under which the seven UK Catapult centres would fall if they manage to meet the expectation of attracting £2 for every £1 of core funding received (as set out in the Catapult strategy and implementation plan of the

“Evaluations done on the Swedish competency centres revealed that leadership, followed by a common vision and trust, were the main success factors and were the main criteria when the call for new centres went out.”

Anna Aspgrén – Consultant, Aspgrén Leadership Resources AB, Sweden

Technology Strategy Board⁶). See chapter 6 regarding a discussion of the breakdown of funding sources for the UK Catapults.

In terms of workforce, almost two thirds of the centres can be classified as large (more than 250 employees), while only 16% of the respondent centres are run by fewer than 50 employees.

Table 2: (i) How many employees work at your Centre? (ii) Which proportion of your staff are research staff? (iii) Which proportion of your research staff hold a PhD?

Number of Employees	Distribution of centres according to size	Research staff proportion (for each size category)	Proportion of research staff which hold a PhD (for each size category)
1 to 50 employees	16%	20%	80%
51 to 250 employees	19%	70%	43%
More than 250 employees	66%	75%	37%
Average	-	69%	39%

The average proportion of research staff across the centres surveyed is about two thirds, out of which more than a third hold a doctoral degree. Interestingly, it seems that the larger the centre, the higher the proportion of research staff (up to 75% on average of employees in centres employing more than 250 staff), but the smaller the proportion of research staff that have a PhD. Putting aside the questions raised by the small size of these sub-samples, it could be that in larger centres, those with PhDs manage larger teams of less-qualified research staff. Whereas those with PhDs employed by smaller centres work on their own or with smaller research team.

The most important asset of a Technology and Innovation Centre is its personnel. The research staff accumulates the knowledge which delivers new discoveries and inventions, and can then be commercialised. Organisations must be able to recruit and retain the best talent which puts emphasis on pay and incentives, and the extent to which remuneration should be linked to competitive industry norms rather than academic scales. Fraunhofer Institutes which are ranked the fourth most attractive employer in Germany behind only Audi, BMW and Porsche, benefit from having directors who concurrently hold university chairs and are uniquely placed to spot talent. Raoul Klinger, Director of International Business Development at the Fraunhofer Institute observes that this is “an important short-cut [...]

⁶ Technology and Innovation Centres. Closing the gap between concept and commercialization. Strategy and implementation plan, May 2001. Technology Strategy Board.

compared to the big boys in industry”.

But excellent research credentials by no means guarantee success, and national models differ. An awareness and understanding of business is equally important. Søren Stjernqvist, CEO of the DTI, makes no qualms about the requirement to make a distinction between academic careers and the vision of the Centre. In a similar spirit, Minatec has convinced the Grenoble School of Management and their Engineering School to relocate to its Innovation Campus.

“Combining applied research and commercial activities is the raison d’être of DTI. We hire top graduates from Danish universities and other universities but if they want to pursue an academic career, they should not come with us.”

*Søren Stjernqvist – Director of Danish
Technological Institute*

“It is very important that young, talented graduates want to work at Fraunhofers – not for the big shots in industry. That’s possible because we have that close relationship to universities. Directors of institutes are able to spot and source students by virtue of their privileged teaching position in universities. That’s a very important shortcut for Fraunhofer”.

*Raoul Klingner – Director,
International Business
Development, Fraunhofer-
Gesellschaft, Germany*

4. Technology and innovation centres de-risk innovation and help firms to go beyond their existing capabilities and what they can achieve with their own resources

“The difficulty with this system is that it can create competition between different institutes. Done correctly, competition can spur agility and create synergies across knowledge domains, leveraging some nice and potentially disruptive things at the interface between production and life sciences or microelectronics institutes.”

Raoul Klingner – Director International Business Development, Fraunhofer-Gesellschaft, Germany

Stronger international competition, higher costs of R&D and increasingly complex products and services have increased the fundamental uncertainty associated with investments in innovation. Technology and innovation centres play an important role in mitigating these risks.

i. Firstly, they are **multi-functional from idea to market**. They provide business and technological services that are beyond the reach of many companies – whether because of lack of competencies or specialised skills, or because the investment needed to produce them in-house is too high or the return on this investment is too slow to materialise.

ii. Secondly, the Centres we surveyed also tend to concentrate on

where they can help the most, which is to **assume risks on early-stage innovation**, be it radical or incremental, basic or applied.

iii. Thirdly, they provide mechanisms, principally involving networks and other forms of non-market organisation that build trust and confidence among the myriad actors in the **innovation ecosystem**, thereby realising synergies or limiting the harmful consequences of uncertain asymmetric information.

“The more complicated, the more we love it. If it’s a simple thing, others can do it.”

Egbert-Jan So – Director of Innovation High-Tech Systems & Materials, TNO Netherlands

In this way, technology and innovation centres help firms go beyond their capabilities. The three areas will now be addressed in turn.

4.1 Multi-functional from idea to market

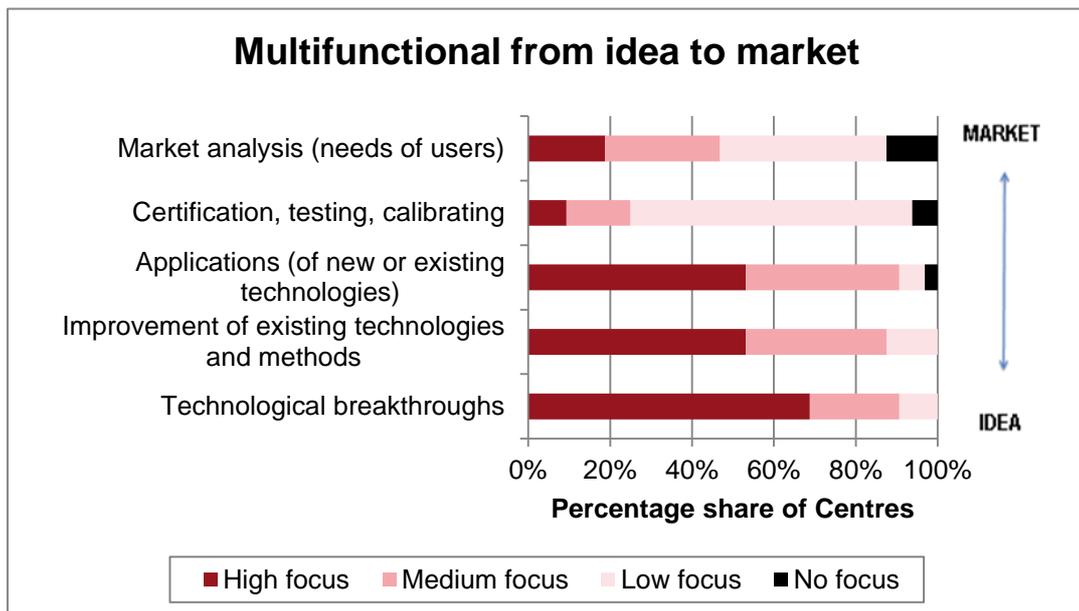
The international technology and innovation centres are providing multifunctional services from idea to market. All those in our sample have a high or medium level focus on technological breakthroughs, improvement of existing technologies and methods, as well as applications of new or existing technologies (see Figure 3), and they all have some kind of focus (either high, medium or low) – or a combination of the three.

One question that warrants further investigation is whether research portfolios are made up of multiple, small projects or a few, large projects – and how well organisations manage the trade-off between demonstrating short-term results and matching the mission preferences of researchers and business partners on the one hand and ensuring ambition and scale on the other.

“We always believe in pushing the limits – for instance additive and rapid manufacturing – referred to by the Economist as the Third Industrial Revolution. If it’s known by industry, it’s like engineering repetitive jobs, we leave it to the private sector. It’s sometimes about surprising combinations – for instance, bringing together top cooks and engineers to create a food printing machine.”

*Egbert-Jan Sol: Director of Innovation
High-Tech Systems & Materials, TNO
Netherlands*

Figure 3: Your innovation activities focus on....



Centres differ in the emphasis they place on disruptive innovation and incremental improvement to existing technologies. Through a commitment to multidisciplinary research, some centres can straddle both worlds without apparent conflict. For instance, the Fraunhofer Institutes focus on incremental innovation – in large part because it is easier to plan and bring under managerial control. However, sophisticated processes and incentives are in place to

“Foresight processes are built into planning so that a clear and up-to-date portfolio can be maintained”.

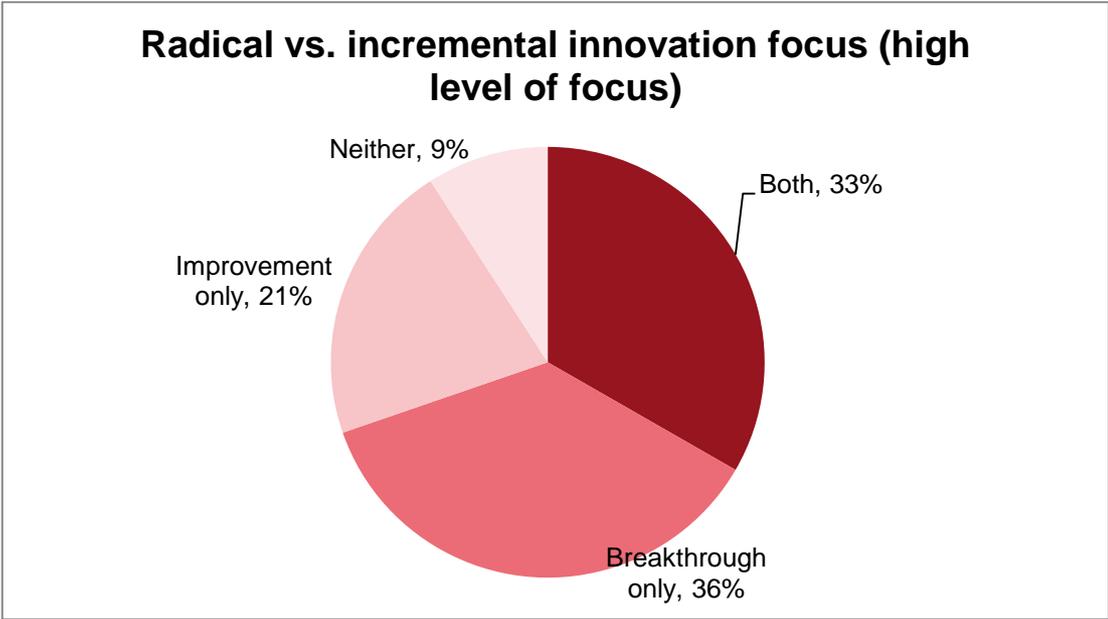
Raoul Klingner – Director International Business Development, Fraunhofer-Gesellschaft, Germany

“The founder of DTI, Gunnar Gregersen was very explicit: We do not do science. The purpose is to develop new fields for manufacturing, a quote that is still on top of the policy agenda today...”

Søren Stjernqvist – Director of Danish Technological Institute

ensure that this steady-state activity can be appropriately and productively linked across programmes, creating the conditions for the occasional radical breakthrough.

Figure 4: Percentage share of Centres which report a high focus on technological breakthrough and/or improvement of existing technologies and methods



Survey evidence also supports the idea that radical innovation and incremental innovation coexist: as shown in the chart above (Figure 4), one third of the centres surveyed report a

high level of focus on both simultaneously: 36% of centres prioritise technological breakthroughs as the high level focus area, while 21% prioritise incremental innovation as the high level focus area. Only 9% do neither, because their main focus is on applications and/or market analysis.

The Danish Technological Institute (DTI), for instance, is the country's largest training provider. DTI, one of the 9 GTS Centres in Denmark, reports that 16,550 people attended its courses, seminars and conferences in 2011. Training by Technology and Innovation Centres can happen at every skill level, from unskilled staff to PhD students and managers. DTI, for example, has trained 100 communication managers from private companies between 2007 and 2011. For that Technology and Innovation Centre, training accounted for 23% of their commercial revenue, and 14.5% of their total consolidated revenue.

Source: It's all about Innovation. DTI Annual report 2011

“Centres evolve over time in terms of the composition and character of project portfolio. They ordinarily start in phase 1 with some small projects, testing the waters and taking the first steps towards success. This can balloon as all partners want their own projects so that after a period of time, this arrangement is no longer possible ... The solution to this conundrum was to cluster projects in themes but then allow smaller projects where knowledge was then shared.”

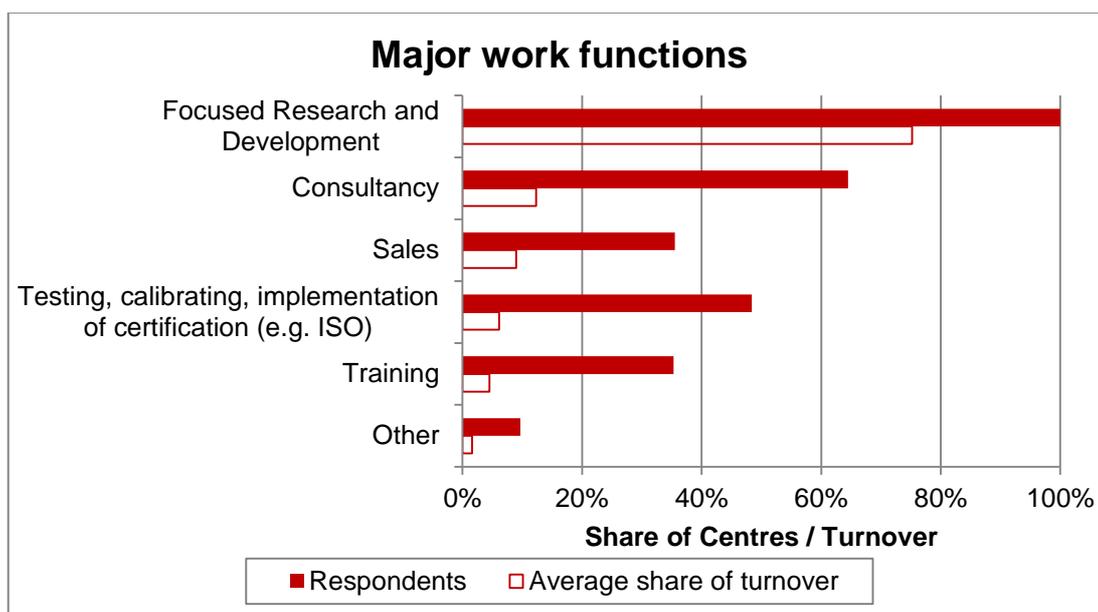
Anna Aspgren – Consultant, Aspgren Leadership Resources AB, Sweden

4.2 Assume risks on early-stage innovation

All technology and innovation centres are engaged in focused applied research and development (R&D). On average, R&D functions account for three quarters of Technology and Innovation Centre turnover, which in turn illustrates that the centres concentrate on where they can help the most, ie to reduce risks in early-stage innovation.

Clearly, an interesting question is the weight each technology and innovation centre carries in its respective national marketplace, ie is it responsible for a significant proportion of the R&D in its country? Being multifunctional, they all carry out a number of other activities, some closer to the market than others, depending on local specificities, see Figure 5.

Figure 5: Which functions does your Centre provide? Please give your answer as the spread of your turnover across the following functions



Three quarters of the centres surveyed – and all of those with a budget of over €50m – carry out a number of other activities such as consulting, training, testing and certification, or sales. While some of these services are quite routine, they are nonetheless the commercial bread and butter for some centres.

Training can therefore be both a net contributor to the Centres’ budgets, and also a way through which technology and innovation centres contribute to the wider economy by disseminating knowledge and increasing skills levels in the workforce.

4.3 Act as anchor institutions and catalysts to build new markets, innovative sectors, clusters and networks

All the 32 centres we surveyed report that they collaborate to varying degrees with the players of the ‘triple helix’: universities, government and business. This is critical to anchoring parties in their respective innovation ecosystems and market sectors, helping them work together to de-risk innovation and take

“What’s important for a multidisciplinary institute like ours is that we are able to transform technologies from one domain to another, that we can deploy technologies elsewhere. That means we must have the processes and culture to encourage this circulation.”

Søren Stjernqvist – Director of Danish Technological Institute

“The chain is only as strong as the weakest link – even with good universities or financial services, if you miss manufacturing capacity and organisational ability to bring it all together on a systematic basis, the rest falls apart.”

Egbert-Jan Sol: Director of Innovation High-Tech Systems & Materials, TNO Netherlands

advantage of all technological opportunities.

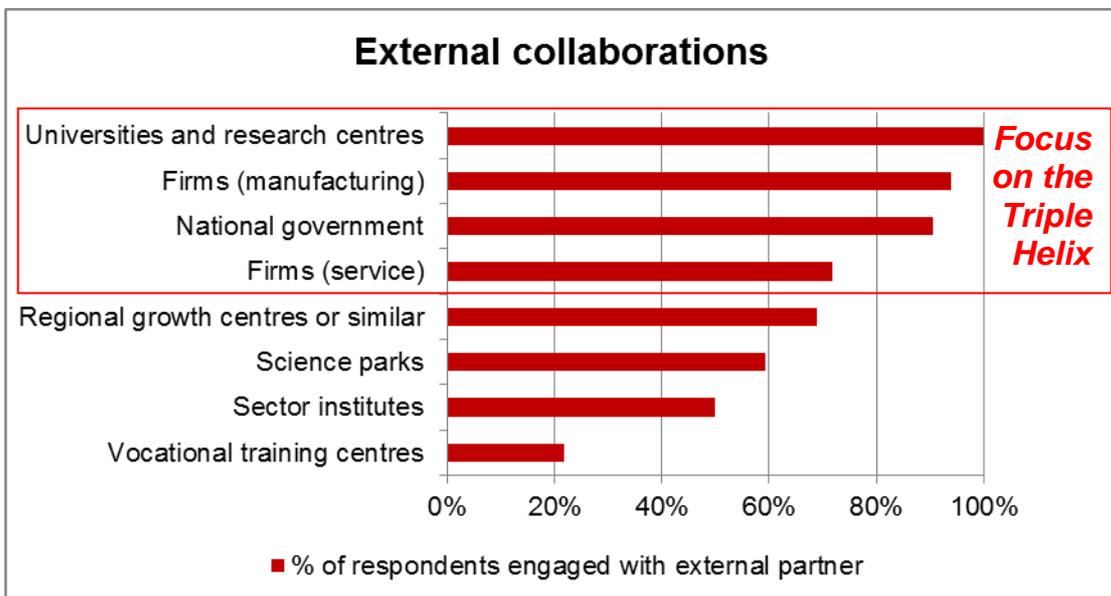
Evidence showing how embedded technology and innovation centres are in their local environment can be seen in Figure 6 below. The majority of centres are engaged with at least three organisations, with 80% collaborating with universities, national governments and firms. Indeed, over half of the Centres surveyed collaborate with 6 or more of the types of partners, an impressive testament to their strong external engagement.

In recent years, there has been a growing awareness that the ‘triple helix’ model does not capture the full spectrum of interests and voices

that populate the innovation ecosystem. Innovation users or groups representing demand-side perspectives and consumers, relevant non-profit organisations representing citizens and workers must also be taken into account. We see (also presented in Figure 6) that a number of centres also collaborate with other organisations, such as regional and local authorities, vocation training institutions, science parks and business associations.

From a sector perspective, the survey finds that most centres have ties to both service and manufacturing firms, although slightly more with the latter: 94% of the Centres surveyed work with manufacturing firms, compared to 72% for service businesses. In addition, some centres collaborate with manufacturing firms only (ie not with service firms), whereas the opposite is not true (ie there are no centres that work with service firms only).

Figure 6: Did your Centre collaborate with any of the following entities last year (funded and unfunded collaborations)?



“Success looks very different from the perspective of industrial, academic and national interests. For instance, research institutes and universities may work according to the principle of excellence whereas in many cases, good enough and relevance are the driving force for industry. Time horizons are also different. As such, success may be understood in terms of the ability to balance and negotiate these tensions”.

*Tommy Jacobson – CEO, CLEEN Ltd
(Finland).*

It is worth emphasising that discussions of the UK Catapult centres have typically focused on how they can strengthen the link between university research and markets, namely to bridge the gap between primary, early-stage research and commerce-ready propositions, but organising them around this goal could mean that they fail to deliver their core mission. Aligning centres too close to universities carries the danger of reproducing many of the problems associated with accelerating commercialisation in conventional university research settings: frequent turnover or churning of staff, ad hoc management of IP and greater reliance on the public purse in light of the market

failures inherent in more basic forms of research.

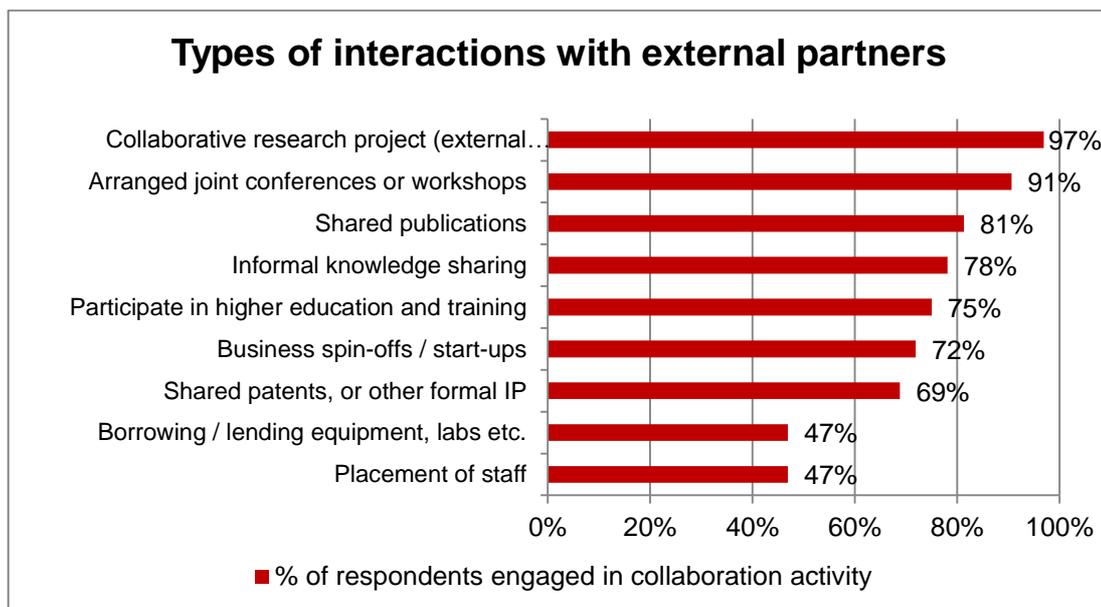
As technology service centres they should build competencies in areas that enable firms, especially resource-constrained SMEs, to go beyond what their internal capabilities would otherwise permit. This may mean drawing on the best from universities (nationally or internationally), but not exclusively. It also means working with a range of universities, and it will certainly not duplicate existing university-industry collaborations or services done by university technology transfer offices, provided that they are operating satisfactorily. Finally they will complement other government-sponsored support interventions such as Knowledge Transfer Networks and the Small Business Research Initiative.

5. Technology and innovation centres enable knowledge, resources, IP and skills to flow with speed and intensity

Catapult-like centres abroad use a number of channels to engage with external partners. Collaborative research projects are the most important of the available pathways and are carried by 97% of centres in our survey; but other knowledge sharing mechanisms are also important: joint conferences, workshops, shared publications as well as the placement of staff and participation in higher education and training.

Indeed, more than half of the centres report using at least 7 of the 9 types of interactions listed in Figure 7.

Figure 7: Which types of interaction did your Centre have with external partners last year, in which knowledge has been shared?



Notably, 91% of the international technology and innovation centres surveyed arrange joint conferences and workshops with external partners, 69% share patents or other formal Intellectual Property, and 78% report they share knowledge informally with external organisations. Knowledge is embodied in people, and accelerating the flow of knowledge in and out of technology and innovation centres occurs through staff placements or secondments (47% of centres).

Unsurprisingly, the high number of collaborative research projects results in the joint outputs

in the form of shared publications (81%). The pursuit of innovation also results in the development of new business models and activities which are best undertaken outside the technology and innovation centre: 72% of the centres are engaged with business spin-offs and start-ups. Supporting directly (eg in the form of incubating new businesses) and by providing these new businesses with technological inputs is a clear contribution of technology and innovation centres to the economy.

technology and innovation centres can also have a positive impact on the economy through the upskilling of the workforce: 75% of the Centres surveyed participate in higher education and training, for instance through integrating PhD students into their workforce. The Industrial Technology Research Institute (ITRI) in Taiwan has taken the skills agenda furthest: 160,000 alumni have graduated from ITRI, with more than 140,000 of them currently employed in the business community. In particular, the knowledge gained in the course of developing and exploiting technology is markedly different to that obtained in a university research role. The profound training opportunities through the Danish DTI were also emphasised previously when discussing the commercial aspects of the technology and innovation centres' major work functions in Figure 5 above.

Finally, the investment in the Centres' tangible assets such as infrastructure can be leveraged when this infrastructure is made available to other organisations or when the Centres themselves have access to their partner's equipment, thus increasing the total returns on these investments. 47% of the Centres surveyed borrow or lend equipment, laboratories etc.

In sum, every centre is different and the type of engagement will depend on the nature of the technology and the dominant mode of innovation in the sector as well as the behaviour and performance of businesses. The wider process of industrial transformation at a regional and national level will also be relevant. In particular, distinctive forms of engagement and anchoring may be required at the technological frontier where knowledge is less codified and new findings between universities, research institutes and firms circulate slowly and can take several years.

“The coffee shop effect is very important. That’s the way we solve most of our problems. In Sweden, most decisions are made before meetings over coffee. Each person drinks 10kg of a coffee a year, compared to 3kg in the UK”.

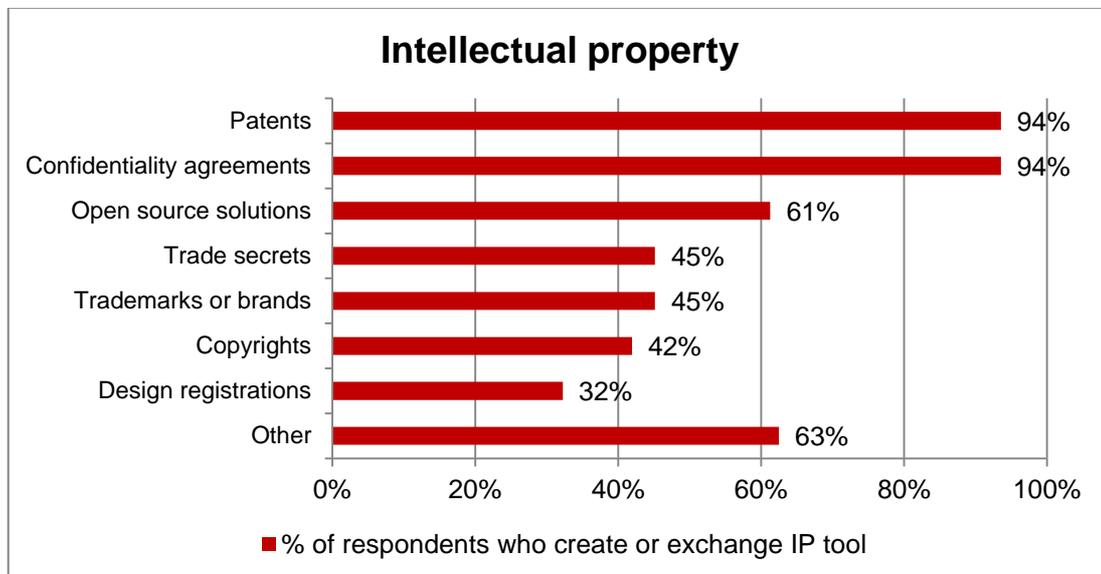
*Anna Aspgren –
Consultant, Aspgren
Leadership Resources
AB, Sweden*

Intellectual property activity

One of the key outputs of technology and innovation centres is the intellectual property they create.

Catapults will need to design Intellectual Property arrangements from their own and their partners' contributions to research projects and inventions, which allow them to reach the conventional value-seeking objectives from IP, mainly related to financial income, innovation, building strategic relationships, and enhanced competitiveness. The survey examined a range of mechanisms which are used to protect and extract value from the centres' work. The results highlight that patents and confidentiality agreements are used by 94% of the centres surveyed, while open source solutions are used by 61% of the centres ahead of trade secrets, trademarks, copyrights and design registrations.

Figure 8: Does your Centre create or exchange the following Intellectual Property tools?



Crucially, all the centres surveyed reported a full toolkit of intellectual property mechanisms to extract value from their work – in fact, they all used at least two different forms of the protections listed in Figure 8 above. Different value creation objectives, projects, outputs, size of centre, and other factors, may call for different intellectual property solutions: 64% of the centres surveyed used at least 4 of the mechanisms listed in Figure 8, and 12% used all of them simultaneously (all the centres in that category managed annual budgets of over €10m).

The same conclusion applies to the use of open source: while these models may be adapted to a certain range of activities and outputs, it is very common for technology and innovation centres to use these solutions in combination with more traditional instruments such as patents, confidentiality agreements or copyrights.

“Indicators such as patents might be good at an aggregate level; but they are less suitable when looking at individual centres. You have to ask what is this about and what can you really expect”.

*Anna Aspgren –
Consultant, Aspgren
Leadership Resources
AB, Sweden*

When it comes to protecting and using intellectual property, some centres have developed their own innovative solutions, such as the ‘shared innovation’ model developed by Cleen Ltd, a Finnish Technology and Innovation Centre which gives its partners unlimited access to the centre’s intellectual outputs.

Many centre directors were keen to emphasise that they engaged in sharing IP, rather than making it openly available insofar as IP arrangements are organised explicitly to benefit partners within a network, not outsiders. While shared or co-innovation provides a much larger base of ideas and technologies on which to draw, allowing firms to explore new growth opportunities at lower cost and risk, there are areas in which it is deemed inappropriate. Tommy Jacobson, the CEO of Cleen points out that his Centre does little shared work on

product development because companies remain guarded over activities and results that are closer to market. It also appears easier to mobilise firms from different sectors that have different markets and business models than competitors inside traditional industrial clusters. A good example is Cleen’s smart grid programme which is sponsored by Nokia Siemens Networks, ABB, the power and automation technologies company and Fortum, the utility giant.

Finally, it was reported that SMEs may be reluctant to dispense with formal IPR, once realised, as they feel that they have no other means of protecting their ideas, unlike larger firms that can fall back on manufacturing facilities, distribution networks, a brand name that gives them some de facto security if experiments in shared or open innovation fail.

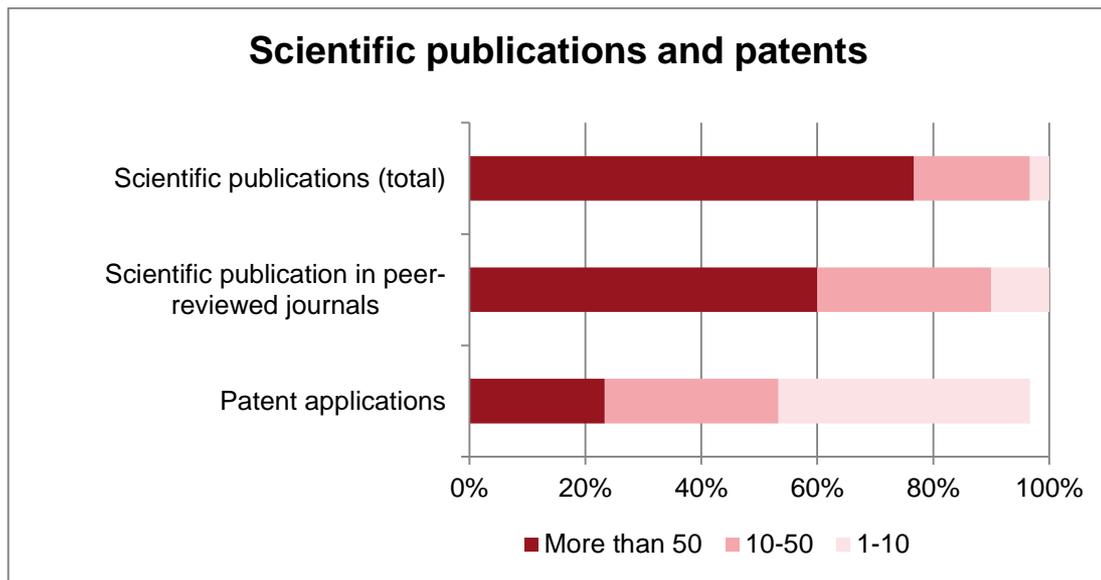
“We insist that IP is shared within the research consortium. Access issues also drive the multidisciplinary character of the organisation as it is much more difficult to share IP between competitors inside the traditional industrial cluster. It’s much easier to share IP between different kinds of industries which have different markets and business models. For instance, in our smart grid program, the biggest contributor is Nokia-Siemens Networks and is joining forces with companies like ABB and Fortum, the utility company”.

Tommy Jacobson – CEO, CLEEN Ltd (Finland)

The survey also sought to quantify the impact of technology and innovation centres on the formal knowledge base, and found out this impact was quite substantial: for the last year

these outputs were recorded, 77% of the technology and innovation centres surveyed created more than 50 scientific publications, and 53% submitted at least 10 patent applications, as presented in Figure 9.

Figure 9: Could you tell us for last year the number of scientific publications and patents?



While in the past, patenting activity may have been seen as the overarching sign of success of an R&D centre, mindsets are changing as the benefits expected from patenting have been met with disappointment. Patents are no longer seen as an economic gold mine, guaranteeing success like they used to. However, a well balanced portfolio of patents is still considered a worthy investment by several Centres, in order to undergird further collaborative research and business spin-offs.

UK Catapults must also adopt a flexible approach to the management of their intellectual property.

6. Financial stability through multiple flexible sources of funding

The structure of funding plays a key role in the orientation of technology and innovation centres. There has been a noticeable trend towards diversification of funding sources

“Innovation is about speed. If there is a new market coming, you have to speed up. If an innovation centre is not secure in its funding, it does not try to take risks and be upfront”

Egbert-Jan Sol: Director of Innovation High-Tech Systems & Materials, TNO Netherlands

through a mix of performance and non-performance related funding granted from the government, collaborative research and development type funding, including funding won competitively from EU programmes, and directly contracted commercial revenue.

The ability of Catapult centres to attract business funding and to win competitive public funding will be a key indicator of their success, reflecting the relevance and quality of their work. While Catapult centres generally are not-for-profit organisations, the ability to run equilibrium or surplus budgets and to put some of the revenues

into reserves should also indicate good performance and management, while allowing for future investment and stability. For example, the Fraunhofer-Gesellschaft can count on a €238m licence-fee revenue reserve (for an annual budget of €1,657m in 2010).

Overview of sources of funding

On average, public sector funding (both national and international) accounts for 47% of the centres' budget, and commercial revenue for 45%, the rest coming from intellectual property revenue and other sources.

However, the meaning of these figures is relative, because of the great heterogeneity of the centres. The ratio of public funding over commercial revenue for individual centres ranges from 1/9 (of the surveyed centres this includes a Carnot and a GTS) to 7/3 (of the surveyed centres this includes 2 Carnot, 3 Fraunhofer institutes, and a VVT). Figures 10 and 11 illustrate the heterogeneity.

“We are very keen that we do not compete with the private sector”

*Søren Stjernqvist –
Director of Danish
Technological
Institute*

Figure 10: Which proportion of your turnover comes from public funding?

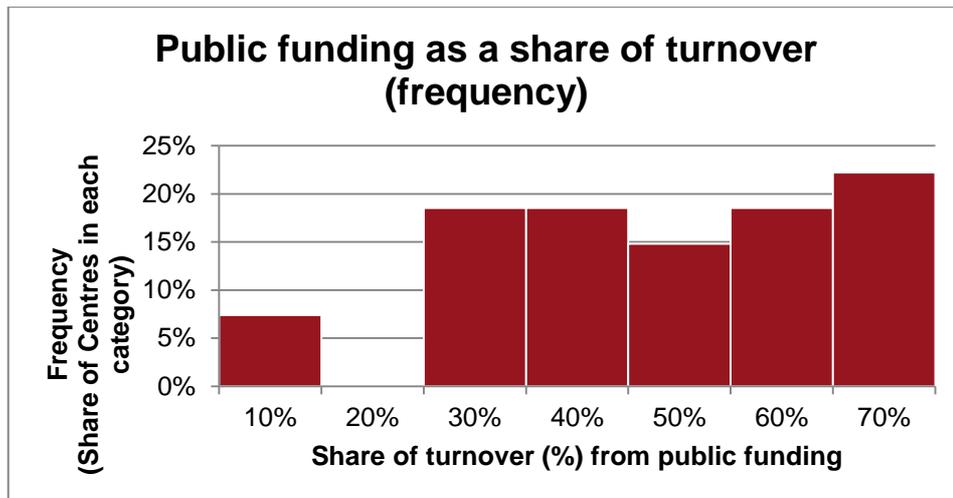
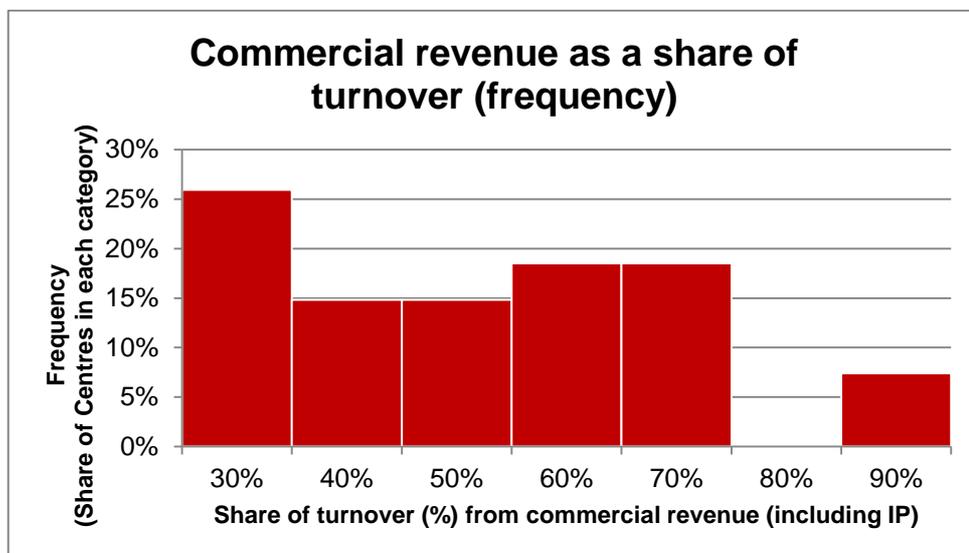


Figure 11: Which proportion of your turnover comes from commercial revenue (including IP)?



The UK Catapults will each receive public grants of £5m to £10m per year, to be used as core funding to cover infrastructure, recruitment, skills development, etc. It is envisaged that this core funding will be 'double matched', drawing on business-funded contracts and collaborative applied research projects (funded by both the public and private sector), each of these sources accounting for roughly a third of overall budgets⁷ Taking into account competitively-won public funds, total public funding may therefore account for up to presumably half of total budgets. Assuming core funding includes both unconditional funding plus performance-related basic funding, the UK model is in line with the *so-called* average

⁷ Technology and Innovation Centres. Closing the gap between concept and commercialization. Strategy and implementation plan, May 2001. Technology Strategy Board.

abroad. However, as mentioned above, the results are very heterogeneous across the different international technology and innovation centres (see Figure 10), showing no single best option. It should be said that national models differ. For example, the more expensive (in terms of public funding) Fraunhofer model provides services already done by UK technology transfer offices and business relations units at UK universities. Due to the well-equipped UK universities, the UK model seems to be more fit for purpose if it is closer to markets, as eg the centres represented by Denmark and Spain and to some extent the Netherlands. The centre models in Finland and France seems especially to span across the spectrum.

With regard to relating public funding to independent income, several funding models of the international technology and innovation centres are quite innovatively based on a formula painstakingly developed over the decades whereby the amount of core funding a Centre receives is linked to its success in winning contracts. Thus, the level of industry funding is kept between 25% and 55% of total revenue (in the Fraunhofer case). It is rewarded with an enhanced return ie 40% of any commercial revenue. However, if it falls below or indeed climbs above this corridor, it is penalised.

Another indicator of performance is the breakdown of the budget: how is the money spent? This question is especially relevant for core funding, which can be allocated more freely than project-specific funding.

Exclusively public sources

When we look exclusively at the sources of public funding, we observe the broad following ratios (see Figure 12 below for more detail):

Core funding from national sources accounts for around one third of public funding, while competitive funding (also national) accounts for a little less than a third.

National core funding is made up almost equally of unconditional and performance-related funding.

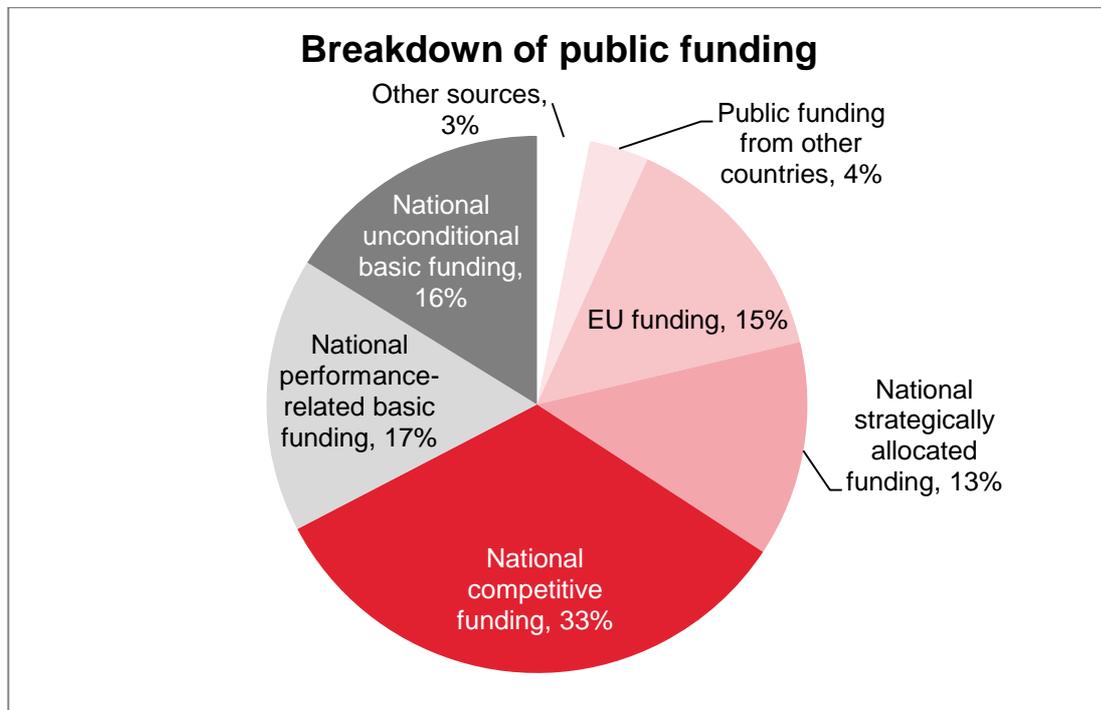
The remaining third comes from abroad (EU funding accounts for 15% of the total funding from public sources) and from national funds strategically allocated (for example a one-off contribution to fulfil a specific objective).

“Stable core funding is necessary. But you must spend it wisely. You must never subsidise your research projects with core funding but prepare for future demands with core funding and spend part of core funding for internal programmes to induce cooperation among institutes”.

*Raoul Klingner – Director
International Business
Development, Fraunhofer-
Gesellschaft, Germany*

Transitioning towards a diversified funding model cannot be willed overnight. History shows that many technology and innovation centres started with considerable public backing before this was gradually reduced. This support served as a catalyst to leverage additional funding and helped to de-risk some of the investments that others made, though there is also evidence that core grants can encourage organisational drift and expensive cross-subsidies for external contracts. Drawing up a credible timetable for rebalancing the share between public and private funding without throwing the baby out with the bathwater is a major challenge for policymakers and has different implications for what success will look like in the short term versus the medium to long term.

Figure 12: Which proportion of your public funding comes from the following sources



To make additional funding bite, it is also vital that centres are well governed. Evidence from the university sector shows that autonomy in budgets, hiring and remuneration is a powerful driver of performance⁸. Another dimension of good governance is that centres reflect a broad range of interests, especially those from the private sector. This is the situation with VTT in Finland: notwithstanding its public status, it only recruits 14% of its board from the public sector, the rest is made up of representatives of the private sectors or of various associations while the board of TNO in the Netherlands does not include a single government representative.

⁸ Aghion, Dewatripont, Hoxby, Mas-Colell and Sapir (2007) "Why Reform Europe's Universities" *Bruegel Policy Review*

This raises interesting questions about the optimal degree of coordination with both public authorities and other centres (contrast the decentralised structure of the Fraunhofer Society with the relative centralisation of TNO and SINTEF). Too little autonomy and independence can stifle agility and initiative; too much can pit centres against each other and make it difficult to formulate and implement strategy. It is precisely for this reason that the board at Fraunhofer retains one third of core funding to support strategic measures such as cooperative programmes, competency building and alliances and mergers.

Exclusively commercial sources

In terms of commercial work and revenue, it may also be of interest to see who technology and innovation centres work with and to break down where money comes from by looking at size of business (small, medium and large, using EU definitions⁹), see Figures 13 and 14:

- 63% of the centres surveyed worked with more than 20 small businesses in the past year;
- 54% worked with more than 20 medium-sized businesses; and
- 67% worked with more than 20 large businesses.

There is little evidence of technology and innovation centres being locked into a particular type of business partner: most of the centres work with businesses of all sizes, rather than work with only ones of a particular size. At the same time, the number of business partners, both large and small, is closely related to the size of the centres themselves: the bigger a centre, the more likely it is to have a large number of business partners.

Figure 13: Approximately how many businesses did you work with last year (sorted by

⁹ Small businesses have fewer than 50 employees, medium-size between 51 and 250, and large businesses more than 250 staff.

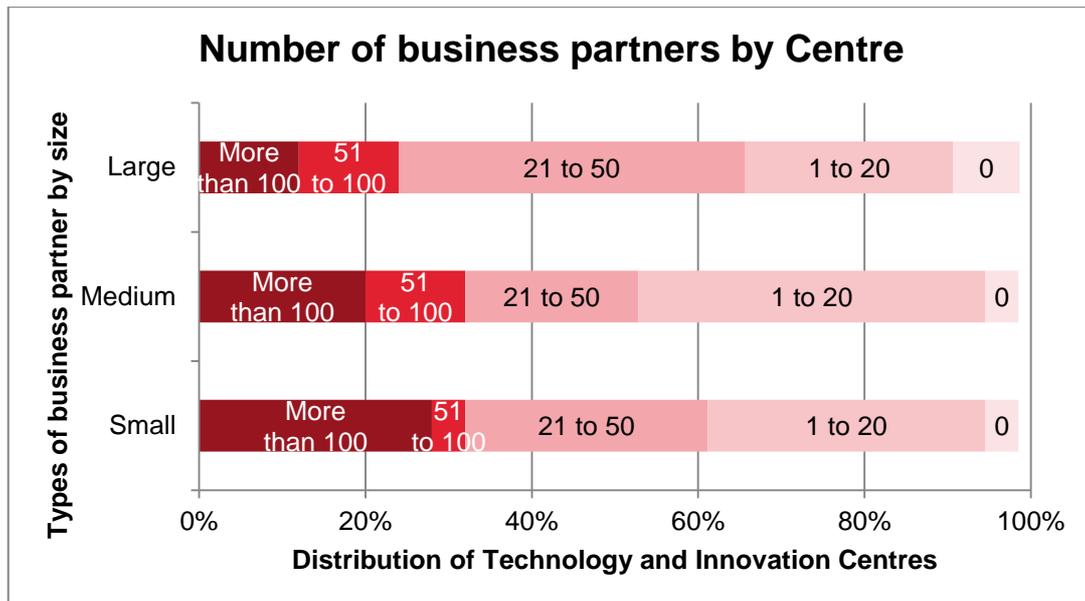
“To work effectively with SMEs, you need a regional approach”.

*Jean Charles Guibert –
Director of Technology
Transfer, CEA, Minatec
(France)*

“Almost 50 per cent of Fraunhofer’s revenue comes from SMEs because they are ones that do not possess large R&D infrastructure. They need you to outsource their possible R&D needs. It’s a business case for them to outsource their R&D rather than build capabilities themselves. Of course, large companies that have their large R&D infrastructures may hire Fraunhofer to do some very specialised work”.

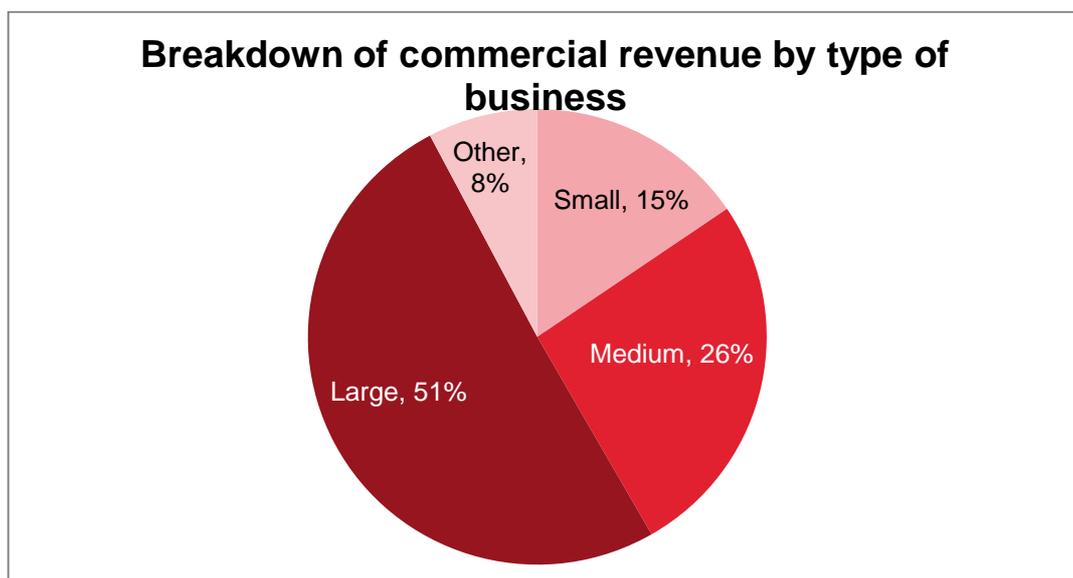
*Raoul Klingner – Director International Business
Development, Fraunhofer-Gesellschaft, Germany*

company size)?



Overall, technology and innovation centres tend to work with a larger number of small businesses. However, the financial contribution a company can make to a Technology and Innovation Centre is proportional to the size of that company. Therefore, it is not surprising that half (51%) of the surveyed centres' commercial revenue comes from large businesses (of more than 250 employees), while small and medium-sized companies account for 41% of commercial revenue (see Figure 14). Other organisations account for 8% of commercial revenue.

Figure 14: Which proportion of your commercial revenue comes from small, medium or large businesses?



“Mission alignment is difficult, especially in terms of end users: should we work with 10,000 SMEs in Denmark or the top 100 companies. Trying to do both can stretch ambition beyond what is feasible.”

Søren Stjernqvist – Director of Danish Technological Institute

On the other hand, centres do make strategic choices about whom to work with and on what terms. An interesting example is SHOK which is run as a limited-liability company and permits only large, multinationals as shareholders, arguing that they are most demanding and globally oriented, providing a more robust basis for target-setting and strategy formulation. However, SMEs are an active and prized member in SHOK’s research programmes and innovation platforms.

“Financing by companies less important than whether they are willing to bring the best people and most exciting research to the table”.

Tommy Jacobson – CEO, CLEEN Ltd (Finland).

Meeting the technological needs of different companies also has implications for the skills needed by technology and innovation centres. For instance, SMEs often lack the capability to diagnose their own technological, organisational, and managerial needs as well as navigate the innovation ecosystem to find appropriate help. This necessitates proactive skills in marketing and business that many centres may not possess, though there are examples of good practice: centres such as Centros Tecnológicos in Spain and HKPC in Hong Kong specifically

cater to this niche while centres such as Fraunhofer arrange special Technology Days which are carefully tailored to individual company needs.

In kind support

Finally, one should not overlook the importance of in-kind contributions, even though they do not always show up in official company accounts. Anna Aspgren, a consultant in Sweden with experience of advising the country’s competency centres, underlines the transformational potential of this kind of resourcing: “If industry puts in only cash, it can walk away whereas we want industry to feel part of the centre and put effort into it – and feel real ownership over results”.

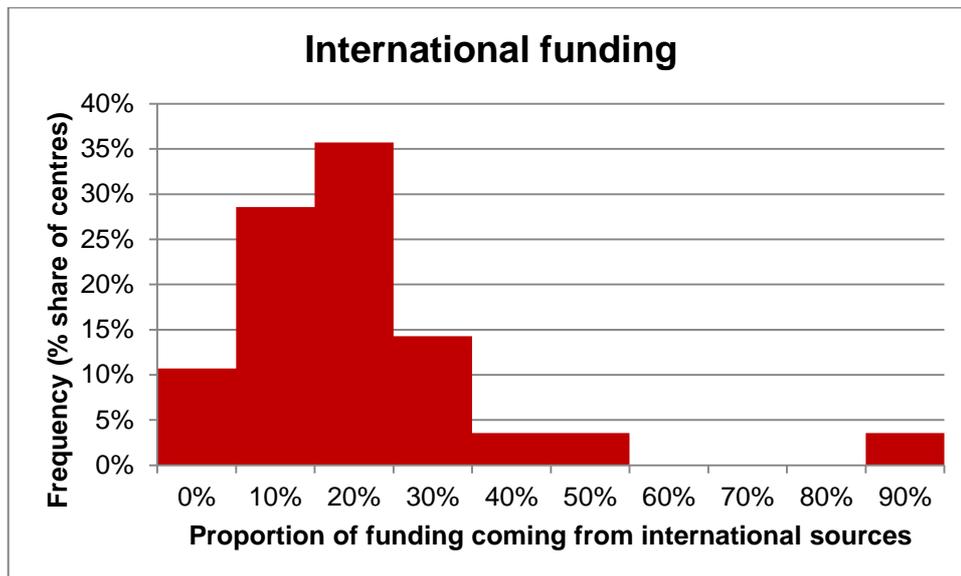
“Half of industry funding is in cash, half of it in-kind. This is a sound figure since if industry only puts in cash, it can leave whereas we want industry to feel part of the centre and put effort into it – and feel real ownership over results”.

Anna Aspgren – Consultant, Aspgren Leadership Resources AB, Sweden

International

technology and innovation centres are increasingly outward looking, and this is reflected in their budget: 89% of the centres surveyed derive some income from international sources (private or public, including EU funding). For 82% of them, the ratio of international funding in their total budget ranges from 10% to 40%. On average, 21% of total funding comes from international sources. Figure 15 illustrates this heterogeneity.

Figure 15: Which proportion of your total turnover (public and commercial) comes from other countries?



“Collaboration is increasingly global. Strathclyde University and Fraunhofer IAF in Freiburg established the Fraunhofer Center for Applied Photonics in 2012 while Southampton University and Fraunhofer IAIS/FOKUS have launched a programme in collective web intelligence”.

Raoul Klingner – Director International Business Development, Fraunhofer-Gesellschaft, Germany

There are many reasons for internationalisation. For centres that have small home markets or receive low levels of core funding, it is a source of leverage and way to make ends meet. For others, it is an opportunity to enrich the knowledge base, test the relevance of the centre’s work and develop networks across communities of expertise. One risk is that the larger, more path-dependent technology and innovation centres become captive to their domestic markets and cannot keep pace with major shifts in economic geography. Clearly there is scope for centres to leverage the EU Framework Programme to raise their profile or export contract research and other services; but many are not able to fulfil a more ambitious role due to the

national nature of their funding. Building international scale, critical mass and quality among

“Institutes must benchmark themselves regionally but also increasingly globally especially as larger companies source knowledge services around the globe.”

Raoul Klingner – Director International Business Development, Fraunhofer-Gesellschaft, Germany

“If you want to be good on a global level or at least a European level, if you don’t have 10–20% from European programmes, you’re too nationally focussed even if you don’t realise it. We have a 30% hit rate but critically we only do it in our focus areas.”

“The dominant innovations are on a global base, that’s why we try to find connections with others – in particular by getting funding from the European Commission’s Horizon 2020 – increasingly from precompetitive research funding all the way to level 8.”

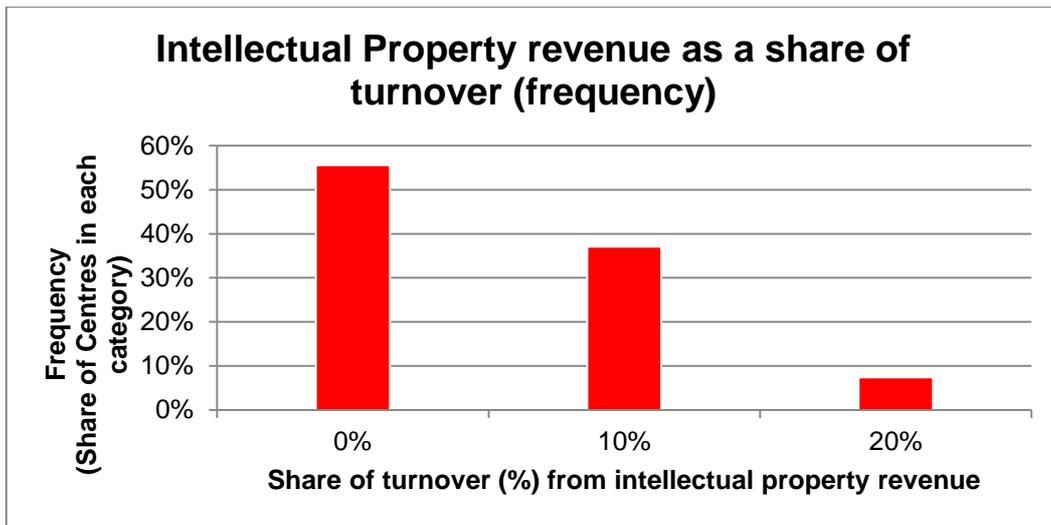
Egbert-Jan Sol: Director of Innovation High-Tech Systems & Materials, TNO Netherlands

technology and innovation centres and enabling them to enter new markets may require relaxing ties and commitments at a national level.

Intellectual Property revenue

Finally, intellectual property income is a small proportion of total income. As shown in figure 16, more than half of the international technology centres report the number to be roughly 0% of total, where it is roughly 10% for most of the remaining part. However, when used strategically (see section 5) intellectual property can reach objectives which are not directly related to financial income, but to building strategic networks, innovation capability and competitiveness.

Figure 16: Which proportion of your turnover comes from intellectual property?



Note: the percentage share of turnover from intellectual property revenue are rough estimates of the international technology and innovation centres, who were only given options of 0%, 10%, 20%, 30% and so forth.

Revenue from intellectual property, although they represent at best a minority of the total revenue, can bring additional funding to Technology and Innovation Centres. The Fraunhofer Gesellschaft has accumulated licence revenues, which are transferred each year to a special reserve and may be used by the Fraunhofer Future Foundation. Over the years, the licence fee revenues have been accrued to a total of €242 million in 2011. In 2011, net licence-fee revenue amounting to €74 million was allocated to the corresponding special reserve, while €70 million was transferred from the reserve to the Fraunhofer Future Foundation as spending capital.

Source: Fraunhofer Annual report 2011

7. Conclusion: Catapult to success in the UK

In the past it has been innovation that has unleashed economic upswings. However, innovation – including the realising the steps from concept to commercialisation of technology and ideas – needs coordinated action. Both innovation and the commercialisation of such do not take place in an institutional vacuum. It involves a complex web of technologists and scientists, businesses, finance, demand (markets), universities, skilled workers, public agencies, government and other institutions that interact in innumerable different ways.

The focus of economic policy is now on putting in place the conditions and frameworks that will enable UK businesses to be the most innovative on earth, and make Britain a global hub for innovation.

The creation of a series of technology and innovation centres for the UK – called Catapult centres – was confirmed in the Government’s Innovation and Research Strategy for Growth, December 2011. They must be fit for purpose to unleash the power of the ideas and technologies that will drive innovation for the 21st century. There is no other way.

With a public and private sector investment of more than £1bn over the coming few years, the seven Catapults – *Cell therapy, Connected digital economy, Future cities, High value manufacturing, Offshore renewable energy, Satellite applications, Transport systems* – which will be operational in 2013 are a major long-term investment which aims to transform the pace of innovation and so accelerate economic growth.

As we know, the competitiveness and economic performance of firms and nations must be understood in a local context. Globalisation is not wiping out the role of the national context, rather it reinforces its importance. As the new Catapults come to play their incredibly important, subtle and multifaceted role in our national system of innovation, it is important they make the UK ecosystem as attractive and internationally competitive as possible, for investment and growth to take place.

In their convening role, they must ensure not to duplicate the activities already taking place in university–business collaborations and science parks, or compete with industry or each

“One of the selling points of the UK as a destination for FDI will be the Catapults which will be able to engage with foreign businesses in an open way”.

*Rt Hon Dr Vince Cable MP,
Secretary of State for Business,
Innovation and Skills*

other in their multi-faced activities. Rather, through their own role, they will close the gaps and reinforce the performance of what is already successfully there, as well as spur new technological and business opportunities.

But what does a well performing Catapult look like?

There are many examples of the business models of similar centres on our doorstep – not confined to Germany’s much-admired Fraunhofer institutes. The UK can learn a great deal about how these institutions work within their national context, and gain useful insight into how their performance is assessed.

By reviewing evidence from similar initiatives in European countries¹⁰, we see that such centres play a central role in their national innovation systems. They promote growth by helping businesses to build and anchor new markets, capabilities and capital structures, and create links with research and university bases. The UK Catapults must aim to make businesses located in the UK more competitive, our universities more world class, our science parks stronger, growth our skills for innovation and speed up the flow of finance, knowledge and IP in the innovation ecosystem.

We can now identify some key performance indicators (KPIs) of UK Catapults as catalysts and co-creators in an open UK innovation ecosystem. These indicators need to go beyond the traditional measures of turnover, jobs, R&D or patents.

7.1 Be ambitious, bold and enterprising

A good indicator for success of the UK Catapults is that they are ‘ambitious, bold and enterprising’. They can be this by anchoring into our innovation ecosystem as catalysts and as co-creators in a variety of ways.

An aim should be to have the most globally sophisticated national network of technology and innovation centres – ie Catapults – organised as far as possible on open innovation principles and committed to supporting open innovation business models. The international evidence is unambiguous.

¹⁰ Evidence was collected through an online questionnaire addressed to 125 individual innovation centres and similar bodies in Europe. Responses were received from 32 centres (representing 26% of the total) across all national initiatives in Europe: They are 61 German Fraunhofer Institutes, 34 French Carnot Centres, 7 TNO centres in the Netherlands, the Finnish Technical Research Centre (VTT) and 6 Finnish SHOK-TEKES centres, 9 Danish Advanced Technology Group GTS centres, the Norwegian SINTEF centre, and 6 Spanish Tecnalia centres. This evidence was supplemented by case accounts from senior representatives (centre directors and stakeholders) from major European innovation and technology centres at an international conference (attended by 100 people) on: “What does success look like for innovation and technology centres?”. This was organised by the Technology Strategy Board, the Institution of Engineering and Technology and the Big Innovation Centre and held on 22 October 2012 at the Institution of Engineering and Technology in London.

European technology and innovation centres generate success in six separate ways:

- They contribute to and deliver their national policy for growth
- They de-risk innovation and help firms to go beyond their existing capabilities and what they can achieve with their own resources by:
 - providing a range of support services from idea to market
 - assuming risk on early stage-stage innovation
 - acting as anchor institutions and catalysts to build new markets, innovative sectors clusters and networks
- They enable knowledge, resources, IP and skills to flow between businesses with speed and intensity
- They realise financial stability through multiple flexible sources of funding

It follows that an ecosystem approach is needed for public policy and Catapult management. Ten recommendations are described below in relation to the lessons learned from similar European initiatives.

7.2 The ecosystem approach – recommendations for public policy and Catapult management

Contributing to and delivering their national policy for growth

European centres contribute to the delivery of national research and innovation policies, and most of them are involved in their design and development.

1. UK Catapults must be a core element of future UK growth policy (including the innovation and research strategy) and contribute to rebalancing the economy. Catapults should be integrated in the Government's ambitious infrastructure investment plans and provide an essential element in the UK knowledge infrastructure for manufacturing, transport, energy, cities, communication, and more.

Operating with a critical mass regarding activity, people, and competencies: European centres are generally classified medium to large, with two third being research-staff of which about 40% holds a PhD – see recommendation 10 below to UK Catapult initiative.

De-risking innovation and helping businesses go beyond their existing capabilities or resources in a variety of ways:

○ **Providing a range of services from concept to commercialisation**

European centres provide business and technological services that are beyond the reach of many companies. This includes applied R&D services as well as other activities close to the market such as consulting, training, testing and certification, or market research.

2. UK Catapults need to be multifunctional in their provision of services to solve the real problems faced by companies in commercialising products – from providing new competencies or specialised skills, applied R&D, testing & certifying, to providing access to resources and investment networks, as well as other consultancy and perhaps even sales. One of the early challenges for UK Catapult centres will be to identify what businesses and markets they are in, what the challenges are, and where they can add value.

○ **Assuming risk on early stage innovation**

European centres concentrate on where they can help the most, which is to reduce risks in early-stage innovation, whether radical or incremental, basic or applied or even application innovation.

3. UK Catapults must mitigate many of the risks associated with investing in innovation – particularly where international competition is strong, R&D costs are high and goods and services are complex, or where the technologies are disruptive to existing markets and business models.
4. UK Catapults must be horizon scanners identifying new technological opportunities, and then use their own convening power, as well as their capabilities and technological and financial resources to work with others to anchor new technologies in the UK.

○ **Acting as anchoring institutions and catalysts for new markets, innovative sectors, clusters and networks**

European centres provide an anchor for collaboration between universities, government, business, and beyond. They co-create and work in concert to de-risk innovation and realise technological opportunities. They also collaborate with other organisations, such as regional and local authorities, vocational training institutions, science parks and business associations. They provide hubs for SMEs to go beyond their capacity and provide a unique environment for innovation.

“Many forms of collaboration are important but extremely important is the ability of Catapults to bring together large companies and SMEs as large companies bring with them their supply chains”

*Phil Smith
Chair of the Technology Strategy Board*

5. UK Catapults must find mechanisms to become brokers that build trust, confidence and absorptive capacity among the myriad of actors in the innovation ecosystem, including businesses, knowledge institutions/universities, funding bodies, government, science parks, regional growth centres and others. They should realise synergies and overcome

“The international context is vital – these new centres will be international and compete internationally. They will be bringing in people and expertise from around the world. There is no point for them to only focus on being the best in the UK, but globally competitive”.

*Phil Smith
Chair of the Technology
Strategy Board*

barriers to collaboration and joint action. Using this convening power in the innovation ecosystem they must help companies go beyond what they can do unaided. They need to be open, networked and absorptive of external ideas themselves. The better they understand their role in the innovation ecosystem, and their role is understood, the better they can underpin it.

Enabling knowledge, resources, IP and skills to flow with speed and intensity

European centres use a variety of tools to engage with external partners. First and foremost they support collaborative research. But they also share knowledge in other ways through organising joint conferences, workshops or publishing. They exchange staff and support business start-ups and spin-offs. Almost all are also strongly engaged in higher education and training for PhD students and other skills levels.

6. UK Catapults must speed up the flow of knowledge, ideas, resources, IP and skills within their target sectors, by finding appropriate platforms to best connect external partners. They should use a range of mechanisms – for example through shared research projects, open workshops, training programmes, sharing equipment, staff placements, intellectual property exchanges, joint publications, business spin-offs and more. They must also find ways to minimise barriers to the wider use and dissemination of information and knowledge.
7. UK Catapults must draw on the best of all UK universities to enhance their role, and build bridges with the best universities abroad.

Realising financial stability through multiple flexible sources of funding

Core funding represents a relatively small proportion of European centres’ income (about one third of their funding from public sources on average) though they all receive other competitive public, or strategically allocated, funding from both national and international sources, pushing total public support to about half of total income on average (although there is a huge variety across centres). International collaboration and competition (from both business and the EU) help centres remain at the technology frontier and allow economies of scale in their activities. Centres benchmark themselves globally as well as nationally and regionally.

European centres work with businesses of all sizes. Work for SMEs is considered essential (and accounts for half of income), and focuses on providing access to infrastructure and meeting capability gaps. Large businesses use the centres for more specialised work.

8. UK Catapults must do business in both national and international markets and collaborations (including EU initiatives) and work across all business sizes. Four benchmarks (derived from a European norm or aspiration):
 - Revenue from small and medium sized firms located in the UK should aim to account for at least half of the commercial revenue arising from UK business engagement.
 - Core Government funding (both unconditional and conditional) should, in the long run, not be expected to exceed one third of total public funding to ensure a sustainable competitive nature. Remaining public funding can come from competitive national and EU funding.
 - Commercial income from businesses should aim to account for at least 50% of total income, increasing after a few years of operation.
 - Total international operations (commercial and public) should aim to account for at least 20% of the total revenue.

Performance metrics for what good looks like

Ambitious, bold and enterprising Catapult centres will also need to test out new business models – some of which will not succeed. They should not be afraid of failure. They therefore need a clear definition of success and a transparent framework against which they can monitor performance so that weaknesses can be quickly identified and action taken.

The performance of technology centres has often in the past been measured through traditional indicators such as, turnover, size, volume of R&D or IP registered and licensed. These indicators fail to capture their full role in their innovation ecosystem and new metrics are needed for this – to measure, for example, the quality of their relationships with businesses, universities and markets, their convening power, how they leverage their resources and how they identify and manage risk.

9. Key performance indicators (KPIs) of UK Catapults must not be assessed merely through traditional measures such as turnover, size, or patents granted, but through the difference they make as catalysts and co-creators in open innovation ecosystems. The dimensions to this approach, and introductory variables, are contributed by this report.
10. Every centre is different, but UK all Catapults must operate with a critical mass regarding activity, people, and competencies. Government can't have a one size fits all policy approach. UK Catapults should develop their own set of metrics and measures consistent with the recommendations in this report which reflects their own strategic targets and the role they intend to play in the innovation environment for their sector.

This is certainly an ambitious agenda for the UK Catapult programme. However, UK Catapult Centres do not start with a blank sheet – there are successful models in Europe from which to learn. The challenge is to ensure that second rate institutions in this space do

not discredit the model. Catapults could also fail if they lack sufficient resources, scale and capability, but, as currently configured, the Catapult Centres represent an extremely promising start.

Annex 1. Dimensions of Key Performance Indicators (KPIs) and introductory variables

From an operational perspective, a well performing Catapult must successfully anchor into all relevant dimensions of the innovation ecosystem. The tables a) to e) listed in Annex 1 exemplify those dimensions (see chapter 1 for explanation) including introductory variables. The first column in all tables lists most of the questions the European technology and innovation centres addressed in an online survey, and columns two and three list the indicators and how they were measured for the purpose of the questionnaire.

Table a)

Links to Product & Service Markets	KPIs	Measurement
MAJOR WORK FUNCTIONS: Which work functions does your Centre provide?	Focused research and development (R&D) Consultancy (applied) Testing, calibrating, implementation of certification (ISO)... Training Sales Other	Spread of turnover (%)
INNOVATION Your innovation activities focus on....	Technological breakthroughs Improvement of existing technologies and methods Application (of new or existing technologies) Certification, testing, calibrating Market analysis (needs of Users)	Focus level: Low or no, Medium, High

Table b)

Links to University and Knowledge Institutions	KPIs	Measurement
COLLABORATION Did you Centre collaborate with any of the following entities last year (funded and unfunded collaboration)?	Firms (manufacturing) Firms (service) Universities and research centres National government Science parks Sector institutes Regional growth centres or similar institutions Vocational training centres	Tick boxes as appropriate (if Yes)

KNOWLEDGE SHARING Which types of interactions did your Centre have with external partner last year, in which knowledge has been shared?	Informal knowledge sharing Participated in research project with external funding Arranged joint conference or workshops Shared publications Participate in higher education and training (PhD programme e.g.) Borrowing/ lending equipment, laboratories etc. from / to external organisation Placement of staff in or from an external organisation Business spin-offs/ Start ups? Shared patents, or other formal IP None of the above	Tick boxes as appropriate (if Yes)
INTELLECTUAL PROPERTY MANAGEMENT Does your Centre create or exchange...(please tick all relevant)	Patents? Design registrations? Copyrights? Trademarks or brands Open source solutions? Trade secrets? Confidentiality agreements? Other intellectual property? None of above	Tick boxes as appropriate (if Yes)
PUBLICATIONS Could you tell us for last year the number of...	Scientific publications? Scientific publication in peer-reviewed journals? Patent applications?	Numbers: Tick boxes (1-10; 10-50; More than 50)

Table c)

The Capital Dimension and Sources of Finance	KPIs	Measurement
TURNOVER Total turnover of your Centre last year was between	Size Micro Small Medium Large	Tick boxes: 0 and 2 million euros (micro) 2 and 10 million euros (small) 10 and 50 million euros (medium) Over 50 million euros (large)
SOURCES OF FUNDING What proportion (%) of your turnover comes from....	Public sector (national or international) funding? Commercial revenue? Intellectual property revenue? Other sources?	Tick boxes: Percentage share of total (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)

INTERNATIONALISATION What proportion of your turnover comes from other countries?	Public and commercial	Tick boxes: Percentage share of total (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)
PUBLIC FUNDING What proportion of your PUBLIC sector funding is...	UNCONDITIONAL BASIC funding (national or regional government)? PERFORMANCE-related BASIC funding (national or regional government)? COMPETITIVE funding (national or regional government)? Strategically targeted funding: ALLOCATED (national or regional government)? EU funding? Public funding from other countries?	Tick boxes: Percentage share of total (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)
COMMERCIAL REVENUE What proportion of your COMMERCIAL revenue comes from.....	Small businesses (up to 50 employees)? Medium-sized businesses (up to 250 employees)? Large businesses (over 250 employees)? Other organisations (e.g. business associations)?	Tick boxes: Percentage share of total (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)
BUSINESSES ENGAGEMENT Approximately how many businesses did you work with over the last year?	Small businesses (up to 50 employees) Medium-sized businesses (up to 250 employees) Large businesses (over 250 employees)	Tick boxes: Percentage share of total (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)

Table d)

People, Competencies and the Skills Dimension	KPIs	Measurement
SIZE How many employees work at your Centre?	Size Micro Small Medium Large	Tick boxes: 1 to 9 (Micro) 10 to 50 (small) 51 to 250 (medium) More than 250 (large)
RESEARCH CAPACITY What proportion of your staff are RESEARCH STAFF?	Research capacity	Tick boxes: Percentage share of total (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)

DOCTORATES Which proportion of your RESEARCH STAFF hold a PHD/Doctorate degree?	Doctorate	Tick boxes: Percentage share of researchers I (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)
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Table e)

Embedded into the Enterprising State	KPIs	Measurement
Does your institute contribute to the national innovation and research strategies?	Contributor	Tick boxes (Yes / No)
Are you, or have you, been involved in defining these strategies?	Impact	Tick boxes (Yes / No)

Annex 2. International conference on ‘What does success look like for innovation and technology centres?’

All day event on the 22 October 2012 at the Institution of Engineering and Technology Savoy Place, Embankment, London. An invited audience of 100 participants were involved in developing and using the new UK network of Catapult centres.

This event contributed to the work of establishing the UK Catapult centres, as well as provided an opportunity for an international exchange between technology and innovation centres on how they identify, measure and benchmark success and good performance.

Attendees included senior representatives and speakers (including centre Directors) from major European innovation and technology centres alongside UK participants working to establish the new Catapult network. The event focused on an interactive and enlightening discussion, with the selected audience including representation from business, policy makers, science and research base and innovation experts. The Rt Hon Dr Vince Cable MP, UK Secretary of State for Business Innovation and Skills provided the keynote address.

An invited audience of 100 participants were involved in developing and using the new UK network of Catapult Centres.

Case accounts from the speakers and the discussion from the audience form part of the evidence base in this report.

Organizers and sponsors

- The **Technology Strategy Board** (the UK’s National Innovation Agency responsible for the establishment of the new network of UK Catapult technology and innovation centres)
- The **Institution of Engineering and Technology** (IET – the UK’s largest professional organisation for engineers and technicians)
- The **Big Innovation Centre** (a business backed initiative from The Work Foundation and Lancaster University to make the UK a global open innovation hub, to build a world-class innovation ecosystem, and re-balance and grow the UK economy)
- The **Economic and Social Research Council** (the UK Government agency for funding research on economic and social issues)

Objective

To share experience on the role of the new Catapult network in the UK's innovation system and to learn about evidence from similar institutions in other countries on 'what does good performance look like and how should this be measured?'

Speakers

SESSION 1: Chair ANDY HOPPER	
	Introduction and welcome from the IET President Andy Hopper
	Keynote address from Vince Cable – Secretary of State for Business, Innovation and Skills Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15213&ptid=1068&t=0
SESSION 2: Chair WILL HUTTON	
	Introduction to Technology Strategy Board Catapult programme from Phil Smith – Chair of the Technology Strategy Board Catapult Centres Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15215&ptid=1068&t=0
	'The role of innovation and technology organisations in promoting high tech growth in the UK' Professor Birgitte Andersen – Big Innovation Centre Technology Innovation Centres serving sectors and nations: When they are ambitious, bold and enterprising Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15223&ptid=1068&t=0
SESSION 3: Chair MIKE SHORT	
	Learning about 'What does success look like and how should it be measured' – contributions from International innovation and technology organisations (Three 15 minute presentations from visiting Innovation Centres with Q&A panel discussion)

	<p>Jean Charles Guibert – Director of Technology Transfer, CEA</p> <p>MINATEC Innovation campus: Challenges and outcomes</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15225&ptid=1068&t=0</p>
	<p>Raoul Klingner – Director, International Business Development, Fraunhofer-Gesellschaft</p> <p>What does success look like and how should it be measured: Contributions from Fraunhofer</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15226&ptid=1068&t=0</p>
	<p>Anna Aspgrén – Consultant, Aspgrén Leadership Resources AB, Sweden</p> <p>What does success look like for innovation and technology centres?</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15227&ptid=1068&t=0</p>
<p>SESSION 4: Chair BOB GILBERT</p>	
<p>Learning about ‘What does success look like and how should it be measured’ – further contributions from International innovation and technology organisations</p> <p>(Three 15 minute presentations from visiting Innovation Centres with Q&A panel discussion)</p>	
	<p>Søren Stjernqvist – Director of Danish Technological Institute</p> <p>Danish Technological Institute</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15235&ptid=1068&t=0</p>
	<p>Egbert-Jan Sol – Director of Innovation High-Tech Systems & Materials, TNO Netherlands</p> <p>Industrial innovation</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15239&ptid=1068&t=0</p>

	<p>Tommy Jacobson – CEO, CLEEN Ltd.</p> <p>CLEEN: Cluster for Energy and Environment</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15241&ptid=1068&t=0</p>
<p>SESSION 5: Chair JEREMY WATSON</p>	
<p>The view from users 'What businesses want from the innovation and technology organisations?'</p> <p>(Three business speakers with experience of working with Innovation with Q&A panel discussion)</p>	
	<p>Steven Burgess – Rolls Royce</p> <p>Manufacturing research centres: What does industry want?</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15229&ptid=1068&t=0</p>
	<p>Professor William Webb – Neul</p> <p>What do SMEs want from the Innovation and Technology Centres?</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15230&ptid=1068&t=0</p>
	<p>Matt Perkins – CEO, SSTL</p> <p>Space and the need for a catapult</p> <p>Link to webcast: http://scpro.streamuk.com/uk/player/Default.aspx?wid=15232&ptid=1068&t=0</p>
<p>Andrew Churchill JJ Churchill Ltd (panellist)</p>	

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Contact details

Big Innovation Centre

The Work Foundation
21 Palmer Street
London SW1H 0AD

info@biginnovationcentre.com
www.biginnovationcentre.com
www.theworkfoundation.com

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