Knowledge Transfer into UK Industry: International Comparison and Options for the Future
Dr Christine H Adams 18/10/04

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Executive Summary

The UK government considers successful knowledge transfer as crucial for stimulating demand for private investment in research & development and enabling industry growth. Government can act to ensure that the basic building blocks necessary for an environment conducive to easier knowledge transfer are in place in the UK. This report sets out to identify the characteristics of successful national innovation systems that could be applied to UK government support for innovation and wealth creation.

In some sectors, technologies and regions, the UK has addressed knowledge transfer issues in successful ways. It is however evident that the mechanisms and initiatives for transferring knowledge in the UK are many and disparate. Failure to operate cohesively at a national level has the following consequences:-

- no meeting of problems and solutions across the boundary of region / sector / technology
- no single voice at operating level in Europe and worldwide
- insufficient sharing of best practice for knowledge transfer
- no single obvious national door for industry to approach for knowledge transfer
- no single national door for academics to approach for knowledge transfer
- no simple means of dialogue between government and knowledge transfer intermediaries
- complex knowledge transfer landscape deters companies from engaging without practical help through the entire process.

In this report, 5 countries were visited (Finland, Sweden, the Netherlands, Germany and Canada) and their knowledge transfer systems compared. Organisations were mapped to a system and benefits and challenges for the UK were analysed for each organisational model.

In broad terms, other countries marry solutions to the knowledge transfer issues as shown in this table.

Knowledge Transfer Issue	A Solution Adopted by Other Countries, not necessarily to be adopted by the UK
Engaged industrial customer	Cadre of Industrial Innovation Technology Advisers*
Access to new technologies	
Access to people with 'soft' knowledge transfer skills	
Access to finance	
	Technology Development Institutes**
Access to people with technical development skills	
Access to physical infrastructure	
Academic assistance with interaction with business	University Liaison Offices, including 'umbrella' organisations assisting several such offices
Academic incentives	Various solutions

*Advisers who go into businesses, diagnose issues, broker partnerships with solution providers, and administer grants locally

** Institutes, of similar size to universities, that carry out technical development from proof of concept to close to market.

Where the overseas knowledge transfer organisations visited are most successful, they have the following characteristics:

- an overarching national framework, with regional delivery
- a well-defined role within a knowledge transfer system, which leads to smooth, non-competitive interactions with other organisations
- input from industry, government and also knowledge holders (in the case of technical development, this means industrially-lead research with the inclusion of knowledge holders and a significant financial input from government (~35% is considered ideal to exert sufficient influence))
- industrially-credible people acting as champions at the top of the organisation.
- a long-term view and long-term funding
- evaluation of the effect on industry rather than numerical target-setting

Based on these observations, this report makes the following recommendations:

1 Create an appropriately skilled cadre of innovation advisers for business to provide combined hands-on advice for industry with Business Support programme delivery. This would be delivered regionally, under a national framework and branding. It would programme-manage existing Innovation Products. This would be sensitively integrated with existing Advisers, providing cohesion.

2 Address the lack of facilities for proof of concept and technology development through a broadening of current Innovation Products to include support through a mix of grant and capital loan similar to the phased capital loan and grant model used by Dutch TNO.

3 Consider other models described in this report such as Canadian Discovery Parks, Canadian Westlink, and in particular, Interact projects.

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Structure of this Report

Chapter 1 sets out the purpose, methodology and context of this work

Chapter 2 introduces the knowledge transfer problem, setting out the building blocks necessary for effective knowledge transfer,

Chapter 3 summarises common knowledge transfer systems in other countries, and highlights the organisations that are particularly valuable to these systems for each country visited.

Chapter 4 describes the recommendations for further consideration and describes the analysis behind these recommendations

The annexes are in three parts

Annex 1 cites the perceptions of some of the UK's Knowledge Transfer Practitioners on the knowledge transfer position in the UK. This Annex is structured using knowledge transfer building blocks outlined in chapter 2, highlighting UK weaknesses.

Annexes 2-8 consider particular organisations that aim to address each of the building blocks necessary for knowledge transfer, as described in chapter 2. It includes analysis of the benefits and challenges for the UK, highlighted by each model.

Annexes 9-13 give some background detail on the countries visited and further, more detailed information on the organisations cited in Annexes 1-8.

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Chapter 1 Purpose, Method and Context of this Work

1.1 Purpose of this report

The UK's economic success relies in part on becoming a key knowledge hub in the global economy and turning that knowledge into new and profitable products and services. The recent Innovation Report, Lambert Review and Science and Industry 10 Year Framework 2004-2014 have again highlighted the need for more effective knowledge transfer between academia and industry. Knowledge Transfer is a key area for government action in order to reduce the productivity gap between the UK and other developed economies.

The Office of Science and Technology (OST) has facilitated 'third stream' activities that seek to push new research know-how and technologies out from the Science and Engineering Base (SEB) through creating spin-off firms and other means. The Innovation Group in the DTI has a complementary objective, which is to encourage the uptake of new technology by UK industry, sometimes referred to as the 'pull'.

The focus of this work is to highlight options for national initiatives aimed at encouraging the adoption of new technology by industry. To be clear, this report does not try to identify a model to be copied. Rather, the intention is to identify characteristics of successful innovation systems by analysing models used in other countries.

1.2 Methodology

UK industry's perception of the barriers to adopting new technologies was discussed with a wide range of UK stakeholders, including intermediaries such as University Technology Transfer offices and Research and Technology Organisations.

I visited key players for knowledge transfer in countries regarded as particularly efficient in this area: the Netherlands, Germany, Sweden, Finland and Canada. All countries visited have government support initiatives akin to LINK or Collaborative R&D and Grant for R&D. This is not an exhaustive study, limited to the organisations that I was able to visit given a few days in each country. I have also discussed other models with UK knowledge transfer practitioners.

1.3 Context

This work has been carried out at a time when it is widely recognised that the UK has a productivity gap compared with other industrial countries. With a policy of increasing regionalisation, the response to this gap in the UK has been the creation of a large number of knowledge transfer products around the country to complement the national products. This presents what can be a confusing landscape to companies, making it difficult for them to engage with what can be valuable assistance. These products are also perceived as having a focus on technology push rather industrial pull. In contrast to this relatively confused picture in the UK, some other countries are practicing more effective knowledge transfer and thereby gaining ground in global markets. This report therefore seeks to learn from best practice in other countries and to point toward a model for effective knowledge transfer that aligns with existing products and infrastructure in the UK.

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Chapter 2 The Knowledge Transfer Problem

Chapter 2 introduces the knowledge transfer problem, setting out the building blocks necessary for effective knowledge transfer, and comments on the UK position with respect to these building blocks, highlighting UK weaknesses.

2.1 The issues that need to be addressed

Knowledge Transfer is not a linear process. It is a process which needs certain inputs at different times, and mostly more than once. Without these inputs, a potentially worthwhile techno-economic offering may never start to create wealth. In order to be effective, **all** inputs must be available. These are as follows:

Knowledge Base	Brokerage	"Engaged" Industrial Customer
• Assistance with making business deals • Academic incentives	• Access to new technologies • Access to correctly skilled personnel • Access to physical infrastructure • Translation of industrial requirement to technical solution • Access to Finance	• Industry needs to know where to go • Industry needs a long-term view / desire to innovate, skills for absorption • Industry needs champions to drive innovation and change

The Knowledge Base includes Higher Education Institutes (HEIs), Public Sector Research Establishments (PSREs), and companies. The knowledge holder must have an incentive to participate in knowledge transfer for it to be successful. Companies often source their knowledge from other companies and sometimes they source it from HEIs and PSREs. Academics and industry often need assistance with making business deals, such as appropriate valuation of the intellectual property (IP).

Without companies with the desire to innovate, the skills to absorb new ideas and the ability to change, knowledge transfer is highly inhibited. Companies with absorptive skills need to know where to go to access new technologies. In order to tailor the technical knowledge, and develop it to give a new or improved product or service, further technical development by skilled personnel is almost always needed. This needs finance, physical infrastructure and personnel with skills including technical development, IP know-how, and market research.

Government has a role to play in trying to create an environment conducive to knowledge transfer.The rest of this chapter will consider the UK in the context of these issues that need to be addressed in order to create such an environment.

Chapter 3 Comparisons of Knowledge Transfer Systems

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Chapter 3 summarises knowledge transfer systems commonly found in other countries, and highlights the organisations that are particularly valuable to these systems for each country visited.

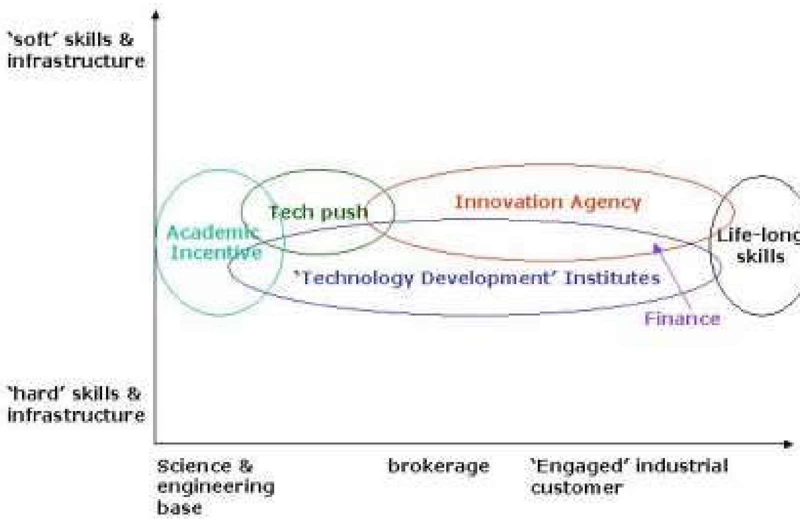
Any given model may work well, but it must be understood in context of a knowledge transfer system for a country. The UK has some of the elements to create an effective knowledge transfer system. The main issue is that these elements are not cohesive. This puts the UK at a disadvantage both internally, and also within the EU in which it does not have the national players to represent the UK. The systems of the other countries visited are examined in this chapter with reference to particular key initiatives.

3.1 Characteristics of an effective system

Other countries visited

- have a cohesive system (see below).
- have national organisations which act on a regional level, with regional support
- are committed to long-term public funding
- Use innovation agency and/ or 'technology development institute' to support R&D strategically.

Other countries tend towards the following system:



A system is particularly important because knowledge transfer is effective when the people involved are working to the same higher-level goal, understanding their organisation's unique primary role within the system. People and their aims, not technology, are the key to effective knowledge transfer. People's incentives are set through their own organisational structure and culture. The organisations' missions and processes must therefore be complementary and collectively address the market failures in the system or at least compensate one part for supporting another. A cohesive system leads to all parties understanding their own role, collective marketing, and easier collective strategy for the nation, as well as lack of duplication, easier networking as well as making forward planning more straight-forward and creating obvious doors for industry.

This system addresses the issues cited in the previous diagram, as follows:

Life-long learning addresses the needs for skills to innovate and absorb new ideas, and may assist with helping industrialists to know where to go for new technologies

Innovation Agencies fill the gap of the soft skills and infrastructure needed, providing access to new technologies, and provide some of the personnel skills.

Technology Development Institutes may play some of the role of the Innovation Agency, but specialise more in the physical infrastructure and 'harder', technology-oriented skills. It is both in Technology Development Institutes and Innovation Agencies that **public money** is often injected, though this is not the only place.

Assistance for academics to make business deals is carried out through individual university technology push offices of some sort in all countries visited, in common with the UK. Some regions abroad have organisations that act as an **umbrella organisation for the technology transfer offices** in the region, thereby also assisting industrialists in knowing where to go.

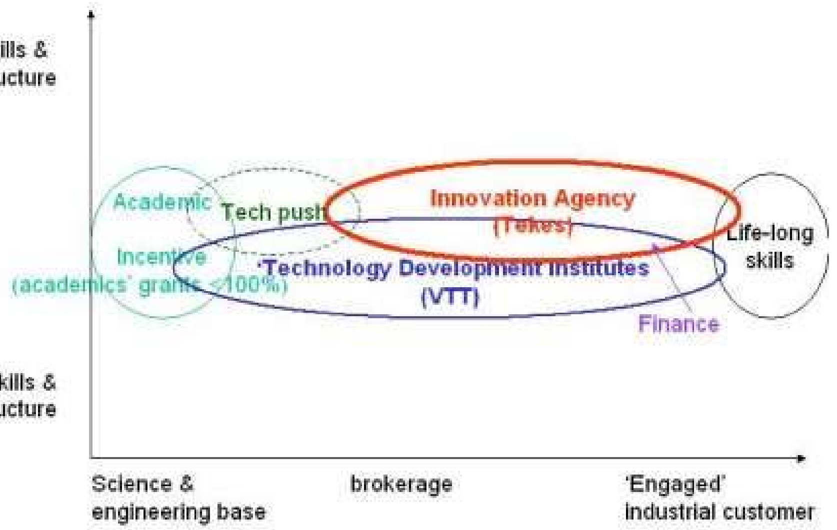
Academic incentives were not a focus of this study, but for knowledge transfer from the academic base, this is important.

3.2 The UK has a plethora of different initiatives

Different countries visited have different strengths and levels of cohesion in the public knowledge transfer system. All were more cohesive than the UK, which has a plethora of different knowledge transfer initiatives, some of which are excellent, but no clear overall system. It does have a relatively strong technology push through some university technology transfer offices and 'third stream' funding. Furthermore universities are becoming more incentivised to carry out knowledge transfer. As described in Chapter 4, a small part of the solution to this issue is the Technology Programme and rationalisation of DTI Products, however, the lack of alignment and cohesion in the UK system remains the paramount issue.

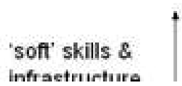
3.3 The Finnish system is highly cohesive

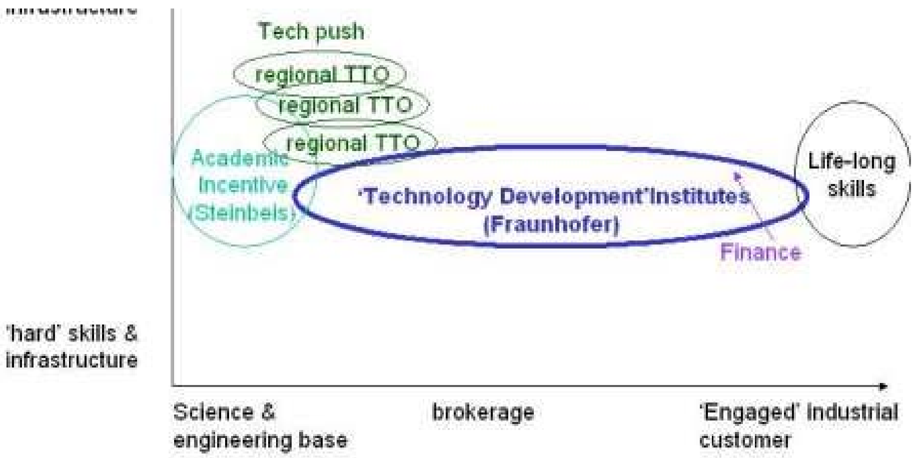
Based on my visit, the Finnish system is particularly cohesive, with the Innovation Agency, Tekes (Annexes 2.2,5.1, 10.1), as its cornerstone. It works closely with the Finnish Technology Development Organisation, VTT (Annexes 3.3, 4.1 and 10.2), and funding bodies Sita, Finpro, Finnvera (Annex 10), all of which are national institutes with a regional aspect to their delivery. Tekes delivers government innovation programmes through tailored 'honest' brokering and writing bids for grants on behalf of the companies that they personally visit. It is highly industry-led and involves people at its core. Tekes enjoys high credibility with Finnish industry. Tekes has a strong emphasis on evaluation of its work, as opposed to setting firm targets, which tend to skew behaviour towards the target rather than higher-level national innovation goals. This is one of Tekes' strengths. It may be argued that another contributory factor to its success is the relative ease of networking and finding the right person in a relatively small population (5 million). The Finnish Technology Development Organisation, VTT is similar to Fraunhofer Institutes described below, providing the facilities and expertise for industrially-relevant research. Tekes aligns its strategy with VTT and was formed in 1983 after an economic recession. The Finns do not support university research by 100%, forcing academics to seek funding from industry, which has the impact of universities being more industrially focussed, possibly to the detriment of more fundamental work.



3.4 The German system's strength is in its technology development institutes

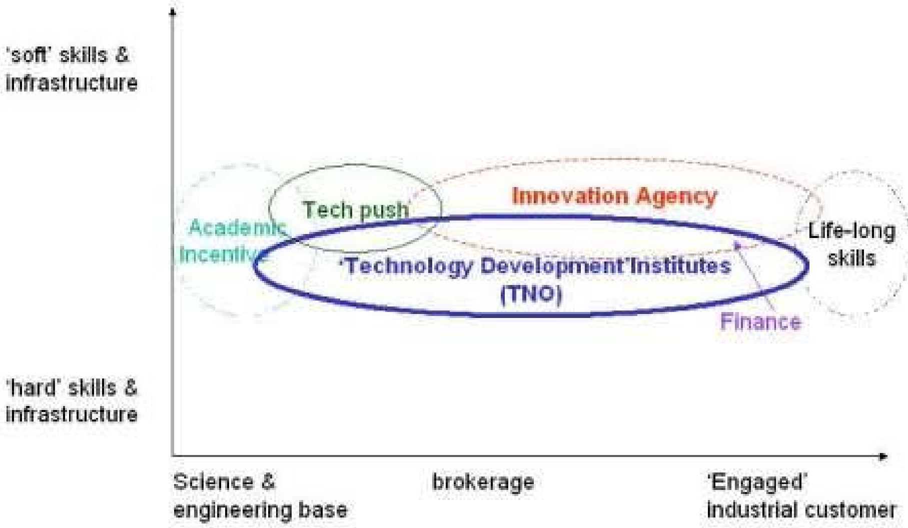
The strength of the German system is partly its strong, partially publicly funded Technology Development Organisations, the Fraunhofer Institutes(Annexes 3.3, 4.1, 11.1). This is another example of regional delivery of a nationally initiative. Regional and national government each fund 25-40% of the Institute. Fraunhofer Institutes carry out research which is applied, close to market and contract. This is a particularly important part of the system as it provides the common facilities and skilled personnel needed to carry out industrially-relevant research.
Germany has much weaker, disparate organisations which take the role of the Innovation Agency. Fraunhofer Institutes therefore take on parts of the roles of an Innovation Agency, namely they are the best-known entry point for industry and they carry out some of the brokering to more suitable scientists if the company enters the system at an 'inappropriate' place (such as to the Optics Fraunhofer with a materials issue). It must be noted, however, that Fraunhofer Institutes regard each other as main competitors so the level of 'honest' brokering may differ from the Finnish model. Also, such technology institutes do not lend themselves well to agile change due to changing industry or research development.





3.5 The Dutch system has more initiatives

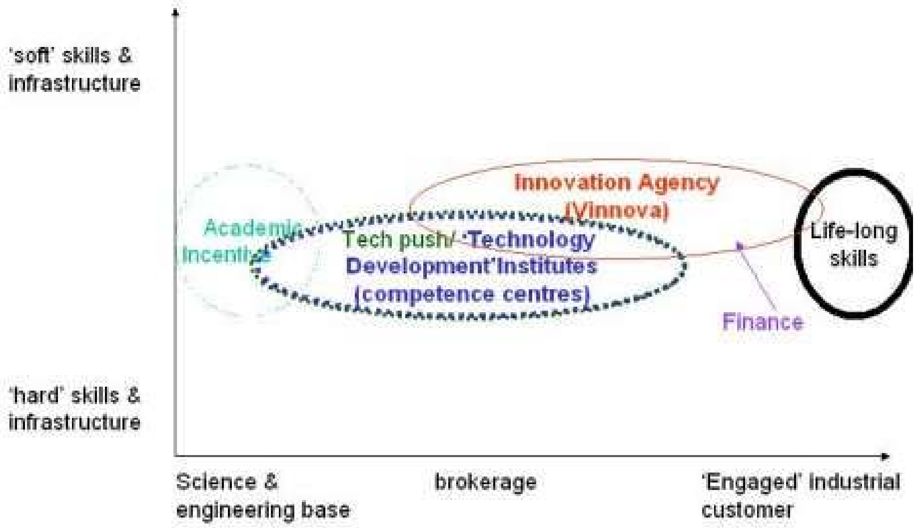
The Dutch system is close to the German system, with TNO (Annexes 3.3, 4.1,4.6, 12.1) as the publicly-funded Technology Development Organisation, delivered regionally. The TNO visited (TPD) had impressive equipment on a par with the Fraunhofer visited (IPA). However they also have tried various other knowledge transfer schemes, particularly aimed towards small and medium sized enterprises (SMEs). The Dutch government has carried out extensive technology road-mapping to determine its overall technology strategy.



3.6 The Swedish system

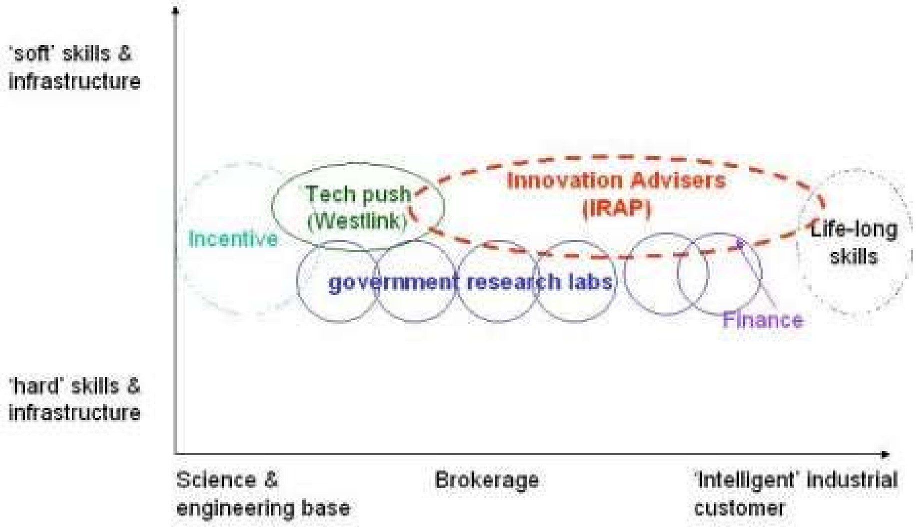
The Swedish system does not have Technology Development Organisations. It has the much weaker 'Competence Centres'(Annexes 4.10, 5.3,13.1), of limited duration, and with an academic bias. It does have an Innovation Agency, Vinnova (Annexes 2.3,13.2), which has aspirations for a cohesive system of knowledge transfer in Sweden. However, Vinnova is more like a government department than Tekes, because Tekes staff spend much of their time visiting companies and brokering, whereas the Finnish Vinnova staff are forming policy. Vinnova was created 5 years ago out of parts of three different government departments, and only 18 months ago agreed that their single aim should be one of increasing economic prosperity for Sweden. Until that point, the other contenders had been regarding life-long learning, and promoting well-being. Sweden's success in terms of R&D spend must stem from the large, previously Swedish, companies, now sold to foreign players.

Government in Sweden occurs from grass-roots upwards, through open discussion and debate. The same administration (or coalition with it) has been in power since 1932. Open debate ensures the continuation of democracy and also gives the public a strong sense of collective responsibility. This positively affects the careful use of public finance by Swedish business, and the culture of collective responsibility & collaboration. Such culture positively affects KT.



3.7 The Canadian system is similar to the UK

The Canadian picture is quite different, and much more similar to the UK one. It has a plethora of different Knowledge Transfer programmes, many of which are more academically-driven than in the UK. It does not have public Technology Development Organisations as such, but does have government laboratories, which suffer from low credibility in industry in comparison with Fraunhofer Institutes, TNO or VTT. Canada also lacks any Innovation Agency. The cornerstone of Canada's support to business is the 60-year-old Industrial Research Assistance Program (IRAP) (Annexes 2.1, 9.1) which consists of 270 industrially-credible technology advisors for business who work on a regional basis, but within a national team framework. IRAP and Tekes advisers both have access to programme spend, which they have some personal accountability for leading to negotiation on behalf of the public purse, which leads to greater efficiencies. It is interesting to note that Tekes and IRAP each independently reported that a public contribution to a project of 35-40% is ideal for many projects (though it does depend on how close to market the project is). A higher contribution may not be necessary for the project to go ahead, and if the public contribution is any lower, government has too small a stake and influence (the project would have gone ahead without any intervention). In terms of technology push, the technology transfer offices in the west of Canada are assisted by Westlink (Annexes 8.2, 9.3) which helps to spread best practice.



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Chapter 4 Conclusions and recommendations for further consideration & analysis

It is clear from my visits and subsequent discussions with British knowledge transfer practitioners, that there are steps that could be taken to improve the effectiveness of knowledge transfer in the UK. The most successful models have greater national coordination of knowledge transfer activities, while still championing local delivery to foster improved industrial engagement. Overseas models also recognise the importance of people who can engage with companies, understand their needs, recommend commercially attractive solutions and guide the companies through all the actions they need to take to reach the solutions and realise their benefits.

4.1 Characteristics of successful organisations overseas

Where the overseas knowledge transfer organisations visited are most successful, they have the following characteristics;

- an overarching national framework, with regional delivery
- a well-defined role within a knowledge transfer system, which leads to smooth, non-competitive interactions with other organisations
- are based on industrially-credible people.
- have input from industry, government and also knowledge holders (in the case of technical development, this means industrially-lead research with the inclusion of knowledge holders and a significant financial input from government (~35% is considered ideal to exert sufficient influence))
- industrially-credible people acting as champions at the top of the organisation.
- a long-term view and long-term funding
- evaluation of the effect on industry rather than numerical target-setting

4.2 Recommendation One Innovation Advisers

Create an appropriately skilled cadre of innovation advisers for business to provide combined hands-on advice for industry with Business Support programme delivery. This would be delivered regionally, under a national framework and branding. It would programme-manage existing Innovation Products. This would be sensitively integrated with existing Advisers, providing cohesion.

Innovation Advisers who assist businesses increase their value-add through innovation, exist in the UK; however there are gaps in provision and no cohesion between the current innovation adviser.

In the UK, the DTI provides assistance to large and small businesses to share best practice irrespective of how long the businesses have been established. This enables many less innovative businesses to be more efficient and competitive. For businesses which regard themselves as part of the manufacturing sectors, the DTI provides tailored advice through the Manufacturing Advisory Service (MAS), which is a national organisation with regional delivery and enjoys a good reputation. It focuses mainly on lean manufacture. MAS and best practice schemes form an important part of DTI's pre-innovation offering and are shown at the base of the diagram below.

The DTI support to business for further innovation, as shown below, are mainly in the form of grants, They support businesses improving products and services, creating step changes in products and services and, having achieved this, scouting for technologies and knowledge that might lead to the next new product or service.

At the top of the diagram above, the Collaborative R&D Grant and Knowledge Transfer Networks are Products designed to assist UK business to be the most advanced globally in strategic technology areas. These Products are designed for the businesses that are working in the areas of new, emerging technologies and so will be those businesses making step changes and scouting for new technologies to provide the basis for the next new step change in their products or services. The DTI Technology Programme provides support for emerging technologies of strategic importance to the UK. It is intended to be clear to business and to give guidance to other government departments, research councils and regional development agencies.

Some grants, such as Grant for R&D, and many regional schemes are designed to be 'demand led', assisting business to become more innovative, supporting all technology areas as the businesses need it. These assist the businesses who are currently mainly focussed simply on efficiency as well as those businesses improving their product or service and those making step changes. However, there is a plethora of such 'demand led' grants. Despite a rationalisation of DTI schemes to 9 Products, the landscape including regional, other government department and European grants is still sufficiently confusing as to alienate many UK businesses.

'Innovation Advisers' can assist businesses in finding innovation support that is most appropriate for their needs. They do this through assessment and diagnosis of the business' innovation issues, through finding and writing the right grant, and through partnering the business with the relevant knowledge provider including academia. They do more than just support the actions that businesses already want to make. They stimulate and facilitate innovation by helping SMEs identify the need to make a step change in the value added of the products/services they offer and then help them devise the new products and product features that will make a difference in their markets. Only then, do they go on to identify the technology needs created by those product ideas, and here these programmes can in some cases overlap or interlink with the knowledge transfer programmes in that country

or region.
Innovation Advisers of some kinds are not a new solution for the UK. Various different public initiatives have led to 'Innovation Advisers' of different titles. However, current UK Innovation Advisers give advice to businesses only in certain sectors / regions/ technology areas and restrict their brokerage to knowledge providers within certain areas of technology, organisation or region. In addition, different advisers assist businesses in different places along the value-add curve above, and in different ways (for example some help write bids, whereas others do not) so businesses do not know what they are getting. In the UK there is a lack of cohesion and connectivity in its Innovation Advisers, resulting in poor coordination of resources, missed business opportunities and low credibility of the national support offer.

For example, a handful of Business Links have retained specialist Innovation Technology Councillors who help businesses towards the lower end of the value-added curve in the diagram above if the solution to the business issue can be found locally. Some Regional Development Agencies (RDAs) and Devolved Administrations (DAs) have Innovation Promoters who help businesses to write bids and may broker to universities and PSREs, but only when the regional university or PSRE can help. Knowledge Transfer Partnership (KTP) consultants not only write bids but also administer them across the country, but only if what the business needs is a KTP. HEIF has provided for many advisers who assist businesses towards the upper end of the value-added curve only if the solution to the business technology issue can be found in the particular university to which the adviser is associated. Technology Translators working for RTOs in Faraday Partnerships act in a similarly restricted manner.

Despite the examples, there are gaps in provision of Innovation Advice for businesses. It is vitally important that business needs are matched with the most appropriate solution whichever sector, technology area, or geographic region the business or solution lie in, and wherever the business lies on the value-added journey. It is therefore recommended to create an appropriately skilled cadre of innovation advisers for business to provide combined hands-on advice for industry with Business Support programme delivery. This would be delivered regionally, under a national framework and branding. It would programme-manage existing Innovation Products. This would be sensitively integrated with existing Advisers, providing cohesion.
It would programme-manage existing Innovation Products because we know from the Finnish Tekes and Canadian IRAP models that the draw for business of a possible grant is necessary for the system to work. This needs to be sensitively integrated with existing advisers such that all 'Innovation Advisers', whatever their title, were part of the same national network. Such a network would give extra benefits as it would facilitate the effective work of the knowledge transfer to and from overseas.

4.3 Recommendation Two. Technology Facilities

2 Address the lack of facilities for proof of concept and technology development through a broadening of current Innovation Products to include support through a mix of grant and capital loan similar to the phased capital loan and grant model used by Dutch TNO.

There is a gap in the UK provision for facilities and appropriate skills for technology development from proof of concept through to a product or service. At present, technology facilities and associated skills are found predominantly in universities, which are mainly involved in fundamental research. This is academically-led and business only have an indirect influence on their nature. Technology Development Institutes found in other comparable countries are expensive and slow to respond to the fast-moving pace of technology. The UK's RTOs have been privatised and many are still concerned with older technologies so not all sectors are covered adequately.

For those businesses that can demonstrate the capacity to deliver the product to market, a further DTI Product to include support through a mix of grant and capital loan similar to the phased capital loan and grant model used by Dutch TNO would help to bridge this gap. Such a Product should be both demand-led, similar to Grant for R&D, and also become part of the Technology Programme such that it is used to fill any gaps in facilities needed for the UK to become a global leader in the emerging technologies specified through the Technology Strategy.

4.4 Recommendation Three. Other models used to change DTI Products

3 Consider other models described in this report such as Canadian Discovery Parks, Canadian Westlink, Interact projects.

Current DTI Products should be analysed to establish whether they are the most suitable Products to assist UK business to climb the value-added chain. Other models in this report such as Canadian Discovery Parks, Canadian Westlink, and especially Interact projects should be considered.

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Annexes

The Annexes are in three parts.

Annex 1 cites the perceptions of some of the UK's Knowledge Transfer Practitioners on the knowledge transfer position in the UK. This Annex is structured using knowledge transfer building blocks outlined in chapter 2, highlighting UK weaknesses.

Annexes 2-8 consider particular organisations that aim to address each of the building blocks necessary for knowledge transfer, as described in chapter 2. It includes analysis of the benefits and challenges for the UK highlighted by each model.

Annexes 9-13 give some background detail on the countries visited and further, more detailed information on the organisations cited in Annexes 2-8.

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Annex 1 Observations by UK Knowledge Transfer practitioners on the UK knowledge transfer environment

In comparison with other countries, the following observations were made, based on perceptions in the UK:-

1.1 UK's 'engaged' industrial customer

Without companies with the desire to innovate, the skills to absorb new ideas and the ability to change, knowledge transfer is highly inhibited. **Perceptions of the UK by some UK intermediaries are as follows**:

- In the UK, business decision-makers are less likely to have technology backgrounds, partly because the career structures do not favour technical managers at the top of the business.
- The efficiency drives (driven by perception of shareholder values) of industry means that long-term consideration is rarer
- The UK has a diminishing number of corporate labs as these have moved overseas.
- The UK has some strong inter-company supply chains, but these are patchy and not generally part of continental European manufacturing supply chains.

- Knowledge Transfer is not only about spinning out new companies. Existing companies with an established record in successfully exploiting technology and a sound financial footing will often be perceived as having a greater chance of further success by finance providers.

1.2 UK's access to correctly skilled human resources

In order to tailor the technical knowledge, and develop it to give a new or improved product or service, further technical development by skilled personnel is almost always needed. Personnel with 'softer' skills including market research, IP, and the ability to ascertain market value of technologies are also needed. These people may be in industry, an intermediary, consultant, or academia. **Perceptions of the UK by some UK intermediaries are as follows:**

- The low numbers of apprenticeships in the UK makes a marked difference
- Industry could be better at carrying out some of the technology advancement from idea to production, due partly to closure of corporate labs which means that lots of good R&D staff are now in SMEs & only of value to a smaller set of people
- Softer skills in the UK are patchy across the nation, for example university technology transfer offices are patchy, there is no simple means of access to either universities or other development capacity.

1.3 UK access to physical infrastructure

In order to commercially exploit technical know-how, further technical development is required. This usually requires specialised physical infrastructure. **Perceptions of the UK by some UK intermediaries are as follows:**

- Price and time-scales for industry and academia are different. Physical infrastructure is needed to bridge that in many cases.
- The UK's public investment does not support technology development which is quite close to market, whereas other countries do. Other EU countries interpret state aid rules more liberally than the UK does.
- UK does have Research and Technology Organisations, knowledge transfer in the private sector, science parks, business incubators, some corporate labs, some particularly applied University Departments (the best for business are not necessarily those rated 5* by the current RAE), private technology development institutes, but no connected structure or clear signposting.

1.4 UK access to new technologies

In order to tailor the technical knowledge, and develop it to give a new or improved product or service, further technical development by skilled personnel is almost always needed. This needs finance, physical infrastructure and personnel with skills including technical development, market research, and intellectual property know-how and deal shaping. **Perceptions of the UK by some UK intermediaries are as follows:**

- Access to new technologies is unnecessarily complex in the UK, but some have expectations that this is an easy issue to solve with a database, or similar solution.
- UK has no National Knowledge management systems, nor is it perceived by knowledge transfer professionals that a one-stop-shop or regional institute exists.
- Some UK Regions have established Science Industry Councils, which are strategic in nature as opposed to operational, whereas the issues lie in the operational side.
- UK knowledge transfer brokerage (S&T attaches, UK Trade & Investment, Global Watch Service including missions, secondments and International Technology Promoters) to and from overseas is excellent, but not mirrored in knowledge transfer brokerage within the UK

- UK Technology Transfer Offices work on behalf of academia (and at the expense of business).

1.5 UK access to financial assistance for business

The picture in the UK is confused, but there are some possibilities:

- UK has a perceived finance gap between HEIF 2 University Challenge financing (which is only open to academics of certain universities) and Venture Capital funding ie £250k to~ £2 bn
- RDAs (with cash, no national strategy, often competing with each other, Science /Industry councils), and a lack of in-house expertise in such a complex subject as knowledge transfer.
- R&D tax credits are designed to encourage firms to spend more on R&D.
- Current DTI support (Grant for R&D, Grant for Investigating an innovative idea, Collaborative R&D, Knowledge Transfer networks and Knowledge Transfer partnerships).
- UK firms see public money differently from foreign counterparts (Some UK businesses feel they have a right to public money, as opposed to other's views of cherished, neighbour's money)
- Smaller UK companies find the procedures for obtaining financial assistance too time consuming to be of real value and need assistance in preparing cases for funding

1.6 UK academic incentive

Academia (HEIs and PSREs) are not always the first or most appropriate source of new technologies from the point of business. However because government has such a strong role in funding academisc, academic incentives are considered in this work. UK Academic Research is comparatively well financed, often without the need to find industrial co-financing. In Finland, by comparison, academics more rarely get 100% of the project costs from a public grant. **Perceptions of the UK by some UK intermediaries are as follows:**

- UK academic staff are considered to be held in lower regard than European counterparts by the population at large and by some industrialists.. It is felt that on the continent, they are comparatively highly regarded, often highly influential figures in the community and more respected in industry than their British counterparts.
- Some UK academics work well with industry, but in some cases this is despite their academic establishments. The perceived situation is improving.
- Lack of incentives has led to failure to prioritise tech transfer leaving it as an activity in which insufficient time is spent
- In order to recognise the achievements of the academics who wish to exploit their work, academic incentives could be changed, changing the academic culture.
- Work-loading and full timetabling of teaching and research leaves little flexibility for business interactions. Capacity for knowledge transfer is therefore small.

1.7 UK academic assistance with making business deals

Businesses and academics often need assistance with making business deals, such as appropriate valuation of their IP. In the UK, Technology push is well funded in comparison with other countries. **Perceptions of the UK by some UK intermediaries are as follows:**

- Technology Transfer offices are patchy in the UK, as in other countries. Academics often do not have the market knowledge nor the business awareness to make fair deals with industry
- Universities as a development partner needs to be distinguished from when it is providing advice on a commercial basis

- The dichotomy between universities as part of public infrastructure and universities as autonomous organisations being pushed towards self-sustainability is not well-understood by industry, nor for that matter, many academics.
- The UK does not have a single clear IP policy for academia, but is pretty consistent
- Academics often overvalue or undervalue IP, as is common in other countries.

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Annex 2 Overseas Models for encouraging 'engaged' industrial customers

Annex 2.1 Canadian Industrial Research Assistance Program (IRAP)

(Annex 9.1 for more detail)

IRAP is a cadre of technology advisors who work on a regional basis, but within a national team framework. They are seen by business as an access to finance as they have responsibility to incur public expenditure. It is considered the cornerstone of Canadian innovation support for small businesses and has been running in Canada for 60 years through the Canadian group of technology development institutes, National Research Council (NRC). With 270 advisers in a country with half the population of the UK, it is the only organisation in the country that provides such support.

Though the UK does not have a single organisation that carries out this role, it has many individual advisory services including those that concentrate on only certain RTOs as the providers of solutions (Defence Diversification Agency, certain Faraday Partnerships) and those that concentrate on solutions found within their geographic region (some regional initiatives).

Benefits of the IRAP model for UK	Challenges of the IRAP model for UK
· The best way to engage industry is to have someone speak to them. This model ensures that a high number of companies are visited by an industrially-credible expert who has a national network through colleagues and the 'carrot' of programme spend. · A single advisory service in the country eliminates any competition between different organisations · Other Government Departments deliver some of their technology programmes through IRAP · A single advisory service can work as a team · Cradle to grave approach · Professional, accredited personnel · Works well in a very similar institutional and cultural framework to the UK. Even the plethora of different public initiatives to business is similar in Canada. · The organisation is a single point of contact for industry	· It is only as good as the people involved therefore funding must be adequate to recruit the right people. · Hard targets for soft skills such as knowledge transfer have proved to be imperfect. As the UK's Treasury is moving towards harder targets, this could be a generic issue for KT initiatives. An indication can be found through evaluation of impact to business (carried out at present in the UK with KTP Product and ITPs) · DDA, Faraday organisations and similar could be subsumed (~100 people) · The interests of the organisation must be aligned with that of the UK economy

· Considerable contact at the early stages of the proposal · Expert advice on nature of industrial problem · Company has a personal contact throughout the entire exploitation process. Continuity of support and mutual trust built. · Able to direct industry to best contact (industrial collaborators / academics). It is important to have same organisation for large enterprises and SMEs as they need each other. · Quick turn-around for bids through advisers being empowered to take funding decisions, achieved through monitoring and assessing advisers based on the impact on business per public £ spent (parallels to Venture capitalists) · Has overall view of markets – helpful to business and government (technology strategy) · Single organisation to share KT best practice and exchange information · Industry benefits from expertise even if grant is not made	

Annex 2.2 Finnish Innovation Agency, Tekes

(Annex 10.1 for more detail)

Tekes is widely regarded as the reason for the recent success of Finnish Innovation. It is an agency which delivers almost all of the Ministry of Trade and Industry's programmes through a cadre of industrially-credible, technically trained staff who go into high or medium tech companies in their region to help to increase their productivity through innovation. They are part of a national team of 150 in a country with a population of ~5M. Business is keen to interact with Tekes as it is the source of funding.

After assessing and correctly identifying the company's technology issue, the Tekes agent will find the right academic / industrial collaborators for the project and build up a case for collaborative funding, where necessary. Any project must have knowledge transfer into industry as its aim and fit at least 2 of the following criteria (preferably 3)

- The project belongs to the Tekes technology strategy (R&D programme)
- the results will be made public
- there is a significant international dimension to the project
- a university is a subcontractor
- an SME is involved

The project is funded through a mixture of grant, industrial loan (an asset rather than liability) and capital loan.

Every Thursday, in Helsinki, the Tekes representatives put any cases for funding to the Tekes committee and can inform the company of the outcome on the following Monday.

Benefits of Tekes model for UK	**Issues regarding implementation of Tekes model for UK**
· Single advisory service in the country eliminates any competition between different organisations · The best way to engage industry is to have someone speak to them. This model ensures that a high number of companies are visited by an industrially-credible expert who has a national network through colleagues and the 'carrot' of programme spend. · Agency is a single point of contact for industry · Delivers government policy. Through feedback, they input to policy development. · Agency is at arms length from government & therefore not subject to strong lobbying, potentially trusted by industry and not subject to the government accounting rules. · It is the Finnish voice for knowledge transfer practitioners in Europe. · Shares best practice with other European knowledge transfer practitioners in TAFTIE. · Considerable contact at the early stages of the proposal · Expert advice on nature of industrial problem (eg. its not a process problem, its measurement – let me introduce you to Prof x at Institute Y) · Company has a personal contact throughout the entire exploitation process. Continuity of support and mutual trust built. · Able to direct industry to best contact (collaborators / academic). It is important to have same Agency for large enterprises and SMEs as they need each other. · Quick turn-around for bids · Tekes has an overall view of markets – helpful to business and government (technology strategy) · Single organisation to share KT best practice and exchange information · Industry benefits from expertise even if grant is not made	· Recruiting the high-calibre, industrially credible staff is essential · Defence Diversity Agency (DDA), Faraday organisations and similar could be subsumed (~100 people) · the interests of the Agency must be aligned with that of the UK economy · Hard targets for soft skills such as knowledge transfer have proved to be imperfect. As the UK's Treasury is moving towards harder targets, this could be a generic issue for KT initiatives.

Annex 2.3 Swedish Vinnova

(Annex 13.2 for more detail)

Vinnova has similarities to Tekes, but with a much stronger emphasis on policy and much less on direct advice to business.

Benefits of Vinnova model for UK in comparison to Tekes	**Challenges of Vinnova model for UK in comparison to Tekes**
· the 'triple helix' model of government, industry and academia working together is a strong theme running through Swedish Innovation policy. It works particularly	· A major weakness in the UK highlighted by both the Innovation Report and the Lambert Review is on the 'demand' side. The Tekes model focuses on businesses

well in Sweden, where government has a very strong 'bottom-up' approach of consensus from grass-roots upwards.	so would therefore be more applicable for the UK.

Annex 2.4 Swedish TUFF model

(Annex 13.3 for more detail)
TUFF involves a network of certified technology brokers stimulating demand for R&D through visiting companies, with the right to incur public spending. This is a Swedish programme based on the Canadian IRAP model. The strengths and weaknesses for the UK are therefore similar to those for IRAP.

Annex 2.5 Life-long learning programmes,

This is a particularly strong philosophy in Sweden, partly due to the history of the Swedish Innovation Agency, Vinnova (Annexes 2.3,13.2). Germany has had strong vocational training as part of their education system. Adult education has also recently become more important in Finish educational policy, with the introduction in 2003 of the Ministry of Education & Ministry of Labour's joint 'NOSTE' programme which aims to improve the vocational skills of Finns lacking vocational training.

In the UK, life-long learning is carried out in the Department for Education and Skills and it is not covered in this work.

Annex 2.6 Movement of personnel between industry and academia.

This occurs much more readily in the continental European countries visited, and, importantly, it occurs at all levels in organisations, including the top.

In particular, in Germany, the Fraunhofer organisations often have three, rotating CEOs. At any given time, each CEO may be working as an academic Professor, an industrial Technical Director or head of the Fraunhofer (Annex 11.1).

Movement of personnel occurs in the UK through the Knowledge Transfer Partnerships initiative (formally TCS) mainly around the level of a junior graduate and have a more operational role than some of the foreign models which have both strategic and operational level exchanges. In the UK, Warwick Manufacturing Group is headed by people with differing backgrounds.

Benefits of Fraunhofer-type movement of personnel model for UK	Challenges of Fraunhofer-type movement of personnel model for UK
· It has been shown to be a powerful means of transferring ideas and know-how and also a powerful means of beginning to mutual understanding of the different cultures in academia and business	· More difficult in the UK due to weaker links and differing career structures, particularly the strong need to publish academic papers for the UK Research Assessment Exercise. · The UK does not have any public technology development organisations akin to Fraunhofer Institutes. This would be more difficult to administer in private UK RTOs.

Annex 2.7 Tax incentives.

(Annex 9.10 for more detail)
Decreases in tax burdens through R&D tax credit incentives are the most generous in the world in Canada, according to OECD. However, Canadian

officials are not convinced that this is good value for money in terms of increasing business R&D spend. The UK currently provides R&D tax credits, in common with many other comparable countries, many of which have higher corporate tax.

Benefits of tax incentive model for UK	**Challenges of tax incentive model for UK**
· A direct incentive to increase business spend on R&D through a very direct lever! · It may encourage companies to have a longer-term outlook	· It is retrospective · The money comes back into the company, but not necessarily to the R&D division · Through increased industry spend on R&D, it is intended that demand for collaboration with the SEB is also increased. This is not necessarily the case. Business may increase R&D spend without interaction with the SEB, business may simply start putting their Design Department under R&D for accounting purposes.

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Annex 3 Overseas Models for Access to Correctly Skilled Personnel

Annex 3.1 Life-long learning programmes

Annex 2.5 describes the role of life-long learning programmes to encourage industry to be more long term in their thinking. Life-long learning can obviously address skill shortages such as those regarding the softer parts of knowledge transfer (assessing techno-economic options, market research, connecting people etc) and also the 'harder' skills such as technical abilities to develop a concept to production.

Annex 3.2 Innovation Agency

An Innovation Agency such as Tekes (Annexes 2.2,5.1, 10.1), or even a programme such as IRAP (Annexes 2.2, 9.1) provides technical advice and also brokerage to business, thereby filling part of the skills gap for knowledge transfer.

Benefits of an innovation agency model for UK	**Challenges of an innovation agency model for UK**
· Knowledge Transfer is starting to be recognised as a profession in the UK, with discussion of accreditation. This may provide some of the ground-work. · It brokers exceptionally well to experts that may be able to help.	· This only addresses some of the skills-shortfall for a knowledge transfer system. Technical skills are not directly addressed through this organisation as this is part of the role of VTT, the technology development organisation. (Annex 3.3).

Annex 3.3 Public Technology Development Institutes train people

As employers, the Technology Development Institutes such as Fraunhofer (Annex11.1), TNO (Annex 12.1) and VTT (Annex 10.2) offer a platform that enables their staff to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, in other scientific domains, in industry and in society.

Benefits of a technology	**Challenges of a technology**

development institute model for UK	development institute model for UK
· PA Technology, TTP, Scientific Generics, RTOs are examples of private UK Technology Development Institutes who already train their staff to a certain level.	· The UK does not have *public* Technology Development Organisations. · This could be expensive to the public purse

Annex 3.4 Movement of personnel between industry and academia.

Exchange in personnel between Fraunhofer Institutes, academia and industry happens throughout the organisation, including the top (Annex11.1).

Benefits of movement of personnel model for UK	Challenges of movement of personnel model for UK
· It has been shown to be a powerful means of transferring ideas and know-how and skills · A powerful means of beginning to mutual understanding of the different cultures in academia and business	· More difficult in the UK due to weaker links and differing career structures, particularly the strong need to publish academic papers for the UK Research Assessment Exercise. · The UK does not have any public technology development organisations akin to Fraunhofer Institutes. This would be more difficult to carry out in private RTOs.

Annex 3.5 Knowledge management Systems (Siemens)

Getting know-how where it is needed is an issue faced by large multinational companies. Siemens have developed a system by which project management skills pooling and know-how co-ordinating come together to ensure that the right people come together for any given project. Very careful consideration is given to which people are needed for any given project.

The starting point for any given project is asking what know-how is needed. Examining the present position, stake-holders and aims in a workshop with the right people gives the roadmap plan of project and leads to milestones and indications of success.

Siemens' knowledge management staff suggest that such a system could work for a nation if it can work for a company.

Benefits of a knowledge management system for UK	Challenges of a knowledge management system for UK
· It is undoubtedly the case that much resource is being spent in recreating know-how that already exists · Parts of the model, which include understanding and carefully updating the skills of staff in the public sector could help putting together the right team for knowledge transfer	· A company has a single, profit-driven mission and can deploy its staff in different projects at different times. A country is quite different. · It is difficult to envisage this model working in an environment in which some of the key players are from different private firms, some from different public sector bodies, and when the output of any given knowledge transfer project cannot be well-defined from the beginning.

Annex 4 Overseas Models for Access to Physical Infrastructure

Annex 4.1 Public Technology Development Institutes

Public Technology Development Institutes such as German Fraunhofer Institutes (Annex11.1), or Finnish VTT (Annex 10.2), have some similarities to universities, but the type of research they undertake is applied and very close to market as well as some basic research. They are partially publicly and partly privately financed. In the countries that fund these, many of such institutes exist, each specialising in a different technology, providing access to industrially-relevant facilities and trained staff.

Benefits of public technology development institute model for UK	Challenges of public technology development institute model for UK
· Provides the applied and close-to-market facilities needed in the UK, including those areas in which the private sector is not willing to take the risks. · Provides a cultural half-way-house between academia and industry which can better serve the needs of industry through more immediate, shorter-term, industrially focussed work. · Provides an integrated technical interface between industry and academia · Can lead business on the path from lean manufacture, new product development, step-change innovation, brokerage with the science and engineering base as they require, whether this is commercially-competitive or not.	· Expensive on the public purse · They do not lend themselves well to agile change due to changing industry or research development · May be politically difficult in the UK due to the change from polytechnics, which had an applied research emphasis, to universities · PA Technology, TTP, Scientific Generics, RTOs are examples of private UK Technology Development Institutes who would potentially be undercut by a subsidised alternative.

Annex 4.2 Canadian NRC's Cluster Building

(Annex 9.4 for further details)

Based on fora and workshops with communities of academics and industrialists, Canada is seeking to set up clusters through providing the infrastructure that these communities collectively require. Already the NRC's Biotechnology Research Institute in Montreal and its Plant Biotechnology Institute in Saskatoon are at the centre of related industries, surrounded by spin offs and related service companies. The NRC is now seeking to establish other such clusters of industry around new research facilities.

Benefits of NRC Cluster-building model for UK	Challenges of NRC Cluster-building model for UK
· It is the communities of experts who know what is needed to take the next steps up in developing their area. They inform government.	· Can be expensive. · Self-selection of the 'community' may exclude involvement of experts from more than one or two relevant disciplines or sectors from being included.

Annex 4.3 German Steinbeis accreditation Model.

(Annex 11.2 for further details)

Initially, an academic who applied to become a 'Steinbeis' academic, would receive accreditation (removed if industry made a series of complaints) and a large lump sum of ~100k Euro to buy any special equipment needed to work with industry. In return, the academic would pay 10% of the value of their industrial research projects to the Steinbeis foundation. The Steinbeis foundation has recently stopped paying the large lump sum.

Benefits of the Steinbeis model for UK	Challenges of the Steinbeis model for UK
· A lump sum for academics to work with industry would help to encourage industrial / academic interaction and potentially open further academic facilities to industry · Branding certified 'Steinbeis' academics would assist business to know which academics are most willing to work with industry	· UK academics are already allowed to carry out contract research for industry, for ~20-35% of their time. · If this model was set up in the UK, it would need to be initiated with the lump sum to work because otherwise the draw for academics to participate would be very weak

Annex 4.4 Dutch vouchers for SMEs to 'buy' R&D elsewhere.

Those Dutch SMEs that can demonstrate some interest in innovating can apply for vouchers worth 2 days' research or consulting. This voucher can be exchanged at universities, technology development institutes (TNO in the Netherlands) or private companies.

A similar scheme was introduced in the UK in the mid-nineties. Innovation Technology Counsellors, which had been introduced through Business Link, administered a similar model, which worked in the UK. Business Links are now adopting a 'generalists' approach.

Benefits of the voucher model for UK	Challenges of the voucher model for UK
· Combats the UK's 'free money' attitude to public funds as the value of the voucher can be printed on it. · Particularly effective if carried out in conjunction with industrially-credible advisers who visit companies, and mitigate bureaucracy.	· May be bureaucratic unless delivered locally.

Annex 4.5 German InnoNet

Regarded as an extension to InnoPro, the German collaborative R&D grant, InnoNet must include at least 4 companies and 2 research institutes. The SMEs must contribute 10% cash and 10% contribution in kind.

Benefits of the InnoNet model for UK	Challenges of the InnoNet model for UK
· Focus on SMEs to participate in academic projects · Can lead academics to be trying to form relationships with SMEs & structure some of their research to be of particular interest to them · Not sectoral in approach. · There is a duty to use the research results such that applications arise, or the companies get to own the IP. · Collaborative R&D Product could be restricted to	· Tend to be quite academically-focussed and directed because academics tend to act as the broker for this type of more complex network.

recreate this model easily, thereby encouraging larger groups to collaborate.	

Annex 4.6 Phased capital loan and grant model used by Dutch TNO,(Annex 12.2 for further details)

The grant offered by TNO is in 3 phases. A business plan for each phase is written before an development commences. It is reviewed and amended after each phase.

	Phase 1	Phase 2	Phase 3
Expected output	Scoping study	Establish whether technology works for the specific application required by company	Finished, designed prototype working in conditions required by company
Development costs contributed by company	10%	25%	50%
Development costs contributed by TNO (public money)	90%	75%	50%

Phase 4 is a period of 12-24 months in which the company has the exclusive right to buy the IPR c licence it. Between them, TNO and company will be expected to own IPR and the finished prototype an pay back the public purse in full. The exact terms need to be laid out at the beginning. The compan would be expected to wish to buy IPR and finished prototype. The cost of this is the same as the tota amount that the public purse has contributed over each of the three phases. It would be paid back a 25% pa over 4 years or maybe based on % profits.

If the company does not choose to buy the IPR and finished prototype, TNO may own it through payin the company and public purse their contributions. If neither party will buy this, then any IPR returns t the government and the grant remains a grant and does not get repaid.

This model is presently piloted by NMS (Innovation Report chapter 4.7). Britech was a UK scheme tha supported near market research in collaboration with Israel in which grants would be paid back b means of royalties.

Benefits of Phased capital loan and grant model for UK	Challenges of Phased capital loan and grant model for UK
· DTI intervenes to greatly reduce the risk of Development and many companies' lack of resources for Development, without ultimately subsidising successful projects. · Supports (& builds) existing skills and physical infrastructure for technology development · Could be subsumed into existing products (Grant for R&D or R&D collaborative Grant) · Changing culture of 'free handouts' by government · Covers the entire technology spectrum from basic to close to market research through a single scheme. · Includes capital loans which the UK has been shy of	· May be bureaucratic if not delivered locally

Annex 4.7 Canada Foundation for Innovation

(Annex 9.11 for further details)

Founded in 1997, the CFI (www.innovation.ca) is an independent corporation established by th Canadian Federal Government to improve Canadian research infrastructure in HEIs and PSREs. T date, the Government has invested C$3.65 billion in CFI, which will fund up to 40 per cent of project's infrastructure costs. Funds can be used to cover state-of-the-art equipment, building laboratories and databases. The initiative has brought huge new building projects to Canadia universities and leveraged matching funds. A proportion of funds has also been spent on larg international science projects.

In the UK, similar models would be the GIF, and SRIF programmes run by OST, DfES and the Welcom Trust, which were also significant financing of HEI and PSRE infrastructure to the tune of £1bn ever two years.

Benefits of Canada Foundation for Innovation model for UK	Challenges of Canada Foundation for Innovation model for UK
· HEI and PSREs strengths from industry's point of view includes its facilities, which only the most research-intensive companies can match.	· This addresses the infrastructural shortfalls in HEI and PSREs as perceived by academics, and not necessarily industry. · The UK has already spent extensive money on university infrastructure through GIF and SRIF

Annex 4.8 Canadian Networks Centres of Excellence.

(Annex 9.7 for further details)

These are networks of academics of different fields are good for a country of such large land mass. U Innovation Manufacturing Research Centres (3 years ago) and Centres of Excellence, including NH Innovation hubs and Welsh Centres of Excellence are the closest UK models to these.

Benefits of Canadian Networks Centres of Excellence model for UK	Challenges of Canadian Networks Centres of Excellence model for UK
· Successful at cutting across academic disciplines, which is where much innovation takes place. · Clustering has occurred around the Networks of Centres of Excellence.	· Only really bringing academics together, with industry on periphery · UK Faraday Partnerships are much more industrially-focussed. · Such a model is less necessary in the UK, where academics can travel to each other within a day's journey. · In Canada, these have not matched expectations according to some academics. This may be because it was expected these to be profit making, rather than needing funds. · Managing as many as 25 different organisations becomes complicated · There is currently a gap in financial asistance for taking these, 'blue sky' results forward.

Annex 4.9 Canadian Ontario Centres of Excellence

(Annex 9.8 for further details)

These are similar to the UKs Faraday Partnerships as they make connections between academics an industry, putting collaborative and 'interact' projects together. Collaborative projects are very similar t the UK's Collaborative R&D Product.

Interact projects

Interact projects are collaborative academic / industrial feasibility projects typically lasting ~90 day costing ~£5k, with 35-50% of this coming from industry, normally an SME. A liaison officer fro Centres of Excellence commonly puts this together.

Benefits of Ontario Centres of Excellence, and Interact models for UK	Challenges of Ontario Centres of Excellence, and Interact models for UK
· Knowledge Transfer occurs at the inception of the research programme. This occurs because the (academic) research occurs in response to industrial demand.	· The UK's Faraday Partnerships are similar, but more industrially-focussed than Ontario Centres of Excellence. However, Faraday Partnerships would benefit from interact-like

· Interact projects enable short projects to be carried out in industry in collaboration with SMEs. 50% of these go on to form further collaborations · Interact projects are of the scale (short and relatively cheap) that may well whet the appetite of companies which do not presently work with academics as much as they might. · Interact projects are the right scale to help overcome the cultural gap between academia and industry.	funding mechanisms to see if ideas could turn into collaborations.

Annex 4.10 Swedish Centres of Excellence

(Annex 13.1 for further details, also Annex 5.3)
The programme is an effort to build bridges between science and industry in Sweden by creating 2 excellent academic research environments in which industrial companies participate actively an persistently in order to derive long-term benefits. They are funded for 10 years, and were initiated i 1995.

UK Innovation Manufacturing Research Centres (3 years ago) and Centres of Excellence, including NH Innovation hubs are the closest UK models to these. The IP is shared by the financial contributors t the R&D so they also have similarities with 'Mobile VCE', a model of a common pot of private fund which involves a limited number of (large) firms, who already have interest in significant R&D spen pooling their resources, thereby encouraging collaboration from the outset. The UK also had 'Industri Research Centres' based in universities that ran for 10 years in the 1990s, which were similar to th Swedish Centres of Excellence.

Benefits of Swedish Centres of Excellence model for UK	**Challenges of Swedish Centres of Excellence model for UK**
· Combining R&D and networking in the same initiative creates a strong combination · Offers the academics who wish to work with industry the framework in which to do so. · It is considered to have changed the academic attitudes to working with industry. · Companies across a supply chain collaborate · Knowledge transfer at the outset is more likely · Research carried out will be demand-lead	· The same, large companies which are already active in R&D (e.g. Volvo, Tetrapak, Ericsson, Astrazeneca) participate in the centres of excellence, which do not attract SMEs to the same extent. · Can be considered by academics as simply another route to funding · Only applicable for businesses which already see the benefits of significant spend on R&D. · Careful negotiation is necessary if competitors are to pool resources. If competitors work together in this way, the research will often be pre-competitive. · Collaboration can break down if IP issues are not fully clarified at the start, or if unexpected results are found.

Annex 4.11 Canadian Discovery Parks

(Annex 9.2 for further details)
Discovery Parks are a private company which develops research and development facilities in close proximity to university labs for early stage companies, particularly university spin-offs. Public (government or university) contribution is limited to leasing, selling or donating land within 5 minutes walk of a university campus. Discovery Parks then builds incubator space which is tailor-made for the types of spin-off companies that the University's Technology Transfer Office recommend are likely to mature to need more space. Discovery Parks is operated on a for-profit basis, and tenant companies pay market rates. The universities receive a proportion of profits from facilities on their campuses.

Benefits of Canadian Discovery	**Challenges of Canadian**

Parks model for UK	Discovery Parks model for UK
· Extremely cheap to the public purse- almost no public money spent · Public expense is limited to granting a monopoly on land that is very close to the university. However, the spin-out management are not obliged to lease from Discovery parks: they can walk slightly further & get other appropriate space. · Spin-outs get the next stage (lab space) at competitive prices · Private sector takes any risks	· Works well because the private firm involved is experienced. However, Discovery Parks would be happy to consider branching out to the UK, and the UK may well have good contenders for similar work. · Property costs in the UK are much higher than in Canada making initial outlays high.

Annex 4.12 Canadian MaRs

(Annex 9.6 for further details)

The Medical and Related Sciences Discovery District, is an Ontario initiative which endeavours to bring together biomedical researchers and businesses in Toronto city centre. It includes buying laboratory space in the heart of Toronto for spin-out companies, and also workshops and other networking events.

Benefits of Canadian MaRs model for UK	Challenges of Canadian MaRs model for UK
	· It is an expensive initial outlay as it involves buying a large amount of real estate in the heart of the city. This is a large risk with public money. · It is a very strong lead from (Regional) government, with less lead from the potential benefactors (academia and industry) · The lab space bought with public money is not necessarily suitable in this case as it is expensive due to its geographic location.

Annex 4.13 Finnish Oulutech Technopolis Incubator

(Annex 10.3 for further details)

This PPP between Finnish Public financing bodies of innovation and the private company, Technopolis, which, among other things specialises in science parks. Oulutech assists companies in finding science park space for start-up companies, and also offering finance, negotiation, and helps build credibility with venture capitalists through its own due diligence. This is a good example of the public sector contributing to change the behaviour of a private company, Technopolis, to include services which are mutually-beneficial to both parties.

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Annex 5 Overseas Models Showing Industry Where they can Access to New Technologies.

Annex 5.1 An Innovation Agency such as Tekes

Tekes (Annexes 2.2,3.2, 10.1) has built a strong reputation in industry and is known as the place to go for funding of technological work and also for advice. It is well-known for brokering to VTT, the Finnish Technology Development

Institutes (Annex 10.2), and to academia.

The UK does not have a single place for industry to source new technologies, though various organisations act as brokers on behalf of industry. Knowledge House is an example of an organisation that brokers to Universities in the NE of England.

Benefits of model for UK	Challenges of model for UK
· UK industry would have a single place to go if a common brand exists to access technology and for honest brokering · Brokerage, financing and monitoring of projects within the same organisation is much more powerful than having these functions separately · Advice is tailored to the needs of business, · Academia would know where to go for industrial problems	· A single national organisation would lack competition and could become complacent · A large, single organisation may not be as easily adapted to changes · It could replace some of the role of private firms in the UK

Annex 5.2 Canadian IRAP

(Annex 9.1 for further details)

Industrial Technology Advisors (ITAs) who work on-site to assess companies' needs and design solutions tailored to their business. ITAs are knowledgeable, experienced individuals, who can provide technical and business advice or referrals, and provide other assistance to help companies "climb the technology ladder". They can also help a company to bid for repayable or non-repayable project grants, which can bring in academic partners.

Benefits of model for UK	Challenges of model for UK
· UK industry would have a single place to go to access technology and for honest brokering · A regional team approach to finding a solution for the company is more effective than an individual approach · Brokerage and financing of projects ensures that companies are keen to engage with ITAs · Advice is tailored to the needs of business, · Academia would know where to go for industrial problems	· A single national organisation would lack competition and could become complacent

Annex 5.3 Swedish Competence Centres (also called centres of excellence)

This is a key part of the Swedish Innovation system (Annex 13.1). They are institutions which are part of university departments, but are meant to include the entire university, where companies also take part in research. Considered by the Swedish Innovation Agency, Vinnova (Annex 13.2), as the place for industry to find out about any new technologies developed with academia

UK Innovation Manufacturing Research Centres, Faraday Partnerships and Centres of Excellence, including NHS Innovation hubs are the closest UK models to these.

Benefits of model for UK	Challenges of model for UK

· Industry knows where to go for the academic experts · IP is shared, thereby enticing involvement by all interested parties · Industry-led collaboration	· Very few SMEs participate · Duplication of existing UK models, such as Faraday Partnerships · As all IP is shared, adding new players can be difficult, even when their expertise is required to take the technology forward.

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Annex 6 Overseas Models for Access to Finance

Almost all of the models described in this chapter so far include some aspect of financial assistance to companies. This section looks specifically at models which only provide financial assistance.

Annex 6.1 Canadian MDS Inc.

MDS Inc is an international health and life sciences company which has a venture capital arm, with more than $1 billion under management, focused exclusively on emerging life science companies. They manage pre-seed, seed and serious VC funds. They pro-actively network with technology transfer offices, educating them what to look for, and then account-manage the technology projects funded with a view to reach initial public offering (IPO).
MDS's equipment, e.g. mass spectrometers, is sometimes used on a trial basis in teaching hospitals.

Benefits of model for UK	Challenges of model for UK
· Very little public funding is needed to substantially grow a sector of the economy · Highly demand-led.	· It is difficult to engineer a situation in which a private firm wishes to create a large Venture Capital arm. · Possible conflict of interest as the public sector TT office starts to 'scout' on behalf of a private company. · A professor's expectations change as the process progresses and so wishes to renegotiate the terms.

Annex 6.2 Proof of Principle Funds

Several of the Canadian research councils (CIHR, http://www.cihr-irsc.gc.ca/e/services/16217.shtml, and NSERC) have introduced in the past year proof of principle grants to help their researchers bring their science nearer to market. The intention of CIHR's Proof of Principle Initiative (POP) is to bridge the gap between discovery-driven research and the time when receptor companies/ investors may wish to take on a concept/ product. Funds of up to C$100,000 are available per project and it is expected that up to 25 proposals may receive funding.

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Annex 7 Overseas Models for Academic Incentive

Annex 7.1 German Steinbeis Model

(Annex 11.2 for further details)
Initially, an academic who applied to become a 'Steinbeis' academic, would receive accreditation (removed if industry made a series of complaints) AND a large lump sum of ~100k Euro to buy any special equipment needed to work

with industry.

Benefits of model for UK	Challenges of model for UK
· A lump sum for academics to work with industry would help to encourage industrial / academic interaction and potentially open further academic facilities to industry · Branding certified 'Steinbeis' academics would assist business to know which academics are most willing to work with industry	· The academic leads on the facilities they think are needed, not necessarily the industrialist · UK academics are already allowed to carry out contract research for industry, for ~20-35% of their time.

Annex 7.2 Canadian's University of Waterloo

The University of Waterloo claims to be the most innovative University in Canada, attributed to its outward views. The major reasons for its greater links with business and starting more spin-out companies than some counterpart universities are twofold. Firstly, the historic rules regarding ownership of IP are more favourable to academics at Waterloo than at other universities. Secondly, the university has a strong emphasis on a low administrative burden. These two factors have the effect of 'self selecting' academics with a wish to work with industry.

They have also carried out a mapping exercise connecting businesses in the geographic region with the university (spin outs, and alumni who started companies, as well as collaborations) which shows a high % of firms in the region with connections to the local university. Such a tool would be useful for UK universities to understand their impact on their region's economy.

Benefits of model for UK	Challenges of model for UK
· A more favourable IP arrangement in certain universities would have the long-term effect of enticing the academics with an inclination to working with companies or to spinning out a company to amass in certain universities. · This would then lead to a stronger need for TT capabilities at these universities	· Could create a battle for which university can give the most IP to the academic. This could lead to an imbalance that is actually detrimental because in practice academics usually need the financial and legal backing of the university to spin out.

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Annex 8 Overseas Models for Academic Assistance with Making Business Deals

Annex 8.1 German Garching Institute and Patentstelle and the Finnish Otaniemi International Innovation Centre and TULI programmes

(Annexes 11.3, 10.4)

These models all provide a 'one-stop shop' national support structure for university technology transfer offices and academics directly. They provide risk analysis, patent advice and carry out some of the deals and admin related to working with industry. They expect to become self-sustaining through taking a % of revenues of licencing deals and fees. The UK's Knowledge House, which operates in the NE of England and provides access to 5 universities is the closest to this model, though Oxford Innovation also has similarities in structure of the organisation itself.

Benefits of model for UK	Challenges of model for UK
· Provides a single stop for businesses who wish to find the right expertise in academia · Provides support for University technology Transfer Offices (which are 'patchy' in quality, as the Lambert report states)	· Technology Transfer Offices work on behalf on the university / its academics & (by implication) at the expense of business. Business does not presently have a specialised broker to look out for their interests. · There would be pros and cons to a single national model, and also to various regional versions. · It could compete with the larger, more successful Technology Transfer Offices, such as Oxford Innovation, if it is not set up sensitively. · Possibly more difficult in the UK where universities are independent bodies, with significant variation in organiastion

Annex 8.2 Canadian Westlink

(Annex 9.3 for further details)
Westlink is similar to the Garching Institute /Oteneimi model described above, and includes networking, sharing best practice and training for Technology transfer Offices in the West part of Canada. It started as a networking facility for the Technology transfer Offices, and has evolved to include training and exchange of information and more of a one-stop shop.

Knowledge House in the UK is a similar model, brokering to universities in the NE of England.

Benefits of model for UK	Challenges of model for UK
· Small (4 people) and comparatively cheap. · Grown slowly over time · Provides a single stop for businesses who wish to find the right expertise in academia · Provides support for University technology Transfer Offices (which are 'patchy', as the Lambert report states)	· May take time to develop

Annex 8.3 Canadian Parteq

Parteq is a particularly well-run technology transfer office, whose success is mainly due to the calibre of industrially-credible people involved.

Benefits of model for UK	Challenges of model for UK
· Demand-led, listening to industry & catalysing action and change through the community	

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Country Annexes

Annex 9 Canadian Innovation Policy Overview and Specific Models

Policy Overview

Canada has a population of around 31.8 million (2004 est) in an area covering a total of nearly 10 million sq km. Canada has an affluent high-tech industrial society, closely resembling the US in its market-oriented economic system, pattern of production, and high living standards. The growth of the manufacturing, mining, and service sectors has transformed Canada from a mainly rural economy into one primarily industrial and urban. The 1989 US-Canada Free Trade Agreement (FTA) and 1994 North American Free Trade Agreement (NAFTA) (which includes Mexico) caused a dramatic increase in trade and economic integration with the US. As a result of the close cross-border relationship, the economic downturn in the United States in 2001/2 had a negative impact on the Canadian economy. Real growth averaged nearly 3% during 1993-2000, but declined in 2001- some recovery on 2002. Unemployment is up, with contraction in the manufacturing and natural resource sectors. Canada's natural resources, skilled labour force, and modern capital plant, provides solid economic prospects. Two concerns cover mostly the continuing constitutional impasse between English- and French-speaking areas, which has, in the past, raised the possibility of a split in the federation. The other is the flow south to the US of professionals lured by higher pay, lower taxes, and the immense high-tech infrastructure. Key economy strength is a substantial trade surplus.

GDP real growth rate is estimated as being 2.75 % (2004), down from 3.4% in 2002. Canada's key industries are: transportation equipment, chemicals, processed and unprocessed minerals, food products; wood and paper products; fish products, petroleum and natural gas. Export commodities cover: motor vehicles and parts, industrial machinery, aircraft, telecommunications equipment; agricultural products; chemicals, plastics, fertilizers; wood pulp, timber, crude petroleum, natural gas, electricity, aluminium. Canada was ranked 3rd in the World Competitiveness Scoreboard 2003 - down from 2nd place in 2002 for countries with more than 20 million population. Canada participates in many world organisations , including IAEA, OECD, EBRD, UNESCO.

Annex 9.1 IRAP (Canada)

The National Research Council's Industrial Research Assistance Programme (IRAP, http://irap-pari.nrc-cnrc.gc.ca) helps small and medium-sized Canadian firms build their capability in technology and innovation. Heralded as a cornerstone of Canada's innovation system, IRAP consists of a network of around 260 Industrial Technology Advisors (ITAs) who work on-site to assess companies' needs and design solutions tailored to their business. ITAs are knowledgeable, experienced individuals, who can provide technical and business advice or referrals, and provide other assistance to help companies "climb the technology ladder". They can also help a company to bid for repayable or non-repayable project funds, which can bring in academic partners. The company has to take on a proportion of the costs.

The programme has been in existence for over 60 years, and is funded by the Federal Government. The total annual budget in 2001 was C$150 million (C$44 million spent on ITAs and the remainder on project funding). It is quoted that $1 of IRAP investment generates $20 in new sales. The programme received a boost of C$5 million per year from the 2004 Federal budget

Annex 9.2 Discovery Parks (Canada)

The Discovery Parks Trust (www.discoveryparks.com) – based in British Columbia - develops research and development facilities in close proximity to university labs for early stage companies, particularly university spin-offs. Originally established in 1979, most of the growth in Discovery Parks has occurred since 1991. Currently, Discovery Parks has facilities adjacent to the British Columbia Institute of Technology (Discovery Place), and operates multi-tenant facilities on the campuses of the University of British Columbia, University of Victoria and Simon Fraser University. Construction of multi-tenant facilities is funded through the sale of real estate at Discovery

Place which is endowed to Discovery Parks. Discovery Parks is operated on a for-profit basis, and tenant companies pay market rates. The universities receive a proportion of profits from facilities on their campuses. It has 6 employees and has incubators in 6 locations. It enjoys very low failure rates, partly due to the Due Diligence carried out on the spin out companies (to ensure that they will be able to pay the rent).

The key to its successes are

- The land is close to the university, and a monopoly exists on such close land
- The university's technology transfer office is good
- The culture in the university is right for exploitation and spin outs
- There is sufficiently large and interested business angle and venture capital network
- Exit mechanisms (Initial Public Offering) exist
- Good due diligence within Discovery Parks

Annex 9.3 Westlink

Westlink (www.westlink.ca) is a not-for-profit organisation formed in 1999 to facilitate communication, collaboration, training and commercialisation in Western Canada. It's main function is to network and spread best practice across the technology transfer offices of Western Canada. Extra projects have been carried out jointly, now, though it took some 3-5 years for Westlink to be fully accepted and utilised. Westlink is run by 4 ½ people (2 Marketing & pulling workshops together, 2 Technology Transfer specialists who get alongside the Technology Transfer offices and understand what needs to be done) Westlink's members include 25 Western Canadian universities, colleges and research institutes and is supported by federal government funding through the Department of Western Economic Diversification and NSERC. Westlink's two year Technology Commercialisation Internship Program, which provides eight month placements in a tech transfer office, in industry and in a venture capital firm, is in high demand. Among their other services is 'Flintbox', an internet application for marketing, licensing and distributing technology online. 200 technologies are currently posted. It is also seeking to network university commercialisation officers across Canada's west.

Annex 9.4 NRC's Cluster Building

The National Research Council (www.nrc.gc.ca), a major Canadian performer of science research with more than 20 labs across Canada, has cluster-building as a significant part of its future vision. Already the NRC's Biotechnology Research Institute in Montreal and its Plant Biotechnology Institute in Saskatoon are at the centre of related industries, surrounded by spin offs and related service companies. The NRC is now seeking to establish other such clusters of industry around new research facilities. These include around the National Institute of Nanotechnology in Edmonton and the Institute for Ocean Technologies in St John's, Newfoundland (http://www.nrc-cnrc.gc.ca/highlights/0404iotcluster_e.html).

Annex 9.5 Canada Research Chairs compete with international players for the best academics

In 2000, the Federal Government set aside funds to support 2,000 new professorial positions in Canada universities. The intention was to compete with other international players for the best academics. To date, 1164 Chairs have been awarded. 161 (14 per cent) of these have been to international scientists coming to Canada, a further 160 have been to attract ex-pat Canadians back home. Women make up 18 per cent of the total new Chairs. Details at www.chairs.gc.ca.

Annex 9.6 MaRs (Canada)

The Medical and Related Sciences Discovery District, is situated in one of the largest biomedical research clusters in North America. It will provide Toronto city centre facilities and support to perform research and to commercialise research outputs. By bringing together researchers and the businesses and other support mechanisms required for commercialisation, both on site and via an Ontario-wide virtual network, MaRS is designed to get the most out of research investment across Ontario, both in terms of wealth and job creation. MaRS will open in 2004. www.marsdd.com

Annex 9.7 Networks of Centres of Excellence (Canada)

A joint funding programme of the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC) and Industry Canada. The NCEs (www.nce.gc.ca) were established as a permanent programme in 1997, and two years later the Federal Government increased the budget by $30 million, giving a total annual budget of $77.4 million per year. The NCEs foster partnerships between universities, government and industry. They fund research projects, staff training and networking, and their funding leverages more than matching funds from partners. There are currently 21 networks funded, the most recent additions being the Advanced Foods and Materials Network, and Arcticnet.

In any given network, there will be around 5 themes which have been chosen by the academics. The research occurs around these themes.

Annex 9.8 Canadian Ontario Centres of Excellence

The centres make connections between university research and Ontario industry. They develop partnerships, fund directed research, train qualified graduate students with an industrial orientation, and transfer knowledge and technology to industry. Mechanisms include funding for matchmaking (short trial of partners working together at the outset), enabling projects (early stage), and collaborative projects (more industry involvement) and 'interact' projects.

Enabling projects are of the OCE (http://www.oce-ontario.org) was founded in 1987, and more recently existed as four separate centres: Communications and Information Technology Ontario (CITO); The Centre for Research in Earth and Space Technology (CRESTech); Materials and Manufacturing Ontario (MMO), and Photonics Research Ontario (PRO). The centres merged in April 2004 to become one unit, but still cover the same areas. In 2002, the Ontario Government renewed the OCE programme for a further five years, with a total investment of C$161 million.

IP remains with the academic partners.

Annex 9.9 Ontario Research and Development Challenge Fund (Canada)

The Ontario Research and Development Challenge Fund (ORDCF) is an $800 million program with a mandate to promote research excellence and partnerships between research institutions and business. The fund supports short term research with immediate industrial applications and longer term discovery research of interest to the private sector.

Annex 9.10 Tax Credits (Canada)

Canada has the following three main tax incentives for R&D:-

Canada's Funding of Indirect costs In the February 2003 budget, the Canadian federal government announced for the first time its intention to pay towards the **indirect costs of research**. It now pays C$245 million a year through the research councils to cover this.

Decreases in corporate tax rates.

In 2000, the Federal Government put into action a five year tax reduction plan. This included cutting the general corporate tax rate from 28 to 21 per cent by 2004. As of January 2003 the rate had been reduced to 23 per cent. The average Canadian corporate tax rate, including capital taxes, was already lower than that of the U.S. by mid 2003. By 2008 it will be more than 6 percentage points below the average U.S. rate, http://www.fin.gc.ca/toce/2003/taxratered_e.html.

Scientific Research and Experimental Development Tax Credits

The Federal Government has foregone revenues of C$2 billion per year in order to give a major boost to private sector research and development. Canadian-controlled private corporations with less than $200,000 in taxable income can receive a refundable investment tax credit (ITC) of 35% of qualifying SR&ED expenditures, to a maximum of $2 million of expenditures. Most other Canadian corporations, proprietorships, partnerships, and trusts can receive an investment tax credit of 20% of qualifying SR&ED expenditures, http://www.ccra-adrc.gc.ca/taxcredit/sred/menu-e.html. The OECD now ranks Canada's as the third most stimulative tax credit system in the OECD.

Annex 9.11 The Canada Foundation for Innovation (CFI)

The Canada Foundation for Innovation (CFI) is an independent corporation created in 1997 by the Government of Canada to fund research infrastructure. The CFI's mandate is to strengthen the ability of Canadian universities, colleges, research hospitals, and other non-profit institutions to carry out world-class research and technology development that will benefit Canadians. The CFI has a budget of $3.65 billion and funds up to 40 percent of a project's infrastructure costs. These funds are invested in partnership with these, eligible institutions and their funding partners from the public, private, and voluntary sectors who provide the remaining 60 percent of a project's cost. Research infrastructure consists of the state-of-the-art equipment, buildings, laboratories, and databases required to conduct research.

The Canada Research Chairs Infrastructure Fund provides infrastructure support to the Canada Research Chairs Program. In 2000, the CFI established two International Funds, each with a one-time $100 million budget. The Canadian portion of projects that qualified under both these funds were eligible to be financed up to 100 percent.
http://www.innovation.ca/about/index.cfm?websiteid=5

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Annex 10 Finnish Policy Overview and Specific Models

Finnish Innovation policy

Finland's response to an economic decline and 18% unemployment ~20 years ago was to invest in innovation. The Prime Minister now leads the science and technology policy council of Finland. It has concentrated on creating an environment in which innovation can flourish and business is encouraged to grow and export. Its population is ~5 Million. Its unemployment rate in 2003 was 9%.

Total research and development (R&D) investment in Finland in 2002 was 4.9 billion euros, which is approximately 3.5 % of GDP. In 2001, the ratio between private and public investment in R&D was 73:27. The private sector plays a major role in both funding and conducting R&D. The share of public R&D funding was about 29% in 2002. Finnish universities are particularly industry-focused as they must get much of their funding from industry.

The majority of the Ministry's technology financing goes through the National Technology Agency Tekes.

In addition to Tekes, which is the major deliverer of the Ministry of Trade and Industry's policy, there are other bodies which provide essential parts of the public sector environment to encourage innovation:

Sitra – public VC fund to promote the economic prosperity of the Finnish people through research and training, innovation and business development, venture capital. These activities are financed by the yield from its own endowment capital and the return on its venture-capital investments.

Finnish Industry Investment Ltd is a government-owned investment company administered by the Ministry of Trade and Industry. It engages in equity capital investment and invests in venture capital funds, private equity funds and directly in selected target companies

Finpro – helps companies to internationalise and is a substitute to Science & technology roles in commissions and embassies.

Finnvera plc is Finland's official Export Credit Agency, a specialised financing company offering financing services to promote the domestic operations of Finnish businesses, and to further exports and internationalisation of enterprises.

Technology financing is also used to strengthen the basic know-how of research institutes, VTT Technical Research Centre of Finland, Geological Survey of Finland and the National Consumer Research Centre.

Finland has a population of just over 5m in an area of 337,000 square kilometres. It has a highly industrialised, largely free-market economy, with per capita output roughly that of the UK. Its key economic sector is manufacturing - principally electronics and telecommunications, alongside more the traditional wood, metals, and engineering. The Finnish economy has shown remarkable recovery since deep recession in the early 1990s brought on by the collapse of its traditional markets in Russia. Trade is important, with exports totalling more than one-third of GDP. In 2000, GDP (real growth rate) stood at 5.6%. The GDP share of R&D increased from 2% in 1991 to 3.4% in 1999 and is now the second highest in the world after Sweden. Most of the increase in R & D expenditure is explained by the increase in BERD (from 57% in 1991 to 68% in 1999), almost entirely due to the growth of the electronic industry. Finland performs well above the EU average on a wide range of innovation indicators. Finland is a member of the UN, OECD, GATT, WTO and the EU, including membership of the single currency (the only NORDIC state to adopt the euro at the start of the system in January 1999). High ranking in technology and education placed Finland second (after the USA) in the World Competitiveness **Scoreboard 2002.**

Annex 10.1 Tekes – the Finnish Innovation Agency

Tekes' primary objective is to promote the competitiveness of Finnish industry and the service sector by technological means. Activities aim to diversify production structures, increase production and exports, and create a foundation for employment and societal well-being. Tekes provides funding and expert services, including internationalisation services for companies and research institutes. Tekes finances technology projects of companies, research institutes and universities with subsidies and loans.

The Technology Units of the Employment and Economic Development Centres (T&E Centres), located in different parts of Finland, provide the companies in their region with Tekes' services and funding. The UK analogue is Regional Development Agencies.

It has a total of 315 staff, 150 of these are technology and business experts. It has a budget of Euro €405 million, of which 380Meuro is programme spend and 25MEuro is running costs

Tekes plans, coordinates and finances technology programmes. It provides funding for applied technical research carried out by institutes and universities, as well as for R&D projects within industry with emphasis on the small and medium sized companies.
Tekes coordinates and finances Finnish participation in international technological R&D cooperation, like COST, EUREKA, EU research programmes and the European Space Agency (ESA). The role of Tekes is to assist the early stages of cooperation and, in some cases, to finance the R&D. The actual work is carried out at universities and research institutes and in industry.

Annex 10.2 Finnish Technology Development Institute,VTT

VTT Technical Research Centre of Finland is a contract research organisation involved in many international assignments. With its 3000 employees, VTT provides a wide range of technology and applied research services for its clients, private companies, institutions and the public sector. Turnover is about 220 million euros. Its mission is 'Through creating and applying technology, we actively enhance the competitiveness of industry and other business sectors, and thus increase the welfare of society'. It has 7 locations, with the majority of personnel in Espoo, near Helsinki. However, other locations have over 300 staff each and state-of-the-art facilities. VTT is both customer-focussed, and committed to delivering government policy.

In terms of remit, culture, and range of research, from basic to competitive, VTT organisations are very similar to Fraunhofer organisations. However, as there are only 7 locations (one main one, with a much smaller one in Oulu, plus some very small satellite sites), they do not see each other as competitors.
http://www.vtt.fi/indexe.htm

Annex 10.3 Oulutech Technopolis Incubator

http://www.oulutech.fi

Oulutech Ltd., founded in 1994, is a company that offers expertise for the licensing and commercialisation of technology-based ideas and research results, developement of business operations, incubator operations and corporate financing. Oulutech shareholders are Technopolis Plc., Oulun yliopiston tukisäätiö (The support fund of the university of Oulu) and Sitra (The Finnish National Fund for Research and Development). The aims of Oulutech are consistent with the objectives of these agencies. It is therefore a PPP.
The aim of Oulutech is to assist people who want to promote high tech-based business, product, or service ideas. Our services are intended for both private persons and companies.
It offers Financing services, assistance in the commercialisation and transfer of technologies, services for idea owners, and services for start-ups.

Annex 10.4 Otaniemi International Innovation Center

http://oiic.hut.fi/index.html

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Annex 11 German Policy Overview and Specific Models

Germany's Gross Domestic Expenditure on R&D was € 53.3 bn in 2002 (2.5% of GDP), includin € 35.0 bn (65.7%) by industry, € 16.7 bn (31.4%) by the Federal and State Governments, an € 1.5 bn (2.9%) by private, non-profit organisations. The Federal Government's total expenditure o R&D was an estimated € 9.1 bn in 2002.

Germany's federal structure is reflected in the organisation of German research infrastructure an funding mechanisms. The Federal Government has responsibility for the legislative framework fc higher education; funding of science, research and technology; support for young scientists, an international collaboration. The Federal and State Governments have joint responsibility for universit infrastructure and large scale facilities. Together they fund Germany's major research organisations the German Research Foundation (DFG); the Max Planck and Fraunhofer Societies; the Leibniz an Helmholtz Associations; and Germany's Academies of Science. Germany's 16 Federal States have sol responsibility for the university sector within the legislative framework for higher education. They ar also responsible for the financing of state departmental research facilities and - in the larger states for their own research programmes. Additionally, most states have their own programmes to suppo technology-based start-ups.

There are 79 Max Planck Institutes; 58 Fraunhofer Institutes; 15 national science centres (Helmholt Centres); 78 Leibniz Institutes and 343 institutes of higher education.

Annex 11.1 German Fraunhofer Institutes

The Fraunhofer-Gesellschaft was founded in 1949, at a time of great economic need, and is recognized non-profit organization. The Fraunhofer-Gesellschaft undertakes applied research of direc utility to private and public enterprise and of wide benefit to society. Its services are solicited b customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains roughly 80 research units, including 58 Fraunhofe Institutes, at over 40 different locations in Germany. A staff of some 12,500, predominantly qualifie scientists and engineers, work with an annual research budget of over 1 billion euros. Of this sum more than € 900 million is generated through contract research. Roughly two thirds of th Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and fron publicly financed research projects. The remaining one third is contributed by the German federal an (regional) Länder governments, as a means of enabling the institutes to pursue more fundamenta research in areas that are likely to become relevant to industry and society in five or ten years' time.

The Fraunhofer-Gesellschaft acts as a strong network of industrially-facing technologists. If a compan approached a Fraunhofer Institute with a technology problem which cannot be dealt with at tha Fraunhofer, the company will be introduced to a more appropriate contact in another Fraunhofer. I this manner, the Fraunhofer network takes on part of the role of an innovation agency, namely bein the regional entry-point for industry, and a national network to find the best solution for the company technology problem. However, it must be recognised that because Fraunhofer organisations regar each other as their competitors, the 'honest, independent broker' aspect of innovation agencies ma not be as strong.

By developing technological innovations and novel systems solutions for their customers, th Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local regior and throughout Germany and Europe. The facilities and skills that they range from those needed fo basic research to competitive research. For instance, a prototype Daimler-Crysler car was on th workshop floor of one Fraunhofer because future additional gadgets were being developed an integrated as part of an industrial- Fraunhofer collaboration. They stop short of manufacture. Th culture is relatively academic, but somewhat more business-like.

Spin-outs from Fraunhofers do exist and the Fraunhofer is obliged not to compete with these spin-outs

As an employer, the Fraunhofer-Gesellschaft offers a platform that enables its staff to develop th professional and personal skills that will allow them to take up positions of responsibility within the institute, in other scientific domains, in industry and in society. Exchange in personnel betwee Fraunhofer Institutes, academia and industry happens throughout the organisation, including the top.

Fraunhofer organisations often work with universities for their expertise, or equipment, or sometime for the physical space for Fraunhofer equipment.

Fraunhofer organisations usually keep at least some of the intellectual property from the researc collaborations that they are involved with, even when they are fully funded by a company (in whic case they may share IP rights). Sometimes this results in agreements with industrial clients that the I will not be sold or used in conjunction with specified competitors.

Affiliated research centers and representative offices in Europe, the USA and Asia provide contact wit the regions of greatest importance to future scientific progress and economic development.
http://www.izm.fraunhofer.de

Annex 11.2 Steinbeis

In 2002, the Steinbeis foundation had a budget of 90MEuros. They had 800 accredited professors 4200 project-based staff (on fixed-term contracts eg postdocs), 1000 others. They carry out mainl consultancy, but also collaborative R&D, training & expert reports.

The accredited Steinbeis experts 'transfer' academic knowledge to industry. They have their desks i research establishments and universities, especially those of applied science, and help to transfer th knowledge to the benefit of industry and the wider community. In total, there are 516 Steinbe Transfer Institutes in Germany, Austria and German-speaking Switzerland.

Initially, an academic who applied to become a 'Steinbeis' academic, would receive accreditatio (removed if industry made a series of complaints) and a large lump sum of ~100k Euro to buy an special equipment needed to work with industry. In return, the academic would pay 10% of the valu of their industrial research projects to the Steinbeis foundation. The Steinbeis foundation has recentl stopped paying the large lump sum.

The Steinbeis Foundation includes the following components:
the network of over 600 **Steinbeis Transfer Centres** (managed by a 100% subsidiary the Steinbe GmbH & Co. für Technologietransfer) nm
the **Steinbeis University** in Berlin (with 40 institutes, which offer degree courses and further training
the **Steinbeis equity branch**, which invests in innovative start-ups and SMEs.

The turnover of the Steinbeis GmbH & Co. was approx. Euro 90 million in 2002. This has bee generated largely by the commercial activities in the 600+ Steinbeis Transfer Centres, which hav been set up since

The Steinbeis Transfer Centres are based at universities and non-university research facilities (115 universities of applied sciences (Fachhochschulen - over 190), vocational training college (Berufsakademien - over 30), and collaborative partners (over 140). Professors interested in settin up a Steinbeis Transfer Centre, will be interviewed by the Steinbeis Foundation and sign a contract Once their universities have agreed to their involvement in Steinbeis activities and hence addition income, they may offer collaborative R&D, consultancy, feasibility studies and other expertise unde the Steinbeis logo on a commercial basis to industrial customers. About 10% of the turnove generated in the transfer centres is transfered to the Steinbeis Transfer GmbH as a kind of managmer fee. The Steinbeis Transfer GmbH in turn offers central services for the transfer centres (e.g accounts; personnel issues)
Steinbeis Transfer Centres may be established in any geographical region or any research field, whic offers knowledge transfer opportunities. The Steinbeis GmbH & Co. will not prescribe specific topics c protect existing Steinbeis transfer centres from competition of new centres covering the same topics.

Annex 11.3 Garching Innovation (Max Planck Society TT agency)
http://www.garching-innovation.mpg.de

Annex 11.4 ipal Gesellschaft für Patentverwertung
http://www.ipal.de

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Annex 12 Policy Overview and Specific Models in the Netherlands
The Netherlands has a population of 16.1m in an area covering 41,500 square kilometres. It has prosperous and open economy in which the Government has reduced its role since the 1980s. Industrial activity is predominantly in food processing, chemicals, petroleum refining and electric machinery. The Dutch rank third world-wide in value of agricultural exports, behind the US an France. Strong GDP growth in 1999 (3.4%) was followed by a downfall to 1.1% in 2001. Th downward trend is expected to continue in 2002, where growth has been forecast at 0.75%. Th Central Planning Agency, however, expects a revival to 1.5% for 2003. Expenditure on R & D in 199 was 2% of GDP. A new Centre-Right Christian economic liberal Government under Prime Ministe Balkenende was sworn in in July 2002. The Netherlands is a member of the EU, OECD, WTO, UN NATO, EIB and EMU.

Annex 12.1 Dutch Technology Development Institute, TNO
TNO consists of 15 institutes employing some 5,000 staff in total. One of these, TNO TPD is part of th Netherlands Organisation for Applied Scientific Research TNO, the largest independent researc institute in the Netherlands.

TNO TPD delivers practical applications in the field of technical physics. For more than 60 years TN have been contributing to the innovative applications used by their clients to strengthen the competitive position. TNO are demand-lead. Each year TNO TPD carries out more than 1,20 assignments for clients at home and abroad. Their client base is varied, ranging from small an medium-sized businesses, sector associations and social and knowledge organisations to th government. Larger, R&D intensive organisations also call on them. They act both as knowledg developer within and as an active partner within collaborative associations with universities an technological institutes. These collaborative links lead, with increasing frequency, to partnershi programmes in which all participants invest in specific research fields.

Annex 12.2 Model of a phased cofunding grant / loan adapted from TNO for UK

For this description, the term 'Development Provider' will refer to any university department, c industrial laboratory (including RTOs and corporate R&D labs and development consultancies) capabl of carrying out the Development work necessary to commercialise a technology. The company c collaborating companies which needs the development carried out will be referred to as 'company X.'

The grant will be in three phases. A business plan for each phase will be written before an development commences. It will be reviewed and amended after each phase.

	Phase 1	**Phase 2**	**Phase 3**
Expected output	Scoping study	Establish whether technology works for the specific application required by company X	Finished, designed prototype working in conditions required by company X
Development costs contributed by company X	10%	25%	50%
Development costs contributed by DTI	90%	75%	50%
Development costs contributed by Development Provider	0%	0%	0%

Phase 4 is a period of 12-24 months in which company x has the exclusive right to buy the IPR c licence it. Between them, the Development Provider and company will be expected to own IPR and th finished prototype and pay back the DTI in full. The exact terms need to be laid out at the beginning c the Company X would be expected to wish to buy IPR and finished prototype. The cost of this is th same as the total amount that the DTI has contributed over each of the three phases. It would be pai back to the DTI at 25% pa over 4 years or maybe based on % profits.

If company X does not chose to buy the IPR and finished prototype, the Development Provider ma own it through paying company X and DTI their contributions. If neither party will buy this, then an IPR returns to the DTI and the grant remains a grant and does not get repaid.

DTI intervenes to greatly reduce the risk of Development and many companies' lack of resources fc Development, without ultimately subsidising successful projects. This option uses and strongl encourages all existing UK capabilities in Development and would subsume the Grant for R&D Produc (formerly SMART scheme). However, it may prove bureaucratic. A pilot of this model is being propose by NMS as a project within the Innovation Report (chapter 4.7 Innovation Report)

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Annex 13 Swedish Innovation Policy Overview

Sweden has a population of almost 9m in an area of 450,000 square kilometres. Aided by peace an neutrality for the whole twentieth century, Sweden has achieved an enviable standard of living under mixed system of high-tech capitalism and extensive welfare benefits. It has a modern distributio system, excellent internal and external communications, and a skilled labour force. Timbe hydropower, and iron ore constitute the resource base of an economy heavily oriented toward foreig trade. Privately owned firms account for about 90% of industrial output, of which the engineerin sector accounts for 50% of output and exports. High technology production in Sweden is considerabl larger than in most other small countries and primarily focused on telecommunications an pharmaceuticals. In recent years, however, this favourable picture has been somewhat clouded b budgetary difficulties, high unemployment, and a gradual loss of competitiveness in internationa markets. Sweden has harmonized its economic policies with those of the EU, which it joined at th start of 1995, but did not introduce the euro in 1999. GDP real growth rate is estimated at 4.3% i

2000. Gross expenditure on R & D in 1999 was 3.78%, by far the highest in the EU, and higher tha both Japan and the USA. The Swedish RTD system is dominated on the one hand by around ten larg RTD-intensive multinational companies, and on the other hand by public universities. However, i recent years, these private multinational companies have come into foreign ownership. Sweden wa ranked 11th in the World Competitiveness Scoreboard 2002, down from 8th place in 2001.

Annex 13.1 The Swedish Competence Centre Programme

These were started in 1995, and have been running for 10 years, reviewed every 2-3 years. They ar research centres in which industry and academia work together, sharing IP between all industria partners. They take place within the host university, with tightly-prescribed structure. Each has different field of interest and is cross-disciplinary, promoting the implementation of new technolog and strengthening technical competence in Swedish industry. Both academic and industrial researcher work together within the same centre.

From 1998 to 2000, the budget for the 28 centres of excellence at 8 universities was 53 MEuros, ~1% of public Swedish R&D spend. Funding for the Centres comes in approximately 3 equal parts fro VINNOVA (and in some cases STEM), the host university, and the industrial partners. The averag funding for a Competence Centre from all parties is around 20 MSEK (approx. £ 1.3M) per year. Th VINNOVA/STEM component is intended to continue for 10 years with reviews carried out generally a the 2, 5, 8 and 10 year points.

The funding is expected to support all activities from administration and salaries to research.
The Competence Centre will be hosted by a single university which undertakes to manage th Competence Centre and is responsible for the administration and reporting. Only one university involved in the Competence Centre. However, the Centre is intended to be multidisciplinary and involv various departments of that university. In Sweden university researchers own the IPR on any IP the generate. Within companies and research institutes the IPR is owned by the company rather than th individual. In participating in a Competence Centre each participant continues to own the IPR a appropriate under these rules but agrees to grant effectively a royalty free license to all participants i the Centre (whether involved in the specific project or not) to commercially use the project results.

All project results shall be published but before this the university must provide the industrial partner with an opportunity to examine the results with a view to protecting any IP necessary.

Annex 13.2 Swedish VINNOVA

w.vinnova.se
Its mission is to finance research, development and demonstration activities that meets the needs o business and the public sector, foster co-operation between universities, industrial research institute and business, promote the diffusion of information and knowledge, and to stimulate increased Swedis participation in the EU framework programme, Eureka and cost.
For the fiscal year 2001, the budget was €100m, with 150 staff

VINNOVA became operational on January 1 2001. The agency integrates research and development i technology, working life and society. VINNOVA cooperates closely with a network of private and publ players who will jointly develop, disseminate and apply the new knowledge. The most worthwhil synergies often arise from innovation systems of this type.
VINNOVA supports needs-driven research by basing its activities on the needs that exist among th different types of players in society. These may be regions, suppliers, emerging industrial clusters, an similar types of networks. One objective is to encourage an increase mobility between sectors to mak people more aware of the forces at work in the economy thus improving its capacity for innovation.

Annex 13.3 Swedish TUFF

VINNOVA supports a number of certified technology brokers and local company groups as part of th nationwide TUFF programme which aims to make it easier for SMEs to interact with technical experts This is based on the Canadian IRAP model.
The three interdependent cornerstones of this programme are:

- Stimulation of the demand capability of SMEs by offers/grants to facilitate e. g feasibility studies, creation of groups/networks of firms and co-operative projects demand.
- Creation of a network of "Certified Technology Brokers" with different competencies individuals in re-search institutes, and the like. The goal is to achieve a network of at leas 100 Certified Technology Brokers. All brokers are single entry points to the complet

network. The list is available on the VINNOVA website.

- The brokers make use of, by contracting, a joint IT-based service function for support t their network.

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